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COST of PRODUCING MILK

In Illinois Portion of the St. Louis Milkshed

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

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CONTENTS

PAGE

Scope of the Study 83

Part I—Determining Costs 84

Level of Production Must Be Considered 85

Feed Expenses 85

Labor Expenses 87

Expenses Other Than Feed and Labor 88

Deductions From Cost 88

No Charge Made for Management 90

Expenses for 100 Pounds of Milk 90

Computing Current Milk Costs 91

Charts for Computing Milk Costs

For Herds Giving 8,500 to 9,000 Pounds per Cow Yearly 94

For Herds Giving 7,500 to 8,000 Pounds per Cow Yearly 95

For Herds Giving 6,500 to 7,000 Pounds per Cow Yearly 96

For Herds Giving 5,500 to 6,000 Pounds per Cow Yearly 97

Part II—Effect of Some Production Factors on Milk Costs 98

Milk Production per Cow 98

Size of Herd 99

Use of Milking Machines 100

Season of Year 100

Month of Year 102

Summary 103

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COST OF PRODUCING MILK IN THE ILLINOIS PORTION OF THE ST. LOUIS MILKSHED

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 St. Louis milkshed, which lies in southwestern Illinois, 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. In this study the cost of feed and man labor made up about 70 percent of the net cost of producing milk. While there have been periods when, because of unusually high or low prices for feed and farm wages, this percentage did not hold, such periods have been exceptional and of short duration.

SCOPE OF THE STUDY

The farms used for this study are located in eleven counties in the Illinois portion of the St. Louis milkshed: Bond, Effingham, Fayette, Jersey, Macoupin, Madison, Monroe, Montgomery, Randolph, St. Clair, and Washington. Ninety-three farms were included in the study in 1938 and 110 farms in 1939.

All these farms are potential sources of fluid milk for the St. Louis market, 84 percent of them having sold all or a part of their milk to St. Louis distributors. The dairies that sold to St. Louis distributors produced 89 percent of the milk considered in this study.

The total milk production recorded for these farms during the two years of the study was 20,969,326 pounds (103,297 pounds per farm,

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which is about 12,000 gallons). Of this amount, 88.8 percent was sold as fluid milk (88 percent to milk distributors and 12 percent to creameries), 2.4 percent was separated and sold as cream, 5.5 percent was fed to livestock on the farm, and 3.3 percent was used in the farm homes.

The number of cows per farm averaged 13, the annual milk production per cow 7,762 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 cost. From these basic figures a method has been devised for computing representative costs of producing milk in southwestern 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 cows each gave about 2,000 pounds more milk per year than the average cow in the area. 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. Depreciation 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 farm 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 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. Also proportionately less of the feed fed high-producing cows is used for maintenance. For example, the herds that were producing 7,500 to 8,500 pounds of milk per cow per year were fed only 16 percent more feed than those giving between 5,500 and 6,500 pounds per cow, but they produced as much as 29 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 7,750 pounds of milk yearly—the average production of the cows included in the study. The quantities of feed and labor and the percentage of the net milk cost which is made up of feed and labor are shown in Table 6 for the herds producing at this level and above or below it.

Feed Expenses

Of the net cost of producing milk, feed expenses made up something less than half (44.5). In the years of the study, the farm price of a ton of feed was as follows: corn-and-cob meal, about $13; alfalfa hay, $9.50; silage, $4.50; and soybean oilmeal containing 41 percent protein, $31.50.

Grain and other carbohydrate concentrates. Corn and oats were the principal grains fed, almost three and one-half times as much corn as oats by weight being used in the ration (Table 1). About one-seventh as much barley as oats was fed. Other carbohydrate concentrates were substituted for farm grains when considered more economical.

These cows consumed yearly an average of about 1,850 pounds of carbohydrate concentrates, including farm grains.

TABLE 1.—AMOUNTS OF FARM GRAINS AND OTHER CARBOHYDRATE CONCENTRATES FED YEARLY PER COW TO 203 HERDS IN SOUTHWESTERN ILLINOIS IN 1938 AND 1939

(Herds were located in Bond, Effingham, Fayette, Jersey, Macoupin, Madison, Monroe, Montgomery, Randolph, St. Clair, and Washington counties. Ninety-three farms were included in 1938 study, 110 farms in 1939. Herds averaged 7,762 pounds of milk per cow yearly.)

Farm grains	Pounds per cow	Other carbohydrate concentrates	Pounds per cow
Corn and corn-and-cob meal	1 260	Dried brewers' grain	53
Oats	372	Malt	61
Barley	52	Molasses	7
Wheat	26	Corn gluten feed	1
Total	1 710	Total	122

Protein supplements. An average of 511 pounds of protein supplement was fed per cow yearly (Table 2)—about 1⅔ pounds to every 6 pounds of grain and other carbohydrate concentrates. Dairymen gave

TABLE 2.—AMOUNTS OF PROTEIN MILL FEEDS FED YEARLY PER COW, SOUTHWESTERN ILLINOIS, 1938 AND 1939

Kind	Pounds per cow	Kind	Pounds per cow
Bran	197	Soybean oilmeal	89
Commercial mixed feeds*	111	Ground soybeans	16
Cottonseed oilmeal	96	Linseed oilmeal	2
		Total	511

* Weighted average protein content of all commercial mixed feeds was 29 percent.

bran first place among the protein supplements because it supplied protein more cheaply than any other feed then on the local market.

Hay and other dry roughage. On a weight basis, alfalfa hay

TABLE 3.—AMOUNTS OF HAY AND OTHER DRY ROUGHAGES FED YEARLY PER COW, SOUTHWESTERN ILLINOIS, 1938 AND 1939

Kind	Pounds per cow	Kind	Pounds per cow
Hay		Hay (continued)	
Alfalfa	1 608	Oat	17
Soybean	615	Alsike	9
Clover	364	Lespedeza	7
Mixed clover and timothy	229	**Other dry roughage**	
Cowpea	44	Corn stover	253
Timothy	21	Corn fodder	214
Sudan	21	Grahoma fodder	10
		Total dry roughage	3 412

made up a little less than half the dry roughage fed. Soybean hay came next, but less than half as much of it as of alfalfa hay was fed (Table 3). Only 14 percent of all dry roughage was corn and grahoma fodder and corn stover.[1] 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 3,952 pounds of silage and harvested green roughage each year (Table 4), practically all of which was silage. In both 1938 and 1939 small quantities of green corn fodder were cut during late August and early September and fed to supplement late summer pastures. In late August two farmers cut green soybeans to feed their cows.

Pasture. On the average, a milk cow was on pasture 187 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, SOUTHWESTERN ILLINOIS, 1938 AND 1939

Kind	Pounds per cow	Percent of total
Silage	3 934	99.5
Green corn fodder	16	.4
Green soybean roughage	2	.1
Total	3 952	100.0
	days	
Pasture	187	....

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 140 hours per cow yearly. The cost of this labor was 25.5 percent of the net cost of producing milk. At this time hired men in the area were being

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

paid $35 to $40 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 $50 a month.

Expenses Other Than Feed and Labor

Twelve items besides feed and man labor entered into the cost of maintaining a dairy herd, but these twelve items made up only 30 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 1,180 pounds was used per cow per year. 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 prorate to any one branch of the business. The following are a few 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

Certain returns from the dairy herd are in the nature of by-products. The most important of these are manure, calves, appreciation in the value of the cow, 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).

TABLE 5.—AVERAGE COST OF MAINTAINING A MILK COW FOR ONE YEAR IN HERDS IN SOUTHWESTERN ILLINOIS, 1938 AND 1939

Item	Cost
Maintenance expense	
Feed	$ 56.08
Man labor	32.09
Horse labor	1.09
Hauling milk and cream	15.21
Buildings	7.47
Equipment, light, and power	2.94
Share in mortality expense	1.42
Interest on investment in cow	3.61
Taxes and insurance on cow	.38
Bull expense	3.42
Veterinary and medicine	.29
D.H.I.A.[a] dues and tester's board	1.42
General overhead expense	8.39
Bedding and miscellaneous	3.27
Gross cost	$137.08
Deductions from cost	
Appreciation	$ 1.00
Manure	5.38
Calves	4.68
Hides, empty sacks, etc.	.06
Total deductions	$ 11.12
Net cost per cow	$125.96
Some relevant statistics concerning herds studied	
Production per cow	
Milk, pounds	7 762
Butterfat, pounds	278
Value of milk produced per cow	$137.75
Feed prices	
Corn-and-cob meal per ton	$ 13.20
Alfalfa hay per ton	9.50
Number of herds and cows	
Herds in study, average of two years	101
Cows per herd, average	13

[a] Dairy herd improvement association.

The value of the manure hauled to the fields from the barn and from the herd lots was computed at 75 cents a load. The manure dropped on the pasture was credited at the same price.

When calves born to 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.

The study shows that in the course of a year 91 living calves were dropped for every 100 cows in the milking herd. This proportion of living calves is high. It is accounted for by freshening heifers, by the relatively high turnover of cows by purchase and sale (22.5 percent) and by the loss of 1.8 percent of the cows by death.[1]

[1] The death of 1.8 percent of the cows lowers the yearly average number of cows in the herd and thus increases the proportion of calves.

The value of the average milk cow on these farms increased about a dollar.[1] Such an increase is believed not to be normal, for it was caused (1) by rising prices for milk cows during these years and (2) by a rather high yearly replacement rate (one heifer or purchased cow for every 4.4 cows in the herd). The increase in the value of these cows tended to lower the net cost of the milk, as the increase was deducted from cost.

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 amounts 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 amounts of feed and labor required to produce a unit of milk are not the same for high-producing and low-producing cows, the records were grouped separately for herds producing at four different levels: 7,500-8,000 pounds of milk per cow per year, the average of all herds in the study; 8,500-9,000 pounds, 6,500-7,000 pounds, and 5,500-6,000 pounds (Table 6).

[1] On a group of dairy farms in northern Illinois in 1936 and 1937, the cows depreciated in value about $3.50 per cow per year (*see Bulletin 511, Cost of Producing Milk in Northern Illinois*).

TABLE 6.—FEED AND LABOR REQUIRED TO PRODUCE 100 POUNDS OF MILK IN HERDS WITH DIFFERENT LEVELS OF PRODUCTION PER COW, SOUTHWESTERN ILLINOIS, 1938 AND 1939

Item	Requirements in herds with average yield per cow indicated			
	8,500-9,000	7,500-8,000	6,500-7,000	5,500-6,000
Number of herds	35	42	33	34
	lb.	*lb.*	*lb.*	*lb.*
Farm grain	23	24	27	28
Protein feeds	6	7	6	7
Hay	41	44	43	51
Silage	49	51	60	50
	days	*days*	*days*	*days*
Pasture	2.2	2.4	2.9	3.0
	hr.	*hr.*	*hr.*	*hr.*
Man labor	1.8	1.8	1.9	2.0
Percent feed and labor expenses were of net milk cost	70.1%	70.1%	68.2%	68.4%

The greatest differences in feed consumption at the different levels of production were in the amounts of hay and pasture; there were slightly smaller differences in farm grain and silage, and there was very little difference in the amounts of protein feed. Herds in the highest of the four production groups produced a unit of milk with the least feed of any of the groups.

The proportion of the net cost that was made up of feed and labor varied only from 70.1 percent for milk from the herds in the two high-producing groups to about 68 percent for the milk from the herds in the low-producing groups, 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.

In this study 73 percent of the items other than feed and labor did fluctuate with feed and labor costs (22 percent of them changing with feed costs and 51 percent tending to fluctuate with farm wages), and about 27 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, a scheme

which is based on feed and labor costs can be used without a large element of error.[1]

Early Illinois method. Some years ago, a formula was developed at this Station which has been found very practicable.[2] 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 91). 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.*
8,750 pounds of milk per cow yearly	42.7
7,750 pounds of milk per cow yearly	42.7
6,750 pounds of milk per cow yearly	46.6
5,750 pounds of milk per cow yearly	46.2

Example: The cost of producing 100 pounds of milk in herds producing between 7,500 and 8,000 pounds of milk per cow would be determined thus:[3]

Farm grain	24	pounds @	$40 a ton	$.48
Protein meal	7	pounds @	60 a ton	.21
Hay	44	pounds @	25 a ton	.55
Silage	51	pounds @	10 a ton	.26
Pasture	2.4 days	@	12 cents a day	.29
Man labor	1.8 hours	@	40 cents an hour	.72
				$2.51
			Add 42.7 percent of $2.51	1.07
			Total cost	$3.58

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

[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 5 to 8 percent (i.e., 27 percent of 20 to 30 percent) does not fluctuate with feed and labor costs.

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

[3] The cost per 100 pounds may also be computed by dividing the cost of feed and labor by 70.1 percent (see Table 6, p. 91).

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 the other items entering into milk costs make up only a small portion of the total costs and fluctuate with the 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.

If, for instance, the cows in a herd produce an average of 7,500 to 8,000 pounds of milk annually (Fig. 2), and if the local price of shelled corn is $1.10 a bushel and the monthly cash wages of a hired man are $85 a month, it would cost $3.59 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 $3.57 ($3.59 − 2 cents).

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

Formulas for simpler method. Those who 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 8,500 to 9,000 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 1.7) + (monthly cash hired man wages ÷ 66) + 25 cents ± adjustment for change in price-level.

Cows producing 7,500 to 8,000 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 1.8) + (monthly cash hired man wages ÷ 62) + 24 cents ± adjustment for change in price-level.

(Continued on page 98)

[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.

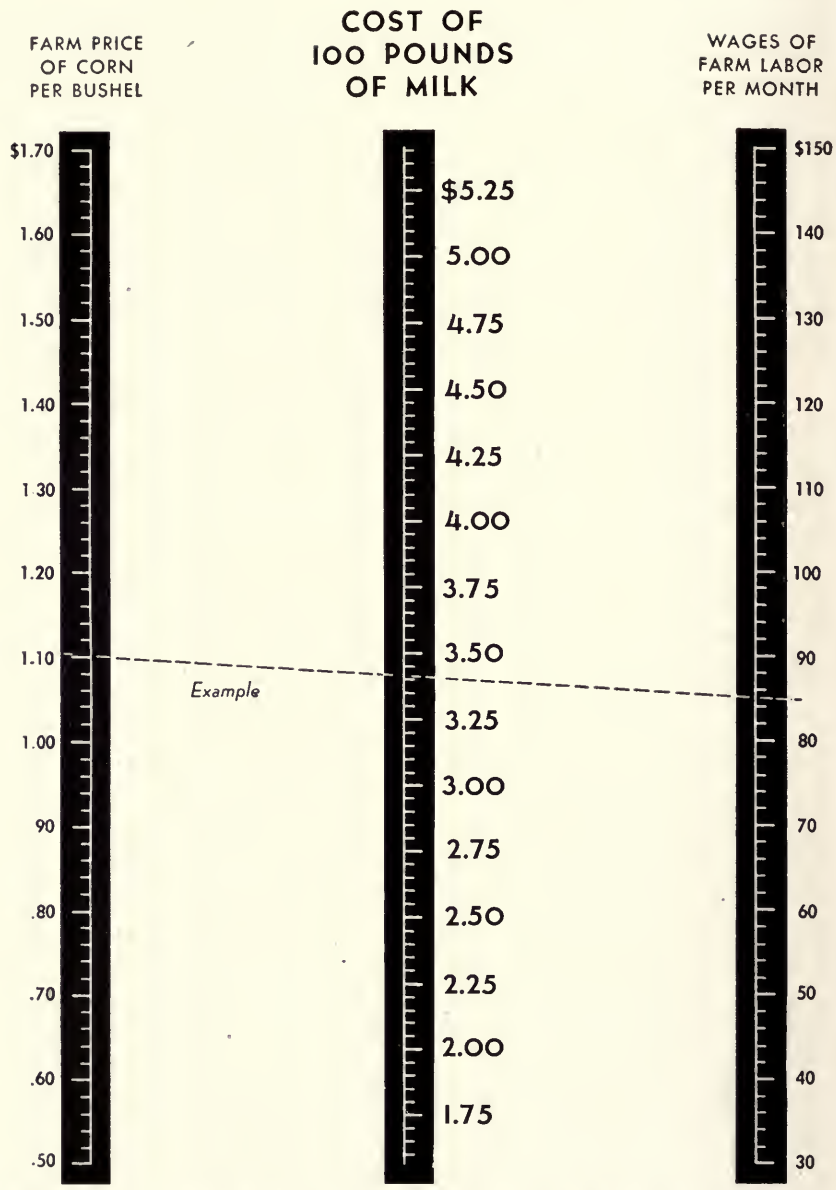

Fig. 1.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 8,500-9,000 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 93 for way to adjust to other price-levels.)

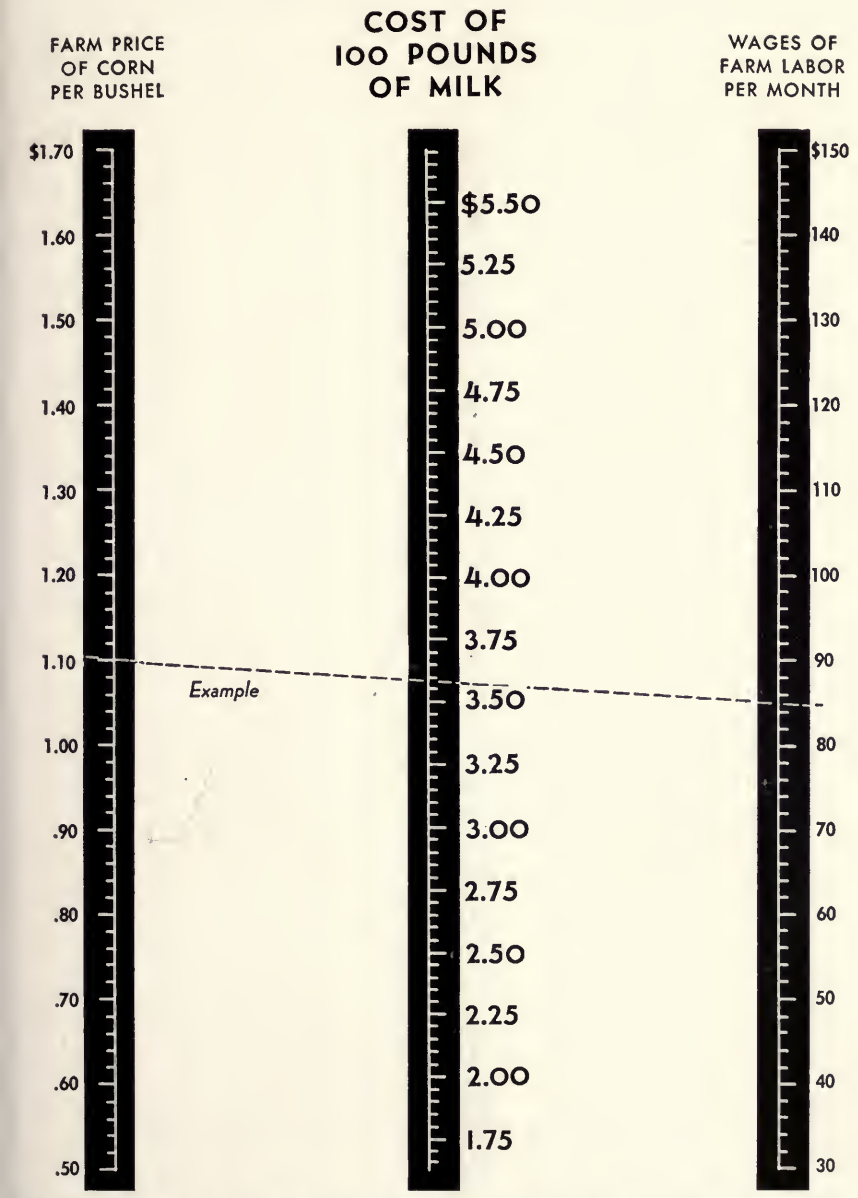

Fig. 2.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 7,500-8,000 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 93 for way to adjust to other price-levels.)

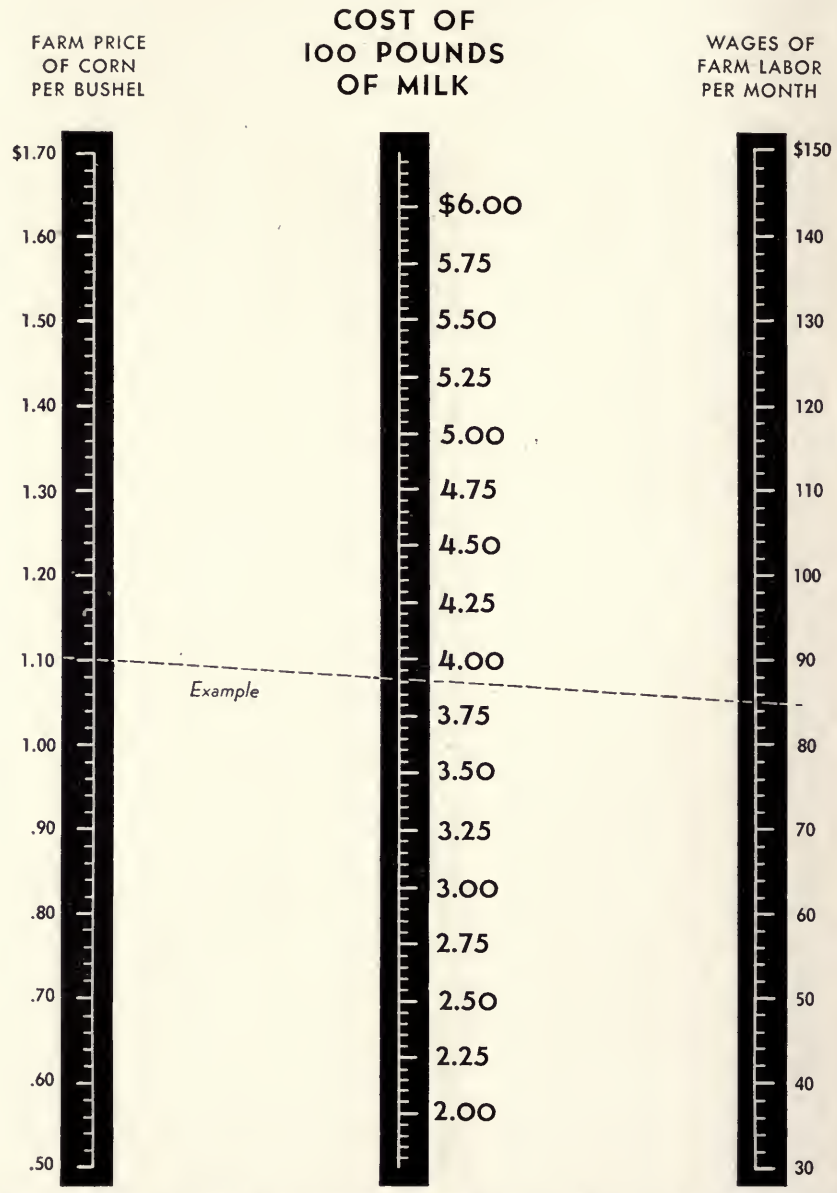

Fig. 3.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 6,500-7,000 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 93 for way to adjust to other price-levels.)

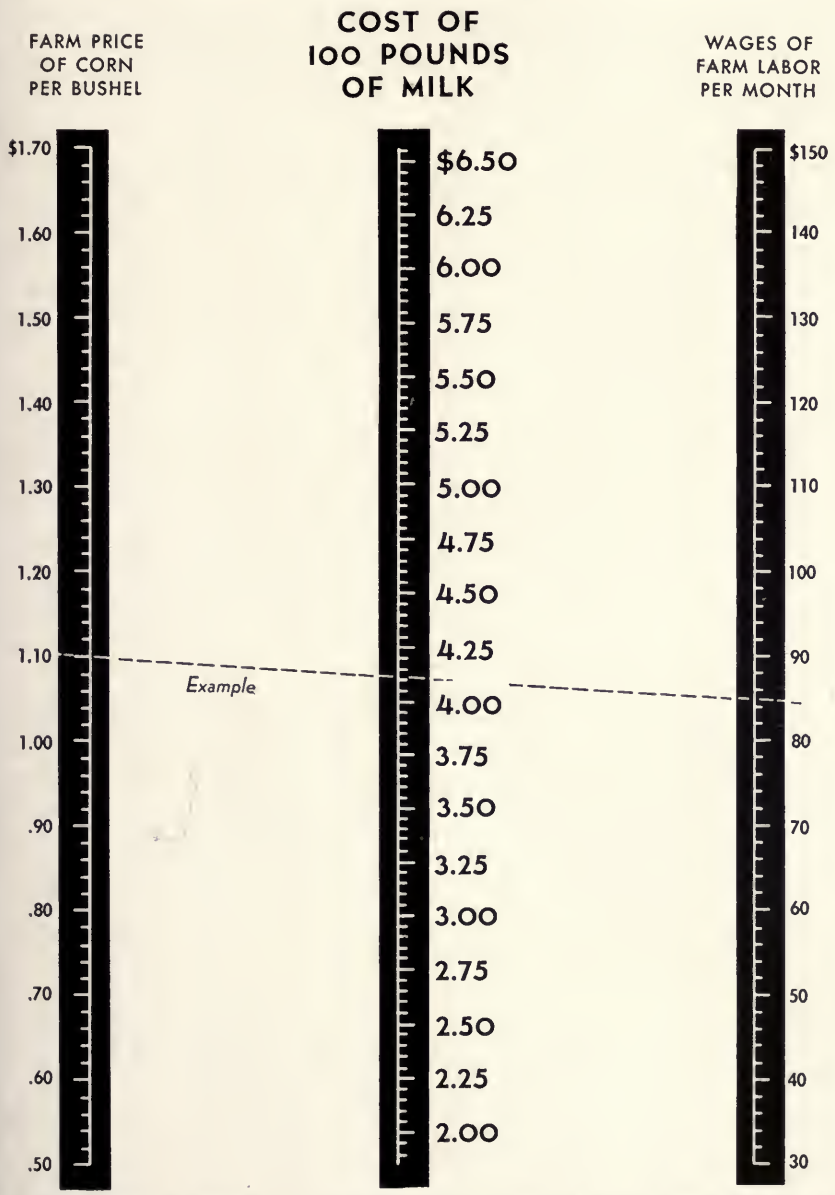

Fig. 4.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 5,500-6,000 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 93 for way to adjust to other price-levels.)

(Continued from page 93)

Cows producing 6,500 to 7,000 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 2.0) + (monthly cash hired man wages ÷ 58) + 24 cents ± adjustment for change in price-level.

Cows producing 5,500 to 6,000 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 2.1) + (monthly cash hired man wages ÷ 55) + 25 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 7,500 to 8,000 pounds of milk when corn is $1.10 a bushel, labor is $85 a month, and the price index is 140:

($1.10 × 1.8 = $1.98) + ($85 ÷ 62 = $1.37) + $.24 = $3.59

Figuring cost 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), further calculations are necessary to determine production costs.

Example: The cost of producing 100 pounds of milk in herds averaging 7,325 pounds of milk per cow yearly would be determined thus:

1. Take the production level below and that above 7,325 pounds and get the midpoint of each (6,750 and 7,750 pounds)
2. Determine what percentage the difference between 6,750 and 7,325 pounds, or 575 pounds, is of the difference between 6,750 and 7,750 pounds (the answer is 57.5 percent)
3. Find the difference between the cost of producing milk at the 6,500-7,000 level and the 7,500-8,000 level, using either the charts or the formulas (if the cost at the 6,500-7,000 level were $3.91 and that at the 7,500-8,000 level were $3.59, the difference between the two would be 32 cents)
4. Multiply the difference found in Step 3 by the percent found in Step 2 (32 cents × .575 = 18 cents)
5. Subtract the result from the cost of producing milk at the 6,500-7,000-pound level ($3.91 — 18 cents = $3.73)

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 4,000 pounds per cow on one farm to over 11,000 pounds per cow on three others, 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, SOUTHWESTERN ILLINOIS, 1938-1939

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.*			
9,500 and over	10 199	$1.42	$37.80	25
8,500-9,499	8 965	1.55	28.43	38
7,500-8,499	7 993	1.60	17.86	45
6,500-7,499	6 985	1.68	2.37	39
5,500-6,499	6 009	1.81	−10.16[a]	40
Under 5,500	4 972	1.98	−13.80[a]	16

[a] Loss.

were to be added to production costs, it would be necessary for the average cow included in this study to give 8,200 pounds of milk a year in order to produce an income equal to the cost of her maintenance in 1938 and 1939. To equal it without a management charge, she would have to yield 7,100 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 closely related 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 production per cow and milk costs in these herds 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 5 to 34 cows, the man labor required to produce the milk and get it to the buyer declined 1¼ 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 1 cent a hundred pounds.

Use of Milking Machines

Milking machines were used on 24 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 17 hours of man labor yearly per cow; or, stated in another way, they enabled these men to produce 7 more pounds of milk with every hour of their labor. In order to make this saving in labor, however, it was necessary to invest capital in milking machines and pay out money for power and other operating expenses (Table 8). Nevertheless, the machines saved

TABLE 8.—RELATIVE ECONOMY OF MILK PRODUCTION WITH AND WITHOUT MILKING MACHINES, SOUTHWESTERN ILLINOIS, 1938 AND 1939

(As shown by two-year study of 46 farms with machines paired with 46 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	7 825	7 829	− 4
Yearly man hours per cow	132	149	−17
Equipment investment per cow	$13.82	$7.86	$5.96
Equipment expense per cow	3.20	1.67	1.53
Cost of 100 pounds of milk	1.63	1.69	−.06
Number of cows in milking herd	18	12	6

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

these men $4.70 a cow, or about $60 a herd. When man labor is scarce and wages are high, the savings made possible by milking machines may easily rise to double 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.

During the two years 1938 and 1939, prices of feed grains re-

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

TABLE 9.—AVERAGE SEASONAL COST OF MILK, LOCAL PRICES OF MILK SOLD, AND PROFIT PER COW, SOUTHWESTERN ILLINOIS, 1938 AND 1939

(Figures are from monthly cost and production records of 198 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.)	$1.42	$1.66	$10.27	$1.61	3 248
Winter (Oct.-Apr.)	1.75	1.84	12.63	.63	4 634
Year	$1.61	$1.77	$11.65	$1.04	7 882

mained fairly steady. The prices of protein meals too held fairly steady until September, 1938, when they advanced rather sharply, remaining about 50 percent above the January-to-July 1938 level until June, 1939, when they declined to about their early 1938 level. From August, 1938, to the end of 1939 the price of hay was about 45 percent below the January, February, and March, 1938, level. Man labor was charged at the same wage summer and winter. Under these conditions the average cost of producing 100 pounds of milk was $1.42 for the period when the cows were on pasture and $1.75 for the time that they were on winter feed (Table 9). The summer price received for milk was $1.66 and the winter price $1.84. Under the cost and price conditions that existed in 1938 and 1939, herds producing milk at the level of those in this study made an average monthly profit of $1.61 per cow during the five summer months and 63 cents per cow during the seven months of barn feeding.

Milk production per cow was highest in March, April, and May 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 April and May. However, the herds yielding the highest profit per cow (23 percent of the herds in this study) were those in which production was *fairly even thru the year,* not rising in March, April, or May as high as 125 percent of monthly average production, nor in any month of the year falling below 80 percent of the monthly average (Table 10). On these farms the yearly profit per cow was $14.28; but it was only $10.40 in the herds where March, April, and May production rose as high as 140 percent of the monthly average and dropped in September, October, and November below 75 percent of the monthly average (33 percent of the herds).

Herds with fairly even production thruout the year made more profit per cow per year than the other herds even tho a large share of milk from the even-producing herds came in the winter months when costs are high. The reasons follow.

1. Even-producing herds were better-managed in many respects. 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. Moreover, these owners kept their costs down. Even tho the feed was somewhat higher per cow in these herds, labor was $2.50 less per cow and costs other than feed and labor were $4.24 less.

2. In even-producing herds, about the same number of cows freshened during each season, but in uneven-producing herds, most of the cows freshened in the late winter and early summer months. Even-producing herds were fed more and were fed more evenly than were uneven-producing herds.

3. Since winter months were also the high-price months, the owners of the even-producing herds received an average of $1.78 a hundred pounds for their milk, whereas the owners of the other herds got an average of $1.73 a hundred, the peak of their production coming in early summer when milk prices are at the seasonal low. Thus milk that cost the owners of even-producing herds a few cents less a hundred pounds to produce brought them 5 cents more a hundred pounds on the market.

TABLE 10.—RELATION OF EVENNESS AND UNEVENNESS OF PRODUCTION TO PROFIT PER COW, 1938 AND 1939

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	287	106	279	100
February	320	118	284	102
March	317	117	288	103
April	341	126	295	106
May	360	133	307	110
June	314	116	282	101
July	268	99	265	95
August	228	84	269	96
September	192	71	263	94
October	179	66	266	95
November	198	73	270	97
December	255	94	276	99
Yearly profit per cow	$10.40		$14.28	

Month of Year

The cost of producing milk was lowest in May and June and highest in December, January, and February (Table 11). In December the feed cost was 92 cents per 100 pounds of milk, nearly twice that

TABLE 11.—COST OF MILK AND PRICES RECEIVED BY MONTHS OF THE YEAR, SOUTHWESTERN ILLINOIS, 1938 AND 1939

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	$.90	$.45	$.63	$1.98	$1.95	701
February	.88	.44	.65	1.97	1.87	665
March	.84	.43	.61	1.88	1.80	728
April	.72	.40	.61	1.73	1.67	722
May	.48	.32	.58	1.38	1.56	803
June	.52	.35	.63	1.50	1.64	686
July	.56	.38	.66	1.60	1.68	632
August	.61	.40	.70	1.71	1.70	587
September	.66	.43	.73	1.82	1.81	540
October	.71	.44	.69	1.84	1.88	576
November	.80	.46	.69	1.95	1.90	589
December	.92	.46	.66	2.04	1.84	653

in May, when the cows were on pasture. A charge of 7.5 cents per cow per day was made in both years for the best pasture. This daily charge was scaled down when the forage on the pastures declined.

These dairymen cut down rather abruptly their feeding of grain when the cows were turned onto pasture in late April and early May, thus reducing their feed costs. Nevertheless the milk flow increased substantially. Feed costs went up again, however, as the summer advanced and the decline in the succulence and abundance of pasture forage made it necessary to feed more grain.

SUMMARY

Milk production per cow averaged 7,762 pounds yearly in the southwestern 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 44.5 percent and man labor 25.5 percent of the net cost of producing milk. Thirteen other items made up the other 30 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 grain and silage, and very little difference in the amounts of protein used.

Twenty-two 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 51 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 8,500 and 9,500 pounds of milk yearly was produced at a cost of $1.55 a hundred pounds in 1938 and 1939. The cost was $1.98 a hundred pounds from cows giving less than 5,500 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 1 cent a hundred pounds.

Milking machines proved labor-savers. They enabled a group of these men to produce 7 more pounds of milk with every hour of their labor. The machines saved them $4.70 a cow a year, or about $60 a herd.

Under the cost and price conditions that existed in 1938 and 1939 the 198 herds for which monthly records were available made an average monthly profit of $1.61 per cow during the five summer months, against only 63 cents a cow a month during the seven months of barn feeding. Thus these dairymen made approximately two and one-half times as much profit per cow while the herd was on pasture as while it was barn-fed. The average yearly profit in these herds was $11.19 per cow.

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 March, April, and May production rose as high as 140 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 $10.40 per cow. Those in which production did not in any month go more than 20 percent above or below the monthly average for the year made a yearly profit of $14.28 per cow. In slightly less than 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 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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