Cost of Producing

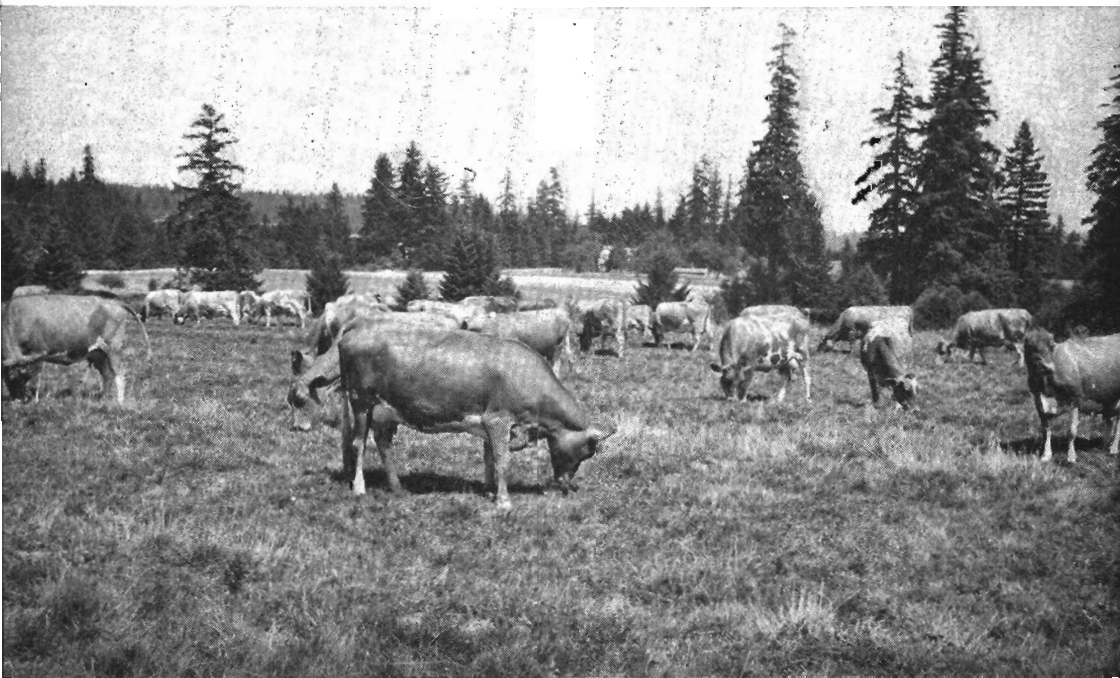
GRADE A MILK

In the Willamette Valley Section, Portland, Oregon, Milkshed

Grant E. Blanch
D. Curtis Mumford
W. Wray Lawrence

Station Bulletin 486
September 1950

Agricultural Experiment Station
Oregon State College, Corvallis



FOREWORD

Oregon's rapidly increasing population is causing our dairy farmers to put more and more emphasis upon the production of Grade A milk for fluid consumption. Because the production and sale of this milk in Oregon is regulated by the provisions of our State Milk Marketing Law, it is fitting that producers, consumers, distributors and retailers exhibit considerable interest in these activities.

This bulletin summarizes the findings of a study on the cost of producing Grade A milk in the Willamette Valley section of the Portland milkshed. The facts presented here will be of particular interest and value not only to individual producers and consumers but also to their group representatives.

It is sincerely hoped that this bulletin will contribute to a fuller understanding and a more genuine appreciation of the problems concerning the cost of producing Grade A milk in Oregon.

F. E. Price

Dean and Director

ACKNOWLEDGMENTS: The study reported herein is the result of a cooperative agreement between the Oregon Agricultural Experiment Station and the Milk Control Section of the State Department of Agriculture. The work was undertaken at the request of E. L. Peterson, Director of the State Department of Agriculture, under whose jurisdiction the Oregon Milk Control law was then administered. The Milk Control Section of the State Department of Agriculture contributed generously toward the cost of the project. For this interest and financial assistance, the authors are deeply indebted.

The authors are grateful for the outstanding cooperation obtained from the dairymen who provided data on their dairy operations, from the several firms who supplied information on the amount and value of milk sold by each cooperator, from the County Agricultural Extension Agents for aid in contacting and locating the cooperating dairymen, and from several resident staff members of the departments of Dairy Husbandry and Agricultural Economics who contributed many helpful suggestions during the course of the study.

The authors express their appreciation to Thomas L. Ohlsen and Cecil Griggs, members of the Milk Control Section of the State Department of Agriculture, for supplying necessary data from their files and for many helpful suggestions and constructive criticisms of the manuscript.

Assisting with the field work were Manning H. Becker, Assistant Agricultural Economist, and Arthur Matson, Graduate Student.

TABLE OF CONTENTS

Cost of Producing GRADE A MILK

In the Willamette Valley Section, Portland, Oregon, Milkshed

by

GRANT E. BLANCH, Associate Agricultural Economist
D. CURTIS MUMFORD, Agricultural Economist
and
W. WRAY LAWRENCE, Extension Agricultural Economist

Introduction

Milk is now recognized as an essential part of the human diet. Without adequate quantities of milk, the human diet today would be seriously lacking in essential nutritive elements, particularly minerals and proteins of a high quality. For this reason, it is important that an adequate and constant supply of wholesome milk be available to consumers at prices that will permit liberal usage.

Families residing in urban centers are, for the most part, dependent on dairymen in fairly close proximity to the city for their supply of milk. Therefore, the production of milk for consumption in fluid form is an important agricultural enterprise adjacent to almost every large city. Metropolitan Portland, the largest city in Oregon, is no exception. Its daily milk needs for a population of about 550,000 are now supplied by utilizing a considerable part of the agricultural resources of 975 farmers within a relatively short radius of the city. If the consumers in Portland are to be insured of an adequate and continuous flow to their doors of a pure and highly nutritious food, the producers of this milk must have a sound financial basis of operation. This can be attained only by receiving a reasonable return for the resources which they employ in the production of this product. Otherwise, these resources, wherever possible, will be withdrawn from the production of milk and employed in more profitable enterprises.

To aid in stabilizing the milk industry in its period of readjustment from wartime to peacetime operations, the Milk Control Section of the State Department of Agriculture, under the control and direction of the Director of Agriculture, requested the cooperation of the Oregon Agricultural Experiment Station in obtaining factual information concerning the costs of producing Grade A milk in the Portland milkshed. The results of the investigation are reported in this bulletin.

Objectives

The major objectives of the investigation reported herein were:

1. To determine, insofar as possible, the average annual costs of producing milk and butterfat under Grade A sanitary regulations in the Willamette Valley section of the Portland milkshed.

2. To determine seasonal differences in production costs.

3. To develop a formula from the data collected in the study for estimating current net costs of producing 100 pounds of milk.

4. To determine the factors affecting production costs and their relative importance.

5. To compare the returns from the sale of milk with its production costs.

Method of Study

The data on which this study is based were obtained from 61 cooperating dairymen whose dairy facilities met the City of Portland's sanitary requirements for the production of Grade A milk. The farms were located in the counties of Clackamas, Marion, Multnomah, Washington, and Yamhill (Figure 1). The study covers the 12-month period from October 1, 1946, through September 30, 1947. The basic information was collected by the survey method. Each cooperating dairyman was visited in the fall of 1947 by a trained enumerator carrying a specially prepared field questionnaire. With the aid of the dairyman and the use of any records kept by him, the enumerator recorded the necessary information on the carefully prepared field schedule. The costs reported herein pertain only to the milk production phase of the dairy enterprise. The home-grown feedstuffs were charged to the milking herd at the price for which they could be sold and not at their production costs.

Great care was exercised in selecting the dairymen who cooperated in the study. They were selected at random from a listing of producers located in the Willamette Valley who held butterfat quotas on the Portland market. A cardinal requirement in selecting a sample for a study of this nature is that the sample truly reflect the conditions in the area that it is intended to represent. This study was designed to be representative of average Grade A producer conditions in the area described as the Willamette Valley section of the Portland milkshed. The 61 dairymen giving records on which the study is based represented slightly more than 18 per

[1]See Appendix A, page 55, for a detailed statement on method of sampling and basis for calculating costs.

Location of the 61 Dairy Farms Studied and the City of Portland

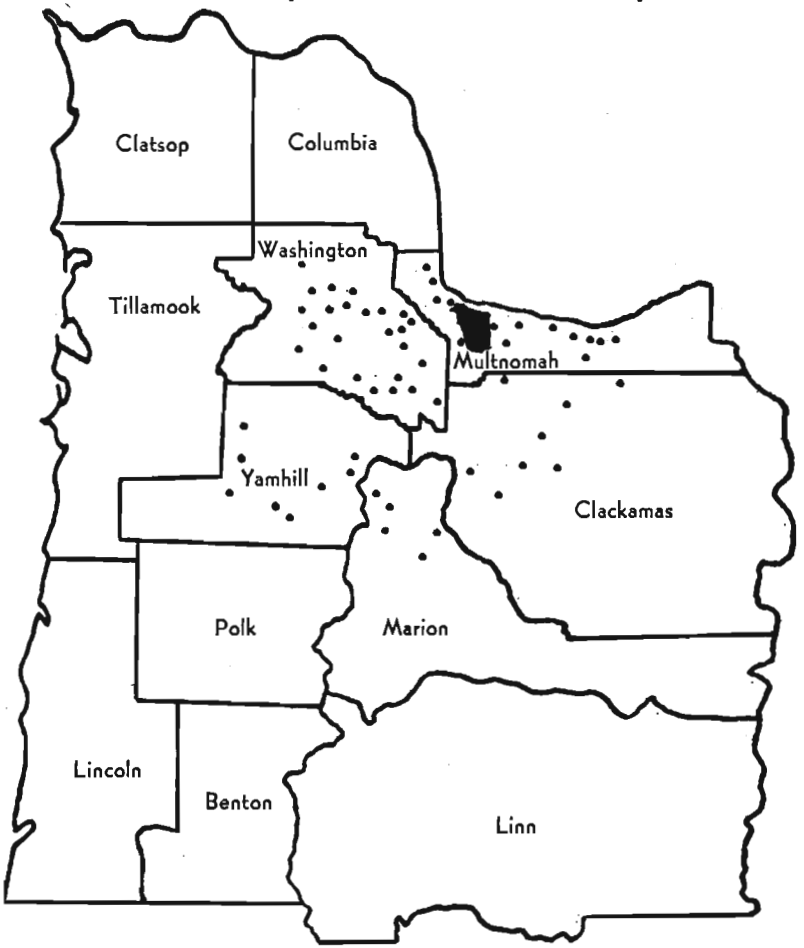


Figure 1. Producers of Grade A milk in the counties in which the farms studied are located held slightly more than two-thirds of the total butterfat quota allotted for the Portland market on March 1, 1946.

cent of the total number of holders of butterfat quota in the six counties from which they were selected. They produced approximately 19 per cent of the total pounds of butterfat quota held by all producers in the six counties. It is felt that the study cooperators reflect average conditions that existed in the specified portion of the Portland milkshed.

Information pertaining to the sale of milk was obtained, by written permission, directly from the firm to which the cooperating dairyman sold his milk.

Description of Farms

Dairying in the area from which records for this study were obtained is conducted as part of a diversified farming system as well as a specialized enterprise. Some of the farms studied produced all of their feed requirements in addition to small acreages of cash crops. Other farms purchased essentially all of the feed fed other than pasture. Of the 61 dairymen interviewed, 58 were producers supplying distributors and 3 were producer-distributors.

Size of farm (acres)

The average size of farms on which milk production cost records were obtained was 134 acres. The smallest farm was only 10 acres, the largest 453. One-fourth of the farms were less than 70 acres in size, and essentially the same proportion were larger than 170 acres. Half of the farms studied were between 70 and 170 acres in size.

Land use

Hay of all kinds accounted for 24.6 acres per farm and represented 18.3 per cent of the total land area. A larger proportion of the land was used for the production of grain than for any other purpose. Nearly 28 per cent of the total land was put to this use. Other crops grown included some seed production, small fruits, nuts, vegetables, sweet corn, and field corn for silage. The pastures were predominantly native and considerable brush and waste land existed. Of the average of 134 acres per farm, only 86 acres were reported as being tillable.

Capital investment

The total capital investment in land and buildings reported by the 61 dairymen that were interviewed averaged $33,145 per farm, or $247 per acre. The range was from $5,000 per farm to $100,000. No attempt was made to obtain values for land and buildings separately.

Tenure

The dairy farms included herein were predominantly owner-operated. Fifty-seven per cent of the units were wholly owned by their operators. Only 4 units were wholly rented. The remainder,

thirty-six per cent, owned part of the land which they operated but rented additional land on either a cash or share basis in order more nearly to provide an economic unit for efficient production.

Of the 4 farms that were wholly rented, 3 were on a cash basis and 1 was share rented. Three of the four rented farms were larger in acreage than the average of all farms. Share renting was more predominant than cash renting for those who owned part and rented part of the land which they operated. These units also averaged larger in size than the owner-operated units.

Annual Milk Production Costs

Costs per cow, hundredweight of milk, and pound of butterfat

The average annual net cost of keeping a dairy cow, as reported by 61 dairymen in the Willamette Valley section of the Portland milkshed for the year ending September 30, 1947, was $438.06 (Table 1). This cost includes a charge of $18.17 for the hauling of the milk from the farm to the distributor's plant in Portland. Included in the annual cost of keeping a cow are all cash expenses

Table 1. AVERAGE ANNUAL COSTS OF PRODUCING GRADE A MILK, 61 DAIRY FARMS, WILLAMETTE VALLEY SECTION, PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Item	Production costs			Total cost (hundredweight milk basis)
	Per cow	Per pound of butterfat	Per hundredweight of milk testing 4.38 per cent	
				Per cent
Costs:				
Hay	$ 67.94	$0.21	$0.92	14.9
Succulence	25.08	.08	.34	5.5
Concentrates	95.27	.29	1.28	20.7
Pasture	21.40	.07	.29	4.7
Total feed	$209.69	$ .65	$2.83	45.8
Labor	$137.17	$ .42	$1.85	29.8
Use of buildings	31.18	.10	.42	6.8
Use of equipment	13.39	.04	.18	2.9
Breeding	6.88	.02	.09	1.4
Depreciation of cows	12.18	.04	.16	2.6
Interest on cows	7.92	.02	.11	1.8
Hauling milk	18.17	.06	.24	3.9
Miscellaneous	22.79	.07	.31	5.0
Total gross costs	$459.37	$1.42	$6.19	100.0
Miscellaneous returns (credits):				
Calves	$ 6.94	$ .02	$ .09	
Manure	14.37	.05	.20	
Total credits	$ 21.31	$ .07	$ .29	
TOTAL NET COST	$438.06	$1.35	$5.90	

chargeable to the milking enterprise, and in addition, all noncash costs incurred in producing milk. These so-called noncash costs consist of such items as farm produced feed and bedding; depreciation and interest on the investment in the cows, the buildings, and the equipment used by the milking herd; a charge for the use of the family automobile, farm truck, and tractor; and wages for the time spent on the milk cows by the operator and members of his family not receiving a regular wage. Credits for calves and manure recovered were subtracted from the gross costs to obtain a net cost figure. With the production per cow amounting to 7,422 pounds of milk testing 4.38 per cent butterfat, the average cost of producing one hundred pounds of milk of this test was $5.90. The average net cost of producing 1 pound of butterfat was $1.35. The average production of butterfat per cow amounted to 325 pounds.

A return equal to these reported net costs of production would have given these cooperating dairymen, during the period of the study, prevailing market prices for the feed and bedding produced on their farms and utilized by the milking herds; wages at prevailing rates for all labor expended on the cows by themselves and their families; depreciation on the cows and on buildings and equipment used by the cows, and 4 per cent interest on the capital investment involved in the milking herd enterprise, in addition to paying the cash out-of-pocket expenses involved in milk production. Any return greater than these reported costs would be considered as profit, as it would be excess income over and above the amounts necessary to remunerate all agents of production employed in the milking herd enterprise at their full competitive market rates. A return less than these reported costs would fail to compensate these dairymen at full market rates for the resources employed in the milk production enterprise. A condition of this nature would tend to limit the expansion of milk production; and, if continued for an extended period, would tend to decrease the flow of milk into the Portland market. This is particularly true when many profitable alternative uses for the resources employed in milk production exist.

Major items of cost

Feed was by far the most important single item in the cost of producing milk, amounting to nearly 46 per cent of the total cost (Table 1). This substantiates again the general rule that feed represents approximately one-half of the annual total cost of producing milk. The 2,669 pounds of concentrates fed per cow represented the largest charge for any single class of feed, amounting to nearly one-half of the total feed cost. Hay and other roughage was the

next most important item of feed cost with succulents and pasture of about equal importance.

Labor chargeable to the milking herd, amounting to $1.85 per hundredweight of average test milk, represented the second most important item of cost. With practically 30 per cent of the cost of producing milk being accounted for by labor, feed and labor combined make up more than three-fourths of the total cost of production. Those producers interested in improving their production efficiency, and thereby reducing their production costs, would do well to study first their feeding and labor programs. With these two items making up such a large proportion of the total cost, it is probable that greater economies could be effected by improving these programs than from any other source.

The third most important item of cost, though of much smaller magnitude than feed or labor, is the charge for the use of buildings. The building charge amounted to 42 cents per hundred weight of average test milk and represents just under 7 per cent of the total cost of milk production. This amount for the use of buildings is made up of that portion of the building depreciation, interest on the investment at the rate of 4 per cent, repairs, insurance, and taxes that could be charged against the milking herd on the basis of use. Only a small portion, 23 per cent, of the charge for the use of buildings is a cash, out-of-pocket expense. Taxes, repairs, and insurance fall into this category. The remainder of the charge is composed of noncash costs of depreciation and interest on the investment. Even though normally classified as a noncash cost, depreciation cannot be deferred indefinitely. Sooner or later it must be met by a cash expenditure for replacements. Also, on many farms, part of the interest on investment is undoubtedly an actual cash expenditure in the form of interest on money borrowed to construct buildings, or to improve existing barns or milkhouses in order to meet the sanitary specifications of the city of Portland Department of Public Health.

All other costs, such as use of equipment, breeding fees, and depreciation of cows, together make up nearly 18 per cent of the total. Of these, however, no single item of expense amounts to more than 4 per cent of the total production cost. The charge for hauling milk, amounting to 24 cents per hundredweight and 3.88 per cent of the total cost, is the largest single item of this remaining group. Miscellaneous costs cover a large number of items that individually are insignificant, but when combined, account for as much as 5 per cent of the total cost of producing milk. A list of these costs would have in it such items as strainer pads, fly spray, electricity, washing powders and soap, chlorine, veterinary fees, medicine, Dairy Herd Improvement Association dues, and others of like nature.

Miscellaneous returns (credits)

Certain returns from the dairy herd are in the nature of by-products and are deducted from cost. The total value of these by-products amounted to $21.31 per cow. The value of the recoverable manure amounted to two-thirds of this total with the value of calves making up the other third. The average amount of manure recovered at the barn reported by these dairymen was 6.5 tons per cow and was valued by them at an average of $2.22 per ton. The 6.5 tons of manure would contain approximately 74 pounds of nitrogen, 20 pounds of phosphorus, 54 pounds of potash, and traces of other elements. While the amount of plant food contained in a ton of manure would cost more than $2.22 in the form of a commercial fertilizer at 1947 prices, it must be remembered that the manure is valued at the barn and not on the land. Because of the smaller cost of applying to the land an equivalent amount of fertility in the form of a concentrated commercially prepared fertilizer, one is not justified in valuing manure on the basis of the full cost of purchasing the elements contained therein in the form of a commercial fertilizer. The manure dropped on fields and pastures is recognized as having value and is reflected in a slightly lowered grazing charge.

The number of calves for which credit was given the milking herd averaged slightly less than one per cow. Sales of cows from the milking herd, additions to the herd through purchasing cows in milk, and the retention of shy breeders in the herds account for there being fewer calf credits than cows in the study. The average value per calf credit was $7.50, which amounts to $6.94 per cow. Heifer calves intended to be raised and kept for herd replacements were valued at time of birth at a level nearly two and one-half times greater than the average of all calves. The remainder of the heifer calves and the majority of the bull calves were valued at time of birth at levels considerably less than $7.50 per calf, reflecting the lack of a profitable means of disposal. While these calves had value and could have been sold in most instances, a number of dairymen chose to dispose of them in other ways rather than be bothered with them.

Variation in costs between producers

While the weighted average cost of producing milk and milk fat was $5.90 per hundred pounds and $1.35 per pound respectively, there was wide variation among the individual producers in their costs of producing these products. The variation in cost of producing milk is illustrated in Figure 2, which shows an array of all the farms as to cost of production and the per cent of the total milk that was produced at each cost. Variation in the cost of producing

Individual Net Costs of Producing Grade A Milk and Per Cent of Milk in Study Produced at Each Cost

61 Dairy Farms, Willamette Valley Section, Portland Milkshed, Year Ending September 30, 1947

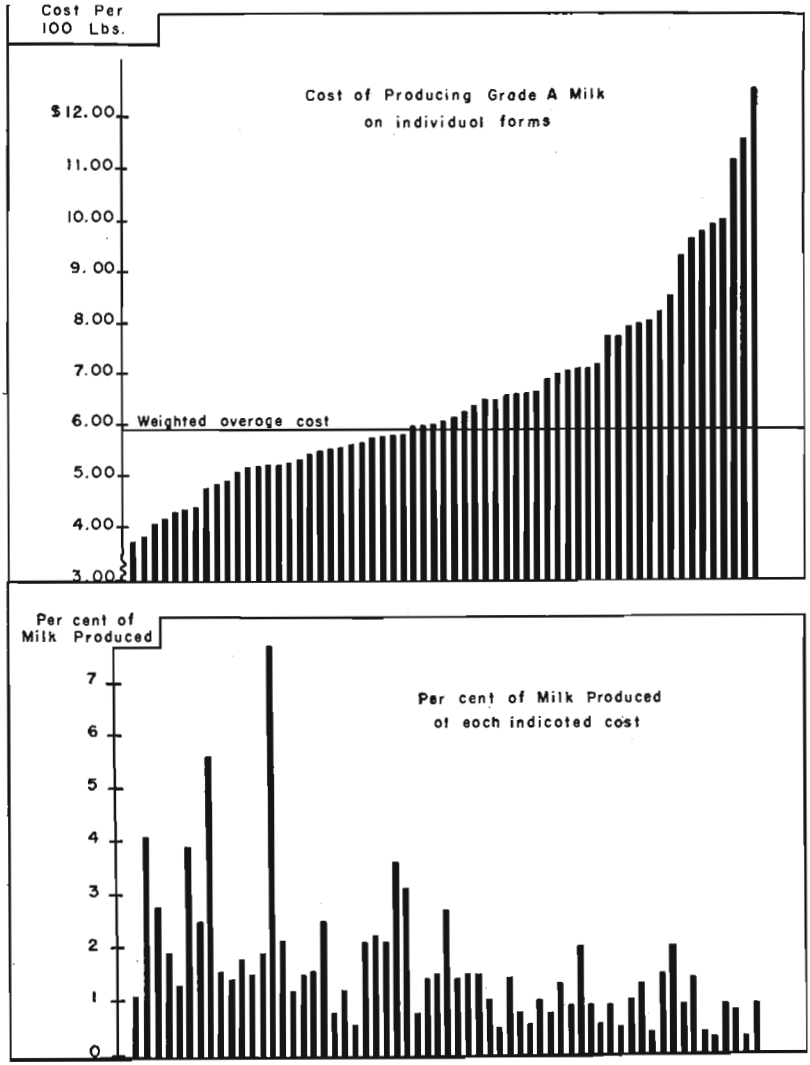


Figure 2. The lower cost dairymen were considerably more efficient in their operations than the higher cost dairymen. One of the reasons is that generally they had larger than average size herds.

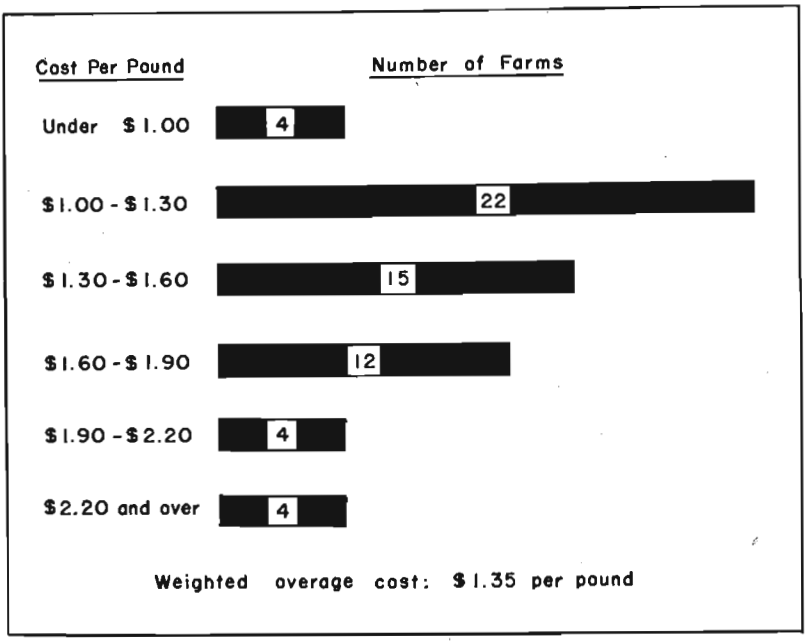


Figure 3. Variation in cost of producing 1 pound of butterfat, 61 dairy farms, Willamette Valley section, Portland milkshed, year ending September 30, 1947.

milk fat is shown in Figure 3. The lowest cost producer of milk reported costs amounting to slightly less than $4.00 per hundred pounds. In contrast, the highest cost producer reported costs amounting to over $12.00 per hundred pounds, three times greater than the lowest cost. Each of these farms produced approximately 1 per cent of the total milk in the study.

If the low cost producers had the capacity to supply the Portland market with its milk requirements at these low costs, it is logical to assume that the price of milk would be sufficiently low to force out of the market the higher cost dairymen. This would give consumers cheaper milk. It is apparent, however, that the market has required and demanded the milk coming from these high cost dairies. As will be shown later, nearly two-thirds of the producers failed to receive their production costs. But because of circumstances or a lack of a more profitable alternative outlet for the factors of production, these dairymen have supplied the margin of milk above that which the low cost dairymen have been able to deliver.

A discussion will be given later of the factors associated with the differences in production costs.

Seasonal Production Costs

The unit cost of producing milk on the dairy farms included in this study was considerably less during the summer months than the winter months (Figure 4). While the annual net cost per hundredweight of average test milk was $5.90, net costs by months varied from a low in May of $4.26 to a high of $7.77 in November—a total spread of $3.51 per 100 pounds. Unit costs in the early winter months of November, December, and January were not materially different. Unit costs in May, June, and July were likewise very similar, but gradually increasing from the low point in May. The seasonal variation in the cost of producing butterfat was relatively less than milk, primarily because of a relatively smaller seasonal variation in the production of butterfat.

Factors affecting seasonal costs

Most of the seasonal variation in production costs can be attributed to two factors:

1. Differences in feeding practices and feed costs.
2. Differences in milk production by months which is primarily a result of herd management.

For example, the November gross feed cost per 100 pounds of milk was $3.83, nearly twice that of $1.94 in May (Table 2). This does not mean that cows eat twice as much in November as in May, or that pasture is only half as costly as other sources of feed, for the seasonal variation in feed cost per cow does not begin to approximate

Table 2. VARIATION IN COSTS OF PRODUCING MILK BY MONTHS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Month	Costs and credits per 100 pounds of milk					
	Feed costs	Labor costs	All other costs	Total gross costs	Miscellaneous returns (credits)	Net cost
January	$3.88	$2.45	$1.78	$8.11	$0.35	$7.76
February	3.50	2.24	1.67	7.41	.32	7.09
March	3.00	1.94	1.49	6.43	.30	6.13
April	2.37	1.58	1.30	5.25	.25	5.00
May	1.94	1.33	1.23	4.50	.24	4.26
June	2.10	1.38	1.31	4.79	.25	4.54
July	2.15	1.45	1.38	4.98	.26	4.72
August	2.52	1.59	1.53	5.64	.29	5.35
September	2.92	1.76	1.71	6.39	.36	6.03
October	3.26	2.29	1.72	7.27	.34	6.93
November	3.83	2.49	1.80	8.12	.35	7.77
December	3.83	2.44	1.77	8.07	.35	7.72
Annual average	$2.83	$1.85	$1.51	$6.19	$0.29	$5.90

Seasonal Variation in per Cow Day Milk Production and Net Costs

61 Dairy Farms, Willamette Valley Section, Portland Milkshed, Year Ending September 30, 1947

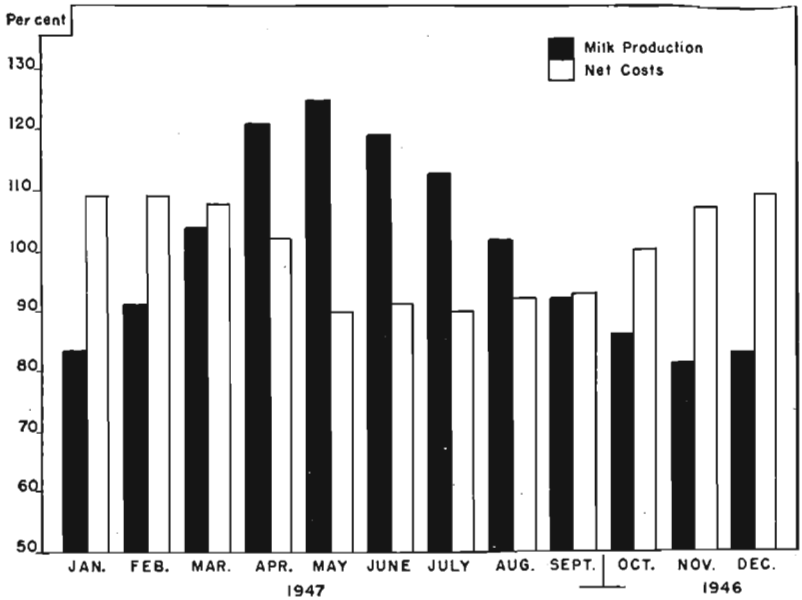


Figure 4. Considerably more variation existed in milk production per cow day during the year than existed in net costs per cow day.

this magnitude. The gross feed cost per cow day in May was 50 cents and in November 64 cents, an increase of only 28 per cent. This difference is wholly attributable to changes in the feeding program—a drastic reduction in the feeding of hay, a slight reduction in the feeding of concentrates, and a heavy reliance on pasture as a source of nutrients in May as compared to November.[1] If the feed costs in May and November were spread over the same units of milk, November costs of producing 100 pounds of milk would be only 28 per cent above May instead of being essentially double as they really are. Therefore, the remainder of the difference in feed cost per 100 pounds of milk must be a result of differences in milk produced during the two months. Actually, feed costs per cow day were spread over a daily production of 26 pounds in May as compared to only 17 pounds in November. The interaction of these two factors in combination—a 28 per cent increase in daily feed costs

[1]See Table 4, page 30.

Seasonal Variation in Gross Costs of Producing Grade A Milk
61 Dairy Farms, Willamette Valley Section, Portland Milkshed, Year Ending September 30, 1947

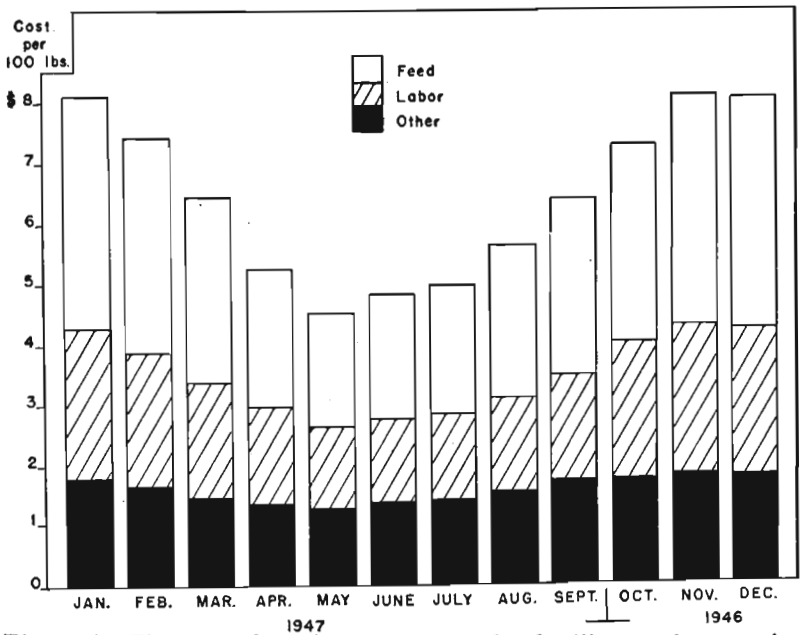


Figure 5. The cost of producing 100 pounds of milk was almost twice as high in the winter months as it was in May largely because of the seasonal variation in milk production. See Figure 4.

between the two periods with a November milk flow of only 65 per cent of that in May—was sufficient to result in feed costs per 100 pounds of milk in November essentially twice those in May.

The same situation exists in explaining the seasonal variation in total costs of producing 100 pounds of milk. In addition to lower feed costs per cow day during the summer months, labor requirements per cow day were hardly as great in summer as in winter. During the period the cows were on pasture, there was less hand feeding and barn cleaning to be done. All other costs, such as use of buildings, interest on investment, depreciation, and miscellaneous, vary very little during the year. Therefore, changes in feed and labor were primarily responsible for the seasonal variation in the net cost per cow. The extent of this variation, measured by expressing the net cost per cow day for each month as a per cent of the

average annual net cost per cow day, is not very great. No month is as much as 10 per cent above the annual average and no month is more than 10 per cent below (Figure 4).

If the milk production per cow day were equal each month during the year, then the pattern of variation in the cost of producing 100 pounds of milk would have been identical to the pattern made by the seasonal variation in the net cost per cow day. Instead, the low production period occurred during the winter months when the costs per cow were at their peak. The months of highest production corresponded to the period when costs were lowest per cow. Because of the wide seasonal variation in milk production—from a low in November of 81 per cent of the annual average daily production to a high of 125 per cent in May—and because the months of low costs per cow correspond to the months of greatest milk flow and vice versa, the seasonal variation in the net cost of producing milk is quite substantial and has far-reaching implications in the fluid milk industry.

One must not conclude that the seasonal pattern of milk production costs as outlined in this section is a fixed pattern. This particular pattern of costs exists primarily because the general tendency in herd management was to have not only a larger than average number of cows in milk during the spring and early summer months, but to have also a larger than average number of cows freshen in the period just prior to the pasture season. This management practice coupled with the stimulating effect of good succulent pastures on all cows resulted in a milk flow considerably higher during the spring and early summer than other times during the year. If the management practices were changed so as to foster an approximately even flow of milk throughout the year, the variation in production costs during different periods of the year would be materially reduced.

It is entirely possible, however, that a change of the production pattern to a more nearly even flow basis, while reducing the seasonal variation in costs, would at the same time change the cost per cow day by months and raise the weighted average level of costs per hundredweight for the year. A smaller than now proportion of milk produced during the period when cows are on pasture, which is the period of lowest feed and labor cost, would probably necessitate a heavier than now feeding of more costly harvested feeds during other periods in order to maintain an even milk flow. More hand feeding requires more labor. These two factors alone would cause a shift upward in the annual cost per cow. With the probability that no material production increase per cow would be forthcoming on a more even flow basis, annual average costs per 100 pounds of milk would probably increase.

In addition to the inputs of feed and labor, certain intangible factors and possibly higher costs are encountered when attempting to maintain more even production. These center around the breeding program and replacement practices. Many farmers consider spring as the "natural" time for cows to freshen, and production specialists indicate that this feeling cannot be wholly discounted. Cows that are difficult to settle do not work into a planned breeding program very well. While they can be replaced in the herd, a higher rate of turnover would tend to result in higher production costs.

Where the dairyman raises his own replacements, it is advantageous whenever possible for him to keep calves born in the mid-winter months. By so doing, time is available to care for them when young and they can be turned in the calf pasture with lush feed available at a young age. This minimizes the total labor and feed costs for growing them. Most heifers are sufficiently mature to freshen from 24 to 26 months of age. If a larger than average number of calves are kept from cows freshening in the winter months, a preponderence of these heifers would be freshening at a time to affect the seasonality of production of the herd unless the breeding of some were delayed to freshen in the summer months. Delayed breeding involves greater than normal costs in raising the replacements to a state of production and this might logically be charged against the cost of producing milk.

Where replacements are purchased, some opportunity exists to buy cows bred to freshen at a certain time. As long as quality of cows purchased does not have to be sacrificed, this is a convenient way for those who can or must use it to shift the herd's seasonal pattern of freshening and thereby level out the seasonal pattern of production.

Considerations for most profitable production patterns

While it is physically possible to change an existing seasonal pattern of production and the resulting seasonal pattern of production costs, the economic feasibility of any production pattern depends on certain relationships. It seems obvious that any individual dairyman considering leveling out or otherwise changing his production pattern should want to base his decision on expected returns from the milk produced as well as costs incurred. Perhaps he should consider also the probable effect a particular pattern of production might have on the profitability of other enterprises that in combination with the dairy make up his total farm business. If some of these enterprises are highly profitable but conflict seriously with the most profitable milk production pattern, perhaps total farm income would be greater if first priority were not given to the dairy.

While a consideration should be given to costs and returns for different patterns of production before attempting to change, there is a great lack of specific data as to differences in costs and returns for different seasonal patterns. Also essentially no information is available dealing with the costs involved in the changing from one pattern to another. A study designed for these specific purposes would be necessary to render the information required.

The most profitable seasonal pattern will vary among farmers, depending on their individual situations and the particular circumstances existing in a given market at a given time. If regulated prices for fluid milk are not adjusted seasonally and if all of the production, irrespective of the amount of quota held, can be sold for fluid purposes, the larger the proportion of milk produced during the period of lowest cost per cow, which is characteristically the spring and early summer months, the greater the net returns from the milking herd.

This situation essentially existed during and immediately following the war. With the existence of a shortage of Grade A milk even during the period of flush production, all available Grade A was sold in fluid form. This meant that production in excess of quota during part of the year and failure to deliver quota during other periods had little economic significance. This situation, coupled with the fact that milk prices were as high in May as in November—except for a slight variation in the amount of the government sub-

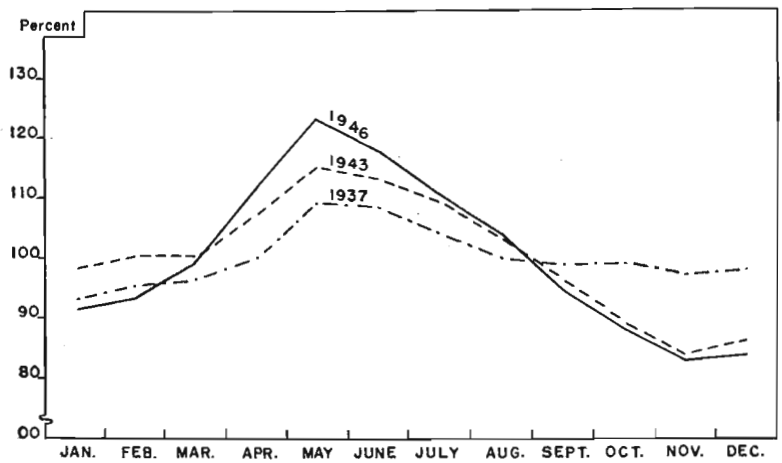


Figure 6. Changes in seasonality of production of grade A milk in the Portland milkshed for selected years.

sidy—most definitely encouraged producers to relax their breeding programs. This resulted in production of a larger than normal proportion of milk in the Portland milkshed in the spring and early summer (Figure 6). Under existing circumstances, this pronounced pattern of seasonal production undoubtedly was the most profitable for a majority of the producers.

This condition changed in 1948 and the resulting imbalance of production and consumption seasonally might be a major problem in the Portland milkshed. Production of Grade A milk has increased to a level that considerable surplus has existed during the flush production period. Because of the seasonality of flow, little more than enough milk to meet the demands of the market has existed during the fall and early winter months. With an abnormally wide spread between the regulated price of Grade A milk for fluid consumption and the price surplus milk has brought in the open market for manufacturing purposes, producers with abnormally high spring and early summer production patterns have obtained average prices considerably lower than those who have essentially stayed within their quotas. It is questionable whether the annual average production costs of these producers were sufficiently lower to compensate for this lower average price.

Another factor that affects the most profitable pattern of production for individual farmers is the type of pastures utilized. The development of improved pastures, both irrigated and nonirrigated, is possibly contributing to a high seasonal production during the spring and early summer months. This might be economically justified under relationships that have normally existed. It is conceivable that production costs could be lowered sufficiently by the use of economical pastures with high grazing capacity, that an individual producer might well be able, under normal conditions, to take a slightly lower price for his surplus during the period of seasonally high production and obtain higher net returns for the year as a whole than if he attempted merely to meet his quota each month of the year. However, the price spread between bottle and manufacturing milk normally is too great to make this likely for any extended period.

In contrast to the operator with pasture, the dairyman who has no pasture that would permit sustained grazing and who must rely primarily on hand feeding during much of the summer would tend to benefit by staying within as high a quota as could be maintained without too much extra effort and expense. Other particular circumstances would dictate the production pattern that would be most feasible for a given situation.

Producer Returns

Annual

For the year of the study, an average of 7,422 pounds of milk testing 4.38 per cent butterfat was produced per cow. This milk was valued at $402.82 per cow, or $5.43 per 100 pounds. The net average cost of production was $438.06 per cow, or $5.90 per 100 pounds of milk (Figure 7). This loss amounted to $36.24 per cow, or 47 cents per 100 pounds of milk.

The value of milk produced was determined in the following manner: Records of milk sold and prices received were obtained directly from the distributors to whom the producers sold their milk. The average farm price received by each cooperator for the period of the study was calculated. Milk used in each home or fed on the farm was valued at this average price received by the producer using the milk. The milk produced by the three producer-distributors and retailed by them was valued at the average market price received by all producers after adjusting for differences in butterfat test. Milk used in the homes or fed on the farms of the producer-distributors was valued at this market price less an allowance for transportation costs from their farms to Portland.

Not all farmers suffered a loss. Primarily because of lower than average production costs, nearly two-fifths, 38 per cent, of the dairymen showed a net profit. This profit averaged 51 cents per 100

Cost and Returns per 100 Pounds Average Test Grade A Milk
61 Dairy Farms, Willamette Valley Section, Portland Milkshed, Year Ending September 30, 1947

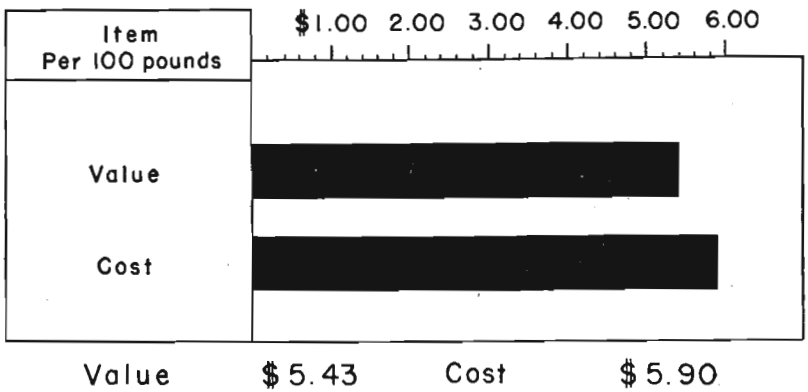


Figure 7. Producers on the average failed by 47 cents per 100 pounds of milk to cover their total costs during the period of the study. The lower cost producers obtained a profit above all costs.

pounds of milk and ranged from a high of $1.94 to a low of 1¢. While the number of producers enjoying a profit amounted to only 38 per cent, they produced 55 per cent of the milk. Thus over half of the milk was produced at a profit, reflecting the fact that the lower cost producers were larger than average. Except for differences in butterfat test, the price received for the milk sold was essentially the same for all producers.

The average loss by those dairymen sustaining a loss was $1.67 per 100 pounds of milk and ranged from a high of $5.32 to a low of 17¢. The combined production of these producers accounted for only 45 per cent of the milk in the study.

The fact that the producers in this study failed, on the average, to meet their production costs does not mean that they suffered a cash, out-of-pocket loss, nor that they were necessarily on the verge of bankruptcy. Included in the cost of producing milk is an allowance for the actual labor input of the operator and members of his family not paid a regular wage. This source of labor accounted for three-fourths of all labor employed on the milking herd enterprise and was valued at an average of $1.02 per hour. If the wages of the operator and his family are subtracted from the net total cost of producing milk, and this adjusted total cost is subtracted from the value of the milk produced, the residual is the amount actually available to pay the operator and his family for their labor and management function. Doing this, one finds that instead of $1.02 per hour, the milking herd actually paid the operators and their families only 70¢ per hour, which is less than the average wage paid to all kinds of labor that was hired. So a loss from the production of milk in this study actually means that on the average the 61 operators and members of their families who worked without a regular wage failed by 32 cents per hour to receive the wage they felt they were worth. However, some of the most efficient operators and their families were paid very high labor returns from their cows while the inefficient, high cost producers worked for very low wages.

If these producers desire to improve their returns from the milking herd, there are two lines of action open to them. They can act independently or jointly in an attempt arbitrarily to raise the price received for milk. With production costs unchanged, any increase in price received would result in either increased returns or decreased losses. The other line of action is concerned with each individual's ability as a manager to reduce his own production costs through improved efficiency. With the price of milk unchanged, returns would be increased by the amount of the reduction in production costs.

Low income producers at times appear to have been more interested in trying to improve returns by obtaining higher prices than by lowering production costs. This has been true in spite of the fact that a dairyman, in the long run, has more permanent control over production costs than over prices received. The price received must, to a large degree, be determined by supply and demand conditions which are not significantly affected by the actions of one or two producers. Yet, to many it seems easier to look everywhere except at home for remedies for low financial returns.

Seasonal

The prices received by months per 100 pounds of milk sold are shown in Figure 8. It will be noted that the information presented is not on a calendar year basis but corresponds to the twelve-month period covered by the study.

The variation in prices received over this period can be accounted for almost entirely by the following factors: (1) The differences in prices received by months from the beginning of the study in October 1946 through May 1947 are due primarily to differences in the richness of the milk. During most of this period the quota pool price approximated $1.37 per pound of butterfat and, except for May, essentially no surplus existed. The butterfat test varied during the year from a high of 4.6 per cent in November to a low of 4.2 per cent in May. With butterfat worth $1.37 per pound, 100 pounds of milk in November was automatically worth 55¢ more than 100 pounds in May. (2) A factor was introduced in June that accounts for the generally lower prices during the last four months of the period. The Milk Control Section of the State Department of Agriculture issued Official Order G. O. No. 64, effective June 1, 1947, establishing minimum producer prices on the basis of solids not fat, as well as fat, and the level of these prices was set several cents below the prices which had existed during most of the preceding period.

A comparison by months of prices received for milk sold and production costs shows very clearly that production costs were covered only during the months of April, May, June, and July. These were the months during which milk flow was greatest and production costs lowest. The margin of net profit, however, was not sufficient during these months to offset the losses incurred during the other eight months.

The prices received for milk sold by individual farmers varied somewhat from the averages shown in Figure 8. Milk of a test higher than the average of the study was paid for at a proportionately higher price, and the lower test milk brought a lower price. However, except as individual producer prices are affected by surplus, the

pattern of monthly relationship of prices received would correspond to the pattern presented here.

Miscellaneous

No account is taken here of the miscellaneous returns from milk production. These returns are in the nature of byproducts and

Seasonal Variation in Prices Received for Milk Sold and Production Costs

61 Dairy Farms, Willamette Valley Section, Portland Milkshed, Year Ending September 30, 1947

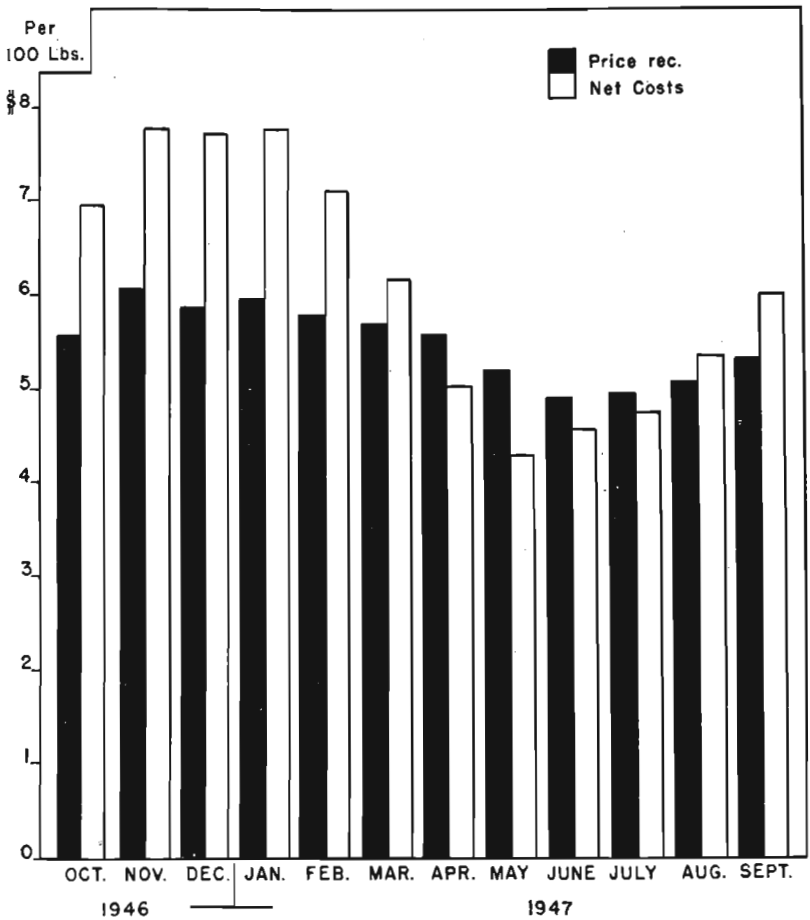


Figure 8. Little variation existed in prices received. Only during the spring and early summer months was price greater than cost.

have been deducted as credits from gross costs. Recoverable manure and calves produced are the only items considered as miscellaneous returns and together amounted to only $21.31 per cow, or 7¢ per pound butterfat. The value of feed sacks either accumulated or returned to the feed dealer was deducted from the cost of the feed purchased in order to arrive at a net feed cost. Any value salvaged from a dead or worthless cow was considered as a sale in arriving at the net cost of cow depreciation.

Physical Input Costs

Feed

One of the primary characteristics of the dairy enterprise is the large amount of feed utilized in the production of milk. During the course of a year, the feed intake of a dairy cow for body maintenance and milk production amounts to several tons. This feed must be of good quality and of some variety if high and economical rates of production are obtained. Characteristically the rations are made up of varying proportions of hay, grains, protein supplements, succulence, and pasture. The annual amounts and sources of the various classes of feed fed per cow in this study are shown in Table 3.

The cows in the study were fed an average of 2.55 tons of dry roughage per cow, of which 35 per cent was vetch hay, 28 per cent alfalfa, 20 per cent clover, and the remainder, 17 per cent, was made up of grains cut for hay, grasses, and mixed hay. Over two-thirds, or 71 per cent, of the dry roughage fed was grown on the farms where fed. Vetch and clover made up the bulk of this amount, with home-grown alfalfa being relatively insignificant. In contrast, however, alfalfa accounted for three-fourths of all hay purchased, and eastern Oregon was by far the predominating source of supply. Locally grown clover hay made up an additional 11 per cent of the

Table 3. AMOUNTS AND SOURCES OF FEED FED PER COW ANNUALLY, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Feed	Home-grown		Purchased		All sources		
	Amount	Price	Amount	Price	Amount	Price	Total cost
	Pounds	*Per ton*	*Pounds*	*Per ton*	*Pounds*	*Per ton*	
Hay	3,636	$24.98	1,465	$30.76	5,101	$26.64	$ 67.94
Succulence	6,329	7.07	927	5.85	7,256	6.91	25.08
Concentrates	850	68.42	1,819	72.76	2,669	71.38	95.27
	Days	*Per day*			*Days*	*Per day*	
Pasture	168	0.127	.....	.....	168	.127	21.40
Total							$209.69

hay purchased. The remaining 14 per cent was made up of miscellaneous kinds such as vetch, fescue, and mixed.

The average value of all hays fed was $26.64 per ton, ranging from a low of $18.00 to a high of $33.00. The home-grown hays averaged essentially $6.00 per ton below the purchased roughages. The hays purchased were valued at the price paid plus hauling costs, whereas the home-grown hay was valued at the farm price. The hay purchased, particularly the eastern Oregon alfalfa, undoubtedly was of superior quality.

In addition to dry roughage, the cows received an average of 3.63 tons of succulence per cow during the year, valued at an average of $6.91 per ton. Of the succulence fed, 85 per cent was silage of all kinds; 6 per cent was factory waste products such as pea vines that were not ensiled and sweet corn husks and cobs that were fed directly from the factory; 5 per cent was harvested green feed such as alfalfa, corn, oats and vetch, and kale; and 4 per cent was miscellaneous products such as turnips, beets, squash, and potatoes. Less than one-sixth of the succulence was purchased and consisted primarily of factory waste products. In some cases, however, the raw products, such as sweet corn after the ears had been removed, was purchased in the field from a neighboring farmer and cut into the dairyman's own silo. The fact that a large proportion of the purchased succulence was factory waste products, and some of it at a low feed value, explains why the home-grown succulence was valued slightly higher than that which was purchased. All silage was valued at an average of $7.06 per ton, factory waste products at $4.36 per ton, green feed at $7.24 per ton, and turnips, beets, squash, etc., at $7.62 per ton.

Of the feeds fed, the concentrates were by far the most important from a cost standpoint. The cows in this study were fed annually an average of 2,669 pounds per cow at an average value of $71.38 per ton, or $3.57 a hundredweight. This classification of feed includes more than the grains and commercial dairy mix. The oil meals and other high nongrain protein feeds, as well as dried beet pulp and molasses not used as a silage ingredient, are included. These feeds, however, are insignificant in relation to the grains and commercial dairy mix that were fed.

Less than a third of the concentrates fed were home-grown. This does not necessarily reflect an inability on the part of the dairy operators to grow a larger proportion of their concentrate needs. In fact, many considered it economical to do so and sold the grains produced and bought their concentrate needs in the form of a balanced commercial dairy mix. With the advent of bulk deliveries of

dairy feed at a nominally lower price, there is even less justification for those who are, or can be, equipped to handle receipt of feeds in this form to grind and mix their own. Few dairymen have the necessary equipment to grind and mix feeds properly without using a great deal of labor.

The home-grown concentrates were made up primarily of the three small grains, oats being as important as the other two combined. Some Austrian winter field peas and vetch in combination with oats were fed, but in no way did they constitute a major feed. Mixed dairy feeds accounted for two-thirds, 67 per cent, of all concentrates purchased. A very large part of this mix carried 16 per cent protein, though some pasture mix carrying 12 per cent protein was used during the spring and early summer months, and small quantities of special, high protein mixes were used. Small grains made up 7 per cent of the purchases, and the remainder was composed of mill run, oil meals for on-the-farm mixing, dried beet pulp, molasses, and screenings.

The average value of the home-grown concentrates was $3.42 per hundredweight compared to $3.64 for those that were purchased. The commercial dairy mix, predominantly 16 per cent, averaged $76.00 per ton, or $3.80 per hundredweight. The cost of commercial rations was charged at the purchase price plus hauling costs, while home-grown grains and other feeds of this kind were valued at the estimated farm value plus, when practiced, the cost of grinding and mixing.

The remaining source of nutrients was from pasture. The average number of days of pasture per cow was 168 with a range from a low of 30 days to a high of 250 days. A very large part of the grazing occurred within the seven-month period from April through October.[1] A few farmers were able, however, to turn their cows out in the latter part of March because they had native grass sidehill pastures that tend to dry out earlier than other pastures. And a very limited amount of grazing was obtained in November from aftermath and new pasture growth following the beginning of the fall rains.

The average acreage of pasture per farm was 36.5, of which 52 per cent was native grass pasture, 43 per cent was dry cropland, and 5 per cent was irrigated cropland pasture. The average acreage of all kinds of pasture was 1.5 per cow. Even though improved pastures amounted to less than half of the total acreage, considerably more than half of the actual grazing was obtained from such pastures. Native grass pastures can be good sources of feed during the early spring months but tend to be only exercise lots from mid-

[1]See Table 4, page 30.

summer until the fall rains provide sufficient moisture to bring the pastures back to life.

The dry cropland pastures included a multitude of different combinations of grasses and legumes. Some, but not a large amount, of sudan grass for late summer grazing was included. The irrigated pastures were almost wholly composed of a ladino clover-grass mixture. For the entire grazing period the grazing capacity of the irrigated pastures was several times that of the native grass, of which part was brush land.

The average estimated cost of pasture per cow for the year was $21.40, or 12.7¢ per cow day of pasture. The range in the cost per cow day of pasture was from a high of 34.9¢ to a low of 3.6¢. This difference is undoubtedly a reflection of the relative quality of the pastures involved. The pasture charge of $6.50 per acre for native grass was only a fourth as much as for the combined dry cropland and irrigated pastures, which reflects a much lower carrying capacity. Even so, in all probability the native pastures were overvalued in relation to the improved pastures in terms of the total amount of grazing provided by each.

The pasture charge per cow day of grazing was not the same for each month during the time the cows were on pasture. When the pastures were lush and provided a large part of the daily nutrients, the pasture charge per cow day was considerably more than when little forage was available. The average charge for regular grazing varied from a high of 15.4¢ per cow day in May to a low of 6.6¢ in September.

While considerable strides have been made in the improvement of pastures to provide sustained grazing, there is much yet to be accomplished by many dairymen. Because of small acreages in most instances, a few farmers had little pasture land and the only pasture that was available to a few others was the aftermath following the hay crop. Other farmers failed to develop advantageously the pasture resources that were available. Proper pasture management, including rotation grazing and more widespread use of nitrogenous fertilizers and the seeding of pasture mixtures adapted to individual field conditions, would go a long way in increasing the forage available from existing pasture resources. Based on the relationships of this study, pasture furnished relatively cheap feed, which reduced the costs of concentrates, roughage, and labor. Many farmers could make a further saving by more thoroughly developing their pasture resources through wise management and an economically sound pasture improvement program, including a grass silage program and more supplementary pasturage in July, August, and September.

The quantities of the major classes of feed fed per cow day and the labor input per cow day by months are given in Table 4. The amount of roughages fed during the pasture season was materially less than during the winter months. While succulence was fed each month of the year, the kinds fed differed considerably and a wide range existed in their feed value. Cannery waste products were the predominating kind fed during the summer months and much of this was of low feed value per pound of product. The amount of concentrates fed did not vary as much as 1 pound per cow day during the year. However, the concentrates fed per 100 pounds of milk produced were 43 pounds during the months of October through March and only 31 pounds during the remaining 6 months of the year when the bulk of the pasturage was obtained and production was high.

Table 4. QUANTITIES OF FEED AND LABOR USED PER COW DAY BY MONTHS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Month	Roughage	Succulence	Concentrates	Pasture	Labor
	Pounds	*Pounds*	*Pounds*	*Days*	*Minutes*
January	21.6	24.2	7.7	....	26
February	21.7	24.3	7.6	....	26
March	20.4	21.4	7.6	0.1	26
April	12.5	12.0	7.1	.6	25
May	3.5	14.3	6.9	.9	22
June	4.2	17.6	6.9	.9	22
July	5.9	18.2	7.0	.9	22
August	6.7	20.2	7.1	.9	22
September	10.4	17.1	7.1	.8	22
October	18.7	21.9	7.4	.3	25
November	21.7	23.4	7.7	.1	26
December	21.6	24.3	7.7	....	26
Average	14.0	19.9	7.3	0.5	24

Labor

The annual average amount of labor input per cow was 145 hours, varying from a low of 78 to a high of 380. Table 5 shows the variation in the amount of labor used by the 61 farmers included in the study. Over 60 per cent of the farms used between 100 and 160 hours per cow, 10 per cent used less than 100 hours, and the remaining 39 per cent used 160 hours or more. It is readily noted that there is a close association between the hours of labor used per cow and the size of the herd. The larger sized herds tend to utilize labor more efficiently. Table 4 gives the variation in labor requirements per cow day by months.

Essentially two-thirds of the labor charged to the milking herd was that of the operator; 25 per cent was hired, and 8 per cent was

Table 5. VARIATION IN ANNUAL LABOR INPUT PER COW, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Range in labor input	Number of farms	Per cent of farms	Per cent of cows
Less than 100 hours	6	10	12
100-129 hours	14	23	30
130-159 hours	17	28	31
160-189 hours	10	16	15
190-219 hours	5	8	4
220 hours and over	9	15	8
Total	61	100	100

furnished by members of the operator's family not paid a regular wage. The labor of the operator included the necessary overhead time involved in managerial functions. The proportion of total labor put in by the operator varied from the managerial function only, which was relatively insignificant, to doing all the work himself.

The average wage rate per hour for all labor charged to the milking herd was 94¢. The wage rate for the operator's labor and management averaged $1.03 per hour, family labor 92¢, and hired labor 73¢. Considerable variation existed in the wage rates reported for the three sources of labor. The wage rates reported for the operators ranged from 50 cents to $2.00 per hour, with over 50 per cent reporting an exact $1.00. Family labor was valued from 27¢ to $1.25 per hour, with over half also being at the $1.00 rate. Hired labor was reported as costing from 45¢ to $1.10 per hour, but there was no concentration of cases around a particular rate. It is assumed, to a degree, that the various labor rates reflect differences in the relative productivity of the labor employed.

Capital investment

The average value of the investment chargeable directly to the milking herd was $11,674 per farm, or $479 per cow (Table 6). This investment includes only the milking herds' proportionate share

Table 6. AVERAGE CAPITAL INVESTMENT CHARGEABLE TO THE MILKING HERD, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Item	Investment per farm	Investment per cow	Total investment
			Per cent
Buildings	$ 5,498	$225	47
Cows	4,823	198	42
Land	731	30	6
Equipment	622	26	5
Total	$11,674	$479	100

of the total value of the buildings, land (barnyard, corral, and lanes), and equipment used in the production of milk. It includes the value of the milking herd but does not include an investment in young stock, the operator's dwelling, crop and pasture land used for the production of dairy feed; nor does it include an investment in automobiles, trucks, tractors, or other farm machinery. A charge on a rate basis was made for the direct use of any of the facilities not included as part of the investment in the milking herd. These rates were adequate to include the investment expense. Home-grown feed was charged to the dairy cows at its market value, which included the investment cost for the land and equipment used in the production of the feed.

The investment in buildings and the milk cows themselves represent nearly 90 per cent of the total investment. The investment in land for buildings, yards, corrals, and lanes needed for the milking herd was very nearly the same as the investment in equipment, such as milking machines, cans, buckets, feed carts, can racks, and milk cooling facilities. The investment in each, however, was insignificant in relation to the money tied up in buildings and the milk cows themselves.

Using the rate of 4.0 per cent as the cost or charge for the use of money invested in the milking herd enterprise, the investment cost per 100 pounds of milk was not large. With a total investment of $479 per cow, the interest on the investment was $19.16. The production of 7,422 pounds of milk per cow gave an investment charge of 26¢ per 100 pounds, which amounted to less than 4 per cent of the total cost of producing milk.

A Cost of Production Formula

A formula by means of which significant changes in the average cost of producing Grade A milk can be estimated from month to month should be of considerable value to producers, consumers, distributors, and the Milk Marketing Administration. A mathematical formula was therefore devised for this purpose.

Derivation of the formula[1]

The formula is derived from average physical and monetary production cost data obtained from the 61 dairy farmers (1,486 cows) included in this study. It is based on physical inputs of hay, succulence, pasture, concentrates, and labor, together with the mis-

[1]See Appendix B, page 58, for a detailed explanation of how the formula was developed, step by step, including revisions of the formula in January and July, 1949, made necessary by the fact that the Bureau of Agricultural Economics, U. S. Department of Agriculture, discontinued certain quotations as of those dates.

cellaneous dollar and cents costs, such as dairy supplies, veterinary and breeding fees, and interest on investment, that went into the production of milk.

Prices are introduced into the formula by relating the actual prices of feed and labor in the study to government published prices of feed and labor in Oregon for the period of the study, October 1, 1946 to September 30, 1947.

All price information required in the cost formula is published regularly at stated intervals by the Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C., hereinafter referred to as the BAE. The price of all baled hay and the price of 16 per cent protein dairy mix in Oregon are published monthly in "Agricultural Prices." Also in this same publication will be found the index of prices farmers pay for commodities, including interest and taxes (often referred to as the "parity index"). Farm wages per month with house, for Oregon, are published quarterly by the BAE in its "Farm Labor" Report.

The formula

The following formula has been developed to estimate, for any particular month, the average cost (in cents) of producing 100 pounds of 4.38 per cent Grade A milk in the Willamette Valley section of the Portland milkshed:

$$[(6.40A + 1.68B + 1.09C) \times D] + [(.55E) \times F] = \text{cost per 100 pounds (in cents).}$$

In this formula:

"A" represents the BAE farm price per ton, issued monthly, of all baled hay in Oregon. (Succulence and pasture have been related to and combined with hay.)

"B" represents the BAE price per ton, issued monthly, of 16 per cent protein dairy mix paid by farmers in Oregon.

"C" represents the BAE price, issued quarterly, of farm wages per month with house in Oregon.

"D" represents the month to month change in physical quantities of feed, pasture, and labor in relation to annual average quantities that go into the production of Grade A milk. Values for "D" are as follows:

January	1.34	April	.83	July	.79	October	1.23
February	1.23	May	.69	August	.87	November	1.36
March	1.03	June	.74	September	.98	December	1.34

If the formula were used to estimate annual costs, the "D" would become unity or 1.00.

"E" represents the BAE index, published monthly, of prices paid by U. S. farmers for commodities, including interest and taxes (parity index).

"F" represents the month to month change in the magnitude of miscellaneous net costs in relation to the annual average. Values for "F" are as follows:

January 1.17	April ..... .85	July ..... .91	October 1.12
February .. 1.10	May ..... .81	August 1.01	November .. 1.18
March ..... .97	June ..... .86	September .. 1.10	December .. 1.15

If the formula were used to estimate annual costs, the "F" would become unity or 1.00.

The formula illustrated

By means of the formula the estimated average cost of producing Grade A milk in the Willamette Valley section of the Portland milkshed for July 1949 is calculated below.

Using data from the July 1949 issue of "Agricultural Prices," published by the Bureau of Agricultural Economics, United States Department of Agriculture:

"A" = $23.00. (July Oregon farm price per ton of all baled hay)

"B" = $78.00. (July per ton price paid by Oregon farmers for 16 per cent protein dairy mix)

Using data from the "Farm Labor" report for July, published by the BAE:

"C" = $175.00. (July farm wages per month with house paid by Oregon farmers)

Using data from this study (page 33):

"D" = .79. (July physical quantity of feed, pasture, and labor in relation to annual average)

Using data from the same July issue of "Agricultural Prices":

"E" = 244. (July index of prices paid by farmers, interest, and taxes)

Using data from this study (top of this page):

"F" = .91. (July magnitude of miscellaneous net costs in relation to annual average)

Substituting these values in the formula gives:

$$[(6.40\times23)+(1.68\times78)+(1.09\times175)\times.79]+[(.55\times244)\times.91] =$$
$$[(147.20+131.04+190.75)\times.79]+[134.20\times.91] =$$
$$[468.99\times.79]+122.12 =$$
$$370.50+122.12 = 492.62$$

Therefore the estimated average cost of producing 4.38 per cent Grade A milk for July was $4.93 per 100 pounds.

Application and use of formula

This formula is particularly valuable for indicating trends in monthly and annual costs of producing milk. Any increases or decreases in costs are immediately reflected because of the sensitivity of the formula to price changes in the several factors making up production costs.

This formula should be helpful to anyone interested in estimating the average cost of producing Grade A milk in the Willamette Valley section of the Portland milkshed as long as there are no significant changes in rates of production, production techniques, sanitary requirements, and/or the seasonality of milk flow.

The relationship between the estimated average cost of production (based on the formula), the Portland Quota Pool price, and the average "Blend" price during the period from April 1936 to April 1949, is presented in Figure 10, Appendix B, page 60.

Factors Affecting Production Costs

A complete analysis of the innumerable factors associated with the operational efficiency of a dairy herd, and thus with the cost of producing milk and butterfat, is not possible from data collected for this study. However, many of the major factors that appear to explain or are associated with the variation in the cost of producing milk have been isolated and their indicated individual effects on production costs determined. The relation of these major factors to production costs and other factors is presented in this section. When showing the relationship of individual factors to the cost of producing 100 pounds of milk, it has been necessary to convert the milk to a 4.0 per cent fat corrected basis (F.C.M.) because of the major influence butterfat test has on the cost of producing milk.

An attempt, wherever possible, is made to show the economic importance of efficient production by showing a measure of financial return. The measures chosen are the returns to man labor per cow and the returns to man labor per hour. While the return to labor per hour does not take into consideration the level of efficiency of the labor, it is thought to be a satisfactory supplementary measure of returns. These measures are calculated by considering the return to labor, both family and hired, as being a residual after subtracting all costs other than labor from the value of the milk and butterfat produced.

Production per cow

There was considerable variation among the herds in the pounds of milk and butterfat produced per cow. Less variation, however,

existed in butterfat production because of the general inverse relation between the characteristic quantity of milk produced and its test. Butterfat ranged from a low of 225 pounds per cow in two herds to a high of 456. Eighteen per cent of the herds had production of less than 280 pounds per cow, and the same proportion of the herds was producing 380 pounds or more.

It would appear that butterfat production per cow had a marked influence on the net cost of production (Table 7). As butterfat produced per cow increased from a herd average of 257 pounds to 420 pounds, the cost of producing butterfat decreased from $1.48 per pound to $1.21. The cost of producing 4.0 per cent fat corrected milk declined from $6.06 per 100 pounds to $5.07 between these two indicated levels of production.

The price received per pound of butterfat was essentially the same for all producers, averaging $1.24. Only the herds producing 380 pounds or more of butterfat showed a net profit above all costs. The others failed to obtain the reported production costs by from 10 to 26 cents per pound.

Table 7. RELATION OF POUNDS OF BUTTERFAT PRODUCED PER COW TO PRODUCTION COSTS AND RETURNS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Butterfat per cow	Average	Number of farms	Production of 4.0 per cent fat corrected milk per cow	Total net cost per pound of butterfat	Total net cost per 100 pounds of 4.0 per cent fat corrected milk	Returns to labor per cow	Returns per hour labor
	Pounds		*Pounds*				
Less than 280 pounds	257	11	6,258	$1.48	$6.06	$ 60	$0.40
280-329 pounds	306	22	7,406	1.35	5.60	87	.64
330-379 pounds	352	17	8,481	1.35	5.61	118	.78
380 pounds and over	420	11	10,039	1.21	5.07	174	1.13
Total or average	325	61	7,842	$1.35	$5.59	$102	$0.70

A measure of economic returns superior to the difference between unit costs and return is the return to all labor per cow. This increased from an average of $60 for those herds having the lowest production to $174 for those having the highest production. This amounted to a variation of from 40¢ to $1.13 per hour of labor reported devoted to the milking herd.

As the production per cow increased, the annual costs per cow for labor and feed increased but not in proportion to the increases in

production (Table 8). The increased labor cost per cow resulted from more hours of labor being reported and a slightly higher rate per hour. The higher feed cost resulted entirely from greater quantities of feed reported as being fed. The cost of labor per pound of butterfat tended to decline as production increased. The cost of feed per pound of butterfat was essentially the same for all except the group with the highest production.

A complete discussion of the factors that affect production per cow is not within the scope of this report. It should be pointed out, however, that the inherent potential or capacity of a cow to produce milk is most important. There is a production limit for each cow. Those cows with little inherent potential reach this limit much sooner than those with great potential.

In spite of the importance of the breeding and individual characteristics of a cow, actual production is influenced by feeding, housing, and other aspects of management and environment. It requires

Table 8. RELATION OF POUNDS OF BUTTERFAT PRODUCED PER COW TO SELECTED FACTORS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Butterfat per cow	Cows per herd	Butterfat test	Labor cost per cow	Labor cost per pound of butterfat	Total feed cost per cow	Total feed cost per pound of butterfat	Investment per cow
		Per cent					
Less than 280 pounds	26	4.27	$126	$0.49	$170	$0.66	$495
280-329 pounds	26	4.36	121	.39	198	.65	484
330-379 pounds	26	4.38	155	.44	233	.66	466
380 pounds and over	17	4.50	163	.39	250	.59	472
Average	24	4.38	$137	$0.42	$210	$0.65	$479

skill and judgment to manage a dairy herd in such a manner that each cow's potential is approached. Probably the profitable limit of production for each cow is something less than her absolute limit. That is, the added cost, primarily feed, of obtaining those last pounds of butterfat may exceed the added value of the production. In fact, with normal price relationships for feed and butterfat, some cows, because of their limited capacity, cannot be made to return a profit regardless of how well they are fed and cared for. At the same time, other cows, because of their high potential, probably are being underfed and will fail to realize the maximum returns possible for their owners. Therefore it is important to have high producing cows and a satisfactory indication or measure of the inherent capacity

of each cow and then to feed according to each cow's ability to produce. The selection of a particular breed is probably less important than the selection of cows with high capacity within the chosen breed.

Hours of labor per cow

A very wide range existed among farms in the amount of labor input per cow. The farm on which labor was used most efficiently spent only 78 hours per cow compared with 381 hours required on the least efficient farm. While the range was wide, a fairly heavy concentration of cases fell between 125 and 169 hours.

The true relationship between efficient use of labor and the cost of producing butterfat and milk is obscured by the interrelationship of size of herd and labor efficiency. The herds on which less than 125 hours per cow, averaging 103, were spent were 2.4 times larger than the herds on which 215 hours or more were spent per cow. As the labor input per cow increased, the average number of cows per herd decreased (Table 9). Essentially no relationship existed between hours of labor spent per cow and the production per cow. Apparently the operators spending the least time in caring for their cows spent enough time, under their conditions, that all essential work was done. Hence, the hours of labor per 100 pounds of 4.0 per cent milk increased from 1.3 for the herds with the most efficient use of labor to 3.1 hours for the herds with the least efficient use of labor.

The herds with the most efficient use of labor produced butterfat for $1.21 per pound compared with $1.77 for the most inefficient herds. Likewise, a cost spread of $2.43 per 100 pounds of 4.0 per cent milk existed between the most and least efficient dairies. As

Table 9. RELATION OF HOURS OF LABOR PER COW TO PRODUCTION COSTS AND RETURNS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Labor per cow	Average labor per cow	Number of farms	Cows per herd	Labor per 100 pounds 4.0 per cent fat corrected milk	Total net cost per pound of butterfat	Total net cost of producing 100 pounds 4.0 per cent fat corrected milk	Returns to labor per cow
	Hours			*Hours*			
Less than 125 hours	103	16	33.4	1.3	$1.21	$4.99	$110
125-169 hours	144	24	25.2	1.8	1.31	5.44	109
170-214 hours	184	11	19.2	2.4	1.53	6.30	93
215 hours and over	251	10	13.7	3.1	1.77	7.42	54
Total or average	145	61	24.4	1.8	$1.35	$5.59	$102

has already been pointed out, it is not known how much of these differences in cost of producing butterfat and milk are due to efficient utilization of labor independent of the size of the milking herd. It is important to know, however, that high labor efficiency is much more easily attained when dealing with herds of large and moderately large numbers of cows.

The dairymen utilizing labor most efficiently received an average labor return of $110 per cow as compared with $54 for the least efficient. It is readily seen that the relative returns per hour of labor input between the efficient and inefficient dairies were much wider than the returns per cow. The efficient group received $1.06 per hour while only 21¢ per hour was available to compensate the labor spent on the herds using labor inefficiently.

Other factors in addition to size of herd undoubtedly are associated with the variation in hours of labor input per cow. One of these is difference in the physical layout of the dairy plant itself. Some pastures are adjacent to the barn area. In other cases, considerable labor is used during the course of a year in driving the cows to and from pasture. The buildings on some farms are more properly grouped in relation to one another to foster efficient use of labor in caring for the milking herd. Proper location of feeds and the milk house in relation to where the feeding and milking are done have significant effects on the time required to do these jobs. The internal arrangement of the dairy barn itself and the chore pattern or routine also have been found to be associated with the time required to care for a cow.

Research done by R. M. Carter in Vermont dealing with ways of increasing labor efficiency on dairy farms has indicated the importance of the several factors already enumerated. After careful study of the barn chores on a 22-cow dairy farm in Vermont, changes were made in the arrangement of the stable work routine, adequate and suitable equipment was added, and the tools and supplies were more conveniently located. The money cost of the changes was small. Nevertheless, as a result of the changes, the time spent on chores was reduced from 5 hours 44 minutes to 3 hours 39 minutes daily, a saving of 2 hours 5 minutes. In addition, the travel distance was reduced from 3¼ to 1¼ miles daily, a saving of 2 miles.[1] Simple arithmetic is adequate to show the magnitude of the time saved on this one farm. Many dairy farmers can make comparable savings in time required to care for their milking herds if they will undertake the task seriously.

[1]Carter, R. M., *Labor Saving Through Farm Job Analysis,* Vermont Agricultural Experiment Station Bulletin 503 (1946) p. 2.

Closely associated with the physical layout of the dairy plant is the construction of the dairy barn. Some of the older barns were not too well suited to the ever changing and more rigid regulations for the production of Grade A milk. Therefore, in order to produce milk low in sediment and bacteria, more labor was required in comparison to the dairymen whose facilities were of later design and construction.

Another factor associated with the variation in the amount of labor spent per cow is the difference in the physical ability of laborers. Some of the dairy farmers interviewed had passed their peak for accomplishing as much work per hour as the more vigorous and younger men. These men should not expect as high return per hour for their labor.

Size of herd

The herds included in this study averaged 24.4 milking cows per herd. The range was from a low of 5 to a high of 105, with a fairly heavy concentration of herds falling between 15 and 24 cows inclusive. Nearly two-thirds, 62 per cent, of the herds contained fewer than 25 cows; 38 per cent of the herds were made up of 25 cows or more.

The total cost of producing a pound of butterfat and 100 pounds of 4.0 per cent milk averaged lowest for the herds that were largest in size (Table 10). While the relationship was consistent, the greatest decrease in cost was between the herds averaging 10 cows and those averaging 19. Between these two sizes, an average reduction of 3 cents per pound butterfat occurred for the addition of each cow to the milking herd.

The returns to labor per cow were highest for the herds averaging 28 cows, which might be called the moderate size herds. The

Table 10. RELATION OF NUMBER OF MILKING COWS PER FARM TO PRODUCTION COSTS AND RETURNS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Cows per farm	Average number of cows	Number of farms	Total net cost per pound butterfat	Total net cost per 100 pounds of 4.0 per cent fat corrected milk	Labor per cow	Returns to labor per cow
					Hours	
5-14 cows	10	17	$1.66	$7.10	214	$ 79
15-24 cows	19	21	1.40	5.75	141	90
25-34 cows	28	13	1.34	5.56	135	120
35 cows and over	55	10	1.21	5.00	132	106
Total or average	24.4	61	$1.35	$5.59	145	$102

returns per hour of reported labor were also highest for this group. The reasons for the lower returns to labor per cow for the larger herds than for the moderate sized herds, in spite of the fact that the total cost per pound of butterfat was lowest for the herds with the most cows, are found in that the production per cow was lower and a smaller proportion of the labor was that of the operator. This latter fact is important because the wage rate paid to hired labor was below the reported rate for the operator and members of his family not paid a regular wage. No relationship existed between the size of the herd and the price received for the butterfat sold. The price received was practically identical for each group.

The greater efficiency in the larger herds comes primarily from lower labor inputs per cow and from a smaller investment in land, buildings, and equipment and therefore a smaller investment charge per cow.

The smallest herds required 214 hours of labor per cow annually compared with 132 hours for the larger herds with 35 cows or more. A somewhat constant amount of overhead labor is required irrespective of the number of cows in the herd. The larger the number of cows over which this overhead is spread, the smaller will be the amount borne by each cow.

Building and equipment costs in the form of interest on the investment, taxes, insurance, repairs, and depreciation were considerably less per cow for the large herds than for the small herds. Those farms averaging 10 cows per herd had building and equipment costs of $59 per cow, compared with $33 for the herds with 35 cows or more (Table 11). Minimum investments in such items as milk house and milking and cooling equipment are required irrespective of the number of cows in the herd. By utilizing such facilities to near maximum capacity the cost is spread more broadly, making for lower per unit production cost.

Table 11. RELATION OF NUMBER OF MILKING COWS PER FARM TO SELECTED FACTORS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Cows per farm	Butterfat produced per cow	Butterfat test	Building and equipment costs per cow*	Total feed cost per cow	Total labor cost per cow	Total net cost per cow
	Pounds	*Per cent*				
5-14 cows	345	4.80	$59	$224	$231	$572
15-24 cows	315	4.25	43	207	137	442
25-34 cows	332	4.43	34	210	147	443
35 cows and over	321	4.30	33	207	101	390
Total or average	325	4.38	$39	$210	$137	$438

* Does not include a charge for use of automobile, truck, or tractor.

Feed costs per cow were not affected by the number of cows in the herd. Likewise no relationship existed between size of herd and miscellaneous costs.

The herds that were smallest in size had the highest production of butterfat per cow. These herds also averaged highest in butterfat test and produced the largest quantity of 4.0 per cent fat corrected milk per cow. The herds that were largest in size were second low in the production of butterfat and 4.0 per cent milk per cow and in average test of milk. No consistent pattern of relationship existed between size of herd and production per cow.

Evenness of production

The measure of evenness of production throughout the year used in this section is the per cent the low quarter production was of the high quarter. The milk produced during the year on each farm was totaled by quarters following as nearly as possible the seasons of the year. For example, October, November, and December made up one quarter; January, February, and March another quarter; and in like manner for the entire 12-month period. Regardless of the quarters that were high and low, the relationship between the two extremes was calculated by determining the per cent the production in the low quarter was of the high quarter. If the production in the low quarter was only half that in the high quarter, unevenness of production during the year is indicated. Likewise, if the low quarter was 95 per cent of the high quarter, it would be judged that little variation in milk flow had occurred during the different seasons of the year.

The herds varied in their production patterns from very uneven to very even. The most extreme uneven herd produced only one-third as much milk in the low quarter as in the high quarter. The herd with the most even pattern of production produced 93 per cent as much milk in its low quarter as in its high quarter. The other herds were fairly uniformly distributed between these extremes. Characteristically, the quarter of the year that includes the months of April, May, and June was the period in which the majority, 79 per cent, of herds produced the most milk. The quarter of lowest production for most herds was the one which includes October, November, and December.

The herds with the most uneven pattern of production produced butterfat and 4.0 per cent milk cheaper than the herds with more even production patterns (Table 12). The herds having most even production had butterfat costs 8 cents per pound greater than the most uneven group. Essentially no difference existed between the moderate and most even producing herds. In contrast, however, the

Table 12. RELATION OF EVENNESS OF PRODUCTION TO PRODUCTION COSTS AND RETURNS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED. YEAR ENDING SEPTEMBER 30, 1947

Per cent low quarter is of high quarter	Average per cent	Number of farms	Net cost per pound of butterfat	Net cost per hundredweight 4.0 per cent fat corrected milk	Price received per pound of butterfat	Returns to labor per cow	Returns per hour of labor
Less than 54 per cent	44	16	$1.28	$5.28	$1.22	$ 99	$0.71
54-71 per cent	63	25	1.38	5.77	1.24	98	.67
72 per cent and over	82	20	1.36	5.60	1.26	108	.74
Total or average	64	61	$1.35	$5.59	$1.24	$102	$0.70

price received for butterfat by the producers with herds having even production patterns was 4 cents per pound higher than was received by the uneven producers. This is a reflection of the fact that a small proportion of the production of the uneven producers found its way into surplus channels during the period of the study when Grade A milk was scarce. This price differential, if calculated in 1948 or 1949, would be considerably greater because of the great increase that has occurred in Grade A surplus during the spring and early summer months. Nevertheless, the loss per pound of butterfat was least for the producers in this study having most uneven production. This group failed to receive production costs by only 6¢ per pound butterfat compared with a loss of 14¢ for the moderate group and 10¢ for the even producers.

The interpretation of which was the most profitable production pattern depends on the measure of profitability used. If the criterion is the magnitude of spread between unit cost and price received, then the most uneven production, under *the conditions existing during the period of the study,* was the most profitable. However, this measure is subject to many limitations. If returns to labor per cow are used, a slight advantage goes to the even producers. If returns per hour of labor are used even production was also slightly more profitable.

Whatever the decision is regarding the most profitable production pattern, it does not necessarily follow that individual producers would have had increased returns had they had a different production pattern during the period of this study. Circumstances and the situation on the individual farm are important considerations. Some farms, because of their size, quality of land, labor supply, combination of enterprises, intensity of the dairying program, and other

conditions, are naturally adapted to following a particular pattern. With very little difference in the price received for the milk sold, the dairymen in this study might have been in a far less favorable position had they had patterns of production any different from the ones exhibited.

It would seem that for the future the answer to the most profitable pattern of production for an individual farmer lies in the manner in which production quota is allocated and in the relationship between the minimum price established for milk sold in the bottle and can trade and the market price of manufacturing milk. It does not appear that differences in production costs alone are of such magnitude as to be a heavy determinant in directing a production pattern.

The relation of evenness of production to a number of selected factors is given in Table 13. The number of cows per herd was essentially the same for each group. However, the production per cow in the herds having the most even flow of milk was 16 per cent greater than the production by the cows having the most uneven flow patterns. While this corresponds generally to findings in other studies, the exact reasons for it are not apparent. No data are available on the dairy merit of the different cows, and possibly more important is the lack of information as to quality of management.

Table 13. RELATION OF EVENNESS OF PRODUCTION TO VARIOUS FACTORS, 61 GRADE A DAIRY FARMS, WILLAMETTE VALLEY SECTION PORTLAND MILKSHED, YEAR ENDING SEPTEMBER 30, 1947

Per cent low quarter is of high quarter	Number of cows per herd	Butterfat per cow	Pasture per cow	Concentrates per cow	Hay per cow	Labor per cow	Net depreciation per cow
		Pounds	*Days*	*Pounds*	*Pounds*	*Hours*	
Less than 54 per cent	26.2	295	200	2,307	4,022	140	$11
54-71 per cent ..	23.2	333	173	2,776	4,851	148	14
72 per cent and over	24.4	342	135	2,854	6,322	146	11
Total or average	24.4	325	168	2,669	5,100	145	$12

The herds having uneven production patterns had more days of pasture per cow than the even herds—200 days compared with 135. The dairymen with the most even production patterns fed ¼ ton more concentrates and 1 ton more hay per cow in making up for the smaller amount of grazing. The heavier feeding of concentrates to the moderate and even herds resulted in greater production per cow, but not in proportion to the additional concentrates fed. These groups produced 1 pound of butterfat for every 8.3 pounds of concentrates, compared with 7.8 pounds for the uneven herds.

With less hand feeding the uneven herds used a little less labor per cow, but more labor per pound of butterfat or hundredweight of 4.0 per cent milk. Essentially no difference existed in the net depreciation per cow in spite of the fact that the turnover in cows is claimed to be higher in the herds on an even production basis.

The net depreciation per cow in this study is thought to be less than normal. During the period of the study demand for meat was high and the cull cows sold over the block for meat brought prices almost as high as cows sold for milking purposes. Dairymen buying cows culled from the herds of other dairymen also paid high prices. Then it must be remembered that young cows may appreciate in value for a year or two following the first lactation period, which partly offsets the declining use value of the older cows.

Butterfat tests of milk

The percentage butterfat in the milk included in this study varied from a herd average of 3.4 per cent to a high of 5.4 per cent. However, over half of the herds fell in the medium test classification of 4.1 to 4.7 per cent, inclusive. The percentage of butterfat in milk usually varies considerably among individual cows within a herd even though composed of only one breed. This variation, however, characteristically is not as great as between herds made up of dissimilar breeds such as the Jersey and Holstein. The richness of milk produced by an individual cow, whatever her breed, is an inherited characteristic.

Production costs were greater for 100 pounds of high test than for low test milk (Table 14). However, when the milk was converted to a 4.0 per cent fat corrected basis, the difference in production costs was relatively small. In general, the higher production cost for milk of high test is due to the fact that this kind of milk required more feed per hundredweight. This is because high test breeds tend to produce fewer pounds of milk per cow (Table 15). This does not mean that the high test herds are inefficient users of feed. In fact, less feed per cow was fed and when the milk was converted to a comparable net energy basis it was found that the high test herds produced 100 pounds of 4.0 per cent fat corrected milk at a lower feed cost than the low test herds. This efficiency in the use of feed is also borne out by the fact that the total digestible nutrients from hand feeding per 100 pounds of 4.0 per cent milk was lower for the high test herds. Days pasture per cow, while lowest for the moderate test group, was not materially different for the low and high test herds.

In contrast to milk production costs, the high test herds produced butterfat at a lower cost per pound than the low test herds. The

Table 14. Relation of Butterfat Test of Milk to Production Costs and Returns, 61 Grade A Dairy Farms, Willamette Valley Section Portland Milkshed, Year Ending September 30, 1947

Butterfat test	Weighted average butterfat test	Number of farms	Net cost per 100 pounds of milk		Net cost per pound of butterfat	Price received per 100 pounds of milk		Returns to labor per cow	Returns to labor per hour
			Actual	4.0 per cent fat corrected		Actual	4.0 per cent fat corrected		
	Per cent								
3.4-4.0 per cent	3.70	11	$5.36	$5.61	$1.45	$4.67	$4.88	$ 91	$0.56
4.1-4.7 per cent	4.38	31	5.81	5.50	1.33	5.40	5.11	95	.71
4.8-5.4 per cent	4.99	19	6.58	5.73	1.32	6.18	5.38	123	.80
Total or average	4.38	61	$5.90	$5.59	$1.35	$5.43	$5.14	$102	$0.70

Table 15. Relation of Butterfat Test of Milk to Various Factors, 61 Grade A Dairy Farms, Willamette Valley Section Portland Milkshed, Year Ending September 30, 1947

Butterfat test	Number of cows	Actual milk produced per cow	Labor cost per 100 pounds of actual milk	Total feed cost per 100 pounds of milk		TDN from hand feeding per 100 pounds milk*		TDN from hand feeding per pound of butterfat	Pasture per cow
				Actual	4.0 per cent fat corrected	Actual	4.0 per cent fat corrected		
		Pounds				*Pounds*	*Pounds*	*Pounds*	*Days*
3.4-4.0 per cent	25.3	9,286	$1.67	$2.63	$2.75	71	75	19	176
4.1-4.7 per cent	25.9	7,035	1.77	2.84	2.68	77	73	18	158
4.8-5.4 per cent	21.4	6,912	2.17	2.99	2.60	79	68	16	182
Average	24.4	7,422	$1.85	$2.83	$2.67	76	72	17	168

* Based on the following total digestible nutrient content of the feed fed: hay 50 per cent; concentrates 75 per cent; succulence 15 per cent.

efficiency of high test breeds in the production of butterfat is rarely denied. Table 15 shows that the total digestible nutrients from hand feeding per pound of butterfat consistently decreased as the per cent of butterfat increased. The high test breeds tend to be smaller animals and therefore are smaller machines to maintain.

The price received per hundredweight of milk increased from $4.67 for milk with an average test of 3.70 per cent butterfat to $6.18 for milk averaging 4.99 per cent. While production costs were not obtained by any of the butterfat test groups, the loss per hundredweight of milk was least for the high test herds. The high test group failed to receive production costs by 40¢ per 100 pounds compared with 41¢ and 69¢ for the moderate and low test groups respectively. Also the high test herds appeared to fare better in terms of returns to labor per cow and returns per hour of labor devoted to the milking herd.

Concentrates fed per cow

Concentrate feed includes all grains and grain products, dairy mix, dried beet pulp, and similar feeds. The amount of concentrates fed per cow varied from 1,027 pounds to 4,500 with fairly even distribution between the two extremes.

The relation between the rate of concentrate feeding and a number of factors is given in Table 16. Apparently the adding of concentrates to the ration had little effect on the quantities of other feeds fed. As the amount of concentrates fed per cow increased,

Table 16. RELATION OF AMOUNT OF CONCENTRATES FED PER COW TO VARIOUS FACTORS

Item	Concentrates fed per cow			
	Low (less than 2,300 pounds)	Medium (2,300 to 3,099 pounds)	High (3,100 pounds and over)	All herds
Number of farms	19	20	22	61
Number of cows per herd	25.6	29.8	18.4	24.4
Net cost per 100 pounds 4.0 per cent milk	$5.29	$5.44	$6.07	$5.59
Average per cow:				
Pounds of butterfat	292	332	354	325
Pounds of 4.0 per cent milk	7,180	7,884	8,573	7,842
Pounds of concentrates	1,801	2,752	3,591	2,669
Pounds of TDN from hand feeding	4,386	6,095	6,479	5,641
Days of pasture	190	143	177	168
Hours of labor	144	134	163	145
Total feed cost	$168	$219	$246	$210
Labor cost	$129	$130	$158	$137
Net cost	$380	$429	$521	$438
Value of milk	$357	$414	$441	$403
Returns to labor	$106	$114	$ 79	$102
Per cent of TDN hand fed derived from concentrates	31	34	42	36
Pounds of TDN per 100 pounds 4.0 per cent milk	61	77	76	72

the total amount of feed fed increased. This is shown by converting all feeds fed by hand into a common denominator, total digestible nutrients. This does not, however, take into consideration the feed obtained from pasture. The days of pasture per cow were highest for those herds receiving the least concentrates and the least digestible nutrients from all hand feeding.

The more intensive feeding of concentrates gave higher production per cow. Those cows fed at the highest rate produced on the average 19 per cent more 4.0 per cent milk than those cows receiving the least concentrates. While greater production was forthcoming, it was not in proportion to the higher rate of feeding. Those herds receiving the lightest feed of concentrates produced 100 pounds of 4.0 per cent milk for every 61 pounds of total digestible nutrients from hand feeding. The herds receiving the medium and high rate of concentrate feed required 77 and 76 pounds of total digestible nutrients respectively for each 100 pounds of 4.0 per cent milk. As has already been stated, it is difficult to evaluate the amount of feed obtained from pasture.

The net cost per 100 pounds of 4.0 per cent milk increased as the intensity of concentrate feeding increased. Little difference existed between the low and medium rate, but the cost increased considerably for the high rate group. Part of the explanation for this higher cost lies in the fact that concentrates characteristically are the most expensive source of nutrients and this source of feed made up 42 per cent of the total nutrients fed by hand to the herds receiving the most concentrates. Based on the feed price relationships reported by the cooperators in this study, and hay at 50 per cent total digestible nutrients, succulence 15 per cent, and concentrates 75 per cent, 100 pounds of digestible nutrients from the three sources cost $2.66, $2.30, and $4.76, respectively. Another reason for the higher cost for the high rate group is the fact that the cows receiving the highest level of concentrate feeding failed to respond in production in proportion to the heavier feeding. Also slightly more labor per cow was used for the cows receiving the most concentrates, reflecting primarily the smaller average size of herd.

It would seem that, for the year of the study, the herds fed concentrates at the moderate rate were the most profitable. The returns to labor per cow and the returns per hour of labor were highest for this group. While only slightly more profitable than the group receiving the least concentrates, the returns decreased significantly for the group receiving the most concentrates.

Some cows appear to have the ability to produce more milk with a given level of concentrate feeding than do others. Thus the level

of feeding concentrates to cows should be on the basis of the individual cow's ability to utilize the concentrates in the production of milk. Since monetary returns are the aim of keeping and feeding dairy cows, the level of feeding should be determined by: (1) the individual cow's ability to utilize the concentrates effectively, (2) the price of the concentrates, and (3) the price or value of the milk produced. If the price of concentrates is low in relation to the price of milk, concentrates can be profitably fed at a rate higher than when the price of milk is low in relation to concentrates.

SUMMARY

This report deals with the cost of producing Grade A milk in the Willamette Valley section of the Portland, Oregon, milkshed for the year ending September 30, 1947. The data on which the study is based were obtained from 61 dairymen located in Clackamas, Marion, Multnomah, Washington, and Yamhill counties. Of the 61 dairymen interviewed, 58 were producers supplying distributors and 3 were producer-distributors. The sample represented 18 per cent of the 1946 holders of Portland butterfat quota within the counties listed. The data were obtained by the survey method and pertain only to the milking herd enterprise.

Costs of Production

The annual average cost of producing butterfat and milk delivered to Portland for the 61 dairymen for the year ending September 30, 1947 follows:

Item	Cost per cow	Cost per pound of butterfat	Cost per 100 pounds of milk (4.38 per cent)	Gross costs
				Per cent
Feed	$210	$0.65	$2.83	46
Labor	137	.42	1.85	30
All other	112	.35	1.51	24
Total gross costs	$459	$1.42	$6.19	100
Credits	$ 21	$ .07	$ .29	....
Total net cost	$438	$1.35	$5.90	....

Concentrates amounted to nearly half of the total feed cost. Use of buildings and equipment, interest and depreciation on cows and milk hauling were the major costs other than feed and labor. The

value of the manure produced as an item of credit to the cost of producing milk was twice as important as the value of calves.

Variation in costs between producers

The range in milk production costs was wide—from $3.85 to slightly over $12.00 per hundred. Nearly 60 per cent of the producers, however, reported costs between $5.00 and $7.00 per 100 pounds. The ten lowest cost producers averaged $4.35 per 100 pounds of milk testing 4.06. The ten highest cost producers had costs averaging $9.66, but their milk averaged 4.70 per cent butterfat. Only 27 of the 61 dairymen had production costs as low or lower than the weighted average of $5.90. They produced approximately 65 per cent of the milk. The lower cost dairies tended to be larger than average in size.

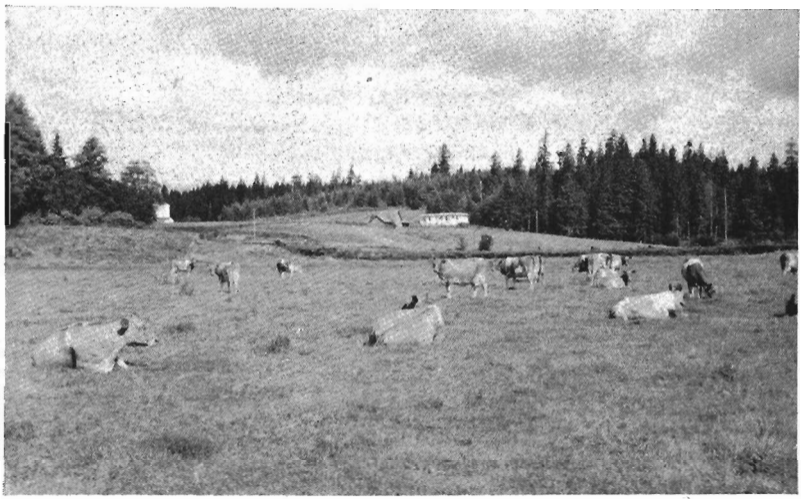


Figure 9. Improved, well-managed pastures supply low cost feed for the dairy herd.

Seasonal costs

Milk produced in November cost 1.8 times as much as milk produced in May—$7.77 and $4.26 respectively. These were the highest and lowest cost months. The seasonal variation in the cost of producing butterfat was slightly less than milk.

Much of the seasonal variation in milk production costs during the different months of the year appears to be associated with differences in kinds and costs of feed fed and in differences in amounts of milk produced. Generally, the months when the cost per cow was

lowest, reflecting primarily cheaper sources of feed and less labor, was when the milk produced per cow was highest and vice versa. This situation greatly magnified the differences in the cost of producing a hundred pounds of milk during the different months of the year. Differences in milk production by months is basically a herd management problem.

Producer returns

The annual average price received for the milk produced by the cooperating dairymen from October 1, 1946 through September 30, 1947 was $5.43 per 100 pounds. This price failed by 47¢ per 100 pounds to meet average production costs of $5.90. Thirty-eight per cent of the producers showed a net profit averaging 51¢ per 100 pounds. This profit resulted from having costs lower than average. More than half of the milk was produced at a profit. Practically no variation existed in the price received for the milk. The average loss by dairymen sustaining a loss was $1.67 per hundred.

After paying for all cost items other than operator and family labor, only an average of 70 cents an hour was left as wages for the operator and other members of the farm family spending time on the milking herd. This is less than the average wage paid to all kinds of labor that was hired. The low cost dairymen obtained good wages from their cows. On those farms having high production costs little was left to pay for family labor.

Seasonally, the price received for milk was high enough to cover production costs only during the months of April, May, June, and July. These were the months during which milk flow was highest and unit production costs were lowest.

Physical input costs

The annual average amounts of the various kinds of feed and the amount of labor that was used in the production of milk follows:

Item	Average annual amount per cow	Price rate	Total cost	Average daily amount per cow
Hay	2.55 tons	$26.64	$ 67.94	14 pounds
Succulence	3.63 tons	6.91	25.08	20 pounds
Concentrates	1.33 tons	71.38	95.27	7 pounds
Pasture	168 days	.127	21.40	....
Labor	145 hours	.94	137.17	24 minutes

Over two-thirds of the dry roughage fed was grown on the farms where fed. Vetch and clover predominated. Alfalfa ac-

counted for three-fourths of the roughage purchased. Less than one-sixth of the succulence and two-thirds of the concentrates was purchased. Commercial dairy mix made up a large part of the purchased concentrates. The average acreage of pasture per farm was 36, of which over half was native grass, 43 per cent was dry cropland, and 5 per cent was irrigated cropland pasture. Much improvement is possible in the pasture programs of many of the dairymen.

Nearly two-thirds of the total labor charged to the milking herd was the labor and management of the operator; 25 per cent was hired, and the remainder was supplied by members of the operator's family who did not receive a regular wage. Considerable variation existed in the amount of labor that was necessary to care for a cow for a year. One dairyman spent labor amounting to 380 hours while the least amount spent was only 78 hours per cow. Over 60 per cent of the farms used between 100 and 160 hours per cow, 10 per cent used less than 100, and the others used 160 hours or more. A close association existed between size of herd and labor per cow.

The average value of the investment per cow was $479. This amounts to about $11,700 per farm. This includes only the milking herd's proportionate share of the value of the buildings, corrals, equipment, and other items used in the production of milk. The value of the milking herd is included but the value of the farm land on which feed was grown for the cows is not. At the rate of 4.0 per cent, the investment charge, other than depreciation and repairs, was only $19.16 per cow.

Production cost formula

A formula for estimating costs of producing milk was developed from the basic data collected for this study. Use is made also of published Oregon farm prices of feed and labor and the "parity" index as "movers" or "adjusters" of cost to current price conditions. The formula and a detailed discussion of it can be found in the text, page 32, and in Appendix B.

Factors Affecting Costs

Production per cow

Production per cow had a marked influence on the net cost of producing milk. As the butterfat per cow increased from a herd average of 257 pounds to 420 pounds, the cost of producing 1 pound of butterfat decreased 27¢—from $1.48 to $1.21. The cost of producing 100 pounds of 4.0 per cent fat corrected milk declined 99¢—from $6.06 to $5.07. Only those herds producing 380 pounds or more of butterfat showed a net profit above all costs.

Production is influenced by breeding, feeding, housing, and other aspects of management. Each cow should be fed according to her capacity to produce. The selection of a particular breed is probably less important than the selection of cows with high capacity within the chosen breed.

Labor per cow

The herds on which labor was used most efficiently produced butterfat for $1.21 per pound compared to $1.77 for those on which labor was used most inefficiently. A cost spread of $2.43 per 100 pounds of 4.0 per cent fat corrected milk existed between the most and least efficient dairies. Because the most efficient herds were larger in size, part of the difference cited is due to this factor. It is important to know that high labor efficiency is much more easily attained with moderate to large herds. Changes in stable work routine, more convenient location of tools and supplies along with adequate and suitable equipment has reduced choring time on several farms.

Size of herd

The cost of producing milk and butterfat decreased consistently as the number of cows increased from a herd average of 10 to 55. The spread was 45¢ per pound of butterfat and $2.10 per 100 pounds of milk. Between a herd average of 10 and 19 cows, the addition of each cow reduced the cost of producing milk by 15¢. The lower cost of production in the larger herds comes from more efficient use of labor, buildings, and equipment. No pattern of relationship existed between size of herd and production per cow.

Evenness of production

A reflection of the relative evenness of production for each herd was calculated by expressing the milk produced during the low quarter of the year as a percentage of the high quarter production. The herd with the most even pattern of production produced 93 per cent as much milk in the low quarter as it did during the quarter of highest milk production.

The herds with the most uneven pattern of production produced butterfat and milk at the lowest cost. Very little difference in cost existed between the medium and most even producing herds. The producers with herds having the most even flow of milk received 4¢ per pound more for their butterfat and their cows produced 47 pounds of butterfat per cow more than the cows in the most uneven herds.

The differences in cost between the even and uneven flow herds lie partly in the fact that the uneven flow herds used relatively

more pasture than the other herds and pasture appeared to be a cheaper source of feed; they used less labor; they used less hay and concentrates; the herds were slightly larger in size. For the year of this study, there did not appear to be any relationship between evenness of milk flow and depreciation per cow.

Butterfat test

Milk production costs were higher for high test herds. Milk with an average test of 3.7 per cent cost $5.36 per 100 pounds; 5.0 per cent milk costs $6.58. Very little difference in cost was found to exist when the milk was converted to a 4.0 per cent fat corrected basis.

In contrast to the milk costs, the cost of producing butterfat decreased as the butterfat test increased. This difference amounted to 13¢ per pound of butterfat between the lowest and highest test herds. The efficiency of the high test breeds in the production of butterfat is rarely denied.

Concentrate feeding

The net cost of producing milk increased as the intensity of concentrate feeding increased though little difference in cost existed between the low and medium rates of feeding. The cows responded to the more intensive feeding of concentrates with higher production rates, but not in proportion to the higher rates of feeding. While high rates of production are necessary to good returns, high production rates must be obtained economically. Based on the feed price relationships reported by the dairymen in this study, 100 pounds of digestible nutrients from concentrates cost approximately $4.75 compared to $2.66 from hay and $2.30 from succulence. The level of concentrate feeding should be determined by: (1) the individual cow's ability to utilize the concentrates in the production of milk; (2) the price or cost of the concentrates; (3) the price or value of the milk produced. If concentrate prices are low in relation to milk prices, concentrates can be profitably fed at a higher rate than when they are high in price in relation to milk.

APPENDIX A

Sampling and Cost Determination Procedures

Sampling

Great care was exercised in selecting the dairymen who cooperated in this study. It must be remembered that a cardinal requirement of a study of this nature is that the sample truly reflect the conditions in the area that it is intended to represent. In order to be representative, a sample must contain all elements in the same proportion as these elements exist in the population from which the sample is drawn. This means, as one example, that the sample should contain the same proportion of small, medium, and large herds as these various size herds exist in the population that the sample is intended to represent. This study was designed to be representative of average producers conditions in the area described as the Willamette Valley section of the Portland milkshed. It is not intended to represent producer conditions in that area of the State of Washington shipping Grade A milk to Portland. Likewise, it is not intended to reflect costs and conditions experienced by producers shipping from the coastal region of Tillamook County or the lower Columbia Basin county of Columbia.

To insure representativeness a listing was made of all producers holding butterfat quota for the Portland market during the spring of 1946. Those producers not in the Willamette Valley portion of the milkshed were then discarded. A random selection from those remaining was made by drawing a fourth of the quota holders. The objective was to obtain records from approximately 20 per cent of the producers of Grade A milk in the area represented by the study. Twenty-five per cent of the producers were drawn originally to allow for cases where the herd had been dispersed, or other inabilities to obtain the necessary information from a particular producer. This method of selecting the sample gave representation to holders of various size quotas in almost exactly the same proportion as they existed in the population from which the sample was drawn. Proportional representation was also achieved in regard to geographical location of producers (Table 17).

The 61 records on which the study is based represent slightly more than 18 per cent of the total number of holders of butterfat quota in the six counties comprising the Willamette Valley section of the milkshed. The pounds of butterfat produced by these 61 dairymen during the period of the study amounted to slightly more than 19 per cent of the total pounds of annual butterfat quota held

by all dairymen in the six counties. Producers in the six counties represented in the study accounted for two-thirds of all butterfat quota holders in the Portland milkshed in 1946. They held nearly 69 per cent of the total allotted quota.

Basis of determining costs

The costs shown in this report pertain only to the milk production phase of the dairy enterprise. The inputs of feed, labor, capital, and other expenses herein reported include only those chargeable directly to the milking herd. The growing of dairy stock for replacement and sale purposes has been considered an enterprise separate and apart from the milking herd enterprise. When a farm-raised heifer freshened and entered the milking herd, the milking herd "bought" her from the heifer enterprise at full, at-the-farm market price at the time of freshening. For individual replacement heifers, this price may have been more or less than the costs incurred in raising her, but approximated what some other dairyman would have been willing to pay for her.

Home-grown grains, hay, and bedding were likewise valued at the barn at local farm prices. The valuation of home-grown ensilage and green feed was more difficult because of the lack of an established market price for such feeds. In case an individual farmer had no adequate basis for placing a value on these feeds, the feeding value of the particular feed was compared to hay and priced in this relation to hay prices after adjusting for differences in production requirements. Pasture costs for the milking herd were estimated by individual dairymen at prevailing local rates for comparable pasturage. Where a local rate for custom pasturing did not exist, it was necessary for the dairyman to use some other basis of estimating the pasture charge to the milking herd. Some reported on the basis of what they estimated the particular pasture would rent for; some on the basis of pasture production costs; and some on the basis of the value of harvested feed the pasture replaced—less an adjustment for differences in production and harvest requirements. It did not appear that materially different results were obtained by these various methods.

Estimated values of the buildings and equipment used by the milking herd and the remaining life over which each asset was to be depreciated was obtained. From this, depreciation on buildings and equipment chargeable to the milking herd was determined. Interest on investment was figured at the rate of 4 per cent on present value. Current repairs and insurance on buildings and equipment were entered at cost. Information pertaining to assessed valuations and

property tax rates was obtained from the county assessor for each school district in which a cooperating dairyman was located. Taxes chargeable to the milk cows were determined from the information. Charges for the use of automobile, truck, or tractor in connection with the milking enterprise were at rates based on cost information obtained in other studies.

Each operator estimated the value of his own labor and management chargeable to the milking enterprise, as well as that of any family labor spent in caring for the cows.

Sire service, if hired or if the dairyman belonged to an artificial insemination association, was charged at cost. If a bull was kept, the producer made an estimate of the sire service charge by determining the approximate cost of feed, labor, and other expenses associated with the keeping of a bull and apportioning the total cost over the number of cows served.

Depreciation of cows in the milking herd was calculated on a "net decrease" basis in the following manner: The sum of the value of all cows sold was added to the sum of the value of the cows at the end of the year.[1] This combined total was then subtracted from the combined total of the sum of values of cows at the beginning of the year, the value of cows purchased and the value of heifers added to the milking herd during the year. The difference obtained from this subtraction is the "net decrease" in the value of the herd for the year. It includes death loss, and loss on cows sold for less than beginning inventory value. A few herds experienced a "net increase" in value during the year.

Any item of expense that was purchased was charged at purchase price. When the purchase price did not include delivery to the farm, the cost of getting it to the farm was considered an expense whether the operator hired it hauled or whether he hauled it himself. Calves born during the year were credited at the farmer's estimate of their value at birth. Manure recovered from the milking enterprise was credited to the enterprise at the farmer's estimate of its value at the barn.

[1]The ending inventory values used do not reflect the rising market values of milk cows between the beginning and end of the study period.

APPENDIX B

Detailed Explanation of Cost Formula

As explained in the body of the bulletin, the cost formula is based on average physical and monetary cost of production data obtained from the 61 dairy farmers included in this study. It was comparatively easy to segregate the physical quantities of hay, succulence, pasture, concentrates, and labor and the miscellaneous dollar and cents costs that went into the production of milk each month. It was more difficult to select appropriate "movers" or price series applying to feed, labor, and miscellaneous costs which would introduce the proper changes from month to month into the price elements of a formula.

Considerable exploratory work was done to see whether there were any outstanding differences between quotations from different sources on similar kinds of feed. For example, several monthly quotations on various kinds of hay and various types of feed concentrates were plotted over a period of years. As a result of these procedures it was concluded that there were no significant differences between quotations on several kinds of hay, for example, insofar as the general trend of the prices was concerned. Essentially all feed items moved up and down together.

An important consideration was to select price series that were readily available from month to month and issued, if possible, by the Federal Government. In this connection it should be pointed out that so long as a series is representative of the general monthly change in price of the item under consideration, and is readily available to the public, it makes little difference which series is selected. The important thing then was to determine the relationship during the period of the study between the price of the commodity or item under consideration and the particular series chosen as its "mover."

All of the selected "movers" included in the cost of production formula are published regularly at stated intervals by the Bureau of Agricultural Economics of the United States Department of Agriculture, herein referred to as the BAE.

The following comments are intended to explain the formula, segment by segment, as presented on page 59, including the latest revision as of July, 1949.

Hay. "A" in the *original formula* (July 1948) represents the BAE farm price per ton, issued monthly, of all loose hay in Oregon. It is multiplied by 1.38 because the average price of all the various types of hay fed to the cows in the study was 38 per cent higher than

Table 17. Composition of Sample Compared with County Totals from Which Obtained, Willamette Valley Section, Portland Milkshed

County	Records obtained		Butterfat in study		Total butterfat quota allotted daily 1946		Total holders of allotted quota	
		Per cent	*Pounds*	*Per cent*	*Pounds*	*Per cent*		*Per cent*
Washington	25	41	173,790	36	2,421	35	140	42
Multnomah	14	23	161,010	33	2,454	36	77	23
Clackamas	9	15	53,970	11	789	12	56	17
Yamhill	8	13	65,240	14	635	9	32	9
Marion	5	8	28,725	6	494	7	28	8
Polk	0	0	0	0	63	1	3	1
Total	61	100	482,735	100	6,856	100	336	100

Formula for Estimating the Cost of Producing 4.38 Per Cent Grade A Milk per 100 Pounds in the Willamette Valley Section of the Portland Milkshed
(Based upon average requirements of 1,486 cows) July 1948

[(Hay + Succulence + Pasture + Concentrates + Labor) × Index] + [Misc. Exp. × Index] = Cost

Yearly hay requirement in tons per cow
BAE price per ton of all loose hay in Oregon × 1.38
Yearly succulence requirement in tons per cow
BAE price per ton of all loose hay in Oregon × 1.38
Price relationship in study between 1 ton of succulence and 1 ton of hay
Yearly pasture requirement in days per cow
BAE price per ton of all loose hay in Oregon × 1.38
Price relationship in study between 1 day of pasture and 1 ton of hay
Yearly concentrates requirement in tons per cow
BAE price per ton of 16 per cent protein dairy mix in Oregon × .94
Yearly man labor requirement in months per cow
BAE price of farm wages per month without board in Oregon × 1.36
Monthly physical seasonal index
Yearly miscellaneous net costs per cow
BAE index of prices paid, interest and taxes (U.S.)
Average index value during study
Monthly seasonal index of miscellaneous costs
Estimated cost of producing 100 pounds of 4.38 per cent Grade A milk

$$\left[\left(\frac{[2.55 \times 1.38A] + [3.63(1.38A \times .26)] + [168(1.38A \div 210)] + [1.33 \times .94B] + [.56 \times 1.36C]}{74.22}\right) \times D\right] + \left[\left(\frac{[91.18(E \div 223.33)]}{74.22}\right) \times F\right] = \left[\text{Cost of producing 100 pounds of milk}\right]$$

Yearly hundredweight of 4.38 per cent milk produced per cow

$$\left[\frac{3.5190A + 1.3024A + 1.1040A + 1.2502B + .7616C}{74.22} \times D\right] + \left[\frac{.4083E}{74.22} \times F\right] = \text{Cost per 100 pounds}$$

$$[(.0798A + .0168B + .0103C) \times D] + [(.0055E) \times F] = \text{Cost of producing 100 pounds of milk (in dollars)}$$

$$[(7.98A + 1.68B + 1.03C) \times D] + [(.55E) \times F] = \text{Cost of producing 100 pounds of milk (in cents)}$$

Revised Formula, July 1949:

$$[(6.40A^* + 1.68B + 1.09C\dagger) \times D] + [(.55E) \times F] = \text{Cost of producing 100 pounds of milk (in cents)}$$

* "A" represents BAE price of "all baled hay" since quotation on "all loose hay" was discontinued beginning with July 1949.
† "C" represents BAE price of farm wages "with house" since quotation on "without board" was dropped beginning with January 1949.

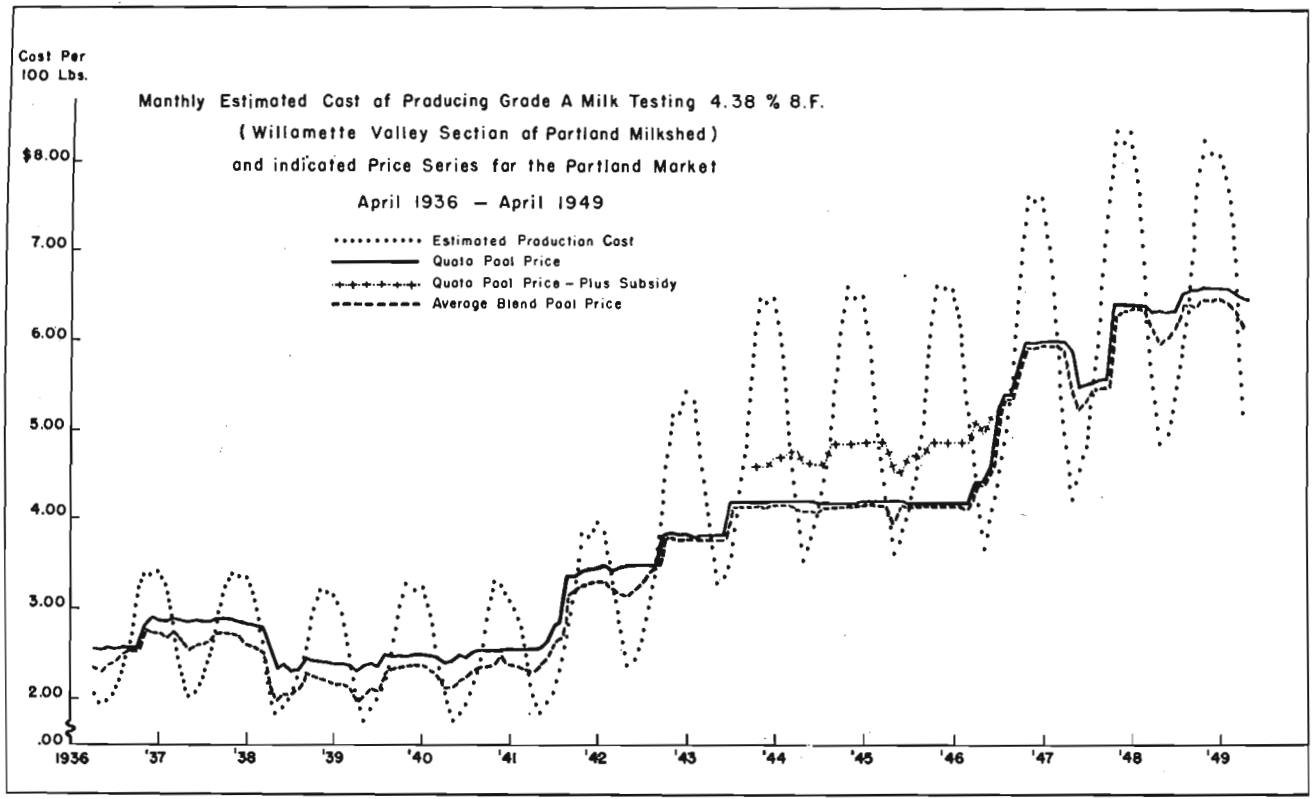


Figure 10. Prior to OPA and subsidy payments there was essentially no difference between the estimated cost of milk production and the Quota Pool price. Since then, production costs have averaged slightly higher than the Quota Pool price including the addition of the feed subsidy during the period it was in effect. The difference was greatest during the period of the subsidy.

the average BAE Oregon farm price of all loose hay during the same period. Beginning with July 1949 the BAE discontinued its quotation on "all loose hay." This made necessary a slight revision in the formula.

"A" in the *revised formula,* beginning with July, 1949, represents the BAE farm price per ton, issued monthly, of *all baled hay* in Oregon. In changing from "all loose hay" in the original formula to "all baled hay" in the revised formula it was of course necessary to change the magnitude of the coefficient as indicated on page 59. This was done by comparing the price per ton of "all baled hay" with the price of "all loose hay" for the 12 months prior to July 1949. Then an adjustment was made so that the new coefficient (6.40) times the price per ton of "all baled hay" would give the same result in the formula beginning with July 1949 as the old coefficient (7.98) times the price per ton of "all loose hay" gave before July 1949.

Succulence. In this formula the cost of succulence is expressed in terms of hay. It was found that, on the average, one ton of succulence was priced by the dairy farmers as being equal to .26 ton of hay. (Considerable cannery waste was utilized at less than ordinary silage prices—hence the lower figure compared with the usual rule of thumb ratio of "one ton of succulence equals .333 ton of hay.")

Pasture. For convenience, the cost of pasture is also expressed in terms of hay. The average value placed on one day of pasture by the dairy farmers in this study figured out to be 1/210th of a ton of hay. In other words, they figured a ton of hay to be worth 210 days of pasture.

Concentrates. "B" represents the BAE price per ton, issued monthly, of 16 per cent protein dairy mix paid by farmers in Oregon. It is multiplied by .94 because the average price of all the various kinds of concentrates fed to the cows in the study was 94 per cent of the average BAE Oregon price of 16 per cent protein dairy mix during the same period.

Labor. "C" in the *original formula* (July 1948) represents the BAE price, issued quarterly, of farm wages per month without board, in Oregon. It is multiplied by 1.36 because the average wage of all dairy workers in the study, including wages for unpaid family help and a management wage for the operator himself as estimated by him, was 36 per cent higher than the average BAE wage reported paid to farm workers per month without board, in Oregon, during the same period. Beginning with January, 1949, the BAE discontinued its quotation on farm wages per month "without board." This made necessary a slight revision of the formula.

"C" in the *revised formula,* beginning with January, 1949, represents the BAE price, issued quarterly, of farm wages per month *with house,* in Oregon. In changing from "without board" in the original formula to "with house" in the revised formula it was of course necessary to change the magnitude of the coefficient as indicated on page 59. This was done by comparing the BAE quotations on farm wages per month "with house" with the quotations of wages "without board" for the four quarterly periods prior to January 1949. An adjustment was then made so that the new coefficient (1.09) times farm wages per month "with house" would give the same result in the formula beginning with January 1949 as the old coefficient (1.03) times farm wages "without board" gave before January 1949.

Monthly physical seasonal index. "D" represents the month to month change in physical quantities of hay, succulence, pasture, and concentrates fed to the dairy cows in the study and the changing hours of man labor spent on the dairy cows in relation to the annual average quantities that went into the production of Grade A milk. It represents *physical quantity* changes only, and does not reflect in any way either seasonal or secular trends in the prices of feed and labor. Such changes in price are taken care of automatically in the use of "A," "B," and "C" in the formula. Values to be substituted for "D" are as follows:

January	1.34	April	.83	July	.79	October	1.23
February	1.23	May	.69	August	.87	November	1.36
March	1.03	June	.74	September	.98	December	1.34

If the formula is used to estimate annual costs, the "D" would be unity or 1.0.

In calculating this monthly physical seasonal index it was necessary first to determine the changing physical quantities of hay, succulence, pasture, concentrates, and labor from month to month during the period of the study. The next step was to find some method by which the physical quantities of unlike items could be added for January, February, etc. (one month at a time), without reflecting the influence of changes in the prices of these unlike items from month to month. This was accomplished by establishing representative prices for each item of feed and labor during the five-year prewar period, 1936-1940. The average for this sixty-month period was used to be sure that the price of each item was not out of line—one commodity in relation to another.

By using these prices (the same price for the same commodity for each month during the 12 months of the study), and multiplying by the changing physical amounts of feed and labor month by month,

and adding the total value of these inputs for each month, it was possible to get a dollar "value" for feed and labor by months during the 12 months of the study which would reflect changes in the physical quantities used, rather than changes in price. When the total "value" of all the feed and labor in the study was thus obtained for each month, this figure was then divided by the hundredweight of milk produced on the 61 farms in the study during the corresponding month. A series of values were thus obtained which were relative, one month compared to another. An index was then constructed by relating the total "value" each month to the average monthly "value" during the year of the study, thus obtaining a monthly physical seasonal index. As pointed out in the body of the bulletin, there was an important seasonal variation in milk flow on the 61 farms studied. Therefore the effect of this step was to accentuate the monthly seasonal variation in the index.

Miscellaneous net costs. Miscellaneous net costs include a number of miscellaneous costs. They include all costs of producing milk over and above feed and labor, minus miscellaneous credits for such items as calves and manure produced. Since this item represents an absolute figure in dollars and cents, it was necessary to make some provision for increases or decreases in this absolute amount, depending on ups and downs in the price level of costs in general. This was accomplished by multiplying the 91.18 by an index of farm costs determined as follows: "E" represents the BAE index of prices paid by U. S. farmers for commodities, interest, and taxes, published monthly. During the 12 months of the study this index averaged 223.33. Therefore "E" at any given time divided by 223.33 gives an index of change in the general level of farm costs compared to the period of the study and is thus self-correcting as time goes on.

Index of monthly seasonal change in miscellaneous net costs. "F" represents the month to month change in the magnitude of miscellaneous net costs in relation to the annual average. It does not represent any change in seasonal or secular trends in the actual prices of commodities or services. Values to be substituted for "F" are as follows:

January 1.17	April ..... .85	July ..... .91	October 1.12
February .. 1.10	May ..... .81	August 1.01	November .. 1.18
March ..... .97	June ..... .86	September .. 1.10	December .. 1.15

If the formula is used to estimate annual costs, the "F" would be unity or 1.0.

APPENDIX C

Comparison of Two Milk Cost Studies in Oregon

It is of interest to compare the results of the present study concerning the cost of producing Grade A milk in the Willamette Valley section of the Portland milkshed (October 1, 1946 to September 30, 1947) with the results obtained in a similar study made of the Portland milkshed a number of years ago.

The previous study included four years of data (year ending April 1, 1930 to year ending April 1, 1933) and the results were published in Station Bulletin 318, "Cost and Efficiency in Dairy Farming in Oregon," issued in September 1933. A comparison of several items in the two studies follows:

Table 18. COMPARISON OF THE RESULTS OBTAINED IN TWO COST OF PRODUCTION STUDIES ON FLUID MILK IN THE WILLAMETTE VALLEY SECTION OF THE PORTLAND MILKSHED

Item	Grade A milk October 1, 1946 to September 30, 1947	Market milk April 1, 1929 to April 1, 1933
Number of farms in study	61	55
Number of cows per farm	24	14
Pounds milk per cow annually	7,422	6,786
Pounds butterfat per cow annually	325	284
Butterfat test, per cent	4.38	4.18
Amount per cow annually		
Hay, pounds	5,101	4,754
Succulence, pounds	7,256	8,298
Concentrates, pounds	2,669	2,013
Pasture, days	168	108
Labor, hours	145	148
Milk produced per hour of labor, pounds	51	46
Butterfat per hour of labor, pounds	2.24	1.92
Net cost of production, delivered		
Milk per 100 pounds	$5.90	$2.14
Butterfat per pound	1.35	.51