Costs of producing and distributing market milk in the Billings-Laurel area of Montana
by Roy Blanch

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the Degree of Master of Science in Agricultural Economics
Montana State University

Abstract:
Date on cost of production and cost of distribution of market milk were supplied by 26 operators located in the BillInge-Laurel market area. These data were used to determine the per quart cost of producing and the per unit and per quart equivalent cost of distributing market milk for each operator. The average production cost of the 22 producers and the average distribution cost of the 11 distributors were also calculated. An analysis was made to determine the factors exerting the greatest in-fluence in causing the wide variation in costs among individual operators.

The average cost of producing milk was 4,19 cents per quart and the range among individual operators was from 2.78 cents to 5.92 cents. Labor and feed were the largest costs, accounting for 40 per cent and 36 per cent respectively of the total cost.

The average cost of distributing market milk was2.79 cents per unit of fluid sales and 3.82 cents per quart equivalent. The range among individual operators in these costs was from 2.01 cents to 5.24 cents per unit and from 2.63 cents to 6.25 cents per quart equivalent. The largest single cost of distributing market milk was for labor which accounted for about 60 per cent of the total cost. The costs of truck operation and of depreciation were the next largest costs, accounting for 12 per cent and 8 per cent respectively of the total cost.

The retail price of market milk in Billings was 11cents per single quart and 10 cents per quart when four or more quarts were taken. The milk handled by the operators furnishing data, however, was sold both as market milk and as surplus milk. The latter was sold in the form of manufactured products at lower prices.

The factors exerting the greatest influence in causing the wide variation among individual operators in costs of producing and distributing market milk were found to be as follows: 1. Production per cow 2. Size of herd 5. Volume of milk handled during the year 4. Labor efficiency 5. Use of equipment to varying capacities 6. Lack of an organized credit system.

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Approved:

Harold F. Hollands
In Charge of Major Work

Harold F. Hollands
Chairman, Examining Committee

H. B. Rother
Chairman, Graduate Committee

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COSTS OF PRODUCING AND DISTRIBUTING MARKET MILK IN THE BILLINGS-LAUREL AREA OF MONTANA

ABSTRACT

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The average cost of distributing market milk was 2.79 cents per unit of fluid sales and 3.82 cents per quart equivalent. The range among individual operators in these costs was from 2.01 cents to 5.24 cents per unit and from 2.63 cents to 6.25 cents per quart equivalent. The largest single cost of distributing market milk was for labor which accounted for about 50 per cent of the total cost. The costs of truck operation and of depreciation were the next largest costs, accounting for 12 per cent and 8 per cent respectively of the total cost.

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The factors exerting the greatest influence in causing the wide variation among individual operators in costs of producing and distributing market milk were found to be as follows:

1. Production per cow
2. Size of herd
3. Volume of milk handled during the year
4. Labor efficiency
5. Use of equipment to varying capacities
6. Lack of an organized credit system.

PART I. INTRODUCTION

Nutritional authorities have recommended a quart of milk a day for children and a pint a day for adults. 1/ On a weighted average basis this is equal to about one and one-third pints per capita. Yet at present the average consumption of milk in the United States is not more than half this amount. 2/ Some consumers would increase their consumption of quality milk if adjustments in the present price relationships were instituted. 3/ These adjustments may take the form of higher consumer incomes, of governmental subsidies, or of lower milk prices.

Studies of the St. Louis, Boston, New York, and other markets have shown that consumers appear to be much more interested in low priced milk than they are in its nutritional value. 4/ This fact seems to indicate that a greater increase in the consumption of milk could be obtained if the present sponsors of educational programs would center more attention on the installation of economies in production and distribution in order to give consumers the low priced milk they want.

The conditions contributing to high costs of producing and distributing milk have existed for many years. Primarily, these conditions exist because of the nature of milk production and distribution, which is

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1/ Recommended by Dr. E. V. McCollum of Johns Hopkins University, Dr. H. C. Sherman and Dr. Mary Swartz Rose of Columbia University. Bartlett, R. W., "Increasing the Consumption of Milk" from Dairy Manufacture's Short Course Manual, Illinois Extension Service, 1938, p. 145.

2/ Bartlett, R. W., "St. Louis Milk Problems With Suggested Solutions," Ill. Exp. Sta. Bul. 412, p. 161, 1935.

3/ Ibid.

4/ Ibid.

characterized by the presence of many firms engaged in the business in one market area. It has been found that these conditions result in inefficiencies which are largely due to small yearly volumes of business, inefficient use of labor, and duplications of facilities utilized in production and distribution. Consequently, costs of production are in many cases considerably greater than necessary, which result in a low return to the producer, a high price to the consumer, or both. If milk production and distribution costs are to be reduced and milk consumption is to be increased, the ways of reducing such costs and their relative merits must be considered. 5/

Milk production and distribution in some of the smaller markets, such as the one involved in this study, have not been completely divided into separate functions. Unlike the usual practice in large cities where different firms perform the functions of production and of distribution, both of these functions may be performed in the smaller markets by one firm. In the Billings-Laurel area there are several individuals performing only one of the functions either production or distribution, while others perform both functions.

Purposes of the Study

The purposes of this study are: (1) to determine the costs of producing and distributing market milk in the cities of Billings and Laurel, Montana, as an aid to those producers and distributors who may wish to use such information in the working out of a more balanced

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5/ Rinear, Earl H., "Milk Distribution Costs of Producer-Distributors and Subdealers in New Jersey," New Jersey Exp. Sta. Bul. 663, p 55.

economic unit; (2) to analyze the costs incurred in the production and distribution of market milk and the factors affecting costs so that individual operators may compare their operations with others in the area; (3) to indicate the conditions that enable one dairyman to produce or distribute milk at a lower cost than another in order that factors affecting the costs may be rearranged to conform with the lowest cost combination; (4) to indicate possible ways whereby dairymen may reduce their costs of producing and distributing market milk in order to reduce the price and stimulate consumption; (5) to give a basis by which the consumer may determine whether or not he is paying unjustifiably high prices for milk; and (6) to furnish government agencies with information that may be of value in carrying out their programs.

Sources and Characteristics of Data

The interview method was employed in obtaining these data. A schedule was prepared to facilitate gathering the essential information and the data were recorded on the schedule during the interview with each operator.

Twenty-eight of the 57 licensed dairymen supplying fluid milk to the Billings and Laurel area cooperated in this study by supplying data concerning their dairy enterprise. The records of two of these later had to be discarded.

Most of the operators who furnished data keep no formal records. The four distributors and the one producer-distributor keeping complete records do not segregate costs between the market milk enterprise and

other enterprises. Several of the operators maintained records on parts of their enterprises.

Records when available supplied the data. When records were not available, costs were computed on the basis of information supplied by the operator. When joint costs were involved, the proportion of the total cost charged to market milk was calculated on a percentage basis. Two such bases were used: (1) the proportion of the total use of equipment that was devoted to the market milk enterprise and (2) the proportion of the total gross receipts of the business that came from the sale of market milk. Equipment costs were calculated by using the first method because the proportion of total equipment used by the market milk enterprise varied widely among operators. For example: Ten per cent of one operator's total equipment may be used by the market milk enterprise and 30 per cent of his total gross receipts may come from the sale of market milk products, while 40 per cent of another operator's equipment may be used by market milk and the sale of market milk products account for only 20 per cent of his total gross receipts. Charging equipment costs of these operators on the basis of the percentage of gross receipts would not be justified. If this method had been used, the first operator would have had an equipment cost too high and the second a cost too low. However in dividing the total cost of building maintenance between the market milk and other enterprises of the business percentage of gross receipts is the more logical method to use. This results from the difficulty of determining the per cent of the total use of the buildings

devoted to market milk and because all the enterprises of the business require the use of the building, it is reasonable to charge each in accordance with its percentage of the total gross receipts.

Information needed for this analysis consisted of a complete record of all costs incurred in producing and distributing market milk. Since this study is concerned only with the production and distribution of market milk, data were obtained only on this portion of the individual's farming operations.

The operators furnishing data showed considerable interest in the study. Due to this and the freedom with which information was given, it is believed that these data were relatively accurate.

Because of the number of dairymen operating in the market area and the unwillingness or inability of some dairymen to give information, it was impossible to obtain data from all operators. Since complete cost data were not obtained from all dairymen, it is desirable to determine what per cent of the total market milk consumed in the market was handled by the operators furnishing data. A rough percentage was computed and indicates that about 65 per cent of the total milk marketed in the area was from the dairymen whose records are used in this study. 6/

Since this study includes both producing and distributing costs, it was necessary to set a point at which production costs end and distri-

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6/ This percentage figure was computed in the following manner: the per capita consumption of milk in cities and villages in the United States was multiplied by the combined populations of Laurel and Billings. Then the product was divided into the total milk handled by the 11 operators furnishing data.

bution costs begin. This point was set on the basis of the costs incurred by the producer who sells his milk in bulk to the distributor. The producer's costs, except for hauling, cease after the milk enters the milk house and is cooled. In calculating producer-distributor's costs, this point was taken as the dividing line between production and distribution costs.

Description of the Market

The City of Billings, county seat of Yellowstone County, is located on the north bank of the Yellowstone River in south central Montana (figure 1).

Due to its favorable location as a distributing point for a large agricultural area, it is a rapidly growing city. The 1930 census reports its population as 16,380 whereas preliminary figures for 1940 report it as 23,313, an increase over the 1930 figure of 6,933 or 42.3 per cent.

Laurel, Montana, with a population in 1940 of 2,754, is located 16 miles southwest of Billings. This city owes its growth chiefly to the fact that it is a freight terminal on the Northern Pacific and the Chicago, Burlington, and Quincy railroads. The extensive railroad repair and construction shops, together with a large oil refinery, furnish employment for many men.

Conditions favorable to the production and sale of market milk are common to both cities. First, adequate supplies of feed can be obtained at low prices because of the general practice of including alfalfa and grains in the crop rotation systems. Second, the growing population of the cities provides an expanding market for the sale of milk and cream.

MONTANA

Figure 1. Location of Billings and Laurel, Montana

The operators engaged in the dairy industry in this area may be classified into three groups; producer, producer-distributor, and distributor. The distributors are located in or near the City of Billings and derive their supplies of fresh milk from the producers, the majority of whose farms lie northeast of the city along the Yellowstone River. The producer-distributors are located principally on the valley floor to the west of the city (figure 2).

Government Agencies in the Market

Montana Livestock Sanitary Board - Producers and distributors of market milk in the State of Montana must comply with the requirements of the Montana Livestock Board. The rules, regulations, and orders of this board are designed to guarantee to the consumer the production of a sanitary product. Milk produced and handled in accordance with the regulations of the Montana Livestock Sanitary Board is designated as inspected milk. All dairies wishing to produce milk and cream for fluid consumption must secure a license to do so from this board. Such dairies must then be inspected annually by an official appointed by the board and must score not less than 70 points on an official score card. Any milk purchased by milk plants from dairies not entitled to sell inspected milk must pasteurize all such milk before selling it to the consumer. Furthermore, uninspected milk cannot be mixed with or added to milk sold under the classification of inspected milk.

Official standards for the sale of fluid milk products published in, "Livestock Sanitary Laws of Montana," Montana Livestock Sanitary Board, 1927, are as follows:

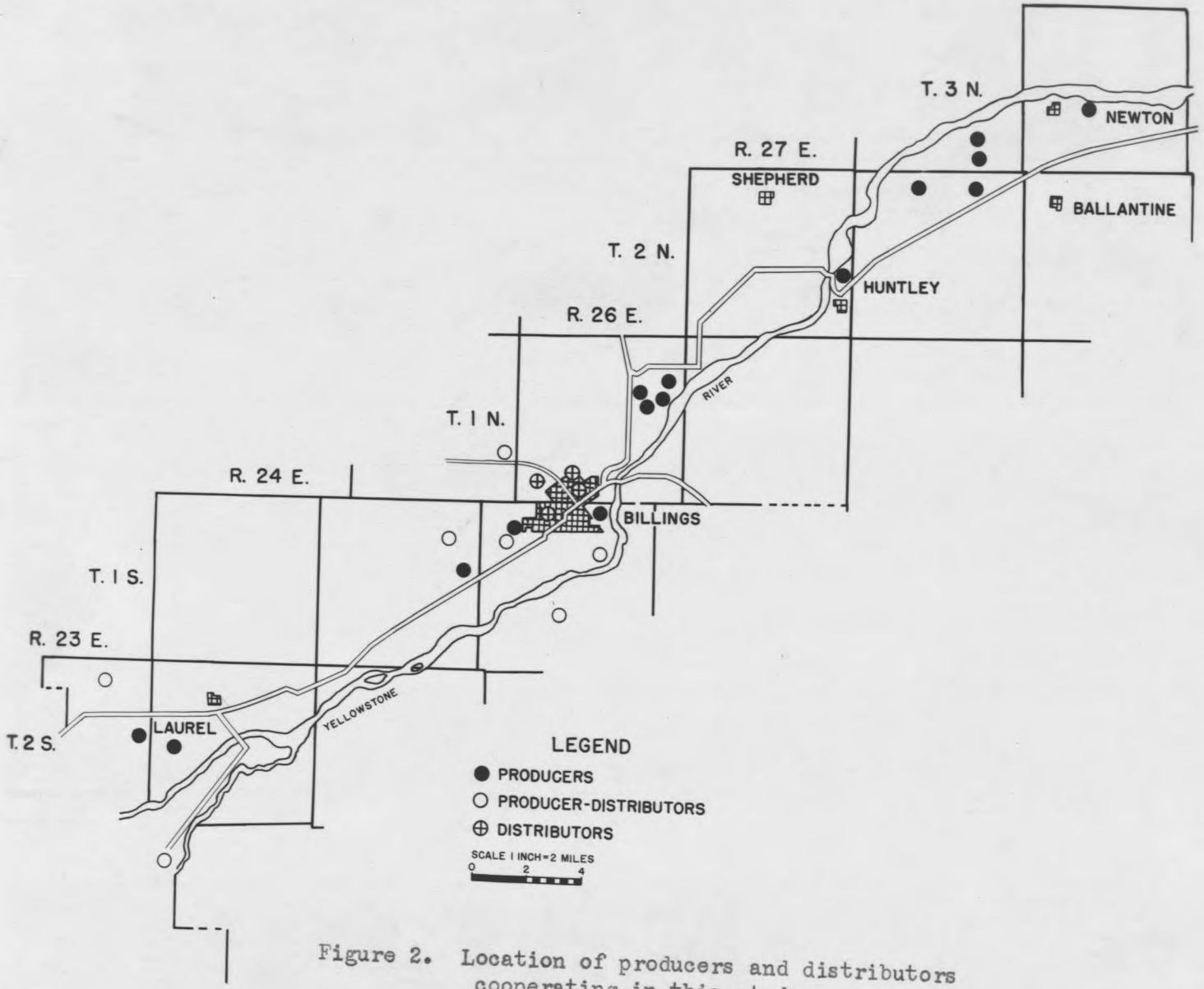

Figure 2. Location of producers and distributors cooperating in this study

1. All milk must contain not less than 3.25 per cent butterfat and not less than 8.5 per cent solids not fat.

2. All cream sold as whipping cream must contain not less than 30 per cent butterfat and not more than .2 per cent of acid reacting substance calculated in terms of lactic acid.

3. Raw milk shall not contain more than 150,000 bacteria per milliliter.

4. Raw cream shall not contain more than 300,000 bacteria per milliliter.

5. Pasteurized milk shall not contain more than 30,000 bacteria per milliliter.

6. Pasteurized cream shall not contain more than 150,000 bacteria per milliliter.

The following grades of fluid milk are sold to consumers in the Billings market.

1. Inspected raw milk or pasteurized milk containing not less than 3.25 per cent or more than 4.00 per cent butterfat.

2. Inspected raw or pasteurized coffee cream containing not less than 20 per cent or more than 25 per cent butterfat.

3. Inspected raw or pasteurized special cream testing not less than 25 per cent or more than 30 per cent butterfat.

4. Inspected raw or pasteurized whipping cream testing not less than 30 per cent or more than 36 per cent butterfat.

5. Inspected raw or pasteurized cream containing 36 per cent or more butterfat.

6. Inspected raw or pasteurized creamed buttermilk containing not less than one-half of one per cent or more than 3.5 per cent butterfat.

7. Inspected raw or pasteurized cultured or natural buttermilk containing not less than one-half of one per cent or more than one per cent butterfat.

8. Inspected raw or pasteurized skim milk containing less than one-half of one per cent butterfat.

Montana Milk Control Board - This market is also subject to the rules, regulations, and powers of the Montana Milk Control Board. The Board is operative and exercises the following powers; to fix by official order:

(a) The minimum prices to be paid by the milk dealers to producers and others for milk. The orders of the Board with respect to the minimum prices to be paid to producers and others shall apply to the locality or zone in which the milk is produced in respect to the market or markets in which milk so produced is sold, and may vary in different localities or zones or markets according to varying uses and different conditions. Each order fixing prices or handling charges may classify milk by forms, classes, grades or uses as the Board may deem advisable and may specify the minimum prices therefor.

(b) The minimum wholesale or retail prices to be charged for milk in its various grades and uses handled within the State for fluid consumption and wheresoever produced when sold by milk dealers whether licensed or unlicensed, to consumer; by stores to consumers except for consumption on the premises where sold; by milk dealers to other milk dealers.

A minimum wholesale or retail price to be charged for milk shall not be fixed higher than is necessary to cover the costs of ordinarily efficient and economical milk dealers, including a reasonable return upon necessary investment.

The Board may, upon its own motion, or upon application in writing from any market, or from any party at interest, alter, revise or amend any

official order theretofore made by the Board provided that before making, revising, or amending any order fixing prices to be charged or paid for milk in any of its grades or uses, the Board shall hold a public hearing on such matter in the same manner provided herein for the original fixing of prices.

The retail price to be charged for milk in quart bottles shall not be more than twice the price paid by the distributor to the producer for the same grade and butterfat content of fluid milk purchased from the producer by such distributor. The Board shall make adjustment from the basic rate in prices of milk sold in less quantities than quarts and at wholesale.

In any market, where the provisions of this Act apply, it shall be unlawful for any producer, producer-distributor, or distributor to produce, transport, process, store, handle, distribute, buy or sell milk unless such dealer be duly licensed as provided by this Act. It shall be unlawful for any such person to buy, sell, handle, process, or distribute milk which he knows or has reason to believe has been previously dealt with or handled in violation of any provision of this Act. The Board may decline to grant a license, or may suspend or revoke a license already granted, upon due cause and after hearing. 7/

The operation of this law in the market may be a factor affecting the efficiency with which milk is being produced and distributed.

Definition of Terms

A number of terms used in this report have not been standardized. In order to indicate clearly their meaning the following definitions are given:

Producer - a dairyman who produces milk and sells it in bulk to distributor or a producer-distributor.

Producer-distributor - a producer of market milk who packages and sells his fluid milk products direct to the consumer or to another retailer. He maintains a milk route and may supplement his own production by purchas-

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7/ Montana Milk Control Board Law, Mimeographed Copy, 1939, pp 12-13.

ing milk from a producer or another producer-distributor.

Distributor - an individual or firm that purchases milk from producers, processes it for sale in fluid form to retailers and consumers.

Market or fluid milk - milk that has been prepared for human consumption without being converted into any other product.

Fluid sales - includes sales of milk in the form of fluid milk, fluid cream, butter-milk, chocolate milk and skim-milk.

Unit of fluid sales - all fluid sales are sold in various size containers ranging from gallons to one-half pint bottles. Each container is considered a unit regardless of its size, i.e., each half-pint, pint, quart, or gallon is considered one unit.

Quart equivalent - refers to one quart or fluid sales. It is calculated by converting all fluid sales into quarts, i.e., two pints are equal to one quart equivalent, one gallon is equal to four quart equivalents.

Wholesale - refers to the sale of milk and milk products to stores, restaurants, and other large consumers at wholesale prices.

Retail - fluid sales at retail prices.

Milk house - refers to the room or building and the equipment used by the producer in cooling and storing his milk until it is delivered to the distributor.

Milk plant - refers to the room or building and the equipment used by the distributor in processing the milk.

Processing - cooling, pasteurizing, spearating the cream, bottling, refrigerating milk.

Distribution - refers to all services performed after the milk enters the milk house and is cooled, until it is purchased and paid for by the consumer.

Delivery - transporting the fluid milk from the milk plant to the purchaser.

Cost of production - represents all the costs incurred in the production of market milk.

Cost of distribution - is the cost of distributing the fluid products and represents all the costs incurred from the time the milk is received at the plant until it is delivered to and paid for by the purchaser.

Cow appreciation - increase in the value of cows during the year due to growth and increased capacity of milk production.

Cow depreciation - decrease in the value of cows during the year because of age, improper care, and injury. 8/

Method of Analysis

The presentation of the cost of production and distribution factors and their analysis is divided into two major parts. The costs and the factors affecting costs of producing milk are presented and discussed as Part II. Distribution costs and the factors affecting costs are presented in like manner in Part III. In each of these parts the factors affecting its cost are analyzed as follows: First, the market as a whole; second,

8/ Changes in the market price of cows during the year resulting from fluctuations in the price level were eleminated in computing appreciation and depreciation of cows.

the characteristics of the individual enterprise; and third, the differences between individual operators. Averages are used to indicate the characteristics of the market as a whole. Scatter diagrams are employed to illustrate the salient features and differences of the individual enterprises.

In order not to reveal the identity of the individual operator, each has been assigned a number. Reference to the same number will indicate the same operator throughout the study. Operators 1 to 15 inclusive are producers, operators 14 to 22 are producer-distributors, while operators 23 through 26 are distributors.

The small number of records obtained from the Laurel area, and the similarity of the factors affecting the costs of production and distribution in the two cities indicates that it is desirable to consider the two as one market. Operators numbered 14 and 15 are producers and operators 21 and 22 are producer-distributors who are located near and market their milk in Laurel.

PART II. PRODUCTION OF MARKET MILK

The cost of producing milk includes the sum of all the cost factors which enter into its production. These factors vary with the different producers and account for the diversity in total costs among producers. 9/

In order to facilitate an analysis, the factors pertaining to production costs are classified as follows: (1) costs, which are made up of labor, feed, buildings and equipment, cow depreciation, hauling, association dues, licenses, taxes, and miscellaneous; (2) credits, made up of market value of calves at birth, value of manure produced, cow appreciation and sale of by-products.

Costs and credits are in turn affected by: (1) volume, (2) production per cow, (3) size of herd, and (4) distance from market.

A summary of the costs of producing milk during the year ending November 1, 1940 is presented in table I. This summary includes all the costs of the 22 dairymen who furnished complete cost data.

The net cost of producing milk in the Billings-Laurel area was 4.19 cents per quart. Labor and feed were the two most important cost factors, contributing 40 per cent and 36 per cent respectively. The remaining 24 per cent of the total cost was divided among buildings and equipment, cow depreciation, hauling, association dues - licenses - taxes, and miscellaneous (table I).

9/ Herrman, L. F., Stelzer, R. O., and Bowling, S. A., "A Study of the Costs Incurred by 51 Farms in the Morgantown and Fairmont Markets in 1934-1935," West Virginia Agricultural Experiment Station Bulletin No. 268.

TABLE I. AVERAGE COSTS AND PROPORTIONATE DISTRIBUTION OF COSTS OF PRODUCING MILK PER COW AND PER QUART, BILLINGS-LAUREL AREA, 1940

Item	Cost per cow	Cost per quart	Per cent of total
	Dollars	Cents	
Costs			
Labor	$72	1.82	40.1
Feed	65	1.64	36.2
Use of buildings and equipment	16	.39	8.6
Cow depreciation	8	.21	4.6
Hauling	7	.17	3.7
Association dues, licenses, and taxes	2	.05	1.1
Miscellaneous	10	.26	5.7
Total costs	180	4.54	100
Credits			
Value of calf at birth	9	.23	64.3
Manure	4	.10	28.6
By-products	1	.02	7.1
Total returns	14	.35	100
Net cost of producing milk a/	166	4.19	

a/ Twenty-two operators

Credits

In the production of milk, joint products are also produced. These joint products, considered as credits, are deducted from the gross costs of producing milk in order to obtain the net costs. These joint products are classified and computed as follows:

Value of calves - Calves at birth were valued at the market price and accounted for 64 per cent of the total credits. The market price of calves averaged $9 per cow, a relatively high value helping to reduce the cost of producing milk.

Value of manure - Operators estimated the value of manure produced. This item averaged $4 per cow or 29 per cent of the total credits.

Cow appreciation - In those cases where the total of the ending inventory value of the herd, sales, and losses was larger than the beginning inventory, purchases, and value of heifers freshened during the year, the net increase was termed cow appreciation. This credit item was practically negligible and was included in by-products in table I.

By-products - The sales value of by-products, including cow hides, dead animals, old dairy equipment and feed bags, was supplied by the operator and together with cow appreciation contributes 7 per cent of the total credits or an average of $1 per cow.

Costs

Among individual operators there was a wide variation in the per quart cost of producing milk. The range was from 2.78 cents to 5.92 cents per quart. The majority of the operators' production costs fluctuated closely about the average; however, two operators had a production cost per

quart below three cents and three incurred a cost above 5 cents.

In analyzing costs, average figures may fail to represent the typical situation in the market because of the wide variation in costs among individual operators. Furthermore, individual figures are valuable in indicating the variations in costs.

The total cost per quart of producing milk of each operator is presented in table II. The data in this table, also, indicate to what extent the individual operator's total cost was made up of: (1) labor, (2) feed, (3) buildings and equipment, (4) cow depreciation, (5) hauling, (6) association dues - licenses - taxes, and (7) miscellaneous. Cost figures appearing in this table have been adjusted for credits granted. 10/ Therefore, the costs appearing represent the net cost to the operators and will be termed costs during the remainder of Part II.

The data in table III indicate for each operator the percentage that each of the 7 items of cost is of his total cost. The cost of labor accounted for the largest percentage of the total cost of 17 operators, while feed was the most important cost item of 5 operators.

There was a wide variation among individual operators in the per cent of the total cost expended for the different cost items. However, the percentage distribution of the total cost among the different cost items apparently has no affect upon the total quart cost of producing milk.

10/ Adjustments were made as follows: the individual operator's gross cost of each of the 7 cost items and his total credits were determined. The total of the credit items was then multiplied by the percentage that each of the cost items was of the total so that the total of the credit items was divided among the cost items according to their percentage of the total cost. These credits were then subtracted from the different cost items to give the net cost of each operator.

TABLE II. COSTS OF PRODUCING MILK PER QUART, BY OPERATORS, BILLINGS-LAUREL AREA, 1940*

Farm no.	All costs	Labor	Feed	Bldgs. and equip-ment	Cow depreciation	Hauling	Assoc. dues, licenses & taxes	Miscellaneous
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
1	2.95	.90	1.10	.20	.39	.09	.07	.20
2	4.79	1.63	1.86	.55	.40	.05	.06	.24
3	5.30	1.80	2.10	.60	.16	.41	.03	.20
4	3.90	1.50	1.40	.30	-	.42	.05	.23
5	4.29	1.85	1.56	.18	.07	.40	.03	.20
6	3.48	1.32	1.29	.20	.29	.24	.07	.07
7	5.86	2.67	1.81	.71	.18	.18	.03	.28
8	4.41	2.00	1.22	.22	-	.70	.06	.21
9	4.04	2.02	.97	.30	-	.53	.05	.17
10	4.22	1.85	1.46	.20	.35	.16	-	.20
11	3.25	1.58	1.00	.39	-	.12	.02	.14
12	4.37	1.53	1.32	.22	-	1.13	.07	.10
13	5.07	2.49	2.03	.10	-	-	.02	.43
14	4.92	2.06	1.78	.34	.45	-	.01	.28
15	5.20	1.80	2.00	.74	-	-	.10	.56
16	5.92	2.34	2.14	.77	.29	-	.03	.35
17	3.71	1.60	1.76	.11	-	-	.02	.22
18	3.98	1.98	1.20	.57	-	-	.02	.21
19	3.37	1.40	1.14	.16	.40	-	.04	.23
20	3.89	2.27	.78	.49	.09	-	.02	.24
21	3.96	1.67	1.57	.26	.09	-	.02	.35
22	2.78	.89	1.56	.10	-	-	.02	.21
Average	4.19	1.68	1.52	.36	.19	.16	.04	.24

*Data in this table have been adjusted for credits

TABLE III. PROPORTIONATE DISTRIBUTION OF COSTS OF PRODUCING MILK, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm No.	Total	Labor	Feed	Bldgs. and equipment	Cow depreciation	Hauling	Assoc. dues, licenses & taxes	Miscellaneous
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
1	100	30.5	37.2	6.6	13.2	3.3	2.4	6.8
2	100	34.0	38.8	11.5	8.3	1.1	1.3	5.0
3	100	47.2	29.5	7.7	3.2	7.8	.6	4.0
4	100	38.5	35.9	7.4	-	11.0	1.3	5.9
5	100	43.1	36.4	4.2	1.6	9.3	.6	4.8
6	100	37.9	37.0	5.9	8.3	6.9	2.1	1.9
7	100	45.6	30.9	12.2	3.0	3.0	0.6	4.7
8	100	45.5	27.6	4.9	-	15.6	1.5	4.9
9	100	50.5	24.0	7.4	-	13.2	1.2	4.2
10	100	43.7	34.6	4.8	8.4	3.8	-	4.7
11	100	48.8	30.7	11.9	-	3.5	0.6	4.4
12	100	35.0	30.2	4.9	-	25.6	1.7	2.6
13	100	49.1	40.1	1.9	-	-	0.5	8.4
14	100	41.9	36.2	6.8	9.1	-	0.2	5.8
15	100	33.7	39.3	14.3	-	-	2.0	10.7
16	100	39.5	36.1	13.0	4.9	-	0.5	6.0
17	100	43.0	47.4	3.1	-	-	0.5	6.0
18	100	49.6	30.1	14.4	-	-	0.7	5.2
19	100	41.5	33.9	4.8	11.9	-	1.2	6.7
20	100	58.3	20.0	12.5-	2.4	-	0.4	6.3
21	100	42.2	39.5	6.7	2.3	-	0.5	8.8
22	100	31.9	56.0	3.7	0.3	-	0.5	7.6
Average	100	40.1	36.2	8.6	4.6	3.8	1.0	5.7

Labor accounted for over 45 per cent of the total cost of producing milk of 8 operators, and of these, 4 had a total cost per quart above the average of the 22 operators and 4 had a cost below. Feed amounted to over 36 per cent of the total cost of 12 operators and these, too, were equally divided, 6 had a cost above and 6 below the average.

The wide variation among individual operators in the per quart cost of producing milk appears to be, from results of this study, caused by differences in the per quart cost of the items making up the total cost and these in turn are affected by differences in such factors as total volume of milk produced, production per cow, and size of herd. An analysis of these cost items and related factors should indicate why costs vary, the effect that the different items of cost and related factors have upon the total cost, and as a result may assist dairymen having high production costs in adjusting their enterprises to conform to low cost combinations.

Labor - Labor costs include those for the operator, the unpaid family, the hired help, and horse labor as expended on the production of milk. Operator's time spent in the dairy enterprise was determined and charged according to the rate of that type of labor as was unpaid family labor. Hired help was charged at the actual rate paid plus the share of board and room and other services furnished by the operator corresponding to the time spent in the dairy enterprise. 11/ Horse labor was valued at $1 per day and charged to the dairy enterprise according to the time spent.

11/ The allowance used for board and room was $30 per month, other allowances were dependent on the type of service furnished.

Man labor accounted for 97 per cent of the total and horse labor, so small as to be almost negligible, 3 per cent. Because of the relative unimportance of horse labor it was considered desirable to combine man and horse labor and analyze them as labor cost.

The total cost of labor per quart of milk produced averaged 1.68 cents (table II). Among individual operators this item ranged from .92 cents to 2.67 cents per quart.

The relative importance of this cost item and the wide range existing among individual operators suggest that it is one of the most important single items causing the wide variation in the total cost per quart of producing milk.

Operator's labor averaged $117 per month and the range among individual operators was from $80 to $200 per month. Of the 22 operators, two valued their labor at $80 per month, four at $90, nine at $100, one at $120, two at $125, one at $150 and three at $200.

Unpaid family labor averaged $65 per month and ranged among enterprises from $40 to $93. The 17 operators utilizing unpaid labor evaluated it as follows: two between $40 and $59 per month, 13 between $60 and $79, and two between $80 and $99.

The value of hired help averaged $64 per month. Ten dairymen hired help during the year and of these, seven paid a wage plus allowances between $50 and $69 per month, one $170, one $175, and one $105.

The variations in the monthly valuation of operator's labor may have an effect upon the per quart cost of labor. The relationship between the per quart cost of labor and the monthly value of the operator's labor

is indicated in figure 3. As the value of operator's labor increases the cost per quart of labor tends to decrease until the value of operator's labor reaches $130 per month and then there is an indication that the cost of labor per quart increases. The variations among individual operators in the monthly value of operator's labor are apparently offset to some extent by differences in the individual operator's working efficiency. There was no relationship between production costs and unpaid family labor or between costs and hired help.

Feed - Feed was the second largest single item of cost, accounting for 36 per cent of the total (table III). The cost of feed averaged 1.52 cents per quart (table II), and the range among individual operators was from .78 cents to 2.14 cents. Feed costs include costs incurred for alfalfa, pasture and field, succulents, concentrates, and straw utilized by the milking herd. Feed raised on the farm was valued at the price it could be sold for at the farm. Cost of pasture and field were charged at the local rental rates and varied in accordance with the quality.

Dairymen in this area usually operate a general farm upon which they grow a major portion of the feed for their dairy herds. Mill feed, dried beet pulp, mineral feeds, and brewer's malt were the principal feeds purchased.

Alfalfa was the only hay the 22 dairymen fed to their milking herds and accounts for 43 per cent of the total cost of feed (table IV). Operators fed an average of 3.8 tons of alfalfa per cow at an average cost

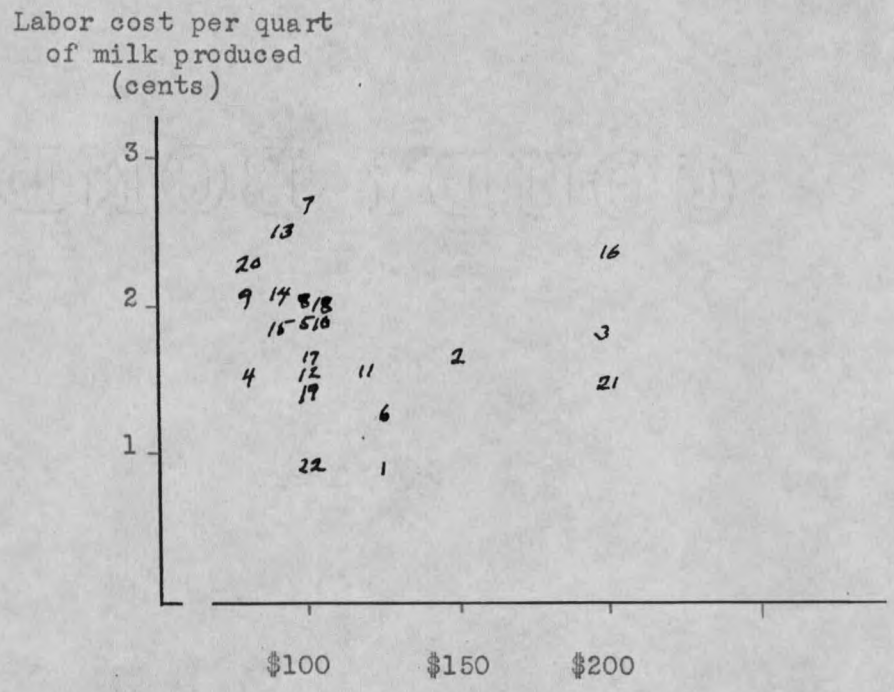

Figure 3. Relation between labor cost per quart of milk produced and value of operator's labor per month, 22 operators

TABLE IV. FEED COSTS AND PROPORTIONATE DISTRIBUTION FOR THE DIFFERENT FEEDS PER QUART OF MILK PRODUCED, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm No.	Total Cost		Alfalfa		Pasture & Field		Concentrates		Succulents	
	Cents	Pct.	Cents	Pct.	Cents	Pct.	Cents	Pct.	Cents	Pct.
1	1.67	100	0.32	28	0.07	2	0.70	61	0.58	9
2	1.54	100	0.63	35	0.30	17	0.88	48	-	-
3	1.49	100	0.58	39	0.31	21	0.60	40	-	-
4	1.42	100	0.41	29	0.21	15	0.76	53	0.04	3
5	1.53	100	0.66	43	0.19	12	0.68	45	-	-
6	1.24	100	0.63	51	0.20	16	0.41	33	-	-
7	1.73	100	0.63	36	0.38	22	0.72	42	-	-
8	1.29	100	0.57	44	0.19	15	0.51	39	0.02	2
9	0.99	100	0.33	34	0.17	17	0.49	49	-	-
10	1.44	100	0.53	37	0.34	24	0.44	30	0.13	9
11	1.11	100	0.47	42	0.10	9	0.54	49	-	-
12	1.44	100	0.76	53	0.10	7	0.48	33	0.10	7
13	2.13	100	0.87	41	0.40	19	0.86	40	-	-
14	1.88	100	1.01	54	0.24	13	0.63	33	-	-
15	2.22	100	1.06	48	0.20	9	0.96	43	-	-
16	2.24	100	1.34	60	0.10	5	0.80	35	-	-
17	1.79	100	0.70	39	0.11	6	0.98	55	-	-
18	1.25	100	0.56	45	0.06	5	0.40	32	0.23	18
19	1.12	100	0.38	34	0.21	19	0.46	41	0.07	6
20	0.74	100	0.59	80	0.12	16	0.03	4	-	-
21	1.78	100	0.48	27	0.13	7	0.96	54	0.21	12
22	1.57	100	0.84	54	0.11	7	0.62	39	-	-
Ave.	1.58	100	0.67	43	0.16	10	0.68	44	0.04	3

of $7 per ton which amounts to a total cost of $27. On a quart basis, the average cost was .67 cents and the range among operators was from .32 cents to 1.06 cents (table IV).

The relationship between the cost of alfalfa per quart of milk produced and total cost of production indicates that low costs of alfalfa are associated with low costs of producing milk and as alfalfa costs increase, total production costs tend to increase (figure 4).

Pasture and field costs averaged $6 per cow. The average cost per quart of milk produced was .16 cents, the range among individual operators was from .06 to .40 cents (table IV).

The wide variation in the per quart cost of pasture and field is due in part to differences in the quality and the quantity of pasture and field used. A number of operators did not have access to an adequate supply of pasture and field and so were forced to hand feed their milking herds during all or a large part of the summer months. Others used pasture and fields of inferior quality and, also, were forced to supplement their pasture and field by hand feeding. No relationship was evident between cost of pasture and field per quart of milk produced and total cost per quart of producing milk.

Concentrates accounted for 44 per cent of the total feed cost. This item averaged .68 cents per quart or $27 per cow. However, among individual operators extreme variations were present, indicating great diversity among operators in the amounts of concentrates fed. The range in the cost per quart was from .03 cents to .98 cents (table IV).

The relationship between cost of concentrates per quart of milk

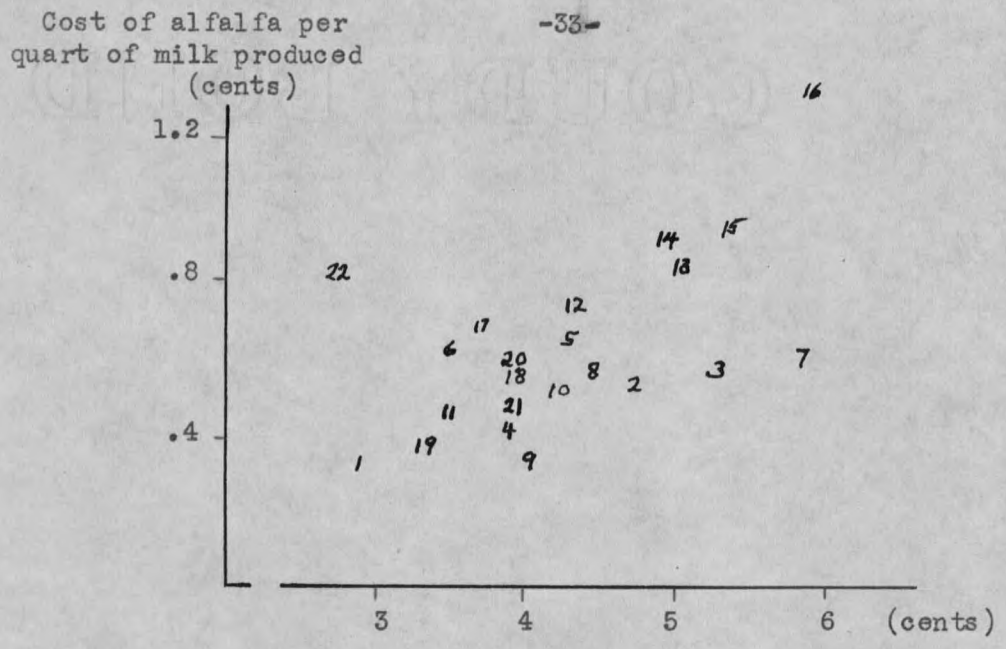

Figure 4. Relation between cost of alfalfa per quart of milk produced and total production cost per quart, 22 operators

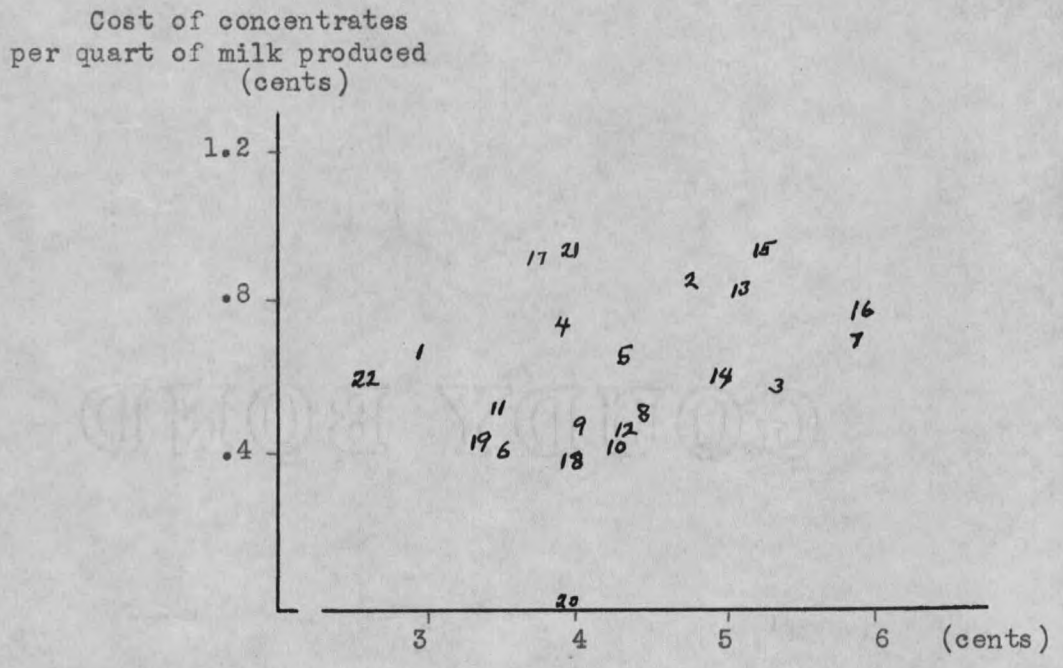

Figure 5. Relation between cost of concentrates per quart of milk produced and total production cost per quart, 22 operators

produced and total cost of production is illustrated in figure 5. The relationship is almost flat indicating that the cost of concentrates has little affect upon the total cost per quart of producing milk.

Concentrates fed by dairymen in this study include dried beet pulp, mill feed, barley, oats, wheat, corn, molasses and mineral feeds. The first four of these were the principal feeds used.

Succulent feeds, including corn silage and brewer's malt, were fed by eight of the dairymen furnishing data and constitute only 3 per cent of the total cost of feed. Each of the operators numbered 1, 4, 8, 10, 12, 18, and 19 who fed succulent feeds had a lower total cost per quart of feed than the average of the group, while the remaining operator, number 21, feeding succulents incurred a higher than average production cost. It may be that the use of succulent feeds tends to reduce feed costs. However, sufficient data are not available to accurately determine the affect that feeding succulents has upon the total cost of feed.

Straw was used for bedding by the 22 dairymen. An average of 1.42 tons costing $1.90 per cow was utilized.

Buildings and equipment - Buildings and equipment costs include the cost of repairs, insurance, depreciation on buildings which was charged at 4 per cent and on equipment charged at the average rates of depreciation for the area, 12/ taxes, determined by the assessed value on the average

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12/ Average depreciation rates for the Billings-Laurel area were obtained from Dr. J. A. Nelson, Professor of Dairy Industry, Montana State College.

investment times the millage rate, 13/and interest on investment at the rate of 5 per cent. 14/

Buildings and equipment costs accounted for 8.6 per cent of the total cost of producing milk. This item averaged .36 cents per quart and the range among individual operators was from.10 cents to .77 cents (table II).

Since the costs of buildings and equipment are dependent largely on their value, the wide range existing among operators is an indication of the diversity in the types of buildings and equipment used. The relationship between the total cost per quart of producing milk and the investment in buildings and equipment per quart, indicates that low production costs are associated with low investments and as investments increase production costs tend to increase (figure 6). Efficiency in the use of buildings and equipment may depend to a greater extent upon the type of buildings and equipment and the convenience of their arrangement rather than their value.

Cow depreciation - Depreciation of cows was obtained by subtracting the closing inventory, sales, and losses from the opening inventory, purchases, and value of heifers freshened during the year. In those cases where the total of the closing inventory, sales, and losses was larger, the increase was credited as appreciation and appears in credits. Interest on

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13/ In the State of Montana the assessed value of buildings, machinery, and equipment for taxing purposes is 30 per cent and for livestock it is 33 per cent. The average millage rate of tax in Billings was 92 mills, outside the city it was 63 mills. For operators located near Laurel the millage rate was 60.8 mills.

14/ This rate is used because it approximates the going rate of interest charged on loans made for this type of investment.

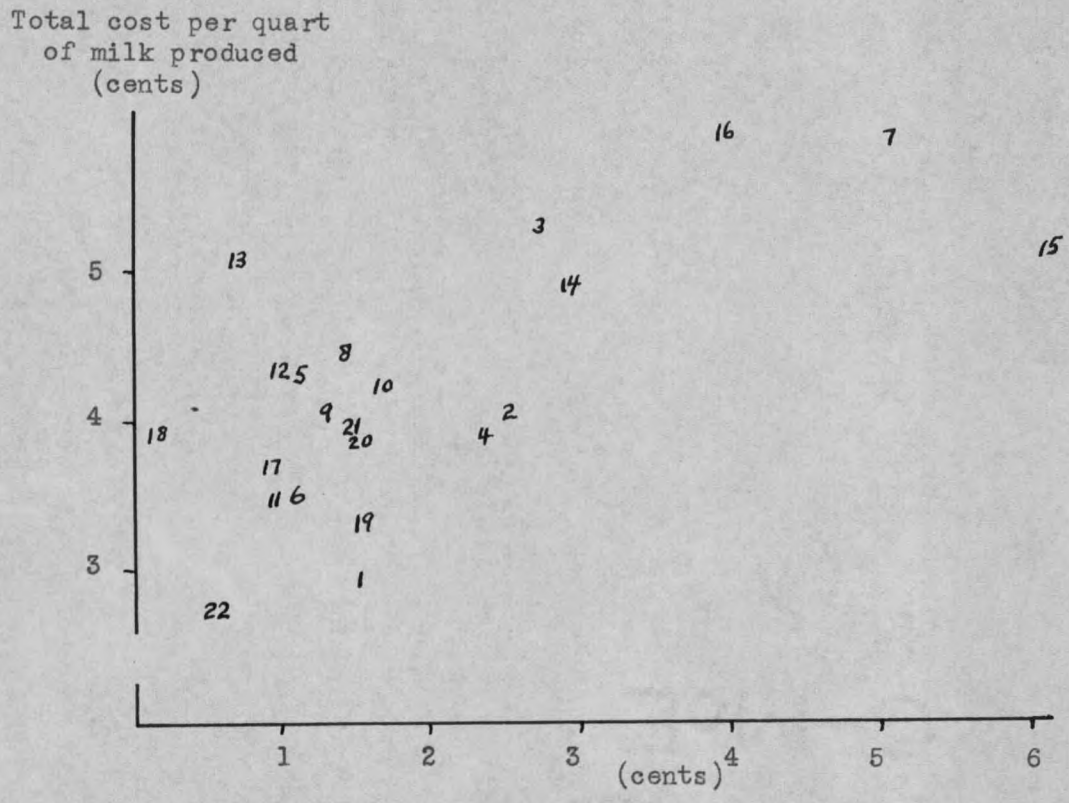

Figure 6. Relation between total cost per quart of milk produced and per quart investment in buildings and equipment, 22 operators

investment in cows was charged at 5 per cent.

Thirteen of the 22 operators had a cost of cow depreciation. Since all the operators in this study do not have a cost of this item, averages of the group would misrepresent the situation.

The data in tables II and III indicate the operators who had a charge of cow depreciation and, for each operator, the cost per quart and the percentage of the total cost that is accounted for by this item.

Cow depreciation had little affect upon the total cost per quart of producing milk. Seven of the 12 operators incurring a cost of cow depreciation had a total production cost above the average of the group while the other 5 had a production cost below the average.

Hauling - Thirteen producers follow the practice of delivering their milk to distributors in Billings. The present system of hauling in use is for each individual producer to deliver his milk personally, or for two or more neighbors to agree to an arrangement whereby one of them hauls his neighbor's milk as well as his own.

The data in tables II and III indicate for each of the 13 producers the per quart cost and the percentage that hauling is of the total. For these 13 producers the total cost of hauling accounted for 6.8 per cent of their total cost of producing milk and the average cost was .27 cents per quart.

Association dues, licenses and taxes - These cost items accounted for one per cent of the total cost of producing milk (table III). The average cost for the 22 operators was .04 cents per quart, and the range was from less than .01 cents to .07 cents (table II).

Since these costs are relatively fixed for the individual enterprise, changes in these costs are dependent upon changes in the present organization of the individual enterprise or changes in the relative cost of these items. Changes in the millage rate of tax, licenses, or association dues usually, however, affect all enterprises by reducing or increasing their costs roughly in proportion to their present cost.

Miscellaneous - Miscellaneous costs, including the cost of herd sire at a flat two dollar fee, medical supplies and services, feed grinding, telephone, strainer discs, and dairy magazines accounted for 5.7 per cent of the total cost of producing milk (table III). The average cost was .24 cents per quart and the range among individual operators was from .07 cents to .56 cents per quart.

Since the information necessary to calculate the individual dairyman's cost of herd sire was not available, a uniform rate of $2 was used. 15/ As conditions exist in the area, a number of dairymen belonging to the Dairy Improvement Association received the service of a government herd sire free, except for the cost of the sire's feed, care, and housing while it was on the operator's farm. Other operators either maintain a herd sire of their own or hire the use of a neighbor's. This cost accounts for 21 per cent of the total of miscellaneous costs.

While miscellaneous costs, excluding the cost of bull service, are important in total, individually they are so small that an analysis of each

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15/ This figure was considered applicable by J. O. Tretsven, Professor of Dairy Industry, and O. A. Parsons, Assistant Professor of Economics and Sociology, Montana State College.

would be of limited value. Since these costs are dependent upon the organization of the enterprise and practices employed by the operators, reductions in the total of miscellaneous costs is a problem of each individual dairyman.

Factors Affecting Production Costs

Volume - The volume of milk produced by individual operators was obtained from Dairy Improvement Association records when available. For producers who had no Dairy Improvement records, volume was based on sales plus the milk used on the farm. The sales of milk were obtained from the statements of the plants to which milk was delivered, records of the producer-distributors, or information furnished by the operator. Operators estimated the amount of milk used in the home, the amount furnished to hired help, and that fed to livestock.

Volume of milk handled varied widely among individual operators. The range was from 15,240 quarts to 319,214 quarts (table V). Two operators handled more than 175,000 quarts and 3 handled less than 130,000 quarts.

Volume is a factor affecting the cost of producing milk. The relationship between volume and the total quart cost of producing milk indicates that high production costs are associated with low volumes and as volume increases the per quart cost of producing milk tends to decrease (figure 6). This relationship is evident until volume handled exceeds 175,000 quarts. Operators numbered 1 and 16, handling about 300,000 quarts had a production cost of 2.95 cents and 5.92 cents respectively. The production cost of operator number 1 seems to indicate a continuation of the

TABLE V. VOLUME OF MILK PRODUCED, SIZE OF HERD AND AVERAGE PRODUCTION PER COW, BY OPERATOR, BILLINGS-LAUREL AREA, 1940

Farm No.	Volume	Size of Herd	Production per Cow
	Quarts	No. of Cows	Quarts
1	304,232	41	7,420
2	173,612	32	5,425
3	88,753	19	4,671
4	105,272	17	6,192
5	91,878	27	3,403
6	113,808	28	4,065
7	53,830	16	3,364
8	65,065	17	3,827
9	67,371	12	5,614
10	56,757	15	3,784
11	74,301	12	6,192
12	39,466	12	3,289
13	12,410	5	2,482
14	17,850	5	3,570
15	15,240	6	2,540
16	319,214	126	2,533
17	110,599	22	5,027
18	63,988	16	3,999
19	62,542	16	3,909
20	31,525	12	2,627
21	113,482	45	2,522
22	144,304	33	4,373
Total	2,125,499	534	--
Average	96,614	24	3,980

same general relationship evident when lesser volumes are involved. However, the high cost of operator number 16 invalidates the assumption that the general relationship continues. Since this operator's high cost is due to his relatively high cost per quart of labor, feed, and buildings and equipment (table II) it may be that the continuation of the relationship is indicated by the production cost of operator number 1 is correct. However, additional information is needed to substantiate this assumption.

Frequency distributions illustrating the relationships between labor costs and building and equipment costs, and volume of milk produced per herd indicate the same correlative tendency as noted above, only for labor the relationship is more pronounced (figures 7 and 8).

Volume had no affect on feed costs. Neither was there evidence that volume affected the cost per quart of cow depreciation, hauling or miscellaneous. However, there was a tendency for operators handling larger than average volumes to have a higher than average cost per quart of association dues, licenses, and taxes.

Production per cow - The production per cow was obtained by dividing the total volume of milk by the average number of cows. There was considerable variation among herds in the average volume of milk produced per cow. The average for the 543 cows in the study was 3,980 quarts and the range among individual herds was from 2,482 quarts to 7,420 quarts (table V).

The variation in the amount of milk produced per cow is one of the important factors affecting the cost of producing milk. The relationship between the total cost of producing milk and the average production per cow is indicated in figure 9. High production costs are associated with low

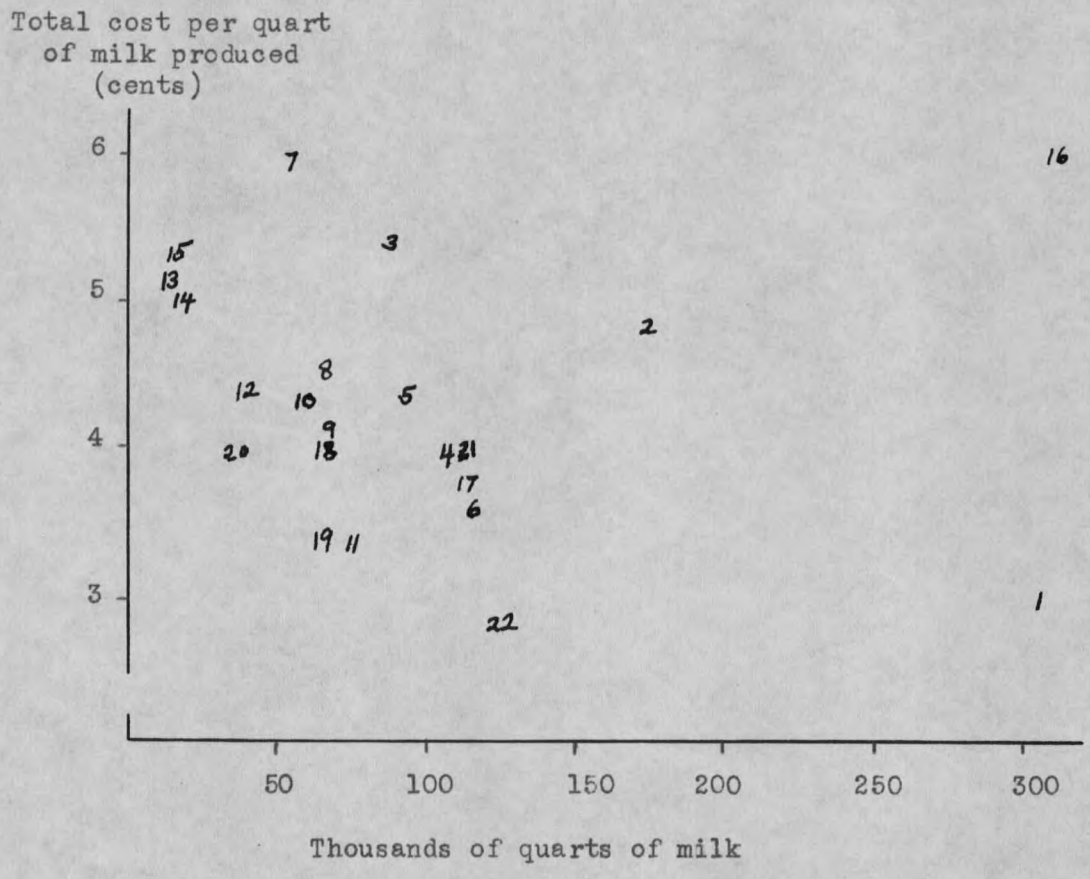

Figure 7. Relation between total cost per quart of milk produced and total volume of milk handled, 22 operators

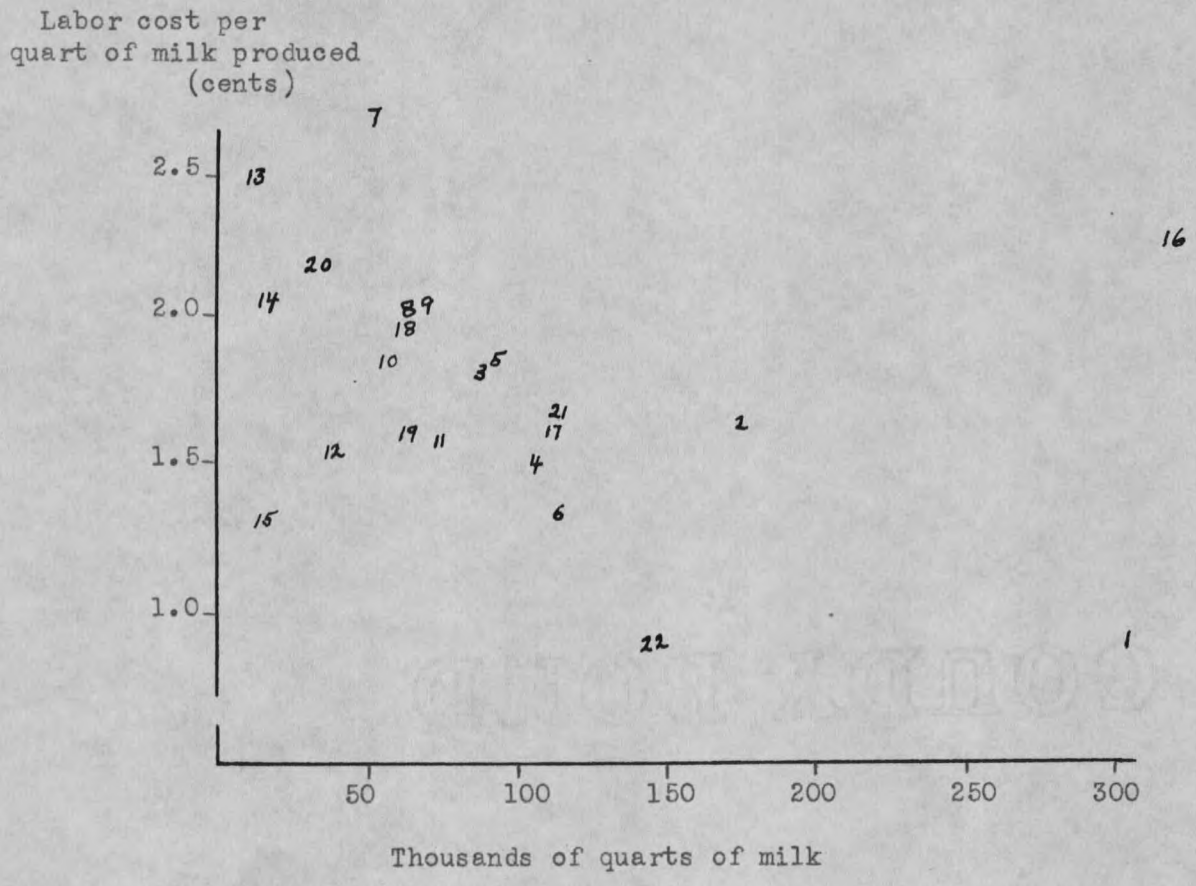

Figure 8. Relation between labor cost per quart of milk produced and volume of milk handled, 22 operators

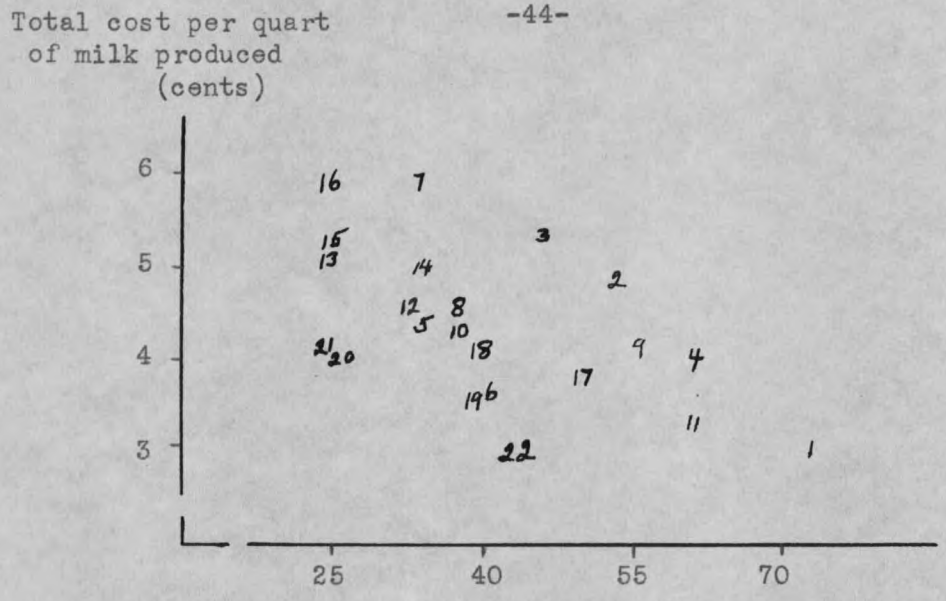

Figure 9. Relation between total cost of quart of milk produced and, average production per cow, 22 operators

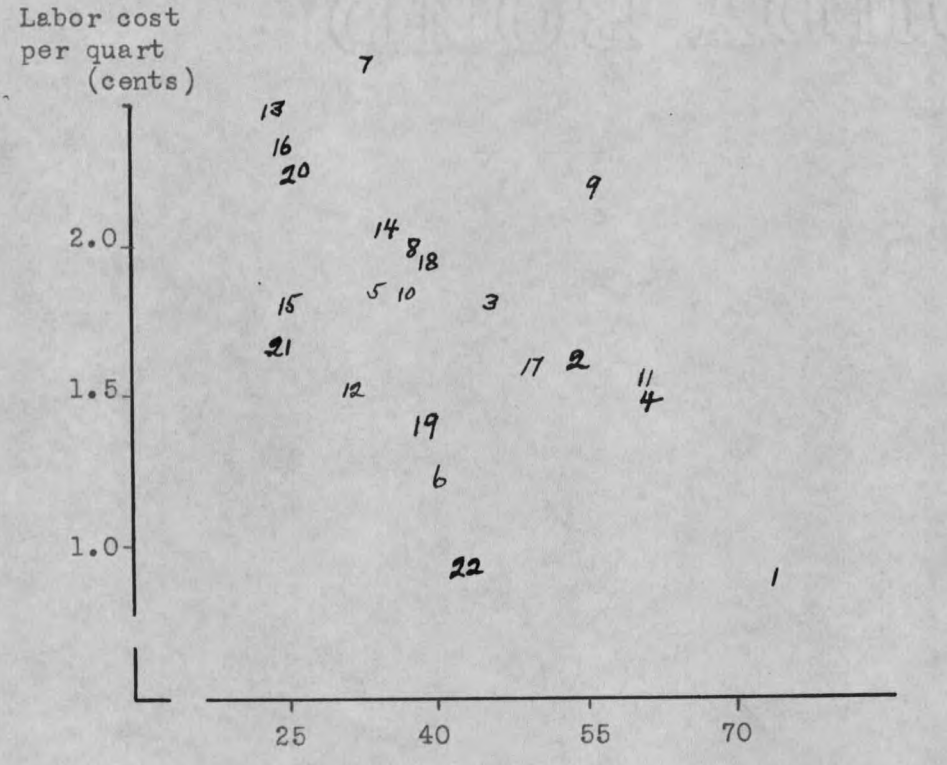

Figure 10. Relation between labor cost per quart of milk produced and, average production per cow, 22 operators

production per cow and as the production per cow increases the per quart cost of producing milk tends to decrease. All the costs of taking care of a cow in an average farm herd is apparently about the same regardless of whether or not she is a high or a low producer.

When relationships are illustrated between the cost per quart of labor, feed, and buildings and equipment, and production per cow, the same correlative tendency as noted above is indicated, only for labor and feed, the relationship is more pronounced (figures 10, 11 and 12).

There was no evidence of a relationship between production per cow and the remaining cost items. However, the 5 operators with an average production per cow below 3,000 quarts had a miscellaneous cost per quart of .35 cents whereas the average for the 22 operators was .24 cents. The remaining operator's cost of miscellaneous items per quart fluctuated closely about the average for the group (table II).

Size of herd - The size of dairy herds varied among operators from 5 to 126 cows per herd. Eighteen per cent of the 22 herds had less than 10 cows and 18 per cent contained more than 40 cows (table V).

Size of herd is another important factor affecting the efficiency with which milk was produced. The relationship between the total cost per quart of producing milk and the number of cows in the herd is illustrated in figure 13. High production costs are associated with small herds and as the size of herd increases production costs tend to decrease.

The 5 largest herds were more efficient in utilizing labor, having an average cost per quart of 1.48 cents as compared with an average cost per quart of 1.97 cents incurred by the 7 smallest herds. This relationship

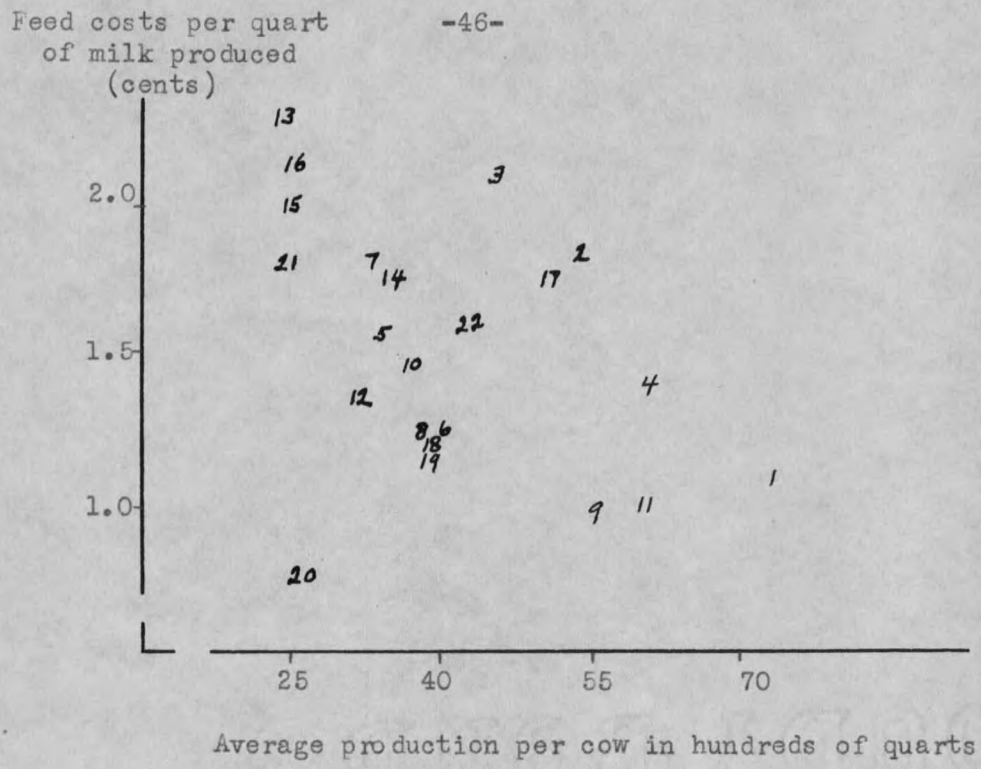

Figure 11. Relation between feed costs per quart of milk produced and, average production per cow, 22 operators

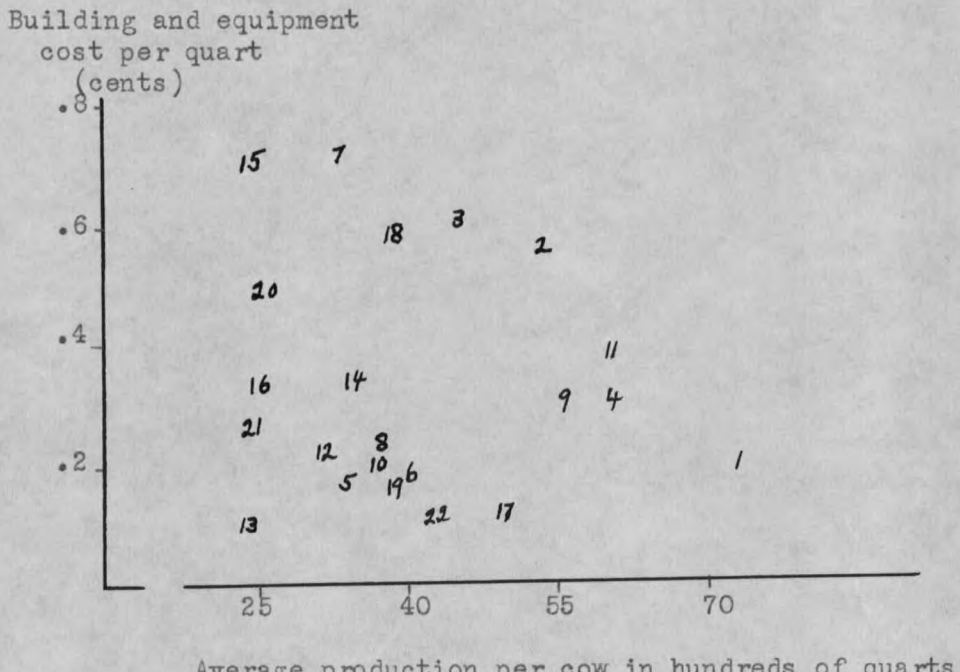

Figure 12. Relation between buildings and equipment cost per quart of milk produced and average production per cow, 22 operators

between labor costs and size of herd is indicated in figure 14. The larger herds are able to utilize labor more efficiently because as the size of herd increases the amount of labor required does not increase proportionately, thus resulting in a lower cost of labor per quart of milk produced.

Size of herd had a slight effect on feed costs. Operators having the 5 largest herds had an average feed cost of 1.64 cents compared to 1.41 cents incurred by the 7 operators having the 7 smallest herds. The larger operators purchased a greater proportion of their total feed which may be the cause of their higher feed costs.

The larger herds utilized buildings and equipment more efficiently than the smaller herds. The relationship between the per quart cost of buildings and equipment and size of herd indicates that as the size of herd increases the cost of buildings and equipment decreases (figure 15). Size of herd had no definite effect on cow depreciation, hauling, association dues - licenses - taxes, and miscellaneous.

Investment per cow - Investment in cows had no effect on the per quart cost of producing milk. Relationships between total cost of producing milk and investment per cow and between cost and per quart investment in cows indicated no correlative tendencies.

Among most of the individual operators there was a tendency to value cows about the same and, consequently, the values obtained do not represent the correct value from a production view point.

Distance from market - Distance from market had no effect on the total cost of producing milk. The 6 operators located over 15 miles from

TABLE VI. DISTANCE PRODUCERS AND DISTRIBUTORS OF MILK ARE FROM THEIR MARKETING CENTER, BILLINGS-LAUREL AREA BY OPERATOR, 1940

Farm Number	Miles From Market Center
1	0.5
2	5.0
3	3.5
4	25.0
5	5.5
6	6.0
7	4.5
8	17.0
9	22.0
10	25.0
11	22.0
12	30.0
13	2.0
14	0.5
15	2.0
16	5.0
17	2.0
18	4.0
19	2.0
20	7.0
21	1.0
22	8.0
Average	9.1

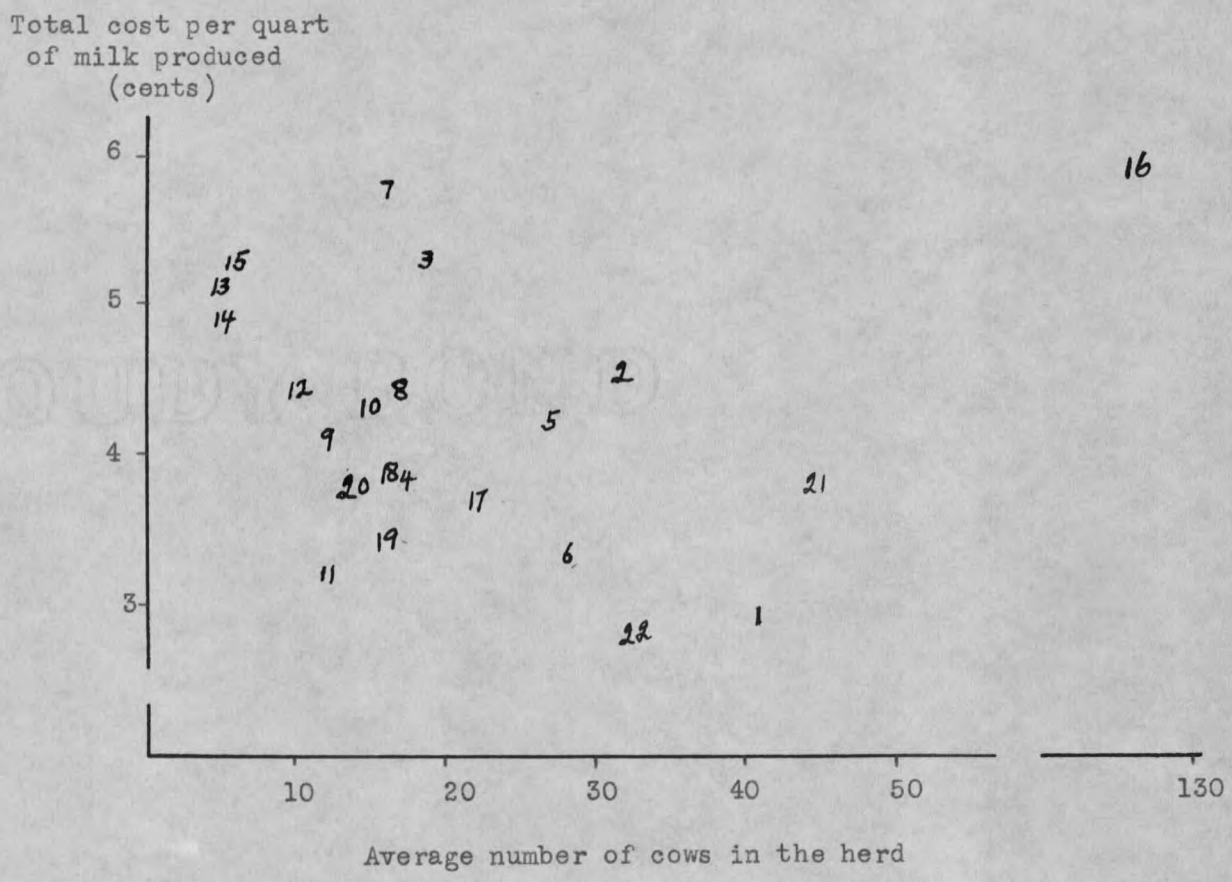

Figure 13. Relation between total costs per quart of milk produced and, average number of cows in the herd, 22 operators

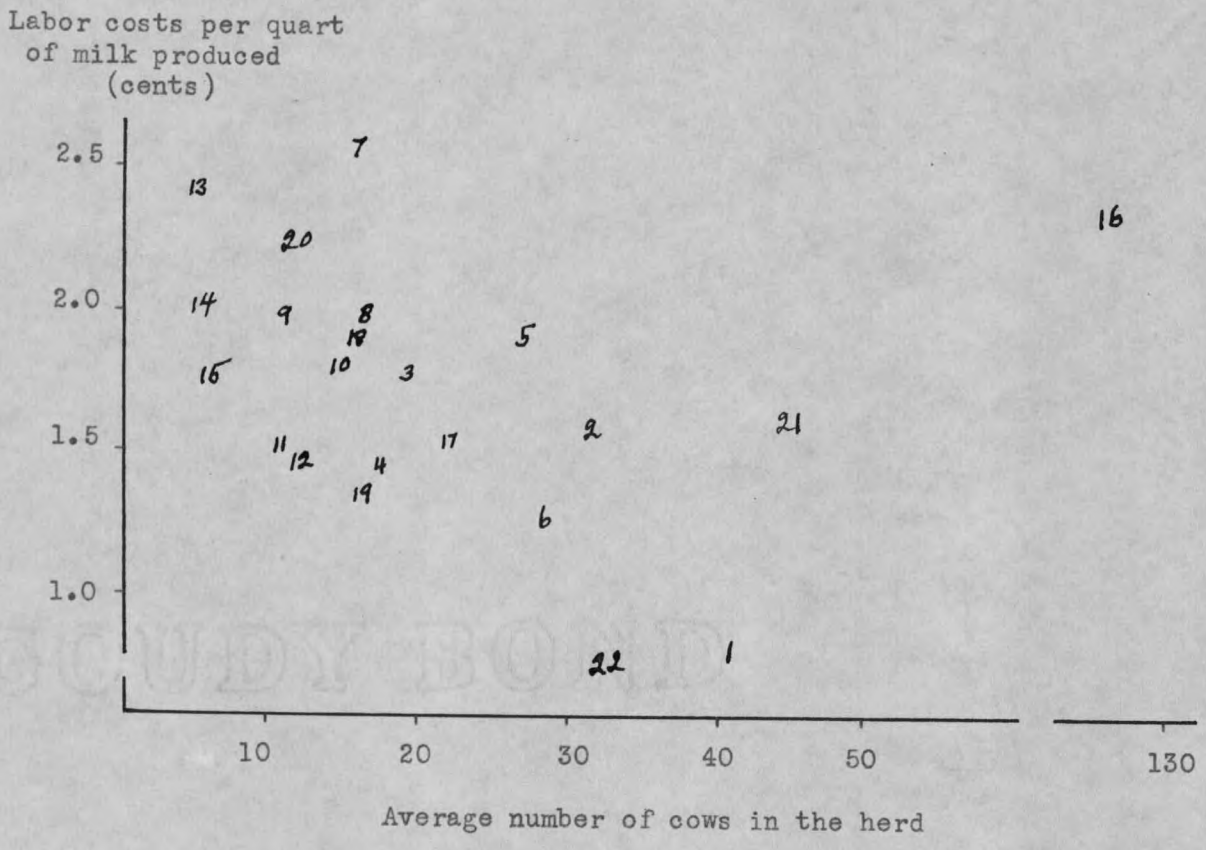

Figure 14. Relation between labor costs per quart of milk produced and, average number of cows in the herd, 22 operators

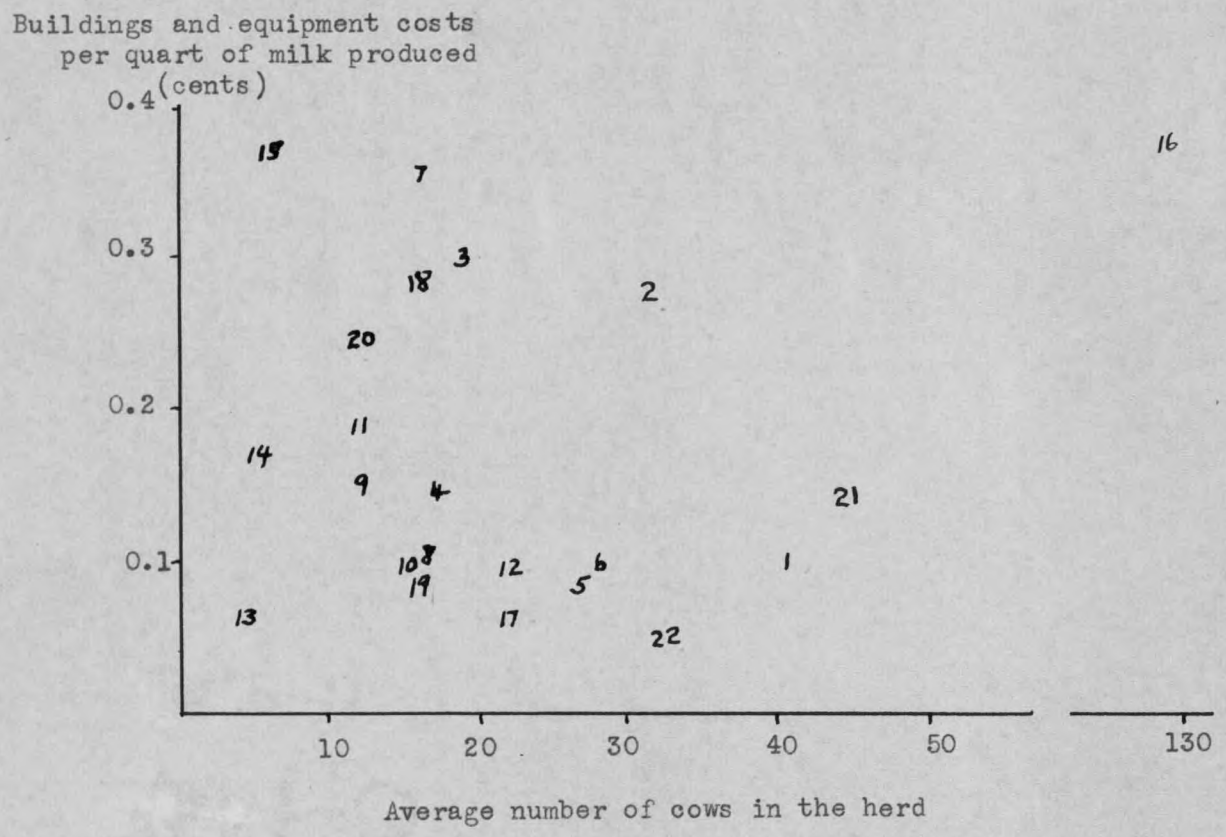

Figure 15. Relation between buildings and equipment costs per quart of milk produced and average number of cows in the herd, 22 operators

the market center had an average cost of 4.03 cents per quart while the 5 operators located less than 3 miles from the market had a cost of 4.18 cents per quart (table VI).

Hauling was the only cost item affected by distance from market. As might be expected, operators farthest from the market center had the highest average hauling costs per quart of milk produced while those near the market had the lowest.

PART III. DISTRIBUTION OF MARKET MILK

Milk distributing plants sell their products in various size of containers ranging from half-pints to gallons. The character of fluid sales of each operator may vary to such an extent that comparing costs only on the basis of either units or quarts would be of limited value. The two measures of volume, (1) units of fluid sales and (2) quart equivalents are used to eliminate this defect and to increase the degree of comparability. To obtain quart equivalents, units are converted into volume in terms of quarts, e.g. four half-pints equal one quart equivalent, one gallon equals four quart equivalents.

Ninety-two per cent of the total unit of fluid sales were sold in half-pint and quart containers. Pint and gallon containers receive limited usuage, accounting for only 8 per cent of the total. The data in table VII show the number of fluid sales sold in each size of container and the per cent each is of the total.

In the calculating of average costs, no distinction is made concerning the type of product making up the total volume of fluid sales. The data in table VIII indicate the proportion of total fluid sales arising from (1) market milk, (2) market cream, (3) chocolate milk, and (4) other products. 16/

16/ Other products include buttermilk, and skim-milk. While other products and chocolate milk involve a higher cost of production, their volume is so small in comparison to the total volume of fluid sales that no effort was made to segregate their costs. Consequently, the higher cost of production of such products is carried by the total volume of fluid sales. The per unit cost of delivery for like-size containers would be the same regardless of the content.

TABLE VII. SALES OF FLUID MILK IN UNITS AND QUART EQUIVALENTS, BY SIZE OF CONTAINER, TOTAL FOR 11 OPERATORS, BILLINGS-LAUREL AREA, 1940

Size of Container	Units		Quart equivalent	
	Number	Per cent	Number	Per cent
Half pint	1,048,436	41.7	262,107	14.2
Pint	132,176	5.3	66,088	3.6
Quart	1,272,538	50.6	1,272,538	69.1
Gallon	60,009	2.4	240,037	13.1
Total	2,513,159	100.0	1,840,770	100.0

TABLE VIII. TOTAL SALES OF FLUID MILK, IN UNITS AND QUART EQUIVALENTS, BY TYPE OF PRODUCT, BILLINGS-LAUREL MARKET AREA, 1940

Product	Operators	Units		Quart equivalent	
		Number	Per cent	Number	Per cent
Milk	11	2,039,460	81.2	1,559,836	84.7
Cream	11	355,271	14.1	203,516	11.1
Chocolate Milk	3	70,704	2.8	22,158	1.2
Other	4	47,724	1.9	55,260	3.0
Total		2,513,159	100.0	1,840,770	100.0

The fluid sales of the 11 operators are divided between wholesale and retail sales. The data in table IX indicate the per cent of the total volume of fluid sales of individual operators that was sold retail and the per cent sold wholesale. An average of 50 per cent of the total units of fluid sales and 55 per cent of the quart equivalents were sold at retail stops and 50 per cent of the total units and 45 per cent of the quart equivalents were sold wholesale. The percentage change between units and quart equivalents is due to the fact that a large number of the wholesale sales were made in half-pint containers.

The 4 distributors, 23, 24, 25, and 26, sold 63.8 per cent of their total units and 60.4 per cent of their quart equivalents wholesale while the producer-distributors sold 18.5 per cent of their total units and 16.0 per cent of their quart equivalents wholesale. The high percentage of their total volume of milk sold wholesale by the distributors may be a factor influencing their costs of distribution as it is normally considered less costly to deliver milk sold wholesale than to the individual consumer because of the larger volume of milk delivered at each stop.

Distribution Costs - Classified

To facilitate analysis, the total costs of each operator have been classified into; (1) plant cost, (2) delivery cost, and (3) administration cost. Plant cost includes all costs incurred from the time the milk enters the plant until it is bottled and ready for delivery. Delivery costs include all costs incurred from the time the market milk products are bottled until they are delivered to the customer. Administration costs include all items that are not specifically included in either of the other two classes of

TABLE IX. RETAIL AND WHOLESALE SALES OF FLUID MILK IN UNITS AND QUART EQUIVALENTS, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Plant No.	Units of Fluid Sales						Quart Equivalents					
	Total		Retail		Wholesale		Total		Retail		Wholesale	
	100 Units	Per cent	100 Units	Per cent	100 Units	Per cent	100 Qt. equivalents	Per cent	100 Qt. equivalents	Per cent	100 Qt. equivalents	Per cent
23	9,015	100	2,744	30.4	6,271	69.6	6,173	100	2,306	37.4	3,867	62.6
24	2,154	100	1,616	75.0	538	25.0	1,539	100	1,154	75.0	385	25.0
25	2,562	100	1,025	40.0	1,537	60.0	1,317	100	527	40.0	790	60.0
26	3,759	100	940	25.0	2,819	75.0	2,813	100	703	25.0	2,110	75.0
16	3,190	100	3,161	99.0	29	1.0	2,736	100	2,729	99.7	7	0.3
17	950	100	630	66.7	315	33.3	814	100	543	66.7	271	33.3
18	420	100	420	100.0	-	-	420	100	420	100.0	-	-
19	548	100	548	100.0	-	-	493	100	493	100.0	-	-
20	278	100	139	50.0	139	50.0	239	100	120	50.0	120	50.0
21	941	100	803	85.3	138	14.7	842	100	805	95.6	37	4.4
22	1,319	100	528	40.0	792	60.0	1,022	100	409	40.0	613	60.0
Total	25,132	100	12,552	49.9	2,580	50.1	8,408	100	10,208	55.45	8,200	44.55
Ave.	2,285	100	1,141	-	1,144	-	1,673	100	928	-	745	-

costs yet are incurred in the operation of the business.

The total distribution costs of the 11 operators are shown in table X. This table also presents the amount and the percentage that each of the three classes of cost - plant, delivery, and administration, are of the total. Among individual operators the percentage of the total cost charged for the individual classes of cost varied as widely relatively as the total cost.

Distributors 23, 24, 25 and 26 had higher and a more uniform percentage of their total cost for plant than the remaining operators. These four operators are distributors who have large plants and maintain a more complete set of equipment, including pasteurizing equipment, than the remaining producer-distributors who do not pasteurize their milk and who have less equipment. The distributors, because of the additional processing, incur additional plant costs.

The average costs and the percentage of the total costs that each of the three classes of cost accounted for were: plant, $2840 or 44.5 per cent; delivery, $2628 or 41.2 per cent; administration, $915 or 14.3 per cent. There was a greater variation in the percentage of the total cost spent for administration than for either plant or delivery.

The data in table XI present for individual operators (1) the total unit cost of distribution, (2) the division of the total unit cost among the different classes of costs, and (3) the average unit cost of distribution for the 11 operators. This same information on a quart equivalent basis is given in table XII.

The average cost of distributing milk was 2.79 cents per unit of fluid

TABLE X. COSTS OF DISTRIBUTING FLUID MILK PRODUCTS BY OPERATORS, BILLINGS-LAUREL MARKET AREA, 1940

Operator	Total costs	Per cent	Plant		Delivery		Administration	
			Amount	Per cent	Amount	Per cent	Amount	Per cent
23	$23,462	100	$11,051	47.1	$9,791	41.7	$2,620	11.1
24	5,159	100	2,475	48.0	1,973	38.2	711	13.8
25	5,163	100	2,446	47.4	2,036	39.4	681	13.2
26	12,731	100	6,371	50.0	4,130	32.5	2,230	17.5
16	7,574	100	3,029	40.0	2,739	36.2	1,806	23.8
17	2,141	100	559	26.1	1,015	47.4	567	26.5
18	2,200	100	743	33.8	1,305	59.3	152	6.9
19	1,529	100	512	33.5	917	60.0	100	6.5
20	1,495	100	489	32.7	800	53.5	206	13.8
21	4,616	100	2,211	47.9	1,870	40.5	535	11.6
22	4,148	100	1,359	32.8	2,335	56.3	454	10.9
Total	70,218	100	31,245	44.5	28,911	41.2	10,062	14.3
Average	6,383	100	2,840		2,628		915	

TABLE XI. COSTS OF DISTRIBUTING FLUID MILK PER UNIT OF FLUID SALES, BY OPERATORS, BILLINGS-LAUREL MARKET AREA, 1940

Operator	Total (cents)	Plant (cents)	Delivery (cents)	Administration (cents)
23	2.60	1.23	1.08	.29
24	2.39	1.15	.91	.33
25	2.01	.95	.79	.27
26	3.39	1.70	1.10	.59
16	2.37	.95	.86	.56
17	2.26	.59	1.07	.60
18	5.24	.77	3.11	.36
19	2.79	.94	1.67	.18
20	5.38	1.76	2.88	.74
21	4.90	2.35	1.99	.56
22	3.14	1.03	1.77	.34
Weighted average a/	2.79	1.24	1.15	.40

a/ Weighted by volume of sales

TABLE XII. COSTS OF DISTRIBUTING FLUID MILK PER QUART EQUIVALENT, BY OPERATORS, BILLINGS-LAUREL MARKET AREA, 1940

Operator	Total (Cents)	Plant (Cents)	Delivery (Cents)	Administration (Cents)
23	3.80	1.79	1.59	.42
24	3.35	1.61	1.28	.46
25	3.92	1.86	1.55	.51
26	4.53	2.27	1.47	.79
16	2.77	1.11	1.00	.66
17	2.63	.69	1.25	.69
18	5.24	1.77	3.11	.36
19	3.10	1.04	1.86	.20
20	6.25	2.04	3.35	.86
21	5.48	2.62	2.22	.64
22	4.06	1.33	2.28	.45
Weighted average a/	3.82	1.70	1.57	.55

a/ Weighted by volume of sales

sales and 3.82 cents per quart equivalent. Among individual operators the unit cost ranged from 2.01 cents to 5.38 cents and the quart equivalent cost ranged from 2.63 cents to 6.25 cents. The four distributors had an average per unit cost of 2.66 cents and a per quart equivalent cost of 3.92 cents. The wide difference between the unit and quart equivalent cost for these operators is due to the large volume of sales made in less than quart-size containers. The seven producer-distributors had a per unit cost of 2.78 cents and a quart equivalent cost of 3.17 cents. A greater proportion of the total fluid sales of these operators was made in quart or gallon-size containers.

Plant, delivery, and administration costs are made up of such items as labor, interest, repairs, depreciation, supplies and bottles. The data in table XIII present the average of these costs for the group of 11 operators. The data in this table also show the average cost both on a unit and a quart equivalent basis and the percentage that each item of cost is of the total cost. Each of these items of cost will be analyzed in an effort to determine their effect on the total cost of distribution.

Factors Affecting Costs of Distribution

The wide variation among individual operators in the cost of distributing milk is caused by differences among operators in such factors as volume, investment, labor, truck operation, depreciation, supplies, repairs, bad debts, bottles and other costs. Analysis of these factors indicating their effect on the total cost should point out why costs vary, the relationships existing between factors, and may assist distributors and producer-distributors in reducing some of their costs.

TABLE XIII. AVERAGE COSTS AND PERCENTAGE OF TOTAL COST PER UNIT OF FLUID SALES AND PER QUART EQUIVALENT, 11 OPERATORS, BILLINGS-LAUREL AREA, 1940

Item of cost	Average cost per unit of fluid sales (cents)	Per cent	Average cost per quart equivalent (cents)	Per cent
Labor	1.39	49.8	1.90	49.9
Truck operation	.33	11.8	.45	11.8
Depreciation	.22	7.9	.30	7.9
Supplies	.15	5.4	.21	5.5
Repairs	.13	4.6	.18	4.7
Bad debts	.10	3.6	.13	3.4
Power and fuel	.10	3.6	.14	3.7
Interest	.08	2.9	.10	2.6
Bottles	.07	2.5	.09	2.4
Insurance	.06	2.2	.09	2.4
Licenses and taxes	.06	2.1	.08	2.1
Miscellaneous	.10	3.6	.14	3.6
Total	2.79	100.0	3.81	100.0

Volume - The volume of fluid milk handled by individual operators furnishing data during the year from November 1, 1939 to November 1, 1940 varied from 27,740 to 901,536 units of fluid sales and from 23,907 to 617,316 quart equivalents (table XIV).

Volume of milk handled has a definite effect on the cost of distributing milk. A definite relationship is indicated between total cost of distribution and volume of milk handled (figures 16 and 17). A volume handled increases, total costs tend to decrease. This relationship is more significant between volume handled and cost per quart equivalent than between volume and cost per unit. Both show a higher degree of relationship when volume handled is less than 150,000 units or quart equivalents. The 5 operators handling over 150,000 units had an average distribution cost per unit of 2.62 cents while the 6 operators handling less than 150,000 units had a cost per unit of 3.62 cents or a 38 per cent higher cost. On a quart equivalent basis the 4 operators handling over 150,000 had a cost of 2.7 cents and the 7 handling under 150,000 had a cost of 2.83 cents, or a cost only 2 per cent higher. The 38 per cent lower cost per unit of the operators handling the large volumes is due mainly to the large proportion of their total sales that were made in less than quart size containers. Operator 25 handling over 150,000 units had less than 150,000 quart equivalents.

The high cost of the operators having less than 150,000 units or quart equivalents was due mainly to their inefficiency in delivering milk. The relationships between delivery costs and volume of milk handled are indicated in figures 18 and 19. These relationships illustrate the same correlative tendency as noted between total costs and volume, only a higher

TABLE XIV. SALES OF FLUID MILK PRODUCTS IN UNITS AND QUART EQUIVALENTS, BY OPERATORS, BILLINGS-LAUREL MARKET AREA, 1940

Operator	Unit of sales		Quart equivalent	
	Number	Per cent	Number	Per cent
23	901,536	35.9	617,316	33.5
24	215,415	8.6	153,917	8.4
25	256,230	10.2	131,674	7.1
26	375,936	14.9	281,334	15.3
16	318,980	12.7	273,597	14.9
17	94,535	3.8	81,395	4.4
18	41,975	1.7	41,975	2.3
19	54,750	2.1	49,275	2.6
20	27,740	1.1	23,907	1.3
21	94,116	3.8	84,186	4.6
22	131,946	5.2	102,194	5.5
Total	2,513,159	100.0	1,840,770	100.0

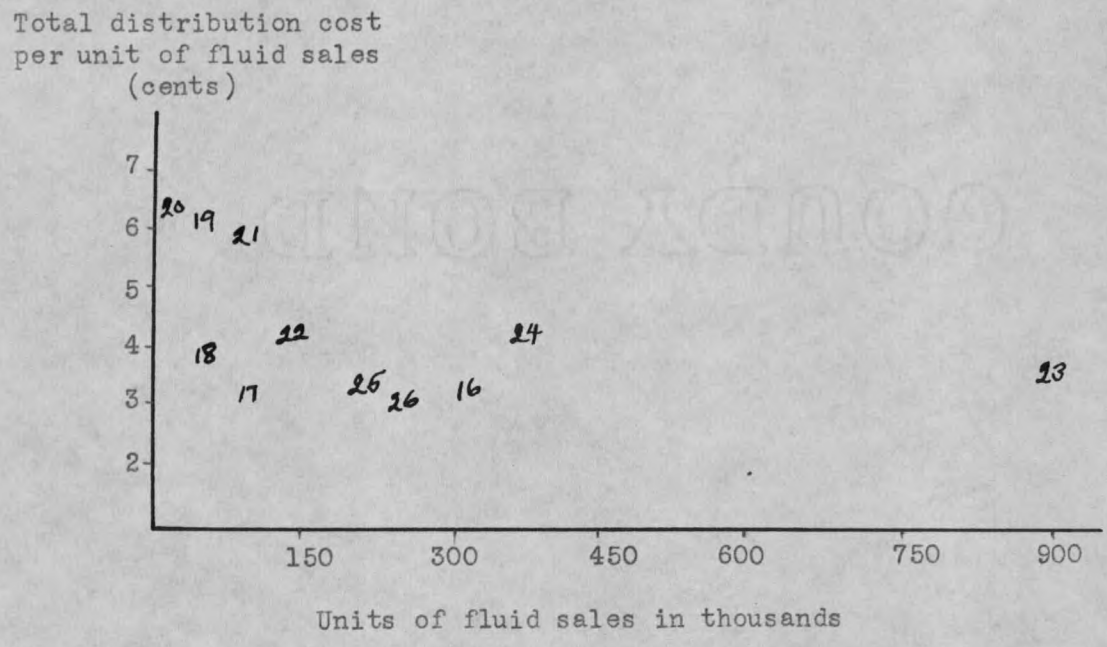

Figure 16. Relation between distribution cost per unit of fluid sales and total units of fluid sales, 11 operators

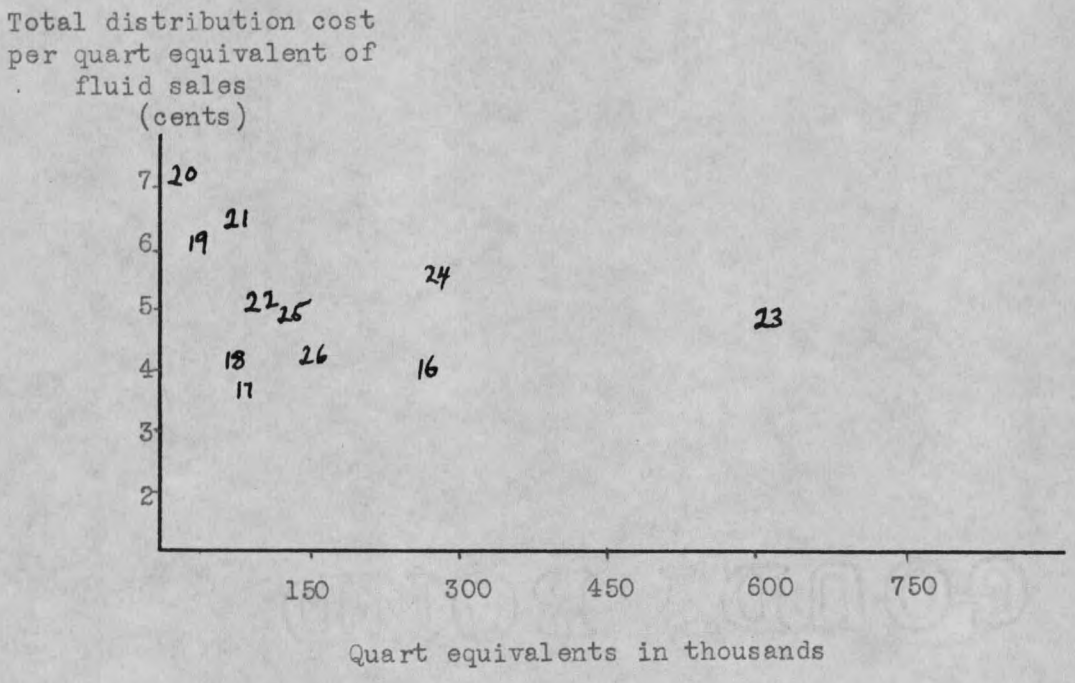

Figure 17. Relation between distribution costs per quart equivalent and total quart equivalents, 11 operators

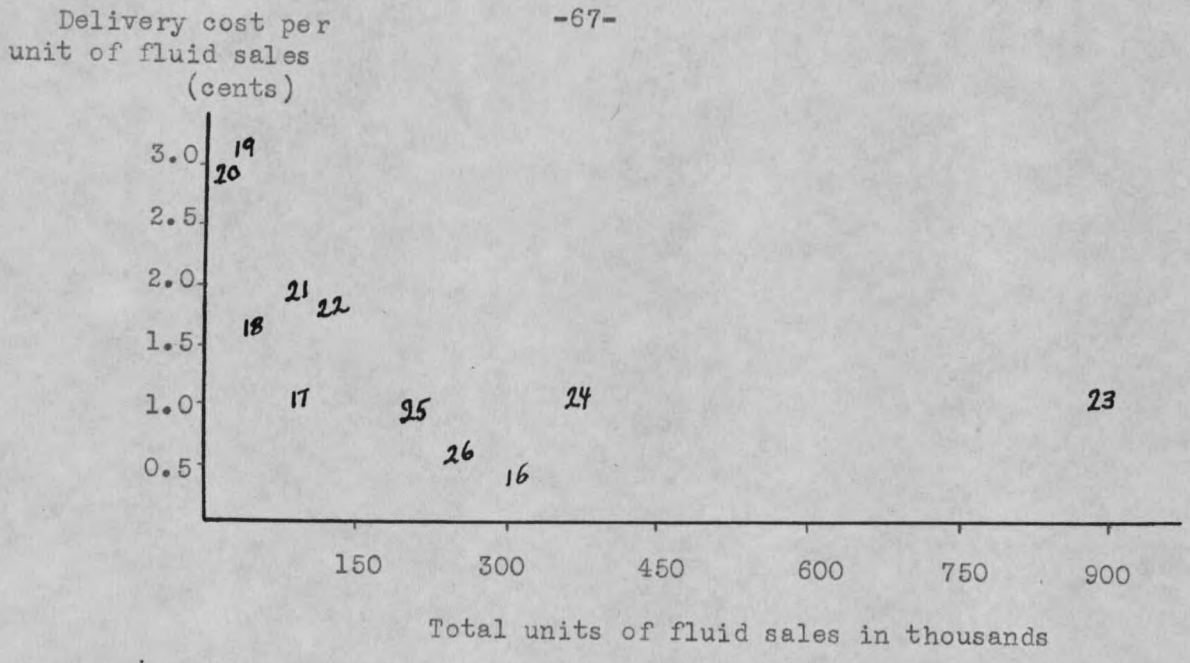

Figure 18. Relation between delivery cost per unit of fluid sales and total units of fluid sales, 11 operators

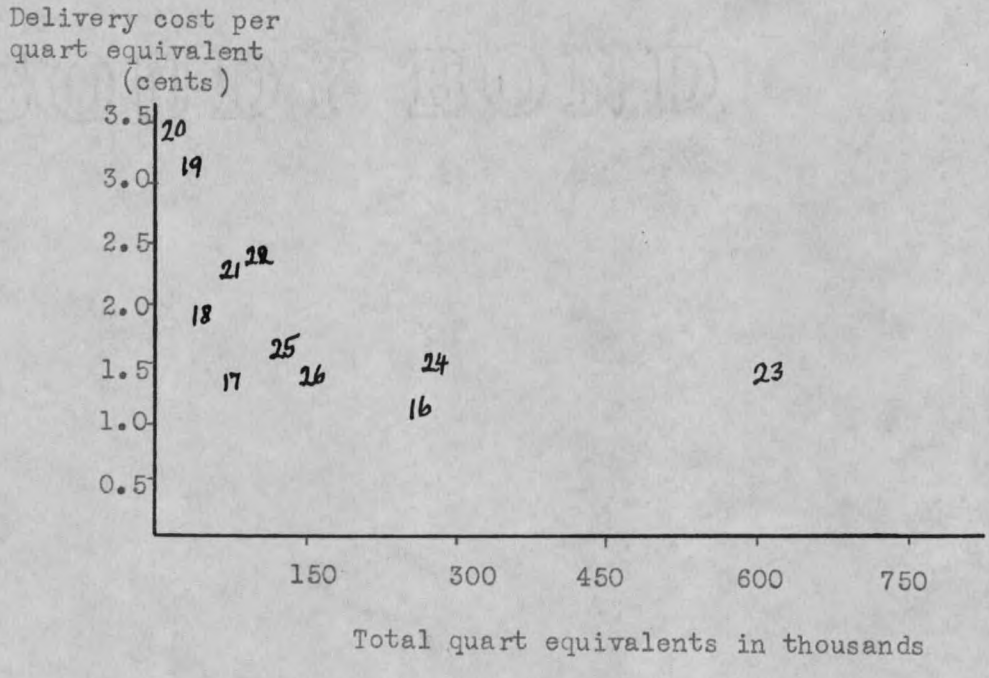

Figure 19. Relation between delivery cost per quart equivalent and total quart equivalent, 11 operators

degree of correlation is present. The average per unit cost of the 5 operators handling more than 150,000 units was one cent compared to an average cost of 1.85 cents incurred by the 6 operators handling less than 150,000 units, an 85 per cent difference in per unit cost. The same comparison on a quart basis is 1.06 cents to 1.28 cents or a difference in cost of 21 per cent. The large proportion of the total fluid sales, handled by the larger operators, sold wholesale account mainly for the difference in the per unit delivery cost between the large and small operators. It is doubtful, however, if wholesale sales account for all of the difference in delivery costs between large and small operators on a unit basis or much of the difference on a quart equivalent basis. Operator number 5 included in the group handling large volumes sold only 5 per cent of his milk wholesale yet has a low delivery cost. It is evident that the operators in this study handling large volumes of milk enjoy at least 15 per cent lower delivery costs because they are able to operate trucks nearer to the optimum capacity than the operators handling small volumes.

No definite relationship is evident between plant costs and volume of milk handled (figures 20 and 21). Any advantage due to volume that may normally be present is apparently offset, in this study, by the higher investment in buildings and equipment, the use of more equipment, and the additional cost of pasteurization incurred by the distributors handling the large volumes.

Volume of milk handled had no effect on the cost of administration (figures 22 and 23). A number of operators handling small volumes of milk did very little if any administrative work.

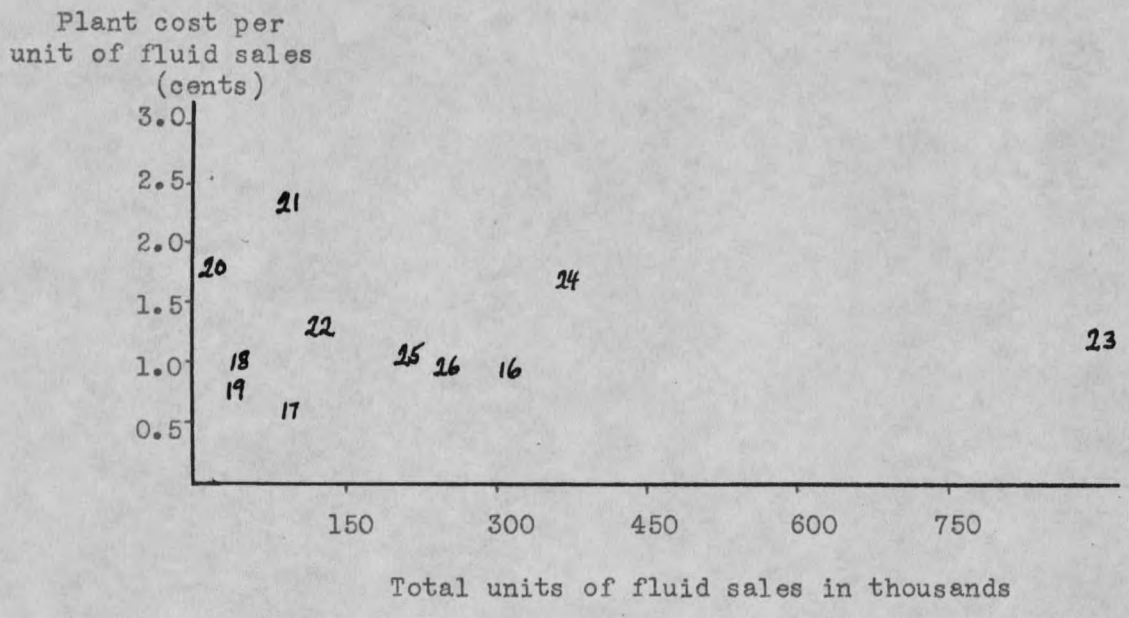

Figure 20. Relation between plant costs per unit of fluid sales and total units of fluid sales, 11 operators

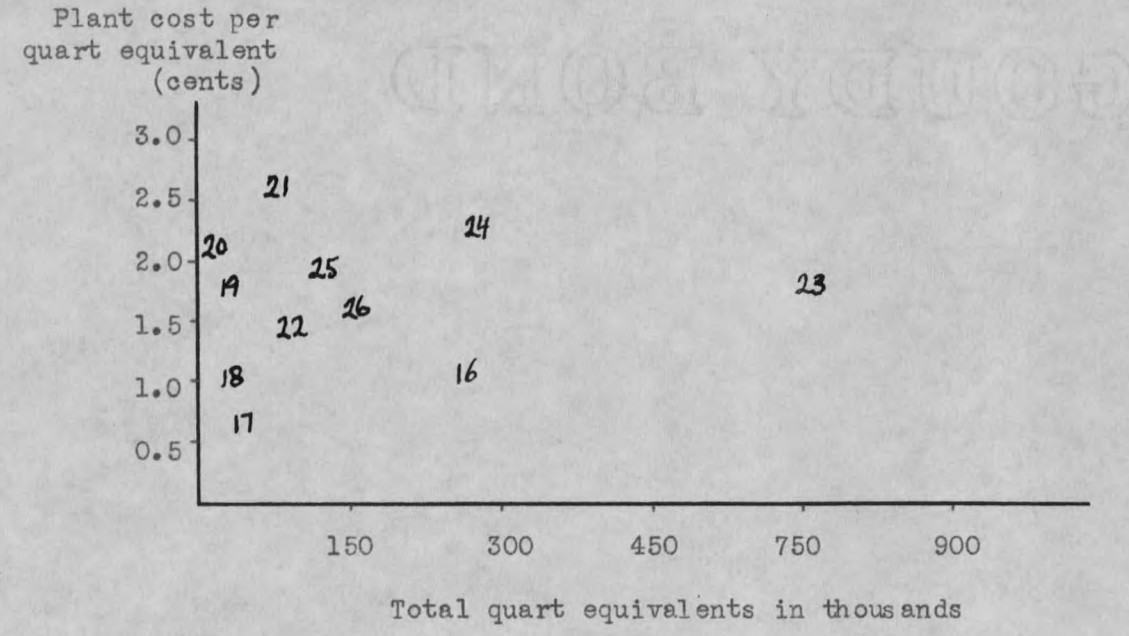

Figure 21. Relation between plant costs per quart equivalent and total quart equivalents, 11 operators

Investment - The total investment is an important factor affecting the cost of milk distribution. The relationships between total investment and the volume of sales are illustrated in figures 22 and 23. In this study, contrary to what is normally expected, investment per unit and per quart equivalent tend to increase as volume handled increases. This relationship between investment and volume of sales becomes more pronounced when shown on a plant investment basis. The 4 distributors have an investment per quart equivalent considerably higher than the producer-distributors. This is due primarily to the larger plants and additional pasteurizing equipment operated by the distributors. Operators handling small volumes, also, do a larger proportion of their work by hand than the operators handling large volumes and consequently, utilize less equipment.

When investment in delivery equipment is related to volume of milk handled the correlation becomes negative, as volume increases investment per unit decreases (figure 24). An explanation of the different relationships existing between plant and volume and delivery equipment and volume, is that operators handling small volume can operate with a minimum of investment in plant and equipment but they are forced to maintain a truck for delivery purposes. The high per unit investment in delivery equipment of operator number 23 is due to the new trucks this operator purchased during the year.

Administration equipment was maintained only by the distributors and producer-distributor number 16 and accounts in part for the higher total investment of the operators handling the large volumes of milk.

Labor efficiency - The cost of labor is the most important single item contributing to the total cost of distribution. The 11 operators had

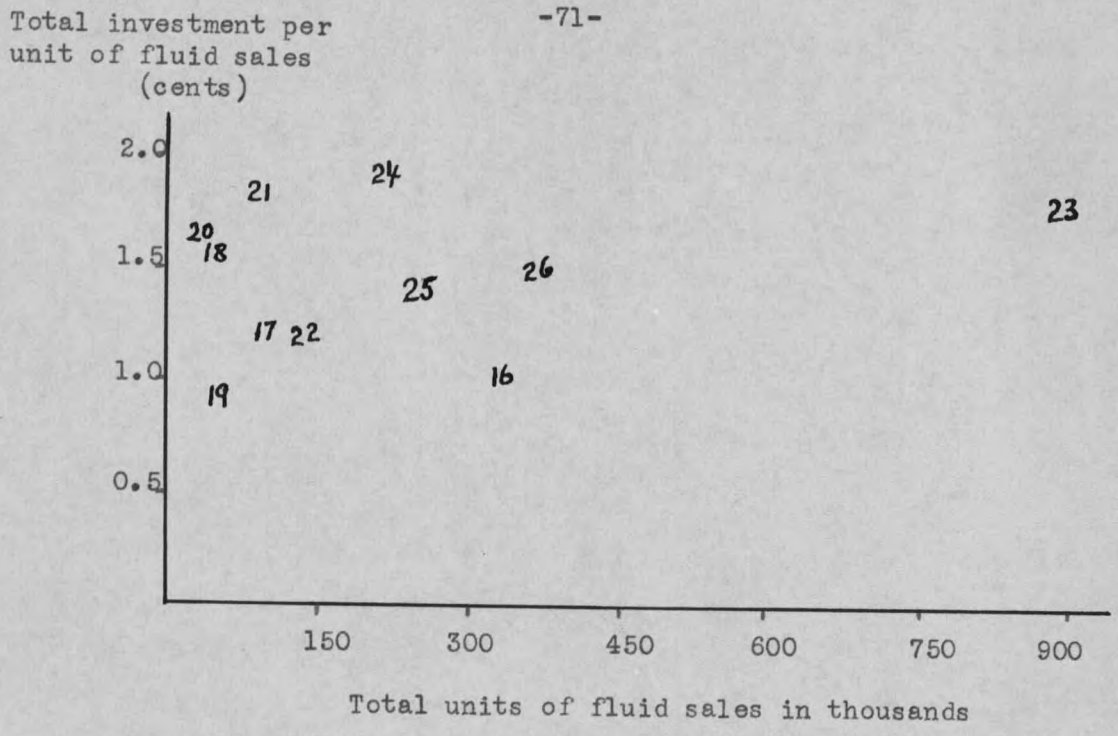

Figure 22. Relation between total investment per unit of fluid sales and total units of fluid sales, 11 operators

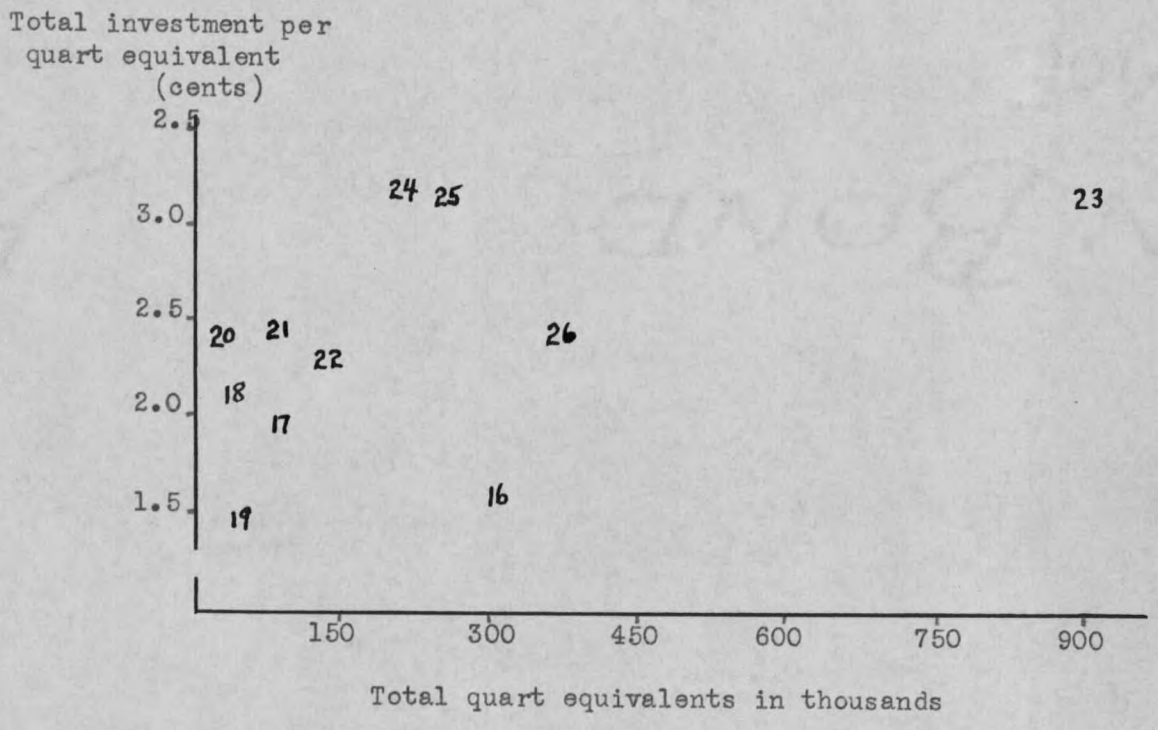

Figure 23. Relation between total investment per quart equivalent and total quart equivalents, 11 operators

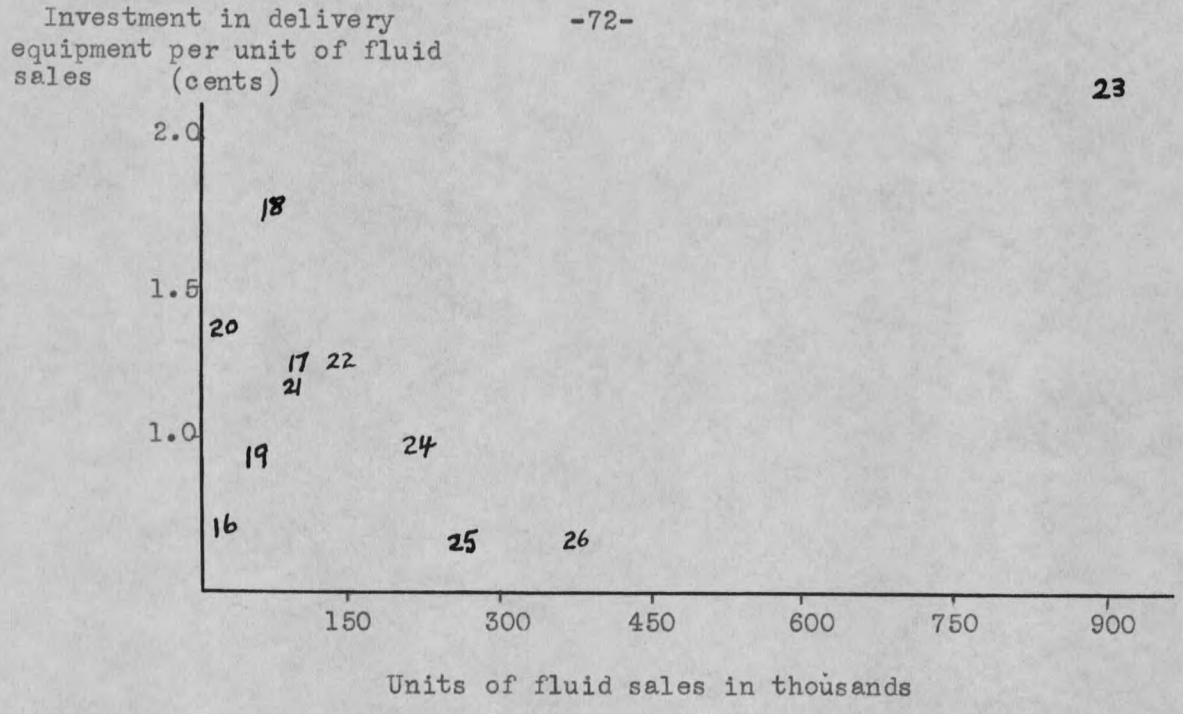

Figure 24. Relation between investment in delivery equipment per unit of fluid sales and total units of fluid sales, 11 operators

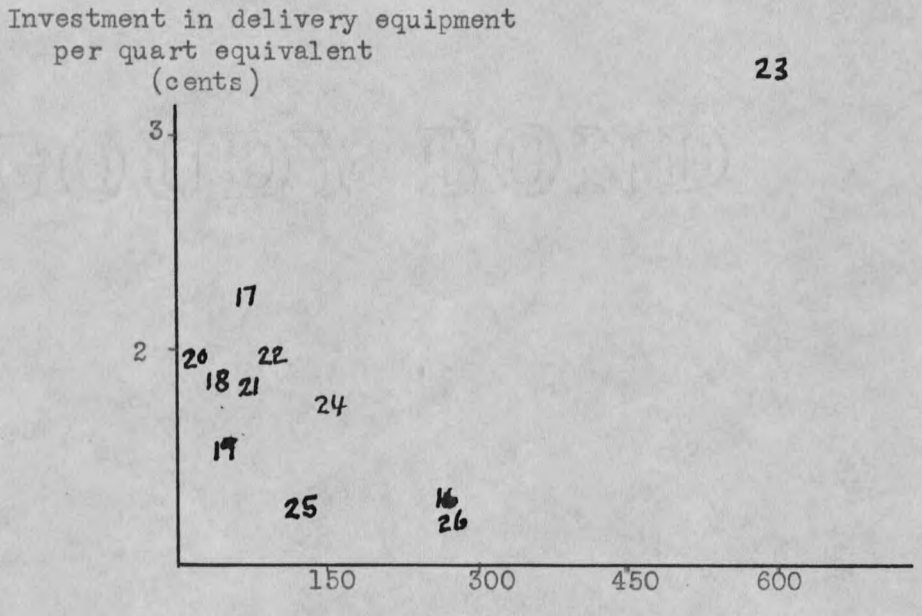

Figure 25. Relation between investment in delivery equipment per quart equivalent and total quart equivalents, 11 operators

an average labor cost of 1.40 cents per unit and of 1.90 cents per quart equivalent, or about 50 per cent of the total cost of distribution. The range among individual operators was from 0.63 cents to 3.25 cents per unit of fluid sales and from 0.74 cents to 3.67 cents per quart equivalent. The wide range existing among operators and the relative importance of this cost item indicates that it is a major cause of the previously noted wide variation among operators in total cost of distribution.

The relationship between labor costs and volume of sales is illustrated in figures 26 and 27. The highest labor costs are associated with the lowest volume of sales and as volume handled increases labor costs tend to decrease. However, after volume handled reaches 150,000 units or quart equivalents, volume handled seems to have little further effect on labor costs.

When relationships are shown between plant labor costs and total volume, and between delivery labor costs and total volume (figures 28 to 31 inclusive), there is indication of negative correlation. As volume increases the cost of labor tends to decrease. While operators handling large volumes of milk have an advantage in labor costs for both plant and delivery costs, their advantage is greater in respect to per unit plant costs. Extreme variations in the cost of labor are present among individual operators handling about the same volume of milk, indicating that factors other than volume are exerting a marked influence on the total cost of labor.

While it may be normally expected that labor costs per unit diminish with an increase in investment per unit, a frequency distribution of these data showing this relationship would be of no value. The

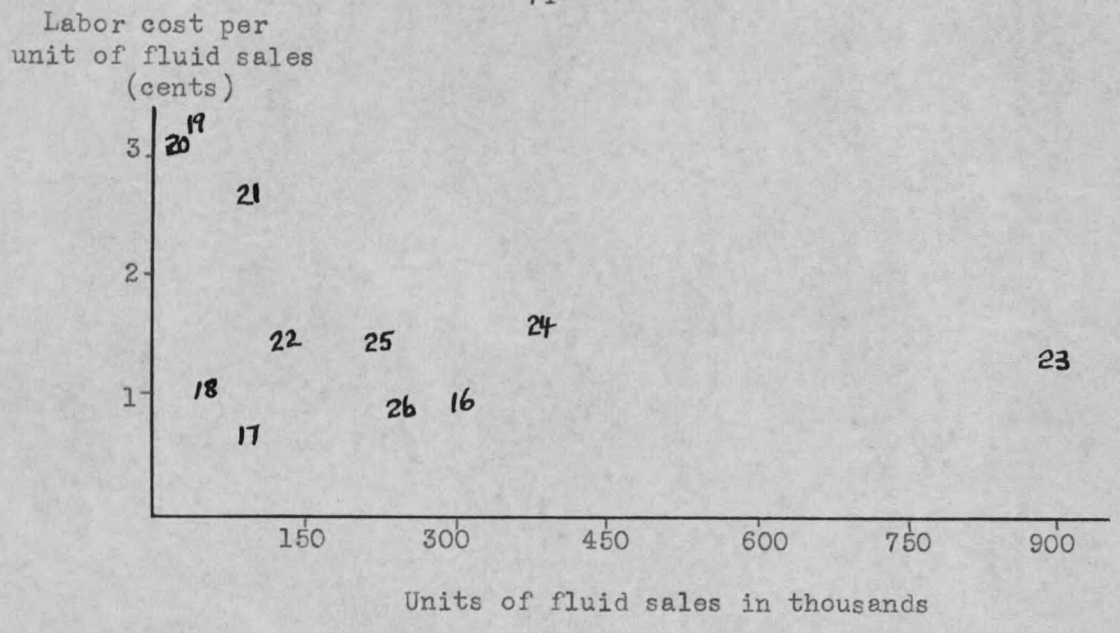

Figure 26. Relation between labor costs per unit of fluid sales and total units of fluid sales, 11 operators

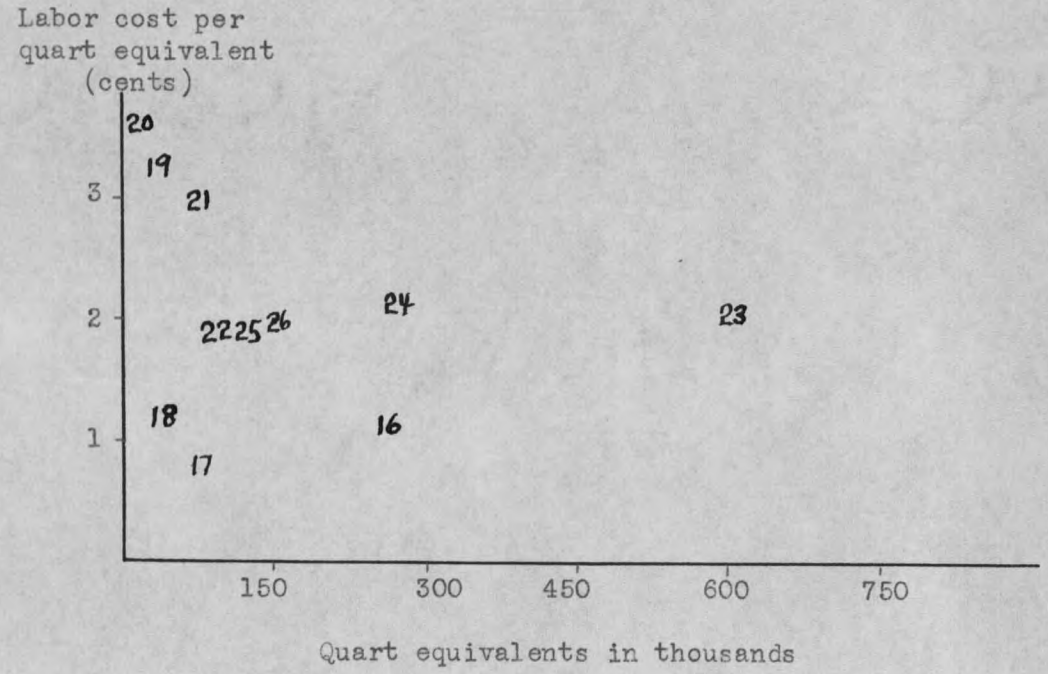

Figure 27. Relation between labor costs per quart equivalent and total quart equivalents, 11 operators

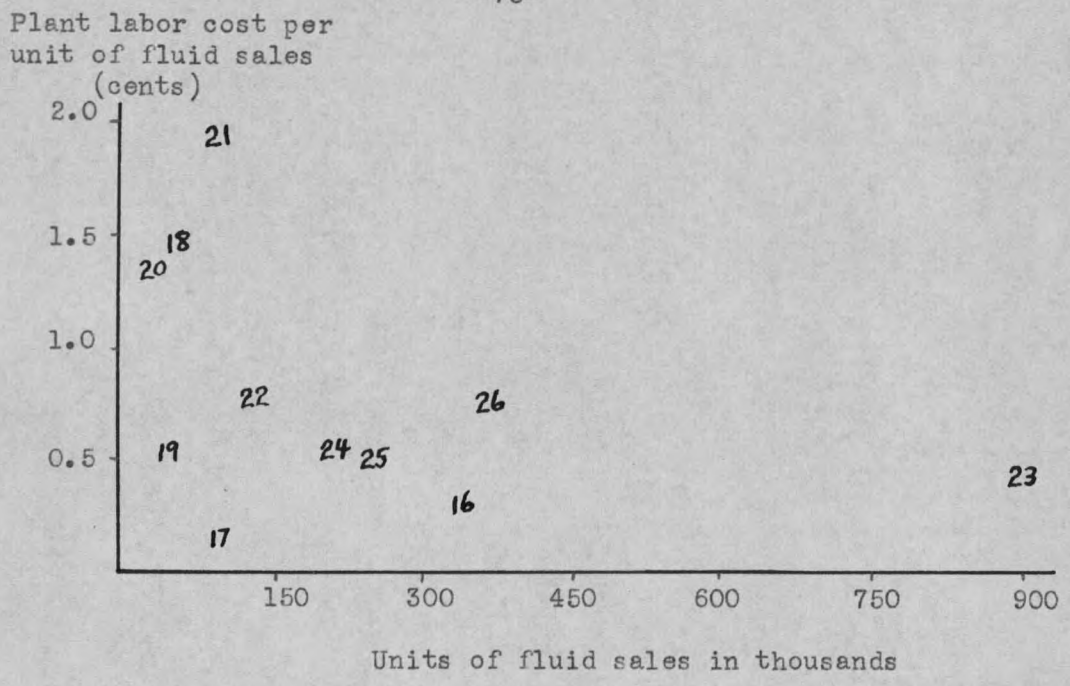

Figure 28. Relation between plant labor costs per unit of fluid sales and total units of fluid sales, 11 operators

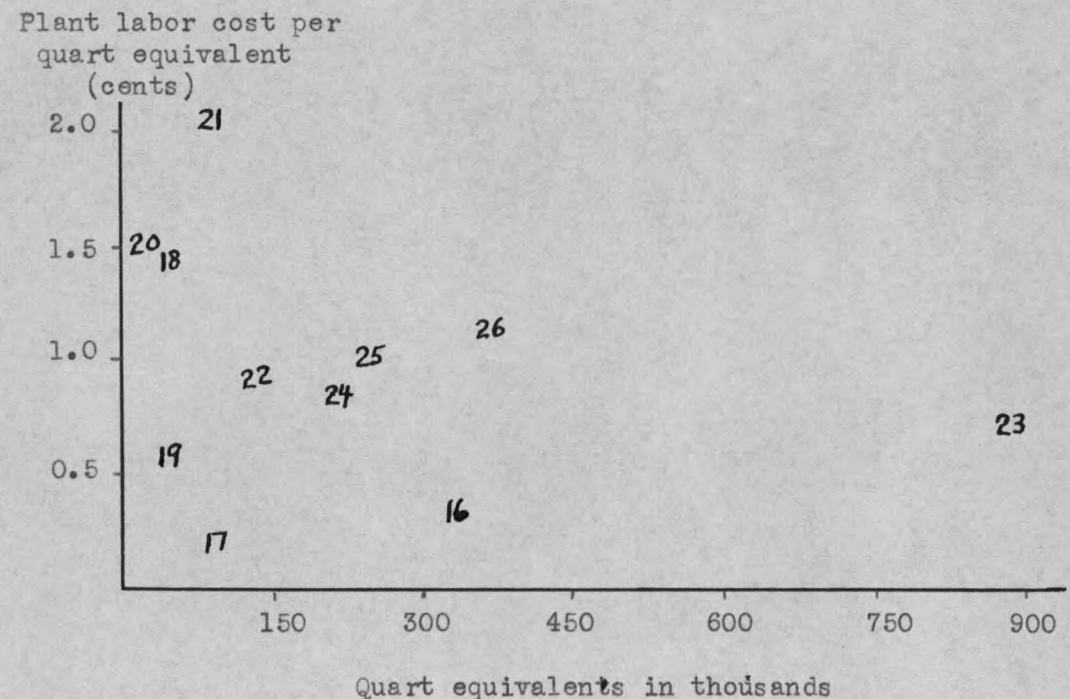

Figure 29. Relation between plant labor costs per quart equivalent and total quart equivalents

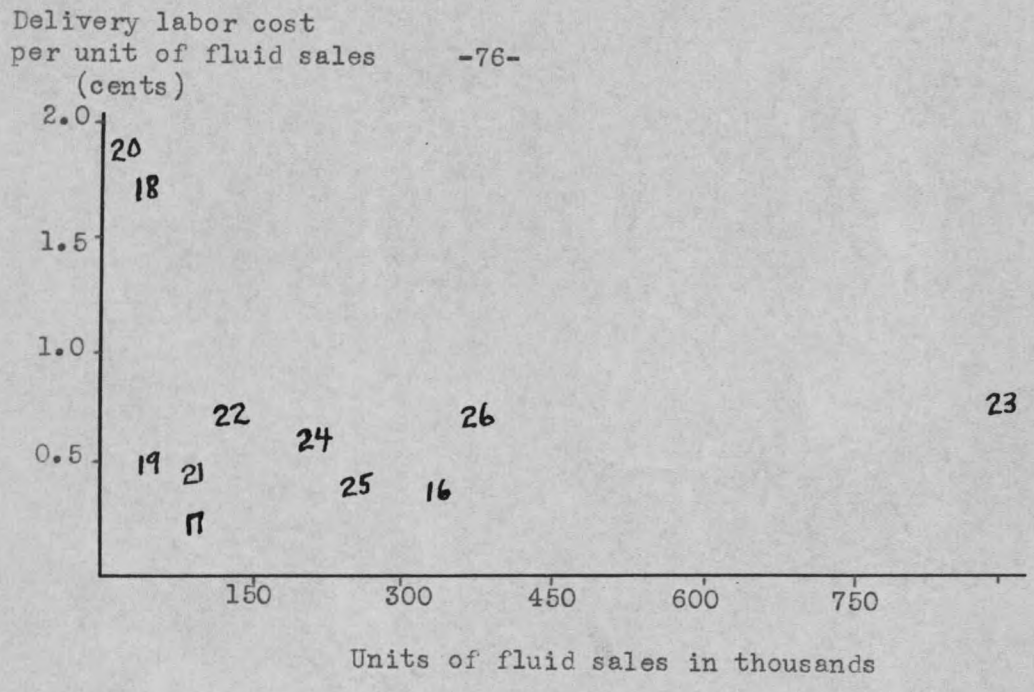

Figure 30. Relation between delivery labor costs per unit of fluid sales and total units of fluid sales, 11 operators

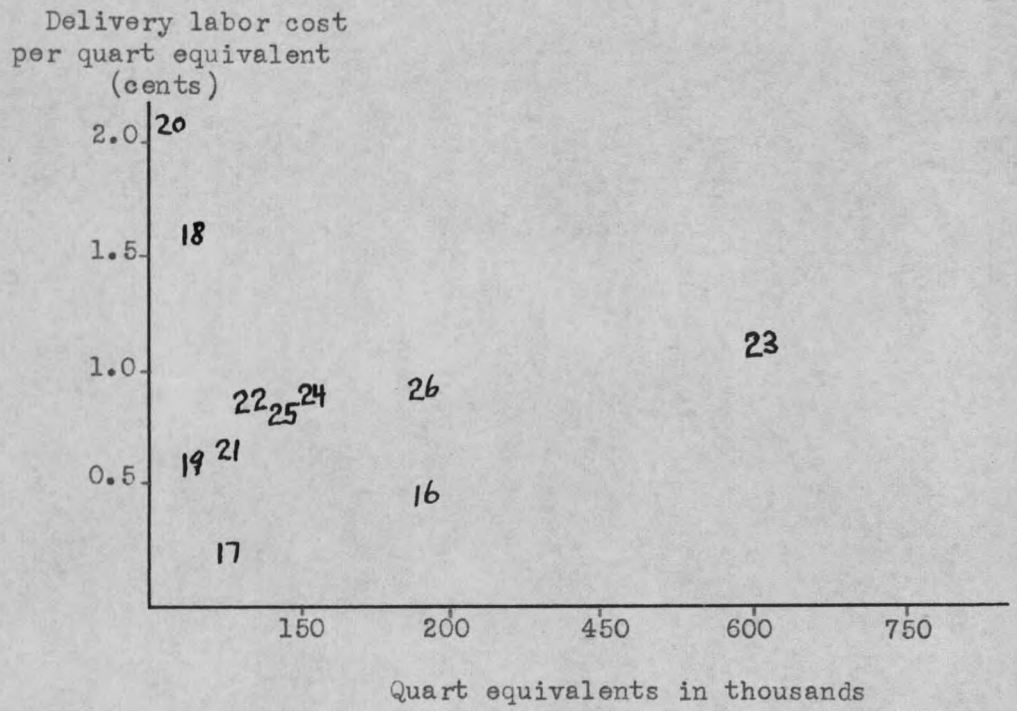

Figure 31. Relation between delivery labor costs per quart equivalent and total quart equivalents, 11 operators

distributors are not on a comparable basis with producer-distributors in this respect due to their investment in pasteurizing equipment and the additional cost of labor they incurred in pasteurizing milk. Two distributors that had higher than average investment per unit had a lower than average per unit labor cost. As these distributors also paid higher than average wages there is some indication that investment in equipment has an effect upon labor cost. It may be that the effect of investment on labor cost depends upon the type of investment as well as upon the amount. Large investments in buildings cannot be expected to increase labor efficiency because buildings alone do not decrease the amount of labor required to handle the milk. Neither can labor costs be decreased when investment is put into equipment which is designed to process fluid sales and which requires additional labor to operate. From a social standpoint, however, it is desirable to distribute a quality product even though to do so requires incurring high labor costs.

The price of labor is another factor that may influence labor costs. The average value of operator's labor was $155 per month. The individual wage rates charged for the 11 operators were as follows: four charged their labor at $100 per month; one, $120; one $175; four, $200; and one $300 per month.

There is no indication of a relationship between the value of operator's labor per month and either the per unit or quart equivalent cost of labor. Two of the operators having the highest wage rates had a per unit labor cost below average, while two of the operators having the lowest wage rates had the highest per unit labor costs. Apparently

the variations in wage rates were offset by variations in individual operator's working efficiency.

Hired labor was employed by eight operators. It was charged at the actual rate paid plus allowances and varied from $65 to $200 per month, depending on the ability and training of the individual worker. A large proportion of the hired labor was employed by the distributors who paid higher average rates than the producer-distributors. Price of hired labor seems to have had no definite effect upon the per unit labor cost. The four distributors paying higher than average wages had per unit labor costs that fluctuated closely about the average for the 11 operators.

Unpaid family labor was utilized by 4 operators and consisted of the labor of the sons and daughters and the wife of the operator. It was usually employed on a part-time basis, washing bottles and bottling the milk. The effect of unpaid family labor upon the per unit cost of labor is difficult to measure because of the small number of operators using family labor. Two of the 4 operators using it, however, had per unit labor costs below average and the other 2 had labor costs above average, indicating that unpaid family labor had little effect on the cost of labor. 17/

Other factors influencing labor efficiency are the type of route maintained by each operator, the design of the delivery truck, and the ability of the driver.

Plants having a high percentage of wholesale trade usually have the largest number of units delivered per stop. One man, on this type

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17/ Operators numbered 23, 16, 18 and 22 used unpaid family labor.

of route, is able to deliver a larger number of units per day than the driver who is forced to cover the entire city, delivering only a small number of units at each stop. The result is, or should be, a lower per unit labor cost because of the less time required per unit. Plants having a high percentage wholesale trade have another advantage over plants delivering direct to the consumer due to the large proportion of wholesale sales made in half-pint size containers. The same truck is capable of delivering a larger number of half-pints than quarts per load which reduces the per unit labor cost when half-pints are handled.

The design of the vehicle used in delivering milk may have an effect on labor efficiency. A number of operators were delivering their milk in touring cars and half-ton trucks with low sides and no top. Trucks designed for delivering milk can haul larger loads than like-size trucks which have no sides or touring cars. The driver can load and unload his truck at the plant more rapidly and with greater ease and has greater accessibility to the bottles of milk while on the route than the driver delivering milk in a vehicle not designed as a milk delivery truck. The previously noted high delivery costs of the operators handling small volumes of milk may in part be attributed to these factors.

The personality and ability of the man on the route is an important factor affecting distribution costs. The man on the route must personally contact the customers and the impression he makes is important in securing and maintaining customers. The driver is, also, instrumental in obtaining the customers' cooperation in returning

bottles and making payments, thus reducing bottle costs and losses from bad debts.

Truck operation - The second largest cost item in distribution was truck operation. The average unit cost of operating the delivery truck was 11.8 per cent of the total cost, or .33 cents per unit of fluid sales and .45 cents per quart equivalent (table XIII).

Volume of milk handled has a marked effect upon the per unit cost of truck operation when volume is below 150,000 units (figure 32). The per unit cost tends to decrease sharply as volume increases to 150,000 units and then remains approximately constant. A truck evidently has an optimum capacity of about 150,000 units. Operating below this capacity increases the per unit cost because the cost of operating a truck is about the same regardless of whether or not the truck is fully or partly loaded.

Additional factors influencing the cost of operating trucks are: (1) volume of milk delivered per mile of route traveled; (2) condition of the roads; (3) size of the truck; (4) adaptability of the truck to the job; (5) efficiency of the truck in respect to the use of gas, oil, tires, etc.; and (6) the care with which the driver operates his truck. 18/

Depreciation - Depreciation costs were third in importance and accounted for 7.9 per cent of the total cost. The weighted average cost

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18/ Armentrout, W. W. and Stilzer, R. O., "Milk-Distribution Costs in West Virginia," West Virginia Agricultural Experiment Station Bulletin No. 270, 1936, pp 24. Allmendinger, Werner, "Bozeman Milk and Cream Distribution," Unpublished Master's Thesis, Montana State College, 1940, pp 64-67.

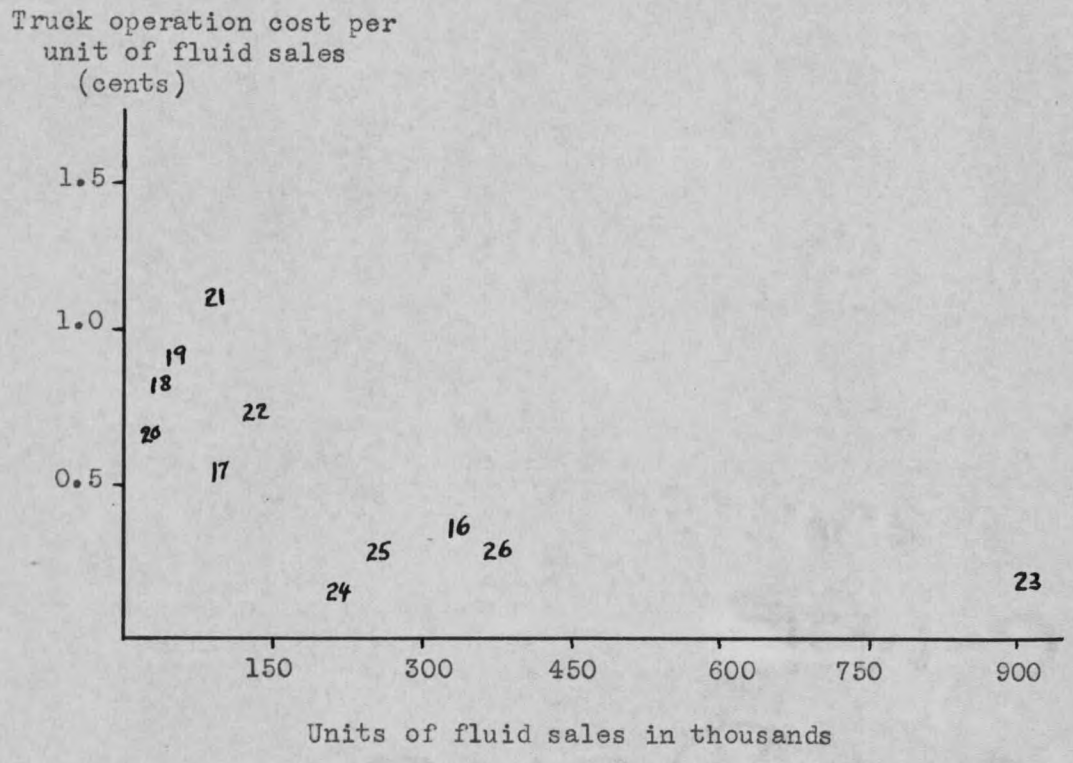

Figure 32. Relation between truck operation cost per units of fluid sales and total units of fluid sales

per unit of fluid sales was .22 cents and per quart equivalent .30 cents.

Depreciation costs are largely dependent upon the value and type of equipment. Some types of equipment have higher depreciation rates than other types and affect costs accordingly. Those operators having relatively large investment in equipment for the volume of milk sold had the highest per unit depreciation costs while operators with low depreciation costs had a smaller investment. A number of operators with small investments used hand methods rather than machinery to do the various types of work connected with distributing milk.

Supplies - Supplies, including the cost of ice, washing powder, disinfecting material, fly sprays, bottle caps, and filters, averaged .15 cents per unit of fluid sales and .21 cents per quart equivalent. Variations among individual distributors were due to such factors as the prices paid, the quantity of supplies used and the kind of equipment operated. Operators handling large volumes of milk were able to obtain price advantages by buying supplies in large quantities.

Equipment used is of special importance, inasmuch as some operators using electric refrigerators have little or no cost for ice. The cost of electricity was included in power and fuel.

Repairs - This item of cost accounted for 4.6 per cent of the total cost of distribution. The average cost per unit of fluid sales was .13 cents and the per quart equivalent cost was .18 cents. The range among individual distributors in the per unit cost was from .15 cents to .20 cents. These variations in cost are due to such factors as age, type

of equipment, investment in equipment per unit of fluid sales, price of repair work, and the care used in handling equipment.

The nature of these factors make them difficult to measure quantitatively. However, general tendencies can be pointed out. Individual pieces of equipment usually require greater expenditures in the way of repairs with advancing age. Trucks and refrigerators are types of equipment which have higher repair costs than bottle racks, cans, and washing tanks. The effect of investment in equipment on repair costs is dependent upon age, type of equipment, and the general repair practice followed by the operator. The cost of repair work is dependent upon the skill and wage of the mechanic and the price of the mechanical parts used. Care in handling is especially important because keeping the machines properly oiled, greased, and operating smoothly can greatly reduce repair bills.

Bad debts - Losses from bad debts amounted to .10 cents per unit of fluid sales and .13 cents per quart equivalent, or about 3.5 per cent of the total cost of distribution. There was a wide variation in this item among individual operators, the range being from zero to .54 cents per unit of fluid sales. This variation is due, to some extent, to the difference in opinion or accounting practice among individual operators as to what constitutes a bad debt.

The producer-distributors incurred larger losses from bad debts than the distributors. This may be due to the producer-distributors greater desire to hold each customer even though he may be a questionable

credit risk. Producer-distributors are likely to be more lenient with collections in order to gain or to keep customers, whereas, large distributors do not value individual customers as highly. 19/

No definite credit policy was followed by the majority of the operators. They depended upon their judgment of the individual customer's credit rating in extending credit. However, during the interview several mentioned the need of an organization which would furnish credit ratings of their customers.

In adopting a policy for the elimination of loss from bad debts, it is desirable to plan the elimination of the loss before credit is given. Good judgment of the customer's credit rating and limiting the amount of credit either on an amount or a time basis are two successful ways used in controlling extension of credit and thereby reducing loss from bad debts. 20/ Use of milk tickets or checks is another method of eliminating losses. When tickets are used, milk is left with a customer only in exchange for a ticket and an empty bottle. The tickets are sold to the customer for cash. 21/ Operator 19, using the ticket method in the Billings market, reported no loss from bad debts.

Bottles - The average cost of bottles per unit of fluid sales was .07 cents or 2.5 per cent of the total cost of distribution. These data show the range in the cost of bottles among individual operators to

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19/ Rinear, Earl H., "Milk Distribution Costs of Producer-Distributors and Subdealers in New Jersey," N. J. Agri. Exp. Sta. Bulletin No. 663, 1939, pp 29-30.

20/ Rinear, Earl H., Op. cit.

21/ Ibid

be from .01 cents to .11 cents per unit of fluid sales.

The average cost of .07 cents for broken and non-returned bottles for these operators is considerably below the weighted average cost of .23 cents which was incurred by dairymen in the Bozeman area during the year 1939. 22/ This is an indication that the operators in the Billings and Laurel area were rather efficient in the use of bottles.

All other - Other costs include power and fuel, interest, licenses, taxes, insurance and telephone. The average cost of these items was .40 cents per unit of fluid sales and .55 cents per quart equivalent or about 14 per cent of the total cost of distribution.

These items are relatively fixed for each operator and can be changed only by fundamental adjustments in the existing enterprise. They are, also, closely related and dependent upon factors that have been previously discussed. Any major changes in such factors would normally be reflected in a change in one or more of these items.

Summary and Conclusions

The market milk products in the Billings-Laurel market area were supplied by producers, producer-distributors, and distributors during 1940. Fifty-seven licensed dairymen were operating in the area. Information concerning the dairy enterprise was obtained from 22 operators producing milk and from 11 operators distributing milk. The volume of milk handled during the year, by individual producers, varied

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22/ Allmendinger, Werner, "Bozeman Milk and Cream Distribution," Unpublished Master's Thesis, Montana State College, 1940, pp 62.

from 12,410 quarts to 304,232 quarts and that handled by individual distributors varied from 27,740 units to 901,536 units.

The average cost of producing market milk was 4.19 cents per quart and the range among individual operators was from 2.78 cents to 5.92 cents. Labor and feed were the largest costs, accounting for 40 per cent and 36 per cent respectively of the total cost. Buildings and equipment accounting for 9 per cent of the total cost, was the next largest cost of producing milk.

The average cost of distributing market milk was 2.79 cents per unit and 3.82 cents per quart equivalent. The range among individual operators in these costs was from 2.01 cents to 5.24 cents per unit and from 2.63 cents to 6.25 cents per quart equivalent. Labor was by far the largest single cost of distributing market milk, accounting for about 50 per cent of the total cost. Truck operation, accounting for 12 per cent and depreciation amounting to 8 per cent of the total cost were the next largest costs.

Important factors causing the higher costs of producing milk were found to be as follows: (1) small production per cow, (2) small volume of milk handled by individual operators during the year, (3) inefficient use of labor, and (4) small number of cows in the herd.

Prominent factors causing the higher costs of distributing milk were: (1) small volume of sales during the year, (2) failure to use equipment to optimum capacity, (3) inefficient use of labor, (4) duplication of services, and (5) lack of a satisfactory credit system.

Many operators are not producing and distributing market milk at the lowest possible costs, largely because they are unaware of existing inefficiencies. Furthermore, the present stabilized price system operating in the market makes it difficult for some operators to expand their output to take advantage of economies in large scale operation. The absence of a competitive price is a factor partially responsible for this situation. Governmentally controlled price systems apparently are not likely to result in economies in production and distribution being passed on to the customer.

Plans to reduce costs of producing and distributing market milk should provide for the following:

1. An increase in the average production per cow by using proven sires, balanced rations, and better care in handling cows.
2. An increase in the scale of operations of some dairymen to attain economies that have been found to be associated with large volume.
3. Improvement in the operation and management of production and distribution plants.
4. Elimination of unnecessarily duplicated services that are present in the market.
5. Economies that may be obtained will result in lower retail milk prices.

TABLE XV. COSTS OF PRODUCING MARKET MILK, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm No.	Total	Feed	Labor	Bldgs. and equip.	Cow depre-ciation	Haul-ing	Assoc. dues, licenses & taxes	Miscel-laneous
	(dols)	(dols)	(dols)	(dols)	(dols)	(dols)	(dols)	(dols)
1	8865	3332	2738	593	1175	300	217	610
2	8310	3225	2828	951	690	86	111	419
3	4704	1387	2220	363	150	365	31	188
4	4109	1474	1585	303	-	452	53	242
5	3937	1433	1699	164	62	365	25	189
6	3956	1464	1500	232	330	272	82	76
7	3157	975	1439	384	95	95	18	151
8	2867	774	1305	142	-	458	44	144
9	2724	654	1361	202	-	360	33	114
10	2396	829	1048	115	200	91	1	112
11	2412	725	1178	287	-	91	15	116
12	1723	509	603	85	-	450	30	46
13	629	252	309	12	-	-	3	53
14	879	318	368	60	80	-	2	51
15	792	311	267	113	-	-	16	85
16	18905	6831	7462	2463	920	-	92	1137
17	4107	1946	1767	126	-	-	20	248
18	2547	766	1264	366	-	-	17	134
19	2105	713	874	100	250	-	26	142
20	1227	246	715	154	30	-	5	77
21	4498	1778	1899	300	101	-	24	396
22	4016	2247	1283	148	10	-	19	309
Total	88965	32189	35712	7663	4093	3385	884	5039
Average	4044	1463	1623	3483	186		40	229

TABLE XVI. FEED COSTS AND PROPORTIONATE DISTRIBUTION OF COSTS OF PRODUCING MARKET MILK, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm No.	Alfalfa	Pct. of total	Pasture and fields	Pct. of total	Succulent feeds	Pct. of total	Concentrates	Pct. of total
1	$ 980	28.3	$ 52	1.5	$306	8.9	$2121	61.3
2	1092	34.7	525	16.7	-	-	1530	48.6
3	516	39.2	272	20.7	-	-	528	40.1
4	432	28.9	216	14.5	45	3.0	799	53.6
5	610	43.2	175	12.4	-	-	626	44.4
6	720	50.9	224	15.8	-	-	470	33.3
7	340	36.6	202	21.7	-	-	387	41.7
8	370	44.2	126	15.1	12	1.4	329	39.3
9	225	33.7	112	16.8	-	-	330	49.5
10	300	36.7	195	23.9	72	8.8	250	30.6
11	346	42.2	75	9.2	-	-	398	48.6
12	300	52.7	40	7.0	38	6.7	191	33.6
13	108	40.7	50	18.9	-	-	107	40.4
14	180	53.9	42	12.6	-	-	112	33.5
15	162	47.8	30	8.8	-	-	147	43.4
16	4291	59.9	333	4.7	-	-	2539	35.4
17	770	38.9	125	6.3	-	-	1084	54.8
18	360	45.0	38	4.7	146	18.3	256	32.0
19	240	34.1	134	19.0	45	6.4	285	40.5
20	186	80.2	38	16.4	-	-	8	3.4
21	540	26.7	150	7.4	240	11.8	1095	54.1
22	1219	53.7	160	7.1	-	-	891	39.2
Total	14287	43.3	3314	10.1	904	2.7	14483	43.9

TABLE XVII. POUNDS OF ALFALFA, CONCENTRATES, AND SUCCULENTS FED PER QUART OF MILK PRODUCED, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm Number	Alfalfa	Concentrates	Succulents
1	.9	.7	2.0
2	2.1	.9	-
3	1.9	.6	-
4	1.4	.8	1.9
5	2.6	.7	-
6	2.1	.5	-
7	2.5	.8	-
8	2.3	.6	1.4
9	1.3	.5	-
10	2.1	.4	2.2
11	1.6	.5	-
12	2.5	.5	3.8
13	2.9	1.0	-
14	4.0	.6	-
15	3.5	1.2	-
16	3.8	.8	-
17	2.0	1.0	-
18	2.4	.4	2.3
19	1.3	.4	.7
20	2.0	.3	-
21	1.6	.5	1.0
22	3.9	.6	-
Average	2.2	.7	.7

TABLE XVIII. HOURS OF LABOR UTILIZED PER COW AND QUARTS OF MILK PRODUCED PER HOUR OF LABOR SPENT, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm Number	Hours	Hours of labor per cow	Quarts of milk produced per hour
1	10,800	263	28.2
2	7,332	229	23.7
3	7,200	379	12.3
4	5,157	303	20.4
5	5,100	189	18.0
6	3,600	128	31.6
7	4,860	304	11.1
8	5,616	330	11.6
9	7,200	600	9.4
10	2,916	194	19.5
11	7,758	646	9.6
12	1,554	130	25.4
13	1,236	247	10.0
14	1,437	287	12.4
15	1,200	200	12.7
16	36,000	286	8.9
17	5,400	245	20.5
18	5,100	319	12.5
19	1,800	112	34.7
20	4,290	357	7.3
21	13,080	291	8.7
22	4,980	151	29.0
Total	143,616		
Average		269	14.8

TABLE XIX. INVESTMENT IN COWS AND BUILDINGS AND EQUIPMENT, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm No.	Investment in Cows			Investment in Bldgs. & Equipment		
	Total	Per cow	Per quart	Total	Per cow	Per quart
1	9,250	226	3.04	4,613	113	1.52
2	3,250	102	2.45	4,265	133	2.45
3	1,295	68	1.46	2,357	124	2.66
4	1,275	75	1.21	2,486	146	2.36
5	1,350	50	1.47	986	36	1.07
6	2,850	102	2.50	1,209	43	1.06
7	1,600	100	2.97	2,722	170	5.06
8	1,360	80	2.09	919	54	1.41
9	1,150	96	1.71	868	72	1.29
10	900	60	1.59	913	61	1.61
11	900	75	1.21	701	58	.94
12	900	75	2.28	390	33	.99
13	300	60	2.42	82	16	.66
14	560	80	3.14	518	74	2.90
15	450	75	2.95	943	157	6.18
16	10,080	80	3.16	12,706	101	3.98
17	1,575	72	1.42	987	45	.89
18	990	62	1.55	60	4	.09
19	1,380	86	2.21	950	59	1.51
20	1,020	85	3.24	461	38	1.46
21	3,338	74	2.94	1,396	31	1.23
22	2,345	71	1.63	730	22	.51
Total	48,118			41,252		
Ave.		90	2.26		77	1.94

TABLE XX. LABOR COST PER UNIT OF FLUID SALES AND PER QUART EQUIVALENT, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Plant	Cost Per unit of fluid sales				Cost per quart equivalent			
	Total	Plant	Delivery	Administration	Total	Plant	Delivery	Administration
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
23	1.37	.50	.70	.17	2.00	.74	1.02	.24
24	1.42	.59	.59	.23	1.99	.83	.83	.33
25	0.96	.49	.40	.07	1.86	.95	.78	.13
26	1.64	.79	.64	.21	2.19	.106	.86	.27
16	.96	.31	.38	.27	1.12	.36	.44	.32
17	.63	.21	.21	.21	.74	.25	.25	.25
18	3.25	1.43	1.67	.15	3.25	1.43	1.67	.15
19	1.09	.51	.51	.07	1.22	.57	.57	.08
20	3.16	1.29	1.80	.07	3.67	1.50	2.09	.08
21	2.70	1.90	.46	.34	3.02	2.13	.51	.38
22	1.48	.72	.68	.08	1.92	.94	.88	.10
Weighted Average a/	1.40	.61	.61	.18	1.90	.83	.83	.24

a/ Weighted by volumes of fluid sales.

TABLE XXI. HOURS OF LABOR UTILIZED IN DISTRIBUTING MARKET MILK AND VOLUME HANDLED PER HOUR, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Farm No.	Hours	Volume handled per hour	
		Units	Quart Equivalents
23	15,120	60	41
24	6,672	32	23
25	5,760	44	23
26	10,320	36	27
16	4,320	74	63
17	3,392	28	24
18	1,440	29	29
19	1,440	38	34
20	2,280	12	11
21	3,312	28	25
22	6,672	20	15
Total	60,728		
Ave.		41	30

TABLE XXII. INVESTMENT PER UNIT OF FLUID SALES AND PER QUART EQUIVALENT, BY OPERATORS, BILLINGS-LAUREL AREA, 1940

Plant No.	Total Investment			Plant Investment			Delivery Investment			Office Investment		
	Amount	Per Unit	Per Qt. Equivalent	Amount	Per Unit	Per Qt. Equivalent	Amount	Per Unit	Per Qt. Equivalent	Amount	Per Unit	Per Qt. Equivalent
	Dollars	Cents	Cents	Dollars	Cents	Cents	Dollars	Cents	Cents	Dollars	Cents	Cents
23	16,141	1.79	2.61	14,064	1.56	2.28	1,827	.21	2.96	250	.03	.04
24	4,055	1.88	2.63	2,903	1.35	1.88	1,027	.48	.67	125	.05	.08
25	3,433	1.34	2.61	3,057	1.19	2.32	326	.13	.25	50	.02	.04
26	5,403	1.44	1.92	4,695	1.25	1.67	575	.15	.20	133	.04	.05
16	3,114	.98	1.14	2,382	.75	.87	642	.20	.24	90	.03	.03
17	1,158	1.22	1.42	457	.48	.56	701	.74	.86	-	-	-
18	668	1.59	1.59	126	.30	.30	542	1.29	1.29	-	-	-
19	481	.88	.98	245	.45	.50	236	.43	.48	-	-	-
20	464	1.67	1.94	228	.82	.95	236	.85	.99	-	-	-
21	1,677	1.78	1.99	1,047	1.11	1.24	630	.67	.75	-	-	-
22	1,712	1.30	1.68	706	.54	.69	1,006	.76	.99	-	-	-
Total	38,306			29,910			7,748			648		
Ave.		1.52	2.08		1.19	1.62		.30	.42		.02	.03

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LITERATURE CITED AND CONSULTED

Allmendinger, Werner, Bozeman Milk and Cream Distribution, Unpublished Master's Thesis, Montana State College, 1940

Allmendinger, Werner, Cost of Bozeman Milk and Cream Distribution, Montana State Agri. Exp. Sta., Mimeo., Cir. No. 26, 1940

Armentrout, W. W., and Stelzer, R. O., Milk Distribution Costs in West Virginia, West Virginia Agricultural Experiment Station Bulletin No. 270, 1936

Bartlett, R. W., Prices and Consumption of Milk in Specific Cities, As Related to Industrial Payrolls and Other Economic Factors, University of Illinois Agri. Exp. Sta. Bul. No. 397, Jan. 1934

Bartlett, R. W., Increasing the Consumption of Milk, Dept. of Agri. Economics, Extension Service, Univ. of Illinois, A.E. 986, 1938

Bartlett, R. W., Some Consumption Studies, Extension Service Univ. of Illinois, A. E. 1265, 1939

Bartlett, R. W., St. Louis Milk Problems with Suggested Solutions, Univ. of Illinois Agri. Exp. Sta. Bul. No. 412, 1935

Blanford, C. J., An Analysis of Dealers' Sales of Milk and Cream in the New York Market, 1933-1938, Cornell Univ. Agri. Exp. Sta., Bul. No. 735, 1940

Blanford, C. J., The Milk Supply for the New York Market, Cornell Ext. Bul. No. 396, New York State College of Agri. at Cornell Univ. 1938

Carter, E. G., Clean Milk and Its Production, Utah Agri. Exp. Sta., Logan, Utah, Circular 29, 1928

Catherwood, M. P., A Statistical Study of Milk Production for the New York Market, Cornell Univ. Agri. Exp. Sta., Bul. No. 518, 1931

Cooperative Dairy Marketing Conference, Abstracts of Papers Given at Cooperative Dairy Marketing Conference, University of Illinois, A.E. 1324, January 1940

Dow, George F., An Economic Study of Milk Distribution in Maine Markets, Maine Agri. Exp. Sta. Bul. No. 395, March 1939

Dow, George F., An Economic Study of Milk Production Costs in Herds of Producer-Distributors in Maine, Maine Agri. Exp. Sta. Bul. No. 385, 1936

Ezekiel, M. J. B., McNall, P. E., and Morrison, F. G., Practices Responsible for Variations in Physical Requirements and Economic Cost of Milk Production on Wisconsin Dairy Farms, Wis. Research Bul. 79, 1927

Herrmann, L. F., Stelzer, R. O., and Bowling, G. A., Milk-Production Costs in West Virginia, I. A Study of the Costs Incurred by 51 Farms in the Morgantown and Fairmont Markets in 1934-35,

Herrmann, L. F., Milk-Distribution Costs in West Virginia, III. A Study of the Costs Incurred by 67 Producer-Distributors in the Charleston, Huntington, and Parkersburg Markets for a Twelve-Month Period During 1935-36, W. Va. Agri. Exp. Sta. Bul. No. 282, 1937

Jensen, Einar, Determining Input-Output Relationships in Milk Production, Feed Input and Milk Output Preliminary Results, Farm Management Reports - No. 5, U. S. Dept. of Agriculture Publication, 1940

Johnson, S. E., Tretsven, J. O., Ezekiel, Mordecai and Wells, O. V., Organization, Feeding Methods and Other Practices Affecting Returns on Irrigated Dairy Farms in Western Montana, Mont. Agri. Exp. Sta. Bul. No. 264, 1932

Maxton, J. L., and Taylor, C. C., Marketing Fluid Milk in Four Virginia Cities, Va. Agr. Exp. Sta. Bul. No. 275, 1930

Montana Livestock Sanitary Board, Livestock Sanitary Laws of Montana, Vol. 1, No. 9, 1927

Montana Milk Control Board, Law, House Bill No. 201, Helena, Montana, 1939

Nixon, A. J., and Reed, O. M., Municipal Milk Distribution In Tarboro, North Carolina, U. S. Dept. of Agr., Marketing Information Series, DM-5, 1938

Parsons, Merton S., Effect of Changes in Milk and Feed Prices and in Other Factors Upon Milk Production in New York, Cornell Univ. Agri. Exp. Sta. Bul. No. 688, 1938

Pond, G. A., and Ezekiel, Mordecai, Factors Affecting the Physical and Economic Cost of Butterfat Production in Pine County, Minnesota., Minn. Agr. Exp. Sta. Bul. No. 270, 1930

Rinear, Earl H., Milk Distribution Costs of Producer-Distributors and Subdealers in New Jersey, New Jersey Agri. Exp. Sta. Bul. 663, 1939

Stelzer, R. O., and Thurston, L. M., Milk-Distribution Costs in West Virginia I. A study of the Costs Incurred by 22 Plants During 1933, Agri. Exp. Sta. of W. Va. Bul. No. 266, 1935

Tinley, J. M., An Analysis of the Fresno Milk Market, Univ. of Calif. Agr. Exp. Sta. Bul. No. 559, 1933

Tolley, H. R., Black, J. D., and Ezekiel, M. J. B., Input as Related to Output in Farm Organization and Cost of Production Studies, U. S. Dept. of Agri. Bul. No. 1277, 1924

U. S. Dept. of Agr., A Survey of Milk Marketing in Milwaukee, Marketing Information Series DM-1, 1937

Waite, Warren C. and Howe, Charles B., The Consumption of Dairy Products in Six New Jersey Townships, N. J. Agr. Exp. Sta., Bul. No. 506 1930

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