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Arizona Milk Production Costs



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Arizona Milk Production Costs

by

Leo J. Moran and Wallace R. Greene¹

INTRODUCTION

This bulletin reports the results of a survey in 1958 of Arizona milk producers to determine the cost of producing milk and how this cost is influenced by size of dairy and production per cow.

Purpose of Study

No previous cost study has been made in a way that would be representative of the Arizona milk producing industry. There was, therefore, a need to describe this important Arizona industry in order that the dairymen and those working closely with them might better understand the industry's problems.

Information about the cost of producing milk in Arizona is useful to individual dairymen as a yardstick for measuring the efficiency of their own operations. Of particular significance are the component parts which make up total production costs. The dairyman can make comparisons between the results of this study and his own records to see how he stands on such items as labor or feed expense, or how his investment per cow stacks up with other dairies in the state. Milk production costs are also needed by financing agencies, extension personnel and others who must be able to budget out dairy operations in their dealings with dairymen.

The cost of producing milk was determined for various groups of dairies. These were classified by herd size and by production per cow to illustrate the effects of these factors on production costs.

The objectives of this study, then, are to:

- 1. Describe the Arizona milk producing industry**
- 2. Determine the cost of producing milk in Arizona**
- 3. Demonstrate the effects of herd size and production per cow on cost of milk production**

¹ Assistant Professor and former graduate student, University of Arizona, respectively.

Source of Data

Most of the data needed were gathered by a 1958 survey of Arizona dairymen. The information was gathered by personally interviewing dairy owners and managers. The sample of dairies to be included was drawn randomly from a list of dairymen delivering milk under the Central Arizona Federal Milk Marketing Order in December, 1957. Ninety dairies, or 20 per cent of the total of 451, were drawn and 73 completed schedules were obtained (Table 1). Unless otherwise specified, all analyses reported here are based on these schedules. Information available on the nonrespondents indicates that their omission caused no serious bias in the cost estimates of this study.¹

Table 1. Distribution of Dairies Delivering Milk Under the Central Arizona Federal Milk Marketing Order in December, 1957, Dairies Included in Sample, and Dairies for which Schedules were Completed by County.

County	No. of Dairies	Dairies in Sample	Completed Schedules
Maricopa	368	76	62
Cochise	19	1	1
Graham	16	7	5
Yuma	13	2	1
Pinal	12	2	2
Pima	9	1	1
Yavapai	8	1	1
Navajo	3	—	—
Greenlee	2	—	—
Santa Cruz	1	—	—
Total	451	90	73

The milk production information needed to complete the analyses was obtained from the office of the market administrator, Central Arizona Federal Milk Market Order 104, through the cooperation of Wilson M. Haverfield and George Gerber, administrator and assistant administrator, respectively, of that office. Institutional restrictions prevented the release of delivery figures for individual dairies from the administrator's office, but it was possible to have the classification and group averages necessary for the success of this study compiled within the office.

ARIZONA DAIRYING

Milk production in Arizona is still primarily for fluid milk consumption, although there has been a marked trend toward producing more milk than is needed for this purpose in recent years. Since the creation of Federal Order 104, which controls about 90 per cent of Arizona milk production, the surplus milk (class II milk) has increased relative to total milk production. In 1956 some 10.4 per cent of the milk produced under the order was diverted to class II usage. By 1959 this percentage had reached 21.7 per cent. During this same 1956-59 period

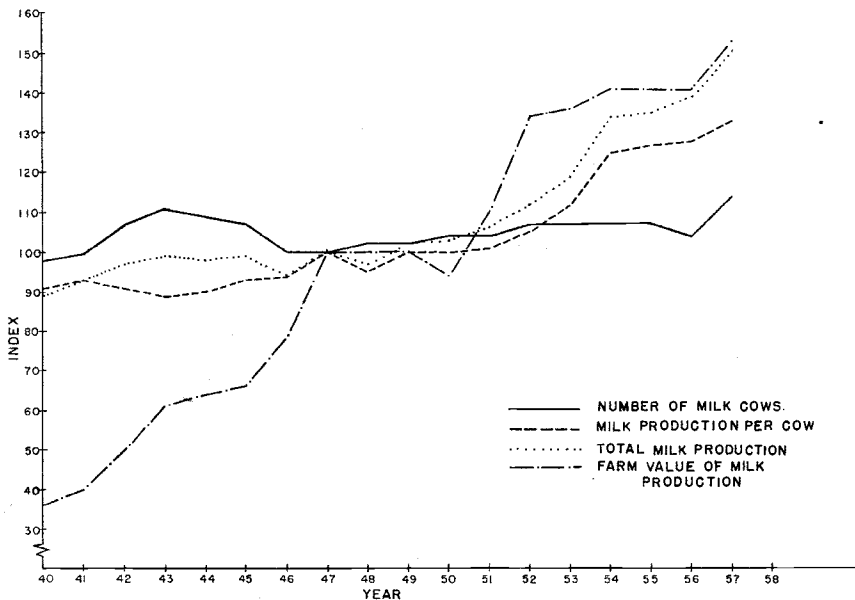
¹ See Appendix A for further elaboration of this point.

the average price paid for Arizona milk dropped from \$5.95 to \$5.33 per cwt. Therefore, while Arizona milk production is mainly for fluid consumption, the industry is characterized by a trend toward more and more surplus production.

Dairying contributes about five per cent to Arizona's total agricultural income. This percentage has changed very little in recent years, although there has been a slight upward trend. In 1952, dairy products were valued at \$17 million which was 4.8 per cent of the state's agricultural income for that year. In 1957, dairy income was \$20.5 million or 5.2 per cent of the total agricultural income. This \$20.5 million resulted from the marketing of 3,840,000 hundredweight of milk, 89 per cent of which was marketed under the Central Arizona Federal Milk Marketing Order.

Figure 1 shows trends in the Arizona dairy industry for the period 1940-57. Cow numbers have been the most stable of the factors shown, having increased temporarily during World War II and again in the 1950's.

Fig. 1. *Indices of milk cow numbers, production per cow, total milk production, and farm value of milk production, Arizona 1940-57.*



Source: Index numbers computed from data in: Agricultural Marketing Service, *Dairy Statistics*, U. S. Department of Agriculture, Washington, D. C. Statistical Bulletin 218, October 1957 p. 46. U. S. Department of Agriculture *Agricultural Statistics 1958*, U. S. Government Printing Office, Washington, D. C. 1959—pp 377-378.

Not until 1957 did the number of milk cows on Arizona farms again reach the wartime peak established in 1943. With cow numbers relatively stable, total production has closely followed production per cow. Total production and production per cow have both increased throughout the period.

The wartime increase in Arizona milk production contrasts significantly with later increases. The wartime expansion of milk production in Arizona followed the general pattern of the United States in that it was at the expense of production per cow. This, of course, was caused by war created shortages demanding a rapid increase in milk production which could be brought about only by postponed culling. On the other hand, the increase in total milk production since the war has been primarily caused by increased production per cow.

Arizona milk production is primarily a specialized area of agriculture. Almost half of the dairies surveyed receive all of their income from the sale of dairy products (Table 2). Only four per cent receive less than one-third of their gross farm income directly from that source. There has also been a trend toward further specialization of the dairy enterprises in that an increasing number purchase all or most of their dairy feed. Thus the "dry lot" or "corral" dairy is replacing the farm dairy where feed was grown by the dairyman.

Table 2. Percentage distribution of dairy operations according to the proportion of gross farm income derived from the dairy enterprise, Arizona 1957.

Portion of Gross Farm Income Derived from Dairy Enterprise	Percentage of Survey Dairies
Less than one-third	4.1
One-third - two-thirds	12.3
Two-thirds - 99 per cent	37.0
100 Per Cent	46.6

Table 3. Percentage distribution of dairies by type of milking arrangement, Arizona 1957.

	Percentage of Survey Dairies
Pipeline - parlor	42.5
Pipeline - Stanchion	28.8
Bucket - Machine Stanchion	24.6
Bucket Machine - Parlor	4.1

A marked increase in herd size and production per cow has accompanied the move toward specialized dairying. The average herd size increased from 55 cows in 1952, to 97 in 1957. The average investment per dairy in 1957 was \$64,637 or about \$670 per cow. The average cow produced 8,546 pounds of 3.7 per cent butterfat milk.

New technologies have been adopted rapidly by Arizona dairymen in recent years. These advancements have included bulk milk handling, pipeline milkers and parlor milking arrangements. Four out of every ten Arizona dairies had parlor-pipeline milking arrangements in 1957 (Table 3) and another 30 per cent had stanchion-pipelines. Thus, 70 per cent of the Arizona dairies were using pipeline milkers in 1957.

National Comparisons¹

Compared to national statistics on January 1, 1959, Arizona holds the following position:

1. *First in percentage of total cow population on test;*
2. *Third in average size per herd with 105.9 cows;*
3. *Tenth in average milk for D.H.I.A. herds in 1958;*
4. *Twenty-fifth in average fat per cow in D.H.I.A. herds;*
5. *Of all dairy cows in 1958 Arizona was fourth in average milk production.*

Table 4. Total cost of producing milk: per dairy, per cow, and per hundredweight of milk produced, by cost components, Arizona 1957.

Cost Item	Per Dairy	Average Cost	
		Per Cow	Per Cwt. of Milk ¹
Feed	\$24,182	\$249.29	\$2.92
Labor	8,528	87.92	1.02
Investment	6,943	71.58	0.84
General Production Expenses	3,142	32.49	0.38
General Marketing Expenses	3,107	32.03	0.37
Management	2,474	25.50	0.30
Total	\$48,376	\$498.81	\$5.83

¹ 3.7 per cent value corrected milk (See Appendix A).

Table 5. Feeds fed to the milking herd, amount and cost per dairy, per cow, and per hundredweight of milk produced, Arizona, 1957.

	Per Dairy		Per Cow		Per Cwt. of Milk ¹	
	Amount (tons)	Cost (\$)	Amount (tons)	Cost (\$)	Amount (lbs.)	Cost (\$)
Alfalfa hay	363.1	11,523	3.7	118.79	86.6	1.39
Silage	130.9	2,801	1.3	28.88	30.4	.34
Greenchop	102.9	2,282	1.1	23.52	25.7	.28
Grain and concentrates	116.4	7,576	1.2	78.10	28.1	.91
Total	713.3	24,182	7.3	249.29	170.8	2.92

¹ 3.7 per cent value corrected milk (See Appendix A).

¹ Arizona Dairy Herd Improvement Association Annual Summary October 1958-September 1959, Cooperative Extension Service, the University of Arizona, Tucson. p. 2.

MILK PRODUCTION COSTS¹

It cost Arizona dairymen \$5.83 to produce 100 pounds of milk during 1957 (Table 4). The average cow produced about 8,500 pounds of milk and thus the expense per cow was about \$500. Over eighty per cent of milk production costs is contributed by feed, labor, and investment expenses (Figure 2).

Feed Cost

Feed accounts for half the cost of producing milk in Arizona. The feed input was broken down into hay, silage, greenchop, grain and concentrate (Table 5). Over two-thirds (69 per cent) of the feed cost was contributed by roughages, leaving 31 percent for grains and concentrates.

Feed costs deserve major attention from every dairyman. Money can be saved by comparing costs and returns from various feed combinations. As the relative prices of feeds change, the least expensive feed mix may change. The seasonal availability and quality of dairy feeds and variations in the feed requirements are other reasons for studying feed expenditures. One question here will be whether to purchase feed when prices are lowest, thus using a lot of credit, or to purchase feed from time to time throughout the year.

Labor Cost

Almost an hour of labor was used to produce each hundred pounds of milk in Arizona during 1957 (Table 6). The cost of this labor contributed about 18 per cent to the total production cost. This labor input includes both hired and family labor (Figure 3).

Almost two-thirds of the labor bill is a direct cost, being wage, social security, or workman's compensation payments for hired labor. The remainder of the labor bill is actually returned to the dairyman and his family for their labor. The importance of considering *all* costs when planning dairy operations should be emphasized. If the total labor cost cannot be paid, the hired labor must be paid first, leaving little or no cash return for the operator and family labor.

Table 6. Labor utilized in milk production per dairy, per cow, and per hundredweight of milk produced, Arizona 1957.

Type of Labor Input	Per Dairy		Per Cow		Per Cwt. of Milk ¹	
	Hours	\$	Hours	\$	Hours	\$
Hired Labor	4,901	5,342	50.5	55.07	.59	0.64
Family Labor	2,740	2,986	28.2	30.79	.33	0.36
Other labor cost ²	—	200	—	2.06	—	.02
Total	7,641	8,528	78.7	87.92	.92	1.02

¹ 3.7 per cent value corrected milk (See Appendix A).

² Social Security and Workman's Compensation payments for hired labor.

¹ Methods used in determining cost components are discussed in Appendix A.

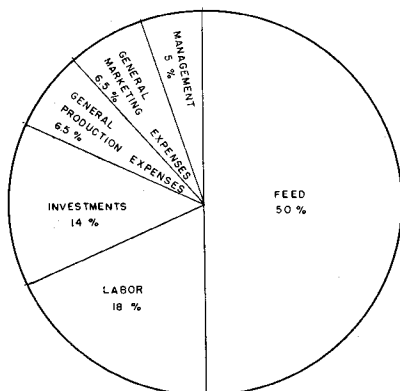


Fig. 2. Percentage Distribution of Total Costs Among Cost Components, Arizona 1957.

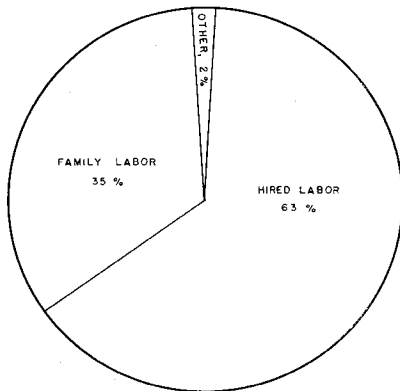


Fig. 3. Percentage Distribution of Labor Costs Between Hired Labor, Family Labor and Other Labor Cost, Arizona 1957.

Investment

The survey indicated that the average Arizona dairy had an investment in capital items of nearly \$65,000 (Table 7). Over half of this investment was in the dairy herd (Figure 4) with the remainder invested in machinery and equipment, land, buildings and improvements.

While investment in capital items does not constitute a cost directly, there are substantial costs associated with investment. These costs are interest, depreciation, repairs, taxes, and insurance (Table 8). Together, these make up an investment cost which must be met if the dairy plants are to be maintained and replaced as they wear out.

Investment costs made up 14 per cent of the cost of producing milk in Arizona during 1957. These costs totaled nearly \$7,000 per year for the average dairy. Interest and depreciation each accounted for about 40 per cent of investment expense, while repairs, taxes, and insurance contributed the remaining one-fifth (Figure 5).

Investment expenses may warrant more attention than is indicated by the portion of total milk production expenses they contribute. This is because of the fixed nature of these expenses. Once the dairy operation is planned, much investment expense will continue from year to year whether milk is produced or not. For example, depreciation and interest charges on the milking parlor continue more or less at a constant rate whether it is used or not. Because of its long-run nature, investment planning requires special attention. Each dairyman has only a few opportunities during his lifetime to revise his complete investment program. Thus, mistakes cannot be easily corrected and may be very expensive.

Other Costs

The remainder of the milk production costs are general production expenses, general marketing expenses, and management cost. These are included with feed, labor, and investment expense in Table 4 and Figure 2 to show the total cost of producing milk.

Table 7. Dairy enterprise investment per dairy, per cow, and per hundredweight of milk produced by type of investment, Arizona 1957.

Type of Investment	Average Investment		
	Per Dairy	Per Cow	Per Cwt. of Milk ¹
Dairy Herd	\$37,096	\$382.43	\$4.47
Machinery and Equipment	12,026	123.98	1.45
Land	7,908	81.52	0.95
Buildings and Improvements	7,608	78.43	0.92
Total	\$64,638	\$666.37	\$7.79

¹ 3.7 per cent value corrected milk (See Appendix A).

Table 8. Total investment cost per dairy, per cow, and per hundredweight of milk produced, by type of cost, Arizona 1957.

Type of Cost	Average Cost		
	Per Dairy	Per Cow	Per Cwt. of Milk ¹
Interest	\$2,693	\$27.75	\$0.32
Depreciation	2,678	27.61	0.32
Repairs	823	8.49	0.10
Taxes	493	5.08	0.06
Insurance	256	2.64	0.03
Total	\$6,943	\$71.58	\$0.84

¹ 3.7 per cent value corrected milk (See Appendix A).

Table 9. Disposable income from milk production for the average dairyman per dairy, per cow, and per hundredweight of milk produced by source, Arizona 1957.

Source	Average Disposable Income		
	Per Dairy	Per Cow	Per Cwt. of Milk ¹
Family Labor	\$2,986	\$30.78	\$0.36
Interest	2,262	23.32	0.27
Management	2,474	25.51	0.30
Total	\$7,722	\$79.61	\$0.93

¹ 3.7 per cent value corrected milk (See Appendix A).

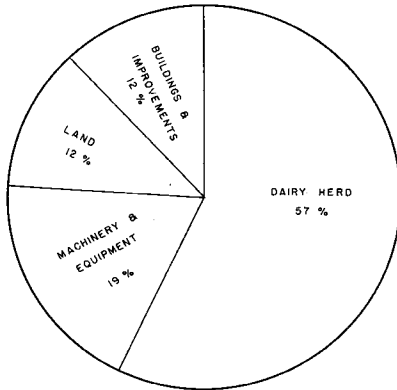


Fig. 4. Percentage Distribution of Dairy Investment by Type of Investment, Arizona 1957.

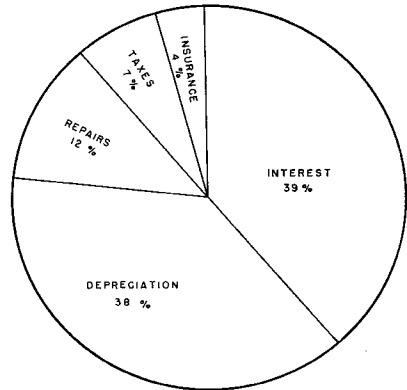


Fig. 5. Percentage Distribution of Investment Cost by Type of Cost, Arizona, 1957.

COSTS AND RETURNS COMPARED

The cost of producing milk in Arizona during 1957 was determined to be \$5.83. This was also the average return per hundredweight for milk sold from the survey dairies. The average price for the 3.7 per cent butterfat milk during 1957 was \$5.68. A credit of \$.02 per hundredweight was added to this for milk consumed at the dairy and \$.13 per hundredweight was added for manure credit. The two credits were determined from the survey responses.

The equality of costs and returns does not mean that the average dairyman receives no net return. Charges for all resources (interest, family labor and management) were included in milk production costs. Therefore, the expenses for these inputs really add up to income that the dairyman and his family receive for management, labor and their equity in the business.

This income available to the dairyman for family living expenditures or saving is called "disposable income" here. It totaled \$7,722 for the average Arizona dairyman during 1957 (Table 9). This is the sum of the interest on owned investment, the family labor expense and the charge for management.

Only 84 per cent of the total interest charge, shown in Table 8, is included in disposable income. This is because the average dairyman borrowed 16 per cent of his investment.¹ The interest on borrowed funds would be paid to others and thus cannot be available as disposable income.

The family labor credit for disposable income was taken from Table 6, while the management income was taken from Table 4.

¹ Otis G. Lough, Unpublished M. S. Thesis, University of Arizona, 1959, Appendix D, Table I.

Many Arizona dairymen have other sources of income in addition to their dairies. These other sources include both farm and nonfarm enterprises. It should be clear, then, that this study shows only the contribution of the dairy to disposable income and it does not describe the dairyman's total income situation.

Some dairymen would add part of the depreciation charge to the disposable income in some years because this cost item can be postponed for a time. While this can be done, the person who follows the practice of living up his depreciation ought to recognize that he is slowly going out of the dairy business. The disposable income computed here assumes that the dairy investment is maintained from year to year, and therefore does not include any depreciation figure.

HERD SIZE AND MILK PRODUCTION COSTS

The survey dairies were classified into four groups with respect to number of cows in the milking herd (Table 10). The groupings were designed to insure that each group contain a sufficient number of dairies to yield a reliable average.

Table 10. Cost of producing milk, per dairy, per cow, and per hundred-weight, by size of herd, Arizona 1957.

Herd Size		No. Dairies	Average Cost (Dollars)			Prod./Cow ¹
Range	Average		Per Dairy	Per Cow	Per Cwt. Milk ¹	Lbs.
Under 40	33	18	\$17,509	\$530.58	\$7.18	7394
41-61	49	18	28,872	589.22	6.81	8654
62-120	87	18	45,605	524.20	6.40	8186
Over 120	214	19	99,994	467.26	5.30	8824
All	97	73	48,376	498.71	5.83	8546

¹ 3.7 per cent value corrected milk (See Appendix A).

The cost of production per hundredweight of milk decreases as herd size increases, about as one would expect. The dairies with the larger herds had a lower cost of production than was true of the smaller herds. Some of this is due to slightly higher production per cow in the larger herds, but certainly much of it is due to other efficiencies in larger herds.

The economies associated with size were due to better utilization of labor, investment and management in the larger herds. These savings in costs are large when comparisons are made between the extremes of herd sizes. Labor, investment and management costs total \$100 less per cow for the largest herds than for the smallest herds.

Probably many dairymen considering herd expansion are in the group which averages 87 cows per dairy. The savings associated with expanding these herds to the 214 cow size are not as striking as was observed above when examining the extremes of herd sizes. A comparison of labor, investment and management costs between the 87 and the 214 cow herds reveals a difference of \$41 per cow, in favor of the larger herds.

Unless the large dairyman gets quantity discounts on his feeds, supplies and services, his only advantage will be in better utilization of his investment, labor and management. These are the costs, then, that should be studied when attempting to determine the optimum herd size.

PRODUCTION PER COW AND COSTS

Another grouping of the survey dairies was made on the basis of production per cow (Table 11). There was wide variation among Arizona dairies on this item. The top one-fourth of the dairies in this regard averaged over twice the production per cow of the lowest one-fourth.

Table 11. Cost of producing milk, per dairy, per cow, and per hundred-weight of milk, by production per cow, Arizona 1957.

Production Per Cow (Pounds) ¹		No. of Dairies	Average Cost (dollars)			No. of Cows
Range	Average		Per Dairy	Per Cow	Per Cwt. ¹ of Milk	
Under 6,780	5,313	17	\$46,436	\$533.74	\$10.05	87
6781-7810	7,405	19	42,590	532.38	7.19	80
7811-10,010	8,955	18	52,268	454.51	5.08	115
Over 10,010	10,941	19	54,917	499.25	4.56	110
All	8,546	73	48,376	498.71	5.83	97

¹ 3.7 per cent value corrected milk (See Appendix A).

There is quite a sharp drop in the cost of producing a hundred pounds of milk as production per cow increases. The effect of increased production per cow is to spread the cost per cow over more units of milk and thus lower the cost per unit.

The story of Table 11 is clouded by the differences in the number of cows per dairy. At the same time that production per cow changes, the average herd size also changes. Thus, all of the differences in cost cannot be attributed to production per cow. The big difference in herd size is between the two low productivity groups and the two high productivity groups. This probably accounts for much of the difference in the cost per cow shown in Table 11.

Two main methods of increasing the production per cow are: (1) improvement of the inherent productive ability of the herd and (2) a better feeding program. In either method the cost of increasing production must be weighed against the return from additional production. One of the main influences of increased production per cow is to spread the relatively fixed cost of owning and maintaining the dairy operation and the herd over a greater output of milk, thus reducing the production cost per hundredweight.

APPENDIX A

Methods Used to Determine Costs and Returns

Only the inputs directly utilized by the dairy enterprise are included in this study. If feed is grown on the dairy farm it is charged at the market price to the dairy enterprise and the labor, investment, and other costs involved in growing the feed are ignored.

Some cost figures used in the analysis reported here are taken directly in dollar amounts as reported by the dairyman. Feed is an example of such an item. In other cases the physical amount of a factor was obtained in the survey and the charge for the input was determined by opportunity cost. This was done in the case of family labor. The purpose here is to briefly account for the methods that might be of interest to persons evaluating the results of this study or comparing them with the results of other studies.

Feed

All feed cost data used in this study are used directly as reported in the survey. Thus, the feed expense for alfalfa hay fed to the dairy cattle is the amount of hay fed multiplied by the hay price, with both the amount and price being taken as reported by the dairyman.

Labor

The hours of all labor used in the dairy enterprise were obtained in the survey. These hours include both paid and unpaid family labor. The charge for hired labor was, of course, the amount as reported by the dairyman. The average hourly wage reported for hired labor was used as the value of the family labor. In other words, it is assumed that family labor just replaced labor that could be hired at the average wage rate of all hired labor reported in the survey. This is a sound basis for valuing this unpaid labor because two-thirds of the dairy labor was hired and only *work* time of unpaid workers was included. Work time excludes the time spent in managing the dairy business.

Investment

The amount of investment utilized in milk production was obtained from the survey. The investment obtained for each item was the dairyman's estimate of its replacement cost. This includes investment in the dairy herd, machinery and equipment, land, buildings and improvements. No distinction is made when computing cost, between owned and borrowed investments. Investment

expenses consist of interest on investment, depreciation, repairs, taxes and insurance.

Interest on investment is charged at the market interest rate for various types of investment as determined by an Arizona credit study.¹ In other words, interest is determined the same as charges for unpaid labor. In the case of labor the wage rate that would be required to hire replacement labor is used to value unpaid labor. In the case of investment the interest rate that would have to be paid if the investment were borrowed is used as a charge on all investment. Four per cent of the land value and four per cent of one-half of the replacement cost for buildings and improvements were the charges for the longer term capital items. Six per cent of the average investment in cattle, machinery and equipment was the annual interest charge for these items. The average investment in cattle is half way between the value of the beginning and ending inventory, while for machinery it is half of the replacement cost.

Depreciation is charged at a certain percentage of the value of the investment item for machinery and equipment and buildings and equipment. Many different rates were used for individual items within these groups, the selected rate being the best in the judgment of the authors while reviewing other research concerning similar equipment. The average rate for machinery and equipment was 8.25 per cent and for buildings and improvements it was 5.34 per cent. The depreciation on the milking herd is the difference between cost of replacements and the value of culls. The replacements charged were those needed to maintain a stable herd size. Thus, bred heifers for replacing deaths and culls are included but not those used for increasing herd size.

Repairs were charged as a percentage of the value of machinery and equipment, and buildings and improvements. Again, as with depreciation, various rates were used for individual items. The average rate used for machinery and equipment was five per cent and for

¹ Andrew Vanvig, *Agricultural Credit in Arizona*, Arizona Agricultural Experiment Station Bul. 262, Tucson.

buildings and improvements it was about three per cent.

Taxes and insurance complete the investment cost picture when combined with interest, depreciation, and repairs. These two items were taken directly as dollar values from the survey schedule.

General Expenses

Two categories of general expense items are included in the cost computation of this study. Both of these are summaries of individual dollar costs as reported on the schedules. "General Production Expenses" include breeding fees, veterinary and medical expenses, barn expenses, electricity, gas and oil, water, milk testing fees, telephone, registration fees, subscriptions, bookkeeping, and legal fees. The other general expense category is called "General Marketing Expenses" and includes milk hauling fees, association dues, and other marketing expenses. These marketing expenses are included in milk production costs because it is easier to price all items at the processing plant than at the dairy. Thus when costs and returns are examined the price at the plant can be compared directly with the cost as determined in this study because the marketing costs are included.

Management

The charge for management is unique among the cost items of milk production in this study. Neither the physical amount nor the dollar rate was obtained from the survey. The reason for this was that it is very difficult to measure management in physical terms and not enough hired managers were contacted to form a reliable basis for charging for management. For these reasons the results of a study of Arizona beef feedlots was utilized in determining the charge for management. The transfer of the charge from feedlot to dairy was on the basis of a percentage of gross that was charged for management. This percentage is, of course, different for different size operations, being higher the smaller the business is. This method assumes that management is a function of gross sales and that the management input per unit of sales is similar between feedlots and dairies. The management rate was determined using the formula $Y = .06 - .00022x$, where Y is the percentage of gross sales to be charged for management, and x is the gross milk sales in thousands of dollars.¹

¹ Unpublished results of research conducted under project Hatch 381, Department of Agricultural Economics, University of Arizona, 1958.

Milk Production

The amount of milk produced in the survey dairies is of major importance because the cost is computed on a per hundredweight basis. The milk volume figures used in this study are actual milk sales. As costs were to be expressed on a per unit of milk basis all milk was adjusted to a value equivalent of 3.7 per cent butterfat milk which was the average test of milk sold from survey dairies. Thus all milk was "value corrected" to 3.7 per cent butterfat.

All milk volume figures, both total and per cow, are then in terms of 3.7 value corrected milk. The adjustment to 3.7 milk was accomplished by the use of the following formula:

Pounds of 3.7 V.C.M. =

$$\frac{\text{Actual Pounds of Milk X Price received per Cwt. at Actual B. F. test}}{\text{Price per Cwt. of 3.7 per cent milk}}$$

Price per Cwt. of 3.7 per cent milk

The average price of milk for 1957 used in computing the returns from milk production was \$5.68 per hundredweight. The average test for Class I milk for 1957 was 3.5677 and the price at average test was \$5.9525 with a differential of \$.1044. The average test for Class II milk in 1957 was 4.0080, and the price at average test was \$3.2756 with a differential of \$.0684. When these figures are blended on the basis of 86.01 per cent Class I and 13.99 Class II, the blend test is 3.6 per cent, the blend price at this test is \$5.578 and the blend differential is \$.0994. Average price of 3.7 per cent milk then is \$5.578 + .0994 or \$5.677 which was rounded to \$5.68.¹

In summary, then, the "out of pocket expenses" were entered at cost, while the unpaid resources were charged at a rate determined to be opportunity cost for such resources. Thus costs and returns were not adjusted to force the equality observed in this study. The equality of costs and returns observed in this study indicates that in general the correct opportunity costs were assigned the unpaid resources.

¹ All information used in this paragraph is taken from pp 7, 9, and 11 of *Compilation of Statistical Material for the Central Arizona Marketing Area, Years 1956-1957*, Market Administrator, Order 104, Phoenix, 1958.

Sample Bias

Seventy-three schedules were completed from a sample of 90 dairies. Five of the nonrespondents were out of business by the time the survey was taken, two others had entered dairy production in 1957 and thus did not have a complete year of experience needed to complete the schedule, and two other nonrespondents were drawn due to sampling error (one was the wife of a respondent and the other was an out-of-state dairy with a Yuma, Arizona, address). The other eight dairies were in operation at the time of the survey but did not cooperate in the study.

Production data was obtained on 12 of the nonrespondents. The average total production of these dairies during 1957 was 501,258 pounds compared to 828,962 pounds for the dairies completing the schedule. The five dairies that had gone out of business averaged only 273,198 pounds of milk, while the eight noncooperators averaged 650,680 pounds of milk per dairy.

The indication is that the survey dairies were larger than the average dairy producing milk in Arizona in 1957. Because of those that had gone out of production, this survey represents the 1957 cost picture of those still producing milk in June of 1958. The bias arising from the eight noncooperators is rather small. If the cost of production for survey dairies of similar size is entered for the noncooperators in the computation of the over-all cost of production it would raise the cost of producing milk \$.016 per hundredweight.

It should be emphasized that the only check of nonresponse bias available on this survey was total pounds of milk produced. When differences are found in this regard they could be due to variation in cow numbers or production per cow. Probably both those that went out of production and those that did not cooperate had slightly smaller dairies and lower production per cow but not sufficiently different, when dairy numbers are considered, to materially alter the results of this study.

APPENDIX B

Interest, depreciation, and repair costs by type of investment, costs per dairy, per cow, and per hundredweight, Arizona 1957.

Type of Cost and Investment	Average Cost		
	Per Dairy	Per Cow	Per Cwt. of milk ¹
	dols.	dols.	dols.
<u>Int. on Investment</u>			
Machinery and equipment	360.60	3.72	0.04
Buildings and improvements	152.46	1.57	0.02
Land	335.49	3.46	0.04
Herd	1,844.11	19.01	0.22
Total	2,696.66	27.76	0.32
<u>Depreciation</u>			
Machinery and equipment	992.24	10.23	0.12
Improvements	406.38	4.19	0.05
Herd	1,279.86	13.19	0.15
Total	2,678.48	27.61	0.32
<u>Repairs</u>			
Machinery and equipment	593.28	6.12	0.07
Buildings and improvements	229.56	2.37	0.03
Total	822.84	8.49	0.10

¹ 3.7 value corrected milk (See Appendix A).