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Managers of Grade A dairy enterprises are continually faced with choices among conflicting objectives and uncertain means of obtaining them. Stability exists in neither the price situation nor the physical framework within which the decision process functions. This study examines trends in the price situation and establishes the physical conditions apparent in dairies in Benton County in 1962.

Prices received for high test milk have declined during the last decade. Low test milk prices have remained at about the same level. Prices paid by dairymen for the factors of production have tended to increase. The individual can influence the price he receives by the butterfat content, degree of contamination, and ratio of quota to surplus milk. His principal managerial decisions,

however, concern the quantities to produce and the techniques of production that may improve efficiency.

The study herds averaged 54 cows producing 9206 pounds of 4. 2% milk each. An average operator's labor and management return of $3246 was realized. Net return to the operator's contributions averaged about 90% of the return expected from optimum alternatives.

Replacement heifers cost an average of $229 to raise - $4 more than the estimated market value. Generally, producers raising less than 10 heifers could have purchased them at lower costs than they experienced raising them.

Pasture costs averaged 26¢ daily per cow. Averaging $117 per acre on pastures of less than 20 acres the cost decreased to $41 per acre on pastures of over 40 acres. No significant difference in cost of providing summer forage was revealed between pasture and dry-lot methods.

Total cost of milk production averaged $475 per cow or $5. 15 per hundredweight of milk produced. This amounts to $5. 02 per hundredweight of 4% corrected milk or $1. 23 per pound of fat.

Feed comprised 55% of the total; labor amounted to 18. 5%; equipment use 6. 4%; building use 4. 6%; and incidental inputs amounted to 15. 5% of the total cost.

Average cost per cow decreased from $517 in the under 40 cow size group to $407 in the over 80 cow group. Less than half the labor per cow was required in the larger group. Economies of size accrued to equipment and building use as well. Production per cow declined in the larger size herds. This reduction in income was more than enough to offset cost economies in the over 80 cow group.

Cost per hundredweight decreased as production per cow increased with the exception of the group averaging over 11,000 pounds of milk. Average cost per hundredweight of 4% corrected milk was lowest when annual herd production approximated 11,100 pounds per cow. Cost per hundredweight increased with the butterfat content. Generally, the cost was below the price received when the test was between 3.7% and 4.8%.

The relationship between cost of producing a hundredweight of milk and size of herd, production per cow and butterfat content was expressed in a multiple regression equation. The study revealed the following coefficients:

$$Y = 7.163 - 0.0167a - 0.189\,b + 0.206\,c$$

where Y = is the cost of producing 100 pounds of milk ($)

a = number of cows in the herd

b = annual production per cow (thousands of pounds)

and c = butterfat test of the milk (%).

A 1% change in the butterfat content of milk was found to be associated with a 1,313 pound inverse change in production per cow.

The study recognizes that adjustment decisions be based upon individual circumstances. Possible adjustment alternatives are illustrated by means of partial budgets on selected enterprises. No single organization can be deemed optimum for all producers because resources and personal objectives differ.

ECONOMIC ANALYSIS AND ADJUSTMENT OPPORTUNITIES OF GRADE A DAIRY ENTERPRISES IN BENTON COUNTY, OREGON

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Any shortcomings in content or presentation remain solely the responsibility of the author.

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INTRODUCTION

THE PROBLEM

Farmers are continually faced with decisions regarding the optimum combination of resources in their productive operations. Assuming their objective is to maximize profits, there exists some optimum combination and quantity of resources under a particular price situation and a particular set of physical conditions. The complexity of their decisions is intensified by the continuous changes in the price situation and physical conditions. The milk producer appears to be especially vulnerable to these changes.

With roots in the eastern seaboard, the dairy industry moved westward as the population moved inland. Dairy farms located primarily around the cities. Technological advances and improved transportation have resulted in a shift from selling cream to selling whole milk and have reduced the advantage of proximity to urban centers.

Milk production was encouraged by subsidies for nearly three years during World War II. At the same time, price ceilings held down the cost of milk to consumers. Through these means both consumption and production were encouraged. Need for strict sanitary

practices in the production and distribution of milk and the wide use of the product by consumers have contributed to the acceptance of legal requirements and controls of many kinds in the industry.

Production decisions continue to be influenced by legislation such as the Milk Stabilization law that came into effect June 4, 1963. The law, among other features, is designed to establish a minimum price to be paid by handlers to producers for Class 1 and Class 2 milk.[1] Market wide pooling provides that each producer be assigned a quota representing his share of the Class 1 market. He receives Class 1 price for his quota and under equalization, can influence his own blend price by producing as much or as little as he wishes above his quota and will receive the established Class 2 price for this surplus.

Per capita consumption of milk and milk products has shown substantial decline in recent years. An average annual drop of 10 pounds per person has reduced the total disappearance to some 630 pounds of milk equivalent per capita (5, p. 17). Whereas this rate of decline is slower than the rate of population growth, the output of milk in Oregon is declining. Table 1 shows a decline from over 1.2 billion to less than 1.1 billion pounds of milk marketed and used

1. Class 1 is that part of Grade A milk used for human consumption in the fluid form whereas Class 2 is used in manufactured products.

Table 1. Milk production and prices in Oregon, 1953-62. [1]

Year	Number of cows (000)	Milk per cow (pounds)	Fat per cow (pounds)	Average Butterfat test (%)	Total Milk (000, 000 pounds)	Av. Price Received ($/cwt)
1953	203	5980	266	4.45	1214	5.20
1954	203	6040	269	4.45	1238	4.64
1955	198	6100	268	4.40	1208	4.39
1956	185	6300	274	4.35	1166	4.62
1957	176	6450	281	4.35	1135	4.73
1958	168	6700	288	4.30	1126	4.59
1959	164	6770	288	4.25	1110	4.65
1960	162	7060	300	4.25	1144	4.67
1961	157	7140	300	4.20	1121	4.54
1962	153	7125	296	4.15	1090	4.48
Average 1953-57	193	6174	272	4.40	1192	4.72
Average 1958-62	161	6959	294	4.23	1118	4.59

1. Source: U. S. Department of Agriculture. Statistical Reporting Service. Milk - production, distribution, and income. (6)

in Oregon during the last ten years. An increase in the total consumption of milk in the United States together with this decline in production in Oregon indicates that Oregon is declining in its relative importance as a producer of milk and milk products.

Although total milk production has declined, the number of cows has decreased considerably faster. Increased production per cow can be attributed to improved production practices in feeding,

disease control and improved breeding due to expansion in the use of artificial insemination.

Average prices received have fluctuated substantially within the last decade and, as indicated in Table 1, show a downward tendency. This decline can be explained primarily by the reduction in average butterfat test.[1] Prices received by an individual fluctuate to a larger extent. The existance of a two price system whereby the price received for surplus milk differs from that received for quota milk complicates the problem of price determination. Prices received by the individual are influenced more by his own blend or percent surplus than they are by the general level of milk prices.

More relevant to the decision making process of producers are the changes that have taken place in the pricing formula. Details of these changes are given in Appendix Table 1. Since 1946, when milk for fluid consumption was paid for on the basis of butterfat content alone, the relative weights of milk and butterfat have shifted considerably. The formula has settled somewhat at a level whereby

1. On the basis of the pricing formula for class 1 milk existing in 1962 (See Appendix Table 1 for details) butterfat was worth $. 735 per pound. The average test for the five year period 1953-57 was 0. 17 pounds per cwt above that for 1958-62. The change in price per cwt of $. 13 between these periods is explained by the change in butterfat. ($. 735 per pound X 0. 17 pounds = $. 125).

milk testing about 4% butterfat is priced in such a way that the milk and fat are of equal value. Milk testing lower than 4% returns more for the milk than the fat and milk above 4% returns more for the fat than the milk.

The trend in milk pricing has been such that the price received for low-test milk has remained about the same whereas milk of high butterfat content has shown some reduction in value over the past years. [1]

Prices received for milk give little indication of the income position of dairy farmers. The other factors determining the financial position are the cost associated with the production of this milk and the number of units produced. The major inputs in milk production are feed and labor. Table 2 shows changes that have occurred in the prices of some of the more important inputs during the ten year period prior to this study. Feed costs, which normally comprise about one half the cost of milk production, have not changed a great deal according to the items chosen as indicators.

Labor costs comprise approximately one third of the cost of milk production in most studies. It is apparent that labor cost has

1. A detailed illustration in Appendix Table 2 shows the price for 3.5% milk has increased at a rate of 2/3¢ per cwt per year, whereas, the price for 5.0% milk has decreased about 3.8¢ per cwt. per year.

increased enough to more than offset any decrease in feed costs. This observation, together with the assumption that there has been an increase in expenses such as taxes, breeding and veterinary, milk hauling, equipment costs, and other costs would indicate that the cost of milk production has risen in the past ten years.

Increasing unit input costs together with a slightly decreasing price received for milk make it apparent that dairy producers must increase output per unit of input or produce more units if they are to maintain or improve their income position.

Table 2. Prices paid for major inputs by Oregon farmers, 1953-62. [1]

Year	Baled Hay $ per Ton	Dairy Mix 16% Protein $ per cwt	Wages Paid (with house) $ per month
1953	20.20	4.32	206
1954	21.40	3.97	203
1955	26.60	3.80	210
1956	23.20	3.68	225
1957	16.00	3.64	232
1958	18.10	3.53	233
1959	25.50	3.63	239
1960	23.10	3.55	241
1961	21.90	3.56	256
1962	23.00	3.60	256
Average '53 - '57	21.48	3.88	215
Average '58 - '62	22.32	3.57	245

1. Source: U. S. Department of Agriculture. Statistical Reporting Service. Corvallis, (1963).

OBJECTIVES OF THE STUDY

Changes in the price situation and physical conditions influencing milk production require that adjustments be made in the farm organization. As an aid to farm management decisions, this study was conducted with the following objectives:

1. to determine the cost and return position of existing Grade A milk enterprises in Benton County, Oregon.

2. to isolate the physical and economic factors contributing to high net returns.

3. to examine, through the budgeting technique, alternative combinations of resources in order to demonstrate economic adjustment possibilities available to Grade A milk producers.

It was hypothesized that some of the existing organizations were employing resources at less than optimum combinations or levels and, therefore, improvement could be demonstrated. Trends illustrated in prices and physical conditions were expected to continue during the period in which the conclusions of this study would be applicable. No attempt was made to evaluate alternative uses of resources. Only internal adjustments within the dairy enterprise were examined.

THE STUDY AREA

Benton County is located primarily in the Willamette Valley between the Cascade and Coastal mountain ranges of Oregon. Agriculture in the area is favored by a long growing season as illustrated by its diversification. Estimates rank agricultural gross income in the county at 8.75 million dollars, third behind forestry at 16 million and Oregon State University at 9.5 million dollars (2, p. 95).

The 1960 census indicated that 895 farms existed in the county compared to 1174 in 1955. Of the farms existing in Benton county in 1962, 32 were producers of Grade A milk. These farmers owned about 65% of the 3000 dairy cows in the county and received about 80% of the total county income from milk sales in 1962 (2, p. 35). Total value of dairy products sold in the county in 1962 amounted to slightly over one million dollars or 13.3% of the total value of agricultural marketings for the year (2, p. 62).

Weather conditions were generally favorable in the area during the study year. General prices were low but small grain and hay prices were normal resulting in a near normal cost and return situation in the dairy industry.

Population in the county was approximately 43,000 in 1962 and is increasing at about 2.4% per year (4, p. 12). If per capita milk

equivalent consumption were the same in Benton county as it was for the nation some 27 million pounds of milk would have been used within the county. Assuming that the 3, 000 cows produced the state average of 7, 125 pounds per cow, some 21. 4 million pounds of milk were produced. Benton county had an apparent net import of between 5 and 6 million pounds of milk equivalent in 1962.

PROCEDURES USED AND CHARACTERISTICS OF ENTERPRISES STUDIED

THE SURVEY

A survey of farms producing Grade A milk in Benton County was conducted to determine the price situation and physical conditions existing in 1962. With the assistance of the county agent, the farm location of each producer was determined. A letter was forwarded by the county agent to each producer soliciting his cooperation and explaining the nature of the study. Data relative to milk production during the 1962 calendar year were then obtained by the author in a personal interview with each producer during the summer of 1963.

Information in this study reflects conditions existing on Grade A dairies during the study year. No attempt was made to determine "normal" or long-run conditions. Figures regarding costs and returns of the dairy enterprise do not necessarily reflect the total farm situation of these producers.

Benton county was selected as the study area because of its proximity to the author's headquarters. It was not selected because of the existence of any special problem nor was it assumed that Benton county is necessarily representative of any larger area.

DAIRY ENTERPRISE DEFINED

The dairy enterprise, for purposes of this study, was defined as that aspect of the farm operation dealing directly with the milking herd. It was divided into three phases; the replacement-raising phase, the pasture phase, and the milking phase.

The replacement-raising phase includes all inputs utilized in raising replacement heifers on the study farms. Included in the cost of raising replacements were pasture and feed costs, breeding and veterinary expenses, and other cash costs as well as charges for the use of buildings, equipment, and labor required to feed and care for replacement stock and to maintain pasture, buildings and equipment used by them.

The pasture phase isolates the cost of establishing and maintaining the pasture used only by the milking herd. Among the items comprising total pasture cost were interest on the investment in land, taxes, fertilizer, irrigation and charges for labor required for upkeep of cow pasture and for inspecting and bringing the cows from the pasture.

Items directly involved in the production of milk were charged to the milking phase. Costs associated with the use of buildings, equipment, and land for the building sites and yard lots were included.

Labor charged to the cow phase includes that required to bring cows from the lot into the barn, wash and milk the cows, clean milking utensils, feed, medical and breeding work, dairy building and equipment maintainance and general clean up. Time spent financing, record keeping, buying and selling livestock as well as general administrative duties associated with the cow herd was also included.

METHODS USED

The replacement-raising and pasture phases were studied independently and then incorporated into the cost of milk production study. Replacement heifers were charged to the cow herd at the cost of raising them. Costs associated with providing pasture for the cows were included in feed costs.

Interest on investment was calculated at a rate of 5% of the average inventory value of land, buildings, equipment, livestock and feed. Land values used were the landowners' estimates of market price for agricultural purposes. Building, improvement, and equipment investment was arrived at by averaging the beginning and ending inventory values. Inventory values were the original purchase price minus accumulated depreciation. Depreciation was calculated by the straight line method on the basis of the farmers' expected useful life of the item. No depreciation was taken on

assets that had reached 10% of their original cost. Buildings and equipment purchased during the study year were treated as being owned for one half of a year for investment and depreciation purposes. Investment and depreciation costs of buildings and equipment used by both the milking herd and replacement stock were pro-rated to each phase on an animal-unit share basis. [1]

Tractors, irrigation equipment, and other equipment used in the dairy enterprise were included in investment values only if the majority of their use during the year was associated with the dairy enterprise. Otherwise, a use cost at a rate sufficient to cover operating costs was included as a cash expense.

Feed and livestock were entered into inventories at the operator's estimate of market value of quantities on hand on January 1st of each year. Cow values, which included the value of quotas, were not allowed to fluctuate due to market changes within the year. Note was made if an abnormal number of cows were purchased, sold or died during the year so that the number of cows could be calculated

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1. An animal unit was defined as; Mature cows and bulls = 1 A. U.; heifers over 1 year = 0.75 A. U.; calves = 0.5 A. U.

   If one fourth of the total animal units came from replacement stock, then one fourth of the costs associated with the assets used by both phases was charged to the replacement phase.

on a cow-month basis. Some indication of the breeding program was necessary in order to allocate the cost of maintaining bulls proportionally between replacement heifers and the cow herd.

One of the study farms had some of the dairy assets rented. This farm was treated as being entirely operator owned by having him estimate the landlord's investment and costs.

Interest actually paid on mortgage loans was deleted because the interest on investment charge was based on the total value of assets rather than on the operator's equity. No interest was charged for the use of the operator's capital on ordinary operating expenses. Interest actually paid on loans for operating expenses was, however, included as a cash expense.[1]

Value of the operator's labor and management was based on the operator's estimate of the proportion of his time spent on the dairy enterprise and his opportunity wage in alternative occupations. Where no opportunity wage was indicated, an annual wage allowance of $4,800 was used. A proportion of the operator's total labor and management allowance relative to time spent was charged to the

1. Few operators borrowed money for operating expenses. Interest charged was often included in the cost of feed purchased or deducted, along with numerous other items, from the milk check making it impossible to isolate.

dairy enterprise. Dairymen do not keep adequate records of time spent on various jobs but they find it easier to estimate than other producers because of the regularity with which most jobs are undertaken. Labor inputs of the operator, unpaid family labor and hired labor were allocated to the three phases of the dairy enterprise according to the operator's estimate.

Home grown feed was charged to the dairy enterprise at a price for which it could have been sold rather than at the cost to produce it. Purchased feed was charged at cost. The average price received for surplus milk was used to value saleable milk fed to calves. Quantities of feed fed were arrived at by adding feed on hand January 1st, 1962, purchases and feed produced and then subtracting sales and feed on hand January 1st, 1963.

Several reasons advocated that a cost of establishment and maintainance rather than an opportunity cost be used as a basis for pasture cost. First, there was no established market for milk-cow pasture in the study area. It was, therefore, impossible to obtain pasture cost on the basis of rent that could have been received. A second reason for using cost of production was that differences in maintainance costs, especially with regard to fertilizer and irrigation, more nearly reflect variations in quality. Another reason for not using opportunity cost for estimating pasture cost was the endless

list of alternative uses that would have to be examined in order to determine the optimum alternative use for the pasture acreage.

Record was made of any feed cut off the acres used for pasture. The purpose of this information was to avoid double charging for this feed. Hand fed feed was entered into feed costs at market value. At the same time some of the cost of production for feed cut off the pasture acreage would have been charged as a pasture cost. An adjustment was made whereby the pasture cost was reduced by an amount equal to one-half of the market value of feed cut off the pasture.[1]

Cash operating expenses were obtained directly from farm accounts. Individual expenses were allocated to their respective phases. Only that proportion utilized by the dairy enterprise was included. Bills paid during the study year but incurred in previous years were deleted and unpaid bills at the end of the year were added to expenses.

Where available monthly sales of quota and surplus milk and fat together with their respective values were obtained. Most

1. This arbitary adjustment assumes that one half of the value of the feed would compensate for the land investment, taxes, establishment cost, fertilizer, irrigation and other items used in the production of this feed and which had been included in pasture costs.

records revealed only total milk sold and total value of this milk making it difficult to establish the prices received for quota and surplus milk separately. The quantity of saleable milk used in the home and fed to calves, valued at average surplus prices, was included in milk sales and production figures.

Included in miscellaneous receipts are gas-tax refunds, government payments and a value of manure. Manure was valued at the operator's estimate of its worth at the barn. Miscellaneous receipts were credited to the respective phases on an animal-unit share basis.

These data were then summarized to present the overall financial position of existing producers. Total costs include charge for the operator's labor and management as well as a charge for the use of his capital. The net difference between total receipts and total cost is referred to as profit.

Costs of milk production were analyzed in order to isolate efficiency factors prevailing in the study area. Three farms representing low, average and above average profit were then examined in detail. Alternative organizations were explored in order to demonstrate adjustment opportunities available to producers desiring to improve the financial position of their dairy enterprise.

CHARACTERISTICS OF ENTERPRISES STUDIED

The Sample

Thirty-two dairymen were producing Grade A milk in Benton county at the time of the study. A preliminary visit was made to each producer in order to arrange a date at which the questionnaire could be completed. This preliminary call resulted in the exclusion of four producers from the study for the following reasons:

(1) refusal to cooperate

(2) insufficient information due to being in production for less than a year

(3) an institutional farm of more demonstrational than functional intent

(4) a hobby-type operation.

Complete cooperation was obtained from the remaining producers despite the lengthy and detailed questionnaire. However, three of the remaining producers were producer-distributors. These three were not included in the study due to difficulties in isolating the production aspects of their operations. Many inputs such as labor, electricity, equipment repairs and other miscellaneous costs overlapped the two aspects. Milk would have had to been valued arbitrarily at the time it left the production and entered the distribution phase of the

operation. It was, therefore, decided to study only the 25 remaining producers.

Most of the dairies from which data were collected had no other enterprises of any importance. Seventeen of the producers received all of their gross farm income from dairy sales and over 90% of the total gross farm income of study farms was from the sale of dairy products. The existance of other enterprises was primarily confined to the producers with few cows.

Size of Herd

Herd size ranged from 20 to 100 cows. Nine producers had less than 40 cows, eight had from 41 to 60 cows, four had between 61 and 80 cows, and four farms had an average of over 80 cows. The overall average was 54 cows per herd giving a total of 1354 study cows in the final sample.

Housing and Equipment

Only two operators housed their cows in conventional stanchion barns. The others used loose housing arrangements modified in three instances to loose housing stalls. Elevated walk-through parlors were used on 14 dairies. Most of these were designed with two parallel rows of stalls. Milk was handled through a pipeline to a

bulk tank on nineteen of the operations studied. The average dairy utilized over 4780 square feet of housing and bedding area and 770 square feet of milk house area. Milk houses contained an average of 5.8 stalls and were equipped with 3.2 milking units.

Production Per Cow

Holstein breeding predominated among the study cows. Fifty-seven percent of the cows were Holstein, 25% were Jersey, 17% were Guernsey, and 1% were of other or mixed breeding. The average cow weighed 1,083 pounds and produced 9,206 pounds of milk testing 4.2% butterfat. Milk production averaged 13,192 pounds of 3.7% milk in the high herd and 5,027 pounds of 5.6% milk in the herd with the lowest average production per cow. Pounds of butterfat produced per cow averaged between 280 pounds and 585 pounds with an overall weighted average of 394 pounds.

The Feeding System

The feeding systems varied to some extent. Two producers fed their cows on a dry-lot basis without providing any pasture. Seventeen herds received some of their nutrients through silage and all herds were fed hay and concentrates in one form or another. An average of 2.3 tons of hay, 6.0 tons of silage, and 1.7 tons of concentrate were fed to each mature cow. The average cow had pasture

available to her for 165 days of the year.

Table 3. Feed fed per cow.

Feed	Pounds per cow	Pounds per day	Value $ per ton
Hay	4, 591	12. 6	25. 74
Silage	12, 098	33. 1	7. 60
Concentrate	3, 338	9. 1	61. 67
Pasture	165 days	---	$. 26 per day

Labor Utilization

The average dairy enterprise required the labor of 1. 2 man equivalents. This labor worked 65. 75 hours per week on the milking phase of the dairy enterprise. Labor required for the milking phase ranged from 5. 00 to 12. 50 hours per day. An average work week of 77. 3 hours or 64. 4 hours per man equivalent was required for the total dairy enterprise when the 5. 00 hours for the pasture phase and 6. 50 hours required to raise replacements are included in the weekly labor.

About 63% of the labor was supplied by the operator himself, 30% obtained through hired labor and the remaining labor was contributed by unpaid members of the operator's family. As indicated in Table 4, most of the labor went into the milking phase of the dairy

enterprise. Expressed in hours of labor required per year, an average of 64 hours per cow was required in the milking phase. Raising replacements utilized 6 hours of labor per cow and 5 hours per cow were required to maintain pastures giving an overall annual labor requirement of 75 hours per cow.

Table 4. Average labor input in hours per year.

Source of Labor	Dairy Enterprise Phases			Total
	Pasture Phase	Replacement Raising	Milking Phase	
Hired	64.5	48.6	1,087.0	1,200.1
Unpaid Family	10.2	42.3	249.6	302.1
Operator	187.8	247.5	2,082.7	2,518.0
Total	262.5	338.4	3,419.3	4,020.2
Average per cow	4.88	6.29	63.58	74.75

COST OF MILK PRODUCTION

1962 INCOME POSITION

The total dairy enterprise was studied to determine the degree of financial success producers achieved in 1962. The classical measures of the operators' labor and management income and percent return on capital were used as indicators.

Total dairy receipts, composed of the value of milk produced, livestock sales and miscellaneous receipts averaged $28,864 per farm. When the value of home grown feed used and livestock purchases were added to cash operating expenses, an average of $21,573 resulted. Inventory values of livestock on hand increased $425 during the year. Crediting this inventory increase and subtracting the value of unpaid family labor ($438) together with depreciation on equipment and buildings ($1,144) left an average net dairy income of $6,134.

Net dairy income is the return to the operator for his own labor, management and the use of his capital. All out-of-pocket or direct costs have been accounted for.[1] Net dairy income would be available for personal expenditure if no mortgage interest had to be

1. Payments of interest on indebtedness would likely have to be met from net dairy income as a direct cost and unpaid family labor may not have to be met.

met. As indicated in Table 5, net dairy income fluctuated substantially between farms. Only one producer failed to show some return to his labor, management and capital however.

One of the more appropriate measures of success is an indication of the return to the operator for his labor and management. After a charge of 5% for the use of the operator's capital (investment averaged $57,710 per dairy enterprise) there remained $3,246 as a labor income. Although this ranged from $-6,932 to $15,124, only two producers had insufficient net dairy income to cover the assigned cost of using their capital.

Table 5. Dairy enterprise income summary.

Item	Average	Range		
		Low	High	50% between
Net dairy income ($)	6,134	-2,541	19,462	3,200 - 7,400
Labor income ($)	3,246	-6,932	15,124	1,000 - 4,000
Return to capital (%)	4.5	-7.2	13.8	-.3 - 6.1
Profit ($)	-260	-8,132	8,787	-2,000 - 750
Quota (lbs. per day)	1,218	290	2,880	700 - 1,550
Price received/cwt. ($)	5.10	4.34	6.81	4.90 - 5.36
Milk produced/cow (lbs.)	9,206	5,027	13,192	8,250 - 10,250
Value of milk/cow ($)	470	335	654	405 - 515

Another measure commonly used is to deduct a charge for the operator's labor and management and express the residual of net dairy income as a percent return to owned capital. The average dairy share value of the operator's labor and management was $3,506. This left $2,628 as a return to the $57,710 worth of capital invested or a 4.5% return. Nine operators failed to obtain sufficient net dairy income to cover the value of their labor and management and, therefore, received negative returns to capital. Eleven producers received over five percent return to capital after the value of their labor and management was met.

Table 5 shows that when both a return of 5% on capital and the value of the operator's labor and management are included in the costs, dairy operators experienced an average net loss of $260 in 1962. In other words, the average producer failed, by $260, to receive what he considered the value of his own contributions. He did not experience an out-of-pocket loss but received just over 90% of the wage or return on capital that he expected he could receive in alternative uses. This loss amounts to $0.05 per hundredweight or $1.01 cost for every $1.00 revenue. (See Table 10).

Total investment in the dairy enterprise averaged $57,710 per farm. Over one third of this was investment in land and nearly 30% was livestock. Capital tied up in buildings accounted for one-sixth

of the total. The remaining 20% of the total dairy investment was composed of equipment and feed inventories. Table 6 shows that investment per cow averaged $1,076. One out of every two producers had between $870 and $1,210 invested per cow.

Table 6. Average investment in the dairy enterprise.

Item	Total Dairy	Investment per cow			
		Average	Low	High	50% between
	$	$	$	$	$
Land	20,005	373	28	1,354	250 - 450
Buildings	9,224	172	50	441	100 - 230
Equipment	6,061	113	27	185	100 - 140
Livestock	16,518	308	162	481	260 - 340
Feed	5,902	110	26	369	85 - 130
Total	57,710	1,076	690 [1]	2,172 [1]	870 - 1,210

1. Individuals having the lowest and highest total investment per cow rather than the sum of the extremes in each item.

The average producer held a quota of 1,218 pounds of milk per day or a daily quota of 22.66 pounds of milk per cow. With the average blend price received by producers at $5.10 per hundredweight, $470 worth of milk was produced per cow.

Based on the producers from which the information was available, the average price received for quota milk was $5.46 per hundredweight, whereas surplus milk brought only $3.10 per hundredweight. In order to obtain a blend price of $5.10 eighty-five

percent of the milk sold must have been quota milk and fifteen percent surplus milk. This means only 21.44 pounds of quota milk were sold per cow each day or the producer was able to sell quota milk equivalent to 95% of the quota held. [1]

REPLACEMENT-RAISING COSTS

Three of the operators purchased all of their replacement stock in 1962. The remaining dairymen raised between five and twenty-five or an average of 12.2 heifers at an average cost of $229 per animal. Included in these costs are the cost of pasture, equipment and buildings used by replacement heifers. Labor costs include the value of the replacement-phase share of hired, family and operator labor. Incidental costs were reduced by an amount equal to the value of manure produced by young stock.

Feed costs which include the cost of maintaining pasture for replacement heifers, make up 45% of the total cost. As indicated in Table 7, labor and interest on capital invested in land and replacement stock were of the magnitude of 19% and 17% of the total cost respectively. Generally, the cost per replacement declined as the number raised per farm increased. The range in cost of raising a

1. These observations are based on data obtained from five producers.

replacement was extremely wide with the three high cost farms experiencing costs of $586, $433, and $328 per animal respectively. The three low cost farms spent $123, $125 and $154 for every replacement raised. One out of two producers raised their replacements for between $188 and $293 apiece.

Table 7. Cost of raising replacements.

Cost Item	Average Cost per Replacement			Percent of Total Cost
	Average all farms	Average on farms raising		
		10 or less	Over 10	
	$	$	$	%
Land and Livestock interest	40	34	43	17
Use of equipment	17	22	13	7
Use of buildings	18	21	16	8
Labor	43	52	38	19
Feed	103	126	90	45
Net Miscellaneous[1]	8	8	8	4
Total	229	263	208	100

1. Miscellaneous costs minus miscellaneous returns.

The wide range in cost per animal can probably be attributed partly to the method of determining the number of replacements raised. The number of home-raised heifers entering the milk herd

during the study year was considered as the number raised. The total cost of raising replacements in 1962 was divided by this number to arrive at cost per replacement. The cost of raising a replacement is a function of time. Producers normally breeding heifers to freshen before they were 27 months of age experienced average costs of $219. Those following a breeding program resulting in heifers freshening at an age beyond 27 months averaged $248 per heifer.

Each producer was asked what price he would expect to pay if he purchased replacements of comparable quality to those he raised. Estimates ranged from $150 to $300 per heifer. One-half the producers estimated that they could purchase replacements for between $200 and $250 with the average estimate being $225. On the basis of individual cost and their respective estimates of what they would have to pay for replacements, eight producers could have purchased heifers at less cost than they experienced raising them and six were better off raising their own. The others would find that the cost of raising replacements was within $20 per heifer of what they would expect to pay for replacements.

PASTURE COST

This section examines the cost of maintaining pasture acreage for the cow herd only. Pasture acreage utilized by replacement heifers and the costs associated therewith were included in the section on replacement raising.

The average dairy had 43 acres of pasture available to the milking herd for 165 days. Pasture acreage, on those farms utilizing this source of forage, ranged from five to 230 acres. Each cow utilized an average of 0.8 acres of pasture on those farms where it was available.

As indicated in Table 8, it cost the average dairyman just over twenty-six cents a day to provide pasture for each cow. The major component of this cost was out-of-pocket expenditures for items such as taxes, fertilizer, irrigation electricity, seed and other supplies necessary to maintain the pasture. A charge for the use of the operator's capital invested in land accounted for over one-fourth of the total pasture cost. Costs associated with the use of equipment and labor necessary to maintain the pasture accounted for 15% and 17% of the total cost respectively.

Costs per acre declined sharply as the size of pasture increased as indicated in Table 8. Direct cash costs decreased substantially indicating less extensive irrigation and fertilizing on the

larger pastures. As a result, yields of forage obtained by the cows would be expected to be higher per acre on the smaller pastures.

Table 8. Annual cost of providing cows with pasture.

Major Cost Items	Cost per acre by size of pasture			Average cost per farm	Cost per cow per day[1]
	Acres of Pasture				
	0 - 20	21 - 40	Over 40		
Interest on land ($)	18.44	14.00	15.12	655	.074
Equipment use ($)	24.01	13.85	4.60	340	.038
Misc. cash[2] ($)	54.61	35.87	16.02	988	.113
Labor ($)	20.11	14.05	6.83	400	.045
Sub-total ($)	117.17	77.77	42.57	2,383	.270
Adj. for feed cut[3]	-	1.35	1.47	58	.007
Net Cost ($)	117.17	76.42	41.10	2,325	.263
Estimated hay yield (tons/acre)[4]	4.36	3.10	3.89	-	-
Apparent hay equivalent yield (tons/acre)[5]	6.30	2.15	1.47	-	-

1. Based on the number of days pasture was available to the cows.
2. Includes taxes, fertilizer, irrigation electricity, seed, and other miscellaneous expenses.
3. Pasture costs were adjusted so that the total cost reflected only the cost of feed harvested by the cows and not costs associated with any feed mechanically harvested off these acres.
4. The average of operators' estimates of hay that could have been harvested had the acres not been pastured.
5. Based on the total digestable nutrients required (See appendix, Figure 1) minus that fed in forms other than pasture. The residual, converted to equivalent tons of hay was assumed to be obtained from the pasture.

Two approaches were used to investigate differences in quality of pasture among the size groups. First, the operators' estimates of hay yields that would have been obtained, had the acreage not been pastured, were averaged for each group. It was observed that the farms having 0 - 20 acres in pasture could have harvested an average of 4.36 tons per acre compared to 3.10 and 3.89 tons per acre from pasture acreages in the 21 - 40 and over 40 acre size groups respectively.

Another approach to determining apparent feed obtained from pasture by the cows is to determine the total nutrients required by the cows and then establish that obtained from pasture by a residual method. Requirements were based on a standard that takes into account both the maintainance and production of the cow. (See Appendix, Figure 1). Total digestable nutrients obtained in the form of the hay, silage, and concentrates fed were subtracted leaving a residual which was assumed to be obtained from the pasture. Converted to equivalent tons of hay the average apparent yield per acre of the three size groups was 6.30, 2.15, and 1.47 tons respectively.

There are several limitations apparent in these methods of investigating the feed value obtained from pasture. It is impractical to assume that the cows will harvest an amount equivalent to that

harvested mechanically from a given acreage. Cows will be turned out on some acres before the forage has matured sufficiently to produce at a maximum nutrient level. Some feed is lost through trampling and manure droppings.

The residual approach to nutrients obtained from pasture assumes that the cows were of a dairy quality comparable to that of cows used in controlled experiments yielding the standards. It was also assumed that the hand fed feedstuffs were of comparable quality to experimental feeds. There can, however, be considerable variation in the nutritive value of all classes of feed. Silage is particularily variable in nutrient content per ton because of the magnitude and variation in water content. This study was not specifically designed to investigate the feed value of pasture, hence, attempts to quantify this aspect are subject to limitations. The approaches do, however, point out individual problem areas over which the producer has control.

Table 9 shows that pasture costs varied substantially from the average of $43 per cow or $0.47 per hundredweight of milk produced. Pasture cost accounted for about 9% of the total cost of milk production or about one sixth of the total feed cost.

Over half the operators provided additional forage during the pasture season. Those providing additional forage fed an average of 0.63 tons of hay and one ton of silage or green-chop per cow during the period that pasture was available. All producers fed concentrates in fairly consistent quantities throughout the year.

Table 9. The average and range of annual pasture costs.

Total Pasture Cost per	Average	Range		
		Low	High	50% between
	$	$	$	$
Cow	43.24	6.00	93.00	35.00 - 60.00
Cwt. milk	0.47	0.13	0.88	0.39 - 0.64
Cwt. 4% milk	0.46	0.10	0.93	0.38 - 0.63
lb. of fat	0.11	0.03	0.24	0.10 - 0.16
$ worth milk	0.09	0.00	0.19	0.08 - 0.13

COST OF MILK PRODUCTION

Pasture and replacement-raising costs were included in the cost of milk production. Pasture costs appear in total feed cost figures and replacement costs were included in net cow depreciation.

One of the costs of milk production is associated with the reduction in productivity as a cow becomes older. If she dies or is sold, then the net cost of replacing her is an actual cost to the operator. A given herd of cows will change in value throughout the year. If no purchases or sales occur, the beginning inventory value minus the ending inventory value would be the decline in herd value for the year. Any death losses would have been taken into account. Young cows may have increased in value and older cows declined in value but the net change in inventory value would be the cost charged.

When transactions have occurred, purchased cows would, and animals sold would not, appear in the ending inventory. Because the purchase price was not included as a direct cost and sales were not treated as income, the net difference between purchases and sales must be accounted for. This was accomplished by adding purchases to the beginning inventory and sales to the ending inventory. Replacement heifers may have been raised on the farm, therefore, the cost of raising replacements was treated in the same manner as purchases.

Part of the decline in value of a cow as she becomes older may be considered to be offset by the value of calves she produces.

In order to account for this offset and at the same time, in effect, to adjust the cost of raising replacement stock so as not to include the cost of raising heifers that were sold before they freshened, the sales of young stock were added to the ending inventory.

The net cow depreciation shown in the study accounts for death losses, decline in value of older cows, increase in value of young stock, purchases and sales. It was computed by summing the beginning inventory of all dairy stock, the cost of raising replacement heifers and dairy livestock purchases. From this total, dairy cattle sales and the ending inventory of dairy stock were subtracted. The remainder was considered to be net depreciation of the cow herd.

Total cost of milk production is the total necessary to remunerate all factors of production including the labor, management and capital of the operator. As Table 10 indicates, the average annual cost amounted to $475 per cow or $5.15 per hundredweight of milk produced. When production was converted to pounds of 4% Energy Corrected Milk, the average cost was $5.02 per hundred pounds. In order to cover total costs, the average producer would have had to receive $1.23 per pound of fat produced. The average producer experienced costs of $1.01 for every dollar received.

Table 10. Average annual cost of milk production

Cost Item	Cost of Production					
	per cow	per cwt. milk	per cwt. 4% milk	per lb. B. F.	per $ milk	% of Total
Feed and Bedding	$	$	$	$	$	%
Interest	4	.04	.04	.01	.01	.9
Hay	59	.64	.62	.15	.13	12.4
Silage	46	.50	.49	.12	.10	9.7
Concentrate	103	1.12	1.09	.28	.22	21.6
Other	1	.01	.01	.00*	.00*	.1
Bedding	5	.06	.05	.01	.01	1.1
Pasture	43	.47	.46	.11	.09	9.1
Total feed	261	2.84	2.76	.68	.56	55.0
Labor						
Hired	28	.30	.30	.07	.06	5.9
Family	7	.07	.07	.02	.01	1.4
Operator	53	.58	.56	.14	.11	11.2
Total labor	88	.95	.93	.23	.18	18.5
Equipment Use						
Interest	5	.05	.05	.01	.01	1.0
Depreciation	10	.11	.11	.03	.02	2.1
Operating	10	.11	.10	.03	.02	2.1
Electricity	6	.06	.06	.01	.01	1.2
Total Equipment	31	.33	.32	.08	.06	6.4
Building Use						
Interest	7	.08	.08	.02	.02	1.5
Depreciation	7	.07	.07	.01	.01	1.4
Operating	8	.09	.08	.02	.02	1.7
Total Building	22	.24	.23	.05	.05	4.6
Other Costs						
Cow depreciation	7	.07	.07	.02	.01	1.4
Cow interest	13	.14	.13	.03	.03	2.7
Land interest	1	.01	.01	.00*	.00*	.3
Taxes	6	.06	.07	.02	.01	1.3
Supplies	7	.08	.08	.02	.02	1.5
Milk haul	24	.26	.25	.06	.05	5.0
Breed & Vet.	8	.09	.09	.02	.02	1.8
Net misc.	7	.08	.08	.02	.02	1.5
Total other	73	.79	.78	.19	.16	15.5
Total Cost	475	5.15	5.02	1.23	1.01	100.0
Milk Value	470	5.10	4.97	1.22	1.00	-

* Less than 0.005

Feed costs accounted for 55% of the total cost or $261 per cow. Hay and silage cost $105 per cow or 22% of the total cost of milk production. The average producer fed $103 worth of concentrates to each cow. Providing pasture for the cows cost $43 per cow.

The second largest cost item was the labor and management utilized by the cow herd. Milking-phase labor averaged $88 per cow or 18.5% of the total cost. The average labor and management of the operator was valued at $1.37 per hour or $53 per cow. Hired labor cost $1.38 per hour and unpaid family labor was valued at $1.45 per hour in the milking phase of the dairy enterprise.

Costs associated with equipment use amounted to $31 per cow or 6.4% of the total cost. Building use totaled 4.6% of the cost or $22 per cow.

The net decline in cow value averaged $7 per cow annually, Interest on the operator's capital invested in cows and the land used for building sites and yard lots totaled $14 per cow. Hauling milk to market cost an average of 26¢ per hundredweight or $24 per cow.

VARIATION IN COSTS OF MILK PRODUCTION

One out of two producers recorded between $220 and $300 feed cost per cow. Milking-phase labor costs fluctuated between $33

and $157 per cow with 50% of the farms showing between $77 and $110 labor cost per cow. The range per cow experienced by the middle 50% of the farms for other costs was: equipment use $22 to $36; building use $15 to $25; and incidental costs $55 to $85. Total cost per cow ranged from $321 to $648 with half of the producers experiencing costs between $450 and $525.

In terms of hundredweight of milk produced, (Costs per hundredweight of 4% Energy Corrected Milk in brackets),[1] costs ranged from $4.09 (3.92) to $6.74 (6.32) with 50% of the farms being between $4.90 (4.80) and $5.70 (5.40). One half of the operators experienced feed costs between $2.60 (2.60) and $3.25 (2.90) per hundredweight. One out of two had labor costs between $0.70 (0.80) and $1.15 (1.15); equipment costs between $0.25 (0.25) and

Table 11. Variations in cost of milk production.

Cost of milk production	Average	Range		
		Low	High	50% between
	$	$	$	$
per cow	475	321	648	450 - 525
per cwt. milk	5.15	4.09	6.74	4.90 - 5.70
per cwt. 4% E. C. M.	5.02	3.92	6.32	4.80 - 5.40
per pound of fat	1.23	0.92	1.73	1.15 - 1.35
per dollar milk	1.01	0.83	1.44	0.95 - 1.10

1. E. C. M. = 0.39 x lbs. milk + 15.25 x lbs. fat.

$0.40 (0.40); building costs between $0.20 (0.15) and $0.25 (0.25); and other costs between $0.65 (0.65) and $1.00 (0.90).

Variation in the cost per pound of butterfat was not as extreme. Four out of five produced butterfat at costs between $1.00 and $1.40 per pound. One half had feed costs between $0.63 and $0.70 per pound of fat.

Costs per dollar value of milk produced averaged $1.01 and ranged from $0.83 to $1.44. Four out of five experienced costs of from $0.93 to $1.20 per dollar value of milk produced.

FACTORS ASSOCIATED WITH VARIATIONS IN DAIRY ENTERPRISE PROFITS

Profits accruing to the dairy enterprise depend upon the profit per unit of milk and the number of units produced. Profit per hundredweight in turn depends upon the cost of producing and the price received for a hundred pounds of milk. Total production of milk is directly related to the output per cow and the number of cows in the enterprise. Because of the fixed nature of some of the input items, cost per hundredweight is influenced by the number of units produced as well as the price paid for the factors of production. Cost of production is also related to the dairy quality of the cows - the ability of a cow to convert inputs into outputs.

Together with adjustments regarding the cost of producing a hundred pounds of milk and the number of units produced, dairymen have the opportunity to influence the price received for their product by variations in the butterfat percentage, the quality of the product with regard to the foreign matter content and the proportion of quota to surplus milk. All of these adjustments can only be made at some cost. This study examines the association between butterfat test and the cost of producing milk. Quotas were negotiable in the study area simplifying the determination of the effect of changes in the proportion of quota on profits. Generally a premium of about

$2.35 per hundredweight was received for quota milk. This margin varies directly with the butterfat content and the market outlet.

The study was not designed to isolate the cost and return effect of different quality control practices. Rigid legislation provides control over the quality of milk entering the Class 1 market. Production practices followed by the dairymen determine the degree of contamination of the milk but no attempt was made to isolate the cost of maintaining the sanitary conditions and practices necessary to provide a product satisfying the established standards.

Many other factors associated with variations in cost of producing milk were beyond the scope of this study. Individual cows were not studied and thus the association between differences in the inherent dairy quality of individual cows and the cost of producing milk could not be examined. The sample did not permit the isolation of economies associated with alternative housing or feeding systems. Natural hazards and factors such as variation in managerial ability of individual producers do not lend themselves to empirical study.

The remaining factors influencing dairy enterprise profit namely, number of cows, production per cow and the butterfat test of milk were examined. The influence of alterations in any of these on the return to the individual producer is readily determinable by

him. The study, therefore, concentrates on the association between these three factors and the cost of producing milk.

SIZE OF HERD

Herds included in the study ranged in size from 20 to 100 cows. Two hundred and seventy-six cows were on the nine farms maintaining herds of less than 40 cows. Eight dairies had herds of between 41 and 60 cows and milked a total of 400 cows. Three hundred and five cows existed on the four dairies milking between 61 and 80 cows and the remaining 364 cows were in the four herds containing over 80 cows.

Cost per cow tended to decrease as the size of herd increased. (Table 12). Economies were achieved as some of the fixed costs associated with the operator's labor and the use of buildings and equipment were spread over more cows. Details of physical and monetary economies associated with size of herd are given in Appendix Table 3. The labor input per cow declined by over 50% as the size of herd increased from less than 40 to over 80 cows. Despite an increase in value of labor per hour, the reduction in annual hours per cow from 98 to 42 resulted in a lower labor cost per cow in the larger herds. Building use costs per cow tended to decline as the size of herd increased due to a reduction in both the housing and milk parlor area per cow.

Table 12. Relation of cost items per cow to number of cows.

Cows per farm	Cost per cow					
	Feed	Labor	Equip.	Bldgs.	Other	Total
	$	$	$	$	$	$
0 - 40	274	111	36	23	73	517
41 - 60	267	102	29	31	92	521
61 - 80	272	77	30	17	60	456
81 - 100	236	65	27	15	64	407
Average (54 cows)	261	88	31	22	73	475

No great economies of size were revealed with regard to equipment costs per cow. Despite an increase in the number of cows using each milking unit and stall as size increased, investment per cow averaged nearly $110 in all size groups. The enterprises with greater numbers of cows tended to have both newer and more costly equipment, no doubt contributing to the lower labor requirements on these enterprises.

No apparent savings were made by quantity feed purchases on farms with greater numbers of cows. Nor was there any significant trend in the quantity or quality of feed fed per cow as size of herd varied. Some reduction in pasture cost per cow was, however, noted as the size of herd increased.

Milk sales per cow tended to decrease along with costs as size increased. Whereas all producers in the largest group did not experience lower production per cow than those in the next smaller group, generally, production per cow fell off as size increased beyond 50 cows (Table 13). It is the margin between costs and returns that is relevant to the decision maker. The profit maximizing optimum would be that size at which the return from an additional cow would just cover the cost of keeping her. If production of existing cows declines with an addition of another cow, the reduced returns from the entire herd must be charged to the additional cow.

Table 13. Relation of number of cows to selected items.

Cows per farm	Milk per cow	Cost per cwt. 4% milk	Daily Quota per cow	Price per cwt. 4% milk	4% milk per cow	Fat per cow
	$	$	lbs.	$	lbs.	lbs.
0 - 40	461	5.25	20.45	4.69	9,841	418
41 - 60	508	5.14	23.91	5.03	10,119	406
61 - 80	476	4.83	23.92	5.07	9,445	375
81 - 100	422	4.82	21.89	5.03	8,441	343
Average (54 cows)	470	5.03	22.66	4.97	9,455	385

Herds averaging less than 40 cows experienced a net loss of $56 per cow. The margin was of the magnitude of a negative $13 per cow in herds averaging from 41 to 60 cows. Not until herds exceeded the mean size of 54 cows were the total costs met on the average dairy. The margin narrowed from $20 to $15 per cow as the average herd size increased from between 61 and 80 to over 80 cows. The average profit per enterprise was -$1696, -$456, $1722 and $1622 for the less than 40, 41 to 60, 61 to 80 and over 80 size groups respectively. The reduced margin per cow was more than enough to offset the effect of the increase in number of cows between the 61 to 80 and over 80 size groups.

Cost per hundred pounds of 4% Energy Corrected Milk showed a steady decrease as size of herd increased. Operators in the largest size group, however, held relatively lower daily quotas per cow resulting in a lower price received per hundredweight of 4% milk. The largest size group would have realized an additional $80 total profit if the ratio of quota to surplus had been equivalent to that of the next smaller group.

PRODUCTION PER COW

In order to examine the effect of annual production per cow on the cost of producing milk, all milk was converted to a 4%

Energy Corrected Milk basis. This was done to eliminate the effect of the butterfat test on the cost of producing 100 pounds of milk.

Average herd production of 4% corrected milk per cow ranged from 6339 pounds to 12, 778 pounds per year. Three out of five producers obtained average production of between 8500 and 10, 500 pounds of 4% corrected milk per cow. Four producers obtained an average of less than 8000 pounds, five had between 8000 and 9000, six from 9000 to 10, 000, six from 10, 000 to 11, 000 and four farms averaged over 11, 000 pounds of 4% milk per cow. The average size of herd in the groups did not vary excessively (Table 15).

The average cost of producing a hundredweight of 4% milk decreased by about a dollar between the less than 8000 and the 10, 000 to 11, 000 pound group. (Table 14). The lowest average cost of about $4. 70 occurred when the average production of 4% milk per cow approximated 10, 700 pounds. Costs increased to over $5. 00 per hundredweight in the over 11, 000 pound group. Costs per hundredweight were less than the price received when the average production was over 9200 pounds of 4% corrected milk per cow.

Feed, labor and equipment costs per hundredweight all decreased as the production per cow increased. Total cost per cow

Table 14. Relation of production of 4% E. C. M. per cow to cost per hundredweight of 4% milk produced.

Average Annual Production per cow (4% E. C. M.)	Average Cost per cwt. 4% E. C. M.			
	Feed	Labor	Equipment	Total
lbs.	$	$	$	$
Less than 8000	2.88	1.17	.38	5.72
8000 - 9000	2.79	.94	.37	5.17
9000 -10000	2.78	.92	.33	4.84
10000 -11000	2.79	.87	.27	4.72
Over 11, 000	2.58	.86	.28	5.08
Average (9455)	2.76	.93	.32	5.02

for the group producing over 11, 000 pound average increased as a result of higher building and incidental costs per hundredweight. Whereas the sample did not provide sufficient data in this group to adequately analyze this phenomenon, it was observed that the cows in this group were housed in more costly buildings and that the net cow depreciation was higher than in other groups. Prices received for 4% milk were substantially higher for the high production group (Table 15). This would indicate that a higher proportion of quota to surplus milk existed on these farms and this may have had some influence on care taken of cows. Although the margin per hundredweight declined from $. 17 to $. 09 as the production increased from between 10, 000 and 11, 000 to over 11, 000 pounds it was

Table 15. Relation of production of 4% E. C. M. per cow to selected factors.

Average annual production per cow	Average Size of herd	Average production 4% milk per cow	Average pounds fat produced per cow	Milk sales per cwt. 4% ECM	Total Cost per lb. of fat
lbs.		lbs.	lbs.	$	$
Less than 8000	48	7,006	292	5.06	1.38
8000 - 9000	68	8,554	347	4.87	1.27
9000 - 10000	59	9,557	388	4.96	1.19
10000 - 11000	49	10,379	428	4.89	1.15
Over 11000	48	12,125	483	5.17	1.28

nevertheless positive despite the increase in cost for the higher production group.

Cost per pound of fat produced followed the same pattern as cost per hundredweight of 4% corrected milk. The margin per pound of fat was - $0.15, -$0.07, $0.03, $0.04 and $0.03 respectively as the production of 4% milk increased.

Expressed on a per cow basis, costs increased more than 50% as the annual production of 4% milk per cow changed from less than 8000 to over 11,000 pounds (Table 16). The primary cause of this increase was the additional feed required to obtain the higher production. Quantities of both roughages and concentrates fed per cow

were substantially higher in the high production herds. Labor input also tended to increase from an annual requirement of about 60 hours per cow to nearly 80 hours in the high production group.

Table 16. Relation of production of 4% E. C. M. to selected factors per cow

Annual item per cow	Average annual production of 4% E. C. M. per cow				
	Less than 8000 lbs.	8000 to 9000 lbs.	9000 to 10000 lbs	10000 to 11000 lbs	Over 11000 lbs.
Labor cost ($)	83	80	88	90	104
Hours of labor	60.9	57.4	60.1	67.2	79.8
Hand fed roughage (tons)[1]	3.55	4.19	4.45	4.65	4.56
concent. (tons)	1.57	1.29	1.76	1.91	1.97
Feed cost ($)	203	239	266	289	313
Total cost ($)	403	442	463	490	616
Milk sales ($)	358	416	474	507	627

1. Includes hay fed plus silage converted to tons of hay equivalent on the basis of three tons of silage equals one ton of hay.

BUTTERFAT CONTENT OF MILK PRODUCED

The price received for a hundred pounds of milk varies with the fat content or butterfat percentage of the milk. Dairymen, therefore, are interested in the relationship between the butterfat content and the cost of producing a hundred pounds of milk.

Butterfat content ranged from 3. 2 to 5. 9 percent among the study farms. Nine producers had a herd average of less than 4%, nine produced milk containing between 4% and 5% and seven herds tested over 5% average butterfat.

The influence of butterfat content on the cost of milk production was difficult to study independently because of the tendency for both size of herd and production of 4% E. C. M. per cow to decrease as the butterfat test increased on the study farms (Table18). On the basis of previous discussion costs would be expected to be higher on the study farms producing high test milk simply because of the effect of size and production per cow on production costs.

As Table 17 indicates, the cost of producing a hundred pounds of milk tended to increase with the butterfat test. Higher labor cost per hundredweight as the test increased can undoubtedly be attributed to the influence of size of herd and production per cow. A margin of returns above costs existed on the average farm when the butterfat content was between 3. 7% and 4. 8%. Profits tended to average highest when the butterfat content of milk produced was about 4. 2%.

The average price received per hundredweight of 4% corrected milk decreased as the percent fat increased indicating that the low test herds existed on farms maintaining a higher ratio of quota to surplus milk. (Table 18). Part of the reduction in profit as butterfat

Table 17. Relation of percent butterfat to cost of producing a hundred pounds of milk.

Butterfat test	Feed cost per cwt.	Labor cost per cwt.	Total cost per cwt.	Total cost per cow	Total cost per lb. fat
	$	$	$	$	$
Less than 4%	2.76	.86	4.94	511	1.35
4% to 5%	2.66	.99	4.92	438	1.14
Over 5%	3.42	1.13	6.25	464	1.17
Average (4.2%)	2.84	.95	5.15	475	1.23

Table 18. Relation of percent butterfat to selected factors.

Item	Average herd butterfat test		
	Less than 4%	4% to 5%	Over 5%
Milk produced per cow (lbs)	10,358	8,893	7,422
4% E. C. M. per cow (lbs.)	9,817	9,340	8,892
Fat produced per cow (lbs.)	379	385	396
Value of milk per cow ($)	508	453	423
Number of cows	573	488	284
Herd size	63.7	54.2	40.6
Butterfat test (%)	3.66	4.33	5.33
Price received per cwt. ($)	4.90	5.09	5.69
Price received per cwt. 4% E. C. M. produced ($)	5.17	4.84	4.73

test increased can be explained by this increase in the proportion of surplus milk. Had the quota to surplus ratio been equal in all groups, profits would have existed on the average until the fat test was about 5.2%.

Cost per cow fluctuated between groups but the value of milk produced per cow declined as the test became higher. Although the fat produced per cow increased from 379 to 396 on the average as the test varied from less than 4% to over 5%, the accompanying decline in milk produced per cow was more than enough to offset the value of the additional fat.

There was an upward trend in net cow depreciation as the butterfat test increased. Veal calves from high test herds generally sold for less and the net depreciation value used had allowed for the value of the calves.

The cost of producing a pound of fat tended to be lower in the high test herd. There was, however, no trend in the cost of producing a hundred pounds of 4% Energy Corrected Milk as the butterfat test of the herds varied.

COMBINED RELATIONSHIPS

The effect of the interrelationship among the factors studied can be minimized by expressing all three variables in a multiple

regression equation. The relationship between the cost of producing a hundred pounds of milk and the size of herd, production per cow and the butterfat test of milk produced was so examined.

The resultant regression equation was of the following nature: (Appendix Table 4)

$$Y = 7.163 - .017a - .189b + .206c$$

where Y = the cost of producing a hundred pounds of milk ($)

a = the number of cows in the herd

b = the annual production per cow in thousands of pounds

and c = the pounds of fat in a hundred pounds of milk produced or the % butterfat test.

Interpretation of the implications of these relationships must be made cognizant of the linearity of the coefficients. Diminishing returns is a generally accepted phenomena in agricultural production. There is, therefore, reason to doubt that any of the variables have linear relationships through changes of any great magnitude. Extrapolation beyond the observed extremes would be of dubious significance.

Generally, data from this study reveal that costs of producing milk were 1.7¢ per hundredweight lower for each cow that

was in the herd. A difference of one thousand pounds in the annual production of milk per cow was reflected in an 18.9¢ inverse change in the cost of producing a hundred pounds of milk. A 20.6¢ variation in the cost of producing a hundredweight of milk was associated directly with a 1% difference in the butterfat content of the milk.

An inherent phenomena in the nature of animals generally suggests that some production per cow is sacrificed as the butterfat test becomes higher. A regression equation developed from these two variables revealed the following relationship. (Appendix Table 4).

$$Y = 14,953 - 1,312.6b$$

where Y = the annual production of milk per cow in pounds

and b = the pounds of butterfat per hundredweight or % butterfat test.

This relationship suggests that a 1% change in butterfat content of milk produced was associated with an inverse change of slightly over 1300 pounds of milk produced per cow during a year.

About two-thirds of the variation in costs of milk production among the study dairies was associated with these three variables. The remainder of the variation was assumed associated with the aformentioned variables that were excluded from the scope of this study.

ILLUSTRATION OF ADJUSTMENT POSSIBILITIES ON SELECTED ENTERPRISES

In a world of change and uncertainty, farm managers must continually choose among goals and uncertain means of attaining them. Budgeting is a technique for estimating the effect of an adjustment in resource use on net income. Conducted on an individual basis, budgeting can be done within the framework of the operator's personal goals and the varying degrees of uncertainty in alternative means.

In analyzing plans for a particular farm, ideally the technical relationships specific for that farm and its resources should be used. Care must be exercised when data from only one year's operation are available. Experimentation was not feasible; therefore, some technical coefficients were obtained from group averages.

This study considers reorganization adjustments that appear feasible and readily adaptable to individual circumstances. The objective, in each case, was to show potential net income improvement on individual enterprises. It is important to recognize that some farmers are not trying to maximize net earnings. Dairymen, like most agricultural producers, are reluctant to make abrupt

changes in their enterprise organization, especially if the existing arrangement has proven fairly successful. Reorganization must be done on an individual basis, taking into account the objectives of the operator and the circumstances of the particular enterprise under study.

No single organization would be optimum for all producers. The proposed changes were selected as being adjustments that, to the author's knowledge, would be within the managerial ability of the operator involved. The illustrations indicate easily adopted adjustments that would result in high net return relative to risks involved rather than adjustments necessary to maximize profits on these enterprises. In the sequence of presentation, the degree of difficulty of adaptation and uncertainty becomes greater.

The technique of examining partial reorganization and the resultant effect on net income is referred to as partial budgeting. Partial budgets were developed for enterprises selected as representative of average, above average and below average net enterprise return. The proposed changes in each case were designed to exploit the apparent advantages and to reduce the influence of disadvantages existing on the individual enterprises.

The enterprise selected as representative of average conditions had a herd size of 50 cows. Production of 4% E. C. M. per

cow was 340 pounds below average. This together with a relatively low value placed on the cows, indicates that the cows on this farm were not of extraordinary quality (Farm A, Table 19).

As indicated in Table 19, this producer fed the cows at a cost of $53 less than the average per cow. Total nutrient requirement was met efficiently if it is assumed that the cows harvested an equivalent of 1-1/2 tons of hay per acre from the pasture during the year. Labor requirements were somewhat above average but building and equipment costs were below average per cow. Total cost of milk production was $419 per cow or $5.09 per hundredweight of milk produced.

In view of a favorable cost position income improvements for this individual should originate from increased returns. An average price received of $4.92 per hundredweight of 4.7% milk would indicate that there is room for improvement in marketing. The average producer received a higher price for 4% milk. Almost one-third of this producer's milk production was in excess of his existing quota. A partial budget was developed to investigate the net effect of purchasing additional quota.

A quota is a guarantee of a proportionate share of the Class 1 market, not a guarantee of Class 1 price for a given amount of

Table 19. Characteristics of enterprises representing average, above average and below average net returns.

	Representative Enterprises			
	Farm A (average)	Farm B (above average)	Farm C (below average)	Average for Study
Size of herd (cows)	50.00	35.00	55.00	54.00
Production /cow (lbs.)	8235.00	10667.00	8256.00	9206.00
Butterfat test (%)	4.70	4.10	3.50	4.20
# 4% E. C. M. /cow	9114.00	10875.00	7597.00	9455.00
Daily # milk/cow	22.56	29.22	22.62	25.22
Daily quota/cow (#)	15.88	31.68	20.47	22.66
Aver. price received ($)	4.92	5.19	4.54	5.10
Profit/cow ($)	-14.00	29.00	-74.00	-5.00
Feed:				
Hay equiv/cow (tons)	2.60	5.26	3.22	4.32
Conc. /cow (tons)	1.40	1.87	1. 82	1.67
Acres pasture/cow	1.00	1.70	1.80	.80
T. D. N. fed/cow (lbs.) 1/	6200.00	10615.00	8650.00	8050.00
T. D. N. required (lbs.)	6250.00	7300.00	6550.00	6650.00
Feed cost/cow ($)	208.00	287.00	218.00	261.00
Labor:				
Hours per cow	69.35	50.71	80.30	63.58
Labor cost/cow ($)	107.00	63.00	122.00	88.00
Equipment:				
Investment/cow ($)	120.00	98.00	101.00	113.00
Cows/milk unit	12.50	17.50	13.80	16.90
Cows/stall	-	8.80	3.50	9.30
Buildings:				
Housing sq. ft. /cow	64.00	97.00	109.00	90.00
Parlor sq. ft. / cow	25.00	22.00	-	15.00
Building cost/cow ($)	16.00	27.00	27.00	22.00
Land invest. /cow ($)	400.00	450.00	504.00	373.00
Average cow value ($)	200.00	280.00	300.00	240.00
Total invest. /cow ($)	918.00	1176.00	1273.00	1076.00
Total cost/cwt. ($)	5.09	4.91	5.43	5.15
Cost/cwt. 4% E. C. M.	4.60	4.81	5.90	5.02
Cost/cow ($)	419.00	524.00	449.00	475.00
Price received (Quota) ($)	5.80	5.33	4.70	-
Price received (Surplus) ($)	3.39	3.20	2.25	-

1/ Assumes that the cows harvested an equivalent of 1-1/2 tons of hay per acre of pasture available to them. Feeds converted to T. D. N. as indicated in Appendix Figure 1.

milk. Generally the study dairies sold quota milk equivalent to 95% of their allotment. However, the price received for this quota was a blend of Class 1 and Class 2 milk. It was, therefore, assumed that any additional quota purchase would result in the receipt of the blend quota price received by the individual in 1962 for an amount equivalent to 95% of the purchased quota.

There is really no established market price for quotas. Normally they are negotiated only at dispersal sales and are sold with the cows. The premium paid, above the market value of the cows alone, was difficult to establish. The cows could be subsequently sold, without quota, and the difference between the purchase price and sale value would indicate the price paid for quota.

In the following illustration, a quota price is initially assumed for illustrative purposes. Later investigation reveals the value of quota to this producer. From this he could determine the price he could afford to pay for quota.

Assuming the purchase price was $10 per daily pound of quota the net effect of purchasing 300 pounds of daily quota was examined. Production would be about 8% above the total quota; sufficient to hedge against seasonal variations in production and guarantee the maintainence of his share of the quota (Proposed change A).

Proposed change A: Purchase 300 pounds of additional daily quota.

Added Costs:		Added receipts:	
300# quota @ $10/lb.	= $3000	285# quota milk per day 104,025 # @ $5.80	= $6030
Interest $\frac{3000}{2}$ @ 7%	= 105		
Reduced Receipts:		Reduced Costs:	
285# surplus milk per day 104,025 # @ $3.39 per cwt.	= 3525	nil	
Added costs and reduced receipts	$6630	Added receipts and reduced costs	$6030

NET EFFECT - $600

This producer would be out $600 at the end of a year as a result of this proposal. However, he would still possess his quota. Because of the nebulous nature of quotas it is difficult to state a period within which the original purchase price should be recovered. As long as the margin between quota price and surplus price is approximately the present $2.40 per hundredweight the purchase of quota now would result in increased total annual receipts of $2500. Receipts would be increased by $8.33 per pound of purchased quota. The problem is to determine what this producer can pay for this quota.

The individual can evaluate this added return the same way he would an annuity. Risk and uncertainty can be accounted for by the estimated years that he expects the value of the quota to remain and by the interest rate he feels adequate. In the above example, the producer may consider the purchase of a pound of quota as a purchase of an annual income flow of $8.33. The breakeven cost per pound would be the present value of an income of $8.33 per year for as long as he expects the margin to exist. The present value of the quota, assuming a 7% interest charge, would be $7.78 if he desires to recover his investment in one year. If the assumption of a one year recovery period is relaxed, the present value of this income flow is $15.06, $34.15 and $58.51 if the recovery period is 2, 5 and 10 years respectively. If quotas could be purchased for less than the present value of the resultant income, profit would be realized.

There are undoubtedly many other adjustment possibilities on this farm. Limited capital availability may require that this investment be forgone in favor of more rewarding alternatives in other enterprises. Some of the internal adjustment possibilities available within this dairy enterprise may be similar to those proposed for the enterprises that follow.

Adjustment possibilities on the enterprise representative of above average returns are more likely to be limited (Farm B, Table 19). The enterprise selected from the group had a fairly small herd that produced an average 10, 667 pounds 4. 1% milk per cow. Average price received was $. 09 per hundredweight above the overall average of $5. 10 for 4. 2% milk indicating that this individual produced very little surplus milk. In fact his daily quota exceeded his average daily production but seasonal variation in production resulted in the receipt of surplus price for some milk.

This producer achieved relatively high production per cow at considerable cost. Feed inputs approximated 5. 26 tons of hay equivalent, 1. 87 tons of concentrate and 1. 7 acres of pasture per cow. Apparent overfeeding exceeding 1. 5 tons of hay equivalent per cow indicated that the dairy quality did not warrant the achievement of production attained.

Labor efficiency was high as labor costs amounted to only $63 per cow compared to $88 in the overall average. Relatively low equipment investment per cow reflects the age of equipment existing on this farm. There is an indication of some excess milk parlor capacity per cow, but, generally, efficient use was made of buildings, equipment and labor.

Despite an apparently well arranged and profitable enterprise there is room for improvement. Adjustment possibilities should take advantage of the labor efficiency, reduce the excess capacity of the milk parlor and assure the maintainence of quota allotment. The illustration shows the net effect of the addition of 4 cows while at the same time, adjusting the feeding program toward feeding existing cows comensurate with their production (Proposed change B).

The net effect of the proposed change would be an increase of about $970 in total profit. Additional labor has been compensated for at $1.50 per hour. If the operator did the work himself and had no alternative use for his labor, he could consider the net effect of the change as adding about $1270 to his labor and management return. In addition to the above, the net effect does not take into account the possible loss of quota under the original organization. The individual may want to add the value of quota saved to the net effect.

Some other adjustment opportunities exist on this enterprise. The purchased cows could be of higher quality than those in the proposal and existing cows could be culled more ridgedly. Increases in the size of herd could also result in greater enterprise profits.

Proposed change B: Add four cows (without quota) and feed existing herd more efficiently.

Added costs;

Housing; 200 sq. ft.
deprec. $\frac{\$300 - 30}{20}$ = $ 14

inter. $\frac{\$300 + 30}{2}$ = 8

Other (per cow);

hay 4 T. @ $25	100
conc. 1.7 T @ $70	119
bedding	5
inter. on feed	5
labor 50 hrs. @ $1.50	75
equip. oper.	15
build. oper.	10
cow deprec.	5
cow inter. $300 @ 6%	18
milk haul	25
breed, vet. etc.	17
	394

$394 x 4 cows = 1576

Added receipts;

4 cows @ 9750# of 4.6% milk = 39,000 pounds

Quota sales 25,200 # @ $5.60 per cwt. =$1411

Surplus sales 13,800# @ $3.50 per cwt. = 483

Reduced receipts;

400# per cow x 35 cows
14,000 pounds milk

@ $5.19 = 727

Added costs and reduced receipts $2325

Reduced costs; (per cow)

hay .9T @ $25	22
conc. .25 T @ $70	17
milk haul	1
	40

$40 x 35 cows = 1400

Added receipts and reduced costs $3294

NET EFFECT + $969

The enterprise representative of low returns can be expected to provide more opportunities for improvement (Farm C, Table 19). A combination of low production per cow and low price received for milk together with high costs resulted in a loss of $75 per cow on this enterprise in 1962. Feed costs were $43 per cow lower than average but production was less than 7600 pounds of 4% corrected milk per cow. Hand fed feed averaged 3.22 tons of hay equivalent and 1.82 tons of concentrate. Pasture averaged 1.8 acres per cow. Despite the low cost of feed per cow it appeared that more feed was provided than should have been needed for the production obtained.

Although herd size was average, inefficient use was made of labor, equipment and buildings. An average of over 80 hours of labor was required per cow resulting in a labor cost of nearly $1.50 per hundred pounds of milk produced. In other words, labor compensation absorbed about one-third of the returns. Excess capacity existed in the milking units, stalls and housing available.

This producer had over $500 invested in land per cow. It is possible that this acreage could be more economically employed in other agricultural production. Alternative uses of resources outside the dairy enterprise were not investigated in this study.

Proposed change C: Purchase 20 cows producing 9000# of 4.8% milk to replace 20 of the less efficient cows.

Added cost;

Interest; 20 cows @ $300 $6000 @ 6%		=$ 360
Other; (per cow)		
hay 4.5 tons	101	
conc. 1.7 tons	114	
cow deprec.	10	
milk haul.	20	
	245	
20 cows @	$245	4900

Added receipts;

20 cows @ 9000# 180,000 pounds	
Quota sales 134,200 @ $5.45	=$7314
Surplus sales 45,800 @ $2.95	1351

Reduced receipts;

20 cows @ 7800# 156,000 lbs.	
Quota sales 134,200 @ $4.70	6310
Surplus sales 21,800 @ $2.25	490
Added cost and reduced receipts	$12,060

Reduced cost;

Inter.; 20 cows @ $175 $3500 @ 6%		210
Other (per cow)		
hay 3.2 tons	72	
conc. 1.8 tons	121	
cow deprec.	-7	
milk haul	17	
	203	
20 cows @ $203		= 4060
Added receipts and reduced cost		$12,935

NET EFFECT + $875

The change proposed for this enterprise examines the effect of increase in size, production per cow and butterfat test of the herd. The initial change includes replacing 20 of the low producing cows with 20 more efficient cows (Proposed change C).

This proposal suggests that income could be improved substantially by a substitution of average cows for the existing herd. More substituting would improve the income even more but additional quota would be required to absorb the added production. Many of the factors contributing to high fixed costs would have to be spread over more output if much improvement is to be attained.

The second proposed change examines the effect of adding 30 cows in addition to the previous proposal (Proposed change D).

The net effect of the second proposed change is an additional profit of $1771. It is a combined effect of increased size of herd, greater production per cow and a higher price received. The two proposals combined would add $2646 to net returns.

Dairymen need to analyze their operations with regard to factors in addition to those illustrated. They should examine the financial aspe cts of buying versus raising replacements and pasture versus year-round dry-lot feeding. Savings may accrue

Proposed change D: Purchase 30 additional cows (with 23 pounds of quota each).

Added costs;

Housing; 1000 sq. ft.

deprec. $\frac{1500 - 100}{20}$ =$ 70

inter. $\frac{1500 + 100}{2}$

@ 5% 40

Milk units; $1000

deprec. $\frac{1000 - 100}{10}$ = 90

inter. $\frac{1000 + 100}{2}$

@ 5% 30

Cow inter. $500 x 30 cows $15000 @6% = 900

Other; (per cow)

hay 4.9T	110
conc. 1.7 T	114
labor 50hrs.	75
equip.oper.	13
bldg. oper.	12
cow deprec.	10
milk haul	21
breed, vet., etc.	25
	380

$380 x 30 cows =11,400

Added receipts;

9200# x 30 cows = 276,000#

Available quota:

23 x 30 x 365 x .95	=239,300
plus reduced output	4,700
	244,000

Quota sales 244,000#

@$5.45 = =$13,298

Surplus sales

276,000	
-239,300	
36,700	
+ 800	
37,500	
@ $2.95	= 1,106

Proposed change D: (continued)

Reduced receipts;		Reduced costs;	
Reduced production of herd 100# per cow = 5500#		Reduced feed due to low lower production	140
Quota sales 4700# @5.00 per cwt.	= 235	Reduced hauling	12
Surplus sales 800# @2.50 per cwt.	= 20		
Added costs and reduced receipts	$12,785	Added receipts and reduced costs	$14,556

NET EFFECT+ $1771

to careful shopping for purchased resources. Cropping enterprises should be evaluated to determine the cost of home grown feeds. They need to know the ratios at which feedstuffs substitute for each other so they can determine least-cost feed combinations.

Time and motion studies reveal potential labor savings can often be made by simple rearrangement of buildings and equipment. Dairymen also need to examine the substitutability of labor and capital if they are to make knowledgeable decisions.

The reader is cautioned in the use of the net effects shown in any general application. The results reflect individual circumstances and similar conditions are not likely to be duplicated on other farms.

The purpose of this section was to demonstrate the effect of some proposed changes on individual enterprises. The list of possible adjustments was by no means exhausted but the technique of investigating possible alternatives was illustrated.

SUMMARY AND CONCLUSIONS

Grade A dairymen, like most business managers, must deal with three general types of decisions. They must decide what and how much of various products to produce. Secondly, they deal with decisions with respect to methods of production to be followed. The third general type of decision has to do with the marketing of their products.

Dairymen are somewhat unique among agricultural producers in that having decided to produce milk they have not completely satisfied the what to produce problem. They can influence the product through sanitary measures, variations in butterfat content, and the amount of production in excess of quota. Individually, their actions in the market place with respect to supply and demand have little influence on the general price level of milk. They can, however, influence the price they receive by variations in the product. The principal managerial decisions, however, concern the quantities to produce and the techniques of production.

This study was designed to reveal data pertinent to the decision making process of Grade A milk producers in Benton county. An optimal decision implies that a producer has certain objectives

and that this decision comes nearer than alternative decisions to fulfilling these objectives. While profit maximization is a realistic objective and one more easily subjected to analysis, non-monetary goals must be recognized in the decision making process.

The product of dairy farms has shifted from cream to fluid milk. Uncertainty has been somewhat lessened by the adoption of a quota marketing system. Individual producers are assured of a proportion of the area sales of fluid milk. While removing some of the uncertainty, quotas complicate the decision making process. A producer must follow a breeding program that insures fairly stable production throughout the year and should produce in excess of his quota if he expects to maintain his proportionate share of the area market. If he is producing at an economic optimum and input costs such as feed costs increase, his decision to reduce feed input must be based not only on the subsequent reduction in production but also upon the effect this reduced output may have on his quota and, consequently, his future income.

Output of milk in Oregon has declined over the past decade. At the same time the average size of herd and the average production per cow have increased substantially. It is clear that if these trends continue there will be a significant reduction in the number of milk

producers in Oregon. Decisions made at any point in time are likely to have future ramifications. Future expectations regarding cost-price relationships can be based upon historic trends.

An important trend to dairymen is the change that has occurred in the methods of payment for milk. The price received per hundredweight for high-test milk has declined while that for low-test milk has been maintained and showed a tendency to increase slightly during the last decade. Prices paid for feed inputs have remained fairly constant while labor costs have shown an annual increase of about $60 per hired man. Many incidental costs associated with milk production have also increased.

Producers will have to achieve a higher degree of efficiency or produce more units if they expect to maintain or improve their income position in view of this decreasing margin per unit. This study was designed to provide information that would be of assistance to producers in their adjustment decisions. The cost and return situation on Grade A dairy enterprises in Benton county was determined. Factors associated with high returns were studied and the technique of evaluating adjustment possibilities through partial budgeting was illustrated.

During the summer of 1963 a survey of Grade A dairy enterprises was undertaken. Data relating to costs and returns for the 1962 calendar year were collected. Only the dairy enterprise - that aspect of the farm operation dealing directly with the milking herd - was studied. The dairy enterprise was subdivided into replacement-raising, pasture and milking phases.

Cash operating expenses and milk production data were obtained directly from farm records. Investment charges were based on 5% of the average inventory value of assets used in the dairy enterprise. Equipment and building depreciation was calculated on a straight-line basis. Home-grown feed and milk used on the farm were charged at the income forgone by choosing not to sell them. Pasture was charged at the cost of establishing and maintaining existing acreages. The operator's labor and management was valued according to the individual's estimate of alternative earnings. Labor costs were prorated to the respective phases according to time spent.

Twenty-five enterprises were included in the study sample. Non-dairy enterprises existed on less than one-third of the farms. The average size of herd was 54 cows. Herd size ranged from 20 to 100 cows. A total of 1354 cows were included in the study.

The average enterprise provided over 4780 square feet of housing area, 770 feet of milk parlor, 5.8 stalls and 3.2 milking units. An average of 2.3 tons of hay, 6 tons of silage and 1.7 tons of concentrates were fed per cow. The average cow had 0.8 acres of pasture available to her for 165 days and produced 9206 pounds of 4.2% milk in 1962. An equivalent of 1.2 men worked an average work week of 64.4 hours each in the dairy enterprise. Less than one-third of the labor was hired; the remainder was contributed by the operator and unpaid members of his family.

An average net dairy income of $6134 was received for the operator's labor, management and invested capital. When a 5% return on capital was charged, the average labor income was $3246. This was $260 below the estimated value of the operator's labor and management. Generally, Grade A dairymen realized a return of over 90% of what they could expect from their best alternative; a relatively high degree of success for agricultural production.

It cost the average producer $229 to raise a replacement heifer. He estimated that the purchase of a comparable heifer would cost $225. Generally, producers raising less than 10 replacements per year would have been financially ahead in the long-run to have purchased them. The optimal decision depends upon

individual circumstances. Unless the fixed resources released by the discontinuance of raising replacements can be reallocated to alternative uses, only the variable cost of raising replacements need be considered. An individual whose herd was of superior quality would experience more risk if he purchased replacements than would a producer with a relatively poor herd.

The study revealed that it cost an average of 26¢ per day to provide pasture for a cow. The cost declined from $117 per acre on enterprises with less than 20 acres of pasture to $41 on those providing a total of over 40 acres. Both the operator's estimate of hay yields and a residual nutrient approach revealed that less feed was available per acre on the larger pastures.

The sample did not permit adequate comparison of dry-lot versus pasture as a summer feeding practice. The cost of apparent nutrients obtained from pasture was investigated however.

Hand-fed roughage approximated 3.33 tons or a daily amount of 33.3 pounds of hay equivalent per cow during the 200 day period in which cows were not pastured. During the 165 day pasture period, daily hand-fed roughage amounted to 12.1 pounds of hay equivalent per cow. If roughage requirements were uniform throughout the year, pasture must have yielded 21.2 pounds of hay equivalent per

cow daily. On the basis of the daily cost of 26¢ per cow, it would be concluded that roughage obtained from pasture cost approximately $24.50 per ton of hay equivalent obtained. This would indicate very little difference in cost between pasture and dry-lot methods of providing summer forage.

Total cost of milk production, including a charge for the operator's contributions, averaged $475 per cow or $5.15 per hundredweight of milk produced. This amounted to $5.02 per hundredweight of 4% Energy Corrected Milk or $1.23 per pound of butterfat produced.

Feed costs were the major component of expenses accounting for 55% of the total. Labor amounted to 18.5%, equipment use 6.4% and building cost accounted for 4.6% of the average cost of milk production. Incidental costs amounted to 15.5% of the total.

Whereas averages are valuable indicators of the general financial situation and the physical requirements, factors associated with variations in dairy cost are more pertinent to the decision making process. Because of the ease with which individuals can determine the returns effect of changes in output of milk, quota to surplus ratio and the butterfat content of milk, this study concentrated on the cost effect associated with these variables.

Total cost per cow was inversely related to size of herd. Labor cost per cow averaged $110 in the size group with less than 40

cows and $65 in the over 80 size group. Economies of size were also revealed in equipment and building use costs.

While average costs per cow decreased as size increased so did the production per cow. Whereas economies of size were sufficient to offset the reduced returns per cow as size increased from between 41 and 60 to between 61 and 80 cows, they were not so between the 61 to 80 and over 80 size groups. Total enterprise profits were maximized when the average herd size was about 82 cows.

With the exception of the over 11, 000 pound group, average cost per hundredweight of 4% corrected milk declined as the production per cow increased. Feed, labor and equipment costs per hundredweight declined as production per cow increased. Building use costs and net cow depreciation increased in the over 11, 000 pound group reflecting more costly housing and a higher turnover of cows in this group.

Average cost per hundredweight was below the price received in groups with average production over 9000 pounds of 4% corrected milk per cow. Costs averaged lowest - about $4. 70 per hundredweight - when production of 4% milk averaged approximately 11, 100 pounds per cow.

Independent association between butterfat content and costs of milk production was difficult to isolate because of the inverse relationship between butterfat content and production per cow. Profit margins existed on enterprises in which the average test was between 3.7% and 4.8%. They tended to be highest when the test was about 4.2%.

A multiple regression equation was developed to investigate the independent relationship between cost of producing a hundred pounds of milk and the size of herd, production per cow and butterfat content of milk. The resultant equation revealed that a one cow increase in size of herd was reflected in a decrease of 1.7¢ per hundredweight; a 1,000 pound increase in average annual production per cow was associated with an 18.9¢ decrease in cost; and, a one percent increase in butterfat content was associated with a 20.6¢ increase in costs per hundredweight.

Although the law of diminishing returns suggests that these linear relationships would not hold throughout the entire production function, adjustments of a minor magnitude could be expected to be reflected in the above changes in cost of production.

The relationship between butterfat content and pounds of milk produced per cow was investigated. A one percent increase in

butterfat content was found to be associated with a 1313 pound decrease in annual production per cow. A one percent increase in the butterfat content would be expected to be reflected in a cost increase of 20.6¢ per hundredweight as a result of the higher test and an additional 24.8¢ increase in cost as result of the decrease in production per cow.

Adjustment decisions by individual producers must be based not only upon the factors associated with dairy enterprise profits but also upon the peculiarities of the individual enterprise. No single organization can be deemed optimum for all dairymen.

Budgeted alternatives were presented to illustrate the technique by which individuals could evaluate the expected effect of a proposed adjustment. Enterprises representative of average, above average and below average profits were selected as examples. Partial budgets of proposed changes illustrated that even the enterprise with above average returns could be improved upon with relatively minor adjustments. All possible adjustment opportunities available to Grade A milk producers could not be illustrated in this paper. The illustrations do point out that adjustments could be made to improve the income positions of many producers.

Grade A milk producers in Benton county have organized their operations quite effectively. Some adjustments may be required if the less successful enterprises are to be maintained. Generally, the financial situation appeared quite sound. Any adjustment toward improving dairy enterprise profits must recognize other alternatives and non-monetary objectives of the dairymen.

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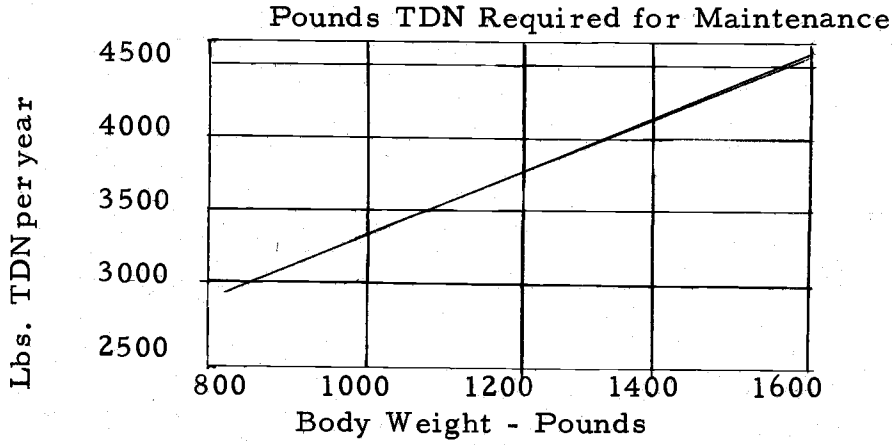
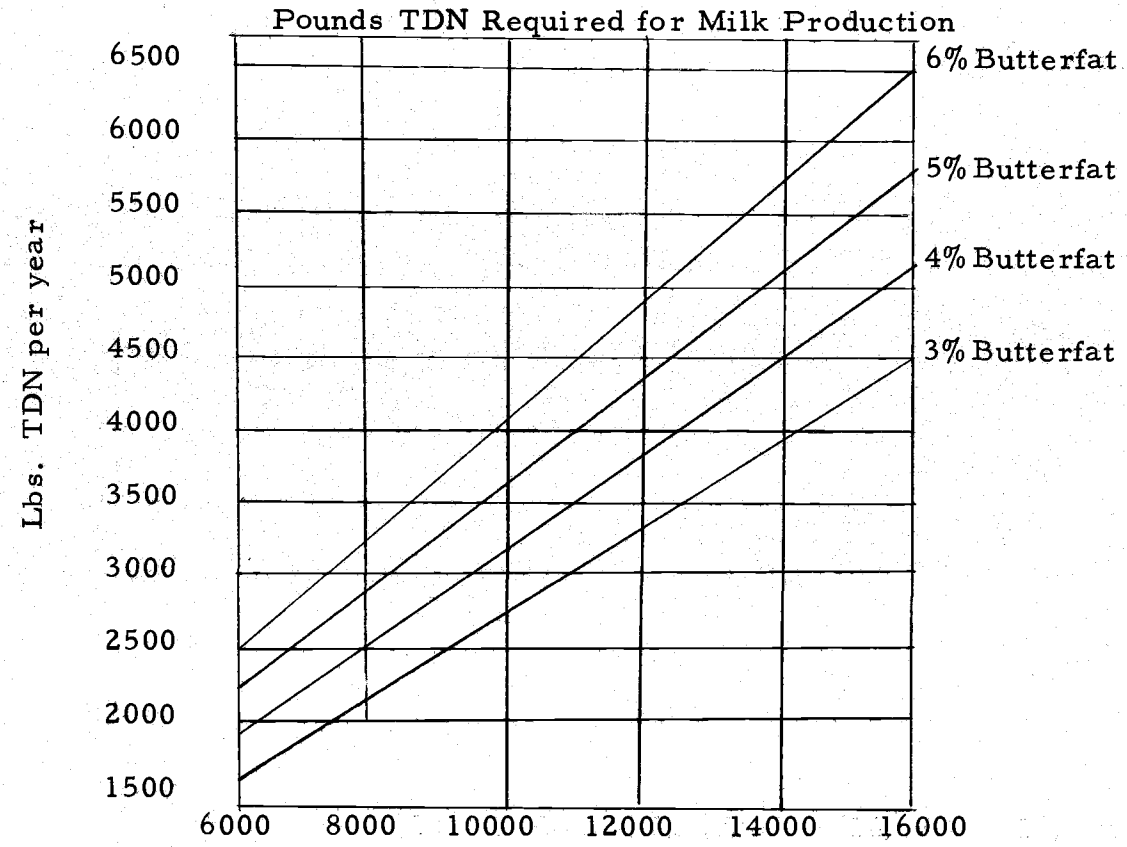
Appendix Figure 1. Dairy Cow Feed Requirements (3) [1]





1. Feeds converted to Total Digestable Nutrients (T. D. N.) on the following basis; Hay 50% T. D. N., Silage 16% T. D. N., Concentrate 75% T. D. N.

Appendix Table I. Methods of paying for Grade A milk entering into Class 1 trade of Portland milkshed. (6)

Dates	Method of Payment		Rate per 100# 3.5%	Rate per 100# 5%
	$ per # B. F. +	$ per 100# Milk	$	$
Oct. 1946 - May 1947	1.37	.00	4.80	6.85
June 1947 - Oct. 1947	1.00	1.20	4.70	6.20
Nov. 1947 - July 1948	1.15	1.40	5.42	7.15
Aug. 1948 - June 1949	1.16	1.58	5.64	7.38
July 1949 - Nov. 15 1950	.90	1.90	5.05	6.40
Nov. 16 1950 - Feb. 8 1951	.95	2.05	5.38	6.80
Feb. 9 1951 - Apr. 15 1953	1.08	2.27	6.05	7.67
Apr. 16 1953 - May 15 1954	.76	3.16	5.82	6.96
May 16 1954 - Nov. 2 1954*	.72	2.82	5.34	6.42
Nov. 3 1954 - Dec. 31 1954	.72	2.36	4.88	5.96
Jan. 1 1955 - Sept. 30 1955	.66	2.60	4.91	5.90
Oct. 1 1955 - May 3 1956	.70	2.79	5.24	6.29
May 4 1956 - Feb. 24 1957	.73	2.95	5.50	6.60
Feb. 25 1957 - May 31 1958	.76	3.05	5.71	6.85
June 1 1958 - Apr. 30 1959	.73	2.94	5.50	6.59
May 1 1959 - June 14 1959	.72	2.86	5.38	6.46
June 15 1959 - Sept. 30 1960	.75	2.98	5.60	6.73
Oct. 1 1960 - Oct. 15 1960	.73	2.92	5.48	6.58
Oct. 16 1960 - Apr. 15 1961	.75	2.98	5.60	6.73
Apr. 16 1961 - June 15 1961	.70	2.05	4.50	5.55
June 16 1961 - Mar 31 1962	.73	2.88	5.44	6.53
Apr. 1 1962 - June 30 1962	.74	2.96	5.55	6.66
July 1 1962 - Feb. 28 1963	.73	2.94	5.50	6.59
Mar. 1 1963 - June 14 1963	.73	2.88	5.44	6.53
June 15 1963 - July 31 1963	.70	2.70	5.15	6.20
Aug. 1 1963 -	.73	2.74	5.30	6.39

* Milk Marketing Act repealed by popular vote.

Appendix Table 2. Analysis of price trends for Grade A milk in the Portland milkshed, 1947-63.

Year	Average Price Received for 3.5% milk $/cwt.	Average Price Received for 5.0% milk $/cwt.	
	Y_1	Y_2	X
1947	4.87	6.68	1
1948	5.53	7.27	2
1949	5.35	6.89	3
1950	5.11	6.47	4
1951	5.99	7.60	5
1952	6.05	7.67	6
1953	5.89	7.17	7
1954	5.44	6.55	8
1955	4.99	5.75	9
1956	5.41	6.50	10
1957	5.68	6.81	11
1958	5.59	6.70	12
1959	5.54	6.65	13
1960	5.60	6.72	14
1961	5.33	6.43	15
1962	5.50	6.59	16
1963 [1]	5.40	6.48	17
Total	93.27	114.93	153

1. Data available for first seven months only.

General Equations: $\Sigma Y = Na + \Sigma X b$

$\Sigma XY = \Sigma Xa + \Sigma X^2 b$

1. Price trend 3.5% milk

$93.27 = 17a + 153b$

$842.16 = 153a + 1785b$

$b = .0067$

2. Price trend 5% milk

$114.93 = 17a + 153b$

$1019.02 = 153a + 1785b$

$b = -.038$

Appendix Table 3. Relation of size of herd to selected items.

Item per cow	Number of cows per farm				Overall Average
	0-40	41-60	61-80	81-100	
Milk phase labor (hrs.)	97.5	70.6	49.2	42.2	63.6
Labor per hr. ($)	1.14	1.44	1.57	1.54	1.38
Housing sq. ft.	91.9	106	87.9	66.1	90.0
Milk parlor sq. ft.	26.1	14.1	10.7	12.7	15.4
Building investment $	179	195	162	121	172
Building investment per sq. ft.	1.52	1.62	1.64	1.54	1.63
Milking units	.08	.06	.05	.04	.06
Milking stalls	.21	.13	.08	.06	.11
Equipment investment	113	116	102	116	113
Hay fed (tons)	2.28	2.49	2.02	2.32	2.29
Silage fed (tons)	5.87	3.51	7.60	7.68	6.05
Concent. fed (tons)	1.97	1.55	1.84	1.17	1.67
Hay ($ per ton)	24.56	25.70	27.23	25.43	25.76
Silage ($ per ton)	6.47	8.83	8.16	7.16	7.60
Concent. ($ per ton)	60.40	72.25	61.41	62.39	61.67

Appendix Table 4. Relationship between cost of milk production and number of cows, production per cow and butterfat test.

Number of cows	Annual production per cow	Butterfat Test (%)	Cost per hundredweight Milk ($)
X_1	X_2	X_3	Y
100	7,300	4.79	4.39
80	9,470	4.08	4.09
100	10,591	3.90	4.17
50	8,235	4.70	5.09
35	10,667	4.13	4.91
80	10,265	3.70	4.61
39	8,874	5.08	5.62
52	9,485	4.57	5.29
19	9,907	5.90	6.41
51	11,874	4.01	5.00
45	7,672	5.11	5.86
37	8,415	5.40	6.19
50	13,192	3.75	4.91
51	12,500	3.50	4.79
32	7,962	5.30	6.33
65	8,441	4.21	5.46
80	9,867	3.78	5.12
81	5,027	5.57	6.74
29	10,575	3.66	5.14
30	7,553	4.10	5.66
46	8,978	3.87	5.58
30	8,258	5.07	6.74
55	8,256	3,48	5.43
25	7,714	4.14	6.27
82	9,694	3.20	5.55
1354	230,772	109.00	135.35

Appendix Table 4. (Continued)

a) Combined relationships:

		F
b_0 =	7.163424	36.68**
b_1 =	.01675621	15.45**
b_2 =	.00018945	8.81**
b_3 =	.2064666	1.63

S^2 = .205857

R^2 = .676882

R = .8227

Resultant equation

Y = 7.163 - .0167a - .189b + .206c

where

Y = cost of producing 100# of milk

a = number of cows in the herd

b = thousand pounds of annual milk produced per cow

c = pounds of fat in a hundred pounds of milk.

b) Relationship between production per cow and butterfat test:

230772 = 25a + 109b

989011.76 = 109a + 488.3082b

b = -1312.6

a = 14953

Y = 14953 - 1312.6x

Where Y = pounds of milk produced per cow

x = pounds of fat in 100# of milk.

Appendix Table 5. Comparison of milk cost studies in Oregon (1, p. 64).

Item	Grade A milk 1962	Grade A milk Oct. '46 to Sept. '47	Market Milk April '29 to May '33
Farms in study	25	61	55
Average herd size	54	24	14
Annual milk per cow (lbs.)	9,206	7,422	6,786
Annual fat per cow (lbs.)	394	325	284
Butterfat test (%)	4.20	4.38	4.18
Amount per cow annually			
Hay, pounds	4,580	5,101	4,754
Succulence, pounds	12,100	7,256	8,298
Concentrates, pounds	3,340	2,669	2,013
Pasture, days	165	168	108
Labor, hours	75	145	148
Milk produced per hour of labor, pounds	123	51	46
Butterfat per hour of labor pounds	5.25	2.24	1.92
Net cost of production			
Per cwt. milk ($)	5.15	5.90	2.14
Per pound fat ($)	1.23	1.35	.51