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To the Graduate Council:

I am submitting a thesis written by Thomas William Little entitled "An Economic Analysis of Alternative Dairy Herd Replacement Policies on Grade A Dairy Farms in the Knoxville Milkshed." I recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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AN ECONOMIC ANALYSIS OF ALTERNATIVE DAIRY HERD REPLACEMENT POLICIES ON GRADE A DAIRY FARMS IN THE KNOXVILLE MILKSHED

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Thomas William Little

August 1964

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CHAPTER I

INTRODUCTION

Increases in the prices of factors used in farm production and family living combined with relatively stable prices for milk and milk products is forcing the dairy farmers in Tennessee to improve the efficiency of their operation or find some way to supplement their income in order to maintain their present level of living.

In an effort to increase the economic efficiency of their operations farmers have in the past expanded, intensified, and/or specialized their operations. Expansion of a firm's limited resources permits more complete utilization of other resources with excess capacity. Improvements in efficiency through expansion often enables the firm to reduce the unit cost of milk production. Intensification of the operation implies producing more of a product from the same set of fixed resources. In a dairy operation this may take the form of carrying more milk cows on a given acreage. Specialization implies using all the resources available to produce one or a few products, rather than several. For example, a farmer producing hogs, sheep, and milk may drop the hog and sheep enterprises and specialize in the production of milk. Adjustments of these types are usually motivated by economic factors and are the result of the farmer's efforts to produce a given product in a more efficient and, thus, more profitable manner.

Farm operators have continued to expand and intensify their operations. However, in many areas of Tennessee expansion, in an acreage sense, is becoming more difficult as metropolitan areas expand and land values increase. Intensification and specialization are thus receiving more emphasis as means of increasing efficiency of the farm operation.

Traditionally dairy farmers have considered the dairy heifer enterprise an essential part of their operation. A general feeling has prevailed that the raising of replacement stock from their best cows is the only means of assuring quality replacement animals. Raising replacements on the farm where they are used is still the most common method of obtaining replacements. But, with improved channels of marketing information, improved health standards, and more widespread production testing, purchasing as a replacement policy is becoming more acceptable.[1]

Contract raising, another method of obtaining replacements, has increased in importance during the past few years. Contracting permits a milk producer to acquire replacements similar to the rest of his herd in quality, thus avoiding the purchasing of animals of unknown ancestry. Under a contractual arrangement the milk producer agrees to pay a grower or a replacement specialist a stated amount to raise the heifers produced

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[1]Albert C. Heaslett, A Study of Herd Replacement Methods on Dairy Farms in North Alabama, Master's thesis, University of Tennessee (Knoxville, 1962), p. 1.

from his own cows. This type of arrangement permits the milk producer to increase the size of his milking herd without large additional investments in buildings, equipment, land, etc.[2]

By purchasing or contracting instead of raising his replacements, a farmer releases land, labor, capital, and management which can be used to increase the size of the milking herd. The returns from the additional cows which can be cared for when not raising replacements is called opportunity cost. Suppose that it costs $200 each to raise replacements and their market value is $225. If a farmer generally needs eight replacements a year, it would appear that he has saved $200 by raising his own. However, if the resources used by the eight replacements would support four cows which would yield a net return of $100 per cow per year, there has been a loss of $400, or an opportunity cost of $400 has occurred. This example illustrates a possible sacrifice in income which should be considered by each farmer in deciding on the method of obtaining herd replacements.

I. THE PROBLEM

Commercial dairy farmers in Tennessee replace between one-fourth and one-fifth of their milk cows annually.[3] The methods or alternatives for procuring replacements are: raising 100 per cent of the needed replace-

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[2]John W. Jack, Economic Considerations in Raising Dairy Replacements, Agricultural Experiment Station Bulletin 123 (Ithaca, N. Y.: Cornell University Press, 1963), p. 19.

[3]M. Lloyd Downen and David W. Culver, The Dairy Cattle Replacement Markets of Tennessee and Florida, the University of Tennessee, Agricultural Experiment Station Bulletin 318 (Knoxville, 1960), p. 11.

ments on the home farm; purchasing calves, bred heifers, or cows; contracting with a grower to raise the needed replacements; or some combination of these.

In order to make a wise economic decision the farmer needs information on actual cost as well as opportunity cost of acquiring replacements by various methods.

II. OBJECTIVES

The objectives of this study are: (1) to determine and describe present methods used by Grade A dairy farmers in the Knoxville milkshed in procuring dairy herd replacements; (2) to determine attitudes and factors affecting the dairy farmers' decisions in obtaining herd replacements; and (3) to estimate actual and opportunity cost of obtaining replacements by various methods.

III. REVIEW OF LITERATURE

According to Downen and Culver, in 1958 the average herd size on Tennessee Grade A dairy farms was 33 milk cows per farm, the average replacement rate was 20 per cent, and the total number of replacements for 1958 in Tennessee was estimated at 34,033 head. Farmers raised 46 per cent of their replacements, bought 17 per cent at auction sales, bought 14 per cent from local cattle dealers, and 23 per cent came from other sources.[4] Fifty-nine per cent of all heifers were kept to be raised,

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[4] Ibid., p. 2.

ten per cent died, and the remainder was sold as baby calves. Within the Knoxville milkshed the average price paid for heifers purchased for replacements was $266 per head, while the average for the state was $225 per head.

A Florida study estimated the average cost of raising a heifer in 1960 to be $323 for all the farms included in the study or $269 per heifer for the four low-cost farms.[5] A 1958 Cornell University study estimated the cost of raising dairy heifers at $187 per heifer.[6] In a 1963 study at Cornell University the cost of home raised replacements was estimated to be $303 per heifer.[7] The cost of raising a dairy heifer to 24 months of age was estimated to be $230 per heifer in an Oklahoma State University study conducted in 1962.[8]

The study conducted at Cornell University in 1963 estimated that the cost of dairy herd replacements when obtained under a contractual agreement was $289 per head when the contract was $10.50 per head per month. The average cost of purchasing heifers was $264, and a contractual arrangement based on $0.25 per pound of gain averaged $250 per heifer.[9]

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[5]A. F. Cribbett and R. E. L. Greene, Costs and Returns in Raising Dairy Heifers, Six Farms, Orange County, Florida, 1960, Department of Agricultural Economics and Agricultural Extension Service, Cooperating, Florida Agricultural Experiment Station, Agricultural Economics Series No. 61-11 (Gainesville, Florida, 1961), pp. 21-22.

[6]L. C. Cunningham, Costs and Returns in Raising Dairy Heifers, Agricultural Experiment Station Bulletin 11 (Ithaca, N. Y.: Cornell University Press, 1958), p. 27.

[7]Jack, op. cit., p. 25.

[8]Clark Edwards, Costs and Methods of Obtaining Holstein Heifers on Oklahoma Dairy Farms, Agricultural Experiment Station Processed Series P-425 (Stillwater, Oklahoma, 1962), p. 1.

[9]Jack, op. cit., p. 25.

Researchers at the Texas Agricultural Experiment Station estimated the cost of raising dairy herd replacements from birth to first calving to be $144.30 for Holsteins and $113.63 for Jersey heifers, excluding pasture cost.[10] These studies indicate not only a wide range in cost of raising heifers, but variations due to factors considered in their computations.

Cost of replacements is not the only reason given for following one particular policy. Farmers usually consider such attributes as annual production, life expectancy, risk of disease, etc. A study by Frick and Henry at the University of New Hampshire in 1956 found no significant differences existed in production when comparing purchased and raised replacements, that no differences in life expectancy existed, and that it is more economical to use purchased replacements as the averaged milk production per cow increases.[11] This study was based primarily on data obtained from Dairy Herd Improvement Association records, plus information obtained from 62 farmers.

IV. IMPORTANCE OF THE STUDY

Grade A dairy farmers in Tennessee produce approximately 35,000-40,000 dairy cow replacements each year. The cost of raising these re-

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[10] S. E. Carpenter and B. H. Stone, Dairy Herd Replacement Costs, Texas Agricultural Experiment Station Bulletin MP-307 (College Station, Texas, 1958), p. 6.

[11] G. E. Frick and W. F. Henry, Production Efficiency on New England Dairy Farms, Agricultural Experiment Station Bulletin 430 (Durham, New Hampshire, 1956), pp. 4-12.

placements is not known for the state as a whole, but studies have indicated that a wide range of costs of raising replacements exist between different geographical regions of the country and that a wide range of costs exist between different methods of obtaining replacements. Thus, with a need for increased efficiency, it was felt that an economic analysis of replacement policies was needed to provide farmers additional information which would aid them in selecting a policy suited to their particular needs.

V. PROCEDURE

In an effort to provide useful information to Tennessee dairy farmers this study was designed to obtain data on replacement policies of a group of small, medium, and large farms in the Knoxville milkshed. The actual as well as opportunity cost of acquiring replacement stock by various methods could vary by herd size. Thus, the study was designed to make comparisons of the cost of acquiring replacements on three different-sized groups of farms.

A readily available description and classification of dairy farms in the Knoxville milkshed was not available. Basic information for the study was obtained through personal interviews with 153 Grade A dairy farmers who market their milk products on the Knoxville Milk Marketing Order. Data were obtained to provide information on the following for each farm included in the survey: land resources and use, the dairy herd, management of the dairy herd, current replacement policy, attitudes

of the farmer relevant to various replacement policies, physical resources of the farm, dairy heifer husbandry, labor availability, and herd expansion intentions.

The Knoxville milkshed was selected as the region of the study for the following reasons: (1) it is the only milkshed in the state which does not include portions of other states; (2) it is one of the major dairy regions in the state; (3) a milkshed provides a grouping of dairymen for which secondary data can be obtained; and (4) a listing of the dairymen in the milkshed provides a convenient source from which a sample can be obtained.

One hundred and fifty-three farmers, or approximately 20 per cent of the Grade A dairy farmers in the region, were selected at random from a listing of the Grade A producers in the region. Interviewers visited the farms and obtained the basic data upon which this study was made. Data on milk sales for each of the sample farms were obtained from the Milk Market Administrator's Office and the Knoxville Milk Producers' Association. Annual data were collected for the year July 1, 1962, through June 30, 1963, and were coded and transferred to IBM cards to facilitate handling and analysis.

Small, medium and large farms were defined in terms of the number of cows, both milking and dry, in the herds. A small farm was defined as a farm with 1 to 30 cows; a medium farm as one with from 31 to 49 cows; and a large farm as one with 50 or more cows. The sample of farms studied included 65 small, 49 medium, and 39 large farms.

CHAPTER II

THE KNOXVILLE MILKSHED, EXISTING ENVIRONMENTAL CONDITIONS, AND DAIRY FARMING WITHIN THE REGION

I. THE KNOXVILLE MILKSHED AND EXISTING ENVIRONMENTAL CONDITIONS

The Knoxville milkshed is comprised of all or portions of twenty-three Tennessee counties. The counties which comprise the milkshed, the number of producers per county as of December 1963, and the three major physiographic divisions within the milkshed are shown in Figure I.

Climatic conditions, soil associations, and the concentration of dairy farms vary as you move from the Cumberland Plateau region in the West to the Unaka Mountain region in the East. The Valley of East Tennessee in the center is the major dairy region in the milkshed, and one of the two major dairy regions in the State.

A dominant force affecting agriculture in the Valley of East Tennessee has been a rapidly expanding industrial economy. Three of the State's six metropolitan counties, Anderson, Blount, and Knox, are located within the Knoxville milkshed. These population centers provide markets for Grade A milk and milk products. In addition to these markets, evaporated milk and cheese plants within the area provide outlets for manufactured grade milk and surplus Grade A milk.

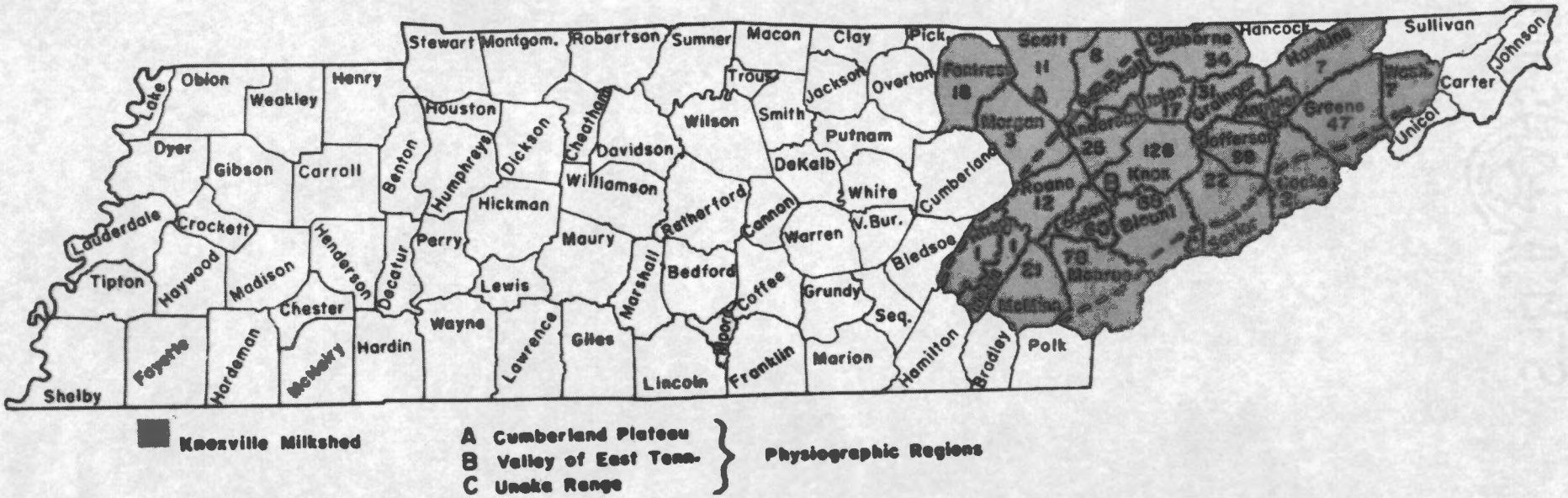


FIGURE 1. THE KNOXVILLE MILKSHED, THE THREE MAJOR PHYSIOGRAPHIC REGIONS OF THE MILKSHED, AND THE NUMBER OF GRADE A PRODUCERS BY COUNTY, DECEMBER 1963.

A farmer in the Knoxville milkshed who markets Grade A milk under the Federal Milk Marketing Order receives a base price for the quantity of milk specified as his quota. The farmer's base is established during the months September through February. Since his production during these months determines the quantity of milk which he can sell at this relatively higher price during the remaining months of the year, there is an incentive to strive for peak milk production during the base forming period. For all milk that is produced above his base during the months March through August, the farmer will receive an excess price. The excess price is essentially the manufacturing milk price adjusted for fat content.

II. DESCRIPTION OF THE CHARACTERISTICS AND ORGANIZATION OF DAIRY FARMS BY HERD-SIZE GROUPINGS

Dairy herds varied in size from 9 cows to 180 cows per herd in the sample of farms studied. Other resources such as land and labor also varied widely. Therefore, in the description of the characteristics and organization of the dairy farms which follows, the analysis and description will contrast differences between a small, medium, and large farm as defined in Chapter I.

Milking Herds

On the 65 small farms, the average number of milk cows per herd was 23. Of these 23 cows, 77 per cent were being milked at the time of the survey in June, 1963 (Table I).

TABLE I

NUMBERS AND KINDS OF DAIRY ANIMALS BY SIZE OF HERD,
153 GRADE A DAIRY FARMS, KNOXVILLE
MILKSHED, JUNE, 1963

Dairy animals	Small farms		Medium farms		Large farms		All farms	
	Average per farm	Per cent per farm	Average per farm	Per cent per farm	Average per farm	Per cent per farm	Average per farm	Per cent per farm
Cows:								
Milking	17.8	77.3	27.7	71.8	54.0	74.6	30.2	74.4
Dry	5.2	22.7	10.9	28.2	18.3	25.4	10.4	25.6
Total	23.0	100.0	38.6	100.0	72.3	100.0	40.6	100.0
Heifers:								
1 year of age or older	6.8	58.9	13.0	63.8	22.1	58.6	12.7	60.3
Less than 1 year of age	4.7	41.1	7.4	36.2	15.7	41.4	8.4	39.7
Total	11.5	100.0	20.4	100.0	37.8	100.0	21.1	100.0
Bulls:								
All ages	.5	--	.8	--	2.1	--	1.0	--

The average number of cows per herd in the medium-farm grouping was 39 cows. In this group 72 per cent of the cows were being milked. The average per cent of dry cows was largest for this size farm, on the average, but was only slightly above the average per cent of dry cows for all the sample farms (Table I).

The large farms in the study had an average herd size of 72 cows, or about 32 more cows per farm than the average for all the farms in the sample. The per cent being milked was 75 which was about the average for all farms in the sample (Table I).

The only significant difference between the small, medium, and large farms, when considering herd composition, was that the large farms had a much greater proportion of registered cows than did the small and medium farms. The large farms had an average of 25 per cent registered cows, while the small farms had 8 per cent, and the medium farms had 9 per cent.

About 46 per cent of the cows on the small and medium farms were bred artifically while only 31 per cent on the large farms were so bred.

Replacement Animals

Small farms reported an average of 12 dairy heifers per farm, the medium farms had 20 and the large farms had 38, which averaged about 50 per cent as many heifers as cows for all farms. Heifers over 1 year of age comprised about 59 per cent of all heifers and averaged 31 per cent of the total number of cows (Table I).

The number of registered heifers varied considerably from the small to the large farms. The large farms had about 31 per cent registered heifers, while the small and medium farms had only 7 per cent each.

Breeds of Cattle

The Holstein-Friesian breed was the major breed of dairy cattle on the sample farms. Of the 153 sample farms, 103 had a majority of Holstein-Friesians, more commonly referred to as Holsteins, in their herds. Fifteen had herds that were divided about equally among two or more breeds. Jerseys were predominant on 17 farms and Guernseys on 13 farms. Other breeds were in the majority on the five remaining farms (Table II).

On the 153 sample farms, 63 per cent of the cows were Holsteins, 16.5 per cent Jerseys, and 12 per cent Guernseys. Only 4 per cent of the cattle were considered to be crossbred animals (Table III).

The Holstein was the major breed of heifers. Heifers on the study farms were 68 per cent Holsteins, 13 per cent Jerseys, 10 per cent Guernseys, and 9 per cent of other breeds of cattle. The per cent of Holstein heifers is greater than the per cent of Holstein cows, indicating that they are increasing in importance (Table III).

Production

On the small farms in the sample, total production averaged 153,318 pounds of milk and 6,211 pounds of butterfat per farm per year. On the medium farms production averaged 270,144 pounds of milk and

TABLE II

MAJOR DAIRY BREED BY SIZE OF HERD, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Major breed	Number of farms			
	Small farms	Medium farms	Large farms	All farms
Cows:				
Holstein-Friesian	38	35	30	103
Jersey	12	3	2	17
Guernsey	7	4	2	13
Brown Swiss	0	1	0	1
Ayrshire	1	0	1	2
Crossbred cows	0	2	0	2
No predominant breed	7	4	4	15
Total	65	49	39	153
Heifers:				
Holstein-Friesian	33	32	28	93
Jersey	7	2	2	11
Guernsey	6	4	3	13
Brown Swiss	0	1	0	1
Ayshire	1	0	1	2
Crossbred heifers	2	3	0	5
No heifers at all	5	2	5	12
No predominant breed	11	5	0	16
Total	65	49	39	153

TABLE III

DISTRIBUTION OF MILK COWS AND HEIFERS BY SIZE OF HERD, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Breed	Small farms		Medium farms		Large farms		All farms	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Cows:								
Holstein-Friesian	803	53.7	1,241	65.7	1,862	66.0	3,906	62.9
Jersey	315	21.0	252	13.3	457	16.2	1,024	16.5
Guernsey	224	15.0	276	14.6	258	9.2	758	12.2
Brown Swiss	10	.6	21	1.1	2	.0	33	.6
Ayrshire	40	2.7	14	.8	175	6.2	229	3.7
Crossbred cows	104	7.0	85	4.5	67	2.4	256	4.1
Heifers:								
Holstein-Friesian	457	60.9	682	68.4	1,037	70.3	2,176	67.5
Jersey	122	16.3	108	10.8	202	13.7	432	13.4
Guernsey	98	13.1	128	12.8	99	6.7	325	10.1
Brown Swiss	3	.4	17	1.7	0	.0	20	.6
Ayrshire	14	1.9	3	.3	131	8.9	148	4.6
Crossbred heifers	56	7.4	60	6.0	6	.4	122	3.8

10,392 pounds of butterfat per farm per year. On the large farms milk production averaged 549,336 pounds of milk and 20,770 pounds of butterfat per year per farm (Table IV).

Milk production per cow per year averaged 6,748 pounds on the small farms, 7,007 pounds on the medium farms, and 7,595 pounds on the large farms. Even though milk production per cow was lowest on the small farms, their butterfat test averaged 4.0 per cent, while on the medium farm it averaged 3.9 per cent and on the large farms 3.7 per cent. Differences in milk production and butterfat test reflect breed differences between sizes of farms. The Holstein was the major breed in each of the farm size groups, but Jerseys and Guernseys were relatively more prevalent on the small farms than on the medium and large farms.

Livestock Other Than Dairy

Twenty-six of the 65 small farms had some type of livestock other than dairy, but in all cases the number of other livestock was minor.

On the 49 medium farms, 21 reported livestock other than dairy, but in most cases other livestock were unimportant compared to the size of the dairy operation.

The large farms which had other livestock usually had significant numbers. Of the 39 farms, 16 had other livestock: 6 had a hog enterprise; 5 had from 10-38 beef cattle each, and 5 had a few horses. However, the dairy enterprise in most cases was the major enterprise.

TABLE IV

AVERAGE MILK PRODUCTION PER FARM, AND PER COW, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JULY 1, 1962-JUNE 30, 1963

	Average production per farm		Average production per cow	
	Milk	Fat	Milk	Fat
Small farms	153,318	6,211	6,748	270
Medium farms	270,144	10,392	7,007	270
Large farms	549,336	20,770	7,595	287
All farms	292,528	12,424	7,212	278

Land Resources

The average number of acres which were owned by the proprietor(s) per farm was 125.5 acres for the small farms, 179.5 for the medium farms and 307.2 for the large farms (Table V). This resulted in an average of 5.5 total acres per milk cow on the small farms, 4.7 on the medium farms, and 4.3 on the large farms. If we subtract wooded acres from total acres the average open land per cow was 4.3 acres on the small farms, 3.9 on the medium farms, and 3.5 on the large farms. If we consider acres per cow as an indication of the intensity of farming operations, the larger farms would be considered to be more intensively farmed.

Corn was grown for grain on about 37 per cent of the farms and for silage on about 53 per cent of the farms. Corn silage increased in importance as the farm size increased.

Grass silage was practically nonexistent on the small and medium farms, with a combined total acreage of 49 acres being grown by 4 producers. Eleven producers on the large farms grew about 269 acres, or an average of 25 acres each. The overall importance of grass silage, based on the average acres grown per farm, was practically nil.

The larger acreage of corn and grass silage on the large farms was one factor which probably made possible more cows per acre.

Tobacco, the principal cash crop grown, was produced on 78 per cent of the farms. Tobacco acreage varied from an average of 1 acre on the small farms to 1.6 acres per farm, on the large farms.

TABLE V

TOTAL ACREAGE OWNED AND LAND USE BY SIZE OF FARM, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, SUMMER, 1962

Land use[a]	Small farms		Medium farms		Large farms	
	Farms reporting	Average acreage per farm	Farms reporting	Average acreage per farm	Farms reporting	Average acreage per farm
	No.	Acres	No.	Acres	No.	Acres
Uses:						
Corn (grain)	22	3.9	19	6.2	16	9.9
(silage)	25	4.0	29	9.9	28	24.9
Grass silage	1	.2	3	.8	11	6.9
Tobacco	50	1.0	40	1.2	30	1.6
Other row crops	2	.2	4	.3	2	.1
Wheat	6	.9	3	1.1	5	1.6
Other small grain	13	3.4	18	10.1	19	16.0
Hay:						
Alfalfa	30	6.5	21	7.1	26	22.7
Lespedeza and oat	16	5.7	20	9.4	15	13.1
Other hay	44	14.0	28	23.1	21	22.4
Permanent pasture	62	51.9	47	99.0	59	152.2
Temporary pasture:						
Summer	5	.4	8	2.3	6	4.1
Winter	10	1.8	14	5.4	9	6.7
Woodland	51	25.5	42	28.1	34	54.4
Idle-waste	18	3.6	12	4.5	11	5.1
Farmstead	51	2.5	45	2.9	36	5.0
Total	65	125.5	49	179.5	39	307.2

[a]The total acres obtained by adding the acreages by use is greater than the acres owned due to double cropping on some acreages.

Small grain acreages were larger on the large farms, but about as many producers grew small grain on the small and medium farms.

Hay was grown on 5,923 of the 28,958 owned acres, being exceeded only by acreage of permanent pasture. Alfalfa hay was grown by 50 per cent of the farmers, but only on the large farms did the average alfalfa acreage per farm exceed what is termed "other hays," which includes the grasses and mixed classes of hay. Lespedeza and oats for hay were grown more often on the small and medium farms than on the large farms. Including rented land that was used for the production of hay, about 2.6 acres of hay was grown for each cow-calf equivalent.*

As would be expected, permanent pasture acreage was more important than any other crop. Including rented land used for pasture, about 2.8 acres of permanent pasture was provided for each cow-calf equivalent on the farms in this sample. Usually permanent pasture on rented land was used to pasture heifers and dry cows, especially when separate from the home tract.

Temporary pasture was of little importance on the small farms. On the medium farms an average of 2 acres of temporary summer and 5 acres of temporary winter pasture was grown per farm. On the large farms an average of 4 acres of temporary summer and 7 acres of temporary winter pasture was grown per farm.

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*A cow-calf equivalent is one cow plus the number of replacements maintained to provide a replacement for the cow. Example--in a herd of 20 cows and 10 replacements a cow-calf equivalent would equal 1 cow and 0.5 of a replacement.

Forty-one of the small farms, 20 of the medium farms and 21 of the large farms reported use of 6,394 acres of rented land. The 65 small farms rented an average of 30 acres per farm; the 49 medium farms an average of 25 acres; and the 39 large farms an average of 82 acres. Rented land was used primarily to grow small grain, corn, hay and pasture (Table VI). Of the 153 sample farms, two rented out a total of 30 acres to other people.

Labor Force

On the small farms an average of 196 days of operator labor was available (see Appendix A for procedure used in estimating labor availability). Assuming that 300 days are available for a full-time farm worker, the operators on the small farms spent, on the average, about two-thirds of their available work days on the farm. In addition, the small farms had available another 204 days, making an average of 400 days of labor available for use on the small farms (Table VII).

Operator labor available on the medium farms was only a little larger than that available on the small farms, the major difference being in the amount of tenant and regular hired labor. The average amount of labor available on the farms was 554 days.

The days of operator labor available for farm work was somewhat higher on the large farms, and more tenant and hired labor was used. The average total days of labor available was 915 days.

The 153 sample farms were classified on the basis of their primary source of labor. On the small farms there was a predominance

TABLE VI

LAND USE OF ACREAGE RENTED-IN, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, SUMMER, 1962

	Small farms Average acres per farm	Medium farms Average acres per farm	Large farms Average acres per farm
Acres rented in:	30.4	24.8	82.2
Crop use:			
Corn (grain)	2.4	3.6	5.9
(silage)	.6	1.8	2.6
Grass silage		.3	.3
Tobacco	.3	.1	.1
Other row crops			
Wheat		.4	
Other small grain	.4	2.1	3.4
Hay:			
Alfalfa	1.6	3.2	
Lespedeza & oat	3.9		2.2
Other	7.1	8.3	15.2
Permanent pasture	9.7	7.5	19.1
Temporary pasture		.1	.9

TABLE VII

AVERAGE DAYS OF LABOR AVAILABLE BY SOURCE AND BY FARM SIZE, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

	Average labor supply per farm		
	Small farms	Medium farms	Large farms
	(Number of days)		
Operator	196	210	228
Family	70	79	110
Tenant	72	128	317
Regular hired	19	82	180
Seasonal labor	43	55	80
All sources	400	554	915
Days per cow-calf equivalent	17	14	13

of owner-operated farms, with owner-tenant and father-son partnerships ranking second and third in order, respectively; the medium farms showed a predominance of owner-tenant and owner-regular hired labor arrangements, with partnerships of third importance; the large farms were predominantly of the owner-tenant arrangement, with partnerships of considerable importance (Table VIII).

On a cow-calf equivalent basis the amount of labor available for all types of work per farm declines as the herd size increases. On the small farms 17 days of labor was available per cow-calf equivalent, and the large farms had an average of 13 days of labor available per cow-calf equivalent.

Feed Supply

On the larger farms a greater proportion of the grain-feed supply was produced on the farm.

The percentage of farmers purchasing 90-100 per cent of their concentrate rations was 64 per cent, 55 per cent, and 43 per cent for the small, medium and large farms, respectively. Table IX lists the number of farms in each group purchasing from 90-100 per cent, 50-89 per cent, and 0-49 per cent of their concentrates.

Milking Facilities

One hundred and three of the farms used a conventional stanchion milking barn, whereas 50 used some form of walk-through parlor.

TABLE VIII

TYPE OF OPERATION BASED ON LABOR FORCE BY FARM SIZE GROUP, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Type	Small farms	Medium farms	Large farms
	No.	No.	No.
Owner-operator	31	5	
Owner-tenant	15	18	17
Owner-regular hired labor	2	13	5
Father-son-partnership	10	7	7
Other	7	6	10

TABLE IX

PER CENT OF CONCENTRATES PURCHASED BY FARM SIZE GROUP, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

% of concentrates purchased	Small farms	Medium farms	Large farms
	No.	No.	No.
90 - 100%	42	27	17
50 - 89%	12	6	13
0 - 49%	11	16	9

On a per cow basis the small farms had a bulk tank capacity of 10 gallons per cow, the medium farms had one of 8.4 gallons per cow, and the large had one of 7.6 gallons per cow. Since milk is only collected from the tanks every two days the capacity per cow per day is actually 5.0, 4.2 and 3.8 gallons, respectively, for the small, medium and large farms. At current production rates bulk tank capacity appears to be adequate. If average production increased to 10,000 pounds of milk per cow per year, bulk tank capacity would become limiting in certain cases. Should there be a need, however, to get the milk hauled to the plant every day instead of every other day, a majority of the farmers felt this service would be provided.

Expansion Expectations

Only 55 of the 153 farms indicated that they plan to expand their dairy operations. Of those which planned to expand, 23 were small farms, 24 were medium farms, and 8 were large farms. The group with the greatest per cent expecting to increase was the medium class of farms.

During the interview, each farmer was asked to give the major reasons which prevent him from expanding his herd size. The three major factors restricting expansion for all farms were land, labor and the price of milk. Of the 42 small-farm operators who indicated that they could not currently expand, 9 gave land as the primary limiting factor, 5 listed feed supply and another 5, the low price of milk. Other reasons given included health of the operator, and personal preferences. The 25 farmers on the medium-size farms who indicated that

they could not expand their herd size gave land and labor as the two major factors preventing expansion. On the 31 large farms which could not currently expand land, labor, and the low price of milk were given as the major factors inhibiting their expansion. Equipment was the only new factor which entered into the list of the large farms that was not included in the small and medium farm list. Of the group of farmers which felt that they could currently expand, the major factor which would eventually limit their expansion was land (Table X).

TABLE X

MAJOR FACTOR LIMITING EXPANSION OF DAIRY HERDS,
153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED,
JUNE, 1963

Farmers felt they could expand, but the following factors would eventually prevent expansion: Major limiting factors	Small farms	Medium farms	Large farms	All farms
Land	11	11	1	23
Bulk tank	1	1	1	3
Feed supply	1	2	0	3
No. of available raised replacements	0	1	0	1
Hay supply	0	2	1	2
Labor	1	0	0	1
Other	8	3	4	15
No response	1	4	1	6

Farmers could not expand at present due to the following major factors: Major limiting factors	Small farms	Medium farms	Large farms	All farms
Land	9	8	10	27
Buildings	0	1	4	5
Feed supply	5	0	0	5
Equipment	0	0	2	2
Personal reasons	4	2	1	7
Labor	0	7	5	12
Age	0	3	0	3
Price of milk	5	1	5	11
At capacity now	1	1	4	6
Going out of business	1	1	0	2
No response	17	1	0	18

CHAPTER III

REPLACEMENT POLICIES

Rate of Replacement

During the year of July 1, 1962, to June 30, 1963, 20.5 per cent of the milk cows included in the sample of farms were replaced (Table XI). If we assume the sample of 153 farms included in the survey is representative of all farms in the Knoxville milkshed, the estimated number of replacement animals needed per year in this market area would be approximately 6,300. At existing prices the value of needed replacements in this market alone would be approximately one and one-half millions dollars annually.

Reasons for Culling Cows

Low production was the major reason for culling and accounted for 56 per cent of the animals removed from the herd on the small farms, 59 per cent on the medium farms, and 66 per cent on the large farms (Table XI). Twenty-two per cent of the small farms used some form of production testing: the Dairy Herd Improvement Association program, the Holstein Improvement Registry program, the Weigh-a-Dam-a-month program, or a personal program of testing. On the medium farms 29 per cent used production testing on the large farms 100 per cent followed some program of production testing (Table XII).

TABLE XI

NUMBER OF COWS REMOVED BY FARM SIZE GROUPS AND REASONS FOR THEIR REMOVAL, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JULY, 1962 THROUGH JUNE, 1963

Reason removed	Small farms		Medium farms		Large farms		All farms	
	Total	Per cent of total removed	Total	Per cent of total removed	Total	Per cent of total removed	Total	Per cent of total removed
Low production	166	55.6	218	58.6	386	65.5	770	61.1
Disease	47	15.7	47	12.6	54	9.2	148	11.8
Breeding difficulties	22	7.3	36	9.7	70	11.9	128	10.2
Died	30	10.0	25	6.7	36	6.1	91	7.2
Age	27	9.1	42	11.3	20	3.4	89	7.1
Other	6	2.3	4	1.1	23	3.9	33	2.6
Total[a]	298	100.0	372	100.0	589	100.0	1,259	100.0

[a]During the 12 months, removals for all reasons average 20.0 per cent of the herds on the small farms, 20.3 per cent on the medium farms, 20.9 per cent on the large farms, and 20.5 per cent on all farms.

TABLE XII

PRODUCTION TESTING PROGRAMS USED BY SIZE OF FARM,
153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED,
JUNE, 1963

Farm size	Per cent testing	Number of farms by type of testing program				
		None	DHIA[a]	HIR[b]	WAD[c]	Personal[d]
Small	21.5	51	3	1	0	10
Medium	28.6	35	7	0	1	6
Large	100.0	0	30	9	0	0

[a]DHIA - Dairy Herd Improvement Association program.

[b]HIR - Holstein Improvement Registry program.

[c]WAD - Weigh-a-Dam-a-Month program.

[d]Personal - Any systematic program carried out by an individual farmer.

The second most important reason given for removing cows from the milking herds was disease. This was far less significant, however, than low production. Disease was the reason for 16 per cent of the cows removed on the small farms, 13 per cent on the medium farms, and 9 per cent on the large farms (Table XI).

The third major reason for the removal of cows from the milking herds was breeding difficulties. They accounted for 10 per cent of all cows removed. Other reasons combined accounted for 17 per cent of all removals (Table XI).

Sources of Replacements

The cows that were removed were replaced by animals from three sources: 1) raised heifers which freshened, 2) purchased heifers which freshened, and 3) purchased cows. From July 1, 1962, through June 30, 1963, 1,259 cows were removed from the herds and 1,330 were added to the herds, indicating a 1 per cent increase in the total number of cows during the period (Table XIII).

Of the 311 cows added on the small farms 73 per cent were raised heifers, 6 per cent were purchased heifers which freshened, and 21 per cent were purchased cows. On the medium farms 76.1 per cent of the 429 total cows added were heifers which were born and raised on the home farms; 11 per cent were purchased heifers which freshened; and 13 per cent were purchased cows. It was noted that there were 372 cows removed and 429 cows added during the year on the medium farms. An expansion of 57 cows on the medium farms represented the greatest

TABLE XIII

NUMBER OF COWS ADDED BY SOURCE AND SIZE OF FARM, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JULY 1, 1962 TO JUNE 30, 1963

Replacements and source	Small farms			Medium farms			Large farms		
	Total	Average per farm	Per cent by source	Total	Average per farm	Per cent by source	Total	Average per farm	Per cent by source
Total number of cows added to the milking herd for the year July 1, 1962, to June 30, 1963	311	4.8	100.0	429	8.8	100.0	590	15.1	100.0
Number of raised heifers which freshened and were added to the milking herd	228	3.5	72.9	328	6.7	76.1	433	11.1	73.4
Number of purchased heifers which freshened and were added to the milking herd	21	.3	6.3	49	1.0	11.4	61	1.6	10.3
Number of purchased cows added to the herd	62	1.0	20.8	52	1.1	12.5	96	2.4	16.3

increase in the number of cows of any of the three groups of farms. The large farms aggregate cow numbers increased by only one during the period. Of the 590 cows added 74 per cent were heifers which were born and raised on the farm; 10 per cent were purchased heifers which freshened; and 16 per cent were purchased cows.

Farmers' Reasons for Following a Particular Replacement Policy

Sixty-nine per cent of the farmers indicated they usually raise 100 per cent of their replacements. They preferred this method because they would then know the breeding of their replacements, and they also felt that it was cheaper to raise replacements than buy them. They objected to buying because: 1) they felt they could not buy quality replacements, 2) they would not know the breeding of purchased replacements, 3) they felt that by raising their replacements the risk of introducing disease was reduced, and 4) they felt that purchased animals were too expensive (Table XIV).

Of the 31 per cent of farmers who regularly purchased part or all of their replacements, their reasons for purchasing varied by size of farm. On the small farms reasons given included a shortage of land and a desire to obtain new bloodlines to improve the quality of their herds and to increase production (Table XV). On the medium farms land was not a major factor. Reasons given were primarily a desire to improve the quality of the herds and to increase production. Also of importance was the fact that several farmers felt that replacements could be purchased cheaper than they could be raised. Forty per cent

TABLE XIV

NUMBER OF FARMERS WHO USUALLY RAISE 100% OF THEIR REPLACEMENTS AND THEIR REASONS FOR RAISING AND OBJECTIONS TO BUYING REPLACEMENTS BY SIZE OF FARM, 153 GRADE A DAIRYMEN, KNOXVILLE MILKSHED, JUNE, 1963[a]

Reasons for raising and objections to buying replacments	Small farms		Medium farms		Large farms	
	Number of farms	Per cent of farms	Number of farms	Per cent of farms	Number of farms	Per cent of farms
Reasons prefer to raise replacements						
Knows breeding	28	63.6	22	66.7	21	72.4
Cheaper	19	43.2	5	15.2	8	27.6
Avoid bulk capital outlay	5	11.4	0	.0	1	3.4
Control disease	3	6.8	2	6.1	3	10.3
Utilize available resources	1	2.3	2	6.1	2	6.9
Raised animals are less temperamental	0	.0	1	3.0	0	.0
No particular reasons	1	2.3	0	.0	0	.0
Other	6	13.6	8	24.2	8	27.6
Objections to buying replacements						
Doesn't know breeding	9	20.5	7	21.2	7	24.1
Can't buy quality replacements	8	18.2	9	27.3	11	37.9
Requires bulky capital outlays	0	.0	3	9.1	2	6.9
Disease infestation avoided	2	4.5	3	9.1	7	24.1
Has resources to raise replacements	1	2.3	0	.0	0	.0
Purchased animals are too expensive	4	9.1	13	39.4	6	20.7
No reason to buy	0	.0	1	3.0	0	.0
Purchased animals are more temperamental	0	.0	0	.0	1	3.4
Other	1	2.3	1	3.0	1	3.4

[a]Of the 65 small farmers 67.7 per cent preferred to raise all their replacements. Sixty-seven point three per cent of the 49 medium and 74.4 per cent of the 39 farmers in the large farm grouping preferred to raise their replacements.

TABLE XV

NUMBER OF FARMERS WHO USUALLY PURCHASE PART OR ALL OF THEIR REPLACEMENTS AND THEIR REASONS FOR PURCHASING, BY SIZE OF FARM, 153 GRADE A DAIRY FARMERS, KNOXVILLE MILKSHED, JUNE, 1963[a]

Farmers per class which usually purchase part or all of their replacements	Small farms 21		Medium farms 16		Large farms 10	
	Farmers	Per cent	Farmers	Per cent	Farmers	Per cent
Reasons for purchasing[b]						
Land shortage	5	23.8	1	6.2	4	40.0
Acquire artificially bred stock	1	4.8	1	6.2	0	.0
Improve quality	4	19.0	4	25.0	0	.0
Maintain or increase production	5	23.8	5	31.2	1	10.0
Buy cheaper than can raise heifers	0	.0	3	18.8	2	20.0
Inadequate facilities to raise	3	14.3	1	6.2	1	10.0
Breeds to a beef bull	3	14.3	1	6.2	2	20.0
Breeding purposes	2	9.5	3	18.8	3	30.0
Other	0	.0	0	.0	1	10.0

[a]Thirty-two point three per cent of the 65 operators of small farms, 32.7 per cent of the 49 medium farm and 25.6 per cent of the 39 large farm operators usually purchase part or all of their replacements.

[b]Since some farmers gave more than one reason, the total number of reasons is greater than the number of farmers.

of the farmers operating large farms said that they purchased replacements because of a shortage of land. Twenty per cent of this group also felt that it was cheaper to buy replacements and 20 per cent bred their cows to beef bulls. The acquisition of breeding stock was an important reason for purchasing on the large farms as well as on the medium farms.

Prices Paid for Purchased Animals

Purchased replacements varied in price with age, pedigree, breed, etc. The average prices of purchased animals, shown below, were based on prices paid by farmers in the sample for approximately 340 replacements during the year July 1, 1962, through June 30, 1963. Calves under one year of age averaged $130 per head. The unbred heifers one year of age and older averaged $175 per head. Bred heifers averaged $246 per head and milk cows averaged $225 per head. The number of calves purchased were not sufficient to give an average figure which would be reliable.

Purchased replacements for the year July 1, 1962, through June 30, 1963, accounted for a greater percentage of the replacements than might be assumed from Table XV. In that table, it was shown that approximately 30 per cent of the farmers generally purchase part or all of their replacements. The per cent, however, that actually purchased replacements during the year was 37 for the small farms, 49 for the medium farms, and 56 for the large farms. This would seem to indicate that purchasing as a practice is largely dependent upon needs, and that there are times when raising as a policy does not completely meet replacement needs.

Purchased Replacements Versus Raised Replacements

Of the 47 farmers who regularly purchase replacements, 77 per cent said they experienced no problems or difficulties with purchased animals that were not experienced with raised dairy animals. Eleven per cent said purchased animals were more tempermental while 6 per cent felt that disease and poor quality were more of a problem with purchased animals than raised animals. About 92 per cent felt that purchased replacements produced as well or better than raised replacements.

At the present, 34 per cent of all the milk cows on the sample farms were purchased replacements (Table XVI). If the farmers procurred all their replacements by purchasing or on a contractual arrangement, they felt they could increase their herds by the following number of cows: small farms, 5 cows per farm; medium farms, 8 cows; and large farms, 14 cows.

Acquiring Replacements on a Contractual Basis

During the interviews farmers were presented with the hypothetical proposition:

> In some cases farmers are having their replacement animals produced on a contract basis, i.e. heifer calves to be kept for replacement purposes are raised by another farmer from shortly after birth to shortly before the first calving on a contract basis. The usual cost of having replacements produced in this manner is from $175-$200. If you could find a farmer who you feel would do a good job of raising your replacements, would you be willing to pay to have your replacements raised by another farmer?

TABLE XVI

TOTAL NUMBER OF PURCHASED COWS, AVERAGE PER FARM, AND PER CENT OF TOTAL COWS BY SIZE OF FARM, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

	Total	Average per farm	Per cent of total cows
Small farms	503	7.7	33.6
Medium farms	713	14.6	37.7
Large farms	926	23.7	32.8
All farms	2,142	14.0	34.5

Their reactions to this proposition were as follows: small farms - 39 per cent reacted positively, medium farms - 38 per cent reacted positively, and large farms - 36 per cent reacted positively. The major comments of the farmers who reacted negatively indicated that they felt they could raise replacements cheaper than $175-$200, and/or that they had a personal desire to raise their own replacements (Table XVII).

Feeding of Replacements

On the small farms, calves were taken from their dams at an average age of 11 days; at an average age of 7 days on the medium farms, and at 9 days of age on the large farms. They were then fed on milk, milk replacer, or by a nurse cow or some combination of these in most cases. Milk replacer was used by approximately 65 per cent of the farmers (Table XVIII). The calves were weaned on the small farms at approximately 62 days, on the average, at 71 days on the medium farms, and at 64 days on the large farms.

Heifers were, on the average, fed concentrates 4.4 months on the small farms, 5 months on the medium farms, and 5.5 months on the large farms. A home-mixed dairy ration was the most common concentrate fed. However, a calf starter and a purchased dairy ration were of importance on the small farms (Table XIX). Heifers received no concentrates on 4 farms. Home-mixed rations generally consisted of corn, oats, molasses, a protein supplement and salt. Hay, bran and purchased concentrates were used occasionally. Concentrates were fed to replacements by 50 per cent of the farmers usually from 2 to 8 weeks prior to freshening (Table XX).

TABLE XVII

FARMERS' REACTION TO THE CONCEPT OF CONTRACT RAISING AND COMMENTS MADE BY FARMERS, BY SIZE OF FARM, 153 GRADE A DAIRYMEN, KNOXVILLE MILKSHED, JUNE, 1963

	64[a] small farms	48[a] medium farms	39 large farms
	Total number of farmers	Total number of farmers	Total number of farmers
Number of farmers who gave an affirmative response:	25	18	14
Comments			
Would save pasture	0	1	0
Is cheaper than can raise replacements	3	0	0
Probably	1	0	2
Interested for part of his heifers	1	0	1
Could purchase for $170-$200	0	1	0
Would like such an arrangement	2	7	0
Other	2	0	4
Number of farmers who gave a negative response:	39	30	25
Comments			
Has poor quality stock	1	0	0
Can raise cheaper	7	5	3
Not as long as can rent land cheaply	2	0	0
Breeding to a beef bull	2	2	3
Personally prefer to raise	7	4	5
Disease would be a problem	0	1	0
Operating at capacity now	0	1	0
Operation is too small	1	0	0
Has resources to raise	2	1	5
Other	4	5	5

[a]There were 2 farms for which no response was recorded - one small farm and one medium farm.

TABLE XVIII

PER CENT OF FARMS USING VARIOUS POLICIES OF FEEDING MILK OR A MILK SUBSTITUTE TO CALVES, BY SIZE OF FARM, 153 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

	Per cent of small farms	Per cent of medium farms	Per cent of large farms
Milk replacer	63.1	65.3	66.7
Milk in summer and milk replacer in winter	1.5	2.0	2.6
Milk and milk replacer	7.7	8.2	5.1
Milk from dam	1.5	.0	2.6
Milk from nurse cow	3.1	6.1	2.5
Milk fed from teat bucket	7.7	10.2	5.1
Not applicable[a]	15.4	8.2	15.4

[a]Refers to farms which did not raise heifers of this age.

TABLE XIX

TYPE OF CONCENTRATES FED TO YOUNG REPLACEMENTS BY SIZE OF FARM, 141 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Type of concentrates[a]	Small farms	Medium farms	Large farms
	No.	No.	No.
Calf starter	25	3	14
Home-mixed ration	19	39	20
Purchased dairy ration	15	5	3
Calf grower	9	5	4
Horse and mule feed	3	1	1
No concentrate	3	0	1
Calf developer	1	2	4
Other	1	0	0

[a]Different types of feed were fed to heifers in different aged groups on some farms.

TABLE XX

NUMBER OF FARMERS FEEDING CONCENTRATES TO REPLACEMENT HEIFERS PRIOR TO FRESHENING BY TIME PERIODS AND BY SIZE OF FARM, 76 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Weeks prior to freshening	Small farms	Medium farms	Large farms
	No.	No.	No.
Less than 1 week	0	0	0
1-2 weeks	1	2	1
2-4 weeks	17	8	6
4-6 weeks	5	4	3
6-8 weeks	6	9	6
8-10 weeks	1	1	1
10-12 weeks	1	1	2
Over 12 weeks	0	0	1

Hay was fed to heifers in some cases at less than 1 month of age and by all farmers by the age of 4 months. Grass and mixed hay and alfalfa hay were the two predominant kinds of hay fed to heifers less than 1 year of age (Table XXI). Grass and mixed hay was the predominant kind fed to heifers one year of age and older (Table XXII).

Silage was not commonly fed to heifers. It was fed to those over a year old on 26 per cent of the small farms, 47 per cent of the medium farms, and 54 per cent of the large farms.

Special pasture was provided for calves on 26 per cent of the small farms, 82 per cent of the medium farms, and 67 per cent of the large farms. This heifer pasture could be used for pasturing milk cows on approximately two-thirds of the farms. The small farms had an average of 5.8 acres of special calf pasture per farm, the medium farms 12.2 acres per farm, and the large farms 13.7 acres per farm. Farmers estimated that these acreages would provide pasture for an average of 1.8, 5.3, and 6.1 cows per farm, respectively.

Special Building Facilities for Heifers

Thirty-four per cent of the small farms, 53 per cent of the medium farms, and 56 per cent of the large farms had special building facilities for heifers. In each farm-size group, more than half of the farms with such facilities could use them to house milk cows. On the small farms, an average of 3 cows could be accomodated, on the medium farms 4 cows, and on the large farms, 11 cows.

TABLE XXI

PER CENT OF FARMS FEEDING VARIOUS KINDS OF HAY TO HEIFERS LESS THAN ONE YEAR OF AGE BY SIZE OF FARM, 141 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Kind of hay	60 small farms	47 medium farms	34 large farms
	%	%	%
Oat	13.3	8.5	2.9
Alfalfa	40.0	40.4	38.3
Lespedeza	15.0	6.4	5.9
Grass and mixed	26.7	40.4	50.0
Any available[a]	3.3	4.3	2,9
Other	1.7	--	--

[a]Was not a particular kind, but usually consisted of several kinds.

TABLE XXII

PER CENT OF FARMS FEEDING VARIOUS KINDS OF HAY TO HEIFERS ONE YEAR OF AGE AND OLDER, BY SIZE OF FARM, 141 GRADE A DAIRY FARMS, KNOXVILLE MILKSHED, JUNE, 1963

Kind of hay	60 small farms	47 medium farms	34 large farms
	%	%	%
Grass and mixed	50.0	55.3	58.8
Alfalfa	21.7	21.3	20.7
Oat	11.7	10.6	8.8
Lespedeza	8.3	6.4	8.8
Any available[a]	5.0	6.4	2.9
Other	3.3	0.0	0.0
Total	100.0	100.0	100.0

[a]Was not a particular kind, but usually consisted of several kinds.

CHAPTER IV

ESTIMATED ACTUAL AND OPPORTUNITY COST OF RAISING DAIRY HERD REPLACEMENTS

I. INTRODUCTION

Chapters II and III have presented a description of the environmental factors affecting dairying in the Knoxville milkshed, a description of dairy farming within the region, and a description of herd replacement policies being used by farmers of the region. These chapters provide basic data which can be used to derive cost and returns, thus net revenue. They also provide a basis from which the effect of changes in replacement policies can be derived.

This chapter will present an estimate of the actual cost of raising a dairy herd replacement, and will make comparisons between a policy of raising all replacements and a policy of purchasing all replacements on representative small, medium, and large farms. This comparison illustrates the opportunity cost concept. A brief summary of a contractual replacement policy and a comparison of it with raising and purchasing replacement animals will then be made.

This study was not intended to provide a prescription for a particular policy, but rather to serve as a guide in directing attention toward possible alternatives and their advantages. Only one case from each farm size grouping has been considered. Since it is highly

improbable that any farm in the area will meet the exact conditions assumed in this study, individual adaptations should be made by each farmer as he evaluates his specific replacement alternatives.

II. ESTIMATED COST OF RAISING A DAIRY HERD REPLACEMENT TO A CALVING AGE OF 27 MONTHS

The actual cost of raising a dairy heifer from infancy to a calving age of 27 months was estimated to be $212.02 (Table XXIII). assuming the more common practices found on the survey farms.

The initial value of the calf was assumed to be $20 which was the average price received by farmers for calves from 3 to 10 days of age. This value may be conservative as good quality calves which are saved for replacements are likely to be more valuable than an average calf.

Feed cost was the largest cost item of raising a replacement animal. It was estimated that 37.5 pounds of milk replacer, 1,100 pounds of grain, 552 pounds of a legume hay, 3,065 pounds of a grass and legume or grass hay, and 2.4 acres of orchard grass and white clover pasture were needed to raise a heifer calf to a calving age of 27 months. Milk replacer was valued at $17 per cwt., concentrate at $57.47 per ton, legume hay at $33 per ton, grass hay or grass and legume hay at $28 per ton, and pasture at $11.20 per acre. The resulting total feed cost for the 27 month period was $117.27 per replacement.

TABLE XXIII

ESTIMATED COST OF RAISING A DAIRY HEIFER TO 27 MONTHS OF AGE

Item	Amount	Unit price	Cost	
Value of calf at birth				$ 20.00
Feed:[a]				
Milk replacer[b]	37.5 lbs.	$17.00 cwt.	$ 6.82	
Concentrate[c]	1100.0 lbs.	57.47 tons	31.56	
Hay (from 0 to 6 months of age)[d]	552.0 lbs.	53.00 tons	9.10	
Hay (from 6 to 27 months of age)[e]	3065.0 lbs.	28.00 tons	42.91	
Pasture[f]	2.4 acres	11.20 acres	26.88	
Total feed cost[g]				117.27
Labor	37.0 hrs.	.75 hr.		28.75
Other:[h]				
Bedding			10.00	
Buildings and equipment			6.00	
Breeding fees			6.00	
Veterinary fees and drugs			9.00	
Interest			13.00	
Miscellaneous			3.00	
Total other cost				47.00
Estimated total cost of raising a replacement				$212.02

[a]Feeding requirements were derived from Morrison's "Feeds and Feeding" for a Holstein heifer which was assumed to weigh approximately 1200 lbs. at approximately 27 months of age. Feeding practices of farmers in this study were assumed and supplemented by recommended practices to provide the necessary nutrient requirements specified by Morrison.

[b]Milk replacer fed approximately 60 days.

[c]A home-mixed dairy ration containing corn, oats, cottonseed oil meal, molasses, and salt, providing approximately 11.6 per cent digestible protein was assumed to be fed.

TABLE XXIII (CONTINUED)

[d]A legume hay assumed to be fed to calves less than 6 months of age.

[e]Grass or mixed grass and legume hay was assumed to be fed to calves over 6 months of age.

[f]Pasture was calculated on a hay-equivalent basis. Since 281 days of pasture are required to raise a calf to 24 months of age, it was assumed that 300 cow-acre days would be required to raise a 27 month old heifer if it was born in the fall. It was assumed that 125 cow-acre days would be provided per acre of pasture at a cost of $11.20 per acre. One cow-acre day equals 25 pounds of dry-feed equivalent.

[g]Since it is a policy of farmers to take their calves from their dams as early as possible, it is assumed that no marketable milk was lost and thus no charge is applied.

[h]Estimates were synthesized from the following studies: Cost and Returns in Raising Dairy Heifers, Six Farms, Orange County, Florida, 1960, by A. F. Cribbett and R. E. L. Green, University of Florida; Cost and Returns in Raising Dairy Heifers, by L. C. Cunningham, Cornell University; Cost and Methods of Obtaining Holstein Heifers on Oklahoma Dairy Farms, by Clark Edwards, Oklahoma State University; and Economic Considerations in Raising Dairy Replacements, by John W. Jack, Cornell University.

Labor requirements per animal were expected to vary with the size of the dairy heifer enterprise. For this phase of the study it was assumed that 37 hours of labor were required per calf over the period. With an assumed labor cost of $.75 per hour, labor cost amounted to $27.75 per replacement.

Other expenses such as bedding, buildings and equipment, breeding fees, veterinary fees and drugs, interest, and miscellaneous cost amounted to $47 per replacement.

If the replacements cost $212.02 to raise and $300.00 to purchase it would appear that raising would be the most profitable replacement policy to follow. This, however, is not necessarily the case. In raising replacements resources are allocated to this enterprise which might have a higher opportunity cost or more profitable alternative.

III. OPPORTUNITY COST

The opportunity cost of using a resource in one way is the return that would be received from the resource when used in its most profitable alternative.[1] If production costs are the same for all products being considered, opportunity cost can be stated as the gross value of the most profitable alternative. However, if production costs are not equal, opportunity costs must be stated in terms of

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[1]H. C. M. Chase and Paul E. Johnston, Principles of Farm Management (New York: J. B. Lippincott Company, 1953), p. 54.

net returns.[2] Two products which produce equal gross revenue, but have different production costs would not produce equal revenue for the business. Opportunity cost in this study will refer to net returns from a dairy operation involving a particular replacement policy.

Two systems of farming are used in the following plans to determine the opportunity cost of raising or purchasing replacement heifers. The first farming system planned was one in which all herd replacements were raised on the farm. The second was one which involved the purchase of all herd replacements. Opportunity cost was estimated on the entire farm operation instead of on one enterprise or a specific resource basis. Thus, in referring to opportunity cost, references will be made to the farming system as it raises or as it purchases its replacements. The difference in opportunity cost will show the loss or gain to the farm operation realized when following one policy instead of the other.

Returns to a farm operator are stated frequently in terms of returns to his capital, labor, and management. Opportunity cost in the following analysis refers to operator(s) labor, capital, and management from a particular farming system.

An illustration of opportunity cost is presented in the following example. Assume a farmer raising his replacements had a net return

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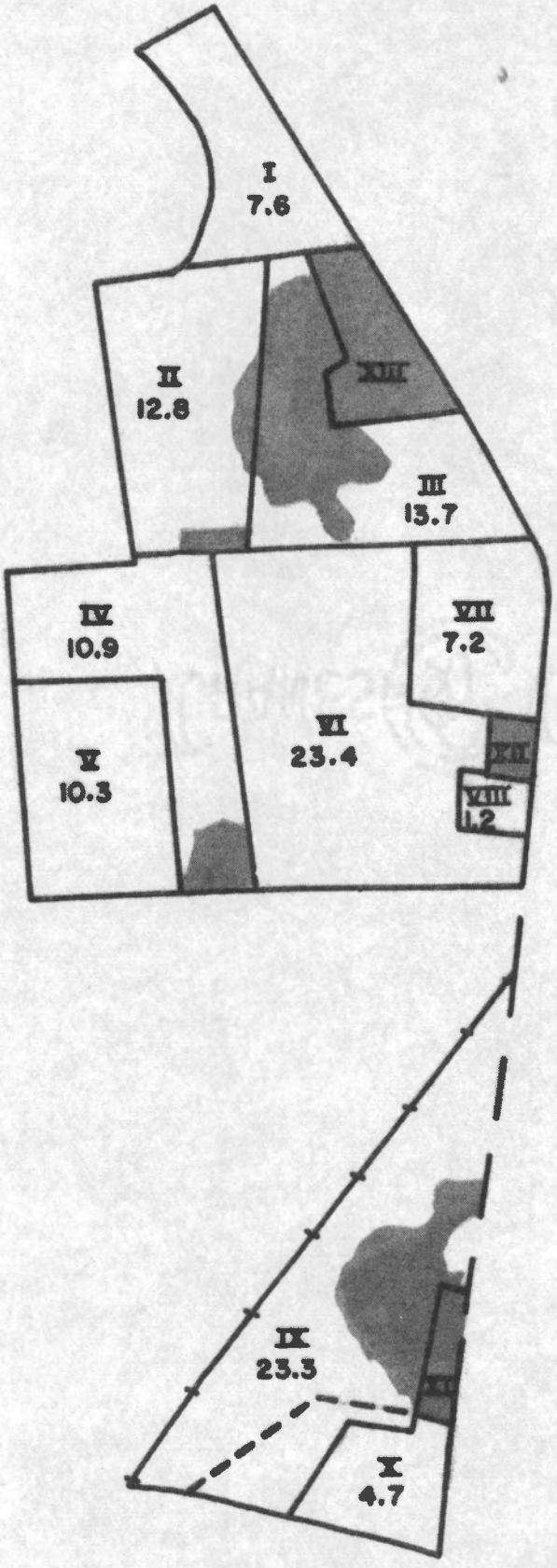
[2]Emery N. Castle and Manning H. Becker, Farm Business Management (New York: The Macmillian Company, 1962), p. 57.

to operator labor, capital and management of $6,000. Assume the farmer switched to a policy of 100 per cent purchased replacements and his net return to operator labor, capital, and management increased to $6,500. Since he is foregoing the opportunity to operate under a policy of purchasing he is foregoing this $6,500. This would be the opportunity cost to operator labor, capital, and management of raising his replacements. The net difference in returns was $500. The farmer was absorbing a $500 reduction in income when raising his replacements instead of purchasing them.

To estimate the opportunity cost of raising, purchasing, and contracting on different sizes of farms, small, medium, and large case farms were selected and budgets derived.

IV. SMALL CASE FARM

Land supply use. Soils on the small farm varied from the shallow, sloping soils with outcropping rock to the bottom soils which were moderately deep. In determining the capability of the soils on this farm, as well as on the medium and large farms, soil maps were obtained from the Soil Conservation Agent of the county in which the farms were located. The productivity of each field was based on predominant soil types present and on the assumption of above average management level. A field map of the small case farm is shown in Figure 2.



Noncropland

Proposed change in field boundaries when purchasing replacements.

Arabic numerals list the acres of cropland per field. Roman numerals identify fields.

FIGURE 2. FIELD MAP OF THE SMALL DAIRY FARMS AND THE ACRES OF CROPLAND BY FIELDS.

Of the 120.4 acres of land in this farm, 100 acres were suitable for crop production. The 20.4 acres not suitable, represented by the shaded areas in Figure 2, were either woodland, severely eroded or rocky soil, or land occupied by buildings.

A detailed summary of the land-use system of one year in the rotation system assumed is shown in Table XXIV. Fields I, II, III, IV, VII, and IX were used for permanent pasture. These fields contained 61.1 acres and were estimated to provide 6,756 cow-acre days of pasture per year. Field V, containing 10.1 acres, was assumed to produce 35 tons of alfalfa hay. Fields VIb and X, containing 16.7 acres, would produce 41 tons of orchard grass and ladino clover hay.* Eleven acres of corn silage were grown in Field VIa and it was assumed to yield 165 tons of silage. Corn silage was the only crop which required a rotation. Field VIa, VIb, and II could be used for this rotation without disrupting the plan. The 1.1 acre tobacco allotment was placed in Field VIII. A yield of 2,530 pounds was assumed.

Changes in cropland use when shifting from a policy of raising replacements to purchasing them would be minor. The limited capacity of the silo prevented expansion of the silage enterprise. Thus, to fulfill the additional roughage requirements when the milking herd was expanded from 26 cows to 32 under a policy of purchasing, the amount of

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*It was assumed that one ton of orchard grass and ladino clover hay had a nutrient value of approximately .9 that of a ton of alfalfa hay.

TABLE XXIV

CROP USE, BY FIELDS, AND EXPECTED YIELDS, SMALL CASE FARM, KNOXVILLE MILKSHED, 1963

Use by fields	Acres of cropland per field	Unit	Average[a] yield per acre	Expected total production
Permanent pasture:				
I	7.6	CAD[b]	101	768
II	11.4	CAD	130	1,482
III	6.8	CAD	97	660
IV	10.2	CAD	124	1,265
VII	7.2	CAD	90	648
IX	17.9	CAD	108	1,933
Total	61.1	CAD		6.756
Hay:				
Alfalfa				
V	10.1	Tons	3.5	35
Labino clover and orchard grass				
VI[b]	12.0	Tons	2.5	30
X	4.7	Tons	2.5	11
Total	26.8	Tons		76
Corn silage:				
VI[a]	11.0	Tons	15	165
Tobacco:				
VIII	1.1	Lbs.	2,300	2,530
Noncropland:	20.4	--	--	--
Total acres	120.4			

[a]Adapted from Knox County, Tennessee Soil Survey by Wallace Roberts and others of the Soil Conservation Service, U. S. Department of Agriculture, U. S. Government Printing Office, 1955.

[b]Cow-acre days of grazing.

hay fed per cow was increased. To grow the additional hay required, the field boundary of Field X was changed as shown by the dotted line in Field IX of Figure 2. This provided 2.8 additional acres for hay production which was sufficient to provide the additional hay requirements.

Livestock numbers under a policy of raising and a policy of purchasing. It was estimated that 26 cows, 6 yearling heifers, and 8 heifer calves was the maximum number of animals that could be carried on this farm when raising all needed replacements. When a policy of purchasing replacements was followed, it was estimated that 32 milk cows could be carried.

Feed requirements. The yearly feed requirements for a cow were estimated to be 2,215 pounds of concentrate, 6.2 tons of silage, 2.0 tons of alfalfa hay or its equivalent, and 180 cow-acre days of pasture. For a yearling one year of age or older feed requirements were estimated to be 242 pounds of concentrate, 1.6 tons of alfalfa hay, and 130 cow-acre days of pasture. For a calf less than a year of age, it was estimated that 805 pounds of concentrate, 1.1 tons of alfalfa hay, and 80 cow-care days of pasture would be required, assuming the calf is born in the fall. These feeding rates, when combined resulted in a total feed requirement for a herd of 26 cow herd and 18 heifers of 65,482 pounds of concentrate, 161 tons of corn silage, 70.4 tons of alfalfa hay or its equivalent and 6,100 cow-acre days of pasture (Table XXV). Concentrates were purchased.

TABLE XXV

ESTIMATED FEED REQUIREMENTS FOR DAIRY HERD WHEN RAISING REPLACEMENTS AND WHEN PURCHASING REPLACEMENTS, SMALL CASE FARM, KNOXVILLE MILKSHED, 1963

Replacement policy	Number of animals	Concentrate Requirements		Roughage Requirements					
				Silage		Hay		Pasture	
		Pounds per animal	Total pounds	Tons per animal	Total tons	Tons per animal	Total tons	CAD per animal	Total CAD needed
100% raised									
Milk cows	26	2,215	57,590	6.2	161	2.0	64.0	180	4,680
Yearlings (1 yr. of age or older)	6	242	1,452	--	--	1.6	9.6	130	780
Calves (less than 1 yr. of age)	8	805	6,440	--	--	1.1	8.8	80	640
Total requirements	--	--	65,482	--	161	--	70.4	--	6,100
100% purchased									
Milk cows	32	2,215	70,880	5.0[a]	160	2.4	77.0	180	5,760
Change in requirement when shifting from a policy of raising to purchasing			+5,398 lb.		- 1 Ton		+6.6 Ton		-340 CAD

[a]No additional silage is produced, therefore the quantity fed per head is reduced; hay is increased to compensate for the reduction in silage.

When replacements were purchased, 6 additional cows were added to the herd to utilize the released resources. This new total of 32 cows required 70,880 pounds of concentrate, 160 tons of silage, 77 tons of alfalfa hay or its equivalent, and 5,760 cow-acre days of pasture. With the silo capacity limiting the available supply of silage, each cow now would receive only 5 tons of silage per year. The reduction of 1.2 tons in silage per cow was compensated for by an increase of .4 ton of alfalfa hay per animal, or one pound of hay for each three pound decrease in silage.

The shift from a raising policy to a purchasing policy brought about the following change in feed requirements after the milking herd was expanded under the purchasing policy: an additional 5,398 pounds of concentrate, 1 ton less of silage, 6.6 additional tons of alfalfa hay, and 340 less cow-acre days of pasture.

The change in concentrate posed no production problem as all concentrates were purchased. The one ton decrease in silage requirements required no change in the farm plan. The additional hay requirement was met by shifting 2.8 acres of pasture no longer needed to hay production.

Labor force requirements. To produce the crops and care for the livestock enterprises under a policy of raising replacements, an estimated total of 3,115 hours of labor would be required. A bi-monthly breakdown of labor requirements per enterprises is presented in Table XXVI. The 26 cows required a total of 1,949 hours of labor

TABLE XXVI

ESTIMATED LABOR REQUIREMENTS WHEN RAISING REPLACEMENTS, SMALL CASE FARM, KNOXVILLE MILKSHED, 1963[a]

Enterprise	Size of enterprise	Labor requirements by period: January and February	March and April	May and June	July and August	September and October	November and December	Total for year
		Hours						
Milk cows	26 head	371	306	292	296	304	380	1,949
Heifers and calves	14 head	128	56	--	--	30	109	323
White clover and orchard grass	16.8 acres	13	32	32	8	2	--	97
Alfalfa hay	10.1 acres	--	5	77	24	--	--	106
Corn silage	11.0 acres	6	28	19	13	--	--	66
Tobacco	1.1 acres	--	27	42	67	173	113	422
Permanent pasture	61.1 acres	49	--	67	30	6	--	152
All enterprises	--	567	454	539	438	515	602	3,115

[a]Adapted from "Labor Requirements on Tennessee Farms," by W. P. Ranney, University of Tennessee Agricultural Experiment Station, Bulletin No. 316, Knoxville, 1960.

and the heifers 323 hours. Tobacco, the second largest user of labor, required 422 hours for the year. March-April and July-August were the bimonthly periods requiring the least labor.

When the replacement policy was changed from raising to purchasing, the milking herd was expanded from 26 to 32 cows. After the crop adjustments were made, the total labor requirements declined 21 hours. The four enterprises affected were: cows, heifers, white clover and orchard grass hay, and pasture. The labor requirement for caring for heifers was removed, and pasture labor requirements were reduced. Labor requirements for hay and cows increased (Table XXVII).

The total labor required when purchasing replacements was 3,094 hours or 21 hours less than the requirement for the system involving raising of replacements. This was 906 hours less than the average amount of labor available on the farms in the small farm grouping. Since labor is required for maintenance of facilities, equipment, etc., 4,000 man hours was assumed to be the necessary labor force on this farm. Assuming that the operator supplies 2,600 hours, 1,400 hours of hired labor would be required when raising replacements, and 21 hours less would be required when purchasing replacements.

Opportunity cost. The total revenue of the farming operation when raising 26 cows, 6 yearlings, and 8 heifer calves, was estimated to be $14,716.64. Total expenses were estimated to be $8,372.46. Net returns to operator labor, capital, and management was $6,343.95. Had the farm operation been operating under a purchasing replacement system

TABLE XXVII

ESTIMATED LABOR REQUIREMENTS WHEN PURCHASING REPLACEMENTS, SMALL CASE FARM, KNOXVILLE MILKSHED, 1963[a]

Enterprise	Size of enterprise	Labor requirements by period						Total for Year
		January and February	March and April	May and June	July and August	September and October	November and December	
		Hours						
Milk cows	32	426	352	336	340	349	437	2,240
White clover and orchard grass hay	19.5	16	37	49	10	2	--	114
Alfalfa hay	10.1	--	5	77	24	--	--	106
Corn silage	11.0	6	28	19	13	--	--	66
Tobacco	1.1	--	27	42	67	173	113	422
Permanent pastures	58.3	47	--	64	29	6	--	146
All enterprises		495	449	587	483	530	550	3,094

[a]Adapted from "Labor Requirements on Tennessee Farms," by W. P. Ranney, University of Tennessee Agricultural Experiment Station, Bulletin No. 316, Knoxville, 1960.

instead of a system in which he raised all replacements, the opportunity cost of purchasing would have been $6,343.95 had the system using raised replacements been the next most profitable alternative (Table XXX).

When the farm operation was planned using a purchasing replacement policy, the maximum herd size was 32 cows and the farming system had a total revenue of $17,671.80. Total expenses were $10,816.13. Net return to operator labor, capital and management was $6,855.67 (Table XXVIII). This value would represent the opportunity cost of the farming system when raising its replacements, assuming purchasing to be the most profitable alternative.

In making decisions to change a farming system as well as a replacement policy, more attention is usually given to the difference in opportunity costs of the present and the proposed systems. The net difference in returns of the two systems for this case farm was $511.72. Assuming the estimates of cost and returns to be correct, purchasing would be the most profitable alternative for this farm. It was assumed that the farmer would be able to purchase replacements capable of producing 10,000 pounds of milk for $300. The farmer in this instance would be able to pay an average of $373.10 for his replacements and still maintain the same returns to operator labor, capital, and management as he would have received from a system using raised replacements.

TABLE XXVIII

COMPARISON OF COST AND RETURNS FOR THE SMALL CASE FARM WITH ALTERNATE REPLACEMENT POLICIES, KNOXVILLE MILKSHED, 1963

Item	Unit	Price[a]	100% raised replacements		100% purchased replacements	
			Quantity[a]	Value	Quantity[a]	Value
Revenue:						
Milk[b]	Cwt.	$ 4.60	2,574	$11,840.40	3,168	$14,572.80
7-day old calves[c]	Hd.	20.00	15	300.00	29	580.00
Culled cows[d]	Hd.	143.00	6	858.00	7	1,001.00
Culled heifers[e]	Hd.	100.00	2	200.00	--	--
Tobacco	Lbs.	.60	2,530	1,518.00	2,530	1,518.00
Total				14,716.41		17,671.80
Expenses:						
Concentrate[f]	Ton	57.47	32.7	1,889.57	35.4	2,034.00
Corn silage[g]	Acre	24.65	11.0	271.15	11.0	271.15
Alfalfa hay[g]	Acre	22.32	10.1	225.43	10.1	225.43
Grass and clover hay[g]	Acre	11.20	16.7	187.04	19.5	218.40
Pasture[g]	Acre	11.20	61.0	683.20	58.3	652.96
Milk replacer[h]	Cwt.	17.00	3.0	51.00	--	--
Breeding fees	Hd.	6.00	26.0	156.00	32.0	192.00
DHIA testing	--	--	--	177.00	--	206.40
Milk hauling	Cwt.	.22	2,574	566.28	3,168	696.96
Veterinary fees and drugs	--	--	--	160.00	--	165.00
Dairy supplies	--	--	--	104.00	--	128.00
Bedding	--	--	--	160.00	--	175.00
Electricity	--	--	--	140.00	--	148.00
Tractor fuel	--	--	--	288.00	--	288.00
Trucking fees	--	--	--	14.00	--	14.00
Marketing fees[i]	--	--	--	28.74	--	30.03
Harvesting silage	Ton	2.50	165	412.50	165	412.50
Tobacco[g]	Acre	199.54	1.1	219.49	1.1	219.49
Replacements[j]	Hd.	300.00	--	--	7	2,100.00

TABLE XXVIII (CONTINUED)

Item	100% raised replacements	100% purchased replacements
Expenses:		
Subtotal	$5,733.40	$ 8,177.32
Equipment cost[k]	1,274.16	1,289.66
Building cost[l]	314.90	314.90
Hired labor[m]	1,050.00	1,034.25
Total expenses	8,372.46	10,816.13
Net returns to operator labor, capital and management	6,343.95	6,855.67
Difference in net returns		511.72

[a]Estimates of prices and quantities were adapted primarily from the following sources: unpublished data of the Department of Agricultural Economics, University of Tennessee; Agricultural Prices, Statistical Reporting Service, United States Department of Agriculture; Cost and Returns from Livestock Production in the Limestone Valley Areas of Alabama, Agricultural Experiment Station, Auburn University; Production Requirements and Estimated Returns from Selected Crop and Livestock Enterprises in the Piedment Area, by Charles P. Butler and Thomas A. Burch, South Carolina Agricultural Experiment Station; Estimated Cost and Returns for Selected Crop and Livestock Enterprises in the Southern Piedmont Area of Virginia, Virginia Agricultural Experiment Station; and Farm Management Manual, Department of Agricultural Economics, North Carolina State University.

[b]A 10,000 pound production rate was assumed with 9,900 pounds of marketable milk being produced per cow per year (4 per cent butterfat test).

[c]A 90 per cent calf crop was assumed.

[d]It was assumed that culled cows would weigh an average of 1,300 pounds and bring $0.11 per pound when sold.

[e]Heifers were culled at one year of age.

[f]A 14 per cent concentrate ration consisting of corn, oats, protein supplement, molasses, and salt was assumed to be fed.

TABLE XXVIII (CONTINUED)

[g]Variable cost of crop production were computed as shown in Appendix B.

[h]Assumed fed for approximately 60 days.

[i]Three per cent of the gross value of culled cows.

[j]Even though figures in this study indicated purchased replacements cost between $225 and $246 per head it is assumed that purchased replacements of sufficient quality to maintain a 10,000 pound production average would cost $300 per head. Average production for this group of farms was 6,748 pounds per cow per year.

[k]Equipment cost--see Appendix C, Table XLII, for a listing of the equipment needs assumed for this farm and the yearly charges of each item.

[l]Building cost--see Appendix C, Table XLIII, for a listing of the building needs assumed for this farm and the yearly cost of each building.

[m]1,400 hours of labor were hired at the rate of $.75 per hour when raising replacements. Twenty-one hours less were required when a change in policy was made from raising to purchasing of replacements.

V. MEDIUM CASE FARM

The medium case farm, even though it had approximately the average herd size and labor force of the farms in this grouping, contained about 30 more acres of land than did the average farm for this grouping. The predominance of moderately sloping land made the use of a cover crop a recommended practice for conservation purposes. Most of the soils were best suited to the production of forage and small grains.

Land supply and use. This farm contained 234.4 acres of land of which 195.8 was cropland. A field map of the farm showing acres of cropland in each field is shown in Figure 3. The 38.6 acres of non-cropland was woodland, land occupied with buildings, or gullied land. The land use by fields for a given year in the seven-year crop rotation system established for this farm is shown in Table XXIX. Fields II, IV, V, VII, X, XII, XIII and XVI, totaling 91.3 acres, were used for permanent pasture. Field III was double cropped. Oats were harvested in the spring and the lespedeza was used as annual pasture in late summer and fall. A total of 11,569 cow-acre days of pasture were provided by the permanent and annual pastures. It was assumed that fields VI, VIII, IX, and XV, totaling 57.3 acres, would produce an estimated 193.1 tons of alfalfa hay. Field I, 8.3 acres, was assumed to produce 19.1 tons of orchard grass and ladino clover hay. Field XIV, 4.7 acres, was doubled cropped. Oats were harvested in

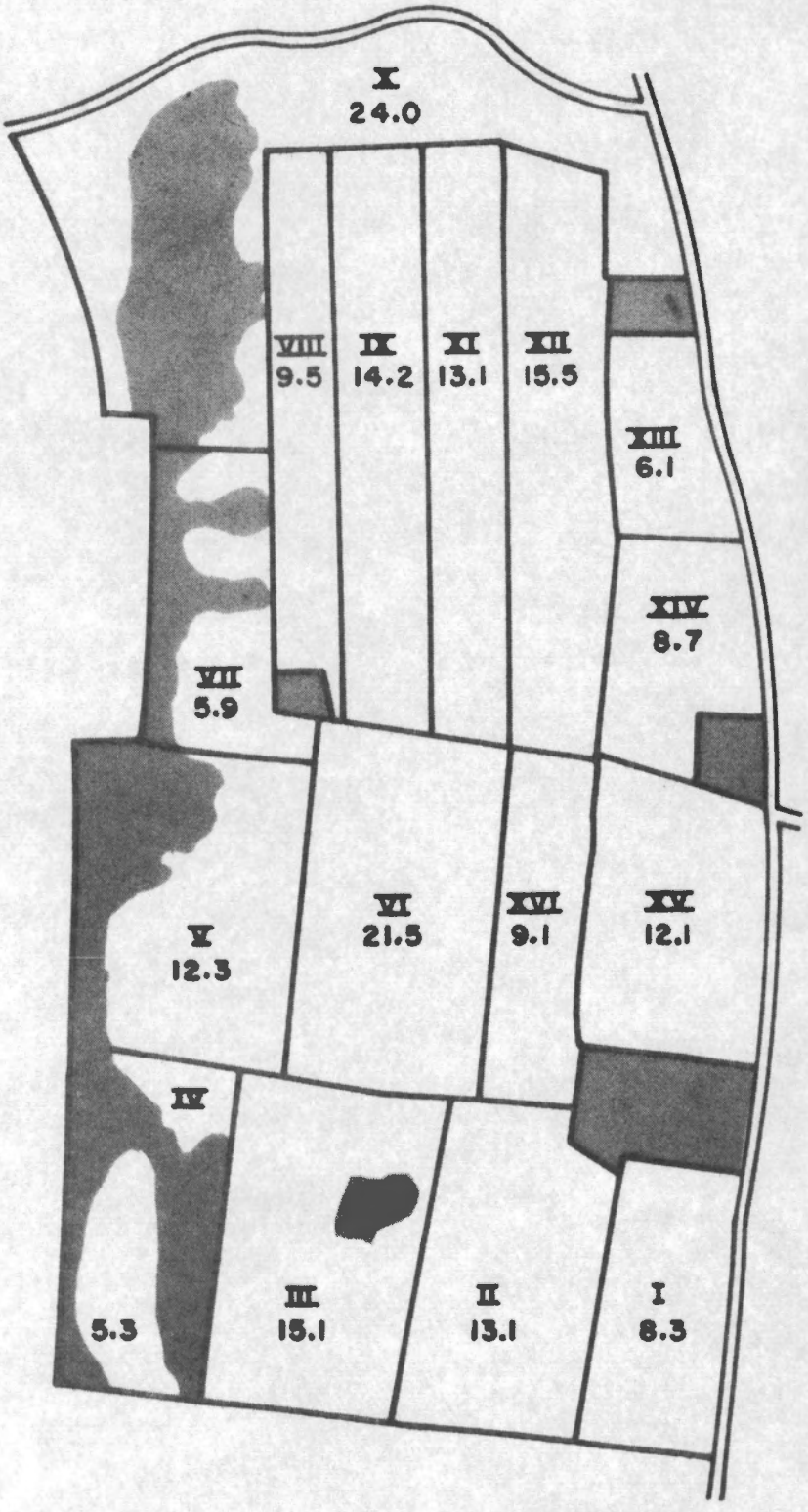


FIGURE 3. FIELD MAP OF THE MEDIUM DAIRY FARM, AND THE ACRES OF CROPLAND BY FIELDS.

TABLE XXIX

CROP USE, BY FIELDS, AND EXPECTED YIELDS, MEDIUM CASE FARM, KNOXVILLE MILKSHED, 1963

Use of fields	Acres of cropland per field	Unit	Average yield per acre[a]	Expected yield
Permanent pasture:				
II	13.1	CAD	116	1,520
IV	5.3	CAD	96	509
V	12.3	CAD	83	1,021
VII	5.9	CAD	93	549
X	24.0	CAD	128	3,072
XII	15.5	CAD	119	1,845
XIII	6.1	CAD	124	756
XVI	9.1	CAD	123	1,119
Annual pasture:				
III	15.1[b]	CAD	78	1,178
Total	106.4	CAD		11,569
Hay:				
Alfalfa				
VI	21.5	Tons	3.4	73.1
VIII	9.5	Tons	3.1	29.4
IX	14.2	Tons	3.4	48.3
XV	12.1	Tons	3.5	42.3
Clover and orchard grass				
I	8.3	Tons	2.3	19.1
Lespedeza				
XIV	4.7[b]	Tons	.9	4.2
Total	70.3	Tons		216.4
Corn silage				
XI	13.1	Tons	15	196
XIV	6.0	Tons	15	90
Total	19.1	Tons		286
Oats				
III	15.1[b]	Bushel	45	679
XIV	4.7[b]	Bushel	45	211
Total	19.8	Bushel		890

TABLE XXIX (CONTINUED)

Use of fields	Acres of cropland per field	Unit	Average yield per acre[a]	Expected yield
Other land[c]	38.6			
Total acres	234.4			

[a]Adapted from the Blount County, Tennessee, Soil Survey by Joe A. Elder and others of the Soil Conservation Service, U. S. Department of Agriculture, U. S. Government Printing Office, 1959.

[b]Double cropped acreages.

[c]Land not used as cropland - woodland, land occupied by buildings, etc.

in the spring, and 4.2 tons of lespedeza hay was harvested in late summer. A total of 70.3 acres of hay was produced, with an estimated yield of 216.4 tons.

Corn silage was grown on the 19.1 acres of Fields XI and XIV, and an estimated yield of 286 tons was expected. Oats grown on Fields III and XIV were expected to produce 890 bushels of oats. The same land-use system would be adequate for both the policy of raising and of purchasing replacements. In the system involving raising of replacements about 100 tons of surplus hay could be sold. When changing to a policy of purchasing replacements, that amount would be reduced to 78 tons.

Livestock numbers under a replacement policy of raising and a policy of purchasing. Under a policy of raising replacements the number of milk cows that could be carried was 45. In order to provide adequate replacements, 10 yearlings one year of age and older were needed, plus 13 calves less than one year of age.

If the replacement policy was changed from raising to purchasing and the herd expanded to utilize resources previously used for heifers, 13 additional cows could be added, which would increase the milking herd to 58 cows.

Feed requirements. Using the same feed requirements for each animal as were used on the small case farm, the medium case farm would require a total of 112,560 pounds of concentrate, 279 tons of silage,

120.3 tons of hay and 10,440 cow-acre days of pasture for all livestock for the system involving raising of replacements (Table XXX). The concentrate ingredients other than oats were purchased. The roughage requirements were adequately met by farm produced forages.

Silage storage capacity on the farm was fixed at approximately 280 tons. When the replacement policy was changed to one of purchasing and the size of the milking herd increased from 45 to 58 cows the available silage per cow was reduced to 4.8 tons. To compensate for the 1.4 tons drop in silage fed per cow, hay was increased to 2.45 tons per cow. Concentrates per cow were held constant at 2,215 pounds per cow and cow-acre days of pasture were held constant at 180 days per cow. The total feed requirements for the system involving purchasing of all herd replacements were 128,470 pounds of concentrate, 279 tons of silage, 142 tons of alfalfa hay or its equivalent, and 10,440 cow-acre days of pasture.

The change in replacement policies with no changes in the cropping system would result in the purchasing of 15,190 additional pounds of concentrate ingredients and would reduce the amount of hay available for sale by 21.7 tons. No change occurred in the total amount of pasture or silage required.

Labor force requirements. There was an average of 5,540 hours of labor available on the farms in the medium grouping (Table VII, page 25). It was estimated that 4,362 hours of labor were required on this

TABLE XXX

ESTIMATED FEED REQUIREMENTS FOR THE DAIRY HERD WHEN RAISING REPLACEMENTS AND WHEN PURCHASING REPLACEMENTS, MEDIUM CASE FARM, KNOXVILLE MILKSHED, 1963

Replacement policy	Number of animals	Concentrate requirements		Roughage requirements					
				Silage		Hay		Pasture	
		Pounds per animal	Total pounds	Tons per animal	Total tons	Tons per animal	Total tons	CAD per animal	Total CAD
100% raised:									
Cows	45	2,215	99,675	6.2	279	2.0	90.0	180	8,100
Yearlings (1 yr. of age or older)	10	242	2,420	--	--	1.6	16.0	130	1,300
Calves (less than 1 yr. of age)	13	805	10,465	--	--	1.1	14.3	80	1,040
Total requirements	--	--	112,560	--	279	--	120.3	--	10,440
100% purchased:									
Cows	58	2,215	128,470	4.8	279	2.45	142.0	180	10,440
Change in requirements when shifting from a policy of raising to purchasing			+15,910	--	--	--	+21.7		

[a]Since no additional silage is produced, the quantity fed per head is reduced. The quantity of hay fed is increased to compensate for the reduction in silage.

case farm for all enterprises when using a policy of raising all replacements (Table XXXI). When the replacement policy was changed from raising to purchasing and the milking herd was expanded from 45 to 58 cows, the required labor force was estimated to be 4576.3 hours, an increase of 214 hours (Table XXXII). An average of 1070 hours of labor was therefore available to make repairs and maintain the equipment, etc.

On this particular farm a father-son partnership existed. The father and son provided 4,410 hours of the 5,540 hours available for farm work. The additional labor force was hired. One hundred and three days or 1,030 hours of labor was assumed hired when replacements were raised. When the replacement policy was changed from raising to purchasing, an additional 214 hours of labor was required.

Opportunity cost. The total revenue of the farming operation when raising 45 cows, 10 yearlings, and 13 heifer calves, was estimated to be $25,968. Total expenses were estimated to be $12,061.60. Net returns to operator's labor, capital, and management was $13,906.40 (Table XXXIII). On this particular farm net returns represented returns to a father-son partnership.

When the farm operation was planned using a purchasing replacement policy, the farming system had an estimated total revenue of $31,648.20, and total expenses of $16,689.80. Net returns to operator(s) labor, capital, and management was $14,958.40 (Table XXXIII). This value would represent the opportunity cost of the farming system when raising its replacements, assuming purchasing to be the more profitable alternative.

TABLE XXXI

ESTIMATED LABOR REQUIREMENTS WHEN RAISING REPLACEMENTS, MEDIUM CASE FARM, KNOXVILLE MILKSHED, 1963[a]

Enterprise	Size of enterprise	Labor requirements by periods						
		January and February	March and April	May and June	July and August	September and October	November and December	Total for year
		Hours						
Cows	45 head	513	424	405	410	421	527	2,700
Heifers	23 head	155	68	--	--	36	132	392
White clover and orchard grass hay	8.3 acres	7	16	21	4	1	--	48
Alfalfa hay	57.3 acres	--	28	436	137	--	--	602
Corn silage - winter cover	21.1 acres	9	48	32	166	15	--	271
Oats followed by lespedeza	19.9 acres	6	6	40	32	38	--	121
Pasture	91.3 acres	73	--	100	46	9	--	228
All enterprises	--	763	590	1034	795	520	659	4,362

[a]Adapted from "Labor Requirements on Tennessee Farms," by W. P. Ranney, University of Tennessee Agricultural Experiment Station Bulletin No. 316, Knoxville, 1960.

TABLE XXXII

ESTIMATED LABOR REQUIREMENTS WHEN PURCHASING REPLACEMENTS, MEDIUM CASE FARM, KNOXVILLE MILKSHED, 1963[a]

Enterprise	Size of enterprise	Labor requirements by periods: January and February	March and April	May and June	July and August	September and October	November and December	Total for year
		Hours						
Milk cows	58 head	628	519	496	502	516	645	3,306
White clover and orchard grass hay	8.3 acres	7	16	21	4	1	--	49
Alfalfa hay	57.3 acres	--	28	436	137	--	--	602
Corn silage	21.1 acres	9	48	32	166	15	--	270
Oats followed by lespedeza	19.9 acres	6	6	40	32	38	--	121
Permanent pasture	91.3 acres	73	--	100	46	9	--	228
All enterprises	--	723	617	1125	887	579	645	4,576

[a]Adapted from "Labor Requirements on Tennessee Farms," by W. P. Ranney, University of Tennessee Agricultural Experiment Station Bulletin No. 316, Knoxville, 1960.

TABLE XXXIII

COMPARISON OF COST AND RETURNS FOR THE MEDIUM CASE FARM WITH ALTERNATE REPLACEMENT POLICIES, KNOXVILLE MILKSHED, 1963

Item	Unit	Price[a]	100% raised replacements		100% purchased replacements	
			Quantity[a]	Value	Quantity[a]	Value
Revenue:						
Milk[b]	Lbs.	$ 4.60	4,455	$20,493.00	5,742	$26,413.20
7-day old calves[c]	Head	20.00	27	540.00	52	1,040.00
Culled cows[d]	Head	143.00	10	1,430.00	12	1,716.00
Culled heifers[e]	Head	100.00	3	300.00	--	--
Hay: alfalfa	Ton	33.00	81	2,673.00	59	1,947.00
clover and grass	Ton	28.00	19	532.00	19	532.00
Total revenue				25,968.00		31,648.20
Expenses:						
Replacements[f]	Head	300.00	--	--	12	3,600.00
Oats	Bu.	.70	--	--	125	87.50
Corn	Bu.	1.25	805.0	1,006.25	919	1,148.75
Cotton seed oil meal	Cwt.	3.50	197.0	689.25	225	787.50
Molasses	Cwt.	3.50	56.3	197.05	64.3	225.05
Salt	Cwt.	1.64	11.3	18.53	13.0	21.32
Corn silage[g]	Acre	24.65	21.1	520.12	21.1	520.12
Hay: alfalfa[g]	Acre	22.32	57.3	1,278.94	57.3	1,278.94
Clover and grass[g]	Acre	11.80	8.3	97.94	8.3	97.94
Pasture[g]	Acre	11.20	91.3	1,022.56	91.3	1,022.56
Oats and lespedeza[g]	Acre	25.05	19.9	498.50	19.9	498.50
Combining	Acre	6.00	19.9	119.40	19.9	119.40
Breeding fees	Head	6.00	45.0	270.00	58.0	348.00
Milk replacer	Cwt.	17.00	3.3	56.10	--	--
DHIA	Year	--	--	265.00	--	317.04
Milk hauling	Cwt.	.22	4,455	980.10	5,742	1,263.24
Vet. fees and drugs	Year	--	--	270.00	--	285.00
Dairy supplies	Year	--	--	180.00	--	232.00
Electricity	Year	--	--	175.20	--	211.70
Tractor fuel	Year	--	--	576.00	--	576.00
Trucking fee	Year	--	--	26.00	--	24.00
Marketing fees	Year	--	--	42.90	--	51.48
Bedding	Year	--	--	280.00	--	310.00

TABLE XXXIII (CONTINUED)

Item	100% raised replacements Value	100% purchased replacements Value
Expense: subtotal	$ 8,569.84	$13,026.04
Annual equipment cost[h]	2,275.41	2,286.91
Annual building cost[h]	443.85	443.85
Hired labor expense[i]	772.50	933.00
Total cost	12,061.60	16,689.80
Net returns to capital, labor and management[j]	13,906.40	14,958.40
Difference in net returns[j]		+1,052.00

[a]Estimates of prices and quantities were adapted primarily from the following sources: unpublished data of the Department of Agricultural Economics, University of Tennessee; Agricultural Prices, Statistical Reporting Service, United States Department of Agriculture; Cost and Returns from Livestock Production in the Limestone Valley Areas of Alabama, Agricultural Experiment Station, Auburn University; Production Requirements and Estimated Returns from Selected Crop and Livestock Enterprises in the Piedmont Area, by Charles P. Butler and Thomas A. Burch, South Carolina Agricultural Experiment Station; Estimated Cost and Returns for Selected Crop and Livestock Enterprises in the Southern Piedmont Area of Virginia, Virginia Agricultural Experiment Station; and Farm Management Manual, Department of Agricultural Economics, North Carolina State University.

[b]A production rate of 10,000 pounds milk and 4 per cent butterfat was assumed with 9,900 pounds being marketable milk.

[c]A 90 per cent calf crop was assumed. Calves were sold to other farmers.

[d]Culled cows were assumed to weigh 1,300 pounds and bring $.11 per pound when sold.

[e]Heifers culled at one year of age.

TABLE XXXIII (CONTINUED)

[f]Replacements were assumed to cost $300 each. This was approximately $50-75 more than was paid for replacements in the sample. However, production was assumed to be 10,000 pounds instead of the 7,222-pound average of cows in the sample.

[g]Variable cost of crop production was computed as shown in Appendix B.

[h]See Appendix C, Tables XLIV and XLV.

[i]When raising replacements it was assumed that 1,030 hours of hired labor were required. When purchasing replacements 1,244 hours of labor were required. Cost of hired labor was assumed to be $7.50 per 10 hours.

[j]Since this was a father-son partnership opportunity cost and net returns pertain to capital, father-son's labor and management.

The net difference in net returns between the two systems was $1,052. Assuming the estimates of cost and returns to be correct, purchasing would the more profitable alternative for this farm. The farmer in this instance would be able to pay as much as $387.66 for his replacements and still maintain the same returns to operator labor, capital, and management as he would receive from a system using raised replacements.

VI. LARGE CASE FARM

Land supply and use. The large farm contained two parcels of land, a tract owned by the farm operator and a parcel rented within the community. The topography of the land varied from flat, river-bottom land to steep hillsides. The owned tract contained 191.3 acres of land of which 175.3 acres were cropland. Sixteen acres were occupied with buildings, lanes, trees, etc. Of the 175.3 acres of cropland, 142.3 acres were planned for permanent pasture. The field arrangement and cropland acreage in each field for the owned tract is shown in Figure 4. Fields III, V, VI, VII, VIII, IX, X, XI, XII, XIII, and XIV were planned for permanent pasture for both of the systems of raising replacements and purchasing replacements (Table XXXIV). These fields would produce an estimated 16,951 cow-acre days of grazing. Field IV, 2.5 acres, would be used as a loafing area for the cattle. Fields Ia and II contained 22.7 acres and would produce an estimated 454 tons of corn silage. Field Ib containing 1.2

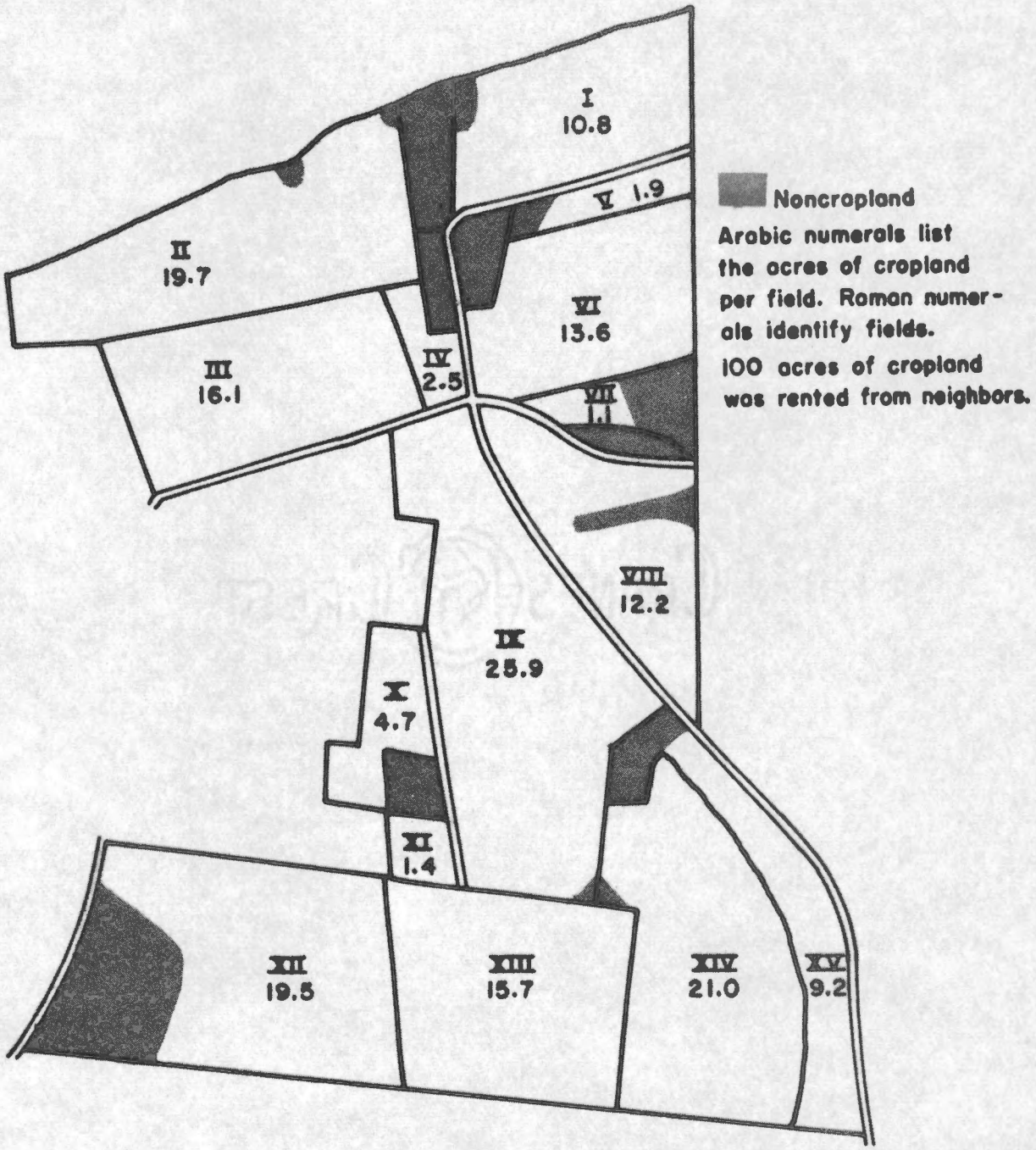


FIGURE 4. FIELD MAP OF THE LARGE DAIRY FARM, AND THE ACRES OF CROPLAND BY FIELDS.

TABLE XXXIV

CROP USE BY FIELDS AND EXPECTED YIELDS OF OWNED LAND, LARGE DAIRY FARMS, KNOXVILLE MILKSHED, 1963

Use by fields	Acres of cropland	Unit	Average yield per acre[a]	Expected yield
Permanent pasture				
III	16.1	CAD	131	2,109
V	1.9	CAD	45	85
VI	13.6	CAD	126	1,713
VII	1.1	CAD	129	142
VIII	12.2	CAD	110	1,342
IX	25.9	CAD	108	2,797
X	4.7	CAD	120	564
XI	1.4	CAD	105	147
XII	19.5	CAD	137	2,672
XIII	15.7	CAD	136	2,135
XIV	21.0	CAD	123	2,583
V	9.2	CAD	72	662
Total	142.3	CAD		16,951
Loafing area				
IV	2.5	--	--	--
Total	2.5	--	--	--
Corn silage				
Ia	3.0	Tons	20	60
II	19.7	Tons	20	394
Total	22.7	Tons		454
Tobacco				
Ib	1.2	Lbs.	2,300	2,760
Total	1.2	Lbs.		2,760
Corn for grain				
Ic	6.6	Bu.	90	594
Total	6.6	Bu.		594

TABLE XXXIV (CONTINUED)

Use by fields	Acres of cropland	Unit	Average yield per acre[a]	Expected yield
Other land	16.0	--	--	--
Total acres owned	191.3	--	--	--

[a]Adapted from the Loudon County, Tennessee Soil Survey by Joe A. Elder and others of the Soil Conservation Service, U. S. Department of Agriculture, U. S. Government Printing Office, 1961.

acres would be used for tobacco production. Total burley tobacco production was estimated to be 2,760 pounds. Field Ic, 6.6 acres, was used for corn to be harvested as grain. It was estimated that a total yield of 594 bushels could be produced on this field.

In determining the expected total production of rented land, average yields of this owned tract of land were applied since soil maps for the rented acreage were not obtained. Since the rented land was located some distance from the milking facilities, its use was limited to harvested crops. When replacement policies were changed from raising to purchasing, a change in the rented land use was the only one required.

When a policy of raising all replacements was followed, land use on the 100 acres of rented land consisted of 36 acres of alfalfa hay, 30 acres of orchard grass and white clover hay, 22.5 acres of oats and lespedeza, and 11.5 acres of corn. The expected total yields were: 108 tons of alfalfa hay, 75 tons of orchard grass and white clover hay, 18 tons of lespedeza hay, 1,193 bushels of oats, and 690 bushels of corn (Table XXXV).

When the replacement policy was changed from raising to purchasing, the only alteration in land use was a shift of the 22.5 acres used for oats and lespedeza to orchard grass and white clover hay production. Even though this was the only shift in land use, in order to meet the needed concentrate requirements additional quantities of corn, oats, etc., had to be purchased (Table XXXVI).

TABLE XXXV

LAND USE AND ESTIMATED YIELD OF 100 ACRES OF RENTED LAND, RAISING DAIRY HERD REPLACEMENTS, LARGE CASE FARM, KNOXVILLE MILKSHED, 1963

Use	Acres	Unit	Average yield per acre	Expected total production
Hay:				
Alfalfa	36.0	Tons	3.0	108
Orchard grass and white clover	36.0	Tons	2.5	75
Lespedeza	22.5[a]	Tons	.8	18
Oats	22.5[a]	Bu.	53	1,193
Corn (for grain)	11.5	Bu.	60	690

[a]Double cropped acres.

TABLE XXXVI

LAND USE AND ESTIMATED YIELD OF 100 ACRES OF RENTED LAND, PURCHASING DAIRY HERD REPLACEMENTS, LARGE CASE FARM, KNOXVILLE MILKSHED, 1963

Use	Acres	Unit	Average yield per acre	Expected total production
Hay:				
Alfalfa	36.0	Tons	3.0	108
Orchard grass and white clover	58.5	Tons	2.5	146
Corn (for grain)	11.5	Bu.	60	690

Livestock numbers under a policy of raising and a policy of purchasing. When following a policy in which all needed replacements were raised on this farm, it was estimated that with the cropping system outlined in the previous section, 72 cows, 15 yearling heifers one year of age or older, and 19 heifer calves less than one year of age would be the optimum herd size, assuming some safety margins in crop production--especially pasture production.

When the replacement policy was changed from raising to purchasing, it was estimated that a milking herd of 91 cows would be the optimum herd size, an increase of 19 cows.

Feed requirements. Using the same feed requirements for each animal as were used on the small case farm, the large case farm would require a total of 178,405 pounds of concentrate, 446 tons of corn silage, 189 tons of alfalfa hay or its equivalent, and 16,430 cow-acre days of pasture per year (Table XXXVII).

To meet the concentrate feed requirements 200 bushels of oats, 31,230 pounds of cotton seed oil meal, 8,920 pounds of molasses, and 1,780 pounds of salt were purchased.

The feed requirements for the 91-cow milking herd maintained under a policy in which all replacements were purchased consisted of a total of 201,565 pounds of concentrate, 446 tons of silage, 220 tons of alfalfa hay or its equivalent; and 16,380 cow-acre days of pasture. Silage production was held constant when shifting from raising to purchasing of replacements due to the limit of silo facilities, therefore

TABLE XXXVII

ESTIMATED FEED REQUIREMENTS FOR DAIRY HERD WHEN RAISING REPLACEMENTS AND WHEN PURCHASING REPLACEMENTS, LARGE CASE FARM, KNOXVILLE MILKSHED, 1963

Replacement policy	Number of animals	Concentrate requirements		Roughage requirements					
				Silage		Hay		Pasture	
		Pounds per animal	Total pounds	Tons per animal	Total tons	Tons per animal	Total tons	CAD per animal	Total CAD
100% raised:									
Milk cows	72	2,215	159,480	6.2	446	2.0	144	180	12,960
Yearlings (1 yr. of age or older)	15	242	3,630	--	--	1.6	24	130	1,950
Calves (less than 1 yr. of age)	19	805	15,295	--	--	1.1	21	80	1,520
Total replacements	--	--	178,405	--	446	--	189	--	16,430
100% purchased:									
Milk cows	91	2,215	201,565	4.9	446	2.41	220	180	16,380
Change in requirements when shifting from a policy of raising to purchasing	--	--	+23,160	--	--	--	+31	--	-50

[a]Since no additional silage is produced, the quantity fed per head is reduced. The quantity of hay fed is increased to compensate for the reduction in silage.

silage available per cow was reduced from 6.2 tons to 4.9 tons. To compensate for the decrease in silage fed, a .41 ton increase in the amount of hay fed per cow was made.

The only changes in feed requirements were in the amount of concentrate, hay, and pasture required. Concentrates requirements increased 23,160 pounds, hay requirements increased 31 tons, and pasture requirements decreased by 50 cow-acre days. The increased hay requirement was met by the shift of the acreage used for oats to orchard grass and ladino clover hay production, mentioned earlier. This resulted in a need for additional purchases of oats along with other concentrate ingredients. The decrease in cow-acre days was assumed to be included in the safety margin assumed for dry weather, etc.

Labor requirements. The large farms had an average of 9,150 hours of labor available for farm work. When the farming system included raising of replacements, it was estimated that 6,306 hours of labor were needed to meet the crop and livestock requirements alone (Table XXXVIII). Additional labor would be needed to maintain fences, buildings, equipment, etc.

When a purchasing replacement policy was used, the labor requirements were estimated to be 6,845 hours plus the labor requirements of fence, building, and equipment maintenance, etc (Table XXXIX). This was an increase of 540 hours.

On this particular farm the operator furnished 300 days or 3,000 hours of labor. Therefore, to provide the average available labor force

TABLE XXXVIII

ESTIMATED LABOR REQUIREMENTS WHEN RAISING REPLACEMENTS, LARGE CASE FARM, KNOXVILLE MILKSHED, 1963[a]

Enterprise	Size of enterprise	Labor requirements by periods: January and February	March and April	May and June	July and August	September and October	November and December	Total per year
		Hours						
Milk cows	72.0 head	752	622	594	602	618	772	3,960
Heifers	34.0 head	162	71	--	--	38	137	408
White clover and orchard grass hay	30.0 acres	24	57	75	15	3	--	174
Alfalfa hay	36.0 acres	--	18	275	85	--	--	378
Corn silage	22.7 acres	11	57	39	179	18	--	304
Tobacco	1.2 acres	--	24	44	64	166	105	403
Permanent pasture	142.3 acres	114	--	156	71	14	--	355
Oats and lespedeza	22.5 acres	7	6	46	36	43	--	138
Corn (for grain)	18.1 acres	--	76	45	--	65	--	186
All enterprises	--	1,070	931	1,274	1,052	965	1,014	6,306

[a]Adapted from "Labor Requirements on Tennessee Farms," by W. P. Ranney, University of Tennessee Agricultural Experiment Station, Bulletin No. 316, Knoxville, September, 1960.

TABLE XXXIX

ESTIMATED LABOR REQUIREMENTS WHEN PURCHASING REPLACEMENTS, LARGE CASE FARM, KNOXVILLE MILKSHED, 1963[a]

Enterprise	Size of enterprise	Labor requirements by periods: January and February	March and April	May and June	July and August	September and October	November and December	Total per year
		Hours						
Cows	91.1 head	943	771	737	747	767	958	4,914
White clover and orchard grass hay	52.5 acres	42	100	131	26	5	--	304
Alfalfa hay	36.0 acres	--	18	275	85	--	--	378
Corn silage	22.7 acres	11	57	39	179	18	--	304
Tobacco	1.2 acres	--	24	44	64	166	105	403
Pasture	142.3 acres	114	--	157	71	14	--	356
Corn (for grain)	18.1 acres	--	76	45	--	65	--	186
All enterprises	--	1,101	1,046	1,428	1,172	1,035	1,063	6,845

[a]Adapted from "Labor Requirements on Tennessee Farms," by W. P. Ranney, University of Tennessee Agricultural Experiment Station, Bulletin No. 316, Knoxville, September, 1960.

of 9150 hours under a policy of raising replacements, 6,150 hours of labor would have to be hired assuming no additional family labor was available. An additional 540 hours would have to be hired if he changed to a policy in which all replacements were purchased. It was assumed in deriving the budgets that the available rather than the estimated required labor force should be provided since all farm labor requirements were not included in the enterprise estimates.

Opportunity cost. The total revenue of the farming operation when raising 75 cows, 15 yearlings, and 19 heifer calves, (the estimated optimum herd size with the assumed crop yields, labor force, and feed requirements) was estimated to be $37,909.80. Total expenses were estimated to be $18,592.18. Net return to operator labor, capital, and management was $19,317.62 (Table XL).

When the farming operation was planned using a purchasing policy, the farming system had an estimated total revenue of $47,454.40 and total expenses of $26,827.44. Net return to operator labor, capital, and management was $20,626.96. This value would represent the opportunity cost of the farming system when raising its replacements, assuming purchasing to be the next most profitable alternative.

In considering changing to a system with a different replacement policy, the difference in the revenue of the two systems would be a primary concern. The net differences in returns between the two systems for this farm was $1,309.34 (Table XL). Assuming the estimates of cost and returns to be correct, purchasing would be the more profitable alter-

TABLE XL

COMPARISON OF COST AND RETURNS FOR THE LARGE CASE FARM WITH ALTERNATE REPLACEMENT POLICIES, KNOXVILLE MILKSHED, 1963

Item	Unit	100% raised replacements			100% purchased replacements	
		Price[a]	Quantity[a]	Amount	Quantity[a]	Amount
Revenue:						
Milk[b]	Cwt.	$ 4.60	7,128	$32,788.80	9,009	$41,441.40
7-day old calves[c]	Head	20.00	46	920.00	82	1,640.00
Culled cows[d]	Head	143.00	15	2,145.00	19	2,717.00
Culled heifers[e]	Head	100.00	4	400.00	--	--
Tobacco	Lbs.	.60	2,760	1,656.00	2,760	1,656.00
Total				$37,909.80		$47,454.40
Expenses: (variable)						
Oats	Bu.	$ .70	200.0	$ 140.00	1,578	$ 1,104.60
Cottonseed oil meal	Cwt.	3.50	312.3	1,093.05	360.0	1,260.00
Molasses	Cwt.	3.50	89.2	312.20	101.0	353.50
Salt	Cwt.	1.64	17.8	29.19	30.0	32.80
Corn[f]	Acre	24.65	18.1	446.16	18.1	446.16
Oats and lespedeza[f]	Acre	25.05	22.5	56.36	--	--
Pasture[f]	Acre	11.20	142.2	1,592.64	142.2	1,592.64
Corn silage[f]	Acre	24.65	22.7	559.56	22.7	559.55
Tobacco[f]	Acre	199.54	1.2	239.45	1.2	239.45
Hay: alfalfa[f]	Acre	22.32	36.0	803.52	36.0	803.52
clover and grass[f]	Acre	11.20	30.0	336.0	52.5	588.00
Combining	Acre	6.00	22.5	135.00	--	--
Milk replacer[g]	Cwt.	17.00	4.8	81.60	--	--
Breeding fees	Head	6.00	72.0	432.00	91.0	546.00
DHIA	Year	--	--	360.96	--	423.00
Milk hauling	Cwt.	.22	7,128	1,568.16	9,009	1,981.98

TABLE XL (CONTINUED)

Item	Unit	100% raised replacements Price	Quantity	Amount	100% purchased replacements Quantity	Amount
Expenses: (cont'd.)						
Corn picking[h]	Acre	6.00	18.1	$ 108.42	18.1	$ 108.42
Vet. fees and drugs	Year	--	--	420.00	--	441.50
Dairy supplies	Year	--	--	288.00	--	364.00
Electricity	Year	--	--	372.00	--	396.00
Tractor fuel	Year	--	--	648.00	--	648.00
Trucking charges	Year	--	--	38.00	--	38.00
Marketing fees[i]	Year	--	--	76.35	--	81.51
Bedding	Year	--	--	440.00	--	475.00
Replacements[j]	Head	300.00	--	--	191	5,700.00
Corn (purchased)	Bu.	1.25	--	--	165	206.25
Expense: subtotal				10,576.62		$18,389.88
Annual equipment cost[k]				2,587.46		2,604.46
Annual building cost[k]				815.00		815.60
Hired labor expense[l]				4,612.50		5,017.50
Total cost				18,592.18		26,827.44
Net returns to capital, operator labor and management[m,n]				19,317.62		20,626.96
Difference in net returns						+1,309.34

[a]Estimates of prices and quantities were adapted primarily from the following sources: unpublished data of the Department of Agricultural Economics, University of Tennessee; Agricultural Prices, Statistical Reporting Service, United States Department of Agriculture; Cost and Returns from Livestock Production in the Limestone Valley Areas of Alabama, Agricultural Experiment Station, Auburn University; Production Requirements and Estimated Returns from Selected Crop

and Livestock Enterprises in the Piedmont Area, by Charles P. Butler and Thomas A. Burch, South Carolina Agricultural Experiment Station; Estimated Cost and Returns for Selected Crop and Livestock Enterprises in the Southern Piedmont Area of Virginia, Virginia Agricultural Experiment Station; and Farm Management Manual, Department of Agricultural Economics, North Carolina State University.

[b]A 10,000-lb. production rate was assumed with 9,900 lbs. of marketable milk being produced per cow per year (4% butterfat test).

[c]A 90% calf crop was assumed. Calves were sold to other farmers.

[d]It was assumed that a culled cow would average 1,300 lbs. in weight and bring $.11 per lb. when sold.

[e]Heifers culled at one year of age.

[f]See Appendix B.

[g]Assumed to be fed 60 days.

[h]Custom corn picking.

[i]Three per cent of gross sales value of cattle sold at auction markets.

[j]Replacements capable of producing 10,000 lbs. of milk were assumed to cost $300.

[k]See Appendix C, Tables XLVI and XLVII.

[l]300 days of labor were furnished by the operator. Six hundred fifteen days of labor were hired when raising replacements. When purchasing replacements 54 additional days of labor were required.

[m]300 days of operator labor.

[n]In computing net returns, rent paid for the use of rented land was not deducted as it was the same for both plans. Thus, net returns are overstated.

native for this farm. The farmer in this instance would be able to pay an average of $368.91 for his replacements, and still maintain the same returns to operator labor, capital, and management as he would receive from a system using raised replacements.

VII. CONTRACTUAL REPLACEMENT POLICIES

Contractual replacement policies were practically nonexistent in the sample farms. The few existing contractual arrangements were not formal, usually consisting of a verbal agreement to give a specified per cent of the heifers as payment to the grower.

Contractual arrangements in other areas are sometimes more formal. Usually the arrangements are set forth in a written contract which specifies the obligations and responsibilities of both the grower and dairyman. Such things as relationship of parties, terms of contract, termination of contract, provision for supplies furnished, management decisions, identification, routine veterinarian care, liability for death loss, liability for fire insurance, assignment of contract, age or weight at delivery and recall, and breeding should be considered in the formation of contracts.[1] Provisions for these items would be helpful in preventing later disagreements between the grower and dairyman.

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[1]John W. Jack, Economic Considerations in Raising Dairy Replacements, A. E. Res. 123, Agricultural Experiment Station (Ithaca, N. Y.: Cornell University Press, 1963), pp. 22, 23.

The reason why contractual arrangements have developed as a form of replacement policy is that they provide some of the advantages of purchasing and some of the advantages of raising. As was noted earlier in the study, farmers' primary objection to purchasing and primary reason given for raising their replacements were that they do not know the breeding of their replacements unless they raise them. A contractual policy, however, permits a farmer to replace his cows with replacements of known ancestry. When his calves are a few days old he passes them on to a grower who raises them until they are ready to freshen, at which time they are returned. This permits the dairyman to specialize his operation, and expand his herd to utilize the released resources.

Contracting also has some disadvantages. A good grower may be hard to obtain and, as in purchasing, a large out-of-pocket-payment may be required. Various arrangements have been initiated to minimize this problem.

There are two basic types of contractual arrangements which have been followed. Under a direct-contract-to-grow arrangement the dairyman retains title to the heifer and keeps control over it. The heifer grower raises the heifer and supplies all or a major portion of the inputs for a monthly cash payment. Essentially the dairy farmer obtains use of facilities without owning them, and the responsibility for day-to-day chores in tending the heifers are transferred to the grower.

The rate of the specified monthly payment will vary according to the inputs and the services the grower provides. The grower usually supplies all roughage, grain, bedding, housing and labor. The responsibility for other cost, such as veterinarian expense, is specified in the agreement between the dairyman and grower.

Most direct-contract growers receive the same monthly rate per heifer regardless of age. One variation to this system is payment based on rate of gain. Following this arrangement the dairyman makes a specified monthly payment of $9 or $10 per heifer, but the final price paid for the heifer is a specified payment per pound of gain--usually in the range of 20-30 cents per pound.[2]

The second type of arrangement is the option-to-purchase contract. In this case the title to the heifer passes to the grower who is responsible for raising the heifer. The only restriction on the disposition of the heifer is that the original owner has the first option to purchase. Under this system the grower has the disadvantage of having to pay all expenses incurred in growing a heifer without any compensation until the animal is ready to sell. Under this system there are two common arrangements for payment. The first is for the dairyman to sell the calf to the grower at approximately one week of age and then repurchase the heifer near freshening time at the current market price. Due to disagreements over the market price of calves

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[2] Ibid., pp. 20-21.

and heifers, a second method of payment has evolved. This method specifies uniform prices to be paid by the grower when purchasing either registered or grade calves and also specifies a price and age at which the dairyman is entitled to repurchase the heifers.[3]

VIII. COMPARISON OF THE COST OF PURCHASING AND CONTRACTING

The two most common forms of contractual arrangements, as described previously, were a per-pound-of-gain agreement and a monthly payment agreement.

Assuming replacements to weigh 100 pounds at birth and 1200 pounds when returned to the farm, a farmer paying $.25 per pound of gain would pay $275 per replacement to have his heifers raised for him. By not selling his replacements as calves there would also be a reduction of $20 per replacement in revenue. The total cost of the replacement would be $295.

If the farmer paid a flat rate per month of $10 per replacement and the replacement freshened at 27 months of age the cost per replacement by this contractual arrangement would be $270, plus the value of the calf at birth or approximately $290.

When compared to the replacement policies of raising and purchasing on the small, medium, and large farms just budgeted, contracting was the most profitable alternative, under the assumed

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[3] Ibid.

conditions. Returns to operator labor, capital, and management, when compared to purchasing, was increased by $35 on the small farm; $60 on the medium farm; and $95 on the large farm when $.25 was paid for each pound of gain. When a flat rate of $10 per replacement per month was paid, net returns to operator labor, capital, and management was increased by $70 on the small farm; $130 on the medium farm; and $190 on the large farm. The farming systems when operated using 100 per cent purchased replacements had net returns to operator labor, capital, and management of $511.72 for small farms, $1052 for medium farms; and $1309.34 for large farms above that received when operating under a system where all replacements were raised. The profitability of contractual arrangements, however, depends upon the relative cost of alternative policies, as does the profitability of other policies.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objectives of this study were to determine and describe herd replacement policies being used by Grade A dairy farmers in the Knoxville milkshed, to determine reasons for these policies, to estimate the actual cost of raising replacements, and to estimate the opportunity cost of various replacement policies.

Of the 153 Grade A dairy farms in the random sample, 42 per cent had milking herds of 30 cows or less; 32 per cent had from 31 to 49 cows; and 26 per cent had 50 or more cows. The average herd size for the small-farm grouping was 23 cows; for the medium-farm grouping, 39 cows; and for the large-farm grouping, 72 cows. Farmers reported 52 per cent as many heifers as cows. About 3/5 of these heifers were one year of age and over.

During the sample year July 1, 1962, through June 30, 1963, 21 per cent of the milk cows on the sample farms were removed from the herd for various reasons. Low production was the major reason for culling approximately 61 per cent of the animals removed. The next two most important reasons were disease and breeding difficulties, which accounted for 12 and 10 per cent, respectively. Reasons, such as age, death, consignment sales, etc., combined, accounted for the remaining 17 per cent.

Approximately 74 per cent of the replacements were raised heifers which freshened, 10 per cent were purchased heifers which freshened, and 16 per cent were purchased cows.

Sixty-nine per cent of the farmers indicated they usually raise 100 per cent of their replacements. Their major reasons for doing so were: (1) they know the breeding and ancestry of their replacements, (2) they feel it is cheaper to raise replacements than buy them, (3) they feel they cannot buy quality replacements, and (4) they feel that the risk of introducing disease is reduced. The remaining 31 per cent usually purchased part or all of their replacements. The reasons given varied by farm-size grouping. The farmers in the small-farm grouping purchased due to a shortage of land on which replacements could be raised, and because they wished to obtain new bloodlines to improve the quality of their herds. Farmers in the medium-farm grouping purchased to improve the quality of their herds. Several farmers in this group also felt that it was cheaper to purchase than raise replacements. The important factors listed by the large farmers purchasing replacements were land restrictions, and the feeling that purchasing replacements was cheaper than raising them.

The actual cost of obtaining replacements varies not only by source, but with age as well. When replacements were purchased the average prices paid by farmers in this sample were: $225 for cows, $246 for bred heifers, and $175 for unbred heifers one year of age or older. The cost of the unbred heifers would be increased during

the 9-15 months from the purchase date to the freshening date.

The actual cost of raising a replacement to 27 months of age was estimated to be $212. Feed cost was the largest cost item, accounting for $117 of the total.

These estimates would seem to indicate that raising was the most profitable alternative. However, replacement cost depends not on the price of the replacement alone, but the total net income loss or gain to the farm operation when one policy is followed in lieu of another. The opportunity cost of one policy is the net return that would have been received using the other policy, when only two policies are being compared. If the opportunity cost is greater than present returns it would be more profitable to change policies, assuming the cost of the change was not greater than the additional income that would be received.

To gain some insight into the opportunity cost of alternative replacement policies a small, a medium, and a large case farm were selected from the three farm-size groupings. The farms selected had about the same acreage of land and available labor force as the mean of their respective size groups. The farms were planned first following a farming system in which all replacements were raised. The system was then altered and a policy of 100 per cent purchasing was introduced. When the system was altered, the milking herd was increased by the number of cows which the released fixed resources would support. It was assumed that the quality of purchased and raised replacements was

equal. Since in planning the farms, production per cow was standardized at 10,000 pounds and the average production per cow for the cows in the sample farms was about 7,200 pounds, the price of purchased replacements was assumed to average $300 per head, instead of the $225-246 actual average of the purchased animals in the sample. Had the average price of replacements obtained from the survey been used, a much greater difference in net returns would have occurred.

On the small case farm net returns to operator labor, capital, and management was estimated as $6,344 when a policy of raising all replacements was followed. The net returns on the same farm when following a policy of purchasing replacements was estimated to be $6,856. Thus, according to these estimates, the farmer growing his own replacements was foregoing the opportunity of earning the $6,856 which was the returns from the farming system using all purchased replacements. The sacrifice in net returns was $512.

On the medium case farm net returns to operators labor, capital, and management was $13,906 when a policy of raising all replacements was followed. A father-son partnership existed on this farm. The net returns of the farming system using purchased replacements was $14,958. The difference in net returns was $1,052.

Results were similar on the large case farm. Net returns to operator labor, capital, and management was $19,318 when a policy of raising replacements was followed. The net returns of the system using all purchased replacements was $20,627. Stated in opportunity cost

terms, by raising his replacements the farmer was foregoing the opportunity of earning $20,627 which was the returns from the farming system using all purchased replacements. The sacrifice in net returns was $1,309.

When a contractual replacement policy in which $.25 was paid for each pound of gain from the time the grower received the calf until the time he returned it, there was an estimated $5 gain per replacement over purchasing of replacements at $300 per head. It was assumed the animal would gain 1,100 pounds while on contract. Including the $20 initial value of the calf the actual cost of a replacement following this arrangement was estimated to be $295.

Following a contractual policy in which the dairyman paid the grower $10 per month per replacement, the cost per replacement was estimated to be $12 less per head than when purchasing replacements.

Even though one system may be more profitable than another, there are other factors which a dairyman must evaluate. A reliable source of good quality replacements may not be available at reasonable prices. Production rates and the risk of introducing disease into the herd should be considered. The cash outlay requirements of purchasing and contracting should be considered. The changes in such factors as bulk tank capacity, labor needed, etc., should be evaluated. Also, the satisfaction a farmer receives from raising his own replacements, as well as other factors, may have more personal value to the farmer than the addtional income received from using a more profitable alternative.

Contracting may not always be the best policy. There are two factors which will contribute greatly to the success or failure of the policy. If a reliable grower can be located and a good working relationship established, along with a just contract, it will probably prove satisfactory. Contracting will permit the farmer to intensify his operation without increasing his physical plant. Contracting also offers an opportunity for some small farmers who are being forced out of business to remain associated with the dairy industry. Research is needed to determine the profitability of various sized contractual operations, some of the problems which would be encountered, and an estimate of the effects of contractual and/or purchased replacement policies on the dairy industry.

If the 69 per cent of the dairy farmers in the milkshed who currently raise their replacements were to shift to purchasing or contracting and expanded their herds by about 25 per cent, as was done on the case farms in this study, the increased output of milk would likely lead to a decline in milk prices. However, purchasing and contracting probably are not suited to all farms in this area. As replacement policies are evaluated on individual farms, existing conditions should be considered and the policy most suited to each particular farm and its operator adopted.

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APPENDIXES

APPENDIX A

METHOD USED TO ESTIMATE THE AVAILABLE LABOR SUPPLY

Estimates of the labor force available on the dairy farms in the samples were based on the following assumptions and procedures:

First, farmers were asked to give the name, age, and days per year available for farm work for themselves, the members of their families, their tenants and their families, regular hired workers, and the days of seasonal labor hired.

Second, it was assumed that 300 man-work units per year for a full-time dairy farmer between the ages of 22 and 31 would constitute one year of labor provided.

Third, the following rates were used to discount farm work done by children and older men as adapted from Technical Bulletin 304. The Labor Force on Tennessee Farms, by W. P. Ranney, University of Tennessee Experiment Station, 1959.

Age	Man Equivalent
10-14	.20
15-18	.53
18-21	.94
22-31	1.00
32-40	.97
41-52	.87
53-64	.62
65-70	.50
71-76	.37
77-80	.14

For part-time male workers the number of days available are adjusted for the age of the worker by using the above coefficents,

Where female labor was used in doing all types of farm work, the following coefficients were used to adjust to man equivalents:

Age	Average-man-equivalent of farm females
12 and under	.09
13-17	.19
18-29	.29
30-49	.36
50-64	.24
65 and over	.12

Where children, elderly people, and females are used primarily for chores and not for all types of farm labor, the following chore-labor coefficients were estimated for various age groups:

Age	Chore: man equivalents
10-14	.40
15-18	.80
18-21	.95
22-31	1.00
32-40	1.00
41-52	.95
53-64	.85
65-70	.70
71-76	.50
77-80	.30

For the following size herds, the time required to do the chores was estimated as follows:

Size of Herd	Time
Less 30 cows	3 hours per day
31-49 cows	4 hours per day
50 cows and over	5 hours per day

Where a laborer does the chores before and/or after school and during the summer, the chore coefficient is used for the chore time allowed for 300 days, and the regular farm labor coefficient is used for the remaining labor.

APPENDIX B

TABLE XLI

ESTIMATED ANNUAL VARIABLE COST OF PRODUCING SPECIFIC CROPS

Crop	Item	Quantity[a]	Unit Price	Total Cost per Acre	Average Cost Per Acre Per Year
Alfalfa (3.5 tons/acre) (5 year stand)					
	Seed: Alfalfa	20 lbs.	.45 lb.	9.00	
	Fertilizer: Establishment (5-20-20)	500 lbs.	60.00 ton	15.00	
	Maintenance (0-9-27)	2000 lbs.	56.00 ton	56.00	
	Insecticide		3.85 yr.	19.35	
	Borax: (20 lbs. per year)	100 lbs.	4.25 cwt.	4.25	
	Lime (2 tons every 5 years)	4000 lbs.	4.00 ton	8.00	$22.32
White Clover and Orchard Grass (2.5 tons/acre) (6 year stand)					
	Seed: White Clover,	2 lbs.	.75 lb.	1.50	
	Orchard Grass	5 lbs.	.30 lb.	1.50	
	Fertilizer: Establishment (5-20-20)	500 lbs.	60.00 ton	15.00	
	Maintenance (0-20-20)	1500 lbs.	44.00 ton	39.60	
	Lime: (2 tons every 5 years)	4800 lbs.	4.00 ton	9.60	$11.20
White Clover and Orchard Grass (2.5 tons/acre) (5 year stand)					
	Seed: White Clover	2 lbs.	.75 lb.	1.50	
	Orchard Grass	5 lbs.	.30 lb.	1.50	
	Fertilizer: Establishment (5-20-20)	500 lbs.	60.00 ton	15.00	
	Maintenance (0-20-20)	1200 lbs.	44.00 ton	33.00	
	Lime: (2 tons every 5 years)	4000 lbs.	4.00 ton	8.00	$11.80

TABLE XLI (CONTINUED)

Crop	Item	Quantity[a]	Unit Price	Total Cost Per Acre	Average Cost Per Acre Per Year
Oats and Lespedeza (55 bu. oats, .9 ton lespedeza/ acre)					
	Seed: Lespedeza (Kobe)	40 lbs.	.18 lb.	7.20	
	Oats	2 bu.	1.50 bu.	3.00	
	Fertilizer: (6-12-12)	550 lbs.	53.00 ton	13.25	
	Lime: (2 tons every 5 years)	800 lbs.	4.00 ton	1.60	$25.05
Corn Silage (15-20 tons/acre)					
	Seed: Corn	12 lbs.	.18 lb.	2.16	
	Fertilizer: (6-12-12)	500 lbs.	53.00 ton	13.25	
	(30-0-0) Nitrogen	60 lbs.	84.00 ton	7.64	
	Lime: (2 tons every 5 years)	800 lbs.	4.00 ton	1.60	$24.65
Tobacco (2300 lbs./acre)					
	Cover Crop Seed: Crimson Clover	12 lbs.	.20 lb.	2.40	
	Rye Grass	20 lbs.	.12 lb.	2.40	
	Methol Bromide	9 lbs.	.75 lb.	6.25	
	Plastic	100 sq. yds.	.10 sq. yd.	10.00	
	Tobacco Seed	- dol.	--	1.50	
	D. D. T.	6 lbs.	.07 lb.	.42	
	Fermate	15 lbs.	.15 lb.	2.25	
	Cheesecloth	100 sq. yds.	.05 sq. yd.	5.00	
	Fertilizer (4-12-8)	.5 cwt.	2.25 cwt.	1.12	
	Nitrogen	55 lbs.	.12 lb.	6.60	
	(5-10-5)	15 cwt.	2.20 cwt.	33.00	
	Insurance	5 $100	5.00 $100	25.00	

TABLE XLI (CONTINUED)

Crop	Item	Quantity[a]	Unit Price	Total Cost Per Acre	Average Cost Per Acre Per Year
Tobacco (Continued)					
	Insecticides	75 lbs.	.60 lb.	45.00	
	Trucking	--	--	8.00	
	Other Marketing	--	--	50.60	$199.54

[a]Adapted from "Tennessee's 1963 Fertilizer Recommendations," Agricultural Experiment Station, Publication 381 (revised), University of Tennessee, Knoxville, January, 1963.

APPENDIX C

ESTIMATED EQUIPMENT AND BUILDING NEEDS AND COSTS

TABLE XLII

ASSUMED EQUIPMENT NEEDS AND ANNUAL COST ESTIMATES FOR THE SMALL CASE FARM

Equipment[a]	New cost	Salvage value	Amount depreciated	Years life	Depreciation per year	Repair per year	Total cost per year
Tractor: 35 hp	3,100	310.00	2,790.00	12	232.50	90.00	322.50
Plow: 2 bottom	290	29.00	261.00	12	21.75	11.60	33.35
Disk: 8 ft.	400	40.00	360.00	15	24.00	10.00	34.00
Cultivator: 2 row	350	35.00	315.00	15	21.00	19.50	40.50
Planter-fertilizer: 2 row	350	35.00	315.00	15	21.00	13.80	34.80
Mower: 6 ft.	370	37.00	333.00	12	27.75	11.00	38.75
Hay rake: side delivery	480	48.00	432.00	15	28.80	9.60	38.40
Hay bales: PTO	2,100	210.00	1,890.00	12	157.50	52.50	210.00
Fertilizer spreader with seeder: 8 ft.	280	28.00	252.00	15	16.80	5.40	22.20
Cultipacker	375	37.50	337.50	15	22.50	11.25	33.75
Wagon	200	20.00	180.00	20	9.00	8.15	17.15
Manure spreader: 90 bu.	475	47.50	427.50	15	28.50	9.50	38.00
Bulk tank: 250 gal.[b]	2,100	210.00	1,890.00	20	94.50	22.80	117.30
Milker: double unit	425	42.50	382.50	15	25.50	21.25	46.75
Water heater	65	6.50	58.50	16	3.65	3.06	6.71
Truck: 1/2 ton	2,000	200.00	1,800.00	10	180.00	60.00	240.00
Total	13,360	1,336.00	12,044.00	--	914.75	359.41	1,274.16

[a]Equipment investment will not equal the cost of new equipment but approximately one-half this value at any given time.

[b]An increase in production per day would necessitate a change in the capacity of the bulk tank if there existed no excess capacity. It is therefore assumed that a larger bulk tank would be needed. A bulk tank with a capacity of 300 gallons would add approximately $15.50 to the annual equipment cost.

TABLE XLIII

ASSUMED BUILDING NEEDS AND ANNUAL COST ESTIMATES FOR THE SMALL CASE FARM

Buildings	New Cost	Salvage value	Amount depreciated	Years life	Depreciation per year	Repairs per year	Total cost per year
Milking parlor	2,000	200.00	1,800.00	15	120.00	24.00	144.00
Paved loafing area	252		252.00	30	8.40	3.00	11.40
Hay storage	590	59.00	531.00	30	17.70	6.50	24.20
Loafing shed	970	97.00	873.00	30	29.10	9.70	38.80
Silo (upright) (165 ton capacity)	1,775		1,775.00	50	35.50	12.50	48.00
Calf barn	300	30.00	270.00	30	9.00	4.00	13.00
Tobacco barn and tool shed	900	90.00	810.00	30	27.00	8.50	35.50
Total	6,787	476.00	6,311.00	--	246.70	68.20	314.90

TABLE XLIV

ASSUMED EQUIPMENT NEEDS AND ANNUAL COST ESTIMATES FOR THE MEDIUM CASE FARM

Equipment	New cost[a]	Salvage value	Depreciation amount	Years life	Depreciation per year	Repairs per year	Total cost per year
Tractors (2): 35 hp	6,200	620.00	5,580.00	12	465.00	186.00	651.00
Plow: 2 bottom	290	29.00	261.00	12	21.75	11.60	33.35
Disk: 8 ft.	400	40.00	360.00	15	24.00	10.00	34.00
Cultivator: 2 row	350	35.00	315.00	12	26.25	11.55	37.80
Planter-fert.: 2-row	350	35.00	315.00	12	26.25	7.00	33.25
Mower: 7 ft.	420	42.00	378.00	12	31.50	12.60	44.10
Hay rake: side delivery	480	48.00	432.00	12	36.00	9.60	45.60
Hay baler: PTO	2,100	210.00	1,890.00	12	157.50	52.50	210.00
Fertilizer spreader (with seeder): 8 ft.	280	28.00	257.00	12	21.00	4.20	25.20
Cultipacker	375	37.50	337.50	15	22.50	11.25	33.75
Wagons (2)	400	40.00	360.00	20	18.00	16.30	34.30
Manure spreader: 90 bu.	475	47.50	427.50	15	28.50	9.50	38.00
Bulk tank: 500 gal.	2,600	260.00	2,340.00	20	117.00	30.00	147.00
Pipeline milker	2,150	215.00	1,935.00	15	129.00	45.00	174.00
Water heater	65	6.50	58.50	16	3.65	3.06	6.71
Truck: 1 ton	2,400	240.00	2,160.00	10	216.00	72.00	288.00
Manure loader	400	40.00	360.00	12	30.00	8.00	38.00
Forage chopper	2,010	201.00	1,809.00	12	150.75	40.00	190.75
Forage blower	670	67.00	603.00	12	50.25	15.10	65.35
Hay crimper	800	80.00	720.00	12	60.00	12.00	72.00
Hammer mill	200	20.00	180.00	15	12.00	4.00	16.00
Elevator: 24 ft. (PTO)	550	55.00	495.00	12	41.25	16.00	57.25
Total	23,965	2,396.50	21,573.50	--	1,688.15	587.26	2,386.91

[a]Equipment investment at any given time will equal approximately one-half the total estimated value listed.

[b]When replacements were purchased and the milking herd increased to 58 cows, it was assumed that a larger bulk tank would be required. The addition to annual cost of the larger tank was estimated to be $11.50.

TABLE XLV

ASSUMED BUILDING NEEDS AND COST FOR THE MEDIUM CASE FARM

Buildings	New cost	Salvage value	Depreciation amount	Years life	Depreciation per year	Repairs per year	Total cost per year
Milking parlor	3,000	300.00	2,700.00	15	180.00	15.00	195.00
Paved loafing area	600	--	600.00	30	20.00	5.00	25.00
Hay storage	700	70.00	630.00	30	21.00	7.00	28.00
Loafing shed	1,400	140.00	1,260.00	30	42.00	11.60	53.60
Silo (2)	3,600		3,600.00	50	72.00	25.00	97.00
Calf barn	500	50.00	450.00	30	15.00	5.50	20.50
Tool shed	600	60.00	540.00	30	18.00	6.75	24.75
Total	10,400	620.00	9,780.00		368.00	75.85	443.85

TABLE XLVI

ASSUMED EQUIPMENT NEEDS AND ANNUAL COST ESTIMATES FOR THE LARGE CASE FARM

Equipment	New cost[a]	Salvage value	Depreciation amount	Years life	Depreciation per year	Repairs per year	Total cost per year
Tractor: 35 hp	3,100	310.00	2,790.00	12	232.50	93.00	325.50
Tractor: 45 hp	4,050	405.00	3,645.00	12	303.75	121.50	425.25
Plow: 2 bottom	290	29.00	261.00	12	21.75	11.60	33.35
Cultivator: 2 row	350	35.00	315.00	12	26.25	11.55	37.80
Planter-fert.: 2 row	350	35.00	315.00	12	26.25	7.00	33.25
Mower: 7 ft.	420	42.00	378.00	12	31.50	12.60	44.10
Hay rake: side delivery	480	48.00	432.00	12	36.00	9.60	45.60
Hay baler: PTO	2,100	210.00	1,890.00	12	157.50	52.50	210.00
Fertilizer-spreader (with seeder): 8 ft.	280	28.00	252.00	12	21.00	4.20	25.20
Cultipacker	375	37.50	337.50	15	22.50	11.25	33.75
Wagons (2)	400	40.00	360.00	20	18.00	16.30	34.30
Manure spreader	475	47.50	427.50	15	28.50	9.50	38.00
Bulk tank: 700 gal.	3,000	300.00	2,700.00	20	135.00	35.00	170.00
Pipeline milker	3,750	375.00	3,375.00	15	225.00	70.00	295.00
Water heater	90	9.00	81.00	16	5.06	4.25	9.31
Truck: 1-1/2 ton	2,800	280.00	2,520.00	10	252.00	84.00	336.00
Manure spreader	400	40.00	360.00	12	30.00	8.00	38.00
Forage chopper	2,010	201.00	1,809.00	12	150.75	40.00	190.75
Forage blower	670	67.00	603.00	12	50.25	15.10	65.35
Hay crimper	800	80.00	720.00	12	60.00	12.00	72.00
Disk: 8 ft.	400	40.00	360.00	15	24.00	10.00	34.00
Elevator: 24 ft. (PTO)	550	55.00	495.00	12	41.25	16.00	57.25
Hammer mill	450	45.00	405.00	15	27.00	6.70	33.70
Total	27,590	2,759.00	24,831.00	--	1,925.81	661.65	2,587.46

[a]Equipment investment at any given time will equal approximately one-half the total estimated value listed.

[b]When replacements were purchased and the milking herd increased to 92 cows, it was assumed that a larger bulk tank would be required. The addition to annual cost of the larger tank was estimated to be $17.

TABLE XLVII

ASSUMED BUILDING NEEDS AND ANNUAL COST ESTIMATES FOR THE LARGE CASE FARM

Buildings	New cost	Salvage value	Depreciation amount	Years life	Depreciation per year	Repairs per year	Total cost per year
Milking parlor	5,200	520.00	4,680.00	15	312.00	65.00	377.00
Loafing barn	4,550	455.00	4,095.00	30	136.50	34.10	170.60
Replacement housing	1,200	120.00	1,080.00	30	36.00	11.00	47.00
Silos (3): 150 ton	5,400		5,400.00	50	108.00	37.50	145.50
Paved loafing area	990		990.00	30	33.00	8.50	41.50
Tool shed	900	90.00	810.00	30	27.00	7.00	34.00
Total	18,240	1,185.00	17,055.00		652.50	163.10	815.60