FACTORS UNDERLYING

MILK OUTPUT AND SUPPLY RESPONSES

IN

THE LOUISVILLE MILKSHED

By

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Department of Agricultural Economics

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The supply and demand conditions affecting the production of Grade A milk in the Louisville Milkshed are constantly changing. These changes affect milk producers in both Kentucky and Indiana since counties of both states are included in the boundaries of the milkshed. Consequently, a joint research project between the Agricultural Experiment Stations of Purdue University and the University of Kentucky was initiated to analyze the technical and economic conditions which influence the actions of dairy farmers marketing Grade A milk in the Louisville milkshed.

THE RESEARCH PROJECT

The title of the overall research project from which this report originated is, "Cost and Returns of Various Sizes of Dairy Operations and Supply Responses of Milk Producers to Changing Prices in the Louisville Milkshed." The specific objectives and problems established for the project were:

(1) To determine input-output relationships on farms with various combinations of productive factors.

(2) To derive cost curves indicating the nature of cost advantages and disadvantages of various sizes and types of dairy operations.

(3) To estimate supply responses of dairy farmers to changes in relative prices of milk and input factors, such as labor, feed and equipment.

(4) To determine and analyze some of the obstacles of dairy farmers in making supply responses to price changes.

PURPOSE OF THIS REPORT

This report presents a summary of some of the preliminary phases of the study. Specifically the objectives of this report are:

(1) To provide a description of the economic and physical environment within which Grade A milk is produced and marketed in the Louisville milkshed.

(2) To analyze some of the technical relationships among factors of production for various sizes of farms.

(3) To analyze the quantity of inputs used on farms of two production levels per cow.

(4) To provide a better understanding of the responsiveness of farmers to changes in the prices of productive factors and of milk.

With this basic information compiled and analyzed for a stratified random sample of 203 farms, it is reasonable to expect that generalizations about the 2,000 farms producing Grade A milk will be relevant and useful. Therefore, it is reasonable to believe that farmers, their advisors, and agricultural policy makers can derive benefits from this publication. This report is also timely in that it will permit interested people and organizations to become oriented to the problems, the solutions to which the supporting studies of the project are directed.

PROCEDURE

This report (1) provides a description of the sample farms and of some of the relevant characteristics of the Louisville Milkshed area. This is done by describing the land, labor, capital and management resources existing in 1957. (2) Demonstrates the association between size of herd and level of input use, input and output comparisons for four size of herd strata are presented and analyzed. (3) Presents and analyzes the combinations of factors of production for two levels of output per cow. The second and third steps are designed to illustrate that a wide range of input combinations will produce milk but that quality of cow is probably the crucial factor in reducing the cost of producing 100 pounds of milk. (4) Presents the willingness to expand and contract the use of inputs to demonstrate some of the subjective, economic, and physical obstacles to changing the supply of milk.

DESCRIPTION OF THE LOUISVILLE MILKSHED

There were 42 counties, 30 in Kentucky and 12 in Indiana, shipping milk into Louisville market in 1957. The concentration of producers in these counties varies from time to time, and as use of bulk tanks becomes more widespread the geographic area of the milkshed increases. Other factors, such as costs of production, comparative advantage of competing products, and transport costs also affect the number of counties and producers.

Louisville, the central market, is located near the center of the producing area, being slightly north of the north-south dimension. The industrial and residential growth of this city has caused a redistribution of adjacent dairy farms and an expansion of the market.

Soil, Topography, and Climate

Soil type, fertility, and characteristics of drainage vary widely over the milkshed. Generally, those counties nearest the market are the more fertile as a whole, but many smaller areas farther from the market are equally fertile. Dairy farms are as a rule sufficiently fertile and well drained to provide forage and varying quantities of grain for the dairy herd. Those farms with relatively steep land usually have sufficient forage but are forced to purchase some hay if climatic conditions are unseasonable. Those farms with relatively level land are confronted with an expensive drainage problem for the production of feed for dairy cows.

The growing season ranges from 170 days in the northernmost counties of Indiana and 180 days in the southernmost Kentucky counties, to 190 days or more in counties along the Ohio river. Rainfall ranges from 40 to 50 inches and is usually well distributed throughout the year. Frequent rains during the forage harvesting season are not uncommon and create a hazard to the production of high-quality hay.

The climate is classified as moderate and humid. Summer daily temperatures average 85° and winter daily temperatures average (for six weeks) 35°. The humidity is moderately high, averaging about 80 percent most of the year, and falling to 60 to 70 percent in the winter.

Land Use

Land use varies from 15 to 80 percent cropland; type of farming ranges from subsistence and family to commercial. Most of the steep land is devoted to woods, pasture, and hay. The less steep land is devoted to tobacco, corn, soybeans, (primarily in Indiana), small grains, hay, and pasture.

Livestock Enterprise

Grade A dairying is an important type of farming in the milkshed. In 1957, producers who shipped Grade A milk to the Louisville market received a return of $1,606,777,669 for 376,405,567 pounds of milk.[1] The significance of the dairy industry in the milkshed is made more apparent when its returns are compared with the income from all livestock and livestock products sold.[2] This comparison reveals that the value of dairy products sold in 1954, the year for which data were available, represented 29 percent of the total.

Institutional Characteristics

The influence of organized industrial labor on farm wage rates is felt throughout the milkshed. This influence is more pronounced in the immediate vicinity of Louisville and smaller urban communities having one or two industrial plants. Any adverse wage influence due to location disadvantage is probably counterbalanced to some extent by lower transport costs due to location advantage.

The bargaining power of the producers is organized and represented by a cooperative producers' association having a membership that includes approximately 95 percent of all producers.

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[1]Joseph E. Bobo, "Bulk Tank Development," The Courier, Vol. 20, No. 9 (Jan. 1960), p. 10.

[2]U. S. Department of Commerce, Bureau of the Census, United States Census of Agriculture: 1954 Counties and State Economic Areas, Indiana, I, Part 4, 69.

U. S. Department of Commerce, Bureau of the Census, United States Census of Agriculture: 1954 Counties and State Economic Areas, Kentucky, I, Part 19, 97.

Prices and classes of milk are administered by a Federal Milk Marketing Order. This intends to provide a uniform price by classes of milk and aids in the seasonal distribution of production through the use of a fall premium price plan.

Sanitary conditions for the production and handling of milk are specified and administered by a central health authority. This authority is empowered to issue and revoke health permits. Thus, costs of production and number of producers are affected to some extent.

The entry of new producers into the market (industry) is largely regulated by relatively high capital requirements for a farm sufficiently large to be efficient and by the willingness of milk handlers to accept milk from new shippers. These approved handlers are under no formal obligation to receive milk from new producers, and they do so only when an anticipated shortage of supply indicates the need.

DESCRIPTION OF A 203-FARM SAMPLE

A stratified random sample of 203 farms was drawn from the 2,000 Grade A milk producers of record as of June 1957. The distribution of the population and the sample by counties is shown in Fig. 1. The sample was stratified so that the distribution of the 203 farms by size of herd was: 56 farms had less than 20 cows, 66 farms had 20-29 cows, 45 farms had 30-39 cows, and 36 farms had 40 or more cows. The distribution of these sizes in the total population has significant implications for milk supply. The approximate distribution of sizes of herds of Grade A milk producers for 1957 in the entire milkshed is: 33.8 percent, less than 20; 27.3 percent, 20-29; 23.4 percent, 30-39; 15.5 percent, 40 or more cows.

SAMPLE ESTIMATES

The sample of farms provides a means for making estimates of various characteristics of the total population of Grade A milk producers. For example, we can estimate the total quantity of milk produced. Since this is known from published sources, the estimate can be compared with the actual and hence provides a gross check on the representativeness of the sample. The estimate of the 1957 milk production from the sample was 381,234,404 pounds, while the actual production was 376,405,567 pounds or an error of about 1 percent. In order to account for the possibility of error in making estimates of other characteristics, we will say that the "true" quantity falls within an interval and our degree of confidence is that 95 out of 100 samples would provide an interval that would include the population value. Some physical and economic facts concerning the entire milkshed for 1957 are given in Table 1.

In addition to these characteristics of the population, we can indicate various frequency distributions of practices followed by the sample farmers.

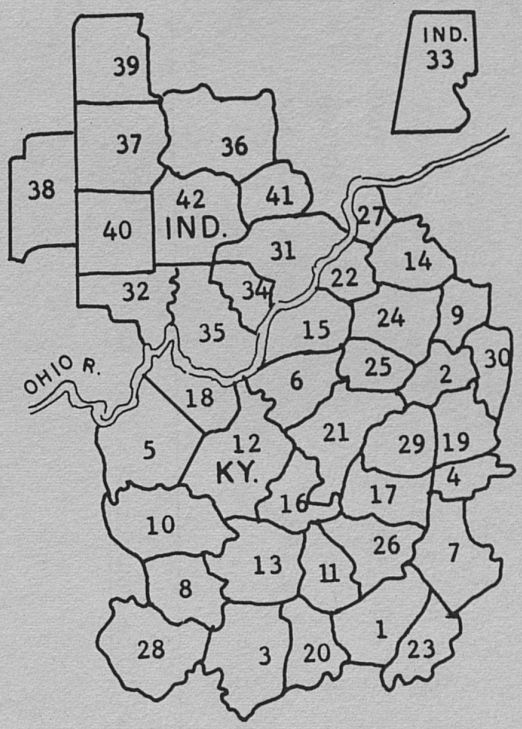

Fig. 1. -- Distribution of population and sample farms by counties.

Legend:

County No.	Kentucky Counties	Number Farms in Population	Number Farms in Sample
1	Adair	7	1
2	Anderson	27	4
3	Barren	33	4
4	Boyle	4	0
5	Breckinridge	14	2
6	Bullitt	74	6
7	Casey	3	0
8	Edmunson	3	0
9	Franklin	4	1
10	Grayson	4	0
11	Green	4	0
12	Hardin	39	4
13	Hart	13	0
14	Henry	160	17
15	Jefferson	147	19
16	LaRue	14	1
17	Marion	41	6
18	Meade	7	1
19	Mercer	7	2
20	Metcalfe	13	3
21	Nelson	105	10
22	Oldham	164	24
23	Russell	6	0
24	Shelby	404	37
25	Spencer	165	17
26	Taylor	8	0
27	Trimble	25	3
28	Warren	15	1
29	Washington	20	0
30	Woodford*	?	0
	Indiana Counties		
31	Clark	92	11
32	Crawford	6	0
33	Dearborn*	?	0
34	Floyd	52	7
35	Harrison	123	8
36	Jackson*	?	1
37	Lawrence	1	0
38	Martin*	?	0
39	Monroe*	?	0
40	Orange	7	1
41	Scott	11	1
42	Washington	121	8

* Not shipping milk in July, 1958

Table 1. - Selected Characteristics of the Louisville Milkshed 1957

Characteristic	Mean quantity per farm	95 percent confidence interval	Total quantity in milkshed	95 percent confidence interval
Milk production	188,203	± *	376,405,567	*
Number of cows	29.6	± .46	59,132	± 920
Acres of land owned	230.6	- 28.9	461,252.4	± 57,800
Acres of land rented	21.2	± 7.9	42,440.0	± 15,800
Value of owned land per acre	242.89	± $33.71	$112,033,595.00[a]	-
Months of labor used	28.9	± 2.10	57,833.4	± 42,000
Investment in dairy bldg.[b]	$11,298	± $955	$ 22,595,580.	± $1,910,000
Investment in machinery[c]	$ 5,451	± $507	$ 10,925,480.	± $1,014,000
Investment in forage equip.[d]	$ 1,442	± $203	$ 2,884,280.	± $ 406,000
Investment in dairy equip.[e]	$ 2,218	± $150	$ 4,436,798.	± $ 300,000
Average age of owner-operator	53.7	± 1.8	-	-

*Actual quantities from J. E. Bobo, "Table on Bulk Tank Development," The Courier, Vol. 20, No. 9 (Jan. 1960) p. 10

[a]Mean value times total quantity of acres owned.

[b]Dairy building investment was estimated by depreciating costs of new buildings at a standard rate per year. Included are: all barns used for housing dairy animals and dairy feed, milking parlors, milk storage houses, corn cribs, silos, and machine sheds. Investment was pro-rated for multiple use buildings.

[c]Investment was estimated by depreciating costs of new equipment at a standard rate per year. The machinery, in addition to forage equipment, included tractors, combines, corn binders, corn pickers, farm trucks, wagons, feed grinders, manure loaders and spreaders, and silo unloaders.

[d]Investment was estimated by depreciating costs of new equipment at a standard rate per year. The equipment included was hay balers, field choppers, blowers, ensilage cutters, hay elevators, hay loaders, hay rakes, and hay driers.

[e]Investment in milk equipment is that reported by the respondents and includes conventional milkers, pipeline milkers, bulk tanks, can coolers, water heaters, barn cleaning equipment, and milk cans.

Table 2. - Cropland utilization by percent of total devoted to hay, grain, and pasture and by number of farms, on 203 sample farms in the Louisville Milkshed 1957

Kind of Crop					
Hay		Grain		Pasture	
Percent of Cropland	Number of Farms	Percent of Cropland	Number of Farms	Percent of Cropland	Number of Farms
Less than 16	35	Less than 11	60	Less than 30	30
16-30	96	11-20	71	13-60	86
31-45	52	More than 20	72	61-90	87
46-60	20				

For example, Table 2 presents cropland utilization and Table 3 shows forage fertilization practices on the sample farms. Some important feeding practices are given in Table 4. All these practices are of considerable importance in producing low-cost milk. Later sections will show relationships among these and other factors affecting the supply and/or production cost of milk.

This descriptive section has been presented to orient the reader to the economic and technical structure of the total milkshed as it existed in 1957, and to indicate the quantities of resources that were employed to produce the milk supplied to the Louisville market for that year. In addition, it indicates that farmers are using various practices in producing milk and are therefore probably operating under various cost conditions.

The farm characteristics that existed when this survey was made are significant and relatively reliable bases for examining the relationship between size of herd and input efficiency. The results presented in the next section are based on grouping of farms by size of herd and various input-output relationships.

COMBINATIONS OF FACTORS OF PRODUCTION BY SIZE OF HERD

For four herd sizes - less than 20 cows, 20-29 cows, 30-39 cows, and more than 39 cows - the average production per cow per year varied less than 125 pounds. This implies that the net returns per cow were determined by the difference in costs of production for a given production per cow among all sizes of herds. Costs of production are determined by prices, input combination, and their efficiency. Indications of input levels, input prices, and efficiency are shown for the four herd size strata in Table 5. Each line of the table shows the percentage of herds of the particular size which possessed the property given along the top of the table. The chains of square links through the body of the table give at a glance the relationship between size of herd and the property given in the heading. This device is used to approximate the association between the factors, yet recognizes that there are differences between farms

Table 3. - Forage fertilization practices by percent of total acres and by pounds per acre on 203 farms in the Louisville Milkshed[a]

Type of Forage	Percent of Total Acres	Number of Farms	Pounds Per Acre	Number of Farms
Hayland fertilized for establishment	None	37	None	37
	11-49	32	100-349	83
	50-89	28	More than 349	80
	More than 89	104	Unascertainable	3
	Unascertainable	2		
Pastureland fertilized for esatablishment	Less than 10	91	None	85
	10-39	29	100-299	42
	40-89	29	300-349	38
	More than 89	50	More than 349	34
	Unascertainable	4	Unascertainable	4

[a]Applies to commercial fertilizer only.

Table 4. - Number of farmers following various feeding practices on 203 farms in the Louisville Milkshed

Pounds of Protein Fed Per Cow	Number of Farms	Total Digestable Nutrients Fed from Silage as a Percent of Hay	Number of Farms	Total Digestable Nutrients Fed from Grain as a Percent of Hay	Number of Farms
Less than 1,500	92	Less than 20	80	Less than 40	54
1,500 - 2,000	55	20-59	71	40-69	62
More than 2,000	55	More than 59	51	70-99	41
				More than 99	45
Unascertainable	1		1		1

as shown by the frequencies around the chain. For example, the frequencies shown in the first section of the table indicate that as the size of herd increases, the pounds of protein fed per cow decreases.[3]

The efficiency of production among the different size farms and within any one size stratum can be indicated by the efficiency of production per cow, and thus may reflect differences in costs and returns. The inputs actually used to obtain two specific outputs are given in the following sections.

SPECIFIED INPUT-OUTPUT RELATIONSHIPS BY PRODUCTION PER COW

The contrast between the input combinations used to produce less than 6,000 pounds of milk and more than 8,900 pounds of milk is more pronounced than between intermediate production ranges. This contrast (1) lends emphasis to the efficiencies of input uses, (2) suggests what is required to increase efficiency, and (3) shows what might be obstacles to increased efficiency of milk production. Table 6 shows these levels of input use for two levels of milk output per cow. The black rings in the body of the table indicate at a glance the high frequency of each line for the property shown across the top of the table.

COMPARISON OF SELECTED INPUTS BY PRODUCTION PER COW

To aid in picturing the differences between the two groups described in Table 6, the contrasts between the two groups for selected inputs used at the modal level of the 8,900 pounds of milk per cow group are shown in Fig. 2. This level of input use is shown since this indicates that the highest frequency of farmers was actually using this level. The picture to be conveyed by Fig. 2 is that the highest frequency of those farmers whose herds are producing more than 8,900 pounds of milk per cow was employing the following resources in the mannner and quantities specified:

(1) They were producing more than three acres of tobacco.

(2) They were using 20 to 39 man months of labor per year.

(3) They were using less than 90 percent family labor.

(4) They were devoting 16 to 45 percent of their hay, grain, and pasture acres to hay.

(5) They were producing 1 to 49 acres of rotation pasture.

(6) They were feeding more than 1,500 pounds of protein per cow per year.

(7) They were deriving from silage more than 20 percent of the TDN provided by silage and hay.

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[3]For the less than 20 cow herds the bimodel frequency weights are interpreted by centering the chain. An analogous procedure was followed in interpreting similar situations.

Table 5. - Input comparisons of 203 sample farms in the Louisville Milkshed by size of dairy herd, 1957

Part I: Feeding Practices.

Size of Herd (No. of Cows)	Pounds of Protein Fed Per Cow*			Total Digestable Nutrients Fed From Silage as a Percent of Hay*			Purchase Protein Fed Per Cow (in lb)		Acres of Rotational Pasture				Hay Acres as a Percent of Hay, Grain and Pasture			
	Less than 1,500	1,500 - 2,000	More than 2,000	Less than 20	20-59	More than 59	Less than 600	More than 600	None	10-49	50-90	More than 90	Less than 16	16-30	31-45	46-60
	Percent			Percent			Percent		Percent				Percent			
Less than 20	43	20	37	59	21	20	66	34	39	16	4	41	11	45	32	12
20-29	46	32	22	47	33	20	86	14	38	20	9	33	18	42	24	16
30-39	44	38	18	18	53	29	86	14	31	22	13	34	18	56	26	--
More than 39	50	17	33	22	36	42	83	17	25	11	45	18	25	50	17	8

*Estimates of protein and total digestible nutrients fed were estimated from the amounts and kinds of feed fed by the farmers the nutrient content estimates of various kinds of feed were taken from F. B. Morrison, Feeds and Feeding (Ithaca: Morrison Publishing Co., 1947).

Table 5.(cont'd) -- Part II: Labor and Equipment

Size of Herd (No. of Cows)	Total Months of Labor				Percent Family Labor				Acres of Tobacco Produced*					Ratio of Investment to Production Per Farm (dollars/cwt of milk)							
														Dairy Building				Forage Equipment			
	10-19	20-29	30-39	More than 39	None	Less than 40	40-90	Less than 90	None	0.5-1.9	2-2.9	3-5.9	More than 5.9	Less than 5	5-6	7-9	More than 9	Less than 1	1-1.9	More than 1.9	
	Percent				Percent				Percent					Percent				Percent			
Less Than 20	[52]	32	7	9	7	18	4	[71]	29	[32]	14	20	5	21	23	[32]	24	[68]	21	11	
20-29	27	[41]	24	8	14	15	24	47	14	20	[33]	24	9	39	[35]	20	6	[51]	29	20	
30-39	11	42	29	18	20	26	31	23	7	16	22	[35]	20	38	31	18	13	42	40	18	
More Than 39	6	22	28	[44]	25	[28]	39	8	39	17	9	19	16	[44]	39	14	3	39	[55]	6	

*Tobacco acres may indicate the possibilities for labor utilization, capital accumulation or credit base.

Table 5 (cont'd) -- Part III: Management Indicators

Size of Herd (No. of Cows)	Production Per Cow				Buying Price of Cows (dollars)				Selling Price of Cows (2,000 farms)			Education of Owner-Operator or First Partner* (Last grade completed)				Number of Farms
	Less than 6,000	6,000-7,100	7,200-8,900	More than 8,900	Less than 225	225-274	275-324	More than 324	Less than 225	225-275	275-424	Less than 8	8-11	12	More than 12	
	Percent				Percent				Percent			Percent				
Less than 20	29	32	23	16	27	30	21	5	57	22	21	22	43	31	4	56
20-29	23	32	28	17	23	30	24	9	48	29	23	33	35	21	11	66
30-39	29	22	18	31	9	24	33	20	24	20	56	17	23	29	31	45
More than 39	28	22	33	17	11	25	33	25	20	37	43	12	46	15	27	36

*This information was not available for 41 respondents.

Table 6. - Levels of use of selected inputs for two specified levels of milk output on 94 farms in the Louisville Milkshed

Part I: Feeding Practices

Production Per Cow (in pounds)		Acres of Rotational Pasture				Hay Acres as a Percent of Hay, Grain, and Pasture				Pounds of Protein Fed Per Cow			Total Digestible Nutrients Fed From Silage As a Percent of Hay			Purchased Protein Fed Per Cow	
		None	1-49	50-90	More than 90	Less than 16	16-30	31-45	46-60	Less than 1,500	1,500-2,000	More than 2,000	Less than 20	20-59	More than 59	Less than 600	More than 600
Less than 6,000	Number Farms	16	15	11	12	11	27	12	4	32	14	7	26	15	12	47	7
	Percent	(30)	28	20	22	20	(50)	22	8	(59)	26	15	(48)	28	22	(87)	13
More than 8,900	Number Farms	11	17	6	6	4	22	12	2	8	17	15	15	12	13	29	11
	Percent	28	(43)	15	14	10	55	30	5	20	43	37	38	(30)	32	73	27

Table 6. - Part II: Labor and Equipment

Production Per Cow (in Pounds)		Acres of Tobacco Produced					Total Months of Labor Used				Percent of Total Family Labor				Investment Ratio to Production Per Farm (Dollars Per Cwt of Milk) Dairy Building				Forage Equipment		
		None	0.5-1.9	2-2.9	3-5.9	More than 5.9	10-19	20-29	30-39	More than 39	None	Less than 40	40-90	More than 90	Less than 5	5-6	7-9	More than 9	Less than 1	1-1.9	More than 1.9
Less than 6,000	Number Farms	7	17	13	8	9	13	22	9	10	10	9	12	23	9	13	10	23	26	15	13
	Percent	13	(32)	24	15	16	24	(41)	16	19	19	16	22	(43)	17	24	19	(40)	48	28	24
More than 8,900	Number Farms	6	9	5	11	9	10	13	13	4	8	10	9	13	20	14	4	2	25	12	3
	Percent	15	22	13	(28)	22	25	33	33	9	20	25	22	33	(50)	35	10	5	(63)	30	7

Table 6. - Part III: Management Indicators

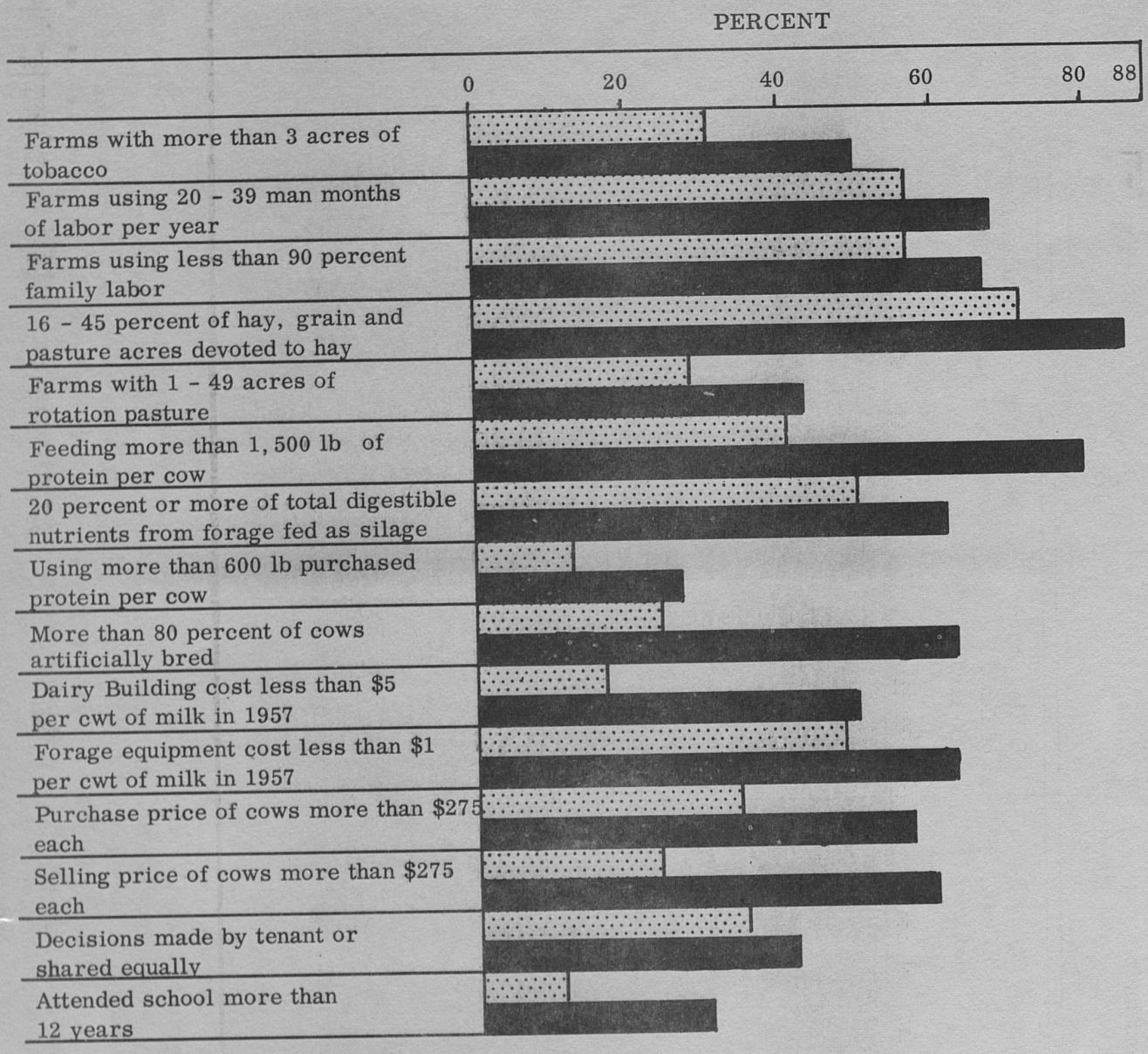
Production Per Cow (in pounds)		Average Herd Size	Buying Price of Cows (Dollars)				Selling Price of Cows (Dollars)			Education of Owner-Operator or First Partner[b] (years in school)					Tenure-Decision Making[c]				Percent of Cows Artifically Bred[d]					
			Less than 225	225-274	275-324	More than 324	Less than 225	225-274	275-424	Less than 8	8	8-11	12	More than 12	Owner-op. without Tenant	Owner-op. with tenant	Equal	Tenant	None	1-20	21-40	41-60	61-80	More than 80
Less than 6,000	Number Farms	32	13	16	10	8	29	11	13	10	8	3	16	6	19	16	10	9	26	4	4	3	3	13
	Per-cent		28	34	21	17	(56)	20	24	23	19	7	(37)	14	(35)	30	19	16	(49)	7	7	6	6	25
More than 8,900	Number Farms	29	3	7	12	11	5	12	23	4	8	2	6	12	11	12	7	9	5	3	3	2	2	25
	Per-cent		9	21	36	33	10	30	(60)	12	25	6	19	(38)	28	(30)	20	22	13	7	7	5	5	(63)

[a]This information was not ascertainable for 19 respondents.

[b]This information was not ascertainable for 14 farms.

[c]The decision-making units used were: (1) owner-operator with no tenant where the owner makes all decisions, (2) owner-operator with tenant where the owner or other family member dominates all decision-making, (3) owner-operator with tenant where the tenant or other family member dominates operational decision-making, and (4) owner-operator or other family member with tenant where the two share equally in decision-making. The delineation of decision makers was purely subjective, depending upon the judgment of the interviewer only. It was felt that this was of some value because E. A. Proctor personally interviewed 185 of the 203 sample respondents. Consequently, any bias involved would be consistent throughout.

[d]This information was not ascertainable for one farm.



Legend:

Less than 6,00 pounds of milk per cow per year

More than 8,900 pounds of milk per cow per year

Fig. 2 - Percentage comparison of selected inputs used for two levels of output on 94 farms in the Louisville Milkshed in 1957

(8) They were using more than 600 pounds of purchased protein per cow (apparently this indicated a recognition of the necessity to feed large quantities of protein).

(9) They were using artificial breeding for more than 80 percent of their cows.

(10) They were investing less than $5 in dairy buildings and less than $1 in forage harvesting equipment per 100 pounds of milk produced in 1957.

(11) They were paying more than $275 per head for cows.

(12) They were selling their cows for more than $275 per head.

(13) They were using tenants and delegating authority to those tenants.

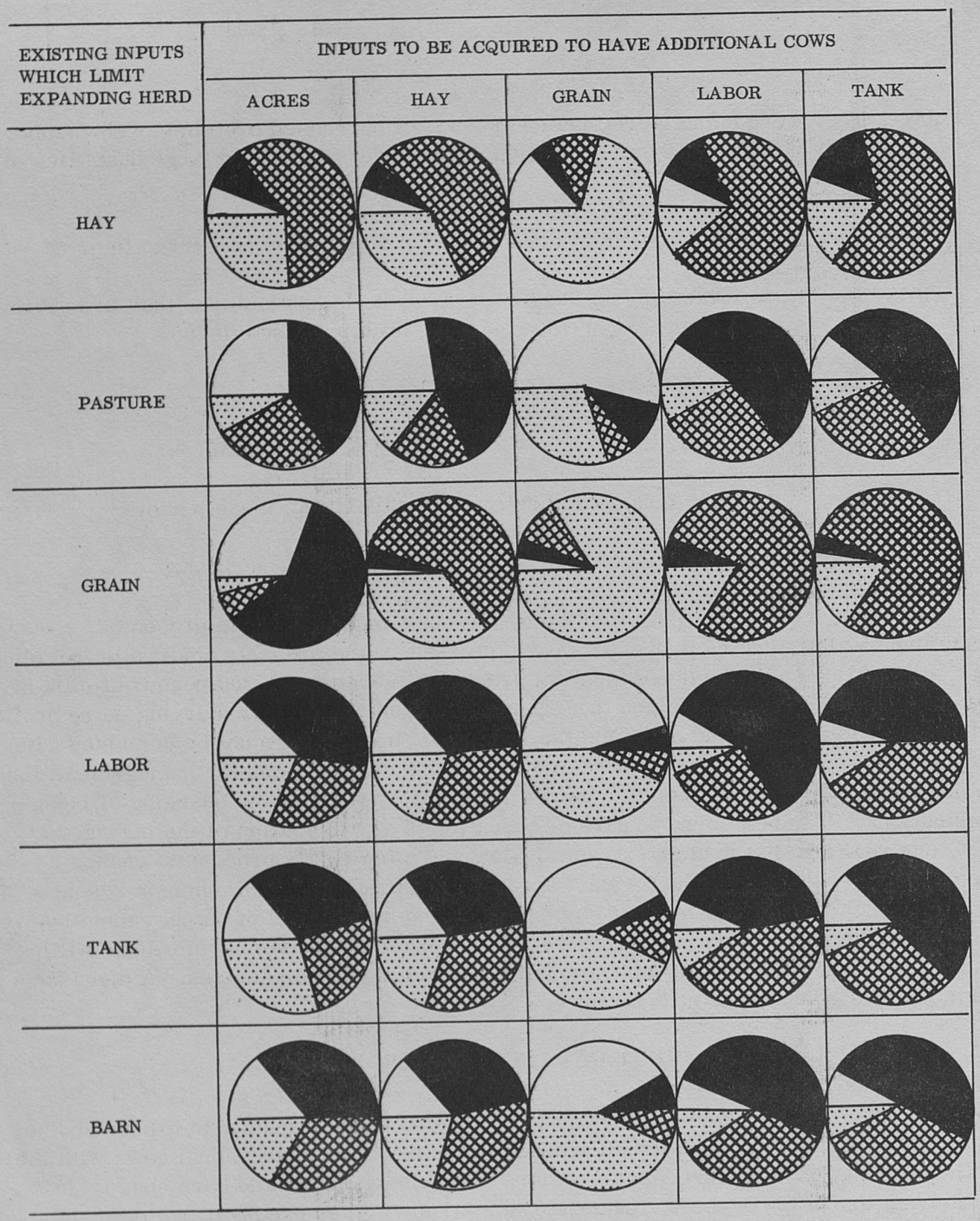
(14) They had acquired more than a formal high school education.

The picture of productivity implied by the input-output analysis presented, although purely technical, indicates that more favorable results are probably obtainable from the input combinations used by those farmers producing more than 8,900 pounds of milk per cow. It would be easy to conclude that all farmers would find their dairying more profitable if they had 8,900 pound cows and the rest of the inputs that must be combined with those kinds of cows. However, there are certain inputs (for example, management) that are not as readily variable as other inputs that limit or restrict the changing of input combinations. If the number of years of education is any indication of the managerial input, one realizes that it is an extremely slow and often costly process to change its level after a person leaves the formal school. The differences in the human resource in explaining the difference in input combinations and hence level of output cannot be overemphasized. However this may be, it remains to be seen whether farmers are willing to adapt and expand their dairy operations in the existing circumstances. A discussion of this point is given in the next section.

INPUT CAPACITY LIMITS

The capacity to expand one input may be limited by the capacity to expand another input. Each farmer was questioned about his capacity to have additional cows with the existing stock of hay, pasture, grain, labor, bulk tank coolers, and barn space. In addition, an indication of the willingness of the farmer to use excess capacity or to acquire additional units of the input was also ascertained. Hence, in Fig. 3 the proportional distribution of all those who would be and would not be willing to acquire inputs that would permit herd expansion is related to the existing capacity of certain inputs.

Each circle provides the total information for all of the respondents answering both the capacity questions and the willingness to expand questions. For example, in the first circle, of the total number of farmers who answered the capacity question as well as the willingness question (1) 6 percent had a hay limit to the expansion of cow numbers and said they would be willing to acquire more acres to expand cow numbers;



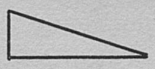
Legend:

- Proportion who had a limit to expanding herd size due to the input at the left and were willing to acquire more of the input at the top.
- Proportion who had a limit to expanding herd size due to the input at the left but were not willing to acquire more of the input at the top.
- Proportion who had no limit to expanding herd size due to the input at the left and were willing to acquire more of the input at the top.
- Proportion who had no limit to expanding herd size due to the input at the left but were not willing to acquire more of the input at the top.

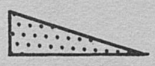
Fig. 3 - Distribution of all respondents who would or would not be willing to acquire inputs that would permit herd expansion related to existing capacity limits.

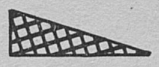
(2) 9 percent had a hay limit and would be unwilling to acquire more acres; (3) 28 percent had no hay limit and would be willing to acquire more acres; and (4) 57 percent had no hay limit and would be unwilling to acquire more acres. Thus, the percentages come to 100 in each circle.

The legend for each circle is as follows:

 stands for the proportion who had a limit to expanding herd size due to the input at the left and were willing to acquire more of the input at the top.

 stands for the proportion who had a limit to expanding herd size due to the input at the left but were not willing to acquire more of the input at the top.

 stands for the proportion who had no limit to expanding herd size due to the input at the left and were willing to acquire more of the input at the top.

 stands for the proportion who had no limit to expanding herd size due to the input at the left but were not willing to acquire more of the input at the top.

Looking at any row one can quickly observe the proportion of farms on which the input given at the left is a limit to expanding herd size by adding together the white and black portions. Glancing down a column one can ascertain the proportion of farmers who would be willing to acquire more of the inputs indicated on top by adding together the white and the dotted portions. Those who were unwilling to acquire that input are indicated by the rest of the circle-the black and double cross-hatched portions.

By studying the circles across a row and for each column one can build a fairly complete picture of the input capacity existing on the farms and infer the possible changes in input use by the willingness-to-acquire criterion. For example, look at the labor row. One observes that a high proportion of farmers considers labor to limit their present herd size, but one notices further in the labor column that an even higher proportion would not be willing to acquire more labor in order to expand their herd size. Thus one could infer that the quantity of labor available and its price would have considerable effect on how farmers might respond to changes in milk prices.

Another interesting example is the grain row. Here one observes that grain has for all practical purposes no limit. By looking at the grain column one sees further that almost all farmers would be willing to acquire more grain in the event of an expanded herd size. Thus one would expect that small changes in milk prices would be reflected in changes in the quantity of grain fed.

To discuss every possibility (there are at least 120 in Fig. 3) is beyond the scope of this report. It is sufficient to remark that many interesting and informative combinations can be constructed with a few minutes of study.

SUMMARY

This report has presented some of the preliminary results from a 1957 survey of physical and economic conditions on Grade A dairy farms in the Louisville Milkshed. It first described the total resources and some specific farm practices used in producing the more than 376 million pounds of milk. Second, some specific input combinations were shown to be related to the size of herd. In general, as the size of herd increases the following also increase: (1) the percent of total digestible nutrients that silage is of hay, (2) acres of rotational pasture, (3) total months of labor used, (4) the forage investment per hundredweight of milk, (5) the buying and selling price of cows, and (6) the educational level of the owner-operator. Also, the following decrease as size of herd increases: (1) pounds of protein fed per cow, (2) purchased protein fed per cow, (3) hay acres as a percent of hay, grain, and pasture, (4) the percent of family labor used, and (5) the investment in dairy buildings per hundredweight of milk. The acres of tobacco produced first increased with size of herd, but then diminished at larger herd sizes.

The third thing that the report presented is a comparison between two different levels of output per cow. It was indicated that the farmers who are producing milk with cows which produce 8,900 pounds of milk per year are probably receiving more profits. Since only technical relationships were examined, further research is necessary before conclusive evidence can be furnished on the profitability of output levels.

Last, the report graphically presented the relationship between the existing inputs which limit farmers from expanding their herd size and those inputs which they said they would or would not be willing to acquire to have additional cows. This analysis showed that available pasture, labor, size of bulk tank, and barn space limit the expansion of herd size in the Louisville Milkshed. In addition, large proportions of farmers indicated they would be unwilling to acquire land, labor, and a larger bulk tank in order to have additional cows. Further research on capacity limits in relation to the technical conditions of production should be useful in ascertaining supply responses of Louisville Milkshed farmers to changes in input prices and milk prices.

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