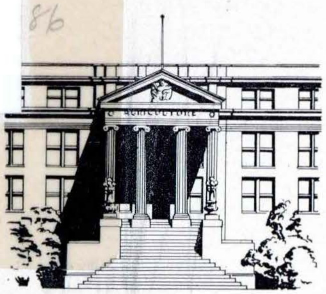

Profit-Maximizing Plans And Static Supply Schedules For Fluid Milk In the Des Moines Milkshed

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CONTENTS

SUMMARY

The objectives of the study reported here were (1) to develop profit-maximizing production plans for dairy farms in the Des Moines area and (2) to derive aggregate fluid milk supply schedules for the area based on these optimum plans. The dairy farms in the area were classified into 24 categories on the basis of acreage, soil type, tenure and dairy-building resources. Optimum plans were developed for an average farm in each category at two levels of production per cow. Plans were developed for the short run and for two long-run planning periods. In plans for the short-run situation, buildings and the supply of operating capital are considered fixed at about current levels. In the long-run plans, buildings are considered variable, and operating capital is limited only by the requirement that it earn at least 5 percent return on investments. Special long-run plans also were developed with allowance for advancement in production techniques.

These plans were developed using linear programming techniques utilizing a variable price for fluid milk. In addition to the usual on-farm enterprises, two off-farm alternatives are included. All labor may be hired out at $0.50 per hour, and capital may be loaned at 5 percent interest. The presence of these alternatives makes it requisite that on-farm enterprises bring at least these minimum returns, or the resources will not be used on the farm.

The majority of plans developed for rented farms are based on a livestock-share lease. Other variations considered include use of the crop-share lease and purchase of additional land.

The resulting short-run optimum plans indicate that fluid milk production is relatively profitable at current prices with high-producing cows. With the price of milk at $4, almost all farms with high-producing cows (10,600 pounds per year) would maximize profit by keeping a herd size as large as possible with present building facilities. This optimum farm plan also contains several litters of pigs in a two-litter system. The hog enterprise is limited by the quantity of labor remaining after fulfillment of crop and dairy needs. The crop program calls for producing only enough forage for the dairy herd. With small herds, this would be a CCSb or CSbCOM rotation; with herds of 25 to 30 cows, it would be a CCOMM or COMMM rotation, depending on farm size. Beef cows or feeder operations have little place in these optimum plans.

With low-producing cows (6,700 pounds per year), only a few farms could produce milk profitably with a milk price of $4. These farms are in the Shelby-Sharpsburg-Winterset or Tama-Muscatine soil areas, where more land remains in permanent pasture and all rotations include some meadow. Even in these areas, beef production is a very close alternative to dairying with low-producing cows. In all soil areas, optimum plans call for hog production at a maximum, limited only by building space. In the Clarion-Webster soil area, plans call for 30 to 60 feeder calves in place of the low-producing dairy cows.

The analysis of leasing arrangements indicates large differences in returns to labor between tenants with crop-share leases and tenants with livestock-share leases. For tenants with little available capital, the livestock-share lease may seem advantageous. Under this lease, however, the tenant receives only half the gross receipts and must provide all the labor. Thus with dairying his returns to labor are very low. Changing from a livestock-share to a crop-share lease would require considerable additional capital outlay to maintain the same livestock program; however, the return on the additional capital might be as high as 30 percent.

For owner-operators, two sets of long-run plans also were developed. The first set assumes current production efficiencies. The main difference between these plans and the short-run plans is in the much larger number of hogs included. With low milk prices and no dairy enterprise, 50 to 70 litters of pigs are included. Beef feeding is included in only a few plans. Because building costs are variable, slightly higher milk prices are needed to make it profitable to begin dairy operations. The elasticity of milk production is greater here, however, than in the short run. Herd size is not restricted by buildings and expands from 28 to 32 cows on all farms.

A second set of long-run plans is based on more efficient production techniques. In these plans, dairying involves a parlor milking system. As fall labor is at a premium, the hog system usually includes early spring farrowing only. From 70 to 94 spring litters are optimum. Small dairy herds are uncommon because of the high capital inputs in dairy equipment. Maximum herd sizes range from 32 to 34 cows. With the expanded hog and dairy enterprises and the greater efficiencies, net incomes run $1,000 to $2,000 higher than in the long-run plans based on current production efficiencies.

Finally, fluid milk supply schedules for the optimum plans in each farm category are weighted by the estimated number of farms of each type in the area and aggregated over all categories. The resulting aggregate normative supply schedules indicate decreasing elasticity of supply as the price increases. In short-run plans, dairy expansion is limited by building space. In long-run plans, fall labor and forage become limiting factors. Thus, the aggregate schedules indicate that elasticity of supply approaches zero at some price level. These aggregate schedules also indicate greater elasticities of supply and lower costs of production as the planning period is lengthened. The same result is noted as resource efficiencies are increased.

Such aggregate schedules should be valuable aids to organizations formulating dairy price policy for such areas as this. Similarly, the individual optimum plans are of value to farmers and extension personnel. These optimum plans are based on average efficiencies and average resource supplies; thus recommendations will differ between farms, depending upon the individual resource structure, off-farm alternatives and family goals.

Profit-Maximizing Plans and Static Supply Schedules for Fluid Milk in the Des Moines Milkshed[1]

BY RONALD D. KRENZ,[2] EARL O. HEADY[3] AND ROSS V. BAUMANN[4]

Recent changes in the farm income situation have placed a premium on efficient farm planning. Costs in farming have remained high, while prices of farm commodities have declined. This is typical of growing economies. As per-capita income rises, consumers tend to spend more of their incomes on nonfarm goods. Producers of nonfarm products, faced with an expanding market, find it profitable to increase the scale of their operations by adding more and more resources. In effect, they attempt to hire resources away from the farmer by paying higher prices. The farmer must pay these high resource prices if he is to stay in business. The result is that his costs rise.

In addition to competition from nonfarm uses for resources, the farmer faces competition from other farms in his own area and from other areas producing the same product. He also is confronted with the possibility of substitution of other, lower-cost products for the one he is marketing. Thus, it is important that he allocate the resources he has as efficiently as possible.

The study reported here was designed to outline alternative production plans for dairy farmers. The production plan for a farm must fit the resources and opportunities peculiar to that farm if profits are to be maximized. Therefore, plans were outlined for planning periods of various lengths for (1) dairy farmers with different amounts of managerial ability, labor and land and (2) farms with different soil types. In addition, estimates were made of the total production of milk in the area and the projected rate of normative response to price changes by selected strata of farms in the area.

OBJECTIVES

The general objective of the study was to analyze profit-maximizing farm organizations and the opportunity costs of producing fluid milk for a selected strata of dairy farms. In addition, the analysis of farm organizations was used to estimate normative and static supply functions. More specifically, the analysis of the study was directed toward answering the following questions:

1. How do such factors as farm size, cost of labor, production per cow, tenure and soil type affect the optimum farm plan and the opportunity costs of producing milk?

2. What are the optimum production plans for farms in each category when building and capital supplies are fixed?

3. How do these plans change when buildings are a variable input and capital is unlimited?

4. How do changes in techniques of production affect these plans, and how do they affect the opportunity costs of producing milk?

5. For a given strata of farms in the milkshed as a whole, what quantity of milk could profitably be produced at a particular milk price, given planning periods of various lengths?

6. What are the supply elasticities for fluid milk for the selected strata of farms in the area, given planning periods of various lengths?

EMPIRICAL METHOD AND SETTING OF STUDY

The empirical procedure used in the study was parametric linear programming.[5] As the first step, profit-maximizing plans were computed for an average farm in each stratum of farms studied. Programming techniques were used to determine the changes in production needed to maximize profits as milk price is changed while all other prices are held constant. This technique calls for discrete changes in production plans and output which result in a "stepped" supply function. These results then were used to estimate supply curves aggregated over all strata of farms studied. The supply function so derived is normative in nature, since it indicates what farmers should do to attain the end of profit maximization under the assumed prices and technical conditions of production. It is static because it parallels the situation that might exist if farmers had perfect knowledge and did not condition their plans to uncertainty. The supply functions were not derived to predict what farmers will do at different price levels, but rather to provide some suggestions of supply

1/ Project 1277, Iowa Agricultural and Home Economics Experiment Station. The authors are indebted to Roy W. Nelson, Frank W. Schaller, Ray E. Armstrong, Norval H. Curry and many farmers in the area who aided considerably in this study. They also are indebted to C. W. Crickman for his counsel and aid throughout the study.

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5/ For a discussion of variable-price programming, see: Heady, Earl O. and Candler, Wilfred V. Linear programming methods. Iowa State University Press, Ames, Iowa. 1958. Chap. 8.

elasticities as they are determined by technical coefficients and resource restrictions.

The programming techniques used specify profit-maximizing plans for a given set of resources and enterprises. A different profit-maximizing plan exists for each combination of resources and each set of production opportunities. The relevant question is: "What resources and production opportunities should be considered?" In many studies of optimum farm organization, off-farm uses of labor and capital have not been considered as alternatives for the farm family. Consequently, the resulting plans may specify the use of these resources even when their marginal productivities are near zero — a situation of doubtful practical significance. Farmers, especially dairy farmers near large cities with extensive labor markets, undoubtedly consider the opportunity return of their labor and capital. Hence, reservation prices of $0.50 per hour for labor and 5 percent return on capital were used throughout this study. It was assumed that labor and capital must have returns equal to or greater than these levels if they are to be used in farming.

Area of Study

The area of study was the Des Moines milkshed. The following nine counties were included: Boone, Story, Guthrie, Dallas, Polk, Jasper, Madison, Warren and Marion. These counties contain 92.3 percent of the producers who were selling fluid milk in the Des Moines milkshed at the time of the study. Figure 1 outlines the study area and soil types. The division of soil types was made along township lines to facilitate collection of necessary data on farm resources. In the area north and west of Des Moines, the soil type is predominantly Clarion-Webster. South of Des Moines the soil is largely of the Shelby-Sharpsburg-Winterset association but also includes a considerable amount of Tama-Muscatine. In that area, the differences between the two soil types are too small, for purposes of this study, to warrant additional computations.

The study deals with 160- and 240-acre farms which could be considered as potentially suitable for milk production. In gathering data from census sources, farms ranging from 120 to 180 acres were considered as 160-acre farms. Similarly, farms from 220 to 260 acres were counted as 240-acre farms. These two size groups contain the majority of farms in the area.

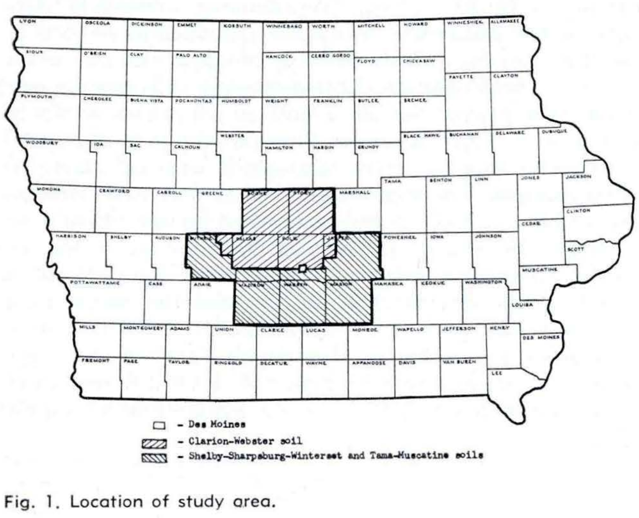


Fig. 1. Location of study area.

These farms were further classified as potential or non-potential fluid milk (grade A) producers. This classification was based on results of a 1957 survey of farms in the area. In this survey, farmers were asked whether they would consider dairying on their farms provided it was a profitable enterprise. Only those farmers who currently had four or more dairy cows indicated that they would consider a fluid milk operation. From the 1956 Iowa Assessors Annual Farm Census, it was determined that 2,167 farms in the area had four or more dairy cows and acreages within the specified range. These farms were used as a basis for the analysis described in this report.

Length of Planning Period

One objective of the study was to determine the effect of length of planning period on the normative supply schedule. In classical economic terms, the short run is a period in which the input of only a few resources can be varied, while the long run implies a period long enough to allow varying the input of all resources. In the short-run plans, land, labor, capital and building resources are fixed at current levels. In the long-run plans, land and labor are fixed in quantity, but capital and building supplies are allowed to vary. The supply of capital is increased by allowing capital to be borrowed at 5 percent interest. Additional buildings are provided by including building inputs as variable costs in the livestock enterprises.

"Long run" as used in this report thus is not synonymous with the classical meaning. Here, long run implies that buildings and capital supplies are variable. The classical meaning of long run would imply that all resources, including labor and land, are variable.

SHORT-RUN PLANS

Short-run plans were obtained for 24 farm situations or categories. Each category distinguishes farms of a particular acreage, soil type, tenure and amount of dairy building space. The 2,167 farms on which the study was based were classified into the 24 categories on the basis of the following characteristics:[6]

I. Acreage
   A. 140-180 acre farms
   B. 220-260 acre farms
II. Soil type
   A. Clarion-Webster
   B. Shelby-Sharpsburg-Winterset and/or Tama-Muscatine
III. Tenure of operator
   A. Owner
   B. Tenant on livestock-share lease
IV. Dairy building space
   A. 4-13 cows
   B. 14-23 cows
   C. 24-40 cows

The farms examined in the 1957 survey were divided into two groups on the basis of annual production per cow. Average production of the upper group was 10,600 pounds per cow per year. Production in the low group

6/ These classifications were based on data from the 1956 Iowa Assessors Annual Farm Census. Basic data on resources and current operations of these farms are summarized in table A-2 of Appendix A.

was 6,700 pounds per cow per year. Two optimum plans were obtained for an average farm in each category, one using the high-producing cows (10,600 pounds) and one using the low-producing cows (6,700 pounds).

The 1957 survey also was used to estimate the supplies of labor, capital and buildings and current production techniques for farms in each category.

LONG-RUN PLANS

In this phase of the analysis, building inputs were included in the livestock enterprise as variable costs. This procedure opened the way for expanding the hog or dairy enterprises. It was assumed that capital was not limited but still must bring at least a 5-percent return before it would be invested in any farm enterprise.

In the long-run phases, optimum plans were developed only for the owner-operator. Although optimum plans could have been computed for tenants, their applicability would have been limited. Such plans would apply only in the very unusual event that the landlord would adjust the building supplies to maximize the tenant's returns.

Two sets of long-run plans were developed. One set was based on current resource efficiencies, using the same enterprises as in the short-run plans. A second set was based on resource efficiencies currently existing on the most well-run farms of the area. The exact changes in the resource requirements will be pointed out in the following sections.

Leasing Arrangements

A 50-50 livestock-share lease was used in determining profit-maximizing plans for rented farms. This arrangement calls for sharing, on a 50-50 basis, all receipts of the farm, except for a small poultry enterprise that is controlled exclusively by the renter. All cash costs for crops, seed, fertilizer, custom work, purchased feed, veterinary expense and purchases of livestock are shared on the same basis. The cropping equipment, repairs, fuel and oil expense and all labor are the responsibility of the tenant. The landlord is responsible for investments in and repair of buildings.

Prices Used

Projected prices were used in developing the plans. They are not official forecasts of prices that may exist in the future but were designed as likely average relationships between products that may hold true in the future. In general, the optimum farm organization will be the same under higher or lower prices, if prices bear the same relationship to each other. Income is a function of price level, however, and will be larger or smaller if the prices of the future are higher or lower, respectively, than those used in the study. The prices used for the analysis described in the following section are given in table 1.

In all situations, the opportunity also is offered to buy corn or hire labor. Corn can be purchased at $1.35 per bushel. Labor can be hired at $1 per hour, but only for the summer. This, in effect, limits the livestock program to a size that can be handled with family labor.

ENTERPRISES CONSIDERED

Types of enterprises and levels of efficiency found on farms in the area at the time of the study are offered in the short-run plans. Most of the necessary input-output data were obtained in the 1957 survey. In the following tables, data on enterprises apply to the owner-operated farms.

Cropping Enterprises

Yields and inputs for the various rotations were estimated by the Department of Agronomy at Iowa State University. Four rotations are offered as cropping alternatives in each soil area. A minimum of 20 percent meadow is included in each rotation for the Shelby-Sharpsburg-Winterset area to control erosion. Levels of fertilization, crop yields and labor and capital inputs required for each rotation are included in table 2. These data apply to a unit of rotation, consisting of 1 acre of each crop in that rotation. For instance, a unit of CSbCOM includes 2 acres of corn, 1 acre of soybeans, 1 acre of oats and 1 acre of meadow. Labor and machine costs for the rotations do not include the costs of converting forage to hay. These costs are charged against the livestock enterprises according to the amount of hay required.

The same rotations are offered when plans are based on advanced production techniques but at higher levels of fertilizer application (table 3). A COMMMM rotation is added to the set of alternatives to provide the means for increased hay production. This rotation requires 20 pounds of P_2O_5 on the second year of meadow to prolong the alfalfa stand.

Livestock Enterprises

Dairy. In linear programming, constant returns to scale are normally assumed within each enterprise. It is likely, however, that this assumption does not hold strictly true for dairying (table 4). With a stanchion barn milking system, fairly important economies of scale, especially in labor and capital savings, probably are present up to a herd size of 25 cows. With a milking parlor system, these economies may extend to still larger herd sizes. To approximate these economies of scale, labor and capital

TABLE 1. PROJECTED PRICES USED IN DETERMINING OPTIMUM FARM ORGANIZATION UNDER THE SEVERAL SITUATIONS STUDIED.

Corn - per bu. (selling price)	$ 1.30	Cull dairy heifer/cwt.	$15.00
Corn - per bu. (buying price)	1.35	Cull dairy cows/cwt.	11.00
Oats — per bu.	0.70	Veal calves/cwt.	20.00
Soybeans - per bu.	2.40	Nitrogen fertilizer/lb.	0.15
Barrows and gilts/cwt. (200-240 lb.)	16.00	Phosphate fertilizer/lb.	0.10
Sows/cwt. (300-400 lb.)	13.50	Potash fertilizer/lb.	0.07
Feeder yearlings (650 lb.)	19.00	Alfalfa seed/cwt.	53.40
Feeder calves (450 lb.)	20.50	Bromegrass seed/cwt.	35.50
Fat steers (choice-1,000 lb.)	21.25	Hybrid seed corn/bu.	10.75
Chickens/lb.	0.21	Seed oats/bu.	1.81
Eggs/doz.	0.35	Laying mash/cwt.	4.77
Dairy cow (6,700 lb. production)	185.00	Hog supplement/cwt.	5.60
Dairy cow (10,600 lb. production)	265.00	Dairy supplement/cwt.	4.80
Beef cow	175.00	Soybean meal/cwt.	4.63

TABLE 2. BASIC INPUT-OUTPUT DATA FOR VARIOUS CROP ROTATIONS WITH CURRENT PRODUCTION TECHNIQUES (FOR ONE COMPLETE UNIT OF ROTATION).

Crop rotation	Inputs: Fertilizer used N-P-K			Cost of fertilizer	Annual labor requirement a/	Machinery costs b/	Seed and spray costs	Production: Corn	Oats	Soybeans	Hay
	(pounds)			(dollars)	(hours)	(dollars)	(dollars)	(bushels)	(bushels)	(bushels)	(tons)
Clarion-Webster soil area:											
CCSb	45	40	20	12.15	20	24.56	10.10	92	—	21	—
CSbCOM	30	60	20	11.90	25	31.35	21.91	121	38	22	2.2
CCOMM	45	60	30	14.85	19	25.31	14.11	119	38	—	4.3
COMMM	5	60	10	8.45	12	10.91	10.96	65	38	—	6.3
Shelby-Sharpsburg-Winterset soil area:											
CCOMM	30	20	0	6.50	19	22.70	14.11	115	30	—	3.5
COMM	0	20	0	2.00	12	12.96	10.96	59	30	—	3.5
CSbCOM	30	30	0	7.50	25	28.80	17.91	117	30	23	1.8
COMMM	0	20	0	2.00	12	12.96	10.96	59	30	—	5.1

a/ Baumann, Ross. Estimates on labor inputs. (Unpublished data.) Farm Economics Research Division, U. S. Dept. Agr. 1955.
b/ Armstrong, Ray. Estimates on machine costs. (Unpublished data.) Farm Service Dept., Iowa State University. 1956.

TABLE 3. BASIC INPUT-OUTPUT DATA FOR VARIOUS CROP ROTATIONS UNDER ADVANCED PRODUCTION TECHNIQUES (FOR ONE COMPLETE UNIT OF ROTATION).

Crop rotation	Inputs: Fertilizer used N-P-K			Cost of fertilizer	Annual labor requirement	Machinery costs	Seed and spray costs	Production: Corn	Oats	Soybeans	Hay
	(pounds)			(dollars)	(hours)	(dollars)	(dollars)	(bushels)	(bushels)	(bushels)	(tons)
Clarion-Webster soil area:											
CCSb	145	110	40	35.60	20	24.56	10.10	110	—	24	—
CSbCOM	135	140	80	39.85	25	31.35	21.91	134	43	25	2.5
COMMM	5	120	80	18.35	12	11.44	10.96	70	50	—	8.7
COMMMM	5	140	80	20.35	12	11.97	10.96	70	50	—	11.4
Shelby-Sharpsburg-Winterset soil area:											
CSbCOM	70	70	0	17.50	25	25.14	17.91	125	40	25	2.3
COMMM	5	60	0	6.75	12	11.10	10.96	66	40	—	6.6
COMMMM	5	80	0	8.75	12	11.63	10.96	66	40	—	8.7

TABLE 4. BASIC INPUT-OUTPUT DATA FOR THE DAIRY ENTERPRISES CONSIDERED, PER COW PLUS REPLACEMENT.

Item	6,700-pound-producing cows with stanchion			10,600-pound-producing cows with stanchion			10,600-pound-producing cows with parlor milking	
	4 to 13 cows	14 to 22 cows	23 to 40 cows	4 to 13 cows	14 to 22 cows	23 to 40 cows	14 to 22 cows	23 to 40 cows
Annual labor requirements (hours)a/	111	85	72	121	95	82	85	71
Capital investments:								
Down payment on bulk tank, total for herd (dollars)	360	465	525	465	570	660	570	660
Investments in all other dairy equipment, total for herd (dollars)	750	970	1,165	750	970	1,165	9,025b/	11,880b/
Investment in livestock (dollars)	222	222	222	320	320	320	320	320
Total annual cash expenses (dollars)	45.71	45.71	45.71	63.94	63.94	63.94	63.94	63.94
Total capital requirement per cow (dollars)	350.90	309.82	289.14	462.09	415.41	393.63	890.41b/	793.63b/
Feed inputs:								
Pasture hay equivalent (tons)	2.8	2.8	2.8	2.9	2.9	2.9	2.4	2.4
Hay (tons)	2.9	2.9	2.9	2.3	2.3	2.3	1.8	1.8
Corn equivalent (bushels)	46.0	46.0	46.0	63.0	63.0	63.0	63.0	63.0
Corn silage (tons)	3.1	3.1	3.1	4.5	4.5	4.5	4.0	4.0
Hay silage (tons)	---	---	---	---	---	---	1.0	1.0
Payment on bulk tank/cwt. (dollars)	0.22	0.17	0.14	0.18	0.13	0.11	0.13	0.11

a/ Labor and capital requirements do not include feed production.
b/ Also includes the investments in parlor equipment and all buildings.

requirements are progressively reduced as the number of cows increases for three ranges of herd size. These ranges are the same as for the amounts of dairy building space; i.e., 4-13 cows, 14-23 cows and 24-40 cows.

In the short-run phase, a stanchion system with bulk tank is assumed for both high- and low-producing cows. The capital requirement per dairy unit includes the investment in one cow and replacements; stanchions and milking equipment; a 30-percent down payment on the bulk tank; 10 percent of annual cash expenditures; and the cost of installing the bulk tank, including probable alterations of the milkhouse. The remaining cost of the bulk tank is borrowed at 6 percent interest, to be paid off in 5 years at a prescribed rate per hundredweight of milk. Only 10 percent of the total annual cash expenditures is included as capital requirement, since it is assumed that milk receipts will provide adequate operating capital for current expenditures such as purchase of feed and milking supplies.

These same dairy systems are offered as alternatives in the long-run phase, except that investments in buildings and depreciation are considered as variable costs. For the advanced technique phase, parlor milking replaces stanchions, and only high-producing cows are considered.

Beef. Four beef enterprises are allowed as programming alternatives in all situations studied. These include pasture-fed calves, drylot-fed calves, a yearling-feeder operation and a beef cow-calf enterprise (table 5). In the cow-calf enterprise, it is assumed that the calves are sold as 400-pound feeders. A higher level of managerial ability, in terms of timing of sales and market grade of cattle, is assumed for the advanced-technique phase. It is reflected in a higher price for the product of $1 per hundredweight.

TABLE 5. BASIC INPUT-OUTPUT DATA FOR BEEF ENTERPRISES.

Item	Beef cow-calf	Calves on drylot	Calves on pasture	Yearlings on drylot
Purchase details:				
Date	---	Oct.	Oct.	Nov.
Grade	---	good to choice	good to choice	good
Weight (pounds)	---	450	450	650
Total cost (dollars)	---	92.25	92.25	123.50
Feed:				
Corn (bushels)	5.0	50.0	45.0	33.0
Hay (tons)	1.5	0.8	1.0	0.6
Pasture hay equivalent (tons)	4.0	---	0.7	---
Total annual labor requirement (hours)a/	15.0	14.5	13.0	8.0
Death loss (percent)	---	2.5	2.5	1.5
Other cash expenditures (supplement, veterinary, etc.) (dollars)	17.79	22.54	20.13	12.76
Selling details:				
Date	Oct.	Aug.	Sept.	May
Grade	good to choice	choice	choice	choice
Weight when sold (pounds)	400	1,000	1,000	950
Total pounds sold	303 lbs. calf 183 lbs. cull cow	975	975	936
Gross receipts:				
Current techniques (dollars)	82.12	207.19	207.19	198.90
Advanced techniques (dollars)	86.98	216.94	216.94	209.26
Capital requirements (dollars)	236.39	128.29	125.88	149.76

a/ Not including labor for producing feed.

Hogs. In all phases of the analysis, the alternatives for hogs are a two-litter system or a single spring-litter system. In both systems, a 5-percent death loss is assumed for the postweaning period. With each system, one gilt is kept for breeding purposes, and thus one sow is sold per litter. Feeding requirements cover the period from time of breeding until time of selling of sow and pigs.

TABLE 6. BASIC INPUT-OUTPUT DATA FOR HOG ENTERPRISES PER LITTER.

Item	Current techniques: Two-litter system	Current techniques: Spring litter	Advanced techniques: Two-litter system	Advanced techniques: Spring litter
Date of farrowing	April, late Oct.	April	March, late Sept.	March
Pigs weaned (number)	13.6	6.8	14.5	7.3
Death loss (number)	0.6	0.3	0.4	0.2
Pigs kept for breeding (number)	1.0	1.0	1.0	1.0
Pigs sold (number)	12.0	5.5	13.1	6.1
Pounds pork sold (marketed at 225 pounds)	2,700	1,235	2,948	1,373
Sow marketed (pounds)	400	300	400	300
Total gross receipts (dollars)	486.00	238.10	525.68	260.18
Feed requirements:				
Corn (bushels)	225	110	215	105
Protein supplement (pounds)	1,180	520	1,400	610
Pasture hay equivalent (tons)	0.7	0.7	0.7	0.7
Other annual cash expenditures (dollars)	39.98	20.23	44.28	21.91
Investments:				
Equipment (dollars)	34.50	23.89	48.80	33.80
Brood sow (dollars)	43.75	33.75	47.25	37.25
Total capital requirement (dollars)	151.23	103.87	184.57	127.12
Total annual labor requirements (hours)	59	26	59	26

Capital requirements given in table 6 include the investment in equipment, commercial feed, breeding stock and annual cash expenses. In the two-litter system, the cash expenses of the fall litter are financed from sales of spring pigs.

In the advanced-technique phase, a higher level of managerial ability and larger capital inputs are assumed. Changes include higher investments in breeding stock and equipment, use of more commercial feed and medicine and earlier farrowing. More pigs are weaned per litter, the death rate is lower, and 5 bushels less corn are used per litter.

Poultry. In all situations, a poultry enterprise is included as an alternative, but it is limited to 150 hens. Labor requirements are met by family labor not available for other enterprises. Sixteen dozen eggs are produced per hen, also 4.3 pounds of meat. Annual gross receipts are $6.53, and annual expenses are $4.88, including 93 pounds of corn per hen. Because of the frequency of sales, only the investment in equipment and chicks is regarded as a capital requirement. In the advanced-technique situation, corn inputs and egg production are increased 10 percent, giving $0.35 more net return per hen.

ANALYSIS OF PLANS FOR THE SHORT RUN

Optimum farm plans for the short-run situations will be discussed in this section. Since a large number of optimum plans are involved, details of all the plans will not be presented here; rather, they will be summarized, and the more important types of changes will be noted. The variables and considerations important in causing particular plans to emerge will be explained. A complete set of these short-run plans is given in Appendix B.

In the tables following which contain optimum plans, income figures presented are based on a constant milk price. This price is $4 in all tables except table 9, in which the incomes are based on a $5 milk price. With incomes from different plans based on one milk price, the differences between incomes can be attributed entirely to the differences between the plans. This facilitates quick comparisons of the relative profitability of the plans and also indicates the magnitude of income lost by following a production plan which is not profit maximizing.

Optimum Plans With Low Milk Prices

The optimum farm plans for low milk prices are presented in table 7. Each plan represents a summary of three farm plans that resulted from programming farms with the same soil type, acreage and tenure arrangements but with different amounts of dairy building space. In all farm situations, the three optimum plans call for the same enterprises. The size of the enterprise varies with the different farms because of variations in capital and labor resources. For instance, all plans for 160-acre owner-operated farms on Clarion-Webster soil call for 9 spring and 9 fall litters of pigs, 33 to 35 drylot calves and either a CCSb or a CSbCOM rotation for all cropland. The number of drylot calves and the percentage of cropland in each rotation varies because of differences in amount of labor available.

The plans given in table 7 are optimum for milk prices ranging from zero up to the "minimum milk price" given in the table. This minimum milk price represents the

TABLE 7. SUMMARY OF OPTIMUM FARM PLANS FOR THE SHORT RUN WITH LOW MILK PRICES.

Type of farm	Minimum milk price a/ (dollars per cwt.)		Hogs	Beef	Rotation	Acres	Net
	10,600-pound-producing cows	6,700-pound-producing cows	(No. of litters)	cattle			income (dollars)
Clarion-Webster soil area							
160 acres							
Owner-operator	3.05-3.16	4.05-4.12	9(1:1)b/	33-35 drylot calves	CCSb CSbCOM	84.3-94.6 38.4-52.0	5,032-5,322
Tenant	3.34-3.41	4.34-4.42	9(1:1)	33-35 pasture calves	CCSb CSbCOM	120.3-132.8 13.0-21.2	2,135-2,203
240 acres							
Owner-operator	2.97-3.19	4.03-4.16	9(1:1)	38-60 drylot calves	CCSb CSbCOM	108.6-165.2 42.8-83.3	7,422-8,162
Tenant	3.08-3.42	3.95-4.45	9(1:1)	59-62 pasture calves	CSbCOM	205.7-213.9	3,382-3,431
Shelby-Sharpsburg-Winterset and Tama-Muscatine soil area							
160 acres							
Owner-operator	2.88-3.12	3.78-3.93	8-10(1:1)	41-43 pasture calves	CSbCOM	108.6-112.4	4,503-4,579
Tenant	3.04-3.37	4.25-4.33	10(1:1)	10-11 beef cows 5- 8 pasture calves	CSbCOM	114.7-119.0	1,639-1,686
240 acres							
Owner-operator	2.88-3.12	3.68-3.93	11-12(1:1)	60-66 pasture calves	CSbCOM	160.5-167.1	6,952-7,458
Tenant	3.04-3.38	3.83-4.33	12(1:1)	9-13 beef cows 22-28 pasture calves	CSbCOM	160.4-170.8	2,625-2,769

a/ These plans are optimum for milk prices ranging from zero up to the "minimum milk price." At this price, milk production would become profitable.
b/ (1:1) signifies the two-litter system; thus 9(1:1) implies 9 spring and 9 fall litters.

price at which milk production would begin to be profitable. Production plans that called for milk production at prices below these levels would not maximize profits.

FARMS ON CLARION-WEBSTER SOIL

Optimum plans for owner-operators on Clarion-Webster farms call for drylot-fed calves. On tenant farms, however, the tenant's share of receipts from drylot calves would not return the prescribed minimum of $0.50 per hour of labor and $0.05 per $1 of capital. Therefore, on tenant farms, drylot calves are replaced by pasture-fed calves. Feeder yearlings return less than pasture-fed calves under any conditions, hence, they do not appear in any of the optimum plans. Likewise, beef cows are never selected because their high forage requirements would necessitate expanding forage acreage at the expense of high-yielding grain crops.

At these low levels of milk prices, hog production expands to the limits of the building space on all Clarion-Webster farms. With rising milk prices, milk production first expands at the expense of beef enterprises. As dairying is increased, all resources are transferred out of beef production before hog numbers are reduced. Here again, forage is an important factor. Hogs, unlike beef, can be produced without sacrificing grain production for forage production.

With high-producing milk cows, an average minimum milk price of $3.20 is required for profitable milk production. With low-producing cows, the minimum price required is $4.19. At these prices, some dairy cows would be included in the optimum plans, and numbers of cows would increase further as the price rose. The large difference between the minimum milk prices for high- and for low-producing cows is primarily due to the difference in labor requirements per unit of milk produced. With high-producing cows, the input of labor per hundredweight of milk varies from 0.8 to 1.1 hours, depending upon herd size. For low-producing cows, the comparable labor requirements are 1.1 to 1.7 hours.

The minimum milk price required for profitable milk production also varies between types of farms. Owner-operators can profitably keep dairy cows at milk prices $0.20 to $0.22 below those needed for profitable production on rented farms. This price differential is small, however, considering that the tenant receives only half the gross receipts but contributes all the labor and half of all capital inputs except buildings. The small size of the differential is due to a lack of good alternatives for the tenant's resources. As previously noted, drylot calves are not profitable for tenants. Returns to resources also are low in other livestock enterprises. As a result, opportunity costs of producing milk are quite low.

FARMS ON SHELBY-SHARPSBURG-WINTERSET AND TAMA-MUSCATINE SOILS

For farms in the Shelby-Sharpsburg-Winterset area, optimum plans for low milk prices (table 7) call for a CSbCOM rotation on all cropland. This rotation results in the least possible production of forages and the maximum production of grain. Forage is generally in excess supply on farms in the area because large acreages of permanent pasture and forage are planted to control erosion. The optimum plans for all owner-operator farms of this area call for purchasing corn. Purchased corn is fed to pasture-fed calves, which in turn also utilize some of the excess forage. Since forage has no alternative use and therefore does not represent a cost, this feeding plan is profitable enough to reduce numbers of hogs in optimum plans for some farms.

On rented farms, plans call for feeding home-grown corn only. Hog production expands to the limits of building space. Corn not fed to hogs is used primarily for pasture-fed calves. Beef cows are kept to utilize the remaining forage. Thus, for a rented farm in the Shelby-Sharpsburg-Winterset area, increasing the building space for hogs would allow expanded hog production and call for a corresponding decrease in pasture-fed calves since corn supplies are limited. In addition, the number of beef cows would be increased to utilize the forage not used for calves. On either rented or owner-operated farms, beef production is not profitable enough to justify changing the rotation to increase forage production.

On Shelby-Sharpsburg-Winterset farms, the average minimum milk price for profitable milk production is $3.10 for high-producing cows and $4.01 for low-producing cows. These minimum prices are slightly below the required prices for the Clarion-Webster area. The main reason for this is the large supply of forage.

Optimum Plans With a Milk Price of $4

Space limitations prohibit our discussion of plans at all price levels. Hence, in this section we present the optimum plans at a milk price of $4. Here we discuss patterns of change occurring as milk prices are increased. These plans are presented in table 8 for farms with high-producing cows. A separate plan is presented for each of the 24 farm categories in the study, grouped according to the amount of dairy building space available.

The trends in plan changes can be noted by comparing the three plans given for farms of the same soil type, acreage and tenure arrangements. For 160-acre owner-operated farms in the Clarion-Webster area, the plan including 13 dairy cows calls for 9 sows farrowing twice a year, no beef and a primarily CSbCOM rotation. The plan with 24 dairy cows calls for 8 spring and 5 fall litters of pigs and a CCOMM rotation. The plan with 35 cows includes only 2 spring and fall litters and a COMMM rotation. On Clarion-Webster farms, the CCSb rotation is used when no dairy cows are called for in the plan. As the size of the dairy herd increases, the rotation is changed to provide more forage. Also as dairying is increased, beef cattle are dropped and hog numbers reduced to provide capital and labor. In only a few plans, however, are hogs eliminated entirely.

On Shelby-Sharpsburg-Winterset farms, the same type of rotation changes occur as dairy cow numbers are increased. Forage supplies are increased by changing from CSbCOM to CCOMM and, in one plan, to COMMM. Although this is not indicated in table 8, beef production can compete with hogs on some Shelby-Sharpsburg-Winterset farms. With rising milk prices, beef enterprises are reduced in size, but so is the hog enterprise. On Clarion-Webster farms, hog numbers are not reduced in any farm plan until beef has been eliminated.

As indicated in table 8, for most farms with high-producing cows a milk price of $4 is sufficient to induce milk production at the maximum as limited by building space. This situation occurs on farms in 14 of the 24 categories. Production would reach this maximum at $4.20 for milk on farms in five of the remaining categories. In contrast, less than half the farms with low-producing cows could profitably produce any milk at a milk price of $4. Hence, for many farms with low-producing cows, the optimum plan with a $4 milk price is the same as is presented in table 7.

Optimum Plans With a Milk Price of $5

As previously indicated, the majority of farms with high-producing cows would produce milk at the maximum level as limited by building space with a milk price of $4 or slightly more. Further price increases would call for greater milk production on only a few farms.

TABLE 8. OPTIMUM FARM PLANS FOR THE SHORT RUN WITH MILK PRICE AT $4 PER CWT. AND WITH MILK COWS PRODUCING 10,600 POUNDS PER YEAR.

Type of farm	Dairy cows	Hogs (No. of litters)	Beef cattle	Rotation	Acres	Net income (dollars)
Farms with building space for 13-14 cows						
Clarion-Webster soil area:						
160 acres						
Owner-operator	13	9(1:1)	0	CSbCOM CCOMM	131.9 4.5	7,062
Tenant	12	9(1:1)	0	CSbCOM	141.6	3,178
240 acres						
Owner-operator	11	9(1:1)	0	CSbCOM CCSb	102.4 105.6	9,504
Tenant	13	9(1:1)	3 pasture calves	CSbCOM CCSb	149.0 64.9	4,359
Shelby-Sharpsburg-Winterset soil area:						
160 acres						
Owner-operator	13	7(1:1)	4 pasture calves	CSbCOM	109.2	6,354
Tenant	13	3 fall 10 spring	0	CSbCOM	114.7	2,759
240 acres						
Owner-operator	14	12 spring	21 pasture calves	CSbCOM	160.5	8,697
Tenant	12	12(1:1)	7 beef cows	CSbCOM	164.0	3,733
Farms with building space for 22-24 cows						
Clarion-Webster soil area:						
160 acres						
Owner-operator	24	5 fall 8 spring	0	CCOMM	136.3	8,453
Tenant	23	6(1:1)	0	CSbCOM CCOMM	18.2 123.3	3,843
240 acres						
Owner-operator	19	9(1:1)	0	CSbCOM	178.3	9,978
Tenant	23	0	0	CSbCOM CCOMM	170.3 36.1	4,893
Shelby-Sharpsburg-Winterset soil area:						
160 acres						
Owner-operator	21	10(1:1)	0	CCOMM	108.6	7,292
Tenant	22	3(1:1)	0	CCOMM	114.9	3,240
240 acres						
Owner-operator	23	0	0	CSbCOM	167.1	9,882
Tenant	24	2(1:1)	0	CSbCOM CCOMM	119.5 40.9	4,514
Farms with building space for 30-40 cows						
Clarion-Webster soil area:						
160 acres						
Owner-operator	35	2(1:1)	0	COMMM	133.0	9,881
Tenant	30	1(1:1)	0	CCOMM COMMM	87.5 58.3	4,221
240 acres						
Owner-operator	19	9(1:1)	0	CSbCOM COMMM	187.8 4.1	10,177
Tenant	28	0	0	CSbCOM CCOMM	127.8 77.9	5,260
Shelby-Sharpsburg-Winterset soil area:						
160 acres						
Owner-operator	25	10(1:1)	0	CCOMM COMMM	37.9 74.5	7,702
Tenant	22	3(1:1)	0	CCOMM	119.0	3,289
240 acres						
Owner-operator	31	8(1:1)	0	CCOMM	161.1	10,895
Tenant	31	5(1:1)	0	CCOMM	170.8	5,020

With low-producing cows, even at a milk price of $5, farms in only 8 of the 24 farm categories would expand the dairy herd to the limits of building space, and in 8 of the remaining categories a price in excess of $5.60 would be needed to push milk production to this maximum. The implication is that farmers with low-producing cows would be better off to discontinue milk production, let their dairy equipment stand idle and transfer as many resources as possible into hog or beef production. Of course, another alternative would be to try to increase production per cow.

Table 9 presents the optimum plans for farms with low-producing cows at a milk price of $5. Some useful comparisons can be made between plans for $4 milk and plans for $5 milk for the same types of farms. Although milk prices are $1 higher, only three plans include more dairy cows at $5 than at $4. Similarly, net incomes with high-producing cows and a $4 milk price are, in all but

TABLE 9. OPTIMUM FARM PLANS FOR THE SHORT RUN WITH MILK PRICE AT $5 PER CWT. AND WITH MILK COWS PRODUCING 6,700 POUNDS PER YEAR.

Type of farm	Dairy cows	Hogs (No. of litters)	Beef cattle	Rotation	Acres	Net income (dollars)
Farms with building space for 13-14 cows						
Clarion-Webster soil area:						
160 acres						
Owner-operator	13	9(1:1)	0	CSbCOM	116.0	6,499
				CCOMM	20.4	
Tenant	11	9(1:1)	0	CSbCOM	141.6	2,800
240 acres						
Owner-operator	13	9(1:1)	5 drylot calves	CSbCOM	150.5	9,414
				CCSb	57.5	
Tenant	13	9(1:1)	8 pasture calves	CSbCOM	185.5	4,135
				CCSb	28.4	
Shelby-Sharpsburg-Winterset soil area:						
160 acres						
Owner-operator	13	10(1:1)	0	CSbCOM	109.2	5,974
Tenant	12	8(1:1)	0	CSbCOM	114.7	2,525
240 acres						
Owner-operator	14	4 fall 12 spring	16 pasture calves	CSbCOM	160.5	8,283
Tenant	12	12(1:1)	5 beef cows 8 pasture calves	CSbCOM	164.0	3,602
Farms with building space for 22-24 cows						
Clarion-Webster soil area:						
160 acres						
Owner-operator	24	9(1:1)	0	CCOMM	100.9	7,490
				COMMM	35.4	
Tenant	12	9(1:1)	0	CSbCOM	141.5	2,868
240 acres						
Owner-operator	22	9(1:1)	0	CSbCOM	111.9	9,091
				CCOMM	61.3	
Tenant	18	9(1:1)	0	CSbCOM	206.4	4,417
Shelby-Sharpsburg-Winterset soil area:						
160 acres						
Owner-operator	19	10(1:1)	0	CCOMM	108.6	6,171
Tenant	13	8(1:1)	0	CSbCOM	114.9	2,569
240 acres						
Owner-operator	20	5 fall 12 spring	0	CSbCOM	167.1	9,180
Tenant	19	7 fall 12 spring	0	CSbCOM	160.4	3,961
Farms with building space for 30-40 cows						
Clarion-Webster soil area:						
160 acres						
Owner-operator	31	9(1:1)	0	COMMM	133.0	7,885
Tenant	30	3(1:1)	0	CCOMM	47.6	3,571
				COMMM	98.2	
240 acres						
Owner-operator	29	9(1:1)	0	CSbCOM	47.8	10,266
				CCOMM	125.3	
				COMMM	18.8	
Tenant	34	0	0	CSbCOM	8.9	4,912
				CCOMM	196.8	
Shelby-Sharpsburg-Winterset soil area:						
160 acres						
Owner-operator	19	10(1:1)	0	CCOMM	112.4	6,266
Tenant	12	8(1:1)	0	CSbCOM	119.0	2,598
240 acres						
Owner-operator	28	12(1:1)	0	CCOMM	161.1	9,459
Tenant	17	12(1:1)	0	CSbCOM	170.8	4,043

one case, higher than with low-producing cows and a $5 milk price. Both these examples serve to emphasize the relative unprofitability of low-producing cows.

The plans for a $5 milk price also indicate the trends that occur in production plans as dairying is increased. Rotations are changed to provide more forage, and beef is eliminated to provide labor and capital. Some changes result from differences in feed requirements of low-producing cows. Cows producing 6,700 pounds of milk per year require less grain and less forage per head than do cows producing 10,600 pounds of milk. Nevertheless, low-producing cows require more forage and more grain per pound of milk produced than do high-producing cows; also the forage requirement per unit of output increases more than the grain requirement. This relative change in inputs has the effect of increasing the demands for forage and decreasing the demands for grain. This difference in input requirements explains why plans for low-producing cows call for more forage production than plans for high-producing cows. It also explains why higher milk prices are needed for profitable milk production with low-producing cows — a higher milk price is needed to compensate for the losses from reduced grain crop production.

Another aspect of this relative difference in feed requirements is that more hog production is allowed with low-producing dairy cows.

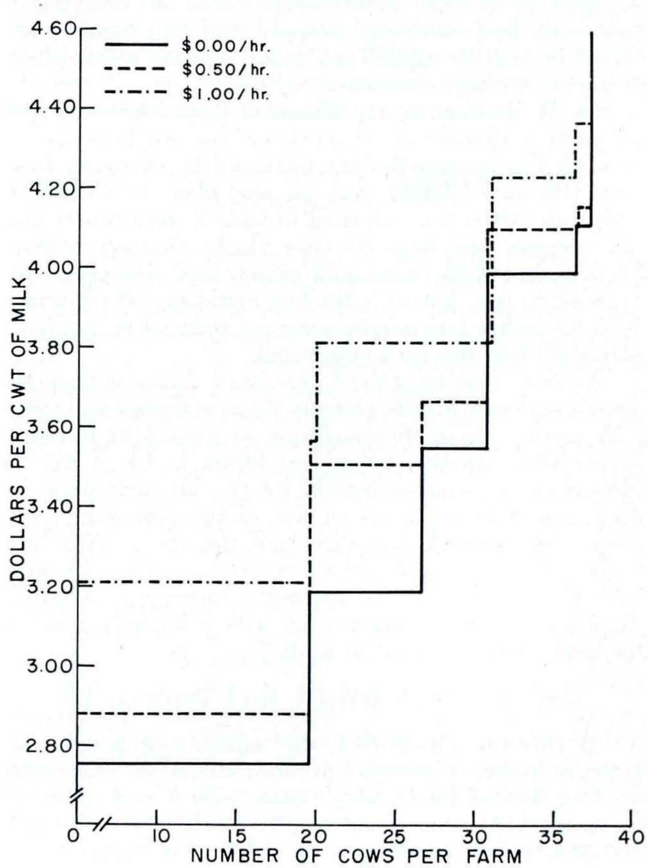
Farm Size

In some specific cases, for instance, where forage is a limiting factor and labor is plentiful, the larger size farm allows larger maximum dairy herds. Where labor is limitational, the larger farm will utilize more labor for crops, leaving less for dairy. Crops generally bring the highest returns to labor. These two factors usually counteract each other, resulting in about the same average size of dairy herd for 160- and for 240-acre farms.

Returns to Labor

A reservation price on labor of $0.50 per hour was used in all optimum plans developed in the study. Some farmers may feel that $0.50 per hour is not a proper reservation price on labor. Individuals who have higher value alternatives will wish to allocate less labor to their farming enterprises. For such farmers, the plans developed are not optimum. Optimum plans, therefore, were developed for 240-acre Shelby-Sharpsburg-Winterset

Fig. 2. Supply schedules for milk, assuming 3 levels of minimum returns to labor.



farms with high-producing cows, assuming zero and $1 per hour reservation prices for labor. These plans are given in Appendix B, table B-2. The resulting supply functions for milk appear in fig. 2.

The sets of plans developed under the three levels of specified returns to labor are quite similar, the main difference being the milk price needed for profitable milk production. As indicated in fig. 2, raising the reservation price on labor has the effect of raising the price of milk that is required for profitable production. This indicates that less labor would be utilized on the farm if the reservation price were increased. It further indicates that on this type of farm, labor is receiving about $1 per hour with a $4 milk price and a herd of 31 cows. With low-producing cows, few farms would produce an income of $0.50 per hour for labor at prices and herd sizes assumed in these farm plans.

Crop-Share Lease

Previous plans for rented farms all have been based on a livestock-share lease — the type of lease most commonly used by tenants with large numbers of livestock. Nevertheless, the crop-share lease also is used by some tenants with large livestock programs. Hence, optimum plans were developed for 240-acre farms in both soil areas assuming a crop-share lease. The resulting plans are presented in Appendix B, table B-3. The plans assume the same quantity of capital as 240-acre owner-operated farms and the same quantities of other resources as 240-acre farms under the livestock-share lease.

These plans indicate a lower opportunity cost of producing milk than occurs on owner-operated farms. The lower opportunity cost results partly from the assumption regarding capital. The same supply of capital is assumed to be available as on an owner-operated farm, but the capital requirement for crops is about half that required by an owner-operator. This arrangement releases capital for investments in livestock.

Two plans developed for the crop-share tenant call for letting land lie uncropped. (Actually, it would be subrented, or not rented in the first place.) The difference between these plans and those for owned and livestock-share farms indicates the change in the relative profitability of enterprises when this type of lease is adopted. With the crop-share lease, the tenant receives all the net proceeds from livestock and only about half the receipts from crops. In practice, the landlord would not allow the tenant to leave some land uncropped, or perhaps even to sublease it. These plans do indicate a division of interest between landlord and tenant, however. The tenant's income would be reduced if he were required to crop all the land, and, of course, the landlord's income would be lower if the land were left idle.

ANALYSIS OF PLANS FOR THE LONG RUN

Optimum Plans With Land Inputs Fixed

In this section, a long-run planning period is considered, during which it is possible for the operator to use more resources than in short-run plans. He can use quantities consistent with profit maximization and the restraints of fewer fixed resources. Costs of buildings, normally considered fixed in the short run, are now treated as variable costs. As fixed costs, building outlays or expenses do not enter the production planning process; however, when treated as variable costs they are charged to the enterprise using their services. In the long run, the quantity of buildings may be chosen at any level, the optimum quantity being that which results in greatest net farm income. This greater flexibility provides the potential for higher net farm incomes. Since tenants are not normally in a position to plan in this long-run framework, all plans in this section are for owner-operators.

In addition to allowing changes in supplies of buildings, long-run plans also allow use of unlimited supplies of capital. A price or interest rate of 5 percent is charged for use of capital, but otherwise no limit is placed on the

TABLE 10. OPTIMUM PLANS FOR FARMS IN THE LONG RUN WITH CURRENT TECHNIQUES OF PRODUCTION.

Range of milk price (dollars per cwt.)	Number of dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk a/ (dollars)
Clarion-Webster soil area, 160-acre farms						
With 10,600-pound-producing cows:						
0-3.36	--	35(1:1)	--	CCSb	110.0	6,669
				CSbCOM	25.2	
3 36-3.49	11	23(1:1)	--	CSbCOM	135.2	7,532
3.49-3.62	24	6(1:1)	--	CCOMM	135.2	8,387
3.62-3.66	31	--	--	CCOMM	60.2	8,738
				COMMM	75.0	
3.66-8.85	33	--	--	CCOMM	31.6	8,895
				COMMM	103.6	
With 6,700-pound-producing cows:						
0-4.47	(Same as first plan above)					
4.47-4.71	10	27(1:1)	--	CSbCOM	136.2	6,556
4.71-4.95	12	13(1:1)	--	CSbCOM	135.2	6,254
4.95	32	--	--	COMMM	135.2	5,375
Clarion-Webster soil area, 240-acre farms						
With 10,600-pound-producing cows:						
0-3.36	--	31(1:1)	--	CSbCOM	13.8	8,904
				CCSb	180.6	
3.36-3.49	9	20(1:1)	--	CSbCOM	108.1	9,663
				CCSb	86.3	
3.49-3.62	18	11(1:1)	--	CSbCOM	194.4	10,263
3.62-5.72	31	--	--	CSbCOM	51.0	11,197
				CCOMM	143.4	
With 6,700-pound-producing cows:						
0-4.47	(Same as first plan, Clarion-Webster 240-acre, above)					
4.47-4.62	12	20(1:1)	--	CSbCOM	153.1	8,679
				CCSb	41.3	
4.62-4.90	16	17(1:1)	--	CSbCOM	194.4	8,669
4.90-4.99	31	6(1:1)	--	CCOMM	194.4	8,150
4.99-7.00	37	--	--	CCOMM	124.0	7,849
				COMMM	70.4	
Shelby-Sharpsburg-Winterset soil area, 160-acre farms						
With 10,600-pound-producing cows:						
0-3.19	--	31(1:1)	33 pasture calves	CSbCOM	110.1	5,788
3.19-3.50	12	20(1:1)	--	CSbCOM	110.1	6,824
3.50-3.90	14	6(1:1)	--	CSbCOM	110.1	6,538
3.90-4.13	22	3(1:1)	--	CCOMM	110.1	7,001
4.13-4.26	25	--	--	CCOMM	67.8	7,168
				COMMM	42.3	
4.26	29	--	--	COMMM	110.1	7,217
With 6,700-pound-producing cows:						
0-4.13	(Same as first plan, Shelby-Sharpsburg-Winterset 160, acres, above)					
4.13-4.71	11	24(1:1)	--	CSbCOM	110.1	5,820
4.71-5.19	13	8(1:1)	--	CSbCOM	110.1	5,076
Shelby-Sharpsburg-Winterset soil area, 240-acre farms						
With 10,600-pound-producing cows:						
0-3.18	--	25(1:1)	58 pasture calves	CSbCOM	162.9	7,905
3.18-3.42	17	9(1:1)	11 pasture calves	CSbCOM	162.9	9,567
3.42-3.85	22	5(1:1)	--	CSbCOM	162.9	9,877
3.85-5.86	30	--	--	CSbCOM	40.5	10,549
				CCOMM	122.4	
With 6,700-pound-producing cows:						
0-4.13	(Same as first plan, Shelby-Sharpsburg-Winterset 240 acres, above)					
4.13-4.48	18	13(1:1)	2 pasture calves	CSbCOM	162.9	8,009
4.48-5.57	19	12(1:1)	--	CSbCOM	162.9	7,928

a/ In this phase, we have assumed that farms have $20,000 of own funds; additional capital is borrowed at 5 percent interest, and incomes have been adjusted accordingly.

amount of capital that can be invested. Crop production still is limited by the supply of land available, but livestock production can be expanded to the limits of the supply of family and operator labor available during the fall and winter seasons. In other words, labor at these times possibly would serve as a restraint on production, while labor in spring and summer would not do so.

In plans with building costs variable, shown in table 10, the average opportunity cost of producing milk is approximately $0.25 per hundredweight higher than for the corresponding short-run plans. This rise in opportunity cost of producing milk does not occur solely because the dairy enterprise is now charged for the building services it utilizes. It occurs partly because building space restrictions for the hog enterprise also are relaxed. As hogs are relatively more efficient in the use of land, labor and capital than beef cattle, they expand at the expense of the beef enterprise and compete directly with dairying for the use of these resources. Long-run plans in table 10 include as many as 35 litters of pigs, fed on large quantities of purchased corn, compared with a maximum of 12 litters for the short-run plans. Beef enterprises are included only on Shelby-Sharpsburg-Winterset farms where excess forage is available.

When building inputs are allowed to vary, the effect of higher milk prices on income is much less than in the short-run situation. Two factors contribute to this: (1) There is no excess dairy building capacity lying idle at the lower price levels, and (2) other profitable alternatives, mainly hogs, are present and can be expanded to employ labor and capital inputs not utilized by the dairy enterprise in the short run.

Under the assumptions of this section, dairy herd size is not limited by buildings. As the price of milk rises, it is profitable to continue expanding the dairy herd until it is limited by the forage supply or by the need to decrease crop production in order to release labor for the dairy enterprise.

Optimum Plans With Land Inputs Variable

The long-run plans presented in the previous section, with building and capital supplies allowed to vary, suppose land input to be fixed. To examine the effect of variable land supplies on optimum plans, the opportunity to buy additional land is considered in this section. Here we analyze situations starting from a 160-acre Shelby-Sharpsburg-Winterset farm with current production techniques. A capital supply limited to $60,000 is made available for investments in farm enterprises, buildings and additional land. Additional land is considered to be 75 percent tillable and 25 percent permanent pasture. It sells for $155 per acre. The only resources with fixed supplies are family labor and capital.

The two resulting plans are presented in table 11. In these plans, capital is the main limiting factor and brings a marginal return of 14 percent. With milk prices below $3.62 per hundredweight, farm size increases to 412 acres, of which 299 acres are tillable. This plan calls for 102 pasture-fed calves. During the summer, 431 hours of labor are hired. When the milk price rises above $3.62, 15 dairy cows are included in the plan in place of the pasture-fed calves. An additional 23 acres of land are purchased, but only 135 hours of summer labor are hired. A milk price of $6.43 is needed to expand the dairy enterprise beyond 15 cows. In both plans, summer labor is the decisive factor in determining the enterprises. Pasture-fed calves are included in place of hogs, since net returns per hour of summer labor are higher with pasture-fed calves.

TABLE 11. OPTIMUM PLANS WITH LAND-BUYING OPPORTUNITIES CONSIDERED ON A 160-ACRE SHELBY-SHARPSBURG-WINTERSET FARM.

Range of milk price (dollars)	Number dairy cows	Beef cattle	Land purchased (acres)	Rotation	Acres	Income at $4/cwt. of milk (dollars)
0-3.62	--	102 pasture calves	252	CSbCOM	299.1	9,272
3.62-6.43	15	---	275	CSbCOM	316.5	10,220

On a 160-acre farm with the same milk prices and supplies of family labor as previously indicated, optimum plans call for 22 cows on 160-acre farms. This difference between plans for 160- and 412-acre farms demonstrates the supplementary nature of the dairy enterprise. It also suggests that dairy production probably would decrease with increasing farm size. If all 160-acre farms in the area were combined into 400-acre units, total milk production would drop 72 percent. With farms in 400-acre units, only 40 percent as many farm families would be required to work this acreage. Net incomes of families on 400-acre units would be about $3,000 higher than the net income of families on 160-acre units, assuming that both followed profit-maximizing production plans.

Plans With Advanced Production Techniques

The plans presented in this section are based on increased production efficiency in all enterprises. They assume use of milking parlors, bulk coolers and high-producing cows. Advanced techniques are applied at the levels of efficiency now maintained by superior farmers.

The average opportunity cost of producing milk is $0.29 more under this situation of advanced techniques than in previously discussed long-run plans. This increase in opportunity cost is largely due to higher capital inputs per cow required with the parlor system. Small herds are discouraged by these high capital inputs, but for large herds the fixed costs are spread over many cows. Hence, while the opportunity cost increases, and the price must be higher before any milk can be produced profitably, much more milk would be produced at higher price levels. Considering the economies to scale for the equipment concerned, herd sizes would average much larger under this situation. Labor considerations also allow an expansion in herd size at higher price levels. Herds can be larger since labor requirements per cow are lower.

Fall hogs are included in only one of the plans presented in this section. This is because the marginal value of fall labor is $3 or more per hour in all of these plans. With the change in farrowing time, 30 percent more pork can be produced for a given amount of fall labor with spring hogs than with the two-litter system. This savings in fall labor offsets other higher costs of the single-litter system.

As with other long-run plans, income differences between different plans for a given farm are small, and labor and capital inputs are quite similar. Because of greater resource efficiencies (i.e., lower per-unit costs of producing milk for larger herd sizes) and larger capital investments, however, net incomes average higher here than in long-run plans discussed earlier.

TABLE 12. OPTIMUM PLANS FOR FARMS IN THE LONG RUN WITH ADVANCED TECHNIQUES OF PRODUCTION.

Range of milk price (dollars per cwt.)	Number of dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk (dollars)
Clarion-Webster soil area, 160-acres						
0-3.47	--	94 spr. a/	--	CCSb	104.9	8,260
				COMMM	30.3	
3.47-3.55	31	5 spr.	--	CCSb	47.0	10,016
				COMMM	88.2	
3.55-3.70	32	--	8 drylot calves	CCSb	42.7	10,095
				COMMM	92.5	
3.70-3.74	33	--	4 drylot calves	CSbCOM	56.0	10,169
				COMMM	79.2	
3.74-5.93	34	--	--	CSbCOM	56.5	10,170
				COMMM	78.7	
Clarion-Webster soil area, 240-acres						
0-3.65	--	83 spr.	--	CCSb	169.9	10,592
				COMMM	24.5	
3.65-3.68	27	--	22 drylot calves	CCSb	113.6	11,892
				COMMM	80.8	
3.68-3.74	29	--	23 drylot calves	CSbCOM	147.1	12,062
				COMMM	47.3	
3.74-5.93	32	--	--	CSbCOM	150.4	12,082
				COMMM	44.0	
Shelby-Sharpsburg-Winterset soil area, 160-acres						
0-3.61	--	86 spr.	4 pasture calves 26 drylot calves	CSbCOM	110.1	8,097
3.61-3.79	7	73 spr.	--	CSbCOM	110.1	8,402
3.79-3.80	15	16(1:1)	--	CSbCOM	110.1	8,467
3.80-7.15	34	--	--	CSbCOM	5.8	8,961
				COMMM	104.3	
Shelby-Sharpsburg-Winterset soil area, 240-acres						
0-3.58	--	70 spr.	49 pasture calves	CSbCOM	162.9	10,577
3.58-3.60	7	53 spr.	36 pasture calves	CSbCOM	162.9	10,847
3.60-3.84	19	20 spr.	5 pasture calves 10 drylot calves	CSbCOM	162.9	11,438
3.84-3.91	23	23 spr.	--	CSbCOM	156.5	11,959
				COMMM	6.4	
3.91-6.78	32	--	--	CSbCOM	125.3	11,996
				COMMM	37.6	

a/ Spr. refers to the single spring-litter hog system.

AGGREGATE SUPPLY SCHEDULES FOR FLUID MILK

In preceding sections, optimum farm plans for the short run and for the long run are presented and analyzed. In this section, aggregate normative fluid milk supply schedules for 140- to 180-acre and 220- to 260-acre farms are presented. These supply schedules are based on the optimum plans previously presented. The general type of supply schedule obtained for an individual farm by variable-price linear programming is shown in fig. 2.

The aggregate supply schedules for all farms considered in the study were obtained in the following manner. The optimum plan for the average farm in each category includes data on the quantity of milk to be produced at each price. For each category, these quantities of milk were multiplied by the number of farms in that category. The resulting supply schedules then were added over all categories at each price to give an aggregate of all categories of farms included in the study.

The number of farms in each category was obtained from the 1956 Iowa Assessors Annual Farm Census. Tables A-1 and A-2 of Appendix A give the description of these farm categories and the number of farms in each category. Included in these estimates of farm numbers are farms termed "potential fluid milk producers" which presently produce butterfat. From the 1957 survey, it was concluded that only farms with four or more cows producing butterfat could be considered as potential fluid milk producers. Hence, these farms are included in the number of farms given in table A-2, Appendix A, and in the weighting of the aggregate supply schedules.

As shown in fig. 2, variable-price linear programming gives stepped supply schedules. These steps are due to discrete changes in optimum plans resulting from interaction of fixed production coefficients and fixed resource supplies. The aggregate schedule for a single category of farms is identical to that for the average farm in the category, except for a change in the quantity axis. Thus, the aggregate schedules also contain these steps. When farms in different categories are aggregated, the resulting schedule still contains steps, but the steps occur at more price levels, and relative changes in quantity at any one price level are smaller. Thus, the resulting schedule more nearly approaches a smooth curve.

Supply elasticity is defined as the percentage change in quantity associated with a 1-percent change in price. In predictive analysis, this quantity relates to changes which producers are expected to make in output in response to price change. Since the analysis reported here is normative in nature, the elasticities refer only, for the particular population of farms studied, to what the production would be if farmers maximized profits under the price and technical conditions assumed.

The supply elasticity is "infinitely inelastic" on vertical segments of a stepped function and "infinitely elastic" on the horizontal segments. Hence, regression equations, although they are not perfectly satisfactory and are somewhat complex to interpret, were used to develop smooth functions from the aggregate stepped functions. The midpoints of all the vertical segments of the stepped functions were taken as the "observations" for fitting these equations. These vertical segments represent the range in prices over which the particular quantity would be optimum and output would be stable. Such observations do not follow the assumptions of normality and independence that are necessary for statistical probability statements; therefore, tests of hypotheses or probability statements are not made. The R^2's, correlation coefficients, are computed only to determine which function to present. Second degree polynomial functions are presented when the addition of the second term gives a marked increase in the R^2.

Aggregate Supply in the Short Run

Two aggregate schedules follow. Both are based on short-run optimum plans, but they differ as to the assumed average production per cow. The first schedule is based on current average production, estimated at 8,130 pounds per cow.[7] To approximate this average production, we assume that 37.2 percent of the farms in each category have 10,600-pound cows and 62.8 percent have 6,700-pound cows. Figure 3 illustrates this supply schedule and the associated fitted continuous function. Along this fitted line or function, supply response is 13,520 hundredweight of milk per 1-cent change in price. On the stepped schedule, supply is quite responsive within some price ranges;

7/ This estimate of current average production was obtained from a 1958 mail survey of grade A milk producers in the Des Moines area. This survey indicated no significant difference in production per cow between farms of different soil types, tenure arrangements, farm size or herd size.

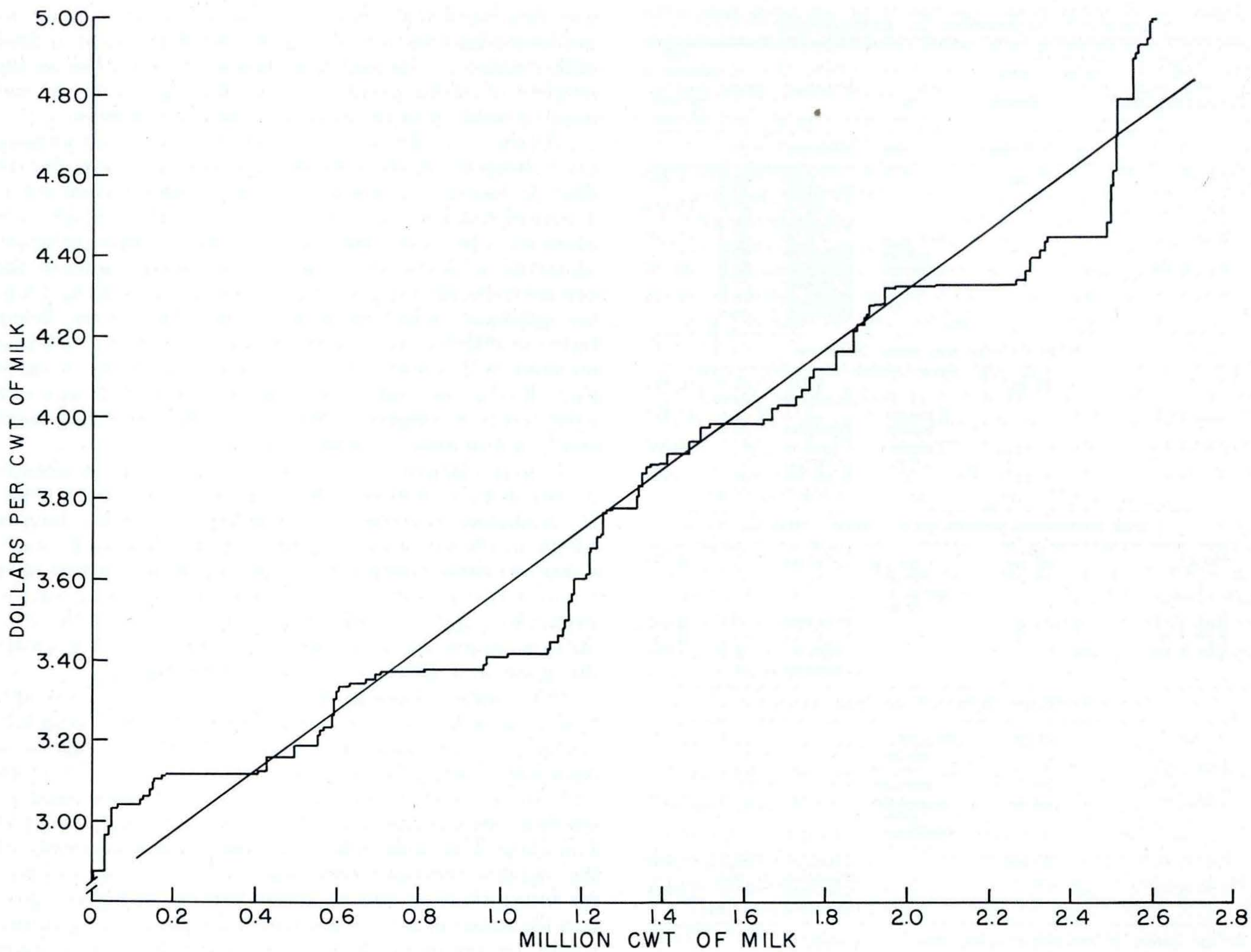


Fig. 3. Aggregate fluid milk supply in the short run (includes both 10,600- and 6,700-pound-producing cows).

in other ranges, price changes have little effect on production. This is partly due to classifying farms into categories as if they were homogeneous with respect to production possibilities. No two farms are alike in this respect; however, if each farmer followed the optimum plan unique to his own farm, production changes would occur at more price levels, and the resulting aggregate supply schedule would approach a smooth line such as the one shown.

At prices above $5, the stepped schedule would become almost vertical, indicating that, regardless of price changes, further increases in production are almost impossible for these particular farms when operated under the conditions and restraints outlined. At such price levels, most farmers would be using all available dairy building space and could not increase herd size in the short run. More farms in the area could produce milk, however; the milkshed could be expanded spatially.[8]

An aggregate schedule for the short run is presented in fig. 4, where it is assumed that all farms have 10,600-pound cows. This assumption, in effect, supposes that farmers might increase managerial abilities in dairy production, but not in other enterprises. A second degree polynomial equation is a much better "fit" for these results than is a linear function. As indicated by the stepped function, elasticity of supply is quite high below 3,000,000 hundredweight of milk. Above this quantity, large price changes produce only small changes in supply.

A comparison of the aggregate short-run supply schedules shows, as would be expected, that production is much higher at any price when all farms have 10,600-pound-producing cows. The shapes of these schedules, however, are significantly different. When all farms are assumed to have high-producing cows, the aggregate schedule has relatively high elasticity at prices below $3.50 but low elasticity above this price. In contrast, when average production per cow is assumed, aggregate production expands more gradually in relation to price. As previously explained, milk production eventually is limited on all farms by the amount of building space. Farms with high-producing cows, however, can profitably produce at this maximum with lower milk prices than are required for maximum production with low-producing cows. This causes a difference in elasticity and shape in the aggregate schedules.

8/ Actually, the normative supply schedules are for farms of the particular situations within the present milkshed, and are not normative supply schedules for the milkshed, considering its full geographic potential.

Aggregate Supply in the Long Run

Here we consider three long-run supply schedules.

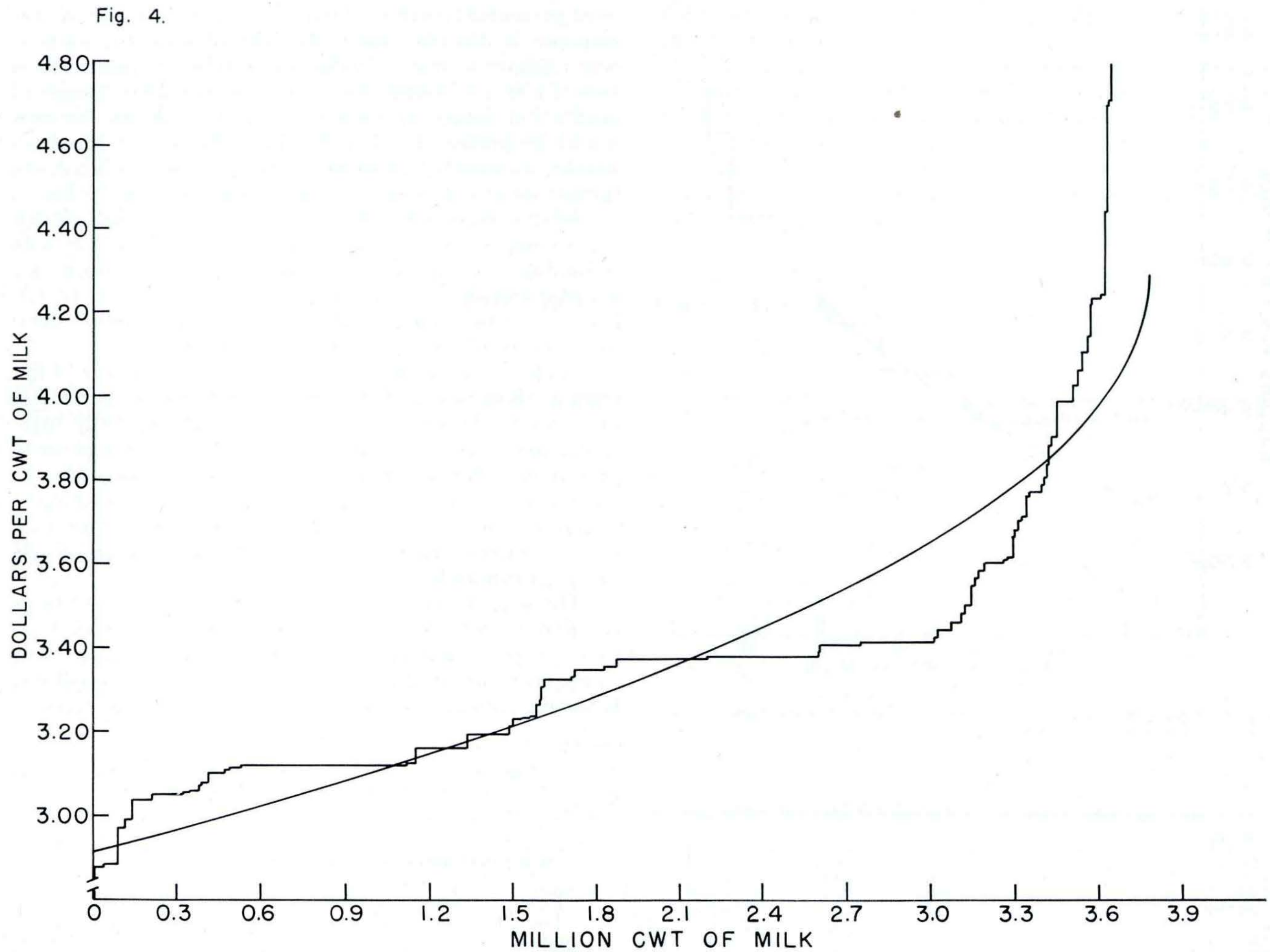


Fig. 4. Aggregate fluid milk supply in the short run (only 10,600-pound-producing cows).

The first is based on long-run optimum plans with current production techniques (table 10). As in one of the short-run supply schedules, an average production of 8,130 pounds per cow is assumed.

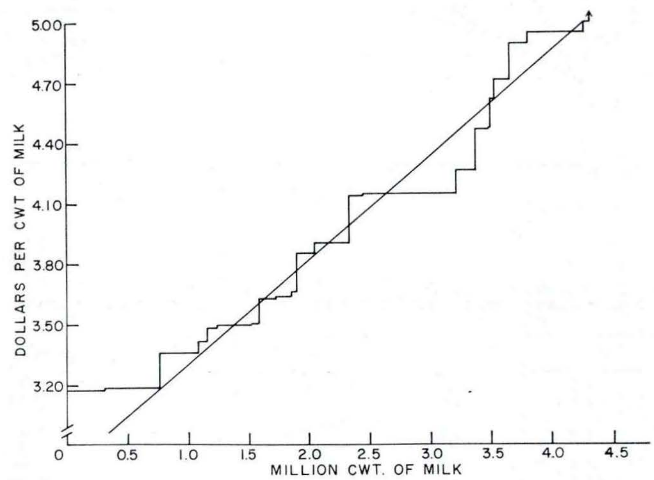


Fig. 5. Aggregate fluid milk supply in the long run with present technologies (includes both 10,600- and 6,700-pound-producing cows).

In the long run (fig. 5), production response along the fitted regression line is 19,240 hundredweight for each 1-cent price change. This compares with a response of 13,520 hundredweight for the short-run curves. An approximate 42-percent increase in rate of response is gained by considering building costs variable and capital unlimited.

The supply schedule for the long run when all farms are assumed to have 10,600-pound cows is presented in fig. 6. Here, again, a nonlinear relationship is indicated. In the short run, milk production was limited by buildings. In the long run, fall labor and forage supplies are the limiting factors. In either the short or the long run, the supply schedules will eventually "turn up" as factors become limiting. Realistically, management also may become limiting as herd size increases.

If all farmers raised their production to that represented by 10,600-pound cows, the effect would be a doubling of production at a milk price of $4. Although the average production per cow would rise only 30 percent, approximately 54 percent more cows could profitably be brought into production.

The aggregate supply schedule presented in fig. 7 is based on advanced techniques in all enterprises. The optimum plans used in determining this supply schedule

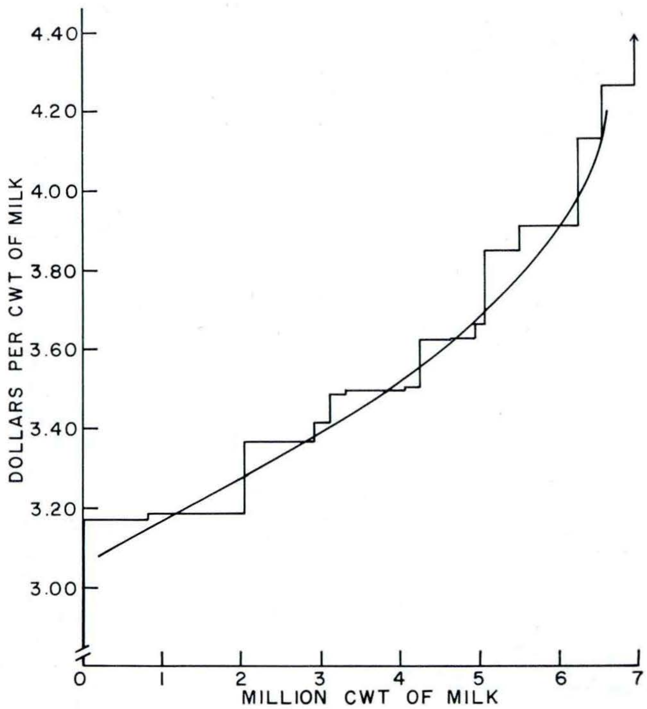
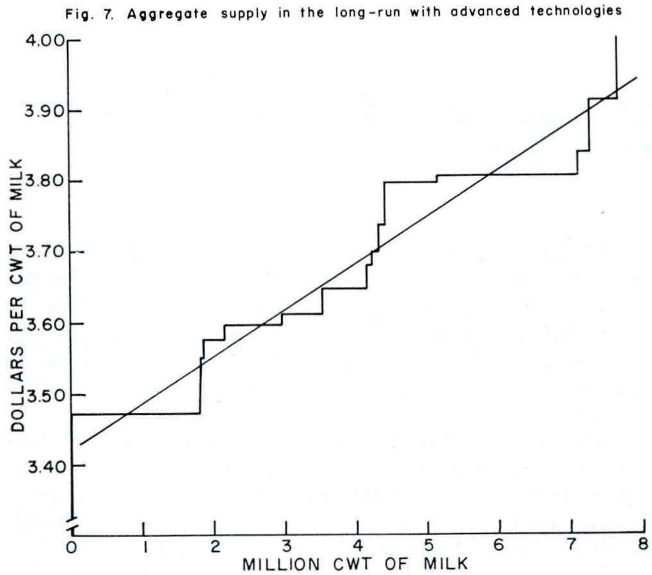


Fig. 6. Aggregate supply in the long run with present technologies (10,600-pound-producing cows only).

Fig. 7. Aggregate supply in the long-run with advanced technologies



were presented in table 12. On this regression line, supply response is 154,690 hundredweight of milk for each 1-cent change in price. Production reaches a maximum at only \$3.91 per hundredweight. The complete range of production occurs within a price range of \$0.44. No milk would be produced below \$3.47; at \$3.91 per hundredweight, 7,700,000 hundredweight would be produced. No further increases in production would occur below \$5.

All the regression curves are presented again in fig. 8 for comparative purposes. Here it is evident that with technological improvements, the supply functions are lowered and shifted to the right (B vs. A, E and D vs. C). Likewise, when more of the inputs are allowed to vary, the same result occurs (C vs. A, D and E vs. B).

Table 13 indicates how elasticities of supply differ among short-run and long-run functions at particular price levels. At low prices, elasticities are typically high, since small absolute changes in quantity represent large percentage changes. For all functions the elasticity decreases as the price and quantity increase, because more resources limit production, and the dairy enterprise must pull resources from other enterprises of increasingly greater profitability.

The supply elasticities just given are all rather large compared with the usual supply elasticities based on time series or annual price and production data.[9] Any comparison of the two types of estimates is hazardous; however, estimates based on time series data measure

9/ See: Shepherd, Geoffrey S. Agricultural price analysis. 4th ed. Iowa State University Press, Ames, Iowa. 1957. Chap. 6.

Fig. 8. Fitted regression lines of aggregate supply functions.

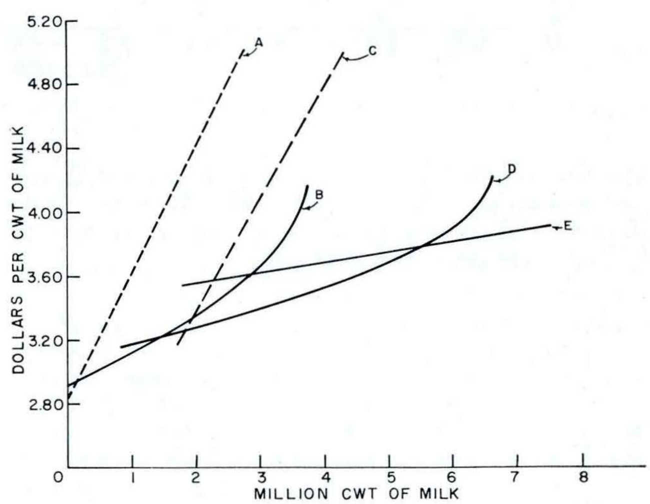


TABLE 13. SUPPLY ELASTICITIES BASED ON FITTED REGRESSION CURVES OF AGGREGATE SUPPLY AT SELECTED MILK PRICES.a/

	Function in fig. 8	Price of milk per cwt. \$3.00	\$3.50	\$4.00	\$4.50	\$5.00	R^2 of regression
Short run, average production per cow	A	17.9	5.2	3.4	2.7	2.3	0.97
Short run, 10,600-pound cows only	B	31.4	4.4	1.6	--	--	0.94
Long run, current techniques, average production per cow	C	13.5	4.9	3.3	2.6	2.3	0.91
Long run, current techniques, 10,600-pound cows only	D	--	6.5	1.6	--	--	0.98
Long run, over-all advanced techniques	E	--	44.4	6.9b/	--	--	0.92

a/ Elasticities given are point elasticities, determined with the formula dq/dpxp/q.
b/ Computed at \$3.90. With this schedule, production reaches a maximum at \$3.91; above this price the elasticity would be near zero.

historical occurrences for larger regions. The linear programming estimates presented here represent optimal adjustments without consideration of lags resulting from uncertainty and from certain inflexibilities. Also, these estimates refer to a group of farmers in a specific climate and soils area which has quite closely competing enterprises. Time series estimates are available only for larger areas to the north and to the south, in which the range of opportunities is not so great. Historical measurements for these areas are based on data for which the calendar length of the response period is known.

These aggregate supply schedules represent attempts to approximate a normative market supply schedule for a particular universe of farms. Some dairy farms fall into the acreage range excluded from this study. Additional study is needed to indicate whether supply elasticities, based on programming of farms in other strata, would differ substantially from those shown here.

APPENDIX A: BASIC DATA

TABLE A-1. INDEX OF CATEGORIES.

Clarion-Webster soil area	Shelby-Sharpsburg-Winterset and Tama-Muscatine soil areas
160-acre farms (140-180 acres)	160-acre farms
Owned -	Owned -
Category 1, 4-13 cows	Category 13, 4-13 cows
Category 2, 14-22 cows	Category 14, 14-22 cows
Category 3, 23-40 cows	Category 15, 23-40 cows
Rented -	Rented -
Category 4, 4-13 cows	Category 16, 4-13 cows
Category 5, 14-22 cows	Category 17, 14-22 cows
Category 6, 23-40 cows	Category 18, 23-40 cows
240-acre farms (220-260 acres)	240-acre farms
Owned -	Owned -
Category 7, 4-13 cows	Category 19, 4-13 cows
Category 8, 14-22 cows	Category 20, 14-22 cows
Category 9, 23-40 cows	Category 21, 23-40 cows
Rented -	Rented -
Category 10, 4-13 cows	Category 22, 4-13 cows
Category 11, 14-22 cows	Category 23, 14-22 cows
Category 12, 23-40 cows	Category 24, 23-40 cows

TABLE A-2. PRESENT AVERAGE FARM PRODUCTION PLANS AND RESOURCES FOR THE 24 CATEGORIES OF FARMS

Category	1	2	3	4	5	6	7	8	9	10
No. farms	161	36	14	262	60	14	66	14	12	82
Total acres	158.3	160.0	157.7	159.4	161.5	163.9	239.4	234.7	236.3	239.7
Total rotation acres	136.4	136.5	133.0	141.6	141.5	145.8	208.0	183.2	191.9	213.9
Acres permanent pasture	11.8	11.7	16.6	8.7	10.0	8.2	18.1	21.1	17.1	12.6
Number of dairy cows	6.9	17.7	30.0	7.5	17.6	27.4	7.5	17.3	30.2	7.6
Fall litters of pigs	2.1	3.2	4.6	3.5	4.1	3.7	3.5	3.1	3.3	4.1
Spring litters of pigs	6.2	8.2	7.0	6.9	6.3	6.9	8.9	5.5	4.0	7.8
Beef cows	0.8	0.8	0	1.2	0.7	0	3.1	0	0	1.2
Beef cattle marketed	4.4	6.8	0	3.9	2.9	4.4	9.2	0	0	11.2
Present annual capital investment in crops ($)	1,890	1,880	1,780	1,315	1,140	1,220	2,885	2,350	2,640	1,860
Present investment in livestock ($)	4,570	9,015	11,635	2,685	4,245	5,750	6,555	7,415	11,350	3,135
Additional capital available ($)	3,000	6,250	4,500	2,065	4,500	2,700	2,500	2,250	2,500	2,550
Total available capital ($)	9,460	17,145	17,915	6,065	9,885	9,670	11,940	12,015	16,490	7,545
Hours of labor available										
May, June, July	940	1,000	975	940	1,170	1,080	1,170	1,210	1,210	1,060
Sept., Oct.	520	585	650	560	650	605	625	650	650	640
Total annual depreciation:										
High level production cow ($)	1,962	2,069	2,152	1,426	1,450	1,466	2,207	2,304	2,387	1,611
Low level production cow ($)	1,932	2,040	2,124	1,411	1,435	1,452	2,177	2,275	2,359	1,596
No. farms with high-producing cows	60	13	5	97	22	5	25	5	4	31
No. farms with low-producing cows	101	23	9	165	38	9	41	9	8	51

Category	11	12	13	14	15	16	17	18	19	20	21	22	23	24
No. farms	43	10	381	89	34	358	61	15	184	28	21	189	23	10
Total acres	243.2	243.0	160.6	157.7	161.0	159.1	161.0	163.2	239.2	242.5	237.9	236.0	240.4	232.1
Total rotation acres	206.4	205.7	109.2	108.6	112.4	114.7	114.9	119.0	160.5	167.1	161.1	164.0	160.4	170.8
Acres permanent pasture	15.3	20.5	39.3	37.5	35.9	34.1	36.2	33.5	58.2	59.8	52.7	56.5	59.8	45.5
Number of dairy cows	17.1	33.6	8.3	16.9	28.4	7.5	17.5	28.7	7.6	17.1	28.0	7.4	18.9	26.2
Fall litters of pigs	5.0	2.8	4.5	2.6	2.0	5.9	5.0	2.5	4.9	8.8	5.5	5.1	7.7	8.3
Spring litters of pigs	5.1	7.2	7.3	5.7	5.3	9.2	9.7	4.0	8.6	9.0	7.6	8.6	9.9	11.4
Beef cows	1.0	0	4.8	1.0	0	4.1	0.7	0	7.6	3.1	0	6.5	1.4	0
Beef cattle marketed	4.3	11.4	3.3	1.1	14.1	2.6	1.1	1.3	7.1	4.0	0.5	4.4	3.7	0
Present annual capital investment in crops ($)	1,670	1,550	1,380	1,390	1,455	875	860	915	2,030	2,100	2,100	1,205	1,150	1,345
Present investment in livestock ($)	4,245	7,285	6,255	7,690	12,620	3,075	4,295	5,605	7,295	9,300	11,595	3,080	4,885	5,570
Additional capital available ($)	1,835	2,300	1,500	3,450	3,450	1,500	1,920	1,920	3,450	3,450	2,650	1,625	2,500	2,270
Total available capital ($)	7,750	11,135	9,135	12,530	17,525	5,450	7,075	8,440	12,775	14,850	16,345	5,910	8,535	9,185
May, June, July	1,080	1,150	950	950	1,150	905	920	1,030	950	1,090	1,190	1,140	1,090	1,090
Sept., Oct.	605	620	520	575	585	605	575	585	560	575	695	670	575	670
High level production cow ($)	1,635	1,651	1,792	1,889	1,972	1,296	1,320	1,336	1,962	2,069	2,152	1,426	1,450	1,466
Low level production cow ($)	1,620	1,637	1,762	1,860	1,943	1,281	1,305	1,322	1,932	2,040	2,124	1,411	1,435	1,452
No. farms with high-producing cows	16	4	142	33	13	133	23	6	68	10	8	70	9	4
No. farms with low-producing cows	27	6	239	56	21	225	38	9	116	18	13	119	14	6

TABLE A-3. BUILDING AND DEPRECIATION COSTS FOR LIVESTOCK ENTERPRISES OFFERED IN LONG-RUN PLANS.

Livestock enterprises	Capital investment in buildings	Depreciation on buildings
Hogs (per litter):		
Current techniques:		
Two-litter system	$272.00	$ 9.50
Spring litter	178.00	6.25
Advanced techniques:		
Two-litter system	308.00	10.80
Spring litter	202.00	7.00
Beef (per head):		
Beef cow-calf	55.00	1.92
Calves on drylot	44.00	1.54
Calves on pasture	33.00	1.16
Yearlings on drylot	44.00	1.54
Dairy (per cow and replacements):		
Stanchion system:		
14 - 22 cow herd	425.00	15.00
23 - 40 cow herd	335.00	11.70
Parlor system:		
14 - 22 cow herd	475.00	16.50
23 - 40 cow herd	400.00	14.00
Poultry (per hen, up to 150 hens)	6.00	0.35

TABLE A-4. CROPPING MACHINERY DEPRECIATION SCHEDULE, ALL PHASES OF THIS STUDY.

160-acre farm, Clarion-Webster area	$1,330
240-acre farm, Clarion-Webster area	1,515
160-acre farm, Shelby-Sharpsburg-Winterset area	1,200
240-acre farm, Shelby-Sharpsburg-Winterset area	1,330

TABLE A-5. BUILDING DEPRECIATION SCHEDULE, SHORT-RUN PHASE OF THIS STUDY.

	Dairy building resources		
	13 cows	22 cows	40 cows
160-acre, Clarion-Webster area	$440	$500	$550
240-acre, Clarion-Webster area	500	550	600
160-acre, Shelby-Sharpsburg-Winterset area	400	450	500
240-acre, Shelby-Sharpsburg-Winterset area	440	500	550

TABLE A-6. DAIRY EQUIPMENT COSTS AND DEPRECIATION SCHEDULE.

Item	4 to 13 cows	14 to 22 cows	23 to 40 cows
Bulk tank investments:			
10,600-pound-producing cows	$1,550.00	$1,900.00	$2,200.00
6,700-pound-producing cows	1,200.00	1,550.00	1,750.00
Investments in other dairy equipment	750.00	970.00	1,165.00
Annual depreciation on all dairy equipment:			
10,600-pound-producing cows	191.50	239.30	272.30
6,700-pound-producing cows	162.40	210.10	243.90

APPENDIX B: OPTIMUM PLANS

TABLE B-1. OPTIMUM PLANS FOR FARMS IN THE SHORT RUN.

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
			Category 1			
10,600 pounds per cow						
0-3.16	0	9(1:1)	35 drylot calves	CCSb	84.5	$5,322
				CSbCOM	51.8	
3.16-3.19	8	9(1:1)	19 drylot calves	CCSb	23.1	6,451
				CSbCOM	113.3	
3.19-3.43	12	9(1:1)	4 drylot calves	CSbCOM	136.4	6,962
3.43a/	13	9(1:1)	0	CSbCOM	131.9	7,062
				CCOMM	4.5	
6,700 pounds per cow						
0-4.13 (Same as first plan above)						
4.13-4.33	9	9(1:1)	20 drylot calves	CSbCOM	136.4	5,691
4.33-4.62	11	9(1:1)	0	CSbCOM	136.4	5,581
4.62a/	13	9(1:1)	0	CSbCOM	116.0	5,628
				CCOMM	20.4	
			Category 2			
10,600 pounds per cow						
0-3.11	0	9(1:1)	35 drylot calves	CCSb	84.3	$5,212
				CSbCOM	52.0	
3.11-3.22	11	9(1:1)	12 drylot calves	CSbCOM	136.3	6,786
3.22-3.24	13	9(1:1)	0	CSbCOM	136.3	6,952
3.24-3.32	18	9(1:1)	0	CSbCOM	75.5	7,680
				CCOMM	60.8	
3.32-3.57	21	9(1:1)	0	CSbCOM	26.5	8,249
				CCOMM	109.8	
3.57-3.71	23	7(1:1)	0	CSbCOM	6.2	8,399
				CCOMM	130.1	
3.71	24	5(1:1) 3 spring	0	CCOMM	136.3	8,453
6,700 pounds per cow						
0-4.08 (Same as first plan above)						
4.08-4.28	9	9(1:1)	20 drylot calves	CSbCOM	136.3	5,606
4.28-4.34	11	9(1:1)	0	CSbCOM	136.3	5,506
4.34-4.40	21	9(1:1)	0	CCOMM	136.3	5,844
4.40-4.72	22	9(1:1)	0	CCOMM	126.7	2,860
				COMMM	9.6	
4.72	24	9(1:1)	0	CCOMM	100.9	5,882
				COMMM	35.4	
			Category 3			
10,600 pounds per cow						
0-3.05	0	9(1:1)	33 drylot calves	CCSb	94.6	$5,032
				CSbCOM	38.4	
3.05-3.22	13	9(1:1)	0	CSbCOM	133.0	6,930
3.22-3.23	16	9(1:1)	0	CSbCOM	95.8	7,383
				CCOMM	37.2	
3.23-3.39	24	9(1:1)	0	CCOMM	133.0	8,509

TABLE B-1 (Continued)

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
3.39-3.61	29	9(1:1)	0	CCOMM	65.9	9,177
				COMMM	67.1	
3.61-4.70	35	2(1:1)	0	COMMM	133.0	9,881
4.70	36	0	0	COMMM	133.0	9,394
6,700 pounds per cow						
0-4.05 (Same as first plan above)						
4.05-4.25	10	9(1:1)	16 drylot calves	CSbCOM	133.0	5,483
4.25-4.31	12	9(1:1)	0	CSbCOM	133.0	5,411
4.31-4.58	22	9(1:1)	0	CCOMM	133.0	5,761
4.58-6.86	31	9(1:1)	0	COMMM	133.0	5,799
			Category 4			
10,600 pounds per cow						
0-3.41	0	9(1:1)	33 pasture calves	CSbCOM	122.9	$2,155
				CCSb	18.7	
3.41-3.42	5	9(1:1)	22 pasture calves	CSbCOM	141.6	2,638
3.42-4.02	12	9(1:1)	0	CSbCOM	141.6	3,178
4.02	13	9(1:1)	0	CSbCOM	138.1	3,216
				COMMM	3.5	
6,700 pounds per cow						
0-4.42 (Same as first plan above)						
4.42-4.45	3	9(1:1)	28 pasture calves	CSbCOM	141.6	2,277
4.45-5.30	11	9(1:1)	0	CSbCOM	141.6	2,470
			Category 5			
10,600 pounds per cow						
0-3.36	0	9(1:1)	33 pasture calves	CSbCOM	120.3	2,135
				CCSb	21.2	
3.36-3.37	6	9(1:1)	20 pasture calves	CSbCOM	141.5	2,660
3.37-3.71	13	9(1:1)	0	CSbCOM	141.5	3,189
3.71-3.72	15	9(1:1)	0	CSbCOM	127.9	3,368
				COMMM	13.6	
3.72-3.77	16	9(1:1)	0	CSbCOM	95.8	3,485
				CCOMM	45.7	
3.77	23	6(1:1)	0	CSbCOM	18.2	3,843
				CCOMM	123.3	
6,700 pounds per cow						
0-4.37 (Same as first plan above)						
4.37-4.40	3	9(1:1)	27 pasture calves	CSbCOM	141.5	2,273
4.40-5.04	12	9(1:1)	0	CSbCOM	141.5	2,480
			Category 6			
10,600 pounds per cow						
0-3.34	0	9(1:1)	35 pasture calves	CSbCOM	132.8	$2,203
				CCSb	13.0	
3.34-3.35	4	9(1:1)	28 pasture calves	CSbCOM	145.8	2,543
3.35-3.61	13	9(1:1)	0	CSbCOM	145.8	3,287

TABLE B-1 (Continued)

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
3.61-3.68	25	6(1:1)	0	CCOMM	145.8	4,065
3.68	30	1(1:1)	0	CCOMM	87.5	4,221
				COMMM	58.3	
6,700 pounds per cow						
0-4.34 (Same as first plan above)						
4.34-4.37	2	9(1:1)	32 pasture calves	CSbCOM	145.8	2,303
4.37-4.81	12	9(1:1)	0	CSbCOM	145.8	2,548
4.81-4.99	23	9(1:1)	0	CCOMM	138.5	2,723
				COMMM	7.3	
4.99	30	3(1:1)	0	CCOMM	47.6	2,566
				COMMM	98.2	
Category 7						
10,600 pounds per cow						
0-3.19	0	9(1:1)	38 drylot calves	CSbCOM	42.8	8,162
				CCSb	165.2	
3.19-4.44	11	9(1:1)	0	CSbCOM	102.4	9,504
				CCSb	105.6	
4.44	13	3(1:1)	0	CSbCOM	117.2	9,360
				CCSb	90.8	
6,700 pounds per cow						
0-4.16 (Same as first plan above)						
4.16	13	9(1:1)	5 drylot calves	CSbCOM	150.5	8,543
				CCSb	57.5	
Category 8						
10,600 pounds per cow						
0-2.99	0	9(1:1)	60 drylot calves	CCSb	108.7	$7,422
				CSbCOM	74.5	
2.99-3.07	17	9(1:1)	5 drylot calves	CSbCOM	183.2	9,776
3.07-3.57	18	9(1:1)	0	CSbCOM	183.2	9,820
3.57-5.23	19	9(1:1)	0	CSbCOM	178.3	9,978
				COMMM	4.9	
6,700 pounds per cow						
0-4.06 (Same as first plan above)						
4.06-4.34	17	9(1:1)	0	CSbCOM	183.2	7,696
4.34	22	9(1:1)	0	CSbCOM	112.9	7,617
				CCOMM	61.3	
Category 9						
10,600 pounds per cow						
0-2.97	0	9(1:1)	59 drylot calves	CSbCOM	83.3	7,609
				CCSb	108.6	
2.97-3.05	17	9(1:1)	4 drylot calves	CSbCOM	191.9	10,005
3.05-3.21	18	9(1:1)	0	CSbCOM	191.9	10,061
3.21-4.14	19	9(1:1)	0	CSbCOM	183.4	10,168
				CCOMM	8.5	
4.14-5.99	24	0	0	CSbCOM	163.6	10,010
				COMMM	19.6	
6,700 pounds per cow						
0-4.03 (Same as first plan above)						
4.03-4.20	17	9(1:1)	0	CSbCOM	191.9	7,937
4.20-4.55	28	9(1:1)	0	CSbCOM	32.6	8,353
				CCOMM	159.3	
4.55-5.12	29	9(1:1)	0	CSbCOM	47.8	8,347
				CCOMM	125.3	
				COMMM	18.8	
Category 10						
10,600 pounds per cow						
0-3.42	0	9(1:1)	59 pasture calves	CSbCOM	213.9	$3,431
3.42-3.45	7	9(1:1)	38 pasture calves	CSbCOM	213.9	3,967
3.45	13	9(1:1)	3 pasture calves	CSbCOM	149.0	4,359
				CCSb	64.9	
6,700 pounds per cow						
0-4.45 (Same as first plan above)						
4.45-4.49	9	9(1:1)	28 pasture calves	CSbCOM	213.9	3,666
4.49	13	9(1:1)	8 pasture calves	CSbCOM	185.5	3,699
				CCSb	28.4	
Category 11						
10,600 pounds per cow						
0-3.10	0	9(1:1)	59 pasture calves	CSbCOM	206.4	3,382
3.10-3.24	15	9(1:1)	14 pasture calves	CSbCOM	206.4	4,595
3.24-3.79	19	3 fall 9 spring	0	CSbCOM	206.4	4,814
3.79-3.88	20	4(1:1)	0	CSbCOM	206.4	4,797
3.88-7.29	23	0	0	CSbCOM	170.3	4,893
				CCOMM	36.1	
6,700 pounds per cow						
0-3.98 (Same as first plan above)						
3.98-5.03	18	9(1:1)	0	CSbCOM	206.4	3,830
Category 12						
10,600 pounds per cow						
0-3.08	0	9(1:1)	62 pasture calves	CSbCOM	205.7	$3,399
3.08-3.22	16	9(1:1)	14 pasture calves	CSbCOM	205.7	4,678
3.22-3.71	20	2 fall 9 spring	0	CSbCOM	205.7	4,904
3.71-5.74	28	0	0	CSbCOM	127.8	5,260
				CCOMM	77.9	
6,700 pounds per cow						
0-3.95 (Same as first plan above)						
3.95-4.79	18	9(1:1)	0	CSbCOM	205.7	3,886

TABLE B-1 (Continued)

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
4.79-4.85	23	9(1:1)	0	CSbCOM	172.5	3,949
				COMMM	33.2	
4.85-4.99	24	9(1:1)	0	CSbCOM	133.8	3,969
				CCOMM	71.9	
4.99-7.61	34	0	0	CSbCOM	8.9	3,773
				CCOMM	196.8	
Category 13						
10,600 pounds per cow						
0-3.12	0	8(1:1)	43 pasture calves	CSbCOM	109.2	4,579
3.12	13	7(1:1)	4 pasture calves	CSbCOM	109.2	6,354
6,700 pounds per cow						
0-3.78 (Same as first plan above)						
3.78-3.98	4	10(1:1)	29 pasture calves	CSbCOM	109.2	4,869
3.98-5.21	13	10(1:1)	0	CSbCOM	109.2	5,133
Category 14						
10,600 pounds per cow						
0-3.04	0	10(1:1)	41 pasture calves	CSbCOM	108.6	$4,503
3.04-3.60	13	10(1:1)	1 pasture calf	CSbCOM	108.6	6,438
3.60-3.81	20	10(1:1)	0	CSbCOM	5.4	7,226
				CCOMM	103.2	
3.81-4.24	21	10(1:1)	0	CCOMM	108.6	7,292
4.24	25	2(1:1)	0	CCOMM	52.4	7,094
				COMMM	56.2	
6,700 pounds per cow						
0-3.93 (Same as first plan above)						
3.93-4.93	12	10(1:1)	0	CSbCOM	108.6	4,984
4.93-5.77	19	10(1:1)	0	CCOMM	108.6	4,919
Category 15						
10,600 pounds per cow						
0-2.88	0	10(1:1)	41 pasture calves	CSbCOM	112.4	4,558
2.88-3.58	13	10(1:1)	0	CSbCOM	112.4	6,875
3.58-3.99	21	10(1:1)	0	CCOMM	112.4	7,377
3.99-4.10	25	10(1:1)	0	CCOMM	37.9	7,702
				COMMM	74.5	
4.10-4.71	28	7(1:1)	0	COMMM	112.4	7,732
4.71	29	0	0	COMMM	112.4	7,379
6,700 pounds per cow						
0-3.91 (Same as first plan above)						
3.91-4.90	12	10(1:1)	0	CSbCOM	112.4	5,055
4.90-5.73	19	10(1:1)	0	CCOMM	112.4	5,001
Category 16						
10,600 pounds per cow						
0-3.37	0	10(1:1)	11 beef cows 5 pasture calves	CSbCOM	114.7	$1,636
3.37-3.38	3	10(1:1)	10 beef cows	CSbCOM	114.7	1,875
3.38	13	3 fall 10 spring	0	CSbCOM	114.7	2,759
6,700 pounds per cow						
0-4.33 (Same as first plan above)						
4.33-4.95	4	10(1:1)	8 cows	CSbCOM	114.7	1,799
4.95-5.81	12	8(1:1)	0	CSbCOM	114.7	2,114
Category 17						
10,600 pounds per cow						
0-3.32	0	10(1:1)	11 beef cows 5 pasture calves	CSbCOM	114.9	1,615
3.32-3.33	3	10(1:1)	10 beef cows	CSbCOM	114.9	1,866
3.33-3.41	13	3 fall 10 spring	1 beef cow	CSbCOM	114.9	2,798
3.41-3.90	14	6(1:1)	0	CSbCOM	114.9	2,889
3.90-4.22	22	3(1:1)	0	CCOMM	114.9	3,240
4.22	23	2(1:1)	0	CCOMM	102.3	3,246
				COMMM	12.6	
6,700 pounds per cow						
0-4.28	0	10(1:1)	11 beef cows	CSbCOM	114.7	1,636
4.28-4.28	4	10(1:1)	9 beef cows	CSbCOM	114.9	1,803
4.28-4.90	12	6 fall 10 spring	0	CSbCOM	114.9	2,127
4.90-5.77	13	8(1:1)	0	CSbCOM	114.9	2,145
Category 18						
10,600 pounds per cow						
0-3.04	0	10(1:1)	10 beef cows 8 pasture calves	CSbCOM	119.0	$1,686
3.04-3.39	13	3 fall 10 spring	0	CSbCOM	119.0	2,879
3.39-3.88	14	7(1:1)	0	CSbCOM	119.0	2,960
3.88-4.07	22	3(1:1)	0	CCOMM	119.0	3,289
4.07-4.24	25	0	0	CCOMM	79.9	3,317
				COMMM	39.1	
4.24	30	0	0	COMMM	119.0	3,523
6,700 pounds per cow						
0-4.25 (Same as first plan above)						
4.25-4.87	6	10(1:1)	7 cows	CSbCOM	119.0	1,950
4.87-5.74	12	8(1:1)	0	CSbCOM	119.0	2,184
Category 19						
10,600 pounds per cow						
0-3.12	0	11(1:1)	64 pasture calves	CSbCOM	160.5	$7,176

TABLE B-1 (Continued)

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net Income at $4/cwt. of milk
3.12-3.13	3	11(1:1)	54 pasture calves	CSbCOM	160.5	7,629
3.13-3.16	5	12(1:1)	1 beef cow	CSbCOM	160.5	7,817
			43 pasture calves			
3.16-3.23	8	12(1:1)	2 beef cows	CSbCOM	160.5	8,200
			34 pasture calves			
3.23-3.34	9	8 fall	36 pasture calves	CSbCOM	160.5	8,304
		12 spring				
3.34	14	12 spring	21 pasture calves	CSbCOM	160.5	8,697
6,700 pounds per cow						
0-3.78	(Same as first plan above)					
3.78-3.99	2	12(1:1)	57 pasture calves	CSbCOM	160.5	7,339
3.99-4.04	3	12(1:1)	53 pasture calves	CSbCOM	160.5	7,362
4.04-4.33	9	12(1:1)	35 pasture calves	CSbCOM	160.5	7,489
4.33-4.72	12	7 fall	24 pasture calves	CSbCOM	160.5	7,406
		12 spring				
4.72	14	4 fall	16 pasture calves	CSbCOM	160.5	7,345
		12 spring				
			Category 20			
10,600 pounds per cow						
0-3.04	0	12(1:1)	66 pasture calves	CSbCOM	167.1	$7,458
3.04-3.10	7	12(1:1)	44 pasture calves	CSbCOM	167.1	8,512
3.10-3.31	14	5 fall	22 pasture calves	CSbCOM	167.1	9,304
		12 spring				
3.31-3.48	18	12 spring	10 pasture calves	CSbCOM	167.1	9,614
3.48-3.71	22	0	2 pasture calves	CSbCOM	167.1	9,881
3.71-6.03	23	0	0	CSbCOM	167.1	9,882
6,700 pounds per cow						
0-3.93	(Same as first plan above)					
3.93-3.95	9	12(1:1)	36 pasture calves	CSbCOM	167.1	7,798
3.95-4.26	15	10 fall	17 pasture calves	CSbCOM	167.1	7,953
		12 spring				
4.26-5.10	20	5 fall	0	CSbCOM	167.1	7,868
			Category 21			
10,600 pounds per cow						
0-2.88	0	12(1:1)	60 pasture calves	CSbCOM	161.1	$6,952
2.88-3.51	20	12(1:1)	0	CSbCOM	161.1	9,813
3.51-3.67	27	12(1:1)	0	CSbCOM	54.2	10,706
				CCOMM	106.9	
3.67-4.10	31	8(1:1)	0	CCOMM	161.1	10,895
4.10-4.16	36	1(1:1)	0	CCOMM	84.7	10,869
				COMMM	76.4	
4.16-5.10	37	0	0	CCOMM	72.2	10,894
				COMMM	88.9	
6,700 pounds per cow						
0-3.68	(Same as first plan above)					
3.68-3.72	16	12(1:1)	7 pasture calves	CSbCOM	161.1	7,606
3.72-4.03	17	12(1:1)	4 drylot calves	CSbCOM	161.1	7,687
4.03-4.79	18	12(1:1)	0	CSbCOM	161.1	7,630
4.79-5.62	28	12(1:1)	0	CCOMM	161.1	7,612

TABLE B-1 (Continued)

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
			Category 22			
10,600 pounds per cow						
0-3.37	0	12(1:1)	12 cows	CSbCOM	164.0	2,713
			24 pasture calves			
3.37-3.46	9	12(1:1)	9 cows	CSbCOM	164.0	3,556
			6 pasture calves			
3.46-3.50	11	12(1:1)	9 cows	CSbCOM	164.0	3,639
3.50	12	12(1:1)	7 cows	CSbCOM	164.0	3,733
6,700 pounds per cow						
0-4.33	(Same as first plan above)					
4.33	12	12(1:1)	5 cows	CSbCOM	164.0	3,200
			8 pasture calves			
			Category 23			
10,600 pounds per cow						
0-3.06	0	12(1:1)	13 beef cows	CSbCOM	160.4	$2,625
			22 pasture calves			
3.06-3.07	15	9 fall	6 beef cows	CSbCOM	160.4	3,989
		12 spring				
3.07-3.24	17	3 fall	13 pasture calves	CSbCOM	160.4	4,109
		12 spring				
3.24-3.34	19	12 spring	6 pasture calves	CSbCOM	160.4	4,234
3.34-3.46	20	12 spring	1 beef cow	CSbCOM	160.4	4,244
3.46-3.79	22	4 spring	0	CSbCOM	160.4	4,330
3.79-3.84	23	1(1:1)	0	CSbCOM	160.4	4,332
3.84	25	2(1:1)	0	CSbCOM	119.5	4,514
				CCOMM	40.9	
6,700 pounds per cow						
0-3.86	(Same as first plan above)					
3.86-3.87	16	12(1:1)	3 beef cows	CSbCOM	160.4	3,290
3.87-4.14	17	9 fall	7 pasture calves	CSbCOM	160.4	3,320
		12 spring				
4.14-5.09	19	7 fall	0	CSbCOM	160.4	3,320
		12 spring				
			Category 24			
10,600 pounds per cow						
0-3.04	0	12(1:1)	9 beef cows	CSbCOM	170.8	$2,769
			28 pasture calves			
3.04-3.39	15	12(1:1)	4 beef cows	CSbCOM	170.8	4,148
3.39-3.76	19	10(1:1)	0	CSbCOM	170.8	4,495
3.76-3.82	30	6(1:1)	0	CSbCOM	10.1	5,014
				CCOMM	160.7	
3.82-4.07	31	5(1:1)	0	CCOMM	170.8	5,020
4.07-8.62	35	0	0	CCOMM	110.7	5,053
				COMMM	60.1	
6,700 pounds per cow						
0-3.83	(Same as first plan above)					
3.83-3.95	15	12(1:1)	9 pasture calves	CSbCOM	170.8	3,395
3.95-5.26	17	12(1:1)	0	CSbCOM	170.8	3,463

a/ Dairy production cannot increase regardless of price increase.

TABLE B-2. EFFECTS OF VARYING THE MINIMUM REQUIRED RETURN TO LABOR ON 240-ACRE, OWNER-OPERATED FARMS IN THE SHELBY-SHARPSBURG-WINTERSET SOIL AREA.

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
$0 per hour return to labor specified						
0-2.76	0	12(1:1)	37 drylot calves 43 pasture calves	CSbCOM	161.1	$7,273
2.76-3.19	20	12(1:1)	--	CSbCOM	161.1	9,813
3.19-3.56	27	12(1:1)	--	CSbCOM CCOMM	54.2 106.9	10,706
3.56-3.99	31	8(1:1)	--	CCOMM	161.1	10,895
3.99-4.11	36	2(1:1)	--	CCOMM COMMM	85.2 75.9	10,947
4.11-5.91	37	--	--	CCOMM COMMM	72.2 88.9	10,894
$1.00 per hour return to labor specified						
0-3.21	--	12(1:1)	60 pasture calves	CSbCOM	161.1	6,952
3.21-3.58	19	12(1:1)	--	CSbCOM	161.1	9,813
3.58-3.81	20	10(1:1)	--	CSbCOM	161.1	9,837
3.81-4.23	31	6(1:1)	--	CCOMM	161.1	10,815
4.23-4.37	36	--	--	CCOMM COMMM	90.0 71.1	10,770
4.37-6.00	37	--	--	CCOMM COMMM	72.2 88.9	10,894

TABLE B-3. OPTIMUM PLANS WITH CROP-SHARE LEASE.

Range of milk price (dollars per cwt.)	Dairy cows	Hog litters	Beef cattle	Rotation	Acres	Net income at $4/cwt. of milk
Clarion-Webster soil area, 240-acre farms						
With 10,600-pound-producing cows						
0-2.88	0	9(1:1)	62 pasture calves	CSbCOM	205.7	$4,120
2.88-3.08	16	9(1:1)	14 pasture calves	CSbCOM	205.7	6,452
3.08-3.12	20	2 fall 9 spring	--	CSbCOM	205.7	6,878
3.12-3.17	25	9 spring	--	CSbCOM CCOMM	151.6 54.1	7,607
3.17-3.38	26	4 spring	--	CSbCOM CCOMM	137.5 68.2	7,783
3.38-4.13	28	--	--	CSbCOM CCOMM	127.8 77.9	7,867
4.13-4.34	29	--	--	CSbCOM CCOMM Idle	87.0 106.7 12.0	7,883
4.34-5.07	32	--	--	CCOMM Idle	168.1 37.6	7,895
With 6,700-pound-producing cows						
0-3.66	0	9(1:1)	62 pasture calves	CSbCOM	205.7	4,120
3.66-3.88	23	9(1:1)	--	CSbCOM COMMM	172.5 33.2	5,212
3.88-4.00	24	9(1:1)	--	CSbCOM CCOMM	133.8 71.9	5,249
4.00-4.06	30	9 spring	--	CSbCOM CCOMM	46.2 159.5	5,374
4.06-4.35	31	7 spring	--	CSbCOM CCOMM	36.5 169.2	5,387
4.35-5.30	34	--	--	CSbCOM CCOMM	8.9 196.8	5,332
Shelby-Sharpsburg-Winterset soil area, 240-acre farms						
With 10,600-pound-producing cows						
0-2.80	0	12(1:1)	71 pasture calves	CSbCOM CCOMM	107.1 63.7	$3,957
2.80-2.93	24	12(1:1)	3 pasture calves	CSbCOM CCOMM	80.2 90.6	7,614
2.93-2.98	26	9(1:1) 3 spring	--	CSbCOM CCOMM	63.2 107.6	7,902
2.98-3.02	28	8(1:1)	--	CSbCOM CCOMM	39.9 130.9	8,199
3.02-3.50	31	4(1:1)	--	CCOMM	170.8	8,460
3.50-5.30	34	--	--	CCOMM COMMM	134.0 36.8	8,608
With 6,700-pound-producing cows						
0-3.57	0	12(1:1)	71 pasture calves	CSbCOM CCOMM	107.1 63.7	3,957
3.57-4.26	28	12(1:1)	--	CCOMM	170.8	5,385
4.26-4.57	30	12(1:1)	--	CCOMM COMMM	127.0 43.8	5,476
4.57-6.71	38	4(1:1)	--	COMMM	170.8	5,229