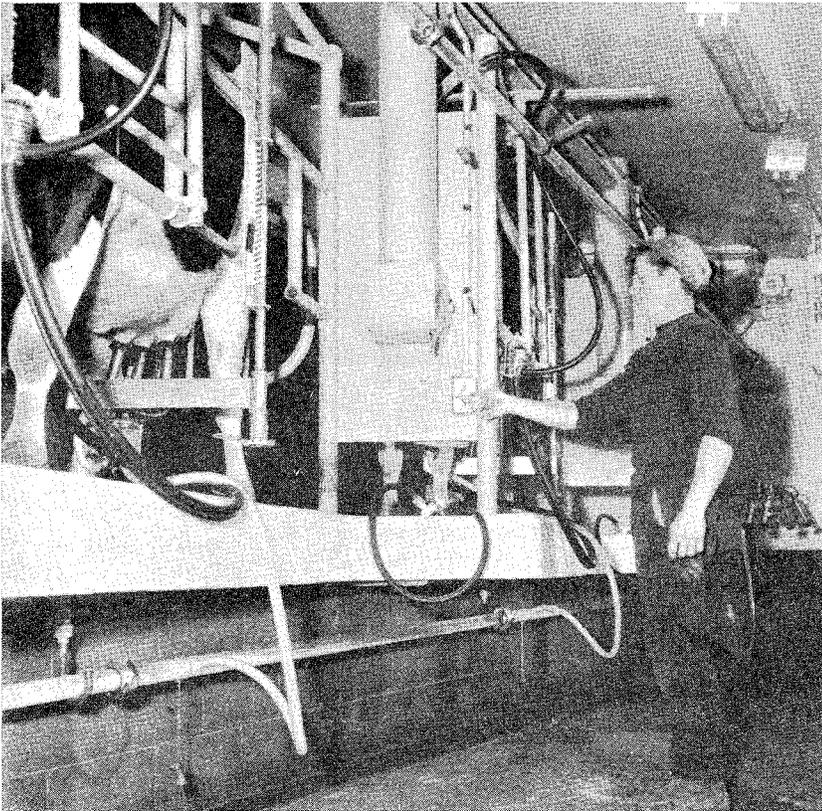


Income-Improving Adjustment Alternatives on Grade A Dairy Farms in Minnesota

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University of Minnesota ■ Agricultural Experiment Station

in cooperation with

Farm Production Economics Division ■ Economic Research Service
U. S. Department of Agriculture



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Problem and Scope

MANY MINNESOTA FARMERS CURRENTLY FACE PROBLEMS of farm reorganization because of increasing production costs, changing farm technology, shifting market structures, and relatively low prices for farm products. They are involved in one of the biggest adjustments ever witnessed in our agricultural economy.

The national trend toward increased specialization in dairying is occurring in Minnesota. In 1955, 116,230 Minnesota farmers kept milk cows. By 1963 this number declined to 74,845—64 percent of the 1955 total.

In 1955 only 11 percent of these dairy enterprises had more than 20 milk cows, compared with over 30 percent in 1963. These data indicate both a large decrease in number of small dairy herds and a rapid increase in number of larger herds.

In Minnesota, milk production of 8,130 pounds per cow in 1961 represented an alltime high—an increase of about 35 percent over 1951. This upward trend in production per cow is partially due to improved culling, breeding, feeding, and management.

Survey results, on which this study is based, help substantiate a general finding that Minnesota grade A dairy farmers have larger, more specialized dairy enterprises than do grade B dairy farmers. The number of cows milked, production per cow, and quality of dairy facilities were found to be higher for grade A producers. Other studies also indicate that production per cow is greater on grade A dairy farms than on other dairy farms.¹ So, many grade A dairymen currently have a higher volume of milk production. Furthermore, the price premium of fluid-eligible (grade A) over manufacturing quality (grade B) milk improves the competitive position of grade A dairymen. Nevertheless, farm adjustment alternatives must be continually evaluated—even on grade A dairy farms—if an adequate farm income level is to be realized.

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¹ Recent unpublished studies of the Department of Agricultural Economics, University of Wisconsin, compare production statistics on grade A and grade B dairy farms.

This study's purpose was to determine how Minnesota grade A dairy farms might be expanded or reorganized using resources typically available to farmers. In addition, it was assumed that quantities of some resources could be expanded with credit. The "most profitable" farm organizations presented are not established farm organizations but are *estimates* of how farm resources could be used to maximize farm income.

Income possibilities were determined by adjusting the current farm organization in several ways. Livestock enterprises considered as possibilities on some but not all farms were:

- Stanchion dairy with grade A milk production.
- Conversion to a labor-efficient loose housing-milking parlor dairy setup if adequate capital was available.
- Production and feeding out of hogs, including the possibility of purchasing and feeding out 35-pound feeder pigs.
- Production of beef calves from a cow-calf enterprise.
- Purchase and feeding out of yearling feeder steers.

Three different crop rotations and two levels of soil fertility and crop management were also examined as choices. The purchase of additional cropland was considered only when adequate capital was available. Most crop and livestock alternatives require improved management.

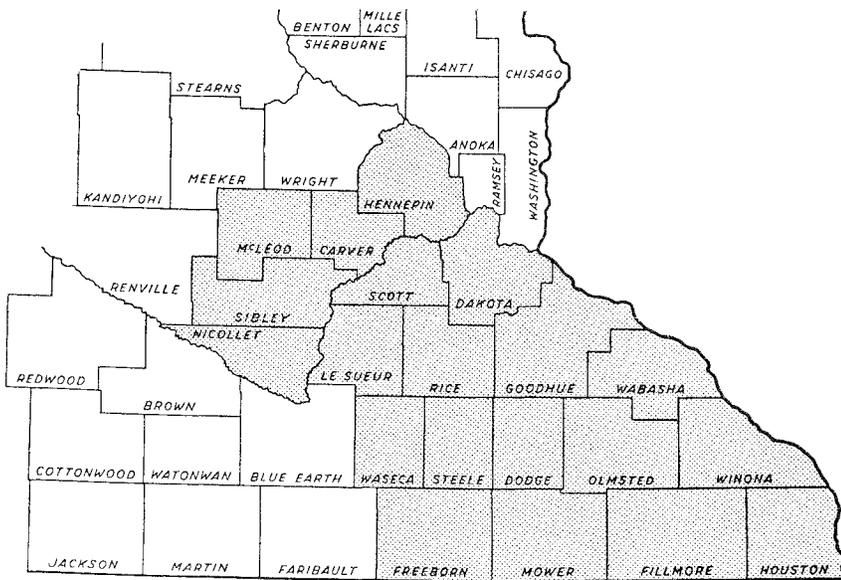
Future prices cannot be known with certainty. Prices of farm products vary from year to year with government farm programs and changes in supply and demand. In this study, profitable farm organizations were estimated with longrange prices varying at regular intervals between \$2.90 and \$4.10 per hundredweight (cwt.) for grade A milk and between \$14 and \$18.50 per cwt. for hogs. Therefore, the representative farm organizations are based on longrun price expectations and not on price changes expected from year to year. Assessment of longrun prices is required when planning major reorganizations and capital investments. Prices were projected for other farm products and expense items at levels expected to hold through the mid-1960's.

Weather conditions for any particular year are also difficult to predict accurately. So crop yields and labor requirements for farm production were estimated with average weather conditions. Crop yields, feed conversion rates for livestock, and other productivity performances used in the study are obtainable with *good* management practices.

The Area Studied

This study has general application to the 20 county area shown in the figure. Most soils in this area are highly productive. However, some less productive soils are intermixed, particularly in the northerly parts.

Moderate to steep slopes in the southeastern counties limit crop rotation possibilities. Therefore, some rotation restrictions were considered necessary to prevent excessive water erosion, particularly on steeper land.



Study Area (dark counties)

Procedures Used

Farm Survey

Before determining possible adjustment alternatives, a random sample of 33 grade A dairy farmers were interviewed in the study area. The purpose was to determine current farm practices and enterprises and to inventory available farm resources. Farmers were questioned relative to farm size, crop rotations, cropping practices, machinery inventories, fertilizer use, livestock enterprises and practices, labor availability, and capital position. This information then served as a benchmark of existing resources, technology, and farm organizations from which adjustment alternatives were considered.

Typical Farms

The 33 farms were further classified into two groups according to crop acreage: farms with 149 crop acres or less (19 farms) and those with 150 crop acres or more (14 farms). These are referred to as the "small" and "large" grade A dairy farms, respectively.

In order to construct a typical farm for each group, characteristics of farms falling within each group were tabulated. When possible, units of resource items (e.g., crop acres, cow stanchions, and available labor) found on the farms were totaled and a simple average obtained. When resource items occurred in "lumpy units" such as tractors and combines, the "most typical" combination of such resources was used.

Therefore, typical farm situations are averages of several farm situations. They do not represent exactly the resource base for any single farm because differences in soil, buildings, and equipment occur between farms. And farmers differ in experience, credit ratings, managerial skills, and enterprise preferences. Nevertheless, investigating the organizational and income possibilities of two typical resource situations provides a more helpful guide than investigating a single average resource situation.

The most profitable farm organizations were determined for the two typical farms. However, organizations producing less profit may be preferable for farmers if, for example, they reduce credit or labor requirements, lessen risk, or better fit existing farm resources or personal preferences.

Linear Programming

A system of budgeting called linear programming was used to determine the most profitable farm organizations. This procedure consists of three major steps:

1. Budgeting resource requirements (such as land, labor, and miscellaneous cost items) and expected income for each crop and livestock enterprise considered.
2. Determining what resources are available for use, in what quantity, and at what cost.
3. Determining the combination of crop and livestock enterprises that can be managed with available resources and produce maximum profits from the farm business.

Limits were placed on the availability of such resources as land, capital (including credit), and hired and family labor. Except for the credit restriction, these limits were based on information obtained from the survey. Credit limits were estimated on the basis of what might be loaned by commercial banks, production credit associations, Federal land banks, or other lending agencies.

Other resource items such as concentrate feeds, fertilizer, and livestock were purchased at market prices until: (1) it was not profitable to purchase more or (2) capital and credit became limiting.

The most profitable farm organizations discussed here are limited to the crop and livestock enterprises considered. They reflect the price levels and resource productivities used in the study.

Typical Farm Situations

Available resources for the two typical farm situations are summarized in table 1. Because land often can only be bought in whole farm tracts, or labor hired only on a year-round basis, quantities of land and labor were initially fixed at their current levels. However, additional analysis for the largest farm considers liberalized credit and the possi-

Table 1. Resources available for typical grade A dairy farms

Resource	Unit	Small farm	Large farm
Cropland	Acres	92	200
Permanent pasture	Acres	56	44
Operator and family labor:*			
January-March	Hours	1,064	1,039
April-May	Hours	825	862
June-July	Hours	1,004	1,048
August	Hours	497	533
September-October	Hours	897	821
November-December	Hours	762	761
Total	Hours	5,049	5,064
Hired labor:			
January-March	Hours	0	150
April-May	Hours	79	210
June-July	Hours	87	270
August	Hours	147	130
September-October	Hours	47	195
November-December	Hours	70	170
Total	Hours	430	1,125
Cash and inventories†	Dollars	7,980	15,930
Real estate credit	Dollars	10,940	13,080
Chattel credit	Dollars	3,680	5,900
Dairy stanchions	Cows	24	37
Farrowing capacity	Sows	5	6
Silo capacity	Tons	90	150

* An overhead labor requirement (time necessary for building and equipment repair, upkeep, etc.) of 4 hours per crop acre was subtracted from available operator and family labor. Consequently, quantities of labor shown here were available for direct use in crop and livestock production.

† Includes cash and bonds on hand besides the market value of livestock and feed inventories. Over 90 percent of these assets were noncash items, primarily livestock.

bility of purchasing up to 100 acres of additional cropland. The inventory of tractors and machinery on this largest typical farm was ample for operating the additional land.

The cash and inventories item in table 1 equals the value of cash or bonds on hand plus feed and livestock inventories less any non-real-estate liabilities. These resource items, though not all ready cash, could be converted to cash or to other resources. For example, dairy cows could be sold and the money used to buy sows if hogs were more profitable. The amount of real estate credit available was estimated by taking 50 percent of the real estate value and subtracting current mortgages on real estate. An interest rate of 5.5 percent was charged for this credit.

On the large typical farm, expansion of the dairy enterprise with a loose housing-parlor arrangement was unduely limited by credit. So the real estate credit restriction of \$13,080 was liberalized to \$25,000 for some analyses.

Non-real-estate or chattel credit available for use equaled 50 percent of the value of machinery and equipment. *In addition*, if either the necessary feed supplies or cash or credit to purchase the feed were available, money could be borrowed to purchase feeder cattle, cows, or hogs. An interest rate of 7 percent per annum was charged for all short-term credit.

Livestock Enterprise Alternatives

Several dairy and hog enterprise alternatives were considered for both typical farms, including a specialized loose housing-milking parlor setup for the larger typical farm.

Dairy

A dairy enterprise alternative with stanchion barn housing was included for both typical farms since such housing was available. Labor requirements for dairy chores were assumed to be the same on both farms because three single-units were used for milking in each case. The use of three single-units is not usually a recommended practice because of the danger of leaving milkers on cows too long, but this was the most common milking system on the farms surveyed.

Barns were typically cleaned with a litter carrier; silage was unloaded by hand from upright silos. Labor requirements were based on feeding of hay and/or silage twice a day. Heifers were raised, cows were bred artificially, and bull calves were sold at 90-pound weights. These practices, reported by farmers interviewed, determined the labor and cost requirements of the dairy enterprise shown in table 2.

Dairy cows were assumed capable of producing 10,000 pounds of 3.5 percent fat corrected milk (f.c.m.) when fed a concentrate ration of

Table 2. Dairy enterprise budgets (per cow per year, including replacements, and with varied feeding rates)

Item	Unit	Grain-milk feeding ratio		
		1:2.5	1:4.0	1:6.0
Gross income (except milk)*	Dollars	78.60	78.60	78.60
Milk production	Pounds (3.5 f.c.m.)	10,900	10,000	9,210
Miscellaneous cash costs†	Dollars	61.60	61.60	61.60
Corn equivalent	Bushels	88.07	54.50	37.36
Forage equivalent	Tons	4.32	4.74	4.90
Livestock pasture	Tons hay equivalent	2.16	2.37	2.45
Investment in cow and replacement	Dollars	371.25	371.25	371.25
Labor, stanchion barn:‡				
First five cows	Hours per cow	189.3	188.1	187.6
Each added cow	Hours per cow	50.3	49.1	48.6
Labor, loose housing-parlor:‡				
First five cows	Hours per cow	221.8	220.6	220.6
Each added cow	Hours per cow	33.4	32.2	31.6

* Includes sales of cull cows, all bull calves, and excess heifers.

† Includes protein feeds, breeding fees, annual costs of machinery and equipment, barn repairs and upkeep, electricity, and veterinary expenses.

‡ Labor requirements for the first five cows include all the fixed labor requirements associated with the dairy herd; these fixed labor requirements are incurred whether 5, 10, or 30 cows are milked. No dairy enterprise smaller than five cows was allowed as an alternative in any farm organization.

1 pound grain to 4 pounds milk. Although this is a better quality cow than is kept on some farms, many grade A dairymen have cows of this quality; others have cows producing 11,000-12,000 pounds of milk or more. The average is constantly increasing. Two other concentrate feeding levels—1 pound grain to 6 pounds milk and 1 pound grain to 2.5 pounds milk—were also considered.

Expanding stanchion facilities beyond those currently available cost about \$530 per cow, including space for replacement heifers and calves. This cost was prorated (amortized) over a 15-year period at 5½-percent interest, as was the cost of adding additional space for silage storage. Most buildings probably last longer than 15 years. However, if revenue from additional milk sales would not pay the added costs over this period, it would be difficult to justify expenditures. Obsolescence was also considered in selecting a 15-year amortization period.

An additional alternative included for the largest farm was a labor-efficient double-four herringbone milking parlor and a pole barn-loose housing system. The investment cost of the parlor including feeders, stalls, and milking equipment was estimated at about \$7,350. When amortized at 5½ percent over 15 years, this represented an annual cost of \$732. A similar amortization of the \$112 per cow investment in a pole barn amounted to an annual cost of \$11.16 per cow. A bulk tank was available but a larger one was needed if cow numbers were expanded. The cost of this expansion was computed at \$50 per additional cow milked.

Comparison of labor requirements of the loose housing-parlor and stanchion systems indicated that total labor requirements were about the same with a 15-cow herd.² For larger herds the loose housing-parlor system required slightly less total labor and substantially less labor per cow added.

Beef Cow-Calf Herd

Because the dairy enterprise was neither large nor specialized on the smaller farm, a beef cow-calf enterprise was an alternative for this farm only (see table 3). A 90-percent calf crop was raised, calves weighing about 430 pounds were marketed by mid-October, and 15 percent of the cows were replaced annually from home-raised heifer replacements. Up to 10 beef cows could be housed in existing buildings. Expansion that required additional building and feeding facilities cost about \$91 per cow. This cost was also amortized over a 15-year period.

Cattle Feeding

A cattle feeding enterprise for the smaller farm included the purchase and feeding out of yearling steers. Steers were bought in October at about 690 pounds, roughed in cornfields with limited grain for 10½

² Using the annual labor requirements in table 2 for the medium level feeding rate, the 15-cow stanchion operation required about $(5 \times 188.1) + 10(49.1)$ or 1,431 hours total. The loose housing-parlor system required about $(5 \times 220.6) + 10(32.2)$ or 1,426 hours total.

weeks, put on full feed in drylot for about 18 weeks, and sold with a gain of about 400 pounds per head. Expansion costs of building and feeding facilities were estimated at about \$52 per head. Labor and feed requirements were based on information obtained from Minnesota and Illinois cattle feeding operations (see table 4). A more highly automated steer feeding system than the one considered here would increase capital but reduce labor requirements.

Table 3. Beef cow-calf enterprise budget (per cow per year, including calves and replacements)

Item	Unit	Amount
Income:		
Sale of calf (net of replacement) ...	Dollars	72.56
Sale of cull cow	Dollars	21.85
Total	Dollars	94.41
Cash expenses:		
Miscellaneous cash costs*	Dollars	10.03
Protein feeds	Dollars	2.84
Total	Dollars	12.87
Other requirements:		
Corn equivalent	Bushels	0.34
Forage equivalent	Tons	2.10
Pasture equivalent	Tons	1.50
Livestock investments†	Dollars	183.50
Labor	Hours	6.46
Expanding buildings (annual cost)‡	Dollars	9.12

* Includes charges for annual costs of machinery and buildings as well as veterinary expenses.

† Includes prorated portion of a herd sire and replacement heifer.

‡ Cost incurred only when the size of enterprise exceeds available space.

Table 4. Feeder cattle enterprise budget (per steer basis)

Item	Unit	Amount
Sale value of steers at \$21.50 cwt. ...	Dollars	233.71
Cash expenses:		
Purchase cost	Dollars	-128.21
Protein feed	Dollars	- 7.44
Miscellaneous cash costs*	Dollars	- 5.56
Net cash income	Dollars	92.50
Other requirements:		
Corn equivalent†	Bushels	43.60
Forage†	Tons hay equivalent	0.23
Labor	Hours per steer	6.19
Expanding facilities (annual cost)‡	Dollars	5.21

* Includes charges for annual costs of machinery and buildings as well as veterinary expenses.

† In addition to grain and roughage obtained from cornfields. These requirements would be increased if steers were not run in cornfields for the period specified.

‡ Cost incurred only when the size of enterprise exceeds available space and feeding facilities.

Hogs

Several hog enterprise alternatives were considered (see tables 5 and 6). These included one-litter and two-litter farrowing and feeding systems and the purchase and finishing of feeder pigs. The cost of 35-pound feeder pigs was allowed to vary, depending on the market hog price. Litters averaging eight pigs were raised with gilts kept for replacements from the spring litter. Spring litters were fed out on pasture, but fall litters were fed out in confinement. Spring litters financed the out-of-

Table 5. Budgets for alternative pig production systems

Item	Unit	Per sow	
		One-litter system	Two-litter system
Sale of sow (market hog equivalent)*	Pounds	320	320
Sale of boar (market hog equivalent)†	Pounds	10	10
35-pound feeder pigs transferred to feedlot	Number	7	15
Cash expenditures:			
Protein and mineral feeds	Dollars	16.50	28.08
Vaccination, power, and miscellaneous costs	Dollars	17.79	34.22
Investment in gilt and boar‡	Dollars	27.73	27.73
Other requirements:			
Corn equivalent	Bushels	38.91	64.16
Forage equivalent	Tons	0.18	0.18
Labor	Hours per sow	16.00	22.90
Expanding farrowing facilities (annual cost)§	Dollars	16.42	16.42

* Based on historical prices, sale of a 350-pound sow equals sale of 320 pounds of market hog.

† This assumes one boar per 15 sows. Based on historical prices, this equals sale of 10 pounds of market hog.

‡ When hogs were priced from \$11 to \$14 per cwt., the investment figure of \$27.73 was used. For the price range of \$15.50 to \$18.50 per cwt., the amount of livestock investment was \$38.13.

§ Cost incurred only when the size of enterprise exceeds available space and feeding facilities.

Table 6. Budgets for market hogs after weaning (per market hog basis)

Item	Unit	Spring	Fall
		farrowed	farrowed
Weight at sale	Pounds	225	225
Cash expenditures:			
Protein and mineral feeds	Dollars	3.59	2.93
Power and miscellaneous costs	Dollars	4.05	4.26
Other requirements:			
Corn equivalent	Bushels	9.77	11.07
Forage equivalent	Tons	0.18
Labor	Hours	1.32	1.32
Expanding feeding facilities (annual cost)*	Dollars	2.00

* Cost incurred only when the size of enterprise exceeds available space and feeding facilities.

pocket (commercial feed and incidental) costs of fall litters when a two-litter system was used.

Expanding hog enterprises to a size exceeding available building and feeding facilities required adding central farrowing house facilities (at about \$157.40 per sow) and waterers, concrete feeding lot, self-feeders, and shelter (at about \$19.09 per hog finished). The cost of buildings was amortized over a 15-year period and the cost of equipment over a 10-year period.

Price Assumptions

Prices used in this study were projected to 1965. The projected level and relationships among products sold are forward estimates made for the research analysis. They are not forecasts of future prices. Prices paid were usually projected to be about the same as 1959 levels. But prices of building material were projected to increase by 12 percent and motor supplies by 10 percent over 1959 levels.

Longrun price expectations for hogs were varied from \$14 to \$18.50 per cwt. at \$1.50 intervals and longrun milk prices from \$2.90 to \$4.10 per cwt. at \$0.40 intervals. Therefore, effects of price changes on most profitable farm organizations can be shown. Prices used in this study are listed in table 7.

Table 7. Longrun price expectations used in the study

Item	Unit	Price (dollars)
Nitrogen fertilizer	Pounds	0.15
Phosphate fertilizer	Pounds	0.10
Potash fertilizer	Pounds	0.05
Corn	Bushels	1.10
Oats	Bushels	0.57
Milk cows	Head	300.00
Fat steers, good	Cwt.	21.50
Feeder calves, good-choice	Cwt.	22.50
Milk, grade A	Cwt.	2.90- 4.10
Market hogs	Cwt.	14.00-18.50
Hired labor	Hours	1.00
Commercial feeds and supplies		1959 prices
Building materials		1959 prices + 12 percent
Motor supplies		1959 prices + 10 percent

The Small Grade A Dairy Farm

The small typical farm (92 crop acres) represents the farm group with less than 150 acres of cropland. Three crop rotations were chosen as alternatives for this farm: (1) a 4-year rotation of corn-corn-oats-hay (CCOH) with a maximum row crop acreage of 50 percent, 25 percent of the cropland in small grain and 25 percent in alfalfa hay; (2) a 4-year rotation of COHH, and (3) a 5-year rotation of CCOHH.

If fertilized at current levels, corn yields average about 60 bushels per acre. With recommended fertility practices, chemical controls of weeds and insects, and minimum tillage, yields can be about 90 bushels per acre. With recommended practices, current hay yields of 2.4 tons might increase to about 3.5 tons per acre. Similarly, current oats yields of 49 bushels per acre can increase to 61 bushels with recommended management practices. Per acre costs with recommended practices are higher, reflecting mainly an increase in fertilizer use.

Even with this relatively small crop acreage, most farmers had two or more tractors. Labor and fuel requirements assumed here are for crop production with two-plow tractors. Combining and silage harvesting are custom hired and charged custom costs. However, the farm operator does corn picking with his own single-row picker. These machine-crop operations correspond closely to current farm operations.

Currently the 24-cow stanchion barn is used almost to capacity and 5 sows are farrowed once a year. The equivalent of almost 2 man-years labor is available for use, but not much seasonal hired labor is available except during August.

Livestock alternatives considered for this farm included stanchion dairy, hogs, beef cow-calf herds, and both calf and yearling feeding enterprises. Table 8 shows the most profitable organizations of this typical farm over a range of milk and hog prices and with or without a dairy enterprise.

Livestock Enterprises

The most profitable type and size of livestock enterprises change with changes in longrun price expectations for hogs and milk. However, in all organizations it is profitable to increase the size of some livestock enterprises beyond current levels.

Dairy—With the small acreage of cropland and the relatively large labor supply, dairying is a profitable enterprise on this farm. At all prices considered, elimination of the dairy enterprise reduces net income. But this elimination also reduces labor requirements of operating the farm.

Blend milk prices of at least \$3.70 per cwt. are necessary to provide profitably for more barn space and expand the dairy herd beyond 24 cows. A \$3.70 price also makes it profitable to increase the rate of grain feeding for the milking herd as compared to the rate of grain feeding

with a lower milk price. Expansion of the dairy herd is most profitable when milk prices are high (\$4.10 per cwt.) and hog prices are low (\$15.50 or less per cwt.).

Hogs—Hog production becomes profitable on this farm only when hog prices are higher than \$15.50 per cwt. With hog prices of \$15.50 or

Table 8. Most profitable farm organizations for the small farm

Organization	Price of milk (cwt.)				
	0	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)*	\$15.50	\$15.50	\$15.50	\$15.50	\$15.50
Net income†	\$5,860	\$6,430	\$7,290	\$8,440	\$9,930
Dairy cows	0	12	24	34	34
Feeding rate	0	1:4	1:4	1:2.5	1:2.5
Yearlings fed	207	175	126	80	80
Hogs	0	0	0	0	0
Crop rotation	CCOH	CCOH	CCOHH	CCOHH	CCOHH
Corn silage (tons)	0	90	118	207	207
Corn purchased (bushels)	6,010	5,340	4,640	4,790	4,790
Real estate credit	\$10,940	\$8,250	\$6,250	\$10,940	\$10,940
Chattel credit	\$32,320	\$29,530	\$26,400	\$23,950	\$23,950
Labor-limiting periods‡	None	1	1	1	1
Price of hogs (cwt.)	\$17.00	\$17.00	\$17.00	\$17.00	\$17.00
Net income†	\$6,500	\$7,400	\$8,360	\$9,330	\$10,600
Dairy cows	0	24	24	28	31
Feeding rate	0	1:4	1:4	1:2.5	1:2.5
Beef cows	16	0	0	0	0
Sows farrowed, two litters	38	28	28	25	21
Crop rotation	CCOH	CCOHH	CCOHH	CCOHH	CCOHH
Corn silage (tons)	90	160	160	170	190
Corn purchased (bushels)	5,350	5,900	5,890	6,120	5,790
Real estate credit	\$5,840	\$8,250	\$8,620	\$10,260	\$10,940
Chattel credit	\$8,090	\$15,470	\$15,020	\$14,930	\$15,790
Labor-limiting periods‡	None	1	1	1	1
Price of hogs (cwt.)	\$18.50	\$18.50	\$18.50	\$18.50	\$18.50
Net income†	\$8,660	\$9,260	\$9,960	\$10,920	\$11,950
Dairy cows	0	12	24	24	28
Feeding rate	0	1:6	1:4	1:4	1:2.5
Beef cows	10	0	0	0	0
Sows farrowed, two litters	38	35	28	28	25
Feeder pigs purchased	40	35	30	30	0
Crop rotation	CCOH	Mixed§	CCOHH	CCOHH	CCOHH
Corn silage (tons)	50	90	165	165	170
Corn purchased (bushels)	5,440	5,800	5,930	5,930	6,120
Real estate credit	\$5,220	\$9,510	\$8,950	\$8,950	\$10,620
Chattel credit	\$7,130	\$9,640	\$13,800	\$13,800	\$14,930
Labor-limiting periods‡	None	None	1	1	1

* Since no hogs are in the most profitable farm organization with a \$15.50 per cwt. hog price, this organization is the same for hog prices of less than \$15.50.

† A charge for real estate taxes, depreciation, and a return to owned capital was deducted. However, no charge was made for operator and family labor.

‡ Labor supplies were divided into six periods: (1) January, February, March; (2) April, May; (3) June, July; (4) August; (5) September, October; (6) November, December.

§ This farm organization requires a crop rotation of about 50 percent CCOH and 50 percent CCOHH in order to provide an adequate roughage supply for livestock.

lower, the combination of cattle feeding and dairy is more profitable. Relative to dairy, the hog enterprise utilizes less labor, more concentrate feed, and much less forage.

Of the hog production alternatives considered, the two-litter farrowing and feeding system is most profitable. With a high hog price (\$18.50) and no dairy, it is profitable to expand the hog enterprise to 38 sows and to purchase some additional feeder pigs for finishing. Since the latter practice increases the disease hazard for home-produced hogs, many producers may not wish to consider this method.

Cattle Feeding—A yearling steer enterprise comes into the most profitable plan when hog prices are \$15.50 per cwt. or lower. With \$15.50 hogs and no dairy, the specialized steer feeding enterprise can be profitably expanded to 207 head. With this large a cattle feeding enterprise, credit requirements are larger than with any other farm plan. Over \$43,000 of real estate and chattel credit are required to finance the purchase of steers, add feeding facilities, and purchase some corn. However, when hog prices are \$17 per cwt. or higher, hog enterprises are more profitable than cattle feeding on this farm.

Beef Cows—With no dairy and no cattle feeding enterprises in the most profitable plan, it is profitable to keep a few beef cows to utilize permanent pasture and available labor. However, the maximum size of the beef cow herd—16 head—remains quite small.

Crop Rotations and Cropping Practices

In all farm organization plans shown in table 8, it is profitable to fertilize crops at the higher (recommended) rates and to utilize a minimum tillage system of cultivation. With no dairy in the farm plan, the most profitable rotation is the one with the largest corn acreage, CCOH. As the dairy enterprise size increases to more than 12 cows, the rotation shifts to CCOHH in order to provide adequate forage. It then becomes profitable to fertilize permanent pasture at the recommended rate in order to provide additional summer forage.

Also, as the dairy herd increases beyond 12 cows, it becomes profitable to add silo capacity beyond the 90-ton silo currently available. Because of limited cropland acreage and the relatively large supply of labor available, it is profitable to purchase large quantities of corn to service large livestock enterprises.

Labor

The labor supply on this farm (two-man equivalents) can handle any crop and livestock operation shown in table 8. Labor is in short supply only when a dairy enterprise is included, and then only during the January to March labor period.

Capital and Credit

The supply of real estate credit assumed available (\$10,940) is fully utilized and limits further expansion in four farm organizations shown in table 8. These farm organizations include either: (1) expanding stanchion facilities and silo capacity for a dairy herd of 31 or more cows, or (2) expanding the yearling steer feeding enterprise to 207 head. The large cattle feeding enterprises require more chattel credit than do hogs or dairy. In addition to large credit requirements, the price and income variability of the cattle feeding enterprises may make it an unattractive enterprise for some farm operators.

General

With the large labor supply relative to cropland available, intensification of livestock enterprises is necessary for an adequate farm income. On this small farm the incentive to add more cropland is great. However, if additional cropland or capital to acquire it is not available, the purchase of large quantities of corn (6,000 bushels or more) is profitable under some price situations.

Table 8 shows the changes in net farm income resulting from changes in hog and milk prices and in farm organizations. With a hog price of \$15.50 and a milk price of \$3.30, the estimated income potential from this farm is \$7,290. This increases to \$9,330 with \$17 hogs and \$3.70 milk. So the level of livestock and livestock product prices is an important determinant of this farm's income potential.

The Large Grade A Dairy Farm

The large typical farm represents grade A dairy farms with 150 acres of cropland or more. Cropland acreage (200 acres) is more than double that of the small farm and it has more of all resources except permanent pasture (see table 1). Family labor, amounting to about two-man equivalents, is about the same as on the smaller farm but considerably more hired labor is available. Facilities are available for housing 37 cows, farrowing 6 sows, and storing 150 tons of silage.

The large typical farm is well mechanized with a 6-foot combine, a two-row cornpicker, a field chopper, and three tractors, two of three-plow size and one of two-plow size. Because more total cropland and a smaller proportion of steep cropland are available on this typical farm than on the small one, a different crop rotation alternative—allowing up to 60 percent in row crops—was considered. The three rotation alternatives considered were a 4-year rotation of CCOH and 5-year rotations of CCCOH and CCOHH. Crop and pasture yields were the same as for the smaller farm and two fertility alternatives, current and recommended levels, were considered.

Real estate credit limits were increased from \$13,080 to \$25,000 for a portion of the analysis in order to consider purchasing up to 100 additional acres and/or converting to a parlor-loose housing milking setup. (Table headings indicate where this liberalization of credit was included.) Because this typical farm was already organized as a rather specialized dairy farm, no beef production or feeding alternatives were considered.

Because the most profitable farm organization plans change considerably at the *lower* (\$14 and \$15.50) and *higher* (\$17 and \$18.50) long-run hog prices considered, specific organization plans are discussed separately for those two situations. Discussions begin with the basic resource plan of \$13,080 of real estate credit and with no land purchase or loose housing-parlor dairy alternatives. Then the latter two alternatives are discussed. It should be remembered that the farm plans presented are not based on year-to-year price changes but on longrun price expectations for hogs and milk.

Organization with Low Hog Prices and Basic Resources

With longrun hog prices expected to be \$14 per cwt., a sizable stanchion dairy enterprise is profitable at all milk prices considered, at least to the extent of filling the existing stanchions (table 9). A substantial supplementary hog enterprise of 33 sows, mostly farrowed on a two-litter system, and the feeding of the 260 farm-produced hogs are also profitable at the lowest milk price. At this milk price about three-fourths of the cropland is in a CCOH rotation and about 1,000 bushels of corn can be sold annually. Fertilization of all pasture is profitable also. Cows are fed a 1:4 grain to milk ratio and the 150-ton silo capacity is used for corn silage.

As the milk price rises above \$2.90 per cwt., it becomes profitable to switch additional resources from hog production to dairy, increasing the dairy enterprise size beyond its original capacity. Credit and hired labor requirements increase with this shift. A switch to a heavier grain ratio (the 1:2.5 grain to milk ratio) also becomes profitable. At the highest milk prices, maintenance of a hog enterprise is profitable only to the extent that farrowing and feeding facilities are already available.

At the highest milk prices, where the dairy herd is expanded to 63 cows, land, peak period labor, and credit availability derived from real estate are fully utilized. Some credit derived from a chattel mortgage carrying a 7-percent interest charge (rather than the 5.5 percent charged on real estate) is still available but its use is not profitable.

With hogs at \$15.50, farm plans are similar to those above except that hogs are more competitive with dairy at all milk prices. Hog enterprises are larger, dairy enterprises are smaller, and income is somewhat higher, reflecting increased income from hog production. At the lowest milk price, maintenance of the dairy enterprise up to the full capacity of existing buildings is not profitable. Some silage storage capacity is also unused at lower milk prices. Family and hired labor available in the winter (Janu-

ary to March) period is completely utilized and this limits further expansion.

Organization with Low Hog Prices and Expanded Resources

Increasing Real Estate Credit Availability—Some credit is still available but unused in all of the above plans. This is usually credit derived from chattel carrying a 7-percent interest charge. Raising the quantity of real estate credit available to \$25,000 makes more credit available at 5.5 percent interest; this is then substituted for chattel credit. In a few cases slight expansion of the farm business is profitable when 5.5 percent credit is available that is not profitable using credit at 7 percent. But the change in income in these cases is negligible.

Changing to Loose Housing—A loose housing-milking parlor system could not be financed at the lower level of credit availability (\$13,080) because it was assumed to be too costly. At the higher level of credit

Table 9. Most profitable farm organizations for the large farm with basic resources and low hog prices

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$14.00	\$14.00	\$14.00	\$14.00
Net income*	\$11,280	\$12,840	\$15,400	\$18,120
Dairy cows	37	51	62	63
Feeding rate	1:4	1:2.5	1:2.5	1:2.5
Sows farrowed, two litters	33	16	6	6
Acres CCCOH rotation	145	84	10	0
Acres CCOHH rotation	55	116	190	20
Corn silage (tons)	150	150	150	150
Corn sold (bushels)	1,010	1,210	1,020	740
Real estate credit	\$8,070	\$10,350	\$13,080	\$13,080
Chattel credit	\$5,720	\$8,690	\$11,170	\$12,160
Labor-limiting periods†	5	5	5	5
Price of hogs (cwt.)	\$15.50	\$15.50	\$15.50	\$15.50
Net income*	\$13,500	\$14,700	\$16,210	\$18,440
Dairy cows	18	37	37	59
Feeding rate	1:4	1:4	1:2.5	1:2.5
Sows farrowed, two litters	51	38	37	11
Acres CCCOH rotation	200	128	141	25
Acres CCOHH rotation	0	72	59	175
Corn silage (tons)	40	135	85	150
Corn purchased (bushels)	60	190	770	0
Corn sold (bushels)	0	0	0	480
Real estate credit	\$13,080	\$9,390	\$9,110	\$13,080
Chattel credit	\$610	\$6,450	\$7,030	\$10,800
Labor-limiting periods†	1,5	1,5	1,5	1,5

* In these computations of net income and all which follow a charge was deducted for real estate taxes, depreciation, and a return to owned capital. However, no charge was made for operator and family labor.

† In these computations and all which follow labor supplies were divided into six periods: (1) January, February, March; (2) April, May; (3) June, July; (4) August; (5) September, October; (6) November, December.

Table 10. Most profitable loose housing dairy farm organizations for the large farm with \$25,000 of credit available but no land purchase permitted (low hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$14.00	\$14.00	\$14.00	\$14.00
Net income	\$13,170	\$16,830	\$20,760	\$24,720
Dairy cows	74	85	91	91
Feeding rate	1:2.5	1:2.5	1:2.5	1:2.5
Sows farrowed, two litters	6	0	0	0
Acres CCOHH rotation	200	200	200	200
Corn silage (tons)	360	550	670	670
Corn purchased (bushels)	1,360	2,180	3,370	3,370
Real estate credit	\$19,800	\$25,000	\$25,000	\$25,000
Chattel credit	\$17,110	\$21,540	\$28,230	\$28,230
Labor-limiting periods	None	None	1	1
Price of hogs (cwt.)	\$15.50	\$15.50	\$15.50	\$15.50
Net income	\$14,000	\$17,020	\$23,760	\$24,720
Dairy cows	46	84	91	91
Feeding rate	1:4	1:2.5	1:2.5	1:2.5
Sows farrowed, two litters	41	6	0	0
Acres CCOH rotation	48	0	0	0
Acres CCOHH rotation	152	200	200	200
Corn silage (tons)	150	560	670	670
Corn purchased (bushels)	2,650	3,380	3,370	3,370
Real estate credit	\$22,550	\$25,000	\$25,000	\$25,000
Chattel credit	\$12,510	\$23,270	\$28,230	\$28,230
Labor-limiting periods	1	1	1	1

availability (\$25,000), changing to loose housing is an alternative; an investment of \$1,583 is required for each of the first five cows. This figure includes the milking parlor and some equipment and facilities that do not have to be expanded as herd size increases. An additional housing investment of \$112 per cow is required as more cows are added. Expenditures of \$50 per cow are required to purchase a larger bulk tank if the cow herd is expanded beyond current size (37 cows).

With the larger amount of credit available, changing to loose housing is profitable at hog prices of \$14 and \$15.50. The change results in a large increase in dairy herd size and net income (table 10) and in almost total specialization in dairying except at the \$15.50 hog and \$2.90 milk price level.

The amount of credit used is increased substantially. In most cases all the real estate-derived credit is used; in every case some available chattel credit is not used. The crop rotation is usually entirely a CCOHH rotation and substantial quantities of corn silage are made, requiring investment in additional silo capacity. Labor in the January to March period becomes exhausted and limits further expansion.

Purchasing Cropland on Land Contract—At the higher (\$25,000) level of real estate credit availability, purchase of up to 100 acres of additional cropland on land contract was considered. A purchase price

of \$240 per acre was assumed with a 20-percent downpayment. So each acre purchased required only \$48 of existing cash or credit but added an additional \$192 to the credit burden of the firm. The purchase was amortized over 25 years at 5.5 percent interest.

When this land purchase alternative is possible, it is profitable to purchase all 100 acres (tables 11 and 12). Then the level of the stanchion dairy enterprise is reduced slightly from that accompanying the 200 acres of cropland. This occurs as labor is shifted from livestock to expanded crop enterprises. The proportion of corn in the rotation increases, resulting in a large increase in corn sales. More hay is raised which is substituted for corn silage. The total indebtedness of the farm also increases, since almost as much credit is used as before for building expansion and an additional obligation of \$19,200 is assumed under the land contract.

Land purchase is profitable with both loose housing and stanchion housing. Little or no reduction in the level of the loose housing dairy enterprise occurs when land is purchased. The size of the supplementary

Table 11. Most profitable stanchion dairy farm organizations for the large farm with land purchase permitted and \$25,000 of real estate credit available (low hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$14.00	\$14.00	\$14.00	\$14.00
Net income	\$14,680	\$16,270	\$18,560	\$21,190
Dairy cows	37	50	58	66
Feeding rate	1:4	1:2.5	1:2.5	1:2.5
Sows farrowed, one litter	4	6	6	0
Sows farrowed, two litters	7	0	0	0
Feeder pigs purchased, fall	30	40	40	0
Acres CCCOH rotation	300	230	150	75
Acres CCOHH rotation	0	70	150	225
Corn silage (tons)	0	0	0	0
Corn sold (bushels)	13,490	11,460	12,980	8,050
Real estate credit*	\$6,300	\$11,910	\$15,700	\$19,960
Chattel credit	\$5,000	\$9,520	\$11,600	\$13,400
Labor-limiting periods	5	5	3.5	3.5
Price of hogs (cwt.)	\$15.50	\$15.50	\$15.50	\$15.50
Net income	\$16,650	\$17,720	\$19,280	\$21,480
Dairy cows	20	37	37	55
Sows farrowed, one litter	24	31	34	15
Sows farrowed, two litters	21	7	3	0
Feeder pigs purchased, fall	420	220	240	110
Feeder pigs purchased, spring	260	0	0	0
Acres CCCOH rotation	300	268	300	164
Acres CCOHH rotation	0	32	0	136
Corn silage (tons)	0	0	0	0
Corn sold (bushels)	2,590	7,930	7,550	7,680
Real estate credit*	\$20,880	\$14,190	\$13,940	\$17,220
Chattel credit	\$11,180	\$10,440	\$10,720	\$12,740
Labor-limiting periods	1.5	1.5	1.5	1.3.5

* In addition, \$19,200 are borrowed on land contract (purchase cost of land less downpayment).

Table 12. Most profitable loose housing dairy organizations for the large farm with land purchase permitted and \$25,000 of real estate credit available (low hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$14.00	\$14.00	\$14.00	\$14.00
Net income	\$17,150	\$20,690	\$24,540	\$28,500
Dairy cows	75	82	91	91
Feeding rate	1:2.5	1:2.5	1:2.5	1:2.5
Sows farrowed, two litters	6	0	0	0
Acres CCCOH rotation	117	113	40	40
Acres CCOHH rotation	183	187	260	260
Corn silage (tons)	210	330	425	425
Corn sold (bushels)	5,520	5,410	2,900	2,900
Real estate credit*	\$21,770	\$25,000	\$25,000	\$25,000
Chattel credit	\$17,910	\$19,870	\$25,590	\$25,590
Labor-limiting periods	3,5	3,5	1,3,5	1,3,5
Price of hogs (cwt.)	\$15.50	\$15.50	\$15.50	\$15.50
Net income	\$17,580	\$20,840	\$24,540	\$28,510
Dairy cows	68	84	91	91
Feeding rate	1:2.5	1:2.5	1:2.5	1:2.5
Sows farrowed, one litter	11	0	0	0
Sows farrowed, two litters	9	6	0	0
Acres CCCOH rotation	131	43	41	41
Acres CCOHH rotation	169	257	259	259
Corn silage (tons)	150	315	425	425
Corn sold (bushels)	4,050	2,920	2,900	2,900
Real estate credit*	\$23,920	\$24,940	\$25,000	\$25,000
Chattel credit	\$17,710	\$20,940	\$25,590	\$25,590
Labor-limiting periods	1,3,5	1,3,5	1,3,5	1,3,5

* In addition, \$19,200 are borrowed on land contract (purchase cost of land less downpayment).

hog enterprise increases when hog prices are at \$15.50 per cwt. and land is purchased in conjunction with stanchion dairy. This increase occurs through the feeding of purchased feeder pigs. Labor can be more profitably employed in crop production than in farrowing additional sows if a dependable supply of good quality feeder pigs is available.

Generally, it is more profitable to switch to loose housing dairy and not purchase land than to purchase land and remain with stanchion housing. This is true for: (1) hog prices of \$14 and milk prices of \$3.30 or higher, and (2) milk prices of \$3.70 or higher at all hog prices. Land purchase is profitable regardless of the dairy setup. But the switch to loose housing generally increases income as much or more than does land purchase. The highest income is obtained when the labor-efficient dairy setup is used and land is purchased. However, credit obligations then increase substantially.

Organization with Higher Hog Prices (\$17 and \$18.50) and Basic Resources

With the basic set of resources and hog prices of \$17 or higher, hogs are strongly competitive with dairying and are the major enterprise at

Table 13. Most profitable farm organizations for the large farm with basic resources and higher hog prices

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$17.00	\$17.00	\$17.00	\$17.00
Net income	\$16,660	\$17,160	\$18,220	\$19,760
Dairy cows	12	26	31	37
Feeding rate	1:4	1:4	1:4	1:2.5
Sows farrowed, one litter	10	0	0	0
Sows farrowed, two litters	57	51	45	37
Feeder pigs purchased, fall	73	0	0	0
Acres CCCOH rotation	200	132	132	140
Acres CCOHH rotation	0	68	68	60
Corn silage (tons)	0	0	45	85
Corn purchased (bushels)	2,850	1,440	760	770
Real estate credit	\$13,080	\$13,080	\$11,370	\$9,110
Chattel credit	\$8,840	\$5,240	\$5,760	\$7,030
Labor-limiting periods	1,5	1,5	1,5	1,5
Price of hogs (cwt.)	\$18.50	\$18.50	\$18.50	\$18.50
Net income	\$20,580	\$20,890	\$21,310	\$21,930
Dairy cows	7	10	12	26
Feeding rate	1:6	1:4	1:4	1:2.5
Sows farrowed, one litter	7	0	0	0
Sows farrowed, two litters	61	61	60	49
Feeder pigs purchased, fall	144	160	140	30
Feeder pigs purchased, spring	95	160	140	30
Acres CCCOH rotation	200	178	173	146
Acres CCOHH rotation	0	22	27	54
Corn silage (tons)	0	0	0	0
Corn purchased (bushels)	4,610	5,240	4,240	2,290
Real estate credit	\$13,080	\$13,080	\$13,080	\$13,080
Chattel credit	\$13,330	\$15,180	\$13,830	\$6,670
Labor-limiting periods	1,5	1,5	1,5	1,5

most hog and milk prices (table 13). As milk prices increase, for any specific hog price, hog numbers are reduced and dairying increases as labor transfers to dairying. But it is profitable to fill all 37 stanchions only at milk prices of \$4.10 and hog prices of \$17. A medium grain ration (grain to milk ratio of 1:4) is generally most profitable.

The basic hog enterprise is farrowing on a two-litter system and finishing out home-raised pigs. Some sows are farrowed on a one-litter system and some feeder pigs purchased to help balance labor requirements with availability. Credit, rather than labor, limits further expansion of plans with large numbers of hogs; labor is the limiting resource for large dairy plans. Credit is required for expanding farrowing and feeding facilities. Large quantities of corn must be purchased; this also uses up cash and credit.

The cropping pattern is planned to produce a maximum of corn for grain, as it is with large dairy plans. However, forage requirements are reduced. Little or no corn silage is made and fertilization of permanent pasture is not always profitable.

Organization with Higher Hog Prices (\$17 and \$18.50) and Expanded Resources

Increasing Real Estate Credit Availability—When real estate credit availability is increased to \$25,000, further expansion of the farrowing and feeding hog enterprise is permitted (table 14). The dairy enterprise level is then reduced to 5-12 cows in most cases. With such a small dairy enterprise, some farmers may profitably eliminate dairying entirely and concentrate resources in hog and cattle feeding enterprises.

With the shift to a small dairy enterprise and a large farrowing and feeding hog enterprise, credit use increases substantially and the level of net income increases in all but one case. This situation contrasts to the low hog price plans where additional credit makes little or no change in income from the most profitable stanchion barn organization without additional credit.

Table 14. Most profitable stanchion dairy farm organizations for the large farm with \$25,000 of real estate credit available but no land purchase permitted (higher hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$17.00	\$17.00	\$17.00	\$17.00
Net income	\$17,090	\$17,800	\$18,290	\$19,760
Dairy cows	5	12	12	37
Feeding rate	1:4	1:4	1:4	1:4
Sows farrowed, one litter	0	6	6	0
Sows farrowed, two litters	68	56	56	38
Feeder pigs purchased, fall	137	0	0	0
Feeder pigs purchased, spring	360	0	0	0
Acres CCCOH rotation	150	200	200	135
Acres CCOHH rotation	50	0	0	65
Corn silage (tons)	0	0	0	135
Corn purchased (bushels)	8,660	1,880	1,880	190
Real estate credit	\$25,000	\$16,550	\$16,550	\$9,390
Chattel credit	\$15,390	\$2,150	\$2,150	\$6,450
Labor-limiting periods	1,5	1,5	5	1,5
Price of hogs (cwt.)	\$18.50	\$18.50	\$18.50	\$18.50
Net income	\$21,550	\$21,750	\$21,950	\$22,390
Dairy cows	5	5	5	12
Feeding rate	1:4	1:4	1:4	1:4
Sows farrowed, two litters	68	68	68	66
Feeder pigs purchased, fall	137	137	137	20
Feeder pigs purchased, spring	360	360	360	390
Acres CCCOH rotation	150	150	150	100
Acres CCOHH rotation	50	50	50	100
Corn silage (tons)	0	0	0	0
Corn purchased (bushels)	8,660	8,660	8,660	8,500
Real estate credit	\$25,000	\$25,000	\$25,000	\$16,760
Chattel credit	\$500	\$500	\$500	\$1,220
Labor-limiting periods	1,5	5	1,5	1,5

Changing to Loose Housing—With \$25,000 of real estate credit available, changing to loose housing proves more profitable than remaining with stanchion housing at intermediate and high milk prices (table 15). The change results in a larger dairy enterprise, fewer hogs, and substantially greater use of credit where it increases profit. Labor in the January to March and September to October periods finally limits expansion.

Purchasing Cropland on Land Contract—Purchasing up to 100 acres on land contract is profitable in all instances (tables 16 and 17). In the case of stanchion dairy, it also becomes profitable to purchase and feed more feeder pigs instead of farrowing as many sows because of higher labor requirements for the latter during crop production periods.

In the case of loose housing and parlor dairy (table 17), land purchase also increases the size of the most profitable dairy operation. Generally, the labor-efficient herringbone dairy setup with land purchase is more profitable than stanchion housing with land purchase; this is not true at the lowest milk prices.

With hog prices at \$17 or above, hogs compete favorably with stanchion dairying at all milk prices, provided sufficient credit is available to provide farrowing and feeding facilities. However, hogs do not com-

Table 15. Most profitable loose housing dairy farm organizations for the large farm with \$25,000 credit but no land purchase permitted (higher hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$17.00	\$17.00	\$17.00	\$17.00
Net income	\$16,620	\$17,960	\$20,990	\$24,720
Dairy cows	29	50	84	91
Feeding rate	1:4	1:2.5	1:2.5	1:2.5
Sows farrowed, two litters	55	36	6	0
Acres CCCOH rotation	106	58	0	0
Acres CCOHH rotation	94	142	200	200
Corn silage (tons)	0	150	560	670
Corn purchased (bushels)	2,830	3,360	3,420	3,370
Real estate credit	\$24,750	\$21,610	\$25,000	\$25,000
Chattel credit	\$8,380	\$14,340	\$24,470	\$28,230
Labor-limiting periods	1,5	1	1	1,2
Price of hogs (cwt.)	\$18.50	\$18.50	\$18.50	\$18.50
Net income	\$20,300	\$20,750	\$22,040	\$24,830
Dairy cows	7	12	41	84
Feeding rate	1:4	1:4	1:2.5	1:2.5
Sows farrowed, two litters	61	59	45	6
Feeder pigs purchased, fall	260	200	0	0
Feeder pigs purchased, spring	260	200	110	0
Acres CCCOH rotation	181	162	95	0
Acres CCOHH rotation	19	38	105	200
Corn silage (tons)	0	0	150	560
Corn purchased (bushels)	6,790	5,810	4,650	3,420
Real estate credit	\$25,000	\$25,000	\$25,000	\$25,000
Chattel credit	\$16,090	\$13,960	\$15,640	\$23,470
Labor-limiting periods	1,5	1,5	1	1

Table 16. Most profitable stanchion dairy farm organizations for the large farm with land purchase permitted and \$25,000 of real estate credit available (higher hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$17.00	\$17.00	\$17.00	\$17.00
Net income	\$20,100	\$20,620	\$21,300	\$22,790
Dairy cows	12	17	27	37
Feeding rate	1:6	1:4	1:4	1:2.5
Sows farrowed, one litter	0	14	0	0
Sows farrowed, two litters	31	25	20	12
Feeder pigs purchased, fall	675	533	537	462
Feeder pigs purchased, spring ...	675	438	537	462
Acres CCCOH rotation	300	300	255	240
Acres CCOHH rotation	0	0	45	60
Corn silage (tons)	0	0	0	0
Corn purchased (bushels)	3,240	0	0	0
Corn sold (bushels)	0	0	0	1,260
Real estate credit*	\$25,000	\$22,580	\$19,270	\$15,400
Chattel credit	\$20,780	\$13,810	\$17,920	\$18,440
Labor-limiting periods	1,5	1,5	1,5	1,5
Price of hogs (cwt.)	\$18.50	\$18.50	\$18.50	\$18.50
Net income	\$24,980	\$25,280	\$25,690	\$26,170
Dairy cows	8	8	12	12
Feeding rate	1:6	1:4	1:4	1:4
Sows farrowed, two litters	34	34	30	30
Feeder pigs purchased, fall	700	700	680	680
Feeder pigs purchased, spring ...	760	760	685	685
Acres CCCOH rotation	300	300	300	300
Corn silage (tons)	0	0	0	0
Corn purchased (bushels)	4,920	4,990	3,550	3,540
Real estate credit*	\$25,000	\$25,000	\$25,000	\$25,000
Chattel credit	\$26,000	\$26,110	\$21,440	\$21,490
Labor-limiting periods	1,5	1,5	1,5	1,5

* In addition, \$19,200 are borrowed on land contract (purchase cost of land less downpayment).

pete favorably with loose housing dairying except at the lowest milk prices.

General Organizational Guides for the Large Dairy Farm

Several features of farm organizations appear generally valid for this farm. These are:

1. If longrun prices for hogs are expected to be \$15.50 per cwt. or less the main enterprise in the most profitable farm plans is dairy with hogs as a supplementary enterprise. This is generally true at all milk prices. With hog prices of \$17 or higher, hogs become more competitive with dairy and are a major enterprise in most farm plans.

2. Although this is a rather large dairy farm already, the farm income potential could be increased by access to additional credit, an increase

Table 17. Most profitable loose housing dairy farm organizations for the large farm with land purchase permitted and \$25,000 of real estate credit available (higher hog prices)

Organization	Price of milk (cwt.)			
	\$2.90	\$3.30	\$3.70	\$4.10
Price of hogs (cwt.)	\$17.00	\$17.00	\$17.00	\$17.00
Net income	\$19,390	\$21,490	\$24,820	\$28,500
Dairy cows	32	68	84	91
Feeding rate	1:4	1:2.5	1:2.5	1:2.5
Sows farrowed, one litter	6	11	0	0
Sows farrowed, two litters	23	9	6	0
Feeder pigs purchased, fall	470	85	0	0
Feeder pigs purchased, spring ...	430	0	0	0
Acres CCCOH rotation	235	130	42	41
Acres CCOHH rotation	65	170	258	259
Corn silage (tons)	0	150	310	425
Corn sold (bushels)	0	4,050	2,900	2,900
Real estate credit*	\$25,000	\$23,920	\$24,780	\$25,000
Chattel credit	\$23,570	\$17,710	\$20,860	\$25,590
Labor-limiting periods	1,5	1,3,5	1,3,5	1,3,5
Price of hogs (cwt.)	\$18.50	\$18.50	\$18.50	\$18.50
Net income	\$23,380	\$24,170	\$25,810	\$28,800
Dairy cows	15	25	54	84
Feeding rate	1:4	1:4	1:2.5	1:2.5
Sows farrowed, one litter	15	0	0	0
Sows farrowed, two litters	25	26	14	6
Feeder pigs purchased, fall	600	595	338	0
Feeder pigs purchased, spring ...	500	595	338	0
Acres CCCOH rotation	300	248	170	42
Acres CCOHH rotation	0	52	130	258
Corn silage (tons)	0	0	150	310
Corn purchased (bushels)	1,360	2,350	0	0
Corn sold (bushels)	0	0	0	2,900
Real estate credit*	\$25,000	\$25,000	\$25,000	\$24,780
Chattel credit	\$24,910	\$28,960	\$22,980	\$20,860
Labor-limiting periods	1,5	1,5	1,3,5	1,3,5

* In addition, \$19,200 are borrowed on land contract (purchase cost of land less downpayment).

in size of the dairy herd, and in some cases, a shift to a specialized loose housing-parlor dairy setup. The income potential of the more specialized dairy organization exceeds that of the stanchion dairy in most situations where longrun price expectations for milk are \$3.30 per cwt. or higher and in all situations where milk is \$3.70 per cwt. or higher. Maximum herd size is 66 cows in stanchion dairy and 91 cows with a specialized loose housing-parlor arrangement. Successful operation of these large dairy herds requires good dairy herd management.

3. Land purchase on land contract is a profitable adjustment alternative when possible. However, operation of additional cropland increases the income premium on labor-efficient livestock enterprises such as loose housing-parlor dairy and finishing purchased feeder pigs. Land purchase

is profitable even with less favorable purchase contract arrangements than those considered here.

4. In all situations, the most profitable cropping system includes recommended practices; high rates of fertilization and minimum tillage are used in preference to crop management practices currently in use. The most profitable rotation in all cases is a CCCOH or CCOHH rotation or a combination of the two. The rotation coming into the most profitable farm plan is geared to production of the hay necessary for the dairy enterprise, with most remaining land going into corn for grain and silage production.

5. It is profitable to fertilize pasture up to the recommended level when the dairy enterprise is large enough to occupy existing stanchions. With fewer than 37 cows, fertilizing unimproved pasture at the higher levels generally is not necessary to provide adequate forage.

Conclusions

Many of the most profitable farm plans for both typical grade A dairy farms include capital inputs and livestock enterprises much larger than those now typically found in southern Minnesota. However, livestock enterprises are increasing in size at a rapid rate. The farm organizations presented in this report require large amounts of capital, good crop and livestock management practices, and full employment of available labor during much of the year.

Many farm operators hesitate to use these large amounts of credit because of risk. Another consideration is the value placed on having some leisure time (on at least 1 day of the week). These and other factors will moderate the degree of adjustment toward the type of organizations described in this report. Nevertheless, several farms with similar resource situations already have livestock enterprises larger than those considered here.

Increasing farm size by adding cropland acreage is a profitable adjustment alternative for many farmers. The income potential of the 200 crop acre farm is much larger than for the 92 crop acre farm. Also, adding more cropland to the 200 acre farm increases its income potential considerably. Many farm operators have little or no opportunity to expand cropland acreage. In these cases, expansion of livestock enterprises is a particularly important adjustment alternative. Often, livestock feeding enterprises need not be limited to the size that can be finished with home-grown feed supplies. Purchase of additional feed grains as well as concentrate supplements can also be profitable.

To avoid more serious surpluses of milk than already exist, increased production from specialized dairy farms needs to be offset by reduced production on some farms. As already indicated, the number of Minnesota farms with some dairy cows is declining at a rapid rate. Continuation of this development will permit some increased specialization on remaining dairy farms. Such specialization is likely to be most advantageous for those Minnesota farmers who can realize a price premium by producing grade A quality milk. Further research is underway to determine the least cost technology which can be used to further specialize the dairy enterprise.