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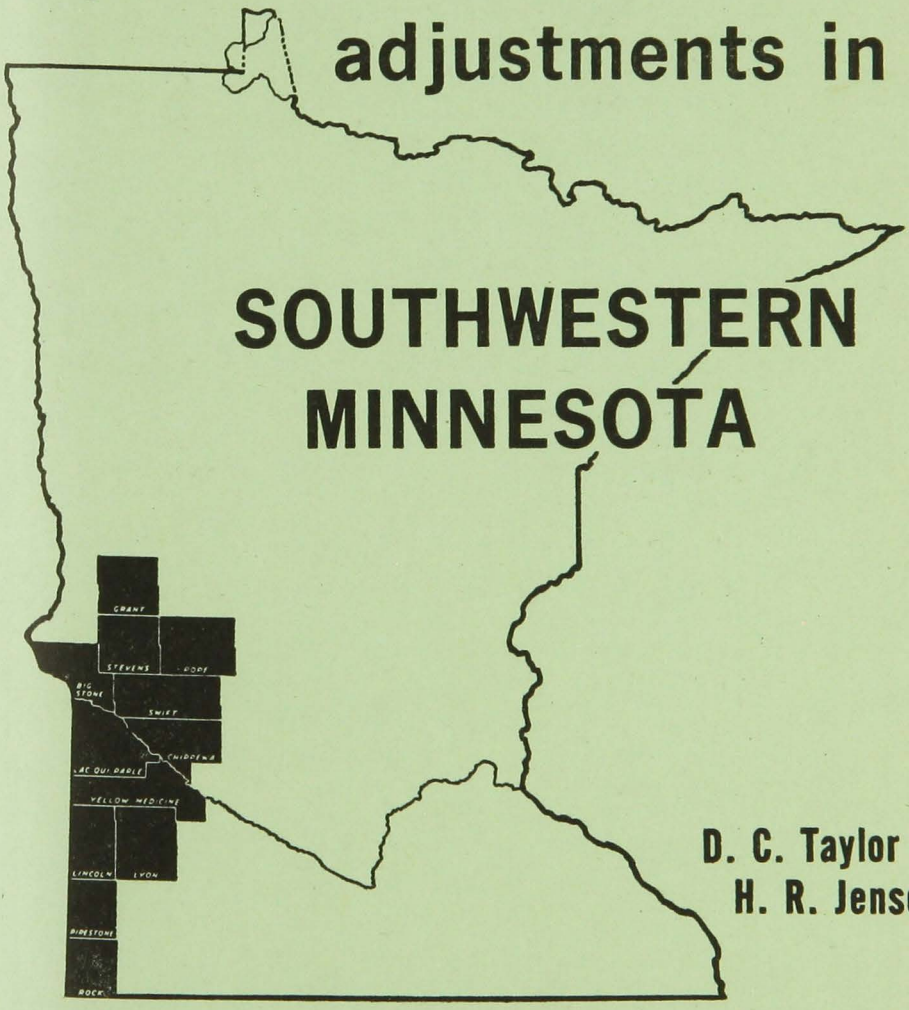

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Profitable Farm Adjustments In Southwestern Minnesota

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Farm operators can use their resources in various ways. Choices exist among different crops and livestock, among numerous production techniques, and between adding capital to existing land and adding land. For each set of price relationships, a certain resource use provides maximum income for each farm. However, this particular resource use varies from farm to farm because farms differ in kind, quantity, and quality of resources.

Knowledge of some alternative income-improving organizations for various farm situations is useful to farmers when organizing their businesses. This study was made to provide such knowledge.

General Background

Without change in agriculture, a farmer simply could continue with the same organization having once determined the most profitable use of his farm's resources. But agriculture has changed constantly and, in recent years especially, it has undergone far-reaching changes.

Agricultural change largely is associated with the rapid development and use of new and improved technology. In total, adoption of this technology has resulted in increased production efficiency in the United States. For example, in the past 25 years, crop output per man-hour more than tripled. The rate of increase in production efficiency for feed grains was almost double that for all crops. Livestock output per man-hour also more than doubled.

Of course, total productivity in agriculture did not advance at these high rates. These productivity increases were accompanied by substantial changes in resource use; the most marked change was the expansion in capital use.

Table 1 indicates some changes in quantities of equipment on Minnesota farms during 1950-59. Over the period, the number of cornpickers

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Table 1. Incidence of farm machinery, Minnesota, 1950-59 (census years)

Years	Number of machines			Tractors, number of farms with		
	Corn-pickers	Grain combines	Pickup balers	Only one	Two	Three or more
1950	45,792	31,262	7,812	94,022	39,136	8,125
1954	62,813	61,331	25,144	69,937	59,879	18,548
1959	73,011	73,278	45,583	39,747	58,272	35,014

Source: *U. S. Census of Agriculture, Minnesota; 1959.* 1960. U. S. Dept. of Comm. p. 7.

increased 60 percent, the number of grain combines doubled, and the number of pickup balers increased almost six times. While the number of farms with more than three tractors increased over fourfold, the number reporting only one tractor declined by more than one-half.

The financing of these expanded machinery inventories (size of equipment increased as well as number), along with the many other purchased farm inputs, required large increases in capital use. At the same time, Minnesota's average farm size in acres increased 15 percent, but the average farm labor force remained almost constant.

Another change influencing Minnesota agriculture has been the cost-price squeeze; this squeeze tightened in recent years. To illustrate, 1951 was the last year that the parity ratio (U. S. agriculture ratio of index of prices received to index of prices paid, interest, taxes, and wage rates on the basis of 1910-14 = 100) exceeded 100. Since then, it has declined. In 1964, this ratio was 76.

These recent changes in agriculture are a challenge to management. To use technological change advantageously, farmers must be perceptive of it. Economic efficiency is becoming increasingly imperative. Basically, a farmer's opportunities for improved efficiency are: new enterprises, improved methods of production, and/or increased size of business. This study explored these basic alternatives.

But choosing among these alternatives to improve a farm's efficiency and income is no easy task. To make these choices requires painstaking information gathering and analysis. A farmer must obtain data for determining expected crop and livestock yields, together with information on the fertilizer, seed, and other resources required to attain these yields. This information will differ with the production techniques considered.

Moreover, the farm planner must assemble information on prices and formulate price expectations. Primarily, he must consider relative prices rather than absolute levels, because the relationship of prices—not the level of prices—affects farm organization. He also has to assemble data on resource supplies. Finally, he must organize all this material through an analytical procedure to see implications for reorganization, costs, investments, and incomes.

Essentially, this procedure was followed in this study. But the procedure was applied to representative farms rather than individual farms. Therefore, study findings should be viewed as *planning guides* for individual farm organizations—guides for each farmer to consider as he plans the future of his own business.

For some types of farms, the guidelines suggest far-reaching changes in resource use. Each farmer should carefully analyze and weigh these suggestions, considering more the suggested direction of the adjustment of resource use than its size or magnitude.

Geographic Area Studied

This study covered a 12-county area in southwestern Minnesota, one of the state's most important hog-beef producing regions (see cover). Approximately 20 percent of the state's 1959 cattle and calf sales and about 17 percent of the state's 1959 hog sales came from this section.

A distinguishing feature of these 12 counties is their relatively homogeneous soil base. Although the principal soil association is the Barnes-Aastad, there are scattered occurrences of the Kranzburg-Vienna-Moody (southern two counties) and the Bearden-Glyndon (north-central area) associations. The Barnes-Aastad association is comprised of medium to fine-textured prairie and prairie border soils. Dark in color, they are of calcareous glacial origin. Controls for erosion and provisions for drainage are required in certain limited regions.

Annual precipitation averages 22-26 inches; the average crop growing season is 130-40 days.

Procedures Used

Sample Survey: Definition of Representative Farms

In summer 1962, a random sample of 195 farm operators in the study area was interviewed. Survey objectives were to: (1) ascertain available resources for farm production and (2) learn how these resources were used in 1961. Based on this information, farms were stratified into 12 size-type groups.

The measurement of *size* was cropland acreage; farms with less than 180, between 180 and 259, and 260 or more cropland acres were designated as small, medium, and large, respectively. The criterion for *type* was the percent of 1961 gross sales realized from various farm enterprises. Farms with 50 percent or more of their gross sales from (1) hogs and beef, (2) cash grain, or (3) dairy were classified as (1) livestock, (2) cash grain, or (3) dairy farms, respectively. If no one enterprise returned as much as 50 percent of the gross sales, the farm was classified as general.

For each stratum, a representative farm resource situation then was defined. For readily divisible resources or inputs found on all farms such as labor, cropland, and capital, simple averages were computed and used. For divisible inputs found on some but not on all farms such as beef, hog, and dairy housing facilities, a determination first was made of whether a majority of the member farms had the input. If they did, the

averaging procedure was used. If not, the representative farm was assumed to have none of the input. For discrete or lumpy inputs such as tractors, disks, and cultivators, the modal value (the most common number and/or size) for each item was determined and used.

The basic reason for defining representative farm situations is that farms differ considerably in kinds and quantities of resources. But the nature of a farm's resource base is critical to determining its most profitable organization. Therefore, a study conducted to provide managerial guidelines has more meaning to potential users if based on some specific resource situations rather than on a single average situation.

Since cost considerations prohibited studying every individual farm, several representative farms were defined, each typical of a relatively homogeneous group. Except by chance, study results are not specifically applicable to any particular farm. Nevertheless, they are broadly applicable to farms that are similar to representative farms in their resource availabilities.

Linear Programming

The most profitable organizations for each representative farm were determined by a linear programming technique. The three basic components of a linear programming analysis are: (1) resource supplies or restrictions, (2) input-output data for crops and livestock, and (3) prices.

Resource restrictions reflected those resources available for production—in other words, the resource bases of the representative farms. In addition, restraints on resource use imposed by government farm programs, credit agencies, and other institutions were included.

The input-output data reflected the assumed rates of transforming inputs such as land, labor, fertilizer, and feed into outputs such as corn, soybeans, hogs, and beef. Price estimates represented the input costs and output prices assumed most likely to occur during the planning period, 1963-70.

Given data for each of these three items, the linear programming process selected from the total set of production possibilities those which were most profitable. It also indicated the levels at which each enterprise should be operated and the resources required to operate at these levels. The selection of production possibilities—crops and livestock—and operating levels was based entirely on profit maximization. Risk, personal preferences, and other goals such as leisure were not involved. Different management levels also were not considered. In the profit-maximizing plan, above-average management was assumed, not what was being attained but what could be attained with a high level of management.

Resource Restrictions and Supplies

Table 2 summarizes the resource restrictions or supplies for each representative farm. The quantities of family labor represent the average

number of hours that the farm operator and his family said they were willing and able to work in 1961. Hired labor figures indicate the average number of hours actually hired in 1961. Upper limits on amounts of hired labor were restricted to 1961 levels because respondents cited a scarcity of hired labor. The wage rate used for hired labor was that shown on the survey schedules, $1 per hour.

In this study, cropland was treated in two ways. At first, quantities of cropland available in reorganizing the farms were fixed at 1961 levels (see table 2). Therefore, capital and labor could be applied only on existing acreages; that is, reorganizational adjustments were limited to those on the intensive margin.

In the succeeding analysis, reorganizational adjustments included the opportunity to purchase additional land; that is, adjustments on intensive and/or extensive margins were permitted. By comparing results of the two analyses, farmers can judge the potential profitability of purchasing additional land with that of using their labor and capital on existing acreages.

No more than 160 acres could be purchased. This limit was set primarily because it was the size of tract most typically bought and sold during recent years in the area. Purchase of tracts less than 160 acres was permitted.

The land could be purchased either through contract for deed, mortgage contract, or some combination of these. Purchase through contract for deed required a 25-percent downpayment with the remaining 75 percent amortized at 5½-percent interest over 20 years. Purchase through mortgage contract required a 50-percent downpayment with the balance amortized at 5½ percent over 25 years.

Since upper limits on land in the initial analysis were set at existing acreages, the power and machinery currently on farms were assumed adequate for reorganization. But when representative farms were reprogrammed with the land purchase alternative, farmers were required to buy machinery for purchased land in the same proportions as machinery to land existed on present acreages. Crop storage facilities, except for silage, were assumed adequate for all reorganizations.

Three restrictions were established on the *use* of cropland. Two reflected the limits imposed by government farm programs; the third was in response to topographic land features. At the time of analysis, the nonallotment limit for wheat was 15 acres. Survey information indicated that 1961 wheat acreages were over 15 acres only on the large cash grain farm. Therefore, 15 acres became the assumed wheat allotment for all other farms; the large cash grain farm had a 20-acre allotment.

Participation in the feed grain program required that upper limits be placed on corn acreages. These limits were set at 10 percent above 1961 corn acreages on the assumption that projected participation rates in the feed grain program were somewhat lower than rates in 1961.

Because of erosion problems in rolling regions of the study area, soil scientists recommended restricted use for 29 percent of the cropland. Specifically, they recommended that 2 percent of the land should be in continuous grass-legume seeding; 4 percent in a rotation of row crops

Table 2. Basic characteristics of the 12 representative farms

Characteristic	Livestock farms			Cash grain farms			General farms			Dairy farms		
	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small
Labor (hours)												
Family:												
Jan.-Mar.	718	629	526	432	483	245	1,109	725	955	1,139	887	849
Apr.-May	828	795	712	706	734	471	1,076	714	850	998	867	727
June-July	975	857	771	795	813	497	1,337	824	986	1,048	982	877
Aug.	493	434	391	403	413	252	677	418	502	531	497	445
Sept.-Oct.	832	799	720	714	742	471	1,084	723	865	1,007	870	735
Nov.-Dec.	490	430	362	298	332	165	758	497	655	779	605	581
Hired:												
Jan.-Mar.	92	0	0	30	0	0	0	0	0	80	0	0
Apr.-May	235	13	0	37	7	13	47	0	0	75	20	16
June-July	254	21	0	61	0	0	75	106	6	319	37	85
Aug.	108	4	0	14	0	0	32	33	6	162	10	28
Sept.-Oct.	215	18	1	32	7	13	42	0	6	90	12	19
Nov.-Dec.	85	0	0	20	0	0	30	0	0	60	0	0
Land (acres)												
Cropland:	350	190	115	341	189	118	319	175	120	336	171	115
Corn allotment	152	81	57	119	86	32	118	72	43	118	63	40
Wheat allotment	15	15	15	20	15	15	15	15	15	15	15	15
Permanent pasture	58	18	16	24	25	3	39	26	15	60	25	13
Capital												
Physical assets*:												
Central farrowing (sows)	12	14	12	8	14	0	14	10	9	7	8	0
Portable farrowing (sows)	0	0	0	0	0	0	0	0	0	0	0	0
Central feeding (head)	153	131	104	74	103	0	116	100	91	75	69	0
Portable feeding (head)	0	0	0	0	0	0	0	0	0	0	0	0
Beef housing (steers)	68	38	39	38	28	32	15	0	0	0	0	0
Dairy housing (animal units)	0	0	0	0	0	0	15	13	9	34	20	17
Silo capacity (tons)	226	79	82	50	0	0	112	62	66	209	141	152
Financial assets (dollars):												
Cash	11,420	7,428	5,795	7,834	3,646	6,746	9,392	6,760	9,931	13,722	6,893	5,486
Credit base												
Real estate mortgage	11,568	10,268	6,095	11,517	7,550	10,298	7,523	2,355	7,150	6,985	2,170	4,404
Chattel mortgage	4,410	2,012	1,660	4,392	2,681	1,511	3,229	1,417	2,200	2,195	1,009	1,398
Total	27,398	19,708	13,550	23,743	13,877	18,555	20,144	10,532	19,281	22,902	10,072	11,288

* In addition to these physical assets, adequate hay, straw, feed grain storage space, and machinery were assumed to be available.

for 1 year, small grain for 1 year, and grass-legume seeding down 4 years; and 23 percent in a rotation of row crops for 2 years, small grain for 1 year, and grass-legume seeding down 2 years. Therefore, minimum acreages of each of these crop classes were required in profit-maximizing organizations of the representative farms. The row crop, small grain, and seeding alternatives were corn, flax, and alfalfa-brome, respectively.

As shown in table 2, quantities of physical assets represent the numbers of animals that could be handled in the farm facilities in 1961. Silo tonnages also represent 1961 availabilities. The analysis provided for purchase of additional physical assets if such purchase was profitable with reorganization.

Quantities of financial assets shown in table 2 indicate the initial credit bases available for financing reorganizational expenditures. They were based on 1961 asset-liability positions of the representative farms. The cash represents the sum of demand deposits, nonfarm investments, and the liquidated value of all crop and livestock inventories, minus all short-term debts such as livestock, crop, and household loans.

Guides for establishing credit availabilities were determined with representatives of lending institutions. Available real estate mortgage credit was determined by subtracting the outstanding real estate debt from one-half the value of existing real estate. Available chattel mortgage credit was determined by subtracting outstanding machinery and equipment loans from one-half the value of existing machinery and equipment.

These procedures for handling real estate and chattel credit were based on the assumption that purchases of real estate and machinery were 50 percent self-financed. Other assets were assumed to be self-financed at the following rates: beef cows, 75 percent of purchase cost; dairy cows, 50 percent; beef feeders, 100 percent; dairy facilities, 10 percent; permanent hog, beef, and silo structures, 15 percent; and portable hog and beef structures (e.g., feed bunks), 20 percent. In addition, a sow was assumed self-financed to the extent of one-third the value of her litter at weaning. Costs used for liquid assets, real estate mortgage, and chattel mortgage credit were 4, 5.5, and 7 percent, respectively.[1]

Thus, the initial credit bases were available to finance the purchase of short-term assets (those used up within 1 year) and the non-self-financed portion of intermediate and long-term assets. As farms were reorganized, expenditures could be made for additional assets if: (1) returns to them in the farming enterprises more than offset the above capital costs of 4, 5.5, or 7 percent and (2) there was a supply of unused credit base.

Input-Output Data for Crops and Livestock

The crop and livestock production alternatives considered in this study generally are the strongest competitors for resources in south-

[1] The cost of 4 percent for liquid assets (cash, table 2) means that use of this cash had a cost in farm use. The programming analysis was set up so that if this "cash" failed to earn 4 percent in farming, it was invested in savings at 4 percent.

Hogs often provide excellent opportunities for growth in capital and farm income because they bring a relatively high and quick turnover on initial capital investment. Corn production in southwestern Minnesota serves as the feed base to make hogs an important planning alternative on most farms.

western Minnesota. Crop alternatives for the cropland unrestricted in use by erosion hazards were corn for grain, corn for silage, alfalfa-brome hay, flax, soybeans, and wheat. Livestock alternatives were hogs, beef, and dairy.

Above-average management was assumed; input-output data or coefficients were intended to reflect the management level of the top 10 percent of southwestern Minnesota farmers. Yield expectations, tillage practices, and input requirements for crops were based on information supplied by soil scientists, agronomists, and entomologists. Rates of gain, feed conversion efficiencies, building and equipment costs, and other livestock management practices and input estimates were based on information supplied by animal scientists, agricultural engineers, and other specialists. These input-output data were compared with information in recent reports of Minnesota Farm Management Services and similar sources.

The following assumptions were made concerning the use of crops produced on the farms. Corn for grain could be either sold or fed to livestock. Corn for silage and alfalfa-brome served as livestock inputs; soybeans, flax, and wheat were cash crops. Crops were managed under minimum tillage practices. Although this assumption required the use of conventional equipment, fewer operations than usual were necessary for preparing seedbeds and for tillage.

Table 3. Yields and seeding, fertilizer, herbicide, and insecticide rates, per acre

Item	Alfalfa-brome		Corn		Soybeans	Wheat	Flax
	First year	Succeeding years	Grain	Silage			
Yield	1 ton	3½ tons*	70 bu.	11 tons	25 bu.	35 bu.	15 bu.
Seeding rate	8 lb. alfalfa, 6 lb. brome	0	0.2 bu.†	0.2 bu.†	95 lb.‡	1½ bu.	48 lb.
Fertilizer§:							
Nitrogen	0	0	50	50	0	40	20
P_2O_5	90	70	50	50	20	40	0
K_2O	0	0	12	12	0	0	0
Herbicide (lb. active ingredient or acid equivalent broadcast)	½, (2,4-DB)	0	3†† (atrazine)	3†† (atrazine)	3†† (amiben)	½ (2,4-D amine)	1 (MCPA)
Insecticide (lb. active ingredient)	0	1** (methoxychlor)	1‡	1‡	0	0	0

* If harvested for hay. If used as pasture, yield is adjusted down for losses due to trampling and fouling.

† Provides a plant population of 16,000-18,000 plants per acre.

‡ Assumes 20-inch rows; the planter covers the ground twice.

§ Pounds of nutrient.

†† When chemical is applied in band, 1 pound actually is used per crop acre. Band application was assumed in this study.

** Diazinon (½ pound per acre) is an alternative. Insecticide is applied when second crop is 8-10 inches high for leafhopper control.

‡ Aldrin or heptachlor at 1 pound per acre for wireworms and other soil insects except rootworms. Alternates for aldrin or heptachlor for rootworms in southwestern Minnesota are: diazinon, phorate, parathion, carbaryl, or 0-5353 at about 1 pound actual toxicant per acre applied as granules with planter attachment.

Table 4. Inputs and cropping alternatives for the large livestock farm

Resource	Corn		Soy-beans	Wheat	Flax	Alfalfa-brome	
	Grain	Silage				Hay*	Harvest
Land (acres)	1.00	1.00	1.00	1.00	1.00	10.00	1.00
Labor (hours):							
Apr.-May	0.61	0.61	0.53	0.85	0.71	1.04	0
June-July	0.30	1.30	0.24	0.60	0.74	9.16	6.13
Aug.	0	0	0	0.56	0.56	4.73	1.81
Sept.-Oct.	1.41	3.86	1.01	0	0	0.56	0
Nov.-Dec.	0.66	0	0.14	0	0	0	0
Cash (dollars):							
Seed	2.40	2.40	5.14	3.60	3.73	7.60	0
Fertilizer	13.50	13.50	2.00	9.20	2.60	65.00	0
Herbicide	4.00	4.00	5.00	0.45	0.75	2.50	0
Insecticide	2.00	2.00	0	0	0	14.40	0
Fuel	1.24	1.37	0.86	0.92	0.92	4.31	1.81
Tractor repair and lubrication	1.45	2.55	0.92	0.78	0.78	5.85	3.17
Machine repair and lubrication	0.93	0.32	0.82	0.98	0.98	2.83	1.06
Custom hire	0	12.30†	0	1.00‡	1.00‡	0	0
Twine§	0	0	0	0	0	0.70	2.10
Total	25.52	38.44	14.74	16.93	10.76	103.19	8.14

* This process provides for establishment of seeding, harvest of hay crop in year of seeding, and maintenance of stand for 9 years.
† Field chopping.
‡ Swathing.
§ Cost incurred only on farms with balers.

Table 3 summarizes expected yields and seeding, fertilizer, herbicide, and insecticide rates for each crop. Table 4 summarizes the cash costs associated with the seeds, fertilizer, herbicides, and insecticides in table 3, along with other cash costs and labor inputs for each crop alternative on the large livestock farm.

Labor, fuel, lubrication, and repair requirements differed among representative farms, depending on machinery size and whether baling was custom hired. Only the large cash grain, large livestock, and medium and large dairy farms had balers; therefore, they did not require the custom harvest of hay. Field chopping and swathing were custom hired on all farms.

The livestock enterprises considered as alternatives were similar for all representative farms. Resource requirements for each enterprise were assumed to be the same for all farms save for the exceptions noted.

HOGS—Hog production activities were considered as alternative one-litter hog systems including both the farrowing and feeding phases. These activities differed as farrowing could occur in each quarter of the year and a choice of facilities and equipment was available (see table 5). Each activity was an independent 1-year production cycle including one farrowing, feeding out of the litter to market weight, disposal of the cull sow, and care of the replacement gilt.

A litter size of eight pigs was assumed, with seven sold at 6 months weighing 225 pounds each and one gilt kept for replacement. The sow

was sold 3 months after farrowing at 400 pounds.

BEEF COW HERD—The beef cow-calf enterprise included the option of a ration with or without corn silage (see table 6). A 95-percent calf crop was raised; calves weighing about 430 pounds were transferred to the feedlot in late October. One replacement heifer was kept per year for each six cows in the herd.

CATTLE FEEDING—Several alternative cattle feeding programs were considered (see tables 7 and 8). For each program, there was a choice between a low mechanization system using ordinary hand feeding methods and/or a high mechanization system with materials-handling equipment. The inclusion of corn silage in the ration was also an option.

Two distinct calf feeding systems were included. Both consisted of purchase, or transfer from the beef cow herd, of a 430-pound good to choice feeder calf in late October. In both systems, calves were wintered

Table 5. Resource requirements for hog production, per litter*

Resource	Central farrow, confinement finish	Central farrow, portable finish	Portable farrow and finish
Corn equivalent (cwt.)	59.25	59.32-62.78	59.32-62.78
Protein supplement (cwt.)	11.96	11.68-12.30	11.68-12.30
Pasture, pasture days (animal unit)	0	13-20	15-25
Nonfeed cash expenses (dollars):			
Power and equipment	12.00	12.00	12.00
Miscellaneous	9.00	9.00	9.00
Annual building costs†	24.20	16.68	8.01
Depreciation‡	30.27	27.87	19.97
Labor (hours)	13.33	13.33-14.68	13.67-15.02

* Where a range is given, the variation arose from differences in requirements among seasonal quarters.

† If two litters use the same facilities, these figures should be cut in half.

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

Table 6. Resource requirements for beef cow herd, per cow

Item	Amount	
	Without silage	With silage
Corn equivalent (cwt.)	2.69	2.69
Protein feed (cwt.)	0.98	0.98
Hay (cwt.)	50.85	32.85
Corn silage (cwt.)	.....	54.00
Pasture equivalent (cwt.)	40.04	49.04
Miscellaneous cash cost (dollars)*	15.23	15.23
Manure credit (dollars)	7.30	7.30
Labor (hours)	25.00	25.00
Expanding housing (annual cost) (dollars)†	3.93	3.93

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

† Cost incurred only when size of enterprise exceeds available space.

Table 7. Feed requirements for feeder cattle, per head

Feed	Calves, drylot		Calves full fed on pasture		Yearlings	
	Without silage	With silage	Without silage	With silage	Without silage	With silage
	cwt.					
Protein feed	3.15	3.80	2.55	2.87	1.80	2.52
Corn equivalent	28.95	25.80	34.65	31.50	29.70	26.10
Hay equivalent	16.50	11.00	15.65	11.55	7.20	3.60
Corn silage	.....	31.30	.....	21.90	.....	18.00
Pasture (hay equivalent)	.....	.....	22.00	22.00	.....	.....

Table 8. Resource requirements for feeder cattle, per head

Resource	Calves, drylot		Calves full fed on pasture		Yearlings	
	High mechanization	Low mechanization	High mechanization	Low mechanization	High mechanization	Low mechanization
	dollars					
Power and equipment	5.04	4.20	5.31	4.42	3.22	2.69
Shelter and miscellaneous	4.08	4.08	4.29	4.29	2.87	2.87
Investment (annual cost):						
Housing	2.55	2.55	2.55	2.55	2.55	2.55
Feeding facilities	5.87	0.89	5.87	0.89	5.87	0.89
	hours					
Labor*	5.91	11.12	5.19	10.43	3.54	6.65
Labor†	4.42	8.83	3.88	7.73	2.63	5.28

* Requirements for a lot size of 50 head for low mechanization and 100 head for high mechanization. These values were used when considering alternatives for all farms except the large livestock farm.

† Requirements for a lot size of 100 head for low mechanization and 200 head for high mechanization. These values were used when considering alternatives for the large livestock farm.

in drylot on a ration of grain, protein supplement, and forage until mid-March. The forage could be hay or a combination of hay and corn silage.

Animals were finished with a full feed of grain in drylot. Under one system, they remained in drylot throughout the summer and were marketed in early September at 1,030 pounds. In the alternative system, animals were placed on good pasture in mid-May, full fed grain while on pasture, and finished in drylot at a weight of 1,110 pounds. They were marketed in late October.

The yearling steer feeding program lasted 180 days and could be started in October or April. Steers could be fed in either or both periods. They were purchased at 693 pounds and sold at 1,089 pounds.

DAIRY—A dairy enterprise with stanchion barn housing was an alternative (see table 9). Winter forage could be supplied by either

Table 9. Resource requirements for dairy herd, per milk cow

Item	Unit	Amount
Protein feed	Cwt.	2.84
Corn equivalent	Cwt.	30.52
Hay equivalent*	Cwt.	94.80
Pasture (hay equivalent)	Cwt.	47.40
Miscellaneous cash costs†	Dollars	45.76-50.66
Labor‡	Hours	135
Labor§	Hours	101
Labor††	Hours	96
Labor¶	Hours	84
Labor**	Hours	71

* Hay equivalent may be provided by hay or by 47.40 cwt. hay and 142.20 cwt. corn silage.

† Range is due to variation arising from size of herd. Costs are slightly lower per head for larger herds. This item includes breeding fees, annual cost of building and equipment, electricity, and veterinary expenses.

‡ For a 10 cow dairy herd—assumed for large, medium, and small livestock farms; large, medium, and small cash grain farms; and medium and small general farms.

§ For a 17 cow dairy herd—assumed for large general farm.

†† For an 18 cow dairy herd—assumed for small dairy farm.

¶ For a 26 cow dairy herd—assumed for medium dairy farm.

** For a 41 cow dairy herd—assumed for large dairy farm.

hay or hay and corn silage. Dairy cows were assumed capable of producing 10,000 pounds of 3.5-percent fat corrected milk when fed a concentrate ration of 1 pound grain to 4 pounds milk.

Prices

The planning period in the study encompassed 1963-70. Price projections were set at a level most apt to prevail on the average during this period (see table 10). However, emphasis was placed on projecting a *relationship* of prices with a strong likelihood of occurrence. As a basis for this projection, past price relationships adjusted for recent trends were used; it was assumed that neither pronounced inflation nor deflation would occur.

In addition to prices shown in table 10, two alternate prices were assumed for corn, hogs, and beef—one lower, hereafter called the low price, and one higher, hereafter called the high price. Corn, hogs, and beef were selected for this detailed treatment because they generally are the most important agricultural products in the study area.

In terms of recent prices, the high prices used for hogs and beef may not appear high. But the high hog and beef prices used were quite high relative to the low corn price used. And the major emphasis in setting prices was to be as realistic as possible with relative prices. First, the range in corn prices was set after considering how high and how low corn prices might go. The medium corn price was set midway between these two extremes. Hog and beef prices then were set in relation to these corn prices on the basis of past price relationships.

The low, medium, and high prices for corn were $0.70, $0.90, and $1.10, respectively, per bushel sold. For hogs, the low, medium, and

high prices were $11.64, $14.00, and $16.96, respectively, per cwt. of barrows and gilts. For beef, the low, medium, and high prices were $15.74, $19.90, and $24.60, respectively, per cwt. of choice slaughter steers. The purchase price for corn was adjusted accordingly. Therefore, it is possible to see both:

♦ The nature of the most profitable farm organizations under the most likely future average prices—the medium prices.

♦ The effect on organizations and incomes of farms if less likely but still feasible low and high prices occurred.

Table 10. Assumed prices, inputs and outputs

Input	Price
Seed:	
Corn (bu.)	$12.00
Soybeans (bu.)	3.25
Wheat (bu.)	2.40
Alfalfa (lb.)	0.65
Brome (lb.)	0.40
Flax (lb.)	0.08
Fertilizer (lb):	
N	0.13
P_2O_5	0.10
K_2O	0.05
Protein feeds (cwt.):	
Soybean meal	3.88
Hog supplement	4.75
Herbicides, insecticides (lb.):	
2,4-D amine	$ 0.90
2,4-DB	5.00
Atrazine	4.00
Aldrin	2.00
Methoxychlor	1.60
MCPA	3.00
Amiben	5.00
Gasoline (gal.)	0.18

Input	Price
Labor, hired (hour)	$ 1.00
Custom work hired:	
Swathing (acre)	1.00
Baling (bale)	0.10
Chopping silage (hour)	10.00
Land purchase (acre)	170.00
Livestock housing and equipment (new cost):	
Hogs	
Farrowing (sow)	
Confinement	275.78
Portable	58.94
Finishing (feeder pig)	
Confinement	41.14
Portable	17.65
Beef (steer)	
Housing	51.03
Feeding equipment	
High mechanization	58.66
Low mechanization	8.90
Dairy (animal unit)	529.31
Silo (ton)	16.00

Output	Price
Hogs* (cwt.):	
Barrows and gilts	$14.00
Sows	11.90
Beef cattle* (cwt.):	
Choice slaughter steers	19.90
Cull cows	11.30
Feeder calves†	21.00
Feeder yearlings‡	19.90

Output	Price
Crops (bu.):	
Soybeans	$1.93
Wheat	1.50
Flax	2.80
Corn	
Sold from farm	0.90
Bought for farm	1.00
Milk, manufacturing (cwt.)	3.00

* Seasonal price differentials were taken into account for both hogs and beef cattle.

† Feeder calf prices were set at $1.10 above choice slaughter steer prices. This average margin was reported in the annual Minnesota Department of Agricultural Economics report on "Feeder Cattle, Costs and Returns" for 1951-60.

‡ Yearling feeder steer prices were set at $0.90 below choice slaughter steer prices on the basis of information in the above mentioned reports.

Farm Organization and Adjustment Guides

The reorganization of farms for increased incomes is influenced by several factors. Three were considered in this analysis: type of farm, size of farm, and output price. Consideration was in terms of how these factors influenced production patterns, resource use, and incomes. The influence of each factor was isolated by holding the other two factors constant. For example, the influence of farm type on reorganization was examined with size of farm and output price held constant.

Farm reorganization with only adjustments on the intensive margin permitted is discussed first. Afterward, the effect of permitting adjustments on both intensive and extensive margin is examined.

Changes on the Intensive Margin Only

Crop Production Patterns

Table 11 summarizes the use of cropland in the 1961 and optimal (under medium prices) organizations for each representative farm. Acreages falling into the "other" cropland category in the optimal plans were less than in the 1961 organizations. This situation resulted because the assumed participation rate in the feed grain program was reduced in reorganization. Therefore, fewer crop acres were diverted, and diverted acres were classified as "other" cropland.

Moreover, in reorganization, the only small grains permitted were wheat and flax. But in 1961, several other small grains such as oats and barley were grown; these were classified as "other" cropland. In reorganization, 1961 acreages in crops such as oats and barley were available for the production of wheat, flax, and the other cropping alternatives.

Crop production patterns in optimal farm plans were influenced much more by land use restrictions and resource availabilities on individual farms than by type of farm. All farms, when reorganized for maximum profits, had diversified cropping systems of corn, soybeans, wheat, flax, and alfalfa-brome except the small cash grain farm which had no soybeans. All farms produced wheat up to the nonallotment limit; this fact meant slight increases in wheat acreages from 1961 levels. All farms, except the medium general and medium dairy, produced corn up to their corn allotment limits. These exceptions possibly reflected relative capital shortages on these two farms. Given these limitations, returns were higher by reorganizing with substantial increases in soybeans than with full use of corn allotments to produce livestock.

Most reorganized farms showed slight increases in flax over 1961 levels. Nevertheless, in all plans, flax occupied relatively few acres except in the profit-maximizing plans of the large and small cash grain farms. The entrance of flax into optimal plans perhaps was due most to the labor shortage in the sixth period (November-December). Sixth-period labor was used up on most farms; soybeans required sixth-period labor and flax did not. Supplies of sixth-period labor were especially short

Table 11. Use of cropland, 1961 organizations versus optimal organizations under medium prices, 12 representative farms

Farm	Corn for grain		Soybeans		Wheat		Alfalfa-brome		Flax		Other cropland*		Total cropland
	1961	Optimal	1961	Optimal	1961	Optimal	1961	Optimal	1961	Optimal	1961	Optimal	
	acres												
Livestock:													
Large	137	152	31	103	11	15	46	47	28	19	97	14	350
Medium	73	81	21	49	7	15	24	32	12	10	53	3	190
Small	49	57	8	7	2	15	15	28	5	6	36	2	115
Cash grain:													
Large	106	119	53	52	18	20	23	31	29	100	112	19	341
Medium	74	86	33	47	11	15	8	27	9	10	54	4	189
Small	29	32	30	0	10	15	5	10	6	50	38	11	118
General:													
Large	103	118	35	106	9	15	48	51	12	17	112	12	319
Medium	63	58	26	68	5	15	18	22	6	9	57	3	175
Small	30	43	17	8	6	15	17	44	4	7	46	3	120
Dairy:													
Large	104	118	21	112	12	15	61	71	10	18	128	2	336
Medium	56	40	5	61	8	15	36	43	6	9	60	3	171
Small	34	40	6	3	7	15	22	50	7	6	39	1	115

* Acres in feed grain diversion; for 1961 organizations, acres in oats, barley, other small grains, and nonuse as well.

on the two cash grain farms with the larger acreages of flax in their optimal plans.

When reorganized for maximum profits, all large and medium farms showed substantial increases in soybean acreages except the large cash grain which showed a large increase in flax. On the other hand, all small farms were reorganized with less acreage in soybeans.

Irrespective of size, all farm types increased alfalfa-brome acreages when reorganized for maximum profits. Dairy farms, the largest alfalfa-brome producers prior to reorganization, retained this position in optimal plans.

Therefore, farm type influenced cropland use for alfalfa-brome. And, to the extent that size of corn allotment was related to farm type, farm type also influenced use of land for corn. Otherwise, it did not significantly affect crop production patterns. The livestock farms, large and small, had the largest corn allotments. Since reorganization almost always called for maximum use of these allotments, these farms remained the largest corn producers.

Of course, size of farm (measured in crop acres) was positively correlated with number of acres for each crop. Acres of each crop increased with farm size both in 1961 organizations and reorganized plans.[2] But crop production patterns, in terms of *kinds* of crops produced, were essentially the same in both 1961 and reorganized plans (except "other crops," see page 17). However, farm size influenced the direction of the most profitable adjustments concerning acreages of particular crops.

In reorganization, soybean acreages increased substantially on all medium and large farms except the large cash grain. On small farms, soybean acreages decreased. At the same time, alfalfa-brome acreages showed much larger relative increases on small than on medium and large farms. Apparently, returns on small farms were higher from devoting land to feed for livestock than from using it to increase soybeans for cash sales.[3]

Generally, acreages of individual crops were rather insensitive to changes in the price of corn, or of hogs, or of beef. Alfalfa-brome acreages were the most sensitive; they fluctuated in direct response to variations in livestock forage requirements which varied in response to changing hog and/or beef prices.

Although farm reorganization provided the opportunity to sell corn as a cash crop, this alternative was seldom most profitable. Rather, farm-raised corn usually was consumed on the farm by livestock, implying that the relationship between corn acreage and corn price was indirect.

In reorganization, profits usually were maximized by expanding corn and wheat acreages to the extent of their allotments. This outcome essentially meant that corn and wheat acreages were insensitive to changes in corn, hog, and beef prices. Nevertheless, as expected, the

[2] Wheat acreages in optimal plans were exceptions because nonallotment acreage was not a function of farm size.

[3] The small cash grain, general, and dairy farms had more financial assets than their medium counterparts.

earning power of an additional acre of corn allotment increased as the corn price increased; the earning power of an input should increase with increases in the price of the output in whose production it is used. Therefore, if the analysis had permitted purchase of additional corn allotments, corn acreages may have varied with changes in hog and/or beef prices.

Since corn and wheat acreages were rather stable irrespective of changes in corn, hog, and beef prices, changes in soybean and flax acreages were associated primarily with changes in alfalfa-brome acreages.

The land use adjustments discussed above have the following implications for profitable farming. Since limitations were established on maximum corn and wheat acreages, these crops are discussed separately.

Profits usually were maximized by expanding wheat and corn acreages to the full extent permitted by allotments or nonallotment restrictions. How much further these crops would have expanded without acreage limitations can only be answered with another analysis. But the full allotments typically were used, thereby indicating that wheat and corn were relatively strong competitors for resources. Corn was a stronger competitor than wheat, because the per acre earning power of corn allotments generally exceeded that of wheat allotments.

Implications of changes in alfalfa-brome, flax, and soybean acreages are less clear than for corn and wheat. The greatest expansion on two farms was in flax; on four farms, in alfalfa-brome; and on six farms, in soybeans. Moreover, 7 of the 12 profit-maximizing organizations had more acres of soybeans than of flax or alfalfa-brome. Increases in alfalfa-brome acreages primarily resulted from substantial increases in beef feeding operations. So, once forage requirements were met, soybeans were stronger and more consistent than flax in bidding for resources.

In short, corn and soybeans—once livestock forage requirements were met—generally were the most profitable crop alternatives. This finding appears to be consistent with recent trends toward increased corn and soybean acreages in southwestern Minnesota. However, flax should not be overlooked as a planning alternative.

Livestock Production Patterns

Table 12 summarizes the numbers of livestock in 1961 and profit-maximizing organizations under medium prices for each representative farm. Before further discussion, some comments are necessary concerning production methods used in optimal farm plans.

In beef production, the calf, drylot, low-mechanization system predominated. In fact, on all farms except the large and small cash grain, this system was the only one used. On the small cash grain farm, the most profitable beef system was second-period (placed on feed in April) yearlings under low mechanization. The large cash grain farm had a combination of calf, drylot, low mechanization and second-period yearlings, high mechanization. These deviations from the most common feeding system resulted from shortages of sixth-period labor supplies.

Table 12. Livestock numbers, 1961 organizations versus optimal organizations under medium prices, 12 representative farms

Farm	Sow farrowings		Fat cattle sold*		Beef cows		Dairy cows	
	1961	Optimal	1961	Optimal	1961	Optimal	1961	Optimal
Livestock:								
Large	12	51	57	184	11	0	2	0
Medium	20	31	25	131	4	0	4	0
Small	12	14	23	114	3	0	3	0
Cash grain:								
Large	5	23	5	134	5	0	2	0
Medium	3	14	2	114	3	0	0	0
Small	0	37	0	51	1	0	0	0
General:								
Large	11	15	3	128	3	0	14	16
Medium	9	16	1	36	0	0	9	10
Small	6	13	1	115	1	0	9	9
Dairy:								
Large	4	18	1	92	0	0	34	30
Medium	10	15	0	15	0	0	22	20
Small	2	0	0	51	0	0	16	17

* Survey schedules did not distinguish between calves and yearlings. In optimal organizations, all fat cattle were calves at the beginning of the feeding period, except on the large and small cash grain farms where there were 17 and 51 yearlings, respectively.

Second-period yearlings (purchased April 10 and sold October 9) required no sixth-period labor. When they occurred in profit-maximizing farm organizations, available sixth-period labor supplies were exhausted and the earning power of an additional hour of this labor was over $10.

High-mechanization feeding systems required less labor and more capital than did low-mechanization systems. Therefore, greater profitability from a high-mechanization system could be expected when the labor supply was short relative to capital in reorganization plans. On the large cash grain farm, with steers fed out under high mechanization, sixth-period labor was particularly short while capital was not.

The hog systems that generally predominated under medium prices were confinement facilities, because they were part of the initial resource endowments of these farms. However, on five farms, profits were maximized by adding portable farrowing and finishing facilities and by handling hogs under both portable and confinement systems.

On the large and medium livestock farms, hog facilities were used throughout the year. On the other farms where hogs were produced, first-quarter hogs always entered optimal plans but hog facilities rested idle in at least one quarter. The third quarter was most often voided due to the seasonality of hog prices; prices were highest for the first-quarter system and lowest for the third-quarter system. Farm organizations were sensitive to this variation.

Rations of dairy cows and steers in profit-maximizing farm organizations included no silage. Moreover, beef-breeding cow herds did not enter the most profitable plans under medium prices on any farm.

With these comments, discussion can now move to the influences of farm type, size of farm, and output price on livestock patterns. As with

crops, one factor was varied at a time.

Beef production patterns definitely were influenced by farm type. In both the 1961 and optimal plans, livestock farms were the heaviest beef producers while dairy farms were the lightest. Farm type had less influence on pork production. Nevertheless, livestock farms were the heaviest pork producers prior to reorganization and they tended to maintain that position under optimal plans. Only the small dairy farm produced no pork when optimally organized.

Dairying was strongly influenced by farm type. Dairying of any significance only appeared in the 1961 and optimal plans of the general and dairy farms. And almost twice as many cows were on the dairy as were on the general farms. The profitability of dairying on these farms was due to the dairy facilities in their initial resource endowments and to relatively low assumed dairy labor requirements. Similarly, the profitability of beef and, to a degree, of hogs on the livestock farms was explained by the facilities that initially existed on these farms.

On the livestock farms, the number of cattle fed increased with farm size under both 1961 and optimal plans. On dairy and general farms, the same relation held between the number of dairy cows and farm size. But farm size had no clear influence on existing livestock production patterns nor on adjustments of these patterns to optimal plans. However, small farms experienced the largest relative increases in beef production when adjusting to optimal plans.

The significance of changes in output prices (beef, hogs, and corn) is whether they essentially call for extensive modifications in a farmer's adopted plan. For example, a farm manager might adjust quite readily to changes in output price if he simply has to adjust slightly the levels of his present enterprises. But adjustments can be difficult if they mean extensive changes in the levels of enterprise operation. When longrun profit is concerned, the manager must consider the likelihood and ex-

Cattle feeding can be an important income-improving alternative, particularly for farmers with the feed or feed sources and the capital and management to withstand the risks. The resource situation on many southwestern Minnesota farms suggests consideration of cattle feeding as a planning alternative.

pected duration of price changes as well as the kinds of adjustments required if prices do change.

Beef and pork production were strongly influenced by the hog price relative to the beef price. With minor exception, farm organizations under a hog-beef price ratio favorable to beef were specialized in beef production; those under a price ratio favorable to pork were specialized in pork production. The criterion for specialization was 80 percent or more of the total weight of beef and pork produced from one or the other commodity. The implication was that the quantity of beef produced increased in response to a decreasing hog price as well as to an increasing beef price, while opposite patterns in pork production took place.

For the pricing situations considered, the large livestock farm was the heaviest producer of both beef and pork; the medium dairy farm generally was the lightest producer. However, beef completely dropped out on the (1) small livestock, small and medium general, and all dairy farms under low beef prices and (2) small general and all dairy farms under high pork prices. Pork dropped out of all farm organizations under low pork prices as well as on the small cash grain, medium and small dairy, and all general farms under high beef prices.

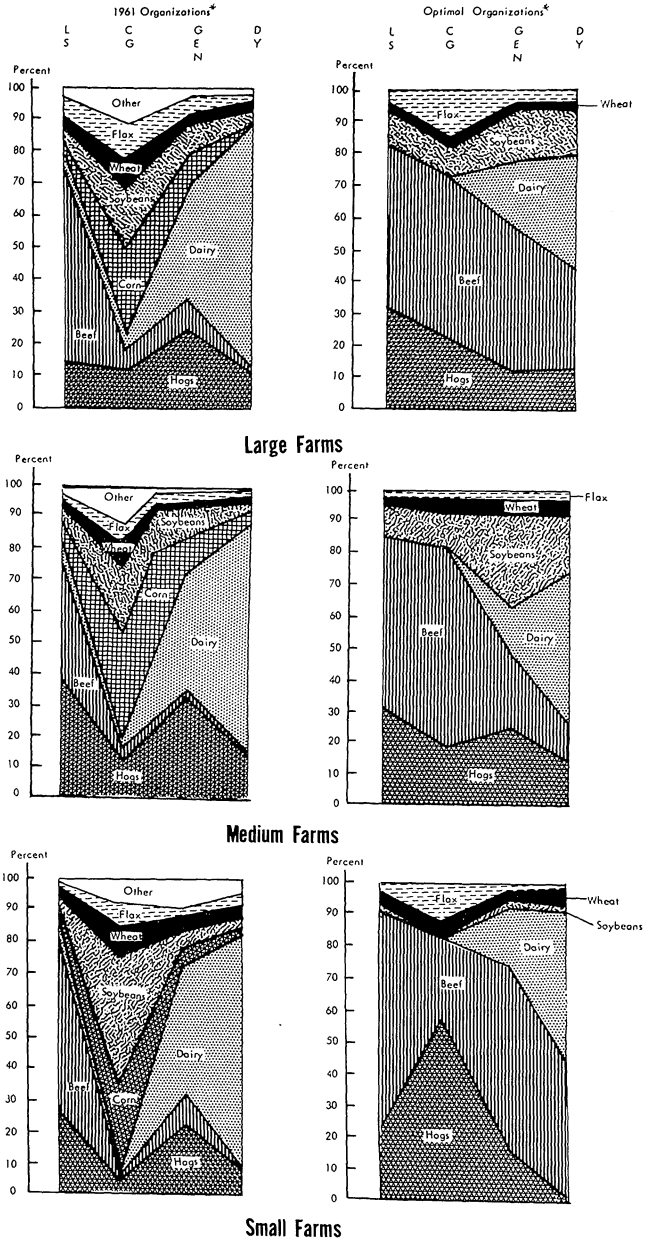
Beef and pork production were much less sensitive to price changes of corn than of beef and pork. The general sensitivity of dairy cow numbers to changes in corn, hog, and beef prices was low, because dairy production was only indirectly related to these prices. Furthermore, in many reorganization plans, dairy facilities in initial resource endowments served as effective upper bounds on dairy expansions.

Comparison of 1961 and optimal livestock production (see table 12) shows that numbers of sows farrowed and fat cattle sold were substantially larger on reorganized farms, except for sows on the small dairy farm. Beef cow herds completely dropped out of profit-maximizing organizations. Dairy cows also were excluded from optimal plans of livestock and cash grain farms. Dairy cow numbers on general and dairy farms changed little; no change involved more than four cows. Implications of the adjustments became apparent after comparing how much the major enterprises contributed to gross incomes in 1961 and profit-maximizing organizations (see the figure).

The figure shows that one significant adjustment in farm reorganization was an increased emphasis on hog and beef production—and beef more than hogs. Under medium prices and on the basis of the classification system initially used to stratify farms by type, all farms except four became livestock farms. The medium general farm maintained its classification; hogs, beef, and dairy each contributed just under 25 percent to gross income and soybeans contributed just under 20 percent.

The three other exceptions were the dairy farms. Although the relative importance of dairying decreased in the profit-maximizing organizations, the medium and small farms maintained their dairy classification with just over 50 percent of their gross incomes from dairy. The large dairy farm became a general farm, but the largest single source of income continued to be dairy.

Hogs and beef gained at the expense of cash crops as well as dairy.



* LS=livestock farms, CG=cash grain farms, GEN=general farms, and DY=dairy farms.

Percent of total gross farm income from various enterprises: 1961 (existing) farm organizations compared with optimal farm organizations (under medium prices), 12 representative farms, by size and type. The primary sources of "other" income in the 1961 organizations were from the sale of sheep, lambs, wool, oats, and barley. Poultry income and feed grain and conservation reserve payments were not included in any of the gross income data.

In particular, percentages of gross income earned by cash crops decreased on all farms except the large and medium dairy. The cash grain farms adjusted most; in the profit-maximizing plans of these farms, the income shares from sale of cash grain were 50 to 75 percent less than in the 1961 farm plans.

Corn was the cash crop that generally required the greatest adjustment. It was an important source of cash sales in the 1961 farm plans, but no corn was sold in any of the profit-maximizing plans. In reorganized farms, the maximum percent of income earned by wheat was only 5.5 and by flax (except for the large and small cash grain farms) only 2.3. For all farms except the large cash grain and the small farms, soybeans was the primary cash crop.

In short, under medium prices, it was profitable to devote more resources to producing hogs and beef and less to producing milk and cash crops. Apparently, recent trends toward fewer dairy cows and more hogs and beef in southwestern Minnesota are consistent with this outcome.

Capital Resource Use[4]

Table 13 summarizes the expenditures required to reorganize representative farms for maximum income under medium prices. In the reorganization of all farms except the small cash grain, initial cash and credit bases were exhausted.

Beef facilities were added on all farms. Hog facilities were added on only six of the representative farms, and on only three of these was the investment more than $2,000. The combined investment in additional housing and equipment for hogs and beef ranged from $900 on the medium dairy to over $13,000 on the large cash grain farm. As a class, cash grain farms required the greatest investments in these livestock facilities and dairy farms the smallest.

The magnitude of these investments increased with the size of the livestock farms. But of the other types, small farms invested more than the medium farms. This situation was not surprising; the small cash grain, general, and dairy farms had greater potential for increasing capital use due to their larger initial cash and credit bases than did the medium farms of these types.

Investments in dairy cows yielded maximum profits only on general and dairy farms. For no farms were profits maximized by investing in beef cows, dairy housing, or silage storage space.

The *total* additional capital investment needed for profit-maximizing reorganization ranged from about $34,000 on the large livestock farm to about $4,000 on the medium dairy (see table 13). As a class, cash grain farms had the largest absolute and relative increases while dairy farms had the smallest. Although a sharp increase in livestock feeding was the most significant aspect of the overall adjustment process, dairying remained important in optimal plans of dairy farms, thereby curbing

[4] Resource data were exclusive of inputs used by poultry flocks on farms in 1961.

Table 13. Farm investments, 1961 organizations versus optimal organizations under medium prices, 12 representative farms*

Farm†	1961	Optimal	Optimal minus 1961	
			Dollars	Percent of 1961
Livestock:				
Large	$73,206	$107,453	$34,247	46.8
Medium	55,388	65,451	10,063	18.2
Small	28,234	45,656	17,422	61.7
Cash grain:				
Large	50,317	82,558	32,241	64.1
Medium	25,512	46,917	21,405	83.9
Small	28,819	49,044	20,225	70.2
General:				
Large	53,184	78,410	25,226	47.4
Medium	23,920	34,196	10,276	43.0
Small	31,872	58,791	26,919	84.5
Dairy:				
Large	59,768	79,816	20,048	33.5
Medium	29,464	33,478	4,014	13.6
Small	31,664	43,159	11,495	36.3

* Included in these investment figures are investments in the following intermediate and long-term assets: land, farm and nonfarm buildings, livestock-handling equipment, machinery, dairy cows, and beef cows. Also included are expenditures for the following short-term assets: purchase of hogs and feeder cattle, feed, electricity, seed, fertilizer, insecticides, herbicides, fuel, tractor and machinery repair and lubrication, custom work hired, and variable costs associated with the use of buildings and equipment by livestock.

† Capital was limiting; initial cash-credit bases were exhausted in the reorganization of all farms except the small cash grain. On the excepting farm, there were $2,560 of unused chattel mortgage credit base.

the additional investment for livestock feeding. On the other hand, cash grain farms made far-reaching changes that required large investments for livestock feeding.

The largest absolute increases in total capital for farm reorganization typically occurred on large farms, followed by the small and then the medium farms. However, increases in total additional capital relative to the amounts used in 1961 were usually largest on small farms. Despite the differences in additional capital expenditures for reorganization, the major point manifesting itself in table 13 is the large expanded capital requirement for nearly all farms.

Again the significance of changing output or product prices to a farm manager depends largely on whether he can readily adjust. Farm plans and investments based on infrequently occurring product prices or product price ratios can place a farmer at a serious income disadvantage. Farm plans based on investments highly specialized in use eliminate or reduce shifts in resource use necessary for taking advantage of changing prices. Investments in intermediate and long-term assets particularly concern farm managers faced with changing product prices. This study provided some information on how changing corn, hog, and beef prices influenced investments in livestock facilities.

As the price of beef rose, investments in beef housing increased while investments in hog facilities decreased. As the price of hogs rose, investments in hog facilities generally increased while investments in

beef housing decreased. On no farm was it profitable to add hog facilities under either high beef prices or low hog prices. Neither was it profitable to add beef housing under low beef prices.

However, under high hog prices, adding some beef housing was profitable on six of the representative farms. As the corn price varied, consistent patterns in investment levels in hog or beef facilities did not become manifest. Investments in dairy cows were relatively unresponsive to changes in corn, hog, and beef prices, as were investments in beef cows, silo space, and dairy housing.

The profitability of expanding hog and/or beef facilities depended greatly on the hog-beef price ratio. Therefore, farm managers will want to build their longrange plans on as accurate a determination as possible of the future hog-beef price relationship. Also, as a hedge against change, farmers may want to plan for some flexibility in their use of these facilities.

Labor Use

Table 14 summarizes the hours of labor used by periods in profit-maximizing organizations (medium prices) on representative farms. This table also shows periods in which labor was limiting—when supplies were completely exhausted.

Initial supplies of family and hired labor represented average levels of 1961 use; labor use could not be increased beyond these levels on the reorganized farms. Therefore, only in those instances where labor was limiting was the amount of labor used in profit-maximizing organizations the same as that used in 1961 organizations. But since labor

Table 14. Labor used by period, optimal organizations under medium prices, 12 representative farms

Farm	Period of year					
	1st	2nd	3rd	4th	5th	6th
	hours					
Livestock:						
Large	799	899	1,199	471	656	575*
Medium	590	645	856	369	487	430*
Small	469	520	715	291	279	315
Cash grain:						
Large	432	598	795	338	447	318*
Medium	464	543	717	286	391	332*
Small	245*	361	453	206	281	166*
General:						
Large	1,013	973	1,278	516	858	732
Medium	679	596	692	298	623	497*
Small	803	726	942	401	435	543
Dairy:						
Large	1,114	998	1,311	528	955	839*
Medium	699	559	712	302	586	503
Small	709	577	747	324	433	509

* Labor was limiting; supplies were completely exhausted.

was limiting in only a few cases on reorganized farms, levels of labor used in reorganization were generally less than 1961 levels. Sixth-period (November-December) labor was most critical, with the incidence of limitations greater on: (1) cash grain and livestock farms than on general and dairy farms and (2) large and medium farms than on small farms.

Changing hog and beef prices also influenced labor use. A hog-beef price ratio favorable to beef was necessary for third-period labor to become limiting. Under these prices, farms specialized in beef production with calves and second-period yearlings on drylot feed.

To summarize, the key change in the input mix from reorganizing farms for highest profits was the increased use of capital; labor requirements were the same as or less than those in 1961 organizations. This outcome coincides with changing patterns in resource use actually taking place on Minnesota farms.

Incomes

Table 15 summarizes the levels of income accruing to 1961 and profit-maximizing organizations (under medium prices) for representative farms. Because of insufficient detail in the cost data reported on survey schedules, net incomes were not reported for 1961 organizations.

Income improvements from reorganization can be measured only by comparing estimated 1961 gross incomes with optimal gross incomes. To the extent that 1961 prices differed from the medium prices used in this analysis, comparisons were in error. But most 1961 selling prices were higher than those used, so comparisons probably underestimated potential income improvement.

Reorganization improved gross incomes on all representative farms—from $5,700 on the small dairy to over $18,000 on the large general farm. Absolute increases in gross incomes varied little among types of large farms. Although the variation was considerable among types of medium and small farms, it had no consistent pattern. Therefore, farm type probably had neither a strong nor consistent influence on the absolute amounts by which gross incomes increased due to reorganization.

Nevertheless, a look at relative increases in table 15 suggests that cash grain and general farms generally improved gross incomes most and dairy and livestock farms least. However, these differences by type should not overshadow the most significant fact—that gross incomes on all reorganized farms were from one and a half to over four times their 1961 levels.

Size of farm strongly influenced income levels. Both gross and net incomes increased with size of farm; income differentials were higher between medium and large than between small and medium farms.[5] Of course, these relationships reflected differences in resource availabilities;

[5] The one exception to this positive correlation was that the small general had a larger gross income than the medium general farm when both were optimally organized; the small general had a much larger cash and credit base than the medium general farm.

Table 15. 1961 gross income and net and gross incomes in optimal organizations under medium prices, 12 representative farms*

Farm	Optimal organization		1961 gross	Ratio of optimal to 1961 gross income
	Net†	Gross		
Livestock:				
Large	$21,913	$42,130	$24,893	1.69
Medium	13,121	27,279	16,056	1.70
Small	8,741	18,579	10,634	1.75
Cash grain:				
Large	17,016	29,533	13,054	2.26
Medium	11,881	20,946	7,312	2.86
Small	6,398	17,178	3,946	4.35
General:				
Large	20,144	31,912	13,622	2.34
Medium	11,131	17,124	8,600	1.99
Small	9,879	22,503	7,570	2.97
Dairy:				
Large	22,652	35,010	18,444	1.90
Medium	11,294	16,739	10,697	1.56
Small	8,413	14,294	8,590	1.66

* Income figures are exclusive of feed grain and conservation reserve payments and poultry income. In terms of 1961 organizations, the farm with the largest gross income from these sources was the small general ($2,179); the farm with the smallest such income was the medium livestock ($484). Also, for purchased feeder cattle, gross income has reference only to value-added; it does not reflect the sale of the poundage embodied in the purchased feeder.

† Net incomes in this analysis are net of cash operating expenses including interest on borrowed capital plus fixed and variable costs on added livestock facilities and equipment. However, (a) real estate taxes, property taxes, insurance and depreciation on existing facilities and equipment, and (b) returns to operator and family labor and to owned capital were not deducted from these net incomes.

larger farms had much greater quantities of initial resources than did smaller farms. And the income significance of having plenty of resources became clearly evident in this analysis.

In optimal farm organizations, a strong positive correlation existed between net incomes and prices of both hogs and beef. This situation was expected since hogs and/or beef were important outputs in most farm organizations. Therefore, as hog or beef prices rose, incomes should have increased.

On the other hand, an inverse correlation generally existed between net incomes and corn prices. Since corn usually was a purchased input, net incomes should have increased as the corn price dropped. Incomes varied more from changes in hog and beef prices than in corn prices. Furthermore, incomes on dairy farms varied less than on the other types of farms in response to changing product prices. This outcome resulted because the dairy enterprise was relatively more important on dairy farms and hog and beef enterprises were relatively more important on the other farms.

The central point suggested by this income analysis is that farm reorganization provides considerable opportunity for southwestern Minnesota farmers to improve their income positions. But to improve incomes by the amounts indicated, these farmers must invest considerably more

capital and use their resources more efficiently than they are presently doing. Of course, use of credit capital to improve incomes involves risks which must be considered.

Changes on Both the Intensive and Extensive Margins

In the preceding analysis, adjustments were permitted only on the intensive margin; labor and capital could be used only on existing acreages. In this section, adjustments include the possible use of labor and capital on additional acreages. Therefore, this discussion has particular reference to farmers who are considering purchasing land.

Tables 16-19 summarize the profit-maximizing organizations under medium prices for representative farms with and without land purchase as an alternative. Land purchase was a profitable alternative on all farms except the medium general and medium dairy. While the least land was purchased on medium farms, the most land was purchased on small farms (except the small livestock). Large land purchases occurred on small farms which, in the earlier analysis, were relatively short on cropland and long on capital. In no instance, however, were the full 160 acres purchased.

All farmers purchasing land used a contract for deed as the instrument of purchase. The small cash grain farmer also purchased part of the land through a mortgage contract. This farm's plentiful capital supply enabled it to finance the mortgage contract's larger downpayment.

Production Patterns

A primary reason for land purchase on the small cash grain farm was to increase flax acreage. On all other farms, land purchase resulted in increased corn and soybean acreages. These crops expanded in both absolute and relative terms; both the numbers of acres and the percentages of cropland in corn and soybeans were larger in land purchase than in nonland purchase reorganizations.

Another indication of the key role of corn in land purchase was the substantial reduction in corn buying brought about by the purchase. Several farms shifted from a corn-deficit to a corn-sufficient status. The other farms decreased their corn deficits in amounts ranging from 1,082 to 3,156 bushels. This outcome indicated that, under assumed production efficiencies and prices, corn can be grown more cheaply than it can be purchased in the market.

Another factor underlying land purchase on the large livestock and the large and small cash grain farms was the expansion of the beef feeding enterprise. From 23 to 45 additional steers were fed out under land purchase reorganizations. On the other farms, except on the small general and small livestock farms, levels of beef feeding changed no more than eight steers. On the two excepting farms, there were decreases of 45 and 24 steers, respectively.

These shifts in beef numbers induced corresponding shifts in alfalfa-

brome acreages. Wheat and flax acreages changed by no more than 5 acres, except on the large and small cash grain farms where flax acreages dropped by 10 and increased by 55, respectively.

Land purchase brought about a reduction of from 14 to 37 sows on the large and medium livestock and the large and small cash grain farms. On the other farms, farrowings changed no more than two sows.

Finally, dairy cow numbers were influenced little by land purchase.

Capital Resource Use

Farm reorganization for maximum profits on existing acreages required substantially more farm credit than was used in 1961. And reorganization with land purchase as an option required even more credit capital than without it. On the 10 representative farms where land was bought, between $1,020 and $17,850 of more credit capital were used than when the farms were optimally organized on their existing acreages. Three of these farms also expanded beef feeding facilities beyond existing levels when organized to maximize profits on existing acreages.

But whereas farm reorganization without the land purchase option required sizable increases in hog facilities and purchased corn, reorganization with land purchase meant that available hog facilities were adequate and corn purchases either were eliminated or greatly reduced. Therefore, the credit capital requirements of reorganization with land purchase were dampened somewhat by the decreased credit capital needs for hog facilities and corn.

Labor Use

Labor requirements in the first through the fourth periods were generally less in land purchase than in nonland purchase reorganizations. However, fifth-period labor requirements increased on all farms where land was purchased, except on the small cash grain farm. These increases were due to the extra labor needed for harvesting the additional soybean and corn acreages. Sixth-period labor was used up on most farms when reorganized both with and without the land purchase alternative.

Incomes

On farms that were reorganized with additional land purchase, annual net incomes increased by from $43 on the large dairy farm where only 7 acres were bought to $1,006 on the small cash grain farm where 108 acres were bought. These increases were based on incomes generated when these farms were optimally organized on existing acreages.

Of the large farms, the livestock had the greatest increases. Within each farm type, income increases declined from small to large farms. In other words, smaller farms gained more than large farms when additional land was purchased.

Because land is often unavailable, some farmers must use their exist-

Table 16. Profit-maximizing plans for livestock farms without and with land purchase as an alternative

Item	Large farm		Medium farm		Small farm	
	Without	With	Without	With	Without	With
Enterprises						
Crops (acres):						
Corn	152	181	81	107	57	86
Soybeans	103	131	49	80	7	41
Wheat	15	15	15	15	15	15
Flax	19	22	10	13	6	9
Alfalfa-brome	47	55	32	32	28	23
Diverted acres	14	17	3	5	2	3
Permanent pasture	58	69	18	22	16	24
Livestock (head):						
Sow farrowings*	51	18	31	16	14	13
Fat cattle sold†	184	229	131	136	114	90
Beef cows	0	0	0	1	0	2
Dairy cows	0	0	0	0	0	0
Resources						
Physical facilities‡:						
Hog farrowing (sows)	31(19)	12(0)	15(1)	14(0)	12(0)	12(0)
Hog feeding (feeders)	328(175)	146(0)	146(15)	131(0)	104(0)	104(0)
Beef housing (steers)	184(116)	229(161)	131(93)	136(98)	114(75)	90(51)
Dairy housing (animal unit)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Investments in farm assets (dollars):						
Short term	39,182	36,998	27,231	23,711	20,415	15,382
Long term	68,271	73,812	38,220	42,275	25,241	28,227
Cropland (acres)	350	421	190	252	115	177
Labor (hours):						
Jan.-Mar.	799	707	590	573	469	421
Apr.-May	899	879	645	672	520	511
June-July	1,199	1,229	856	873	715	644
Aug.	471	476	369	348	291	252
Sept.-Oct.	656	686	487	552	279	395
Nov.-Dec.	575	575	430	430	315	316
Net income (dollars)	21,913	22,562	13,121	13,848	8,741	9,459
Acres purchased		84		71		75
Corn purchased (bu.)	4,292	1,136	4,417	1,313	3,406	0

* Seven pigs per farrowing were assumed sold for slaughter.

† All fat cattle sold began the feeding period as calves.

‡ Figures in parentheses reflect numbers of added facilities over and above those on representative farms in 1961.

Table 17. Profit-maximizing plans for cash grain farms without and with land purchase as an alternative

Item	Large farm		Medium farm		Small farm	
	Without	With	Without	With	Without	With
Enterprises						
Crops (acres):						
Corn	119	130	86	96	32	58
Soybeans	52	80	47	55	0	0
Wheat	20	20	15	16	15	20
Flax	100	90	10	14	50	105
Alfalfa-brome	31	35	27	25	10	18
Diverted acres	19	21	4	4	11	20
Permanent pasture	24	27	25	28	3	5
Livestock (head):						
Sow farrowings*	23	9	14	13	37	0
Fat cattle sold†	134	157	114	110	51	78
Beef cows	0	0	0	0	0	0
Dairy cows	0	0	0	0	0	0
Resources						
Physical facilities‡:						
Hog farrowing (sows)	22(14)	8(0)	14(0)	13(0)	17(17)	0(0)
Hog feeding (feeders)	188(114)	74(0)	116(13)	103(0)	211(211)	0(0)
Beef housing (steers)	134(96)	157(119)	114(86)	110(82)	51(19)	78(46)
Dairy housing (animal unit)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Investments in farm assets (dollars):						
Short term	24,885	24,560	20,063	18,666	15,760	11,451
Long term	57,673	59,598	26,854	27,797	33,284	43,235
Cropland (acres)	341	376	189	210	118	221
Labor (hours):						
Jan.-Mar.	432	362	464	444	245	178
Apr.-May	598	590	543	540	361	338
June-July	795	795	717	704	453	497
Aug.	338	335	286	280	206	219
Sept.-Oct.	447	496	391	422	281	219
Nov.-Dec.	318	318	332	332	166	166
Net income (dollars)	17,016	17,233	11,881	12,151	6,398	7,404
Acres purchased		38		26		108
Corn purchased (bu.)	1,141	0	1,445	363	4,329	0

* Seven pigs per farrowing were assumed sold for slaughter.
† On the large and small farms, both calves and yearlings were fattened and sold.
‡ Figures in parentheses reflect numbers of added facilities over and above those on representative farms in 1961.

Table 18. Profit-maximizing plans for general farms without and with land purchase as an alternative

Item	Large farm		Medium farm		Small farm	
	Without	With	Without	With	Without	With
Enterprises						
Crops (acres):						
Corn	118	123	58		43	76
Soybeans	106	116	68		8	83
Wheat	15	15	15		15	15
Flax	17	18	9		7	12
Alfalfa-brome	51	49	22		44	29
Diverted acres	12	13	3		3	5
Permanent pasture	39	41	26		15	26
Livestock (head):						
Sow farrowings*	15	15	16		13	11
Fat cattle sold†	128	121	36		115	70
Beef cows	0	0	0		0	0
Dairy cows	15	15	10		9	9
Resources						
Physical facilities‡:						
Hog farrowing (sows)	14(0)	14(0)	10(0)		9(0)	9(0)
Hog feeding (feeders)	116(0)	116(0)	100(0)		91(0)	91(0)
Beef housing (steers)	128(113)	121(106)	36(36)		115(115)	70(70)
Dairy housing (animal unit)	15(0)	15(0)	10(0)		9(0)	9(0)
Investments in farm assets (dollars):						
Short term	24,803	23,467	11,274		23,079	14,818
Long term	53,607	54,121	22,922		35,712	39,687
Cropland (acres)	319	334	175		120	220
Labor (hours):						
Jan.-Mar.	1,013	997	679		803	637
Apr.-May	973	961	596		726	684
June-July	1,278	1,247	692		942	784
Aug.	516	503	298		401	321
Sept.-Oct.	858	885	623		435	650
Nov.-Dec.	732	727	497		543	520
Net income (dollars)	20,144	20,271	11,131		9,879	10,753
Acres purchased		17		0		122
Corn purchased (bu.)	691	0	0		4,894	0

* Seven pigs per farrowing were assumed sold for slaughter.
† All fat cattle sold began the feeding period as calves.
‡ Figures in parentheses reflect numbers of added facilities over and above those on representative farms in 1961.

Table 19. Profit-maximizing plans for dairy farms without and with land purchase as an alternative

Item	Large farm		Medium farm		Small farm	
	Without	With	Without	With	Without	With
Enterprises						
Crops (acres):						
Corn	118	120	40		40	46
Soybeans	112	124	61		3	16
Wheat	15	10	15		15	15
Flax	18	18	9		6	7
Alfalfa-brome	71	68	43		50	46
Diverted acres	2	2	3		1	1
Permanent pasture	60	61	25		13	15
Livestock (head):						
Sow farrowings*	18	19	15		0	0
Fat cattle sold†	92	92	15		51	43
Beef cows	0	0	0		0	0
Dairy cows	30	29	20		17	17
Resources						
Physical facilities‡:						
Hog farrowing (sows)	8(1)	7(0)	8(0)		0(0)	0(0)
Hog feeding (feeders)	105(30)	75(0)	69(0)		0(0)	0(0)
Beef housing (steers)	92(92)	92(92)	15(15)		51(51)	43(43)
Dairy housing (animal unit)	30(0)	29(0)	20(0)		17(0)	17(0)
Investments in farm assets (dollars):						
Short term	22,977	23,146	8,666		11,369	10,064
Long term	56,839	56,320	24,812		31,790	32,282
Cropland (acres)	336	342	171		115	131
Labor (hours):						
Jan.-Mar.	1,114	1,090	699		709	689
Apr.-May	998	978	559		577	571
June-July	1,311	1,287	712		747	722
Aug.	528	531	302		324	311
Sept.-Oct.	955	991	586		433	469
Nov.-Dec.	839	839	503		509	504
Net income (dollars)	22,652	22,695	11,294		8,413	8,605
Acres purchased		7		0		20
Corn purchased (bu.)	0	0	0		791	0

* Seven pigs per farrowing were assumed sold for slaughter.
† All fat cattle sold began the feeding period as calves.
‡ Figures in parentheses reflect numbers of added facilities over and above those on representative farms in 1961.

ing capital and labor on their existing acreages. Others can use these same resources on additional acres. But whether profits will increase more by such extended use than by increased efficiency on existing acreages is not a certainty. On two farms, the medium general and medium dairy, land was not bought even when that choice was given. Available resources were used on existing acreages for the most profits.

Five farms (the large and the medium cash grain, the large general, and the large and small dairy) were optimally organized with from 7 to 38 additional acres. But this use of resources increased their annual net incomes only from $43 to $270 above levels attained from optimal use of resources on existing acreages. The remaining five farms (all the livestock, the small cash grain, and the small general) attained optimal use of their resources by adding from 71 to 122 acres. These land purchases upped their annual net incomes from $649 to $1,006 above levels reached with the most profitable organizations on existing acreages.

Therefore, income improvements may be essentially as high or higher from increasing efficiency of resource use on existing acreages as from extending the use of these resources to more acres. The results depend on the kinds and quantities of existing resources and which enterprises are the high profit alternatives.

Nevertheless, if land is available, a farmer should carefully consider land purchase when reorganizing his farm for maximum profits, particularly if his existing acreage is relatively small.

Livestock farms already were equipped to produce hogs and beef —high profit alternatives in this analysis. Extending the livestock feed base by buying more land resulted in relatively large annual increases in net incomes on these farms. The small general and small cash grain farms initially were relatively well supplied with cash and credit capital. Purchase of land on these two farms added substantially to annual net incomes by providing a larger and more economical livestock feed base and more land for cash crops.

General Guidelines for Profitable Farming

This study first described the organizations and resource availabilities on 12 representative farms in southwestern Minnesota. These farms were representative of farm types and sizes existing in this area. On the assumption of improved management levels, and on the basis of a set of medium projected prices (wherein the relationship of prices for long-run planning was emphasized), each farm then was programmed to determine the profit-maximizing use of available resources. To determine the effects of varying prices on farm organizations and adjustments, each farm also was programmed with corn, hog, and beef prices higher and lower than the medium projected prices.

The following general guidelines should serve farmers in southwestern Minnesota as a basis for income-improving farm reorganization or adjustment.

♦ Corn and soybeans are strong competitors for land use. However, flax should not be overlooked as a crop alternative.

♦ When planning reorganization, most farmers should consider increasing their emphasis on hog and beef production, and on beef more than hogs.

♦ Beef cow herds apparently are not profitable alternatives for farm situations similar to those analyzed in this study. But in some other farm situations, they may be necessary parts of the profit-maximizing plans.

♦ Dairying with production of manufactured milk may belong in income-improving plans on farms already equipped for dairying. But, production of manufactured milk probably cannot compete with beef and/or hogs for resources if facilities must be added to include dairying as a planning alternative.

♦ If additional land is not available, farmers should consider augmenting the home feed supply through corn purchase to expand beef and/or hog production.

♦ If additional land is available, land purchase warrants careful investigation. Land purchase may increase income substantially, particularly on farms that are already organized for beef and hog production or that are well supplied with capital relative to land. But on some farms, reorganization with a more intensive use of capital on existing acreages may improve incomes as much as reorganization with additional land.

♦ Varying corn, hog, and beef prices do not greatly influence the *kinds* of crops and livestock included in most income-improving plans. Given the feed grain program and wheat production restrictions, varying corn, hog, and beef prices influence the cropping systems very little. Corn ordinarily will be grown up to the allotment limit and wheat up to the nonallotment or allotment limit. Varying prices mainly affect the acreage of alfalfa-brome for feed which, in turn, influences the levels of soybean or flax production.

Hogs will be in most income-improving plans except at: (1) low hog prices in combination with medium or high beef prices and (2) low hog and beef prices in combination with high corn prices. Beef feeding can be expected in most income-improving plans except at low beef prices in combination with medium and high hog prices.

However, the *levels* at which hogs and beef are likely to be in income-improving plans depend greatly on the hog-beef price ratio. Therefore, farmers should determine carefully the most likely future prices of hogs relative to beef. In addition, some may want to build flexibility into their facilities.

♦ Improvements in income from farm reorganization will differ from farm to farm as kinds and quantities of resources differ. But across the different types and sizes of farms studied, the opportunity for substantial income improvements did exist, primarily through use of more capital and careful farm management analysis and planning. These potentially higher incomes rested on a sharp increase above present levels in use of borrowed capital. Farmers will want to weigh the potential risks against the potentially higher incomes from reorganization.

2,500—7-66