10-1-1969

Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income, North Central South Dakota

E. O. Ulrich

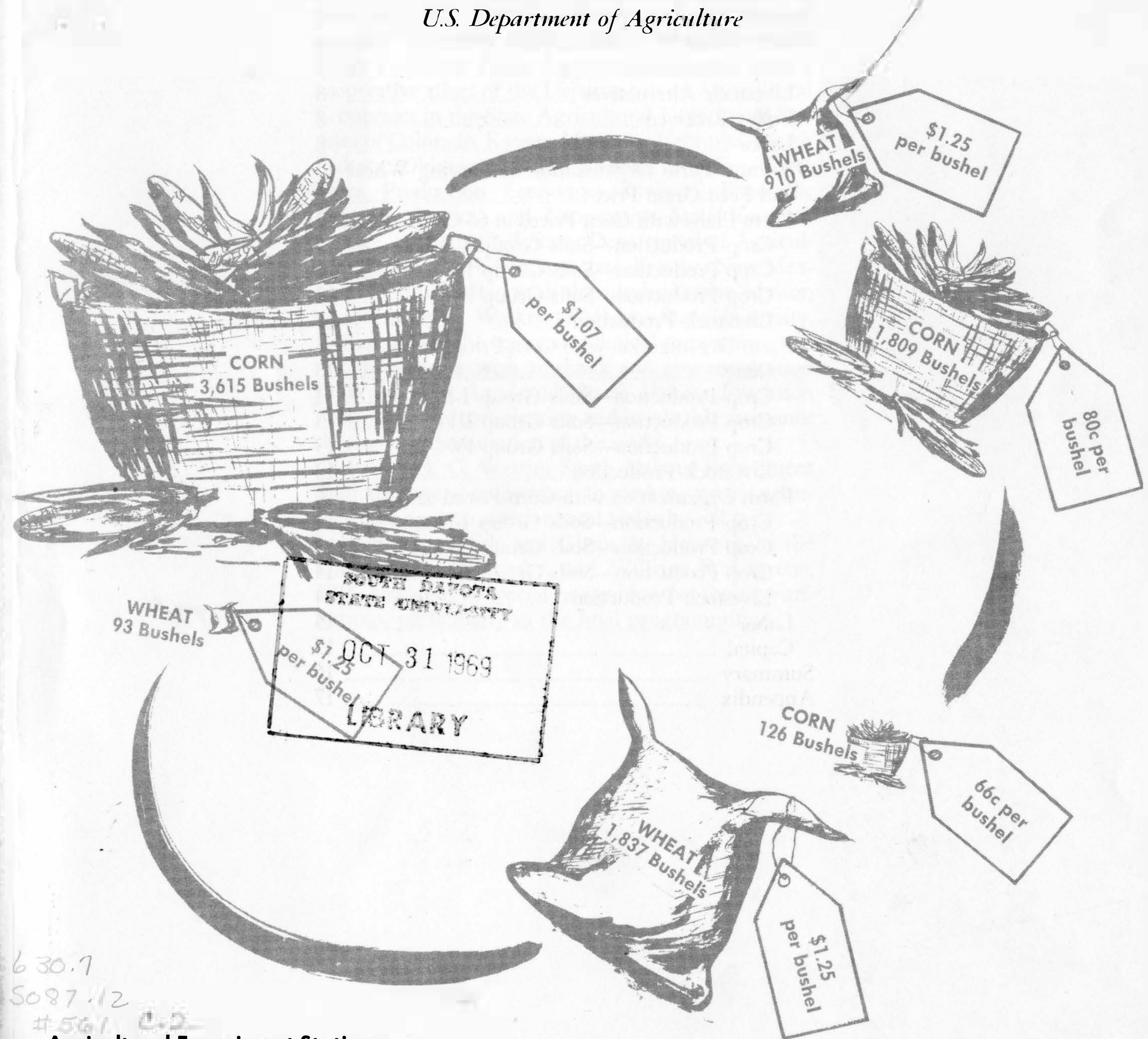
J. T. Sanderson

Experiment Station Bulletin No. 561
October 1969

Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income North Central South Dakota

Campbell, Edmunds, McPherson, and Walworth Counties

Department of Economics in cooperation with
Farm Production Economics Division, Economic Research Service
U.S. Department of Agriculture



Agricultural Experiment Station
South Dakota State University, Brookings

CONTENTS

Acknowledgments

This research contributes to the regional research project—GP-5, "Economic Problems in the Production and Marketing of Great Plains Wheat," sponsored by the Great Plains Agricultural Council. It is a cooperative effort of the Departments of Agricultural Economics in the State Agricultural Experiment Stations of Colorado, Kansas, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas; the Farm Production Economics Division, Economic Research Service, and Cooperative State Research Service, of the United States Department of Agriculture. Dr. M. L. Wilson, associate director, New Mexico Experiment Station, is the administrative advisor, and Dr. Odell L. Walker, Olkahoma State University, is chairman of the regional technical committee.

The authors wish to thank and give recognition to Wallace G. Aanderud, South Dakota Extension Service, for his participation and invaluable assistance throughout the duration of the study.

Frederick C. Westin, South Dakota Experiment Station, devoted many hours to working up the necessary data on crop rotations and yields by soil type.

James Kendrick and Glenn A. Helmers, of the University of Nebraska, and William F. Lagrone, ERS, also deserve special recognition for their contributions, particularly in the final programming.

PREFACE

The purpose of this report is to present some results of a cooperative research project between the South Dakota Agricultural Experiment Station and the Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture. This research contributes to a larger project—GP-5, "Economic Problems in the Production and Marketing of Great Plains Wheat."

The general objectives of the research undertaken in South Dakota were: (1) To provide economic data needed by farmers to make profitable adjustments in their farming systems and production practices, and (2) To develop a research background for evaluating government farm programs under varying assumptions.

Similar contributing projects to GP-5 were simultaneously conducted in most of the other Great Plains states. Objectives, in the regional research project, which were specifically related to production and farm management are as follows:

1. To develop information on technical production relationships and opportunities for grain farms in the Great Plains.
2. To determine the nature and magnitude of adjustments needed in specific farm situations which will achieve the most profitable systems of farming under a range of conditions with respect to prices of major products and quantities of available resources, such as land, labor, and capital, and to determine the quantities of resources required to provide selected levels of income.
3. To determine the effect upon total agricultural production, farm income, farm organization, and resources employed in the Great Plains if selected percentages of all farmers adjust to their most profitable farming systems for various assumed product-demand conditions, factor supply conditions and specific agricultural programs and institutional arrangements.

The South Dakota study area included 26 counties in Central South Dakota (Figure 1). This area normally accounts for about 68% of the state's wheat acreage, 43% of the feed grain acreage, 60% of the state's flax acreage, and about 55% of the total tame- and native-hay acreage. For analytical purposes, the GP-5 study area was divided into eight sub-areas on the basis of selected farm and soil characteristics and cropping practices.

The analysis of this study was based on possible adjustments on individual farming units. Thus, model farms were developed to represent a significant number, group, or segment of farms within a defined geographic area. Model farms were grouped on the basis of similar characteristics, plus similar alternative production opportunities.

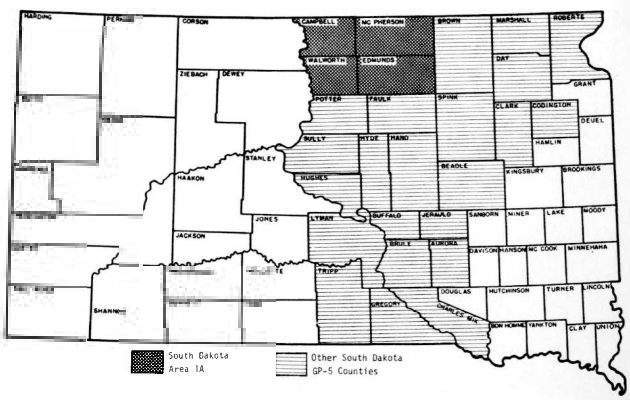
Determining characteristics for grouping farms into model or typical farms included: Farm size, proportion of cropland to native hay and rangeland, soil characteristics, land use and tillage practices, farm organization and enterprise, labor use and labor availability.

In all, 14 model farms were developed in the eight sub-areas of the 26-county study. Characteristics were so similar in four subareas that only one model farm was needed in each, but in the remaining areas there existed enough diversity to require three model farms in each of two subareas and two model farms in each of the other two.

Data used to develop model farms for each South Dakota study area and costs for crop and livestock enterprises for each model farm were derived from a variety of sources, which included: Farm surveys, Agricultural Stabilization and Conservation Service county office records, county assessor's records, U. S. Agricultural Census, S. D. State-Federal Crop and Livestock Reporting Service statistics, South Dakota State University Economics Department and actual cost data from machine dealers, insurance agents, and others.

The purpose of this bulletin is to present the most profitable combination of farm enterprises at various combinations of crop and livestock product prices on a 640-acre model farm in Campbell, Edmunds, McPherson, and Walworth Counties. The optimal farm plans presented herein are the results of computer programming using specific assumptions with regard to farm size and cropland acreage, crop yields, costs, commodity market prices, and other such factors.

Figure 1. South Dakota GP-5 study area.



Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income, North Central South Dakota

By Erwin O. Ullrich Jr. and John T. Sanderson*

INTRODUCTION

The United States has witnessed rapid technological advances in agricultural production over the past several decades. At the same time, changes in the nature of demand also have occurred. These two phenomena have helped to create or further aggravate an imbalance between supply and demand for specific agricultural commodities. **Stated differently the nation's productive capacity for wheat greatly exceeds the domestic needs and export demand at satisfactory prices under free maket conditions.**

Associated with technological advancement in agriculture is the trend toward fewer and larger farms. In 1967, 31.5% of the nation's farms accounted for 85.1% of the total farm cash receipts.[1]

The upward trend in per capita income has been associated with a declining per capita consumption of wheat and wheat products; total domestic consumption, however, remains fairly constant. With a continued increase in income, the decline in per capita consumption of wheat can be expected to continue. As income levels rise, dietary changes also occur—usually from lower-priced bulky and starchy foods to those which may be higher in protein as well as higher-priced food items. Thus, there is now a growing tendency for people with rising incomes to view foods, once considered luxuries, as necessities. In addition, convenience foods now command an increasing share of the consumer's food dollar. The future level of total domestic demand depends upon the rate of population growth relative to the rate of increase in per capita income.

Exports of wheat, cereal grains, and other agricultural commodities often are looked upon as a possible solution for American agricultural problems of oversupply. However, American exports compete in the world market with other exporting nations and world demand fluctuates with crop failures and bumper crops. The long-term future of American agricultural exports is uncertain, considering such factors as increased world food production through increased mechanization and technical assistance programs, changes in attitudes towards birth control and in traditions concerning types of foods used.

The problem of farm adjustment thus centers around the changing demand for farm products and the continually changing technology.

The nature of desirable farm adjustment in the Great Plains becomes somewhat complicated by the limited number of feasible alternatives available due to relatively low rainfall and extreme variability of climatic conditions. Considering climatological and other related factors, there exists a comparative advantage in production of small grains (particularly in either hard red spring or winter wheat), depending upon the region of the Great Plains. Wheat, having a comparative advantage over other crops, means that the ratio of costs-to-yield favors wheat. Thus wheat would be the most profitable crop alternative.

Thorough appraisals of adjustment opportunities on typical farms are needed to evaluate probable effects of farm programs and other external factors and to guide farmers in making adjustment decisions.

TYPE OF AGRICULTURE IN AREA

The average farm size for the four-county area was 951 acres in 1964; the individual county average size varied from a low of 899 acres in McPherson County to a high of 1,025 arces in Walworth County. Average farm size is increasing annually and this trend is expected to continue. The Census of Agriculture in the period from 1959 to 1964 shows a percentage decline in farms under 500 acres, from 24.8 to 21.1%, and in farms between 500 and 999 acres, from 48.7 to 42.7%. In contrast, farms of 1,000 acres or more increased from 26.5 to 36.2% during the same period.

Twenty-two per cent of the 2,446 farms in the four-county area in 1964 were classified as cash-grain, 46% as livestock (including ranches), 22% as general farms, and the remaining 10% as poultry, dairy, and miscellaneous farms. The major cash crops produced in this area are wheat, flax, and rye. The cash sales of corn, barley and oats amounted to approximately 17% of the total grain sales in the four counties (see Table 1).

*Agricultural economist, Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, and assistant professor of economics, respectively, South Dakota State University, Brookings.

[1]Source: Farm Income Situation, July, 1968.

Table 1. Number and Percentage of Farms on Which Major Grain Crops Were Raised and Harvested in 1964, Campbell, Edmunds, McPherson, and Walworth Counties

Crop	Number of farms	Percentage of farms	Acres Harvested Number	Per Cent
Corn*	1,739	71.1	129,801	18.0
All Wheat†	2,184	89.3	312,130	43.2
Oats	2,086	85.3	183,953	25.5
Barley	398	16.3	13,600	1.9
Flax	815	33.3	49,062	6.8
Rye	369	15.1	24,222	3.4
Other‡			9,239	1.2

*Includes corn harvested for grain, silage, and other purposes.
†Includes 2,857 acres of winter wheat and 10,337 acres of durum.
‡Includes proso, emmer and speltz, soybeans and sorghum.
Source: U. S. Census of Agriculture, 1964.

Livestock were found on nearly 80% of the area's farms. Beef cattle were the most common, with about 70% of the herds being composed of from 10 to 50 cows. Fifty-four per cent of the farms maintained dairy herds which were relatively small. About 80% of these herds numbered fewer than 15 cows In 1964, 18% of these farms sold whole milk and nearly 80% sold cream.

Approximately two-fifths of the farms had farrowed sows. A few bought feeder pigs. Sow numbers were usually low, about two-thirds of the sow herds contained fewer than 10 head per farm. The bulk of the farrowings occurred in the spring; however, about one-fourth were fall farrowings.

Sheep production in this area was limited to small flocks numbering less than 50 ewes. About 17% of the area's farmers maintained a farm flock.

MODEL WHEAT FARM

Description

A farm sample, drawn in 1962, provided the basis for determining the model farms. Farms were stratified on the basis of various characteristics, such as farm size, proportion of cropland to native hay and rangeland, land use and farm organization. Farms which differed greatly, such as those which did not have a wheat allotment or those which had either an unusually high or low proportion of cropland to total farmland, were not used to determine the model farm.

The model farm size selected in the Campbell, Edmunds, McPherson, and Walworth County area was 640 acres, which consisted of 333 acres of cropland, 277 acres of native hay and pasture, and 30 acres of farmstead, roads, and wasteland. The size of the model farm chosen does not represent an arithmetic average—rather it is intended to represent one size of wheat farm which will exist in 1970. Although farms are becoming larger, there is a relatively large percentage of farms with fewer than 640 acres; some of which will survive and will be enlarged by land rental or purchase. The nature of farm adjustment and farm organization should not differ significantly for farms larger than 640 acres, provided the ratios of farmland, cropland, labor, and capital resources are about the same as for the 640-acre farm.

The crops and crop acreages on the 640-acre representative farm were as follows:

Crop	Acres
Spring Wheat	101
Oats, Barley, Flax	86
Corn Grain	20
Corn Silage	29
Summer Fallow	45
Afalfa	34
Other Tame Hay and Pasture	18
Native Hay	92
Native Pasture	185

Several major soil associations are found in the four-county area. The Agar-Williams Association, in the western part of the area, occurs in undulating or sloping landscapes. These soils are well-drained with grayish-brown silt loam and loam surface layers. The major problems associated with these soils are: (1) Maintenance of organic matter and nitrogen, (2) Moisture conservation, and (3) Control of run-off. Livestock and general types of farming are best suited to the Agar-Williams soils area.

The Williams-Zahl Association soils, found in the central portion of this area are undulating to steep and are well to excessively-drained. These soils have grayish-brown loam surfaces. The major management problems are similar to the soils of the Agar-Williams Association soils, namely: (1) Maintenance of organic matter and nitrogen supply, (2) Moisture conservation, and (3) Control of run-off and water erosion. The land use depends mainly upon topography and includes cash grain, livestock and general farming, and ranching.

The Houdek and Bonilla Association soils, classified as Chernozem Soils, are found in eastern McPherson and Edmunds Counties. These soils are undulating to nearly level and are well-to moderately-well-drained. The soils have dark grayish-brown, slightly acid, surface layers. The major problems are maintenance of organic matter and conservation of moisture. The major soil uses are: Cash grain production, livestock, and general farming.

Each soil series and soil type, within the soil association found in the four-county area, was classified into one of four groups on the basis of: (1) Land use, (2) Topography, (3) Potential soil hazards and problems, and (4) Management practices needed. Yield projections were developed under assumption of normal weather conditions, recommended fertilizer usage, and specific management and rotation practices recommended for the productive capability of the soils (see Table 2). In cases where the soils of a particular group comprised less than 10% of the area's cropland, the soils of that group were combined with those of a second group and the yields were weighted accordingly.

A total of 25 crop rotations or sequences, including continuous small grain, were selected for the three soils groups—14 rotations for soil Group I-II, 16 for soil Group III, and 10 for soil Group IV (appendix Table 1). These rotations, chosen from a wide range of alternatives, were within the requirements of the various soils within each group.

The cropland designated as soil Group I-II amounted to 156 acres, soil Group III accounted for 140 acres, and 37 acres were classified as Group IV soils.

Crop Alternatives

Cash grains, feed grains, and forage crops were considered as crop alternatives in this four-county area. The small grains included were: Hard spring wheat, flax, rye, barley, and oats. The other crops considered as alternatives included corn-grain, corn-silage, alfalfa, and grass and legume seeding for permanent pasture on cropland.

Flax and rye were grown strictly as cash crops, while corn-grain, spring wheat, oats, and barley could either be used as livestock feed or sold off the farm. The corn-silage and alfalfa which may be produced on these farms would have to be fed to livestock and could not be sold off the farm. Native hay and pasture could either be used by the farm operator for cattle or be left unused.

A cost summary of the crop enterprise budgets considered is shown in Table 3. Costs included in the budgets were: Seed, fertilizer and spray materials, all fixed and variable machine costs, custom harvest costs for corn-grain and silage, crop hauling to storage, and interest on operating capital. Interest charge on land was not included.

Table 2. Crop Yields and Fertilizer Usage per Planted Acre by Soil Group, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Crop and Rotation	Group I & II Soils			Group III Soils			Group IV Soils		
	Projected Yield Bushels	Fertilizer* Nitrogen Pounds	Fertilizer* P_2O_5 Pounds	Projected Yield Bushels	Fertilizer* Nitrogen Pounds	Fertilizer* P_2O_5 Pounds	Projected Yield Bushels	Fertilizer* Nitrogen Pounds	Fertilizer* P_2O_5 Pounds
Spring Wheat on Fallow	23.0		15.0	18.5		12.0	19.8		13.0
Spring Wheat After Corn	18.5	20.5	12.0	15.1	16.5	9.5	16.1	17.5	10.0
Spring Wheat After Small Grain	15.4	16.5	10.0	12.6	14.5	8.5	13.4	14.5	9.0
Oats, Continuous Crop	29.3	12.0	9.5	28.0	11.5	9.0	26.0	11.0	8.5
Barley, Continuous Crop	26.9	16.5	11.5	26.0	16.0	11.0	24.1	14.5	10.0
Rye, Continuous Crop	18.2	9.0	11.0	17.0	9.0	10.5	17.2	9.0	10.5
Flax, Continuous Crop	17.5		15.0	10.1		9.0	13.0		11.0
Corn Grain, Continuous Crop	26.6	25.5	8.5	25.8	24.0	8.0	29.3	27.0	9.0
Corn Silage, Continuous Crop	4.98†	28.0	9.5	4.80†	26.5	9.0	5.20†	29.5	10.0
Alfalfa	1.58†			1.30†			1.40†		
Native Hay	.8†								

*Actual pounds applied per acre.
†Unit is in tons.

Livestock Alternatives

The livestock activities allowed included: (1) A cow-calf operation, (2) Raising calves to be sold as stockers, and (3) Buying calves to raise and sell as stockers. Fattening activities such as feeding cattle or raising hogs were excluded as enterprise alternatives; these livestock activities are not primarily land based and are somewhat independent of wheat production.

Feeding systems which were allowed as alternatives included: (1) A stocker ration with corn-silage and (2) A stocker ration without corn-silage.

Table 3. Total Man Hours and per Acre Costs for the Crop Alternatives Budgeted for the 640-Acre Model Farm, by Soil Group*

Crop	Total Man-hours	Costs per Acre for Soil Group: I-II	III	IV
Summer Fallow	1.38	$ 3.76	$ 3.76	$ 3.76
Spring Wheat Following Fallow	1.79	8.83	8.54	8.64
Spring Wheat Following Corn	2.21	12.92	12.23	12.39
Spring Wheat Following Small Grain	2.08	12.31	11.93	11.99
Oats	2.08	12.33	12.23	12.13
Barley	2.08	13.04	12.92	12.67
Rye	2.08	13.72	13.63	13.64
Flax	2.08	10.03	9.46	9.65
Corn Grain	2.41	18.49	18.31	18.83
Corn Silage	2.88	22.76	22.48	23.09
Alfalfa (2 cuttings—1 baled)	2.14	13.20	13.20	13.20
Native Hay, loose	.80	2.60		

*Excludes a charge for land.
†Excludes hauling and storing.

Prices Received

Optional farm plans were determined for various combinations of crop and livestock product prices. The market prices were held constant for flax at $2.22 per bushel, rye at 75 cents per bushel, feeder calves at $25.28 cwt., and stocker cattle at $23.08 cwt. Wheat prices were varied from zero cents to $3 at corn price levels of 66 cents, 80 cents, and $1.07 per bushel. Oat and barley prices were converted to a corn equivalent based on feed value.

The flax, rye, and cattle prices are those which may be expected to occur in 1970 under certain assumed supply and demand conditions. The assumed grain prices are received at local elevators while the livestock prices are those received at the Sioux City Terminal Market.

Table 4. Summary of Budget Items for the Cow-calf Herd and Stocker Calf Alternatives Considered for the 640-Acre Model Farm

Item	Cow-Calf Herd	Stocker Calves Wintered and Grazed with silage	without silage
Per Cent CalfCrop	92.0%		
Purchase Weight		430 lbs.	430 lbs.
Sales Weight	430 lbs.	700 lbs.	700 lbs.
Purchase Cost		$108.70	$108.70
Pasture	6.5 aum	3.25 aum	3.25 aum
Hay Equivalent	2.60 ton	.40 ton	.64 ton
Corn Silage		1.20 ton	
Corn Grain Equivalent	2.70 cwt.		3.60 cwt.
Variable Cash Costs*	$11.40	$25.94	$25.76
Allocable Fixed Costs†	$11.40	$ 6.90	$ 6.90
Labor Per Head	12.0 hrs.	5.3 hrs.	5.3 hrs.

*Includes: Salt and minerals, protein supplement, veterinary and drugs, taxes, insurance, marketing, machinery and equipment cash expenses.
†Includes: Depreciation, insurance, taxes, and investment interest on machinery, buildings, and facilities used for enterprise.

Labor

The available labor supply was determined from data obtained in several recent farm surveys. Operator and family labor were combined and classified as resident labor. Hired labor, as a category, included regular and part-time help.

The work year was divided into five labor periods, each identified with a season or type of work usually expected to be performed in that period. However, the type of work performed in each period is not as clear-cut as the dates for each period since there is usually some overlapping of tillage, planting, and harvesting from one labor period to another.

The resident labor used for livestock and field crops could not exceed the numbers of hours allotted to each period, which is as follows: (1) 803 hours, November 16 to March 15; (2) 417 hours, March 16 to April 30; (3) 781 hours, May 1 to July 15; (4) 804 hours, July 16 to September 30; and, (5) 308 hours, October 1 to November 15.

Labor could be hired in any or all periods, but was restricted to the amounts used on sample farms. The hired labor wage rate used was $1.25 per hour.

OPTIMUM FARM PLANS AT VARYING WHEAT AND FEED GRAIN PRICES

Linear programming is a method of analysis used to determine farm plans which provide maximum net returns, given input factors such as crop and livestock enterprise costs, amount of available land, amount of available labor, capital requirements and availability, price and income factors. This method of analysis was used to determine probable wheat and feed grain production which would maximize net income at various price combinations. Because linear programming solutions were obtained for a wide range of wheat prices, a large number of optimum farm organizations resulted. Many of the optimal farm plans indicated insignificant changes in production or net income.

Tables 5 through 7 show only major changes in crop acreages, crop and livestock production, labor, capital, and net returns at contstant feed grain, flax, and cattle prices with increasing wheat prices.[2] Since minor changes in farm plans were not shown, breaks in the wheat prices are shown in the tables. The wheat prices are shown as a range over which the farm organization, crop and livestock production, and other such factors remain constant.

Farm Plans with Corn Priced at 66 Cents

Result of the linear programming analysis indicate net returns would be greatest with the model farm oriented towards production of cash-grain rather than cattle. A cattle enterprise was maintained on the model farm, although it was supplementary in nature, using labor, native hay and range which might not otherwise have been utilized.

In general, wheat acreage and production increased as the wheat price increased. Wheat becomes increasingly competitive with flax and corn as cash grain when wheat prices rise while flax and corn prices remain constant. The main adjustment taking place as the wheat increases is a shift from flax to wheat. However, this change occurs at different price ratios on different soil types. The key to this difference is in the relative yields of these two crops by soil type. The crop rotations by soil groups at the various levels of wheat prices are shown in Table 8.

Crop Production—Soils Group I-II. Spring wheat, barley, oats, flax, corn-grain, corn-silage, alfalfa (including a pasture-type alfalfa), and summer fallow in a combination of 14 crop rotations were the cropping alternatives considered. These soils are somewhat

[2]The net returns are to land, labor, and management.

Table 5. Crop and Livestock Production, Labor, Capital, and Net Returns for the Optimum Farm Plans at Various Levels of Wheat Prices and 66 Cents per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Item	Price of Wheat $.36 to $.71	$.91 to $1.11	$1.16 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66
Crops (in acres):						
Wheat	6	53	95	110	232	241
Flax	154	131	110	95	6	—
Barley	—	—	—	—	—	7
Oats	—	—	—	—	—	7
Summer Fallow	—	47	89	80	55	58
Corn	155	84	21	21	22	20
Tame Hay or Pasture	18	18	18	18	18	—
Crop production (in bushels):						
Spring Wheat	93*	909	1,837	2,090	3,513	3,635
Flax	2,037	1,818	1,465	1,288	76	—
Feed Grain (corn equivalent)	3,238	1,364	126	126	126	220
Corn Silage **(in tons):**	165	178	89	89	89	102
Tame Hay	—	—	26	26	26	—
Native Hay	65	65	65	65	65	65
Livestock (head):						
Beef Cows	6	8	26	26	26	8
Stockers Sold†	114	111	56	56	56	92
Total Labor Use **(hours)**	1,840	1,712	1,558	1,560	1,630	1,559
Total Capital Used	$30,194	$28,877	$23,951	$23,988	$24,986	$25,722
Net Returns‡	$ 4,750	$ 4,768	$ 5,038	$ 6,041	$ 7,201	$ 8,673

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refer to the lowest wheat price and do not include a charge for land or operator's labor.

Table 6. Crop and Livestock Production, Labor, Capital, and Net Returns for the Optimum Farm Plans at Various Levels of Wheat Prices and 80 Cents per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Item	Price of Wheat $.36 to $.90	$1.22 to $1.35	$1.36 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66 to $3.09
Crops (in acres):						
Wheat	6	53	95	110	232	241
Flax	154	131	110	95	6	—
Barley		—	—	—	—	7
Oats		—	—	—	—	7
Summer Fallow		47	89	89	55	58
Corn	154	84	21	21	21	20
Tame Hay or Pasture	19	19	19	19	19	—
Crop Production (in bushels):						
Spring Wheat	93*	910	1,837	2,090	3,513	3,635
Flax	2,037	1,818	1,465	1,288	76	—
Feed Grain (corn equivalent)	3,615	1,809	126	126	126	220
Corn Silage **(in tons):**	89	89	89	89	89	102
Tame Hay	26	26	26	26	26	—
Native Hay	65	65	65	65	65	65
Livestock (Head):						
Beef Cows	26	26	26	26	26	8
Stockers Sold†	56	56	56	56	56	92
Total Labor Use **(hours)**	1,802	1,682	1,558	1,560	1,630	1,559
Total Capital Used	$26,456	$25,151	$23,951	$23,988	$24,987	$25,723
Net Returns‡	$ 5,245	$ 5,275	$ 5,410	$ 6,041	$ 7,201	$ 8,673

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refer to the lowest wheat prices and do not include a charge for land or the operator's labor.

Table 7. Crop and Livestock Production, Labor, Capital, and Net Returns for the Optimum Farm Plans at Various Levels of Wheat Prices and $1.07 per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Item	Price of Wheat $.36 to $1.64	$1.65 to $1.84	$1.85 to $2.24	$2.26 to $3	$3.15
Crops (in acres):					
Wheat	6	76	128	241	241
Flax	154	84	58	—	—
Barley		—	—	7	7
Oats		—	—	7	7
Summer Fallow		—	52	8	58
Corn	154	154	76	70	20
Tame Hay or Pasture	19	19	19	—	—
Crop Production (in buhels):					
Spring Wheat	93	1,080	2,223	3,464	3,635
Feed Grain (corn equivalent) **(in tons):**	3,615	3,615	1,504	1,350	220
Flax	2,037	1,382	947	—	—
Corn Silage	89	89	89	135	102
Tame Hay	26	26	26	—	—
Native Hay	65	65	65	65	65
Livestock (head):					
Beef Cows	26	26	26	12	8
Stockers Sold‡	56	56	56	85	92
Total Labor Use **(hours)**	1,802	1,897	1,652	1,702	1,559
Total Capital Used	$26,456	$26,610	$25,131	$27,113	$25,723
Net Returns‡	$ 6,215	$ 6,257	$ 6,480	$ 8,721	$10,466

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refer to the lowest wheat price and do not include a charge for land or the operator's labor.

more productive since the spring wheat and flax yields were considerably higher than the soils of the other two soil groups, and barley, oats, and alfalfa yields were slightly higher. Corn grain yielded nearly 3 bushels less than Group IV soils, but almost a bushel higher than on the Group III soils.

Most profitable, at wheat prices of 36 cents to $1.11 per bushel was a corn-flax rotation with an average return of $13.61 per acre. Flax, priced at $2.22, was the single most profitable crop enterprise with returns of about $27.16 per acre. Considering the corn yield, production, and harvesting costs, 66 cents for corn was about the break even price. Thus, with continuous flax not allowed, the best returns were obtained from a corn-flax rotation. Continuous wheat returned $3.67 per acre and wheat-fallow returned $5.91 at a wheat price of $1.11 per bushel.

An increased price of wheat, $1.16 to $1.70 per bushel, brought about a shift in acreage from corn-flax to fallow-wheat-flax, since $1.16 was the break even price between the two rotations. The fallow-wheat-flax rotation produced net returns of an average of $17.32 with wheat priced at $1.70 per bushel, compared with returns of $13.61 per acre from corn-flax. Neither continuous wheat nor wheat-fallow were competitive—even with wheat prices at $1.70 per bushel. The maximum returns were obtained from 29.5 acres in a corn-flax rotation and 126.5 acres in a fallow-wheat-flax rotation. The corn acreage produced feed for the livestock enterprise; the wheat and flax production was sold.

Wheat, becoming even more profitable at prices of $1.71 to $2.11 per bushel, replaced corn as the 29.5 acres of corn-flax was shifted to fallow-wheat-flax. Thus, with the entire 156 acres of Group I-II soils in fallow-wheat-flax, corn production for livestock feed was shifted to the Group III soils. Neither wheat-fallow nor continuous wheat returned as much as the $20.33 per acre from fallow-wheat-flax with wheat priced $2.11 per bushel.

A rotational change to continuous wheat occurred at a wheat price of $2.24 per bushel—the break even price between the fallow-wheat-flax cropping system and continuous wheat. This is the maximum—production from continuous wheat would remain unchanged unless feed grain and/or flax prices rose enough to become a competitive factor, assuming no change in the costs of production.

Per acre net returns from continuous wheat become greater than from fallow-wheat-flax or from fallow-wheat as wheat prices continue to rise. Annual net returns from 2- and 3-year rotations must be averaged over 2 or 3 acres, as the case may be. As an example, net returns from continuous wheat are $1.28,

Table 8. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 66 Cents per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

	Cropland Acres at the Following Wheat Prices					
Crop Rotation	$.36 to .71	$.91 to $1.11	$1.16 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66
Soil Group I-II						
Corn, Flax	156.0	156.0	29.5			
Summer Fallow, Spring Wheat, Flax			126.5	156.0		
Spring Wheat					156.0	156.0
Soil Group III						
Corn, Flax	140.0					
Summer Fallow, Spring Wheat, Flax		140.0	140.0	109.6		
Corn, Spring Wheat				30.4	30.4	39.4
Summer Fallow, Spring Wheat					109.6	100.5
Soil Group IV						
Spring Wheat, Corn, Flax, Alfalfa (two years)	37.0	37.0	37.0	37.0	37.0	
Summer Fallow, Spring Wheat, Spring Wheat, Barley Oats						37.0

$1.63, and $2.97 per acre higher than from fallow-wheat-flax at wheat prices of $2.61, $2.65, and $2.85 per acre, respectively.

Crop Production—Soils Group III. Most of the crop alternatives considered were the same as on Group I-II soils. Rye was added as an alternative crop and continuous wheat, barley, or oats were not allowed as on Group I-II soils. Sixteen crop rotations, which varied from 2 to 7 years, were allowed on these soils. These soils were less productive—crop yields were lower and the costs of producing a bushel of grain were higher.

A corn-flax rotation was most profitable with returns averaging $5.01 per acre at wheat prices up to 71 cents per bushel. The returns from an acre of flax were $11.30, but those from an acre of corn were negative—a minus $1.28. The break even corn price on these soils is 71 cents per bushel, but since continuous flax was not allowed, the combination of corn-flax provided the best returns. Once again, both were raised as cash crops. A wheat-fallow combination produced returns of 7 cents per acre at a wheat price of 71 cents.

A rise in wheat price, to a range of 91 cents to $1.11 per bushel, resulted in a shift in rotations to fallow-wheat-flax. This shift occurred at a much lower wheat price on Group III soils than on the Group I-II soils. Returns from fallow-wheat-flax equaled those from corn-flax (with wheat at 91 cents per bushel), but when wheat was $1.11 per bushel, the return averaged $6.14 per acre, compared with $5.01 for corn-flax.

No further change in rotations occurred at wheat prices of $1.16 to $1.70 per bushel and net returns from fallow-wheat-flax averaged $6.43 and $9.58 per acre. A wheat-fallow rotation would have averaged $3.99 and $8.73 per acre.

A further rise in the price of wheat, $1.71 to $2.11, induced a shift of 30.4 acres to a corn-wheat rotation. This shift was primarily due to the change from corn-flax on the Group I-II soils at the same wheat prices. The livestock enterprise needed corn grain and silage. This shift was logical, since the flax yield on Group III soils was less favorable. The returns from fallow-wheat-flax averaged $11.16 per acre compared with $8.12 per acre from corn-wheat, with wheat priced $2.11 per bushel. However, an acre of wheat returned $17.52 per acre when grown in a corn-wheat rotation (corn was fed to livestock).

The 109.6 acres in fallow-wheat-flax shifted to fallow-wheat when wheat rose to $2.24 per bushel. No change occurred in either the acreage of corn-wheat or the livestock enterprise. Returns from the fallow-wheat rotation exceeded those from fallow-wheat-flax by nearly $2 an acre with wheat priced at $2.61 per bushel.

Nine acres shifted from fallow-wheat to corn-wheat with the wheat price rising to $2.66 per bushel. This shift was due to the relative profitability of an acre of wheat in the corn-wheat rotation. A fallow-wheat rotation returned an average of $18.45 per acre, but an acre of wheat in the corn-wheat rotation returned $25.28 per acre and the corn production, used as feed, enabled the carrying of additional feeder calves. A further change in acreage from one rotation to another (at this wheat price) would result in decreased net returns.

Crop Production—Soils Group IV. These are soils on which productivity would be enhanced by use of longer rotations, preferably with a stand of legume or grass. Continuous cropping is allowable, however, provided proper tillage practices are employed to control erosion. Eleven crop rotations were allowed, most of which contained from 2 to 4 years of alfalfa. One alternative included a permanent seeding of a grass and legume and 2 rotations allowed 1 year of summer fallow and 4 years of small grain.

Group IV soils comprised only 11.1% of the cropland and, thus, could not figure prominently in cash-grain production. However, since the wheat, flax, and corn yields were higher than on Group III soils, the most profitable rotation included these three crops. Corn and alfalfa were grown as feed for the livestock enterprise and wheat and flax for the cash grain market. This six-year rotation remained the most profitable crop combination at wheat prices up to $2.61 per bushel, but at $2.66 shifted to a 5-year rotation—1 year of fallow, 2 years of wheat, and 1 year each of barley and oats. Barley and oats replaced corn-grain as livestock feed.

Livestock Production. The livestock enterprise in the optimum farm organization was one of raising calves to a weight of 700 pounds. Most of the calves were purchased in the fall and some were calves raised from a small stock-cow herd.

The livestock enterprise was supplementary in nature—without livestock some land resources would remain idle and farm income, unquestionably, would be lower. No provision was made to sell or rent out native hay or range. It is recognized that in most real situations, native hay or rangeland would be leased out if not used by the farm operator.

With $25.28 and $23.08 cwt. prices used for feeder and stocker calves, respectively, both were profitable, particularly at a corn price of 66 cents. In reality, such a large disparity between grain and livestock prices probably would not occur, or if it did, it would not remain for long since the demand for corn for livestock feeding would force corn prices to rise. However profitable, the cattle enterprise existed primarily to make use of the native hay and range, although cropland was used to produce feed which supplemented the native hay and range. The labor supply was adequate since most of the labor needed for the livestock occurred in the fall and winter months, there was no competition with labor needed for the crop enterprises.

Most of the calves fed to a weight of 700 pounds were purchased, since they were relatively more profitable than maintaining a herd of stock-cows. In addition, more labor is needed to maintain a stock-cow herd. Also more labor is needed at a time when it competes with spring labor for crops. Less short-term capital is required to maintain a stock-cow herd than to purchase feeder calves, but if owned capital or credit is ample there is no problem.

Feed, other than minerals, feed additives and salt, was homegrown and consisted of hay, corn-silage, and a small amount of grain. The grains used for feed depended upon the price of wheat in relation to corn, since the main enterprise was cash grain and crop rotations changed as wheat increased in price. Spring wheat was used as feed when wheat was priced below 72 cents per bushel. As the wheat price increased, corn-grain replaced wheat in the livestock ration up to a price of $2.61 per bushel. A further increase in wheat price brought about a change in the crop rotation which contained both oats and barley to be used as livestock feed.

The amount of cropland used for livestock feed varied from 55.5 acres, (16.7% of the cropland) at the low wheat price to 34.5 acres (10.4% of the cropland) when wheat reached $2.65 per bushel.

Farm Plans with Corn Priced at 80 Cents

Very little difference occurred in farm plans when the price of corn was raised to 80 cents. No change occurred in crop rotations, but there was a shift in land use—from tame pasture to tame hay and from corn-silage to corn-grain. This change from corn-silage necessitated a shift from purchasing as many feeder calves as in the plans for 66-cent corn. Accompanying the shift to fewer purchased calves was an increase in the number of stock-cows.

A 14-cent rise in corn price forced the wheat price to higher levels also (see first three farm plans in Table 6 on page 10). Net returns were higher for the first three farm plans due to higer wheat and corn prices as well as an increased volume of corn-grain sold. At wheat prices of $1.71 per bushel and up, the net returns were the same as when corn was worth 66 cents per bushel, since no further change occurred in either the price of wheat or the optimal farm plans.

Crop rotation by soil groups at the various levels of wheat prices are shown in Table 9.

Crop Production—Soils Group I-II. With wheat priced at 90 cents per bushel, a corn-flax rotation returned $15.07 per acre compared with $11.55 per acre returns from fallow-wheat-flax. Returns from other rotations—wheat-fallow, corn-wheat, and continuous wheat were much lower.

Wheat was still not competitive with an increase in price to $1.35 per bushel. Fallow-wheat-flax was nearly competitive with corn-flax with returns of $14.85, but other rotations were far less profitable with returns of $8.70 per acre and less.

Table 9. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 80 Cents per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices: $.36 to .90	$1.22 to $1.35	$1.36 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66 to $3.09
Soil Group I-II						
Corn, Flax	156.0	156.0	29.5			
Summer Fallow, Spring Wheat, Flax			126.5	156.0		
Spring Wheat					156.0	156.0
Soil Group III						
Corn, Flax	140.0					
Summer Fallow, Spring Wheat Flax		140.0	140.0	109.6		
Corn, Spring Wheat				30.4	30.4	39.5
Summer Fallow, Wheat					109.6	100.5
Soil Group IV						
Spring Wheat, Corn, Flax, Alfalfa, (3 years)	37.0	37.0	37.0	37.0	37.0	
Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats						37.0

With an increase in wheat price above $1.70 per bushel, the farm plans remained unchanged from the optimal organization with a 66-cent corn price.

Crop Production—Soils Group III. The crop rotations at all wheat price ranges were identical to those with corn priced at 66 cents per bushel. Net returns to the corn-flax rotation were slightly higher due to the higher corn price.

Crop Production—Soils Group IV. The crop rotations on this group of soils were also identical to those with corn priced at 66 cents per bushel. However, corn production on these soils was used for livestock, thus the increased corn price did not add to the net returns.

Livestock Production. The only major change in farm plans, with a 14-cent rise in corn price, was in the livestock enterprise. Essentially the change was one of raising fewer calves to stocker weights—the stock-cow herd was increased to 26 and the number of calves purchased was reduced by well over half. This change occurred at wheat prices below $1.36 per bushel—the livestock enterprise becoming identical to those at wheat prices above $1.36 per bushel when corn was priced at 66 cents per bushel.

The change in land use also necessitated a change in feeding (hay substituted for corn-silage since silage production shifted to corn-grain and tame pasture to hay).

Farm Plans with Corn Priced at $1.07

The competitive position and relative profitability of corn was further enhanced with an increase in corn price to $1.07 per bushel. This would force a rise in the price of wheat if it were to remain on a competitive level with corn for the use of cropland.

Crop rotations by soil groups at the various levels of wheat prices are shown in Table 10.

Crop Production—Soils Group I-II. A corn-flax rotation with corn at $1.07 per bushel returned a per acre net of $19.07 with corn contributing returns of $10.97 and flax returns of $27.16 per acre. The second most profitable crop combination was fallow-wheat-flax with per acre returns of $16.89 at a wheat price of $1.64 per bushel.

The corn-flax rotation, which remained unchanged as wheat rose in price to $1.84 per bushel, shifted to fallow-wheat-flax with a rise to a range of $1.85 per bushel. The fallow-wheat-flax rotation remained until the wheat price rose above $2.24 per bushel. This shift involved the entire acreage rather than only a portion, as was the case at the lower corn price levels. With wheat priced at $2.24 per bushel, fallow-wheat-flax returned $21.29 per acre and continuous wheat, $19.95. Corn-flax, corn-wheat, and wheat-fallow rotations were considerably less profitable than the corn-flax rotation.

Continuous wheat became most profitable as wheat prices rose to $3 per bushel with per acre returns of $30.89. This compared with the second best alternative of wheat-fallow, returning $26.71 per acre at the same wheat price. Summer fallow-wheat-flax and corn-wheat were the third and fourth best crop combinations.

Crop Production—Soils Group III. The fallow-wheat-flax rotation, which was in the cropping system at the lower corn price levels, was not as relatively profitable at the $1.07 per acre corn price. The flax yield was relatively less favorable (10.1 bushels per acre) and wheat was forced to higher price levels to remain competitive with corn at $1.07 per bushel.

Table 10. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.07 per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices $.36 to $1.64	$1.65 to $1.84	$1.85 to $2.24	$2.26 to $3.00	$3.15
Soil Group I-II					
Corn, Flax	156.0	156.0			
Summer Fallow, Spring Wheat, Flax			156.0		
Spring Wheat				156.0	156.0
Soil Group III					
Corn, Flax	140.0				
Corn, Spring Wheat		140.0	140.0	140.0	39.5
Summer Fallow, Spring Wheat					100.5
Soil Group IV					
Spring Wheat, Corn, Flax, Alfalfa (3 years)	37.0	37.0	37.0		
Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats				37.0	37.0

Thus, corn-flax, returning $10.30 per acre at a wheat price of $1.64, per bushel was the most profitable crop combination; corn-wheat was a close second with net return of $10.10 per acre. Summer fallow-wheat-flax and wheat-fallow were less profitable.

The corn-flax rotation shifted to corn-wheat as the wheat price rose above $1.64 per bushel. This crop combination remained unchanged until prices rose above $3 per bushel. Wheat-fallow-flax were the second and third most profitable crop combinations, although the differences were less than $1 per acre between each.

About 50 acres of corn shifted to summer fallow when wheat rose to $3.15 per acre. This left about 20 acres in corn, which was needed as feed for the livestock enterprise. A wheat-fallow rotation returned $21.42 per acre, compared with $20.89 per acre from a corn-wheat combination. An acre of wheat in the corn-wheat rotation returned a net of $32.48.

Crop Production—Soils Group IV. No change occurred in crop rotations other than that which occured at the same wheat prices at the lower corn price levels. Wheat-corn-flax-alfalfa (3 years) shifted to fallow-wheat-barley-oats when wheat rose to $2.26 per bushel. This same shift occurred at the lower corn price levels.

Livestock Production—The livestock enterprise, consisting of a stock-cow herd and purchased feeder calves to raise to stocker weights, remained unchanged from that at wheat prices up to $2.24 per bushel when corn was 80 cents per bushel. Wheat was included in the ration up to a wheat price of $1.64 per bushel, since wheat was worth more as a feed when corn was priced $1.07 per bushel. As wheat rose above the $1.64 per bushel price, corn replaced wheat in the ration.

The number of stock-cows decreased and an increased number of calves were purchased when wheat reached $2.26 per bushel. At the same time, some corn-grain acreage shifted to corn-silage, which was included in the calf ration.

A further increase in wheat price to $3.15 per bushel resulted in another decrease in stock-cow number and a commensurate increase in the number of purchased calves. Production of corn silage, however, was reduced as some calves were switched to grain and hay in the ration — barley and oats providing the grain.

Labor

Labor was not expected to be a limiting resource, particularly on a farm of this size. As farms increase in size and become more intensively farmed, capital substitutes for labor at an increasing rate. In addition, farmers work longer days as well as on Sunday to make up for labor lost due to wet or otherwise inclement weather. Often, some family labor is available, other than the operator himself, if only for emergency needs.

Results showed that labor needs were neither a crucial nor a limiting factor. In fact, labor was in surplus since the minimum annual labor needed amounted to 50% of the available labor and the maximum amounted to 60.9%. The minimum amount of labor used during the planting and harvesting seasons amounted to 58.7% of that labor available. The maximum labor used amounted to 62%.

Labor use by periods for the various wheat and feed grain price levels is shown in Table 11.

Capital

Short-term capital and credit was assumed to be ample and, thus, was not a critical factor. The short-term capital needs varied between $30,194 and $23,951 when corn was priced at 66 cents per bushel, with little change occurring at the other two corn prices. The purchase of feeder calves raised the capital requirements by $4,000 to $8,000, depending upon the numbers purchased.

Table 11. Resident Labor Use by Periods for the Optimum Farm Organization at Specified Wheat and Corn Prices, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Labor periods	Corn Price Per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $.36 to $.71	$.91 to $1.11	$1.16 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66
			Hours					
Nov. 16 to March 15	66c	803	309.1	311.5	296.1	296.1	296.1	268.2
March 16 to April 30	66c	417	130.6	141.5	149.4	152.3	191.3	187.6
May 1 to July 15	66c	781	613.9	496.8	429.6	425.5	406.7	368.0
July 16 to Sept. 30	66c	804	498.8	566.2	564.5	567.5	617.5	620.1
Oct. 1 to Nov. 15	66c	308	287.2	195.7	118.5	118.5	118.5	114.9
			Hours					
Total Annual		3,113	1,839.6	1,711.7	1,558.1	1,559.9	1,630.1	1,558.8

Labor periods	Corn Price Per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $.36 to $.90	$1.22 to $1.35	$1.36 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66 to $3.09
			Hours					
Nov. 16 to March 15	80c	803	296.1	296.1	296.1	296.1	296.1	268.2
March 16 to April 30	80c	417	130.7	140.5	149.4	152.3	191.3	187.6
May 1 to July 15	80c	781	653.5	610.2	429.6	425.5	406.7	368.0
July 16 to Sept. 30	80c	804	457.9	457.9	564.5	567.5	617.5	620.1
Oct. 1 to Nov. 15	80c	308	264.2	177.5	118.5	118.5	118.6	114.9
			Hours					
Total Annual		3,113	1,802.4	1,682.2	1,558.1	1,559.9	1,630.1	1,558.8

Labor periods	Corn Price Per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $.36 $1.64	$1.65 to $1.84	$1.85 to $2.24	$2.26 to $3	$3.15
			Hours				
Nov. 16 to March 15	$1.07	803	296.1	296.1	296.2	274.0	268.2
March 16 to April 30	1.07	417	130.7	155.4	155.6	193.4	187.6
May 1 to July 15	1.07	781	653.5	631.1	500.0	447.6	368.0
July 16 to Sept. 30	1.07	804	457.9	550.3	535.7	626.3	620.1
Oct. 1 to Nov. 15	1.07	308	264.2	264.2	164.6	159.9	114.9
			Hours				
Total Annual		3,113	1,802.4	1,897.1	1,652.1	1,701.2	1,558.8

SUMMARY

The purpose of this publication is to provide some results of a research study in which optimum farm plans were determined for a representative 640-acre wheat farm in Campbell, Edmunds, McPherson, and Walworth Counties.

Linear programming techniques were used to determine the optimal farm organization at alternative price combinations of wheat and feed grains. Optimal farm plans were determined at three levels of corn prices ranging from a low of 66 cents to a high of $1.07 per bushel, while wheat prices were varied from zero to $3 per bushel.

Results of the programming analysis indicate net returns would be greatest with the model farm oriented toward production of cash-grain. A supplementary cattle enterprise was maintained, using 16% or less of the cropland as well as labor, native hay and range which might otherwise not have been used.

The three cash crops were corn, flax, and wheat, each having a different break even price, depending upon the yield ratios and production costs on the various soils groups. The break even price is the key in knowing which crops are the most profitable at the various price levels.

Given the objective to optimize net returns to land, labor, and management, the strategy is then to employ the break even prices of each crop so as to obtain the maximum acreage of the most profitable crops on each of the soil groups. For example, with corn priced at 66 cents per bushel, wheat replaced corn as a cash grain on soil Groups I-II when wheat reached a price of $1.16 per bushel. Corn with a break even price of 66 cents per bushel lost its competitive advantage when wheat rose to a price of $1.16 per bushel, since the break even price of wheat on fallow was $1.14 per bushel. Thus, wheat after fallow with flax in the rotation was most profitable up to wheat prices of $2.24 per bushel. A rise in wheat prices above $2.24 per bushel favored continuous wheat, with a break even price of 85 cents per bushel. Wheat grown in a rotation with corn had a lower break even price, 74 cents per bushel, but with corn priced at 66 cents per bushel, the returns per acre were reduced if the corn was marketed as a cash grain.

The crops grown on soils Group III had a completely different set of break even prices as the yields and costs were different. Corn, for example, had a break even price of 71 cents per bushel and flax had a break even price of 40 cents higher than on the other soils group.

Wheat acreage and production increased as the wheat price increased, while the flax and corn prices remained constant. The maximum wheat acreage allowable, due to the crop rotation restrictions on each soil group, was 241 acres. In keeping with the objective of optimum net returns, wheat acreage did reach the allowable maximum of 241 acres. However, the wheat price at which the maximum wheat acreage was attained varied by soil group and the corn price level.

Corn, as a cash grain, was competitive for cropland at relatively low wheat prices, although the degree of competition depended also upon the price of corn. With corn priced at 66 cents per bushel, corn as a cash grain was produced only until wheat reached $1.16 per bushel. When the price rose to 80 cents per bushel, cash corn was produced until a wheat price of $1.36 per bushel was reached. With an increase in price to $1.07 per bushel some cash corn was produced until wheat reached a price of $3 per bushel.

Flax at the price of $2.22 per bushel was the main competing cash crop as long as wheat was priced below $2.24 per bushel. Flax was produced at all three corn price levels until the wheat price of $2.24 per bushel was reached. Thus, when corn was priced at 66 and 80 cents per bushel, flax and wheat were competing for the use of cropland until a relatively high level of wheat price was reached. When corn was priced at $1.07 per bushel, the two crops competing for the use of cropland were corn and flax.

The allowable maximum wheat acreage of 241 acres was reached at the high wheat prices. The remaining 92 acres of cropland were used for production of livestock feed, since the livestock enterprise was more profitable than cash corn at prices up to $1.07 per bushel and flax at a price of $2.22 per bushel. The livestock enterprise was one of raising calves to a weight of 700 pounds. Most of the calves were purchased in the fall and some calves were raised from a small stock-cow herd. Feed, other than minerals, feed additives, and salt, was homegrown and consisted of hay, corn silage, and a small amount of grain. The grains used depended upon the price of wheat in relation to corn. Spring wheat was used as feed when wheat was priced below its break even point, as its value as feed was greater than the market price. But as the wheat price increased, corn-grain replaced wheat in the ration.

Labor was not a limiting resource, since the minimum annual needs amounted to 50% of the labor available and the maximum amounted to 60.9%. Most of the surplus labor existed during the winter months.

The optimal farm plans presented herein are the results of computer programming using specific assumption with regard to farm size and cropland acreage, crop yields, costs, commodity market prices, and other such factors. Consequently, these results cannot be construed as being representative of all or a specific 640-acre farm in this four-county area. The results, however, do present the most profitable farm organization under the stated assumptions and may serve as a guide for determining profitable farm enterprise combinations under a similar cost and price structure.

APPENDIX

Appendix Table 1. Crops and Crop Rotations Allowed as Activities by Soil Group

Rotation	Soil Groups I & II	III	IV
Spring Wheat (continuous)	X		
Barley (continuous)	X		
Oats (continuous)	X		
Oats-Alfalfa (3 years)	X		
Flax-Spring Wheat-Barley-Oats-Alflafa (3 years)	X		
Corn-Spring Wheat	X	X	
Corn-Barley	X	X	
Corn-Oats	X	X	
Corn-Flax	X	X	
Summer Fallow-Spring Wheat	X	X	
Summer Fallow-Spring Wheat-Flax	X	X	
Spring Wheat-Flax-Alfalfa (2 years)	X	X	
Summer Fallow-Spring Wheat-Barley-Corn	X	X	
Corn-Spring Wheat-Corn-Oats-Alfalfa (3 years)	X	X	
Summer Fallow-Spring Wheat-Oats-Corn		X	
Summer Fallow-Spring Wheat-Spring Wheat-Barley-Oats		X	X
Summer Fallow-Spring Wheat-Barley-Barley-Oats		X	X
Spring Wheat-Corn-Oats-Alfalfa (3 years)		X	X
Spring Wheat-Corn-Flax-Alfalfa (3 years)		X	X
Summer Fallow-Spring Wheat-Corn-Oats-Alfalfa (3 years)		X	X
Rye-Corn-Oats-Alfalfa (4 years)		X	X
Flax-Spring Wheat-Corn-Oats-Alfalfa (2 years)			X
Flax-Barley-Corn-Oats-Alfalfa (2 years)			X
Spring Wheat-Barley-Corn-Oats-Alfalfa (2 years)			X
Spring Wheat-Barley-Corn-Flax-Alfalfa (2 years)			X
Grass and Legume (continuous)			X

Appendix Table 2. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 66 Cents per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Crop	Crop Acres at the Following Wheat Prices $.36 to .71	$.91 to $1.11	$1.16 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66
Soil Group I-II						
Corn	78.0	78.0	14.7			
Flax	78.0	78.0	56.9	52.0		
Summer Fallow			42.0	52.0		
Spring Wheat			42.0	52.0	156.0	156.0
Total Acres	156.0	156.0	156.0	156.0	156.0	156.0
Soil Group III						
Flax	70.0	46.7	46.7	36.5		
Corn	70.0			15.2	15.2	19.8
Summer Fallow		46.6	46.6	36.5	54.8	50.2
Spring Wheat		46.6	46.6	51.7	70.0	70.0
Total Acres	140.0	139.9	139.9	139.9	140.0	140.0
Soil Group IV						
Corn	6.2	6.2	6.2	6.2	6.2	
Flax	6.2	6.2	6.2	6.2	6.2	
Alfalfa	18.5	18.5	18.5	18.5	18.5	
Spring Wheat	6.2	6.2	6.2	6.2	6.2	14.8
Barley						7.4
Oats						7.4
Summer Fallow						7.4
Total Acres	37.1	37.1	37.1	37.1	37.1	37.0

Appendix Table 3. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 80 Cents per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

	Crop Acres at the Following Wheat Prices					
Crop	$.36 to $.90	$1.22 to $1.35	$1.36 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66 to $3.09
Soil Group I-II						
Corn	78.0	78.0	14.7			
Flax	78.0	78.0	56.9	52.0		
Summer Fallow			42.2	52.0		
Spring Wheat			42.2	52.0	156.0	156.0
Total Acres	156.0	156.0	156.0	156.0	156.0	156.0
Soil Group III						
Flax	70.0	46.7	46.7	36.5		
Corn	70.0			15.2	15.2	19.8
Summer Fallow		46.6	46.6	36.5	54.8	50.2
Spring Wheat		46.6	46.6	51.7	70.0	70.0
Total Acres	140.0	139.9	139.9	139.9	140.0	140.0
Soil Group IV						
Corn	6.2	6.2	6.2	6.2	6.2	
Flax	6.2	6.2	6.2	6.2	6.2	
Alfalfa	18.5	18.5	18.5	18.5	18.5	
Spring Wheat	6.2	6.2	6.2	6.2	6.2	14.8
Barley						7.4
Oats						7.4
Summer Fallow						7.4
Total Acres	37.1	37.1	37.1	37.1	37.1	37.0

Appendix Table 4. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.07 per Bushel for Corn, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

	Crop Acres at the following Wheat Prices				
Crop	$.36 to $1.64	$1.65 to $1.84	$1.85 to $2.24	$2.26 to $3.00	$3.15
Soil Group I-II					
Corn	78.0	78.0			
Flax	78.0	78.0	52.0		
Summer Fallow			52.0		
Spring Wheat			52.0	156.0	156.0
Total Acres	156.0	156.0	156.0	156.0	156.0
Soil Group III					
Flax	70.0				
Corn	70.0	70.0	70.0	70.0	19.8
Spring Wheat		70.0	70.0	70.0	70.0
Summer Fallow					50.2
Total Acres	140.0	140.0	140.0	140.0	140.0
Soil Group IV					
Corn	6.2	6.2	6.2		
Flax	6.2	6.2	6.2		
Alfalfa	18.5	18.5	18.5		
Spring Wheat	6.2	6.2	6.2	14.8	14.8
Barley				7.4	7.4
Oats				7.4	7.4
Summer Fallow				7.4	7.4
Total Acres	37.1	37.1	37.1	37.0	37.0

Appendix Table 5. Crop Rotations on All Soil Groups at Specified Wheat and Corn Prices, 640-Acre Model Farm, Campbell, Edmunds, McPherson, and Walworth Counties

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel: $.36 to $.71	$.91 to $1.11	$1.16 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66
		Acres					
Spring Wheat, Corn, Flax, Alfalfa	66c	37.0	37.0	37.0	37.0	37.0	
Corn, Flax	66c	296.0	156.0	29.5			
Summer Fallow, Spring Wheat, Flax	66c		140.0	266.5	265.6		
Corn, Spring Wheat	66c				30.4	30.4	39.5
Summer Fallow, Spring Wheat	66c					109.6	100.5
Spring Wheat	66c					156.0	156.0
Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats	66c						37.0

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel: $.36 to $.90	$1.22 to $1.35	$1.36 to $1.70	$1.71 to $2.11	$2.24 to $2.61	$2.66 to $3.09
		Acres					
Spring Wheat, Corn, Flax, Alfalfa	80c	37.0	37.0	37.0	37.0	37.0	
Corn, Flax	80c	296.0	156.0	29.5			
Summer Fallow, Spring Wheat, Flax	80c		140.0	266.5	265.6		
Corn, Spring Wheat	80c				30.4	30.4	39.5
Spring Wheat	80c					156.0	156.0
Summer Fallow, Spring Wheat						109.6	100.5
Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats							37.0

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel: $.36 to $1.64	$1.65 to $1.84	$1.85 to $2.24	$2.26 to $3.00	$3.15
		Acres				
Spring Wheat, Corn, Flax, Alfalfa	$1.07	37.0	37.0	37.0		
Corn, Flax	1.07	296.0	156.0			
Corn, Spring Wheat	1.07		140.0	140.0	140.0	39.5
Summer Fallow, Spring Wheat, Flax	1.07			156.0		
Spring Wheat	1.07				156.0	156.0
Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats	1.07				37.0	37.0
Summer Fallow, Spring Wheat	1.07					100.5

Catalog Dept.
S. D. State University Library
Brookings, S. D. 57006 4 Copies