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Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income: Beadle, Clark, Codington, Day, Marshall and Roberts Counties

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

SOUTH DAKOTA STATE UNIVERSITY
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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 farm 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, 45% of the feed grain acreage, 60% of the state's flax acreage, and about 55% of the total tame- and native-ray 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 range-land, soil characteristics, land use and tillage practices, farm organization and enterprises, 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 sub-areas 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 sub-areas 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 combinations of farm enterprises at various combinations of crop and livestock product prices on a 640-acre model farm in Beadle, Clark, Codington, Day, Marshall, and Roberts 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 related factors.

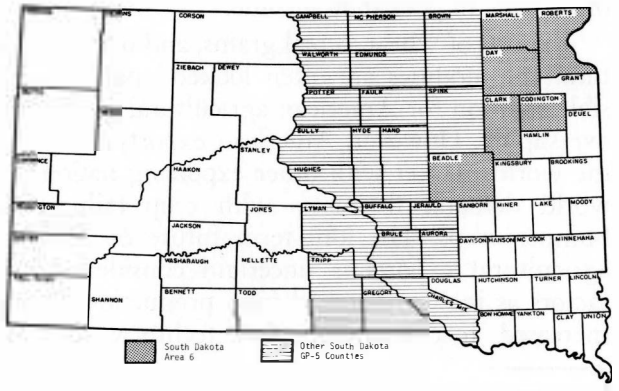

Figure 1. South Dakota GP-5 Study Area

Effects of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Beadle, Clark, Codington, Day, Marshall and Roberts Counties

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 market 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 United States 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 in price. There is now a growing tendency for people with rising incomes to view some 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 are often 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 toward 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, simply 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 in the Beadle, Clark, Codington, Day, Marshall, and Roberts County area was about 558 acres, according to the 1964 census. Average farm sizes varied among counties, ranging from 427 acres in Roberts County to 673 acres in Marshall County. There were 6,650 farms in the six counties in 1964, of which 17.8% were classified as cash grain, 45.7% were livestock, and 10.5% were general farms. The remaining 26.0% were poultry, dairy and miscellaneous farms.

Farms in the six-county area were diversified, with cash grains, feed grains, and livestock. Crops grown strictly for cash (wheat, flax, rye, and soybeans) occupied nearly 40% of the cropland used for grain production in 1964. In addition, significant amounts of corn-grain, oats, and barley were sold as cash crops.

In 1964, about 53% of the corn harvested was picked for grain, and nearly 40% of the corn grain was sold. Thirty-nine percent of the oats and 66% of the barley harvested also were sold off the farm. The remaining feed grains were fed to livestock on the farm.

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

Table 1. Number and Percent of Farms that Raised and Harvested Major Grain Crops in 1964 in Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Crop	Number of Farms	Percentage of Farms	Number of Acres Harvested	Percentage of Acres Harvested
Corn*	4,754	71.5	372,857	28.3
All Wheat†	4,262	64.1	252,012	19.1
Oats	4,878	73.4	342,835	26.0
Barley	1,196	18.0	47,335	3.6
Flax	3,116	46.9	203,817	15.4
Rye	858	12.9	35,215	2.7
Other‡			64,288	4.9

*Includes corn harvested for grain, silage and other purposes.
†Includes 9,742 acres of winter wheat and 44,756 acres of durum.
‡Includes proso, emmer and speltz, soybeans and sorghum.
Sources: U. S. Census of Agriculture, 1964.

The number and percentage of farms in the six-county area that raised and harvested major crops in 1964 are shown in Table 1.

Although only 46% of the area's farms were classified by the census as livestock farms, some type of livestock enterprise was reported on about 80% of the farms. Slightly more than half of the farms maintained a beef-cow herd, but two-thirds of the herds had fewer than 35 cows. Production of dairy products was important in the area—half of the farms kept one or more dairy cows. Although some of these enterprises were maintained for home consumption, 20% of these farms sold whole milk. Cream was also sold by about 17% of the area's farms in 1964. Much of the dairy production was from herds of 12 to 20 cows.

Nearly 30% of the farms kept sows or gilts for farrowing in 1964. A large part of the production came from sow herds of 3 to 9 sows in 1964, although the average number of sows on farms having hogs was 12.

Ewe flocks were found on about 23% of the farms in this area in 1964, the flocks averaged 58 head. The bulk of production came from 20- to 75-head flocks. Very few flocks were as large as 200 head.

MODEL WHEAT FARM

Description

A farm sample, drawn in 1962, provided the basis for determining the model farm. 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 was 640 acres, which consisted of 477 acres of cropland, 129 acres of native hay and pasture, and 34 acres of farmstead, roads, and wasteland. The size of 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 to 1975. Although farms are becoming larger, there is a relatively large percentage of farms with fewer than 640 acres. Many of these farms will survive and will be enlarged by land rental or purchase. The nature of farm adjustment and farm oraganization 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	73
Oats, Barley, Flax	154
Corn Grain	53
Corn Silage	40
Summer Fallow	50
Alfalfa	89
Other Tame Hay and Pasture	18
Native Hay	45
Native Pasture	84

Soils

The soils in this six-county area are Chernozems. Major soil associations are Houdek-Bonilla, Beotia-Aberdeen, Hecla-Ulen, Poinsett-Sinai, Kranzburg-Vienna and Barnes-Aastad.[2] Soils of the Houdek-Bonilla association are undulating to nearly level and are well to moderately well drained. Developed from calcareous loam till, these loams are dark grayish-brown and slightly acid. The major problems in soil and water management are the maintenance of organic matter and the conservation of moisture. Major soil uses are: (1) cash grain production, (2) livestock farming, and (3) general farming.

The Beotia-Aberdeen association soils are nearly level, well to imperfectly drained, dark grayish-brown silt loams and silty clay loams. The Beotia soils developed from lacustrine silts of the Lake Dakota Plain. The Aberdeen soils are solodized solonetz soils which also developed from these materials. Major problems in soil and water management are: (1) the maintenance of soil fertility, (2) moisture conservation, and (3) seasonal ponding and drainage of low areas due to slow permeability. The major soil uses are cash grain and general farming.

The Chernozem soils of the Hecla-Ulen association are nearly level to hummocky and somewhat excessively to moderately well drained. These grayish-brown soils, which developed from sandy fluvial-

[2]Names of soil associations are subject to change as a result of reclassification. For a more detailed break-down and description of soil associations in the area, see Derscheid, Lyle A., and Fred C. Westin, **Soil Atlas and Crop Production Guide for North Central South Dakota.** Cooperative Extension Circular 660, South Dakota State University, 1968.

Table 2. Crop Yields Per Planted Acre By Soils Groups, Average Management Area 6: Beadle, Clark, Codington, Day, Marshall and Roberts Counties, South Dakota

Crop and Rotation	GROUP I SOILS—16.5% Projected Yield	Fertilizer N	Fertilizer P_2O_5	Weed Spray	GROUP II SOILS—62.2% Projected Yield	Fertilizer N	Fertilizer P_2O_5	Weed Spray	GROUP III & IV SOILS—21.3% Projected Yield	Fertilizer N	Fertilizer P_2O_5	Weed Spray
	Bu.	Pounds		Dol.	Bu.	Pounds		Dol.	Bu.	Pounds		Dol.
S. Wheat-Fallow	28.1	—	19.5	.41	25.4	—	17.5	.41	22.7	—	15.5	.41
S. Wheat-After Corn	25.8	30.0	18.0	.41	23.3	26.5	16.0	.41	20.8	23.5	14.5	.41
S. Wheat-After Sm. Gr.	24.3	27.5	16.5	.41	18.9	21.5	13.5	.41	16.9	20.0	11.5	.41
Oats-Continuous Crop	59.0	27.0	21.5	.12	49.0	22.0	17.5	.12	44.0	20.0	15.0	.12
Barley-Continuous Crop	37.0	25.0	16.5	.34	34.0	22.0	15.0	.34	29.9	20.0	13.5	.34
Rye-Continuous Crop	29.0	16.5	15.0	—	23.8	12.0	14.0	—	20.7	11.5	13.0	—
Flax-After Alfalfa or Row Crop	16.0	—	14.0	.20	13.0	—	11.5	.20	10.9	—	10.0	.20
Corn-Grain-After Sm. Grain	55.0	57.0	18.0	3.23	38.0	40.0	12.5	3.23	31.0	32.5	10.0	3.23
Corn-Silage-After Sm. Grain	10.75	62.5	20.0	3.23	7.50	44.0	14.0	3.23	6.20	36.0	11.0	3.23
Alfalfa	2.70	—	—	—	2.00	—	—	—	1.69	—	—	—

eolian materials, are slightly acid sandy loams. The Hecla-Ulen soils are low in organic matter, subject to wind erosion, and subject to seasonal ponding and drainage problems in low areas due to slow permeability. The major soil uses are livestock and general farming.

The Kranzburg-Vienna soils are sloping and well drained. These soils are black, slightly scid silt loams, silty clay loams, and loams. The Kranzburg soils developed from moderately deep loess mantle over calcareous glacial till. The Vienna soils developed from a loam or light clay loam calcareous glacial till. The major problems in soil and water management associated with these soils are: (1) maintenance of organic matter and supply of nitrogen, (2) maintenance of soil fertility, and (3) moisture conservation. The Kranzburg-Vienna soils are best suited to general farming.

The Barnes-Aastad soils, occurring in most of Roberts County, are nearly level to rolling and developed from calcareous loam till. These black or nearly black loams to clay loams range from neutral to alkaline and are productive, responding to phosphate and nitrogen fertilizers. The major problems of these soils are: (1) maintenance of organic matter and nitrogen, (2) maintenance of soil fertility, and (3) conservation of moisture. These soils are suitable for cash grain farming.

Each soil series and soil type, within the soil associations found in the six-county area, was classified in 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. In cases where the soils of a particular group comprise 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. For this area, Soils Groups I and II were treated as separate groups, but Soils Groups III and IV were combined. The yield projections and fertilization rates, by crop, for each of the three final soils groups are shown in Table 2.

A total of 27 crop rotations or sequences, including continuous small grain, were selected for the three soils groups (Appendix Table 1). These rotations, chosen from a wide range of alternatives, were within the requirements of the various soils within each group. For the model farm, 79 acres of cropland were classified as Soils Group I, 297 acres as Soils Group II, and 101 acres as Soils Group III-IV.

Table 3. Total Man Hours and Per Acre Costs for the Crop Alternatives Budgeted for the 640-Acre Model Farm, by Soil Group,* Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Crop	Total Man Hours†	Costs Per Acre for Soil Group I	II	III
		Dollars		
Summer Fallow	1.54	4.49	4.49	4.49
Wheat Following Fallow	1.58	9.47	9.38	9.11
Wheat Following Corn	1.97	14.76	14.18	13.69
Wheat Following Small Grain	1.94	14.39	13.42	13.39
Oats	2.28	15.30	14.34	13.89
Barley	2.28	14.82	14.30	13.93
Rye	2.16	15.61	14.98	14.83
Flax Following Row Crop	1.97	11.52	11.29	11.15
Flax Following Alfalfa	2.82	11.52	11.29	11.15
Corn Grain	2.85	28.71	26.93	25.70
Corn Silage	3.88	37.16	33.30	31.50
Alfalfa (2 cuttings—1 baled)	2.22	15.84	14.88	14.45
Native Hay	.95	4.14	4.14	4.14

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

Crop Alternatives

Cash grains, feed grains, and forage crops were considered as crop alternatives in this six-county area. The small grains include: 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 considered 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, could be used only as feed for livestock on the farm, since sale of those crops was not allowed as an alternative. Native hay and pasture could either be used for cattle or left unused.

A summary of the budgets for the crop enterprises 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—an interest charge on land was not included.

Livestock Alternatives

The livestock activities considered included: (1) a cow-calf operation producing 430-lb. calves, (2) wintering and summer grazing calves produced on the farm for sale as 700-lb. stockers or feeders, and (3) buying 430-lb. calves for the wintering and grazing enterprise. Fattening activities, such as cattle feeding or raising hogs, were excluded as enterprise alternatives; these livestock activities are not primarily land based and are somewhat independent of wheat production. Stocker feeding systems which were allowed as alternatives included: (1) a stocker ration with corn-silage, and (2) a stocker ration without corn-silage. A summary of budget items for the cow-calf and stocker calf enterprises is shown in Table 4.

Prices Received

Optimal farm plans were determined for various combinations of crop and livestock product prices. The market prices were held constant for flax at $2.41/bu., rye at $.82/bu., feeder calves at $25.28/cwt., and 700-lb. stockers at $23.08/cwt. Wheat prices were varied from 36 cents to $3.37 per bushel at corn price levels of 73 cents, 87 cents, and $1.14 per bushel. Oat and barley prices were converted to a corn equivalent value based on feed value.

The flax, rye, and cattle prices are those which may be expected to occur in 1970 to 1975 under certain assumed supply and demand conditions. The assumed grain prices are those received at local elevators, while the livestock prices are those received at the Sioux City Terminal market.

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

Item	Unit	Cow-calf Herd	Stocker calves Wintered and Grazed w/silage	Stocker calves Wintered and Grazed wo/silage
Percent Calf Crop	pct.	92.0		
Purchase Weight	lbs.		430	430
Sales Weight	lbs.	430	700	700
Purchase Cost	dol.		108.70	108.70
Pasture	aum.	6.5	3.25	3.25
Hay Equivalent	ton	2.60	.40	.64
Corn Silage	ton		1.20	
Corn Grain Equivalent	cwt.	2.70		3.60
Variable Cash Costs*	dol.	40.87	25.94	25.76
Allocable Fixed Costs†	dol.	11.40	6.90	6.90
Labor Per Head	hrs.	12.0	5.3	5.3

*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

Estimates of the available labor supply were made based on 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 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 usually is 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 number of hours allotted to each period: (1) 1017 hours, November 16 to March 15; (2) 528 hours, March 16 to April 30; (3) 989 hours, May to July 15; (4) 1018 hours, July 16 to September 30; and (5) 390 hours, October 1 to November 15.

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

OPTIMUM FARM PLANS AT VARYING WHEAT AND FEED GRAIN PRICES

Linear programming is a method of analysis used to determine the farm plan which provides 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, and product prices. This method of analysis was used to determine 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 plans

Table 5. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Organization at Various Levels of Wheat Prices and 73 Cents Per Bushel for Corn, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Item	Units	Price of Wheat $.36 to $.42	$.82 to $.90	$.94 to $1.38	$1.79 to $1.97	$2.03 to $2.34	$3.04
Crops							
Spring Wheat	Acre	64	74	105	194	261	268
Corn	Acre	60	54	21	—	—	2
Flax	Acre	104	114	112	74	7	—
Rye	Acre	20	14	—	—	—	—
Oats	Acre	20	14	—	20	20	20
Barley	Acre	—	—	—	20	20	20
Summer Fallow	Acre	—	—	14	20	156	167
Tame Hay or Pasture	Acre	209	207	225	149	13	—
Crop Production							
Spring Wheat	Bushel	1,413*	1,637	2,357	4,207	5,985	6,155
Flax	Bushel	1,362	1,484	1,368	891	79	—
Feed Grain (corn equivalent)	Bushel	3,266	2,914	781	866	866	866
Corn Silage	Ton	—	—	—	—	—	12
Tame Hay	Ton	158	221	249	180	26	—
Native Hay	Ton	—	—	—	—	31	31
Livestock							
Beef Cows	Head	—	72	81	58	19	—
Stockers Sold†	Head	248	55	61	44	14	52
Total Labor Use	Hour	2,356	2,333	2,420	2,052	1,275	1,214
Total Capital Used	Dollar	55,503	54,895	48,395	38,144	18,857	18,987
Net Returns‡	Dollar	5,675	6,046	6,267	8,846	9,928	16,074

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡Net returns are for the lower wheat price and include returns to land and the operator's labor and management.

resulted. Many of the optimal plans indicated insignificant changes in production or net income and are not presented here.

Tables 5 through 7 show only major changes in crop acreages, crop and livestock production, labor, capital and net returns[3] at constant feed grain, flax, and cattle prices, with increasing wheat prices. Since minor changes in farm organization are not shown, there are breaks in the wheat prices shown in the tables. The wheat prices are shown as a range over which the farm organization, crop and livestock production, and resource requirements remain constant.

Farm Plans With Corn Priced at 73 Cents

With feed grain prices at the low level of 73 cents per bushel corn equivalent, results of the programming analysis indicate that optimal organizations, and the general type of operation, for the model farm would change substantially with changes in wheat prices. With wheat prices in the range from 36 cents to 42 cents per bushel, net returns were greatest with a stocker calf enterprise as the major source of income, and with flax and corn as the major cash crops. The total production of feed grains was sold, and all the livestock grain requirements were provided by wheat. On the other hand, with wheat prices of 82 cents per bushel and above, the farm became primarily a cash grain farm, with a beef cow-calf herd and stocker calves as supplementary enterprises to utilize available labor, hay, and native pasture.

With the prices of flax and yearling feeder cattle held constant at$2.41/bu. and $23.08/cwt., respectively the stocker calf enterprise and flax production were the two most profitable enterprises with wheat prices in the range from 36 cents to 42 cents per bushel. Because of the relatively high profitability of the stocker calf enterprise, tame hay production also was relatively profitable. Thus, the most profitable cropping system included rotations which maximized alfalfa and flax production. Those rotations also included corn, oats, and wheat. Based upon the price of corn, the corn equivalent value of wheat as a feed grain was approximately 82 cents per bushel (1.12 times $.73), 40 cents above the highest cash wheat price in the range. As a result, all wheat produced was utilized as feed, and provides the total livestock feed grain requirement. The total production of corn and oats was sold for cash.

At a wheat price of 82 cents per bushel, the cash value of wheat was equal to its value as a feed grain, and all wheat was sold. Since it was no longer profitable to utilize wheat as a feed grain for the stocker

[3]Net returns are to land, labor, and management.

Table 6. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Organization at Various Levels of Wheat Prices and 87 Cents Per Bushel for Corn, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Item	Units	Price of Wheat					
		$.36 to $1.00	$1.05 to $1.33	$1.43 to $1.62	$1.63 to $1.87	$1.94 to $2.13	$2.39 to $3.36
Crops							
Spring Wheat	Acre	—	89	170	194	262	268
Flax	Acre	188	128	91	74	7	—
Corn	Acre	203	54	17	—	135	8
Rye	Acre	14	—	—	—	—	—
Barley	Acre	—	—	17	20	20	20
Oats	Acre	14	—	—	20	20	20
Summer Fallow	Acre	—	14	—	20	20	161
Tame Hay or Pasture	Acre	58	192	182	149	13	—
Crop Production							
Spring Wheat	Bushel	—	1,947	3,786	4,207	5,701	6,141
Flax	Bushel	2,375	1,619	1,049	891	79	866
Feed Grain (corn equivalent)	Bushel	8,557	2,620	897	866	6,008	—
Corn Silage	Ton	—	—	—	—	—	64
Tame Hay	Ton	89	211	203	178	26	—
Native Hay	Ton	—	—	—	—	31	31
Livestock							
Beef Cows	Head	29	68	66	58	19	6
Stockers Sold*	Head	22	52	50	44	14	40
Total Labor Use	Hour	1,827	2,261	2,195	2,052	1,581	1,266
Total Capital Used	Dollar	32,917	44,454	42,241	38,144	26,210	19,323
Net Returns†	Dollar	6,661	6,743	7,486	8,241	9,602	12,219

*Includes calves raised and purchased.
†Net returns are for the lower wheat price and include returns to land and the opertaor's labor and management.

Table 7. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Organization at Various Levels of Wheat Prices and $1.14 Per Bushel for Corn, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Item	Units	Price of Wheat					
		$.36 to $1.10	$1.12 to $1.43	$1.44 to $1.57	$1.58 to $1.65	$1.79 to $1.95	$2.27 to $2.85
Crops							
Spring Wheat	Acre	10	17	166	205	217	268
Flax	Acre	205	205	56	17	8	—
Corn	Acre	205	205	205	205	196	149
Barley	Acre	17	17	17	17	19	20
Oats	Acre	7	—	—	—	11	20
Summer Fallow	Acre	—	—	—	—	11	20
Tame Hay or Pasture	Acre	33	33	33	33	15	—
Crop Production							
Spring Wheat	Bushel	199*	328	3,604	4,574	4,799	5,846
Flax	Bushel	2,533	2,533	751	158	74	—
Feed Grain (corn equivalent)	Bushel	8,847	8,855	8,713	8,713	8,696	6,191
Corn Silage	Ton	—	—	—	—	—	64
Tame Hay	Ton	57	57	57	57	26	—
Native Hay	Ton	14	20	20	20	31	31
Livestock							
Beef Cows	Head	23	30	30	30	19	6
Stockers Sold†	Head	18	—	—	—	14	40
Calves Sold	Head	—	23	23	23	—	—
Total Labor Use	Hour	1,734	1,723	1,755	1,764	1,675	1,583
Total Capital Used	Dollar	30,768	30,004	29,974	29,982	28,667	26,938
Net Returns‡	Dollar	8,990	8,992	9,078	9,581	10,561	13,122

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡Net returns are for the lower wheat price and include returns to land and the operator's labor and management.

calf enterprise, the number of stockers was reduced by approximately 78%. All calves for the stocker enterprise were produced by a beef cow herd, rather than being purchased. Wheat and flax acreages were increased by 16% and 10%, respectively, while feed grain and rye acreages were reduced.

A wheat price of 94 cents per bushel resulted in a 28% increase in wheat acreage in the most profitable plan. The most profitable rotations at this wheat price also include large acreages of tame hay, and the beef cow herd and stocker calf enterprises increased in size to utilize the increased forage production. Corn acreage was reduced to supply only the livestock grain requirements and other feed grains and rye were eliminated from the plan.

As the price of wheat increased to $1.79 and above, wheat becomes increasingly competitive with cattle and flax in the farming system. Accordingly, wheat acreage and production increased with rising prices, and flax and tame hay production decreased. Feed grain production was maintained at, or near, levels necessary to supply the grain requirements for livestock. With wheat prices of $3.04 per bushel or higher, the most profitable plan included the maximum wheat acreage permitted by the crop rotations considered. Flax and tame hay were eliminated from the cropping system, and beef production was limited to the stocker calf enterprises, with purchased calves, at a level to utilize available native hay and pasture. Additional roughage requirements were supplied by a small amount of corn silage.

Shifts in cropping patterns occur at different levels of wheat prices on the three soil groups. The reason for these differences may be found in differences in crop yields and the cropping systems allowed. Crop rotations by soil groups in the most profitable plans at the various levels of wheat prices are shown in Table 8.

Crop Production—Soils Group I. The cropping alternatives considered on Group I soils included spring wheat, corn-grain, corn-silage, flax, barley, oats, alfalfa (for hay or pasture), and summer fallow in 14 cropping systems, or rotations. Soils in this group are more productive than those in either Group II or Group III-IV.

The cropping systems that are competitive on Group I soils, over the range of wheat prices considered, were the corn-flax and wheat-flax-alfalfa (2 years) rotations and continuous wheat. With corn and flax prices at 73 cents and $2.41 per bushel, respectively, the corn-flax rotation yielded a net return of $16.06 per acre. With a corn price of 72 cents, wheat is valued for feed at 82 cents per bushel. Using 82 cents as the wheat price, net returns from continuous wheat were only $5.99 per acre. With wheat at 82 cents per bushel, net returns from the spring wheat-flax-alfalfa (2 years) rotation would equal those from the corn-flax rotation, however, tame hay requirements for livestock could be provided at a lower cost from rotations on the other two soil groups. Thus, with the feed value of wheat of approximately 82 cents per bushel, it was most profitable to utilize the entire acreage of Group I soils for the corn-flax rotation.

At a wheat price of 94 cents per bushel, net returns from continuous wheat were $8.76 per acre, still much less than returns from the corn-flax rotation. The higher wheat price, however, reduces the break even value of alfalfa in the wheat-flax-alfalfa (2 years) ro-

Table 8. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $.73 per Bushel for Corn, 640-acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Crop Rotation	Range of Wheat Prices per Bushel					
	$.36-$.42	$.82-$.90	$.94-$1.38	$1.79-$1.97	$2.03-$2.34	$3.04
	Acres					
Soil Group I						
Corn, flax	79.0	79.0	12.1			
Spring wheat, flax, alfalfa (2 years)			66.9			
Spring wheat				79.0	79.0	79.0
Soil Group II						
Rye, corn, oats, alfalfa (4 years)	40.5					
Spring wheat, flax, alfalfa (2 years)	256.5	297.0	297.0	297.0	26.4	
Summer fallow, spring wheat					270.6	293.9
Corn, spring wheat						3.1
Soil Group III and IV						
Rye, corn, oats, alfalfa (4 years)	101.0	101.0				
Summer fallow, spring wheat, corn, flax, alfalfa (3 years)			101.0			
Summer fallow, spring wheat, spring wheat, barley, oats				101.0	101.0	101.0

tation and about 67 acres of this rotation replaced the corn-flax rotation.

With a wheat price of $1.79 per bushel, net returns from continuous wheat were $28.35 per acre, and hence it was most profitable to devote the entire acreage of Group I soils to continuous wheat.

Crop Production—Soils Group II. Soils included in Group II are less productive than those in Group I, but more productive than those in Group III-IV. Cropping alternatives considered on Group II soils are spring wheat, corn-grain, corn-silage, flax, rye, barley, oats, alfalfa (for hay or pasture), and summer fallow in 19 cropping systems, or rotations.

With the corn price at 73 cents per bushel, four cropping systems were competitive on Group II soils: (1) rye-corn-oats-alfalfa (4 years), (2) wheat-flax-alfalfa (2 years), (3) summer fallow-wheat, and (4) corn-wheat rotations. With wheat values at 82 cents per bushel (its feed value) it was most profitable to devote the major portions of the Group II soils to the wheat-flax-alfalfa (2 years) rotation and the remainder to the rye-corn-oats-alfalfa (4 years) rotation. All wheat produced was utilized as livestock feed.

Wheat is more profitable as a cash grain at a price of 82 cents per bushel than when fed to livestock. Hence, the entire acreage of Group II soils was utilized for the wheat-flax-alfalfa (2 years) rotation with the alfalfa used for the cow-stocker enterprise.

The wheat-flax-alfalfa (2 years) rotation would be the most profitable cropping system on these soils below a wheat price of $2.03 per bushel. At that price, net returns from the summer fallow-wheat and corn-wheat rotations are $18.51 and $16.05 per acre, respectively. Thus, it was most profitable to utilize approximately 91% of the Group II soils for the summer fallow-wheat rotation. The remaining acreage was devoted to the wheat-flax-alfalfa (2 years) rotation to provide livestock hay requirements.

With a further increase in the wheat price to $3.04 per bushel, net returns from the summer fallow-wheat and corn-wheat rotations increased to $30.71 and $27.19 per acre, respectively. Alfalfa production for use by livestock does not yield these rates of return, thus, it is most profitable to devote nearly the entire acreage of Group II soils to the summer fallow-wheat rotation, with a small acreage of the corn-wheat rotation to provide corn silage for stocker calves. This combination of crop rotations provided the maximum acreage of wheat permitted by the cropping systems considered on Group II soils.

Crop Production—Soils Group III-IV. Soils in Group III-IV are less productive than those in either Group I or Group II, and cropping systems which will allow maintenance of productivity are somewhat more restrictive. Continuous grain cropping (without either summer fallow or alfalfa in the rotation) was not allowed on these soils. Cropping alternatives considered on Groups III-IV soils were spring wheat, flax, rye, barley, oats, corn-grain, corn-silage, alfalfa (for hay or pasture), and summer fallow in 10 cropping systems, or rotations.

Three cropping systems were found to be competitive on Group III-IV soils. These were: rye-corn-oats-alfalfa (4 years), summer fallow-wheat-corn-flax-alfalfa (3 years), and summer fallow-wheat-wheat-barley-oats rotations. With the wheat price in the range from 36 cents to 42 cents per bushel (where the feed value of wheat was 82 cents per bushel), and at a cash price of 82 to 90 cents per bushel, the total acreage of Group III-IV soils was devoted to the rye-corn-oats-alfalfa (4 years) rotation, since total hay production was greatest with this rotation. Because of the greater profitability of grain crops relative to hay on Soils Group I and II, it is more profitable to concentrate grain production on those two soils groups and produce as much forage as possible on the Group III-IV soils.

With an increase in the wheat price to 94 cents per bushel, net returns from the summer fallow-wheat-wheat-barley-oats rotation increased to $3.11 per acre. Since it became profitable to utilize a rotation including more hay on Group I soils, at this wheat price, maximum hay production from Group III-IV soils was not required. As a result, the entire acreage of Group III-IV soils shifted to the summer fallow-wheat-corn-flax-alfalfa (3 years) rotation.

Further increases in the wheat price would increase net returns from the summer fallow-spring wheat-spring wheat-barley-oats rotation to $9.42, $11.20 and $18.70 per acre at wheat prices of $1.79, $2.03 and $3.04, respectively. Thus, at wheat prices of $1.79 per bushel, and higher, it is most profitable to use this rotation on the entire acreage of Group III-IV soils. This cropping system includes the maximum wheat acreage permitted (40.4 acres) on those soils by the rotations considered.

Livestock Production. The primary livestock enterprise in the most profitable farm plans, at all levels of wheat prices considered, was the stocker calf enterprise, in which 430-pound calves were wintered and grazed, with only supplementary grain feeding, and sold at the end of a 12-month period as 700-pound yearling feeders. With wheat prices at the lowest levels (36 cents to 42 cents per bushel), and with the price of 700-pound yearlings at $23.08 per cwt., it was most profitable to purchase all calves for the stocker enterprise, and to maintain that enterprise at a relatively high level. As the wheat price increased, the profitability of tame hay and pasture, and feed grain (including feed wheat), decline relative to cash wheat. As a result, the number of calves in the stocker enterprise decreased, and all calves were produced by a

Table 9. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $.87 per Bushel for Corn, 640-acre Model Farm, Beadle, Clark, Codington, Day, Marshall and Roberts Counties

Crop Rotation	Range of Wheat Prices per Bushel					
	$.36-$1.00	$1.05-$1.33	$1.43-$1.62	$1.63-$1.87	$1.94-$2.13	$2.39-$3.36
	Acres					
Soil Group I						
Corn, flax	79.0	79.0				
Spring wheat			79.0	79.0	79.0	79.0
Soil Group II						
Corn, flax	297.0					
Spring wheat, flax, alfalfa (2 years)		297.0	297.0	297.0	26.4	
Corn, Spring wheat,					270.6	16.7
Summer fallow, Spring wheat						280.3
Soil Group III and IV						
Rye, Corn, Oats, alfalfa (4 years)	101.0					
Spring wheat, corn, flax, alfalfa (3 years)		101.0				
Spring wheat, barley, corn, flax, alfalfa (2 years)			101.0			
Summer fallow, spring wheat, spring wheat, barley, oats				101.0	101.0	101.0

beef cow herd, which utilized available native hay and pasture. However, at the highest wheat prices (above $2.34 per bushel), it was most profitable to utilize all of the limited forage production for stockers, and the calves were then purchased.

With the prices of feeder calves and yearlings at $25.28 and $23.08 per cwt., respectively, both the cow-calf and stocker enterprises were profitable at a corn price of 73 cents. Actually, such a high beef-corn price ratio would rarely occur, and then it would exist only over a brief time period, since the demand for corn for livestock feeding would soon force corn prices to rise. However, as evidenced by the size of the stocker enterprise with the wheat price at $3.04, it generally would be profitable for a farm with a resource combination similar to that of the model farm to maintain a cow herd or stocker enterprise at a level to utilize available native hay and pasture. Livestock used labor that otherwise would have been unused, since most of the livestock labor requirements occurred in the fall and winter months, and thus did not compete with crop enterprises for available labor.

Aside from protein supplement, minerals, and salt, feed was home grown and consisted primarily of hay and pasture, with a small amount of grain. The grains used for feed depended on the price of wheat in relation to the price of corn. Wheat was used as feed when the wheat price was below 82 cents per bushel. As the wheat price increased, corn replaced wheat in the livestock ration up to a wheat price of $1.79. Further increases in the wheat price resulted in a change to a crop rotation on Group III-IV soils that included barley and oats, which were used as livestock feed. The amount of cropland used for livestock feed production varies from 273 acres (57.2% of total cropland), at the lowest wheat prices, to 15.1 acres (3.2% of total cropland), at a wheat price of $3.04 per bushel.

Farm Plans With Corn Priced at 87 Cents

The most significant effect of an increase in the price of corn (to 87 cents) was that the most profitable farming operation emphasized cash grain production at all levels of wheat prices considered. The cow-calf herd and stocker calves were reduced in numbers, and became supplementary enterprises at all wheat prices except those in the range from $1.05 to $1.87 per bushel.

At wheat prices below $1.05 per bushel, corn and flax were more profitable than either spring wheat or hay. Limited grain requirements for cattle were provided by feed grain crops—no wheat was produced at wheat prices below $1.05 per bushel. With wheat price at $1.05 per bushel, it became profitable to include spring wheat in the cropping system and reduce some of the corn and flax acreage.

In general, as the wheat price was further increased, spring wheat acreage gradually replaced flax and alfalfa. When the wheat price reached $1.94 per bushel, wheat acreage amounted to 54.8% of the total cropland acreage, feed grain crops equaled 36.8% and the remaining 8.4% of the cropland was in flax, alfalfa, and summer fallow. Wheat acreage increased only slightly as the wheat price was raised to $2.39 per bushel, but nearly all the corn acreage shifted to summer fallow. A relatively small acreage of corn, barley, and oats was used for livestock feed production. Crop rotations, by soil groups, in the most profitable plans at the various levels of wheat prices are shown in Table 9.

Crop Production—Soils Groups I. The rise in corn price added $3.85 per acre to net returns from the

corn-flax rotation. Thus, corn and flax, which returned $19.91 per acre, occupied these soils until spring wheat became competitive. Net returns from continuous spring wheat were $11.29 per acre at a wheat price of $1.05 and at a price of $1.43 continuous spring wheat returned $20.05 per acre. Thus, the entire 79 acres shifted to continuous spring wheat. Net returns from continuous wheat were $24.66, $31.81 and $42.18 per acre at wheat prices of $1.63, $1.94 and $2.39 respectively.

Crop Production—Soils Group II. Four crop rotations were competitive on these soils with corn priced at 87 cents. The corn-flax rotation was most profitable with the 16 cent increase in corn price, when wheat prices were below $1.00 per bushel. Net returns from corn due to the price increase of 16 cents were $6.08. A shift to the spring wheat-flax-alfalfa (2 years) rotation occurred at a wheat price range of $1.05 to $1.87 as wheat became relatively more profitable than corn. The results of the shift reduced flax acreage by half, eliminated corn from these soils and provided alfalfa for the livestock enterprise.

With a continued rise in wheat prices, crop rotations which allowed a high percentage of wheat became the most profitable. Two rotations allowed as much as 50% wheat acreage—corn-spring wheat and summer fallow-spring wheat. One rotation provided for 40% of the acreage to be in spring wheat and the balance of the rotations contained 20% wheat or less. The two most profitable rotations, at a wheat price of $1.94, were corn-spring wheat which returned $17.72 per acre and summer fallow-spring wheat with net returns of $17.43 per acre. Although the corn-wheat rotation was considerably more profitable than the spring wheat-flax-alfalfa (2 years) rotation, some alfalfa was needed for the livestock enterprise. Thus, all but 13.2 acres of alfalfa and 6.6 acres of flax were devoted to corn and spring wheat.

As wheat rose to a price of $2.39 per bushel, the net return advantage shifted to summer fallow-spring wheat and all but 8.4 acres of the cropland in Soils Group II shifted to a summer fallow-spring wheat rotation. Corn acreage was grown for silage to replace the alfalfa grown at the lower wheat prices. The corn-wheat rotation returned a net of $22.68 per acre compared with $22.86 from summer fallow-spring wheat.

Crop Production—Soil Groups III-IV. The crop rotations which were competitive at a corn price of 73 cents were also competitive at a corn price of 87 cents per bushel. However, the break even price for alfalfa was somewhat higher because the corn price was higher.

Because of the greater profitability of grain crops relative to hay on Soils Groups I and II, it was more profitable to concentrate grain production on those two soils groups and produce as much as possible of the livestock hay requirements on the Group III-IV Soils.

The rye-corn-oats-alfalfa (4 years) rotation which occupied these soils at wheat prices of 36 cents to $1.00 per bushel shifted to a spring wheat-corn-flax-alfalfa (3 years) rotation as wheat rose to a price of $1.05. Cash grain production increased as spring wheat and flax replaced rye and oats. Alfalfa production decreased about 14%, alfalfa acreage on the Group II soils increased.

Land use shifted only slightly as the wheat price rose to $1.43, about 17 acres of alfalfa shifted to barley; spring wheat, corn, and flax acreage remained the same. As spring wheat became more profitable, the break even point for alfalfa became relatively less favorable. Thus, the rotation would shift from roughage to cash grains.

Land use again shifted as wheat increased in price to $1.63 per bushel and above. Spring wheat was the most profitable crop on this group of soils at these wheat and feed grain prices. Thus, spring wheat acreage increased from 16 to 40% of the Group III-IV Soils. Net returns from this rotation increased from $9.43 at a wheat price of $1.63 per acre to $15.07 at a wheat price of $2.39 per bushel. The barley and oats produced from this rotation could either be fed to livestock or sold as cash grain.

Livestock Production. Although the cow-calf and stocker enterprises remained profitable, each lost some competitive advantage as the corn price was raised to 87 cents while the livestock prices remained the same. The character of the livestock enterprise remained the same as home raised calves were carried to 700 pounds and sold as yearling feeders. Additional calves were purchased at wheat prices above $2.39 per bushel.

The size of the livestock enterprise decreased slightly when the price of corn was raised by 14 cents. Thus, for most of the wheat price levels, a larger percentage of cropland was devoted to cash grain. No change occurred in the livestock ration except that feed grains were fed at the lowest wheat price level since no spring wheat was grown.

Farm Plans With Corn Priced at $1.14

The competitive position and relative profitability of corn was further enhanced with an increase in corn price to $1.14 per bushel. This increase forced a slight rise in the price of wheat if wheat was to compete with corn for the use of cropland.

With cash grain production becoming even more profitable, the cow-calf and stocker enterprises became merely supplementary at all wheat prices considered. The amount of cropland used for livestock feed was reduced considerably as upwards of 100 acres

of alfalfa hayland was shifted to grain production. Native hay replaced some alfalfa hay, and spring wheat, grown at the lowest wheat price, was fed. Aside from these changes, the livestock rations remained the same as when the crop price was 87 cents.

The cash grain production consisted of flax, feed grains, and spring wheat. At this level of corn price, spring wheat could not compete with corn on either the Group I or II Soils until wheat reached a price of $2.27 or better. Spring wheat, on the other hand, could compete with flax on these soils at wheat prices ranging from $1.44 to $1.58.

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

Crop Production—Soils Group I. With corn at $1.14 per bushel, a corn-flax rotation returned a net of $27.34 per acre compared with only $12.35 per acre from a corn-spring wheat rotation when wheat was priced at 36 cents.

The corn-flax cropping combination remained the most profitable at wheat prices as high as $1.58. However, when the wheat price rose above $1.58, spring wheat became more profitable than flax and thus replaced flax.

Spring wheat could not compete for the use of cropland with corn priced at $1.14 until the wheat price rose to over $2.00 per bushel. At this price level, net returns from continuous spring wheat were $39.41 per acre compared with returns of $35.81 from a corn-spring wheat rotation and the entire Group I Soils shifted to continuous spring wheat.

The yield relationship favors continuous spring wheat over spring wheat on summer fallow in this area of South Dakota since the fallow increases the average yield only by 4 bushels per acre. Thus, the net returns from continuous spring wheat were $14.50 per acre more than with a spring wheat-fallow rotation at a wheat price of $2.27.

Crop Production—Soils Group II. With the 14 cent increase in corn price, only 2 crop rotations were used on these soils. Spring wheat could not compete with corn at any of the wheat prices which were considered, but spring wheat did compete with flax at wheat prices of $1.44 and higher. Thus, the corn-flax rotation, which returned a net of $17.44 per acre, was the most profitable crop combinaiton with wheat prices below $1.44. Spring wheat became more profitable than flax at a wheat price of $1.44 and the land use shifted from flax to spring wheat.

Continuous spring wheat was not allowed on this soils group, hence the allowable maximum wheat production was reached at a wheat price of $1.44 per bushel. Although spring wheat on summer fallow was allowed, the price of wheat would need to be fantastically high before corn grain would be shifted to summer fallow since the average yield of spring wheat on fallow was only 2 bushels per acre more than wheat following corn.

Crop Production—Soils Group III-IV. The cost and yield relationships are not as favorable toward feed grains on the Group III-IV Soils as on the Group I and II Soils. Land use was divided principally by alfalfa, flax, corn and barley when wheat prices ranged between 36 cents and $1.09. Oats occupied only 6.6% of these soils and spring wheat about 10.2%. Spring wheat was used for livestock feed.

As wheat increased in price to $1.12 and spring wheat became more profitable than oats, the crop rotation shifted entirely to spring wheat-barley-corn-flax-alfalfa (2 years). This rotation remained unchanged until wheat reached a price of $1.79, then 54

Table 10. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.14 per Bushel for Corn, 640-acre Model Farm, Beadle, Clrak, Codington, Day, Marshall, and Roberts Counties

Crop Rotation	Range of Wheat Prices per Bushel					
	$.36-$1.10	$1.12-$1.43	$1.44-$1.58	$1.58-$1.65	$1.79-$1.95	$2.27-$2.85
	Acres					
Soil Group I						
Corn, flax	79.0	79.0	79.0	—	—	—
Corn, spring wheat	—	—	—	79.0	79.0	—
Spring wheat	—	—	—	—	—	79.0
Soil Group II						
Corn, flax	297.0	297.0	—	—	—	—
Corn, spring wheat	—	—	297.0	297.0	297.0	297.0
Soil Groups III and IV						
Flax, barley, corn, oats, alfalfa (2 years)	39.9	—	—	—	—	—
Spring wheat, barley, corn, flax, alfalfa (2 years)	61.1	101.0	101.0	101.0	47.1	—
Summer fallow, spring wheat, spring wheat, barley, oats	—	—	—	—	53.9	101.0

Table 11. Resident Labor Use by Periods for the Optimum Farm Organization at Specified Wheat and Corn Prices, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Labor Period	Corn Price per bu.	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices					
			$.36-$.42	$.82-$.90	$.94-$1.38	$1.79-$1.97	$2.03-$2.34	$3.04
			Hours					
Nov. 16 to March 15	.73	1017	584.1	577.6	651.0	464.4	150.2	121.5
March 16 to April 30	"	528	269.2	271.9	324.0	344.6	253.8	242.5
May 1 to July 15	"	989	549.7	544.2	643.2	478.6	282.5	249.4
July 16 to Sept. 30	"	1018	575.4	573.1	613.2	651.1	551.3	544.1
Oct. 1 to Nov. 15	"	390	377.7	366.3	188.8	113.5	36.7	56.1
Total Annual	**.73**	**3942**	**2356.1**	**2333.1**	**2420.2**	**2052.2**	**1274.5**	**1213.6**
			Resident Labor Use at the Following Range of Wheat Prices					
			$.36-$1.00	$1.05-$1.33	$1.43-$1.62	$1.63-$1.87	$1.94-$2.13	$2.39-$3.36
Nov. 16 to March 15	.87	1017	233.4	550.1	530.1	464.4	150.2	130.6
March 16 to April 30	"	528	120.0	277.9	339.8	344.6	272.7	247.7
May 1 to July 15	"	989	662.2	632.7	535.7	478.6	382.6	256.4
July 16 to Sept. 30	"	1018	440.1	566.0	640.4	651.1	543.2	581.1
Oct. 1 to Nov. 15	"	390	371.0	234.0	149.3	113.5	232.1	50.0
Total Annual	**.87**	**3942**	**1826.7**	**2260.7**	**2195.3**	**2052.2**	**1580.8**	**1265.8**
			Resident Labor Use at the Following Range of Wheat Prices					
			$.36-$1.09	$1.12-$1.43	$1.44-$1.58	$1.58-$1.65	$1.79-$1.95	$2.27-$2.85
Nov. 16 to March 15	1.14	1017	185.3	185.3	185.3	185.3	150.2	130.6
March 16 to April 30	"	528	119.3	120.4	209.5	233.2	234.3	267.4
May 1 to July 15	"	989	633.5	628.6	539.5	515.8	462.5	360.1
July 16 to Sept. 30	"	1018	434.0	437.9	470.6	479.3	484.6	572.7
Oct. 1 to Nov. 15	"	390	362.0	350.5	350.5	350.5	342.9	252.4
Total Annual	**1.14**	**3942**	**1734.1**	**1722.7**	**1755.4**	**1764.1**	**1674.5**	**1583.2**

acres shifted to a crop rotation which allowed a larger acreage of spring wheat. The net return from summer fallow-spring wheat-spring wheat-barley-oats was $12.79 per acre. The shift of 36 acres of alfalfa was accompanied by a reduction in the beef cow numbers and a shift from selling 400-pound calves to 700-pound stockers.

The final acreage shift occurred at a wheat price of $2.27 as the remaining acreage in alfalfa, corn, and flax shifted to the summer-fallow-spring wheat-spring wheat-barley-oats rotation. The net returns from this rotation was $16.53 per acre at a wheat price of $2.27 per bushel.

Livestock Production. The livestock enterprise was supplementary at all wheat prices considered. The beef cow herd was reduced at wheat prices below $1.79 when the price of corn was raised from 87 cents to $1.14—at a wheat price range of $1.12 to $1.65, the beef cow herd was reduced by 50% or more. In addition to a reduction in cow herd, the enterprise did shift from 700-pound stockers to selling 400-pound feeder calves at a wheat price of $1.12 per bushel and then back to 700-pound stockers at a wheat price of $1.79. The shift from selling stockers to feeder calves enabled the cow herd to be expanded slightly due to the reduced pasture needs.

In general, very little change occurred in the livestock rations. Spring wheat was fed at wheat prices up to $1.10 per bushel above which it was replaced by feed grains. Both alfalfa and native hay provided the roughage requirements at wheat prices below $2.27 per bushel. As the wheat price rose to $2.27 and above, no alfalfa hay was produced and it was replaced by corn silage.

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 30.8% of the available labor and the maximum amounted to 61.4%. The minimum amount of labor used during the planting and harvesting seasons

amounted to 40.9% of that labor available. The maximum labor used amounted to 62.3%.

Labor used 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 $55,503 and $18,987 when corn was priced at 73 cents. The purchases of feeder calves accounted for nearly half of the $55,503 and a third of the $18,987. Capital and credit needs were less at the two higher corn price levels and varied according to the number of feeder calves purchased.

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 Beadle, Clark, Codington, Day, Marshall, and Roberts 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 73 cents to a high of $1.14 per bushel, while wheat prices were varied from zero to $3.36 per bushel.

Results of the programming analysis indicate net returns would be greatest with the model farm oriented toward production of cash-grain. Although a cattle enterprise was maintained at all wheat and feed grain prices it became a supplementary enterprise when the corn price was $1.14 per bushel or at a wheat price of $2.00 or higher.

The three main cash crops were corn, flax, and spring 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 maximize net returns to land, labor, and management, the strategy is 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 soils groups. For example, the break even price on corn grain was 52.2 cents compared with 57.2 cents for spring wheat when it followed corn. However, for wheat to compete with corn grain priced at 73 cents, the wheat price would have to be $1.02 per bushel.

Each crop alternative has a completely different break even price on each of the soils groups as the yields and costs are different. Alfalfa, corn, and flax were the chief competitors of spring wheat for the use of cropland at corn prices of 73 and 87 cents. The prices used for flax and cattle were relatively high and remained constant. Since alfalfa could be grown only in rotation with cash or feed grains and alfalfa yields were relatively high, alfalfa was highly profitable when fed to cattle as it had a low break even price. Spring wheat could compete with these crops only at relatively high wheat prices. For example, at a corn price of 73 cents, spring wheat at $1.79 became more profitable than its competing crops on the Group I and III-IV Soils and on the Group II Soils, at $2.03 per bushel. However, where spring wheat was grown at low wheat prices it was only because it was in the rotations with corn, flax, and alfalfa.

Alfalfa and livestock could no longer compete with either spring wheat or corn as the corn price rose from 87 cents to $1.14 per bushel. Flax became the chief competitor on Soils Groups I and II at wheat prices of $1.44 to $1.58 per bushel. Continuous spring wheat was more profitable than spring wheat on fallow on the Group I Soils because there was only a difference of about 5 bushels in the average yield. At wheat prices of $2.27 and above, a corn-spring wheat rotation replaced spring wheat on summer fallow when corn rose in price from 87 cents to $1.14 per bushel.

Corn grain was competitive for cropland at wheat prices below $1.38 when corn was priced at 73 cents per bushel, but as the corn price rose to 87 cents, corn grain became competitive with wheat at prices as high $2.13 per bushel and with $1.14 corn, it was competitive with wheat at prices as high as $2.85. Corn acreage, at a price combination of $2.27 for wheat and $1.14 for corn, equaled 31% of the cropland, or a total of 149 acres. This was in contrast to minimal corn acreage used for silage at comparable wheat prices when corn prices were either at 73 or 87 cents per bushel.

Flax, with a $2.41 price, competed for cropland at wheat prices ranging up to about $2 per bushel. However, most of the flax acreage was planted at wheat prices of $1.62 per bushel or less. Flax enjoyed a complementary relationship with the combination of medium wheat prices and low corn prices because it was used as a nurse crop for alfalfa. But when corn rose to $1.14 and became more profitable, flax lost its competitive position to corn and competed with spring wheat only at wheat prices below $1.44. Although some flax was grown at wheat prices from $1.44 to $1.95, it was

partly due to the complementary relationship with alfalfa.

The main livestock enterprise was raising calves to a weight of 700 pounds. Most of the calves were raised from a stock cow herd. Calves were purchased in a few instances, at the combination of low wheat and low corn prices and at the high wheat prices of all corn price levels. The cattle enterprise was a major source of farm income at low corn and low wheat prices. When corn rose to $1.14 per bushel or when wheat rose to $2.00 or above, the cattle enterprise became supplementary and served mainly to utilize the native pasture and hayland—very little cropland is used in maintaining the enterprise. Other than minerals, feed additives, and salt the feed 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 only where wheat prices were low as its value of feed was greater than the market price. But as the wheat price increased feed grains replaced wheat in the ration.

Labor was not a limiting resource since the minimum annual needs amount to 30.8% of the labor available and the maximum amounts to 61.4%.

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. Consequently, these results cannot be construed as being representative of all or a specific 640-acre farm in this 6-county area. The results, however, do present the most profitable farm plans 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 Soils Group

Rotation	Soils Groups I	II	III & IV
Spring Wheat	X		
Barley	X		
Oats	X		
Oats—Alfalfa (three 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	
Flax-Spring Wheat-Barley-Oats-Alfalfa (three years)	X	X	
Spring Wheat-Flax-Alfalfa (two years)	X	X	
Summer Fallow-Spring Wheat-Barley-Corn-Corn	X	X	
Corn-Spring Wheat-Corn-Oats-Alfalfa (three years)	X	X	
Summer Fallow-Spring Wheat-Barley-Corn	X	X	
Summer Fallow-Spring Wheat-Corn-Oats-Alfalfa (three years)		X	
Spring Wheat-Corn-Flax-Alfalfa (three years)		X	
Flax-Spring Wheat-Corn-Oats-Alfalfa (two years)		X	
Flax-Barley-Corn-Oats-Alfalfa (two years)		X	X
Spring Wheat-Barley-Corn-Oats-Alfalfa (two years)		X	X
Spring Wheat-Barley-Corn-Flax-Alfalfa (two years)		X	X
Summer Fallow-Spring Wheat-Barley-Barley-Oats		X	X
Summer Fallow-Spring Wheat-Spring Wheat-Barley-Oats		X	X
Rye-Corn-Oats-Alfalfa (four years)		X	X
Summer Fallow-Spring Wheat-Corn-Flax-Alfalfa (three years)			X
Summer Fallow-Spring Wheat-Corn-Oats-Alfalfa (three years)			X
Spring Wheat-Corn-Flax-Alfalfa (three years)			X
Flax-Spring Wheat-Corn-Oats-Alfalfa (two years)			X

Appendix Table 2. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $.73 per Bushel for Corn, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Crop	Crop Acres at the Following Wheat Prices $.36-$.42	$.80-$.90	$.94-$1.38	$1.79-$1.97	$2.30-$2.34	$3.04
Soil Group I						
Corn	39.5	39.5	6.1			
Flax	39.5	39.5	22.8			
Alfalfa			33.4			
Spring Wheat			16.7	79.0	79.0	79.0
Total	**79.0**	**79.0**	**79.0**	**79.0**	**79.0**	**79.0**
Soil Group II						
Rye	5.8					
Corn	5.8					1.5
Oats	5.8					
Flax	64.1	74.2	74.2	74.2	6.6	
Alfalfa	151.4	148.5	148.5	148.5	13.2	
Spring Wheat	64.1	74.3	74.3	74.3	141.9	148.5
Summer Fallow					135.3	147.0
Total	**297.0**	**297.0**	**297.0**	**297.0**	**297.0**	**297.0**
Soil Group III and IV						
Rye	14.4	14.4				
Corn	14.4	14.4	14.4			
Alfalfa	57.8	57.8	43.4			
Flax			14.4			
Barley				20.2	20.2	20.2
Oats	14.4	14.4		20.2	20.2	20.2
Summer Fallow			14.4	20.2	20.2	20.2
Spring Wheat			14.4	40.4	40.4	40.4
Total	**101.0**	**101.0**	**101.0**	**101.0**	**101.0**	**101.0**

Appendix Table 3. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $.87 per Bushel for Corn, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Robert Counties

Crop	Crop Acres at the Following Wheat Prices $.36-$1.00	$1.05-$1.33	$1.43-$1.62	$1.63-$1.87	$1.94-$2.13	$2.39-$3.36
	Acres					
Soil Group I						
Corn	39.5	39.5				
Flax	39.5	39.5				
Spring Wheat			79.0	79.0	79.0	79.0
Total	**79.0**	**79.0**	**79.0**	**79.0**	**79.0**	**79.0**
Soil Group II						
Corn	148.5	74.2			135.3	8.4
Flax	148.5	74.2	74.3	74.3	6.6	
Alfalfa		148.6	148.5	148.5	13.2	
Spring Wheat			74.3	74.3	141.9	148.5
Summer Fallow						140.1
Total	**297.0**	**297.0**	**297.1**	**297.1**	**297.0**	**297.0**
Soil Group III and IV						
Rye	14.4	14.4				
Corn	14.4	14.4	16.8			
Alfalfa	57.8	57.7	33.7			
Flax			16.8			
Barley			16.8	20.2	20.2	20.2
Oats	14.4	14.4		20.2	20.2	20.2
Summer Fallow				20.2	20.2	20.2
Spring Wheat			16.8	40.4	40.4	40.4
Total	**101.0**	**100.9**	**100.9**	**101.0**	**101.0**	**101.0**

Appendix Table 4. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.14 per Bushel for Corn, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall, and Roberts Counties

Crop	Crop Acres at the Following Wheat Prices					
	$.36-$1.10	$1.12-$1.43	$1.44-$1.58	$1.58-$1.65	$1.79-$1.95	$2.27-$2.85
Soil Group I						
Corn	39.5	39.5	39.5	39.5	39.5	
Flax	39.5	39.5	39.5			
Spring Wheat				39.5	39.5	79.0
Total	**79.0**	**79.0**	**79.0**	**79.0**	**79.0**	**79.0**
Soil Group II						
Flax	148.5	148.5				
Corn	148.5	148.5	148.5	148.5	148.5	148.5
Spring Wheat			148.5	148.5	148.5	148.5
Total	**297.0**	**297.0**	**297.0**	**297.0**	**297.0**	**297.0**
Soil Group III and IV						
Flax	16.8	16.8	16.8	16.8	7.8	
Corn	16.8	16.8	16.8	16.8	7.8	
Alfalfa	33.7	33.7	33.7	33.7	15.7	
Barley	16.8	16.8	16.8	16.8	18.6	20.2
Oats	6.7				10.8	20.2
Spring Wheat	10.2	16.8	16.8	16.8	29.4	40.4
Summer Fallow					10.8	20.2
Total	**101.0**	**100.9**	**100.9**	**100.9**	**100.9**	**101.0**

Appendix Table 5. Crop Rotations on All Soils Groups at Specified Wheat and Corn Prices, 640-Acre Model Farm, Beadle, Clark, Codington, Day, Marshall and Roberts Counties.

Crop Rotation	Corn Price per bu.	Range of Wheat Prices per Bushel					
		$.36-$.42	$.82-$.90	$.94-$1.38	$1.79-$1.97	$2.03-$2.34	$3.04
		Acres					
Rye, corn, oats, alfalfa (4 years)	.73	141.5	101.0				
Corn, flax	.73	79.0	79.0	12.1			
Spring Wheat, flax, alfalfa (2 years)	.73	256.5	297.0	363.9	297.0	26.4	
S. fallow, Spring wheat, corn, flax, alfalfa (3 years)	.73			101.9			
Spring Wheat	.73				79.0	79.0	79.0
S. fallow, Sp. wheat, Sp. wheat, barley, oats	.73				101.0	101.0	101.0
S. fallow, Sp. wheat	.73					270.6	293.9
Corn, Sp. Wheat	.73						3.1
		Range of Wheat Prices per Bushel					
		$.36-$1.00	$1.05-$1.33	$1.43-$1.62	$1.63-$1.87	$1.94-$2.13	$2.39-$3.36
Rye, corn, oats, alfalfa (4 years)	.87	101.0					
Corn, flax	.87	376.0	79.0				
Sp. Wheat, corn, flax, alfalfa (3 years)	.87		101.0				
Sp. Wheat, flax, alfalfa (2 years)	.87		297.0	297.0	297.0	26.4	
Sp. Wheat, barley, corn, flax, alfalfa (2 years)	.87			101.0			
Spring Wheat	.87			79.0	79.0	79.0	79.0
S. fallow, Sp. wheat, Sp. Wheat, barley, oats	.87				101.0	101.0	101.0
Corn, Sp. wheat	.87					270.6	16.7
S. fallow, Sp. wheat	.87						280.3
		Range of Wheat Prices per Bushel					
		$.36-$1.10	$1.12-$1.43	$1.44-$1.58	$1.58-$1.65	$1.79-$1.95	$3.37
Flax, barley, corn, oats, alfalfa (2 years)	1.14	39.9					
Corn, flax	1.14	376.0	376.0	79.0			
Sp. Wheat, barley, corn, flax, alfalfa (2 years)	1.14	61.1	101.0	101.0	101.0	47.1	
Corn, Sp. Wheat	1.14			297.0	376.0	376.0	297.0
S. fallow, Sp. wheat, Sp. wheat, barley, oats	1.14					53.9	101.0
Spring wheat	1.14						79.0