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Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Central South Dakota: Buffalo, Hand and Hyde Counties

E. O. Ullrich

J. T. Sanderson

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Department of Economics in cooperation with
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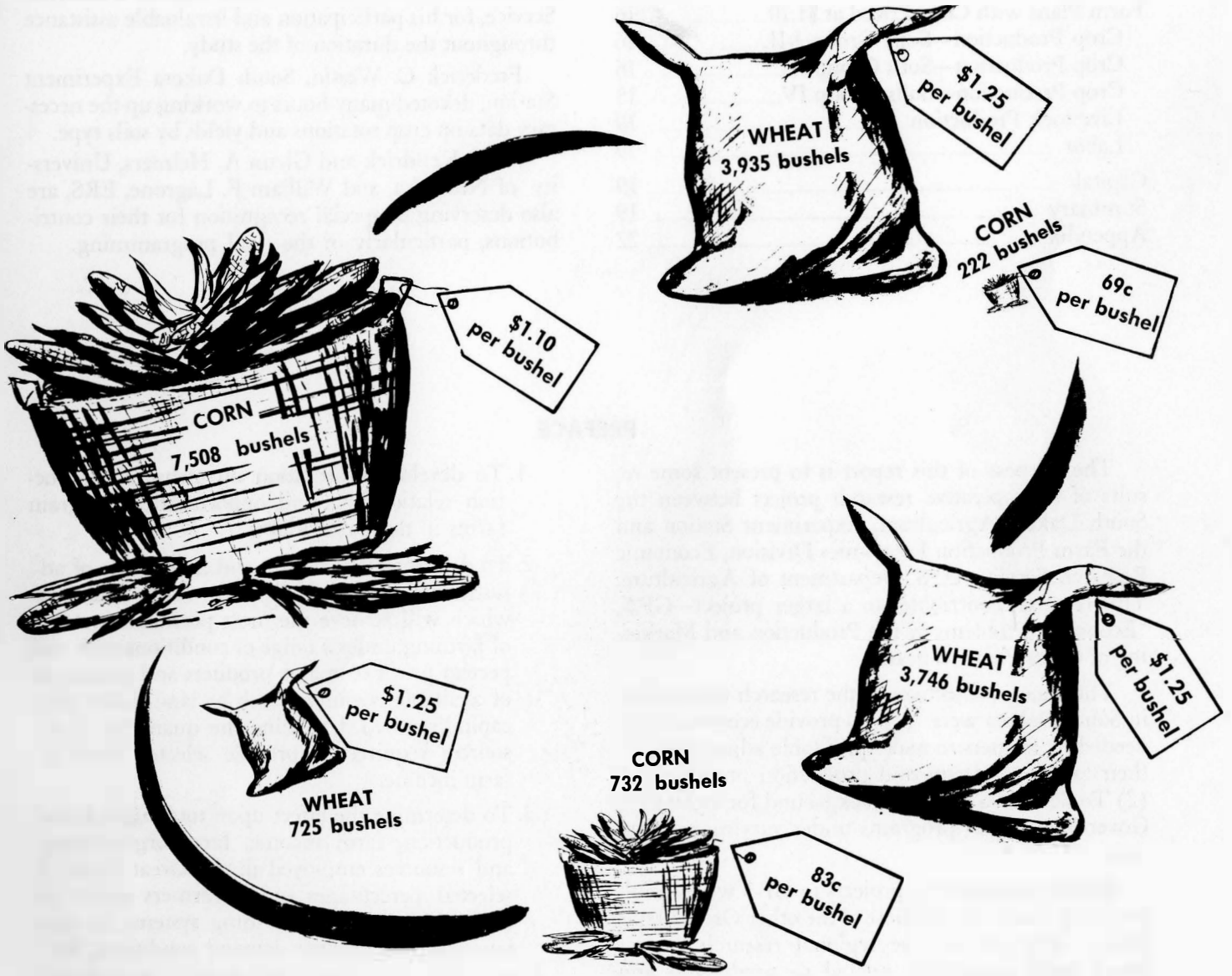

SOUTH DAKOTA STATE UNIVERSITY
Agricultural Experiment Station
Brookings, South Dakota

CONTENTS

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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 or 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 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 combination of farm enterprises at various combinations of crop and livestock product prices on three different size model farms in Buffalo, Hand, and Hyde 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.

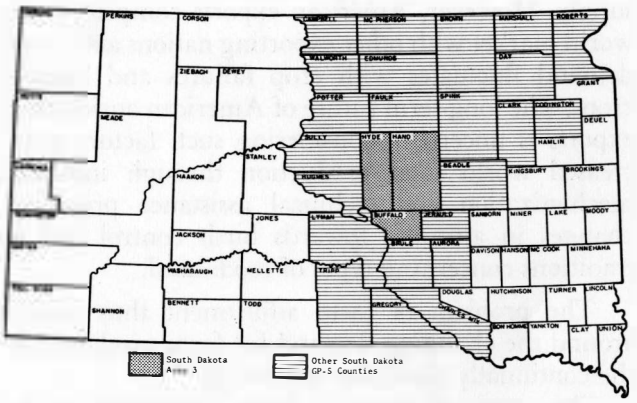

Figure 1. South Dakota GP-5 Study Area

Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Central South Dakota, Buffalo, Hand, and Hyde 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 have also 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 agricultural 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 U. S. per capita income has been associated with a declining per capita consump-

*Agricultural economist, Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, and assistant professor of economics, respectively, SDSU.

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

tions 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 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 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 and 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 in this three-county area was 1,340 acres in 1964; the individual county average size varied from 1,090 acres in Hand County to 1,569 acres in Hyde County to 2,320 acres in Buffalo 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 slight percentage increase in farms under 500 acres but a decrease in farms between 500 and 999 acres, from 34.0 to 30.3% in this area. In contrast, farms of 1,000 acres or more increased from 28.9 to 31.0% in the same period.

About 79% of the farms were classified as livestock farms and ranches, 6% were general farms and 4.5% were cash grain farms. Miscellaneous categories made up the remaining 10.5% of the area's farms.

Wheat was the principal cash crop in 1964. Small acreages of barley, flax, and rye were grown—flax and rye as cash crops and barley, for both cash and feed. About 62% of the row crops, corn and sorghum, was harvested as silage or for purposes other than grain. Thirty per cent of the oats harvested were sold off the farm, 20% of the corn grain and about 31% of the grain sorghum harvested were sold off the farm. Feed grains which were not sold were fed to livestock on the farm.

Table 1 shows the number and per cent of farms in the three-county area on which the major grain crops were raised and harvested in 1964.

Table 1. Number and Percentage of Farms on Which the Major Grain Crops were Harvested in 1964 in Buffalo, Hand, and Hyde Counties

Crop	Number of farms	Percentage of farms	Acres Harvested Number	Acres Harvested Per Cent
Corn*	883	68.5	89,636	38.6
All Wheat†	604	46.9	59,797	25.8
Oats	779	60.4	58,929	25.4
Rye	101	7.8	7,148	3.1
Sorghum‡	244	18.9	9,972	4.3
Others§			6,654	2.9

*Includes corn harvested for grain, silage, and other purposes.
†Includes 23,572 acres of winter wheat and 876 acres of durum.
‡Includes sorghum harvested for grain, silage, and other purposes.
§Includes barley, flax, emmer and speltz, and proso.
Source: U.S. Census of Agriculture, 1964.

Livestock were found on nearly all of the area's farms. Cattle, including dairy, were on 91% of the farms. Beef-cow herds, which were the most common enterprise, on the average were large with 50 cows or more. Dairy enterprises, on the other hand, were small.

Sow herds, which averaged about 15 head, were found on about 29% of the area's farms. Ewe flocks, kept by about 34% of the farmers, averaged about 96 per flock.

MODEL WHEAT FARMS

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.

Three model farms were selected. The first, 640-acre farm, had 390 acres of cropland, 228 acres of native hay and pasture, and 22 acres of farmstead, roads, and wasteland. The second farm, 1,280-acres, had 447 acres of cropland, 775 acres of native hay and pasture, and 58 acres of farmstead, roads, and wasteland. The third farm, 2,240-acres, had 464 acres of cropland, 1,671 acres of native hay and pasture, and 105 acres of farmstead, roads, and wasteland. The size of the model farms chosen does not represent an arithmetic average—rather it is intended to represent a dominant size or sizes of wheat farms which will exist in 1970. About 37% of the farms in this three-county area had fewer than 500 acres in 1964. Many of these farms will be enlarged by land rental or purchase. The nature of farm adjustment and farm organization would not differ significantly for farms larger than the model farms, provided the ratios of farmland, cropland, labor, and capital resources were about the same as for the model farms.

The crops and crop acreages on the representative farms were as follows:

Crop	Model farm 640	1,280	2,240
		Acres	
All Wheat	107	81	68
Oats and Other Small Grain	62	59	54
Corn Grain	24	45	38
Corn Silage	29	42	41
Summer Fallow	61	21	14
Alfalfa	83	135	148
Other Tame Hay and Pasture	24	64	101
Native Hay	82	307	649
Native Pasture	146	468	1,022

Soils

A number of major soil associations are found in this three-county area. The Williams-Zahl Association soils, found in all three counties, are undulating to steep and are well to excessively drained. Thus, the major soil and water management problems are: (1) Maintenance of organic matter and the supply of nitrogen, (2) Moisture conservation, (3) Control of runoff, and (4) Maintenance of stock water. The major soil uses include cash grain farming, ranching, livestock, and general farming. The land use depends mainly upon topography.

Table 2. Crop Yields and Fertilizer Usage per Planted Acre by Soil Group, 640, 1,280, and 2,240-Acre Model Farms, Buffalo, Hand, and Hyde Counties

Crop and Rotation	Group I-II Soils Projected Yield	Fertilizer*		Group III Soils Projected Yield	Fertilizer*		Group IV Soils Projected Yield	Fertilizer*	
	Bushels	Nitrogen Pounds	P_2O_5 Pounds	Bushels	Nitrogen Pounds	P_2O_5 Pounds	Bushels	Nitrogen Pounds	P_2O_5 Pounds
Winter Wheat on Fallow	26.9		17.0	25.5		16.0	24.3		15.5
Spring Wheat on Fallow	24.9		16.0	22.3		14.0	22.4		14.0
Spring Wheat after Corn	18.4	20.0	12.0	14.6	16.0	9.5	16.4	18.0	10.5
Spring Wheat after Small Grain	12.0	13.5	8.0	10.4		6.0	11.7	13.5	7.0
Oats, Continuous Crop	36.4	15.0	11.5	35.0	15.0	11.5	34.0	14.0	11.0
Barley, Continuous Crop	26.5	16.0	11.5	25.0	15.0	10.5	22.0	13.0	9.0
Corn Grain, Continuous Crop	27.4	25.5	8.5	25.4	24.0	8.0	26.4	25.0	8.5
Corn Silage, Continuous Crop	5.20†	28.0	9.5	4.80†	26.5	9.0	4.98†	27.5	9.5
Grain Sorghum, Continuous Crop	35.3	33.0	10.5	35.6	33.0	10.5	27.6	25.5	8.5
Forage Sorghum, Continuous Crop	6.95†	36.5	11.5	7.00†	36.5	11.5	5.43†	28.0	9.5
Alfalfa	1.55†			1.40†			1.20†		
Native Hay‡	.50†								

* Actual pounds applied per acre.
† Unit is in tons.
‡ Native hay is harvested from non-cropland.

The Raber-Eakin Association soils are undulating, grayish-brown loams, clay loams, and silt loams. Maintenance of organic matter and nitrogen supply, maintenance of soil fertility, conservation of moisture and control of run-off, and water erosion are the major soil and water problems of these soils. Cash grain farming and ranching are best suited to these soils, with the specific land use restricted by land topography.

The Pierre soils, bordering the Missouri River in Buffalo County, are undulating to steep and are well to excessively drained. The major soil and water management problems are: (1) Maintenance of organic matter and nitrogen supply, (2) Moisture conservation, (3) Control of water erosion, and (4) Maintenance of stock water. The major soil uses are cash grain farming and ranching.

Houdek-Bonilla Association soils are undulating to nearly level and are moderately well drained. These dark grayish-brown loams are slightly acid. Major problems in soil and water management are the maintenance of organic matter and the conservation of moisture. Major soil uses include: (1) Cash grain production, (2) Livestock farming, and (3) General farming.

Each soil series and soil type, within the soils association found in the three-county area, was classified into one of three 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 assumptions of normal weather conditions, recommended fertilizer usage, and specific management and rotation practices recommended for the productive capability of the soils. The yield projections and fertilization rates, by crop, for each of the soil groups so classified are shown in 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 corn and sorghum, were selected for the three soil groups—16 rotations for Soil Group I-II, 16 for Soil Group III, and 8 for Soil Group IV (appendix Table 1).

The 640-acre model farm contained 133 acres of Group I-II soils, 132 acres of Group III soils, and 125 acres of Group IV soils. The 1,280-acre farm contained 152 acres of Group I-II soils, 152 acres of Group III soils, and 143 acres of Group IV soils. The 2,240-acre farm contained 158 acres each in Soils Group I-II and III, and 148 acres in Soils Group IV.

Crop Alternatives

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

The small grain and row crops which would be harvested as grain could either be used as livestock feed or sold off the farm. The corn silage, forage sorghum, 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.

Cost summaries of the crop enterprise budgets considered are shown in Tables 3, 4 and 5. Costs included in the budgets were: Seed, fertilizer and spray materials, all fixed and variable machine costs, custom harvest costs when applicable, crop hauling to storage, and interest on operating capital. No interest charge on land was included.

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 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.

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

Prices Received

Optimal farm plans were determined for various combinations of crop and livestock prices. The market prices were held constant for feeder calves at $25.28/cwt. and stocker cattle at $23.08/cwt. Wheat prices were varied from zero to about $3 per bushel at corn price levels of 69 cents, 83 cents and $1.10 per bushel. Oat and barley prices were converted to a corn equivalent based on feed value.

The cattle prices are those which may be expected to occur in 1970 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.

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. How-

Table 3. Total Man Hours and per Acre Costs for the Crop Alternatives Budgeted for the 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties, by Soil Groups*

Crop	Total Man Hours†	Costs per Acre for Soil Group: I - II	III	IV
Summer Fallow	1.41	$ 3.34	$ 3.34	$ 3.34
Winter Wheat after Fallow	1.76	9.54	9.44	9.40
Spring Wheat after Fallow	1.76	9.41	9.22	9.22
Spring Wheat after Corn	2.51	13.24	12.53	12.87
Spring Wheat after Small Grain	2.51	12.21	10.47	12.12
Oats	2.51	12.55	12.55	12.39
Barley	2.51	12.62	12.42	12.04
Corn Grain	2.75	19.83	19.58	19.76
Sorghum Grain	3.23	17.34	17.35	16.28
Corn Silage	3.25	24.26	23.82	24.05
Sorghum Silage	3.12	22.35	22.16	20.98
Alfalfa	1.68	15.99	15.88	15.80
Native Hay, loose	.99	2.97		

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

Table 4. Total Man Hours and per Acre Costs for the Crop Alternatives Budgeted for the 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties, by Soil Groups*

Crop	Total Man Hours†	Costs per Acre for Soil Group: I - II	III	IV
Summer Fallow	1.30	$ 5.26	$ 5.26	$ 5.26
Winter Wheat after Fallow	1.71	8.44	8.35	8.30
Spring Wheat after Fallow	1.71	8.31	8.12	8.12
Spring Wheat after Corn	2.41	11.89	11.18	11.52
Spring Wheat after Small Grain	2.41	10.88	9.13	10.78
Oats	2.41	11.33	11.33	11.16
Barley	2.41	11.30	11.19	10.72
Corn Grain	2.65	19.81	19.56	19.74
Sorghum Grain	3.14	17.32	17.33	16.27
Corn Silage	4.41	29.85	30.01	25.62
Sorghum Silage	4.29	28.89	27.95	26.05
Alfalfa	2.22	9.73	10.40	10.26
Native Hay, loose	1.14	2.88		

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

ever, 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 number of hours allotted to each period. The hours by labor period are as follows:

	Model Farm 640 Acres	1,280 Acres	2,240 Acres
		Hours	
November 16 to March 15	836	1,192	1,117
March 16 to April 30	393	608	550
May 1 to July 15	873	1,246	1,078
July 16 to September 30	918	1,261	1,121
October 1 to November 15	366	521	463

Labor could be hired in any or all periods but was restricted to the amounts used on sample farms. The labor wage rate 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 the 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 optimize 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 resulted. Many of the optimum farm plans indicated insignificant changes in production or net income.

Table 5. Total Man Hours and per Acre costs for the Crop Alternatives Budgeted for the 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties, by Soil Groups*

Crop	Total Man Hours†	Costs per Acre for Soil Group: I - II	III	IV
Summer Fallow	1.30	$ 6.02	$ 6.02	$ 6.02
Winter Wheat after Fallow	1.52	10.13	10.41	10.37
Spring Wheat after Fallow	1.60	10.78	10.59	10.59
Spring Wheat after Corn	2.24	14.43	13.72	14.06
Spring Wheat after Small Grain	2.24	13.40	11.66	13.31
Oats	2.24	13.83	13.83	13.67
Barley	2.24	13.91	13.70	13.33
Corn Grain	2.46	19.96	19.71	19.89
Sorghum Grain	3.07	17.47	17.57	16.41
Corn Silage	4.22	29.88	29.61	29.11
Sorghum Silage	4.22	28.02	29.60	26.13
Alfalfa	2.22	9.78	9.67	9.53
Native Hay, loose	1.06	2.36		

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

Tables 7 through 15 show only major changes in crop acreages, crop and livestock production, labor, capital and net returns[2] at constant feed grain and cattle prices with increasing wheat prices. Since minor changes in farm plans were not shown, breaks in the

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

Table 6. A summary of Budget Items for the Cow-calf Herd and Stocker Calf Alternatives Considered for the 640-Acre, 1,280-Acre, and 2,240-Acre Model Farm

Item	Cow-Calf Herd	Stocker Calves Wintered and Grazed with silage	Stocker Calves Wintered and Grazed without silage
Per Cent/Calf Crop	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 tons	.40 ton	.64 ton
Corn Silage		1.20 tons	
Corn Grain Equivalent	2.70 cwt.		3.60 cwt.
Variable Cash Costs*	$ 40.87	$ 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.

Table 7. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $ .64	$ .84 to $ .92	$ .93 to $1.01	$1.16 to $1.21	$1.23 to $1.26	$1.27 to $1.83
Crops (in acres):						
Spring Wheat	—	—	—	—	27	50
Winter Wheat	17	66	124	138	146	158
Oats	17	—	—	5	—	—
Corn	17	—	—	5	—	—
Sorghum	133	133	18	—	—	—
Summer Fallow	17	66	124	138	146	158
Barley	—	—	—	—	13	25
Tame Hay or Pasture	191	125	125	104	58	—
Crop Production (in bushels):						
Wheat	409*	1,610	3,108	3,465	3,935	4,452
Feed Grain (corn equivalent)	4,679	3,477	21	100	222	415
Corn Silage (in tons):	—	—	—	25	—	—
Sorghum Silage	—	119	119	—	—	—
Tame Hay	62	—	—	20	—	—
Native Hay	41	41	41	41	41	16
Livestock (head):						
Beef Cows	27	4	4	21	13	5
Stockers Sold†	52	74	74	16	10	4
Total Labor Use (hours)	1,471	1,294	1,053	969	894	856
Total Capital Used	$24,929	$21,605	$19,742	$15,373	$12,750	$9,863
Net Returns‡	$ 2,225	$ 2,283	$ 2,425	$ 3,197	$ 3,450	$3,606

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 8. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 69 Cents Per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $1.03	$1.04 to $1.05	$1.068	$1.07 to $1.29	$1.293 to $1.47	$1.50
Crops (in acres):						
Spring Wheat	—	—	—	—	—	57
Winter Wheat	19	76	121	146	160	181
Oats	57	38	14	—	8	—
Corn	19	—	—	—	8	—
Sorghum	—	—	8	13	—	—
Summer Fallow	19	76	121	146	160	181
Barley	—	—	—	—	—	29
Tame Hay or Pasture	333	257	183	143	112	—
Crop Production (in bushels):						
Wheat	471*	1,854	3,023	3,665	4,010	5,103
Feed Grain (corn equivalent)	1,434	641	227	183	326	165
Sorghum Silage **(in tons):**	—	—	57	46	—	—
Tame Hay	87	39	—	—	37	—
Native Hay	154	154	137	110	104	53
Livestock (head):						
Beef Cows	78	62	47	38	34	17
Stockers Sold†	59	47	36	29	26	13
Total Labor Use **(hours)**	2,169	1,867	1,544	1,348	1,287	1,182
Total Capital Used	$41,491	$35,449	$29,549	$25,862	$24,389	$19,660
Net Returns†	$ 3,443	$ 3,569	$ 3,629	$ 3,642	$ 4,451	$ 5,302

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 9. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 69 Cents Per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $1.02	$1.03 to $1.05	$1.08 to $1.34	$1.36 to $1.58	$1.62 to $2.44
Crops (in acres):					
Spring Wheat	—	—	—	—	59
Winter Wheat	20	65	149	170	188
Oats	59	44	—	12	—
Corn	20	5	—	12	—
Sorghum	—	—	19	—	—
Summer Fallow	20	65	149	170	188
Barley	—	—	—	—	30
Tame Hay or Pasture	346	285	148	98	—
Crop Production (in bushels):					
Wheat	490*	1,586	3,735	4,268	5,299
Feed Grain (corn equivalent)	1,490	862	570	519	492
Tame Hay **(in tons):**	294	210	—	59	—
Native Hay	313	275	182	166	118
Livestock (head):					
Beef Cows	101	89	59	54	38
Stockers Sold†	77	68	45	41	29
Total Labor Use **(hours)**	2,433	2,220	1,776	1,740	1,615
Total Capital Used	$53,630	$49,837	$39,865	$39,414	$36,556
Net Returns‡	$ 4,628	$ 4,756	$ 4,844	$ 5,877	$ 7,015

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refers to the lowest wheat prices and includes their returns to land and the operator's labor.

Table 10. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $ .87	$ .89 to $ .90	$ .91 to $1.00	$1.01 to $1.20	$1.25 to $1.26	$1.29
Crops (in acres):						
Spring Wheat	—	—	—	—	—	50
Winter Wheat	11	41	70	82	150	158
Oats	11	8	4	16	19	—
Corn	11	8	4	16	12	—
Sorghum	133	133	133	133	3	—
Summer Fallow	11	41	70	82	150	158
Barley	45	—	—	—	7	25
Tame Hay or Pasture	169	158	107	63	49	—
Crop Production (in bushels):						
Wheat	271*	1,008†	1,712	1,973	3,746	4,452
Feed Grain (corn equivalent)	5,293	4,178	4,165	4,562	732	415
Sorghum Silage (in tons):	—	37	26	20	17	—
Tame Hay	56	46	21	7	—	—
Native Hay	41	41	41	41	41	41
Livestock (head):						
Beef Cows	31	30	21	16	14	5
Stockers Sold‡	24	23	16	13	11	4
Total Labor Use (hours)	1,540	1,372	1,243	1,235	937	846
Total Capital Used	$22,369	$21,176	$17,620	$16,260	$13,306	$9,863
Net Returns§	$ 2,903	$ 2,904	$ 2,919	$ 3,096	$ 3,570	$3,737

*Wheat fed to livestock.
†129 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 11. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $ .91	$ .92 to $1.10	$1.11 to $1.28	$1.29	$1.30	$1.50
Crops (in acres):						
Spring Wheat	—	—	—	—	—	5
Winter Wheat	19	19	76	94	167	181
Oats	19	19	—	18	18	—
Corn	19	19	—	18	18	—
Sorghum	152	152	152	152	5	—
Summer Fallow	19	19	76	94	167	181
Barley	—	—	—	—	—	29
Tame Hay or Pasture	219	219	143	72	72	—
Crop Production (in bushels):						
Wheat	471*	471†	1,854	2,269	4,176	5,103
Feed Grain (corn equivalent)	5,354	5,072	4,361	5,155	753	475
Sorghum Silage (in tons):	—	65	46	37	37	—
Tame Hay	6	3	—	—	—	—
Native Hay	154	154	110	88	88	53
Livestock (head):						
Beef Cows	51	54	38	30	30	17
Stockers Sold‡	45	41	29	23	23	13
Total Labor Use (hours)	$ 1,868	$ 1,919	$ 1,638	$ 1,641	$ 1,336	$ 1,182
Total Capital Used	$32,314	$32,885	$26,774	$24,776	$23,815	$19,660
Net Returns§	$ 4,023	$ 4,034	$ 4,122	$ 4,446	$ 4,467	$ 5,322

*Wheat fed to livestock.
†231 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 12. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $1.09	$1.10 to $1.26	$1.27 to $1.35	$1.36 to $1.42	$1.61
Crops (in acres):					
Spring Wheat	—	—	—	—	59
Winter Wheat	20	79	149	170	188
Oats	20	—	—	12	—
Corn	20	—	—	12	—
Sorghum	158	158	19	—	—
Summer Fallow	20	79	149	170	188
Barley	—	—	—	—	30
Tame Hay or Pasture	227	148	148	98	—
Crop Production (in bushels):					
Wheat	490*	1,928	3,735	4,268	5,299
Feed Grain (corn equivalent)	5,565	4,741	570	52	492
Tame Hay (in tons)	111	—	—	59	—
Native Hay	231	182	182	166	118
Livestock (head):					
Beef Cows	75	59	59	54	38
Stockers Sold†	57	45	45	41	29
Total Labor Use (hours)	2,349	2,069	1,776	1,740	1,615
Total Capital Used	$44,751	$39,777	$39,865	$39,414	$36,556
Net Returns‡	$ 5,133	$ 5,216	$ 5,555	$ 5,877	$ 6,950

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 13. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $ .59	$ .90 to $ .98	$1.23 to $1.30	$1.47 to $1.58	$1.69 to $1.86	$1.87 to $2.01
Crops (in acres):						
Spring Wheat	—	6	—	—	50	50
Winter Wheat	13	12	31	31	91	158
Oats	13	18	31	31	—	—
Corn	13	12	—	—	—	—
Sorghum	133	133	133	133	133	—
Summer Fallow	13	18	31	31	91	158
Barley	132	145	163	163	25	25
Tame Hay or Pasture	74	47	—	—	—	—
Crop Production (in bushels):						
Wheat	295*	407†	725	2,335	2,723	4,452
Feed Grain (corn equivalent)	7,034	7,299	7,508	5,000	4,406	415
Tame Hay	—	—	—	—	—	—
Native Hay	41	41	17	17	17	17
Livestock (head):						
Beef Cows	4	13	7	7	7	7
Stockers Sold‡	48	10	—	—	—	—
Total Labor Use (hours)	1,371	1,348	1,269	1,122	1,133	856
Total Capital Used	$19,827	$16,845	$13,420	$11,704	$11,841	$9,691
Net Returns§	$ 4,728	$ 4,790	$ 4,980	$ 5,406	$ 5,932	$6,425

*Wheat fed to livestock.
†115 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 14. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $ .81	$ .82 to $1.00	$1.24 to $1.33	$1.51 to $1.66	$1.67 to $1.91	$1.92
Crops (in acres):						
Spring Wheat	—	—	—	—	57	57
Winter Wheat	12	18	23	112	105	181
Oats	12	18	18	36	—	—
Corn	82	87	91	—	—	—
Sorghum	152	152	152	152	152	—
Summer Fallow	12	18	23	112	105	181
Barley	82	83	69	36	29	29
Tame Hay or Pasture	96	72	72	—	—	—
Crop Production (in bushels):						
Wheat	276*	415†	532	2,684	3,127	5,103
Feed Grain (corn equivalent)	8,397	8,644	8,491	5,715	5,036	475
Tame Hay	—	—	—	—	—	—
Native Hay	99	91	99	57	57	57
Livestock (head):						
Beef Cows	32	29	38	22	22	22
Stockers Sold‡	24	22	—	—	—	—
Feeder Calves Sold	—	—	29	17	17	17
Total Labor Use **(hours)**	2,678	2,672	2,657	1,470	1,495	1,180
Total Capital Used	$25,663	$25,042	$23,843	$19,923	$20,038	$19,042
Net Returns§	$ 5,865	$ 5,865	$ 5,956	$ 6,364	$ 6,790	$ 7,570

*Wheat fed to livestock.
†254 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 15. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Item	Price of Wheat $ .36 to $ .96	$1.25 to $1.35	$1.36 to $1.61	$1.62 to $1.70	$1.71 to $1.89	$1.98
Crops (in acres):						
Spring Wheat	—	—	—	—	59	59
Winter Wheat	19	71	98	116	109	188
Oats	19	19	19	37	—	—
Corn	98	71	19	—	—	—
Sorghum	158	158	158	158	158	—
Summer Fallow	19	71	98	116	109	188
Barley	79	—	—	37	30	30
Tame Hay or Pasture	74	74	74	—	—	—
Crop Production (in bushels):						
Wheat	429*	1,719	2,357	2,786	3,245	5,299
Feed Grain (corn equivalent)	9,028	6,863	5,520	5,935	5,232	492
Tame Hay	—	—	—	—	—	—
Native Hay	159	171	171	128	128	128
Livestock (head):						
Beef Cows	52	66	66	49	49	49
Stockers Sold†	36	50	50	—	—	—
Feeder Calves Sold	4	—	—	38	38	38
Total Labor Use **(hours)**	2,298	2,168	2,068	1,932	1,942	1,609
Total Capital Used	$39,806	$37,241	$37,192	$34,876	$35,038	$35,139
Net Returns‡	$ 6,849	$ 6,895	$ 7,085	$ 7,700	$ 7,960	$ 8,985

*Wheat fed to livestock.
†Includes calves raised and purchased.
‡The net returns refers to the lowest wheat prices and includes the returns to land and the operator's labor.

Table 16. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $ .64	$ .84 to $ .92	$ .93 to $1.01	$1.16 to $1.21	$1.23 to $1.26	$1.27 to $1.83
	Acres					
Soil Group I-II						
Sorghum	133.0	133.0	17.8			
Summer Fallow, Winter Wheat			115.2	133.0	133.0	133.0
Soil Group III						
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	132.0					
Summer Fallow, Winter Wheat		132.0	132.0	132.0	132.0	132.0
Soil Group IV						
Grass	125.0	125.0	125.0	81.8	58.1	
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)				43.2		
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley					66.9	125.0

wheat prices are shown in the tables. The wheat prices are shown as a range over which the farm plans, crop and livestock production, and other such factors remain constant.

Farm Plans with Corn Priced At 69 Cents

Results of the linear programming indicate net returns on the 640-acre model farm would be greatest with a farm plan oriented toward production of cash grain. Net returns on the two larger model farms were greatest with a farm plan somewhat balanced between production of cash grains and livestock with wheat priced at $1.05 per bushel and below. The wheat production was fed at the low wheat prices and the feed grains were sold. But as wheat prices rose, the emphasis in grain production leaned increasingly more toward wheat as a cash grain with livestock becoming a supplementary enterprise. Winter wheat and summer fallow increasingly replaced oats, corn, and sorghum as a cash crop. Calves were purchased for the 640-acre farm at the low wheat price levels while a stock-cow herd was maintained on the other model farms.

Wheat acreage and production increased substantially on the 640-acre farm when wheat rose in price to 93 cents and to $1.04 and $1.03 per bushel for the 1,280- and 2,240-acre farms. The two main sources of income, below these wheat prices, were feed grain[3] sales and stocker cattle. But as wheat became increasingly competitive as a cash grain, a production adjustment from feed grain and livestock feed crops to winter wheat and summer fallow occurred. This change occurred at different price ratios for each of the model farms since each farm had a different set of costs for the same crop enterprise. The changes in crop rotations by soil group, at the various wheat price levels are shown in Tables 16 through 18 for each of the model farms.

Crop Production—Soils Group I-II. Winter wheat, spring wheat, barley, oats, corn grain, grain sorghum, corn silage, forage sorghum, alfalfa (including a pasture-type alfalfa), and summer fallow in a combination of 16 crop rotations were the cropping alternatives. Continuous small grain, with the exception of winter wheat, was allowed as well as continuous corn and sorghum. Corn is the only row crop shown in the crop rotations allowed, although sorghum can be substituted if it is more profitable. Group I-II soils are more productive and crop yields are higher than yields on the other soils groups.

The two most profitable crops on the 640-acre model farm were barley and grain sorghum at wheat prices of 64 cents or less per bushel. Per acre returns for barley and grain sorghum were $2.22 and $4.60, respectively. Although the returns from barley were somewhat higher on both of the other model farms, the returns from grain sorghum were also higher.

An increase of 20 cents in the price of wheat brought the net returns from winter wheat-fallow to within 16 cents of the net returns from grain sorghum, on the 640-acre farm. Although the acreage of sorghum remained the same, about 18 acres of grain sorghum shifted to forage sorghum. This resulted from a change in crop rotations and an increase in wheat production on Group III soils. A change in the livestock enterprise also occurred with the shift in crop rotations. An additional increase of 9 cents, to 93 cents per bushel, raised the returns from winter wheat-fallow to $5.61 per acre compared with $4.58 from grain sorghum. Consequently, land use shifted as 115 acres of grain sorghum went to winter wheat-fallow. The balance of the acreage remained in forage sorghum as the livestock enterprise was still somewhat competitive with wheat. But with a further increase in price, to $1.16 per bushel, the remaining sorghum acreage shifted to winter wheat-fallow. Net returns from winter wheat were $8.58 per acre compared with $7.49 from spring wheat-fallow, $6.49

[3]Continuous corn and sorghum were allowed as crop enterprise activities. However, to reduce duplicating crop enterprise activities, only corn was used in crop rotations with the assumption that corn would be replaced by grain sorghum if it were the most profitable grain crop.

from spring wheat following corn, and only 55 cents from spring wheat following small grain. Thus, with winter wheat-fallow being the most profitable crop at a price of $1.16 per bushel, no further change in wheat production would occur without a change in either livestock or feed grain prices.

Oats and alfalfa were the only crops raised on Group I-II soils at wheat prices up to $1.05 per bushel on the 1,280-acre farm. Wheat was profitable as it returned $6.75 per acre, but the cattle enterprise combined with oats was slightly more profitable. The oats was sold as feed grain and the alfalfa was fed. But as wheat increased in value, to $1.06 per bushel, approximately 98 acres shifted from oats and alfalfa to forage sorghum, winter wheat, and summer fallow. At this wheat price, winter wheat-fallow returned $6.98 per acre and forage sorghum replaced reduced hay production. With the reduction in roughage production, the size of the stock-cow herd was also decreased. A very slight additional increase in wheat price caused a further shift of the remaining acres in oats and alfalfa to sorghum, winter wheat, and alfalfa. Total feed production decreased and the livestock enterprise was again reduced. Winter wheat-fallow returned a per acre net of $7.01 at a price of $1.07 per bushel and this farm plan remained unchanged until wheat reached a price above $1.29 per bushel. As the wheat price rose above $1.29 per bushel and winter wheat-fallow returned $9.90 per acre, the acreage remaining in sorghum shifted to winter wheat-summer fallow and this acreage remained unchanged through a wheat price of $3 per bushel as long as feed grain and livestock prices remained unchanged. Barley returned $3.54 per acre, grain sorghum net returns were $4.60 per acre, oats returned 53 cents per acre, and corn returns were negative. With wheat prices at about one dollar, winter wheat-fallow was the most profitable rotation, because net returns were about one dollar higher than spring wheat-fallow, about fifty cents higher than spring wheat following corn, and about six dollars higher than spring wheat following small grain. As the wheat prices rose, winter wheat-fallow remained slightly more profitable than spring wheat.

The cropping pattern on the 2,240-acre model farm was quite similar to that on the 1,280-acre farm. The oats and alfalfa rotation shifted to sorghum, winter wheat, and summer fallow at a wheat price of $1.08 per bushel, compared with a similar shift on the 1,280-acre farm at a wheat price of only 1 cent less. A shift of sorghum acreage to winter wheat-fallow occurred at a wheat price of $1.36 per bushel compared with a comparable shift at a price of $1.29 on the 1,280-acre farm. Although the returns from grain sorghum were only slightly less than on the 1,280-acre farm, the returns from barley, corn grain, and

Table 17. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 1,280-Acre Model Farm Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $1.03	$1.04 to $1.05	$1.068	$1.07 to $1.29	$1.293 to $1.47	$1.50
			Acres			
Soil Group I-II						
Oats, Alfalfa (3 years)	152.0	152.0	53.8			
Sorghum			8.3	12.7		
Summer Fallow, Winter Wheat			89.9	139.3	152.0	152.0
Soil Group III						
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	152.0					
Summer Fallow, Winter Wheat		152.0	152.0	152.0	152.0	152.0
Soil Group IV						
Grass	143.0	143.0	143.0	143.0	81.1	
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)					61.9	
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley						143.0

Table 18. Crop Rotations by Soils Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 2,240-Acre Model Farm Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $1.02	$1.03 to $1.05	$1.08 to $1.34	$1.36 to $1.58	$1.62 to $2.44
		Acres			
Soil Group I-II					
Oats, Alfalfa (3 years)	158.0	158.0			
Sorghum			19.0		
Summer Fallow, Winter Wheat			139.0	158.0	158.0
Soil Group III					
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	158.0	37.5			
Summer Fallow, Winter Wheat		120.5	158.0	158.0	158.0
Soil Group IV					
Grass	148.0	148.0	148.0	49.3	
Summer Fallow, Wheat, Corn, Oats, Alfalfa (4 years)				98.7	
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley					148.0

oats were considerably less—in fact, the returns from corn and oats were both negative. Per acre returns from wheat were about one dollar less on the 2,240-acre farm than on the 1,280-acre farm. Although most of the variable costs were about the same on both the 1,280-acre and 2,240-acre farms, the machine costs were higher on the 2,240-acre farm.

The maximum wheat acreage and production was reached on the 640-acre farm at a price of $1.16 per bushel compared with $1.29 on the 1,280-acre farm, and $1.36 on the 2,240-acre farm.

Crop Production—Soils Group III. Most of the crop alternatives and rotations were identical to those allowed on Group I-II soils. Although continuous small grain was allowed, continuous row cropping was not. These soils are less productive and crop yields are slightly below those of the Group I-II soils.

Group III soils were used primarily to furnish feed for the livestock enterprise on all three model farms at the lowest wheat prices, but the 8-year crop rotation used also produced grain for cash sale. Net returns from grain sorghum were slightly higher than on the Group I-II soils and those from wheat were slightly lower, but neither continuous corn nor grain sorghum were allowed. The net returns were somewhat lower for the remaining crop alternatives also.

Summer fallow-winter wheat - corn - oats - alfalfa (4-years) returned $2.34 per acre on the 640-acre farm and $5.78 on the 1,280-acre model farm. At wheat prices of 84 cents and $1.04 on the 640-acre and 1,280-acre model farms, respectively, summer fallow-winter wheat-corn-oats-alfalfa (4 years) shifted to summer fallow-winter wheat. Net returns on the 640-acre farm were $3.90 per acre from summer fallow-winter wheat at a wheat price of 84 cents per bushel, and $5.94 on the 1,280-acre farm at a wheat price of $1.04. Wheat acreage and production reached the maximum potential on both model farms at these prices, and, consequently, no further change in rotations occurred with further wheat price increases.

The same rotation, summer fallow-winter wheat-corn-oats-alfalfa (4 years), was also used on the Group III soils on the 2,240-acre farm at wheat prices of $1.02 and less. Farm income from cattle was far greater than from the sale of cash grain at this combination of wheat and feed grain prices. But as the wheat price rose to $1.03 per bushel, wheat became somewhat more competitive with cattle and 81 acres of corn, oats and alfalfa were shifted to summer fallow and winter wheat. Approximately 28 acres were left in corn, oats, and alfalfa. Feed grain for cash sale was reduced by about 500 bushels, but wheat production increased by over 1,000 bushels. Feed production decreased with a corresponding decrease in the stock-cow herd.

The remaining acreage in corn, oats, and alfalfa shifted to winter wheat and summer fallow when wheat reached a price of $1.08 per bushel. At this price, summer fallow-winter wheat reached its maximum acreage and production with returns of $4.41 per acre. No further changes in acreage could be expected with wheat continuing to rise in price with the other commodity prices remaining constant. At the highest programmed price, $2.44, summer fallow-winter wheat returned $21.68 per acre—considerably higher than returns from spring wheat.

Crop Production—Soils Group IV. The cropping alternatives were somewhat similar to those on the other soil groups with some modification. Although the crops were the same, most of the crop rotations allowed were not. A permanent grass and legume seeding for pasture was added as a cropping alternative. These soils were less productive than the Group I-II soils. However, compared with the Group III soils, spring wheat and corn yields were slightly higher, while winter wheat, oats, barley, sorghum, and alfalfa yields were somewhat lower.

The entire acreage of Group IV soils was seeded as tame pasture at wheat prices which ranged up to $1.01 per bushel on the 640-acre model farm, $1.29 on the 1,280-acre farm, and $1.34 on the 2,240-acre model farm. Some acreage remained in tame pasture at wheat prices as high as $1.26 per bushel on the 640-acre farm, $1.47 on the 1,280-acre farm, and $1.58 on the 2,240-acre farm. Wheat at these prices is the most profitable grain crop; winter wheat is more profitable than spring wheat. Oats and corn produced negative returns, while barley and grain sorghum returned a dollar an acre or less. However, the livestock enterprise was profitable enough to be a major contributor to farm income on all three model farms at these wheat prices. Tame pasture was needed to supplement native range.

A rise in wheat price produced a shift of some tame pasture acreage to an 8-year rotation of summer fallow-winter wheat-corn-oats-alfalfa (4-years) on each of the model farms, but the shift in acreage occurred at a different wheat price on each model farm. The amount and percentage of Group IV soils which shifted to the 8-year crop rotation differed from farm to farm. Forty-three acres (34.4%) of tame pasture shifted to the 8-year crop rotation, on the 640-acre farm, at a wheat price of $1.16 per bushel. The change in tame pasture acreage compared with a similar change of 62 acres (43.4%) on the 1,280-acre farm at a wheat price of $1.29 per bushel and 98.7 acres (66.7%) on the 2,240-acre farm at a wheat price of $1.36. These differences resulted from the interaction of the various enterprise cost structures and the ratios of cropland to native hay and range on each of the model farms.

The trend from tame pasture continued as wheat prices continued to rise, but the acreage shifted principally into wheat and summer fallow. Twenty-four acres of tame pasture and approximately 32 acres of corn, oats, and alfalfa shifted to a 5-year rotation of summer fallow-winter wheat-spring wheat-barley at a wheat price of $1.23 per bushel on the 640-acre farm. As wheat increased to a price of $1.27 per bushel, the remaining acreage in tame pasture also shifted to the 5-year rotation of summer fallow, wheat, and barley. Similarly, the acreage in tame pasture, corn, oats, and alfalfa on the two remaining model farms shifted to the 5-year rotation of summer fallow, wheat, and barley. This acreage shift occurred on the 1,280-acre farm at a wheat price of $1.50 and $1.62 per bushel on the 2,240-acre model farm.

The wheat was produced for the cash market while the barley was fed to cattle. The net cash returns from this rotation were $2.27 per acre at a wheat price of $1.27 per bushel on the 640-acre farm, $4.27 on the 1,280-acre farm with wheat priced at $1.50, and 67 cents per acre on the 2,240-acre farm with wheat priced at $1.62 per bushel. It was at these prices that the potential maximum wheat acreage of 60% was reached on each of the model farms.

Although wheat was relatively more profitable than the other crop alternatives on the Group IV soils, supplementary pasture was needed for the cattle enterprise. Thus, these soils were used as pasture, at the lower wheat prices, since the Groups I-II and III soils were used for cash grain production. As wheat rose in price and the profitability of wheat increased, tame pasture ultimately gave way to wheat production and the livestock enterprise was accordingly reduced.

Livestock Production. The livestock enterprise, in the optimum farm plan, was one of raising calves to 700-pound weights. The calves were raised from a stock-cow herd, although some additional calves were purchased for the 640-acre model farm at the low wheat prices.

The livestock enterprise contributed significantly to total farm income on all model farms at the lower wheat prices, but as wheat rose in price, the livestock enterprise became supplementary in nature. Without any livestock, some land resources would remain idle. No provision was made to sell or rent out native hay or range. It is recognized that in most real situations, native hay or range land probably would not remain idle—if not used by the farm operator, it would be leased out.

With the $25.28 and $23.08 prices used for feeder and stocker calves, respectively, both were profitable, particularly at a corn price of 69 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. The livestock enterprise was profitable with this combination of feed grain and livestock prices. However, the size and nature of the livestock enterprise was influenced by the increase in wheat price as cropland shifted to a larger wheat acreage and fewer acres in feed crops. The cattle enterprise became relatively less profitable as wheat rose in price. Thus, the livestock enterprise became a supplementary enterprise which existed to utilize native hay and range. At the higher wheat prices only a few acres of cropland were used to produce livestock feed.

The livestock enterprise on the 640-acre model farm consisted partly of fall purchased calves and a relatively small stock-cow herd at wheat prices below $1.01 per bushel. At wheat prices above $1.01 per bushel, the livestock enterprise shifted entirely to a stock-cow herd. In contrast, the livestock enterprise, on both larger model farms, consisted entirely of a stock-cow herd at all wheat prices.

Fall-purchased calves fed to 700-pound weights were relatively more profitable than maintaining a herd of stock cows. In addition, more labor is needed to maintain a stock cow and more of the labor would be needed at a time when it would compete with crops. Less short term capital is required to maintain a stock cow than to purchase feeder or stocker calves, but if owned capital or credit is ample, there then is no problem.

Feed, other than minerals, feed additives, and salt, was home grown and consisted of hay, corn and sorghum silage, and some grain. The grains used for feed depended upon the price of wheat in relation to corn, since cash grain was produced and crop rotations changed as wheat increased in price. Wheat was fed on all three model farms generally at relatively low wheat prices. All the wheat grown on the 640-acre farm, at wheat prices up to 64 cents a bushel, was fed, as well as that grown on the 1,280-acre and 2,240-acre model farms at wheat prices of $1.03 and $1.02, respectively. Feed grains replaced wheat as a livestock feed, on the 640-acre farm, at a wheat price of 84 cents per bushel. In contrast, feed grains were fed at all wheat prices on the two larger model farms. Roughages included native hay, supplemented by some tame hay production, corn and sorghum silage. Some sorghum and corn silage was fed on the 640-acre farm, while only sorghum silage was fed on the 1,240-acre model farm; no silage was fed on the 2,240-acre farm. Tame pasture was used to supplement native range on all three model farms at nearly all the programmed wheat prices.

The percentage of cropland used for feed production on the 640-acre farm varied from 53.1% at the

low wheat price to less than 1% at the highest programmed price. On both of the remaining model farms, the percentage of cropland used for feed production varied from 78.7% at the lowest wheat prices to 6.5% at the highest prices.

Farm Plans with Corn Priced At 83 Cents

Differences in farm plans occurred on all model farms, at the low wheat prices, when the corn price was raised from 69 cents to 83 cents. Crop production was shifted from wheat and tame pasture to grain sorghum and other feed grain crops. The main source of farm income was derived from cash sales of grain. The livestock enterprise, on each model farm, was smaller than when the corn price was 69 cents; no feeder calves were purchased on any of the model farms.

Net returns were higher on the model farms due to the 14-cent increase in corn price and an increased volume of feed grain sold at the lower wheat prices. The changes in crop rotations by soil group at the various wheat price levels are shown in Table 19 through 21.

Crop Production—Soils Group I-II. Crop production was oriented toward feed grain production on all three model farms at relatively low wheat prices. However, livestock production was an important contributor to farm income on the two larger model farms, particularly, the 2,240-acre farm.

With the increase of 14 cents in the corn price, grain sorghum returned a net of approximately $9 per acre on all the model farms. Barley was the second most profitable feed crop, returning $5.23 per acre on the 640-acre farm and $6.55 and $3.94, respectively, on the 1,280- and 2,240-acre model farms. Corn grain returned just under $3 per acre and oats was the least profitable of the feed crops.

The price of wheat would have to rise for wheat to maintain its relative profitability and its competitive position for the use of cropland. Consequently, with sorghum being the most profitable feed grain crop, only sorghum and winter wheat were grown on the Group I-II soils.

Sorghum was grown on the 640-acre farm with wheat prices below $1.20 per bushel. At this price, winter wheat-summer fallow returned $9.10 per acre, compared with $9.03 from grain sorghum. Approximately 130 acres of sorghum shifted to winter wheat and summer fallow at a wheat price of $1.25, at which price the net returns were $9.75 per acre. Three acres remained in forage sorghum until it shifted to winter wheat-summer fallow at a wheat price of $1.29 per bushel.

Similarly, continuous sorghum was grown on the 1,280-acre model farm until wheat reached a price of $1.30 per bushel. At this price, the income from winter wheat-fallow exceeded the $9.07 per acre re-

Table 19. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $ .87	$ .89 to $ .90	$ .91 to $1.00	$1.01 to $1.20	$1.25 to $1.26	$1.29
	Acres					
Soil Group I-II						
Sorghum	133.0	133.0	133.0	133.0	2.5	
Summer Fallow, Winter Wheat					130.5	133.0
Soil Group III						
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	87.5	66.2				
Barley	44.5					
Summer Fallow, Winter Wheat		65.8	132.0	132.0	132.0	132.0
Soil Group IV						
Grass	125.0	125.0	90.1			
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)			34.9	125.0	98.8	
Summer Fallow, Winter Wheat, Barley, Oats					26.2	
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley						125.0

Table 20. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $ .91	$ .93 to $1.10	$1.11 to $1.28	$1.29	$1.30	$1.50
	Acres					
Soil Group I-II						
Sorghum	152.0	152.0	152.0	152.0	5.3	
Summer Fallow, Winter Wheat					146.7	152.0
Soil Group III						
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	152.0	152.0				
Summer Fallow, Winter Wheat			152.0	152.0	152.0	152.0
Soil Group IV						
Grass	143.0	143.0	143.0			
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)				143.0	143.0	
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley						143.0

turn from grain sorghum by about 90 cents, and approximately 147 acres shifted from grain sorghum to winter wheat and summer fallow. The remaining 5 acres of forage sorghum shifted to winter wheat and summer fallow at a wheat price of $1.50 per bushel; winter wheat on summer fallow returned $12.58 per acre.

Grain sorghum, when grown on the 2,240-acre farm, returned $8.90 per acre. With wheat priced at $1.27, 139 acres of grain sorghum shifted to winter wheat and summer fallow, which returned about $8.50 per acre. In addition, the annual labor was reduced by about 300 hours. The remaining acres in sorghum shifted to winter wheat and summer fallow as the wheat price rose further to $1.36 per bushel. The returns from winter wheat-summer fallow were $9.54 per acre.

Production of winter wheat would remain unchanged on all the model farms at the high programmed wheat prices unless feed grain prices rose enough to become a competitive factor, assuming no change in the costs of production.

Crop Production—Soils Group III. In general, the same cropping system was followed on all three model farms (at low wheat prices) when the feed grain price was increased from 69 to 83 cents per bushel. The only exception to this was the 44.5 acres of barley on the 640-acre farm at wheat prices up to 88 cents.

Table 21. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $1.09	$1.09 to $1.26	$1.27 to $1.35	$1.36 to $1.42	$1.61
	Acres				
Soil Group I-II					
Sorghum	158.0	158.0	19.0		
Summer Fallow, Winter Wheat			139.0	158.0	158.0
Soil Group III					
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	158.0				
Summer Fallow, Winter Wheat		158.0	158.0	158.0	158.0
Soil Group IV					
Grass	148.0	148.0	148.0	49.3	
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)				98.7	
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley					148.0

The rise in the feed grain price increased the net returns from corn, sorghum, oats and barley. Thus, for wheat to maintain its profitability relative to the feed grains, wheat, too, would have to rise in price. For this reason, the rotations shifted to summer fallow and winter wheat at higher wheat prices than for the comparable shift with feed grains priced at 69 cents.

The rotation of summer fallow-winter wheat-corn-oats-alfalfa (4-years) and about 44 acres of continuous barley occupied the Group III soils at wheat prices up to 88 cents on the 640-acre model farm. The rotation furnished feed for the livestock enterprise as well as some cash grain. Barley was grown as a cash grain and returned $4.35 per acre. The barley and approximately 16 acres of corn, oats and alfalfa shifted to winter wheat and summer fallow at a wheat price of 89 cents. The remaining acreage in corn, oats and alfalfa shifted into winter wheat and summer fallow as the wheat price rose another 2 cents, to 91 cents per bushel. Winter wheat and summer fallow returned a per acre net of $4.52 at 89 cents and $4.76 at 91 cents. As summer fallow-winter wheat was the most profitable of the rotations allowed on these soils, no further change occurred in the cropping pattern.

A similar pattern occurred on the 1,280-acre and 2,240-acre model farms, with the exception of barley which was grown on the 640-acre farm. The summer fallow-winter wheat-corn-oats-alfalfa (4-years) rotation shifted to winter wheat and summer fallow at wheat prices 7 cents per bushel higher with the 14-cent increase in the price of corn. The rotation shifted to summer fallow-winter wheat at a price of $1.11 on the 1,280-acre farm and $1.10 on the 2,240-acre model farm. No further change occurred in the cropping pattern on either farm.

Crop Production—Soils Group IV. A 14-cent rise in the corn price did not materially affect the cropping system on the Group IV soils—in fact, no change occurred on the 2,240-acre model farm. Although barley, oats, corn and sorghum became more profitable, the feed grains still were not profitable enough to compete with the livestock enterprise for the use of this cropland at low wheat prices.

The entire acreage of Group IV soils on the 640-acre farm was seeded as tame pasture at wheat prices up to 90 cents. At a wheat price of 91 cents, approximately 35 acres of tame pasture shifted to an 8-year rotation of summer fallow-winter wheat-corn-oats-alfalfa (4-years). This change did not occur because the rotation was more profitable, but because tame hay was needed due to the shift toward winter wheat and summer fallow on the Group III soils. With an additional 10-cent increase in wheat price, the acre-

age in tame pasture shifted to the 8-year rotation. Although the summer fallow-winter wheat-barley-oats rotation returned 70 cents per acre more than the 8-year rotation, tame hay was needed for the livestock enterprise as the cropland of the other two soil groups was used for cash grain production. A further increase in wheat price, to $1.25 per bushel, shifted a few acres from alfalfa to summer fallow, wheat, barley, and oats, but with an increase to $1.29 per bushel, the entire acreage of Group IV soils shifted to summer fallow, wheat and barley (Table 19). At this price, wheat acreage and production reached the maximum possible on the 640-acre farm.

Although feed grain production became more profitable, with the 14-cent increase in corn price, the increased profitability made only a slight difference in the cropping pattern on Group IV soils of the 1,280-acre model farm. The entire acreage of tame pasture shifted to an 8-year rotation of summer fallow-winter wheat-corn-oats-alfalfa (4-years) at a wheat price of $1.29 per bushel and remained unchanged until the wheat price reached $1.50 per bushel. At this price, the 8-year rotation which returned approximately $7.08 per acre was shifted to a 5-year rotation of summer fallow-winter wheat-spring wheat-spring wheat-barley which returned $7.17 per acre. This rotation brought wheat acreage and production to the maximum possible.

No change occurred in the cropping pattern on the 2,240-acre model farm with the increased feed grain price. Maximum wheat acreage and production was realized at a wheat price of $1.61 per bushel and higher.

Livestock Production. Changes in the livestock enterprise came about as a result of increased profitability of cash feed grain production due to the 14-cent increase in price. Cash feed grain production increased on all three model farms. Wheat production at the lower wheat prices decreased and total feed production also decreased. Silage was used more at the higher feed grain prices but the total tonnage, when produced, was generally less. Native hay production, which was greater at the low wheat prices, decreased as wheat prices rose. The cropland used for tame pasture gradually shifted to grain crops with the result that native hayland was needed as pasture.

The changes in the livestock enterprise occurred at the low wheat prices and, generally, involved a reduction in the stock-cow herd commensurate with the feed supply. The livestock enterprise on the 640-acre model farm was one of raising calves, from a relatively small stock-cow herd, to sell at 700-pound weights. This was somewhat in contrast to the livestock operation at a corn price of 69 cents when additional calves were purchased. Livestock production on the 1,280-acre and 2,240-acre model farms was reduced by about 25% as the feed grain price was increased by 14 cents.

Farm Plans with Corn Priced at $1.10

The competitive position and relative profitability of corn was further enhanced with an increase in corn price to $1.10 per bushel. This would, again, 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 Tables 22 through 24.

Crop Production—Soils Group I-II. With a rise of 27 cents in the corn price, to $1.10 per bushel, wheat was not profitable enough to raise on any of the model farms at wheat prices less than $1.85 on these soils. Considering the cost and yield relationships, continuous grain sorghum was clearly the most profitable feed grain crop, followed, in turn, by barley, corn, and oats.

Thus, the cropping patterns were simple on all three model farms as they consisted of either grain sorghum or winter wheat on fallow. Per acre returns from grain sorghum ranged from $17.54 on the 2,240-acre farm to $17.63 on the 1,280-acre model farm. Grain sorghum then shifted to summer fallow-winter wheat on each of the model farms as winter wheat became more profitable than sorghum. Net returns from summer fallow-winter wheat were as follows: $17.78 per acre on the 640-acre model farm at a wheat price of $1.87 per bushel, $18.02 on the 1,280-acre farm at a wheat price of $1.92 per bushel, and $17.59 on the 2,240-acre farm with wheat priced at $1.98 per bushel.

Crop Production—Soils Group III. Although grain sorghum and corn were crop alternatives on these soils, they could not be continuously cropped. This, coupled with somewhat lower productivity, meant net returns from feed grains grown on Group III soils would be lower than the net returns from the same crops grown on Group I-II soils.

The feed grains in order of profitability were: Sorghum, barley, corn and oats. However, neither sorghum nor corn could be continuously cropped, but barley could; hence, barley was grown as a cash grain on the 640-acre farm at wheat prices below $1.69 per bushel. At a price of $1.69 per bushel for wheat, summer fallow-winter wheat returned a net of $14.32 per acre. A two-year rotation of barley and corn would reduce the per acre returns from the feed grains since an acre of corn was less profitable than barley. Sorghum and corn can be substituted for each other, if one is more profitable, and a rotation of barley and sorghum would increase net returns by about $4 per acre as sorghum returned nearly $18 per acre

at this $1.10 per bushel price. However, summer fallow-winter wheat, at a per bushel wheat price of $1.69, still was more profitable than a rotation of barley and sorghum which would be shifted to winter wheat production at the same wheat price. Hence, the only difference that sorghum, substituted for corn, would make would be to increase the net returns below a wheat price of $1.69 per bushel.

Corn and barley were grown on the 1,280-acre model farm at wheat prices below $1.51. However, sorghum would be substituted for corn in the corn-barley rotation since it was far more profitable than corn. Barley returned about $11 per acre, and sorghum returned nearly $18 compared with about $1.50 for corn. At a wheat price of $1.24 per bushel, a minor acreage adjustment occurred as approximately 10 acres shifted to summer fallow and winter wheat. A change also occurred in the livestock enterprise which increased the number of stock cows. The results of these changes were a slight increase in the cash income and some reduction in the annual capital and credit needs. The emphasis in production remained with feed grains, but wheat was no longer fed to livestock at the $1.24 per bushel wheat price.

Table 22. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $ .59	$ .90 to $ .98	$1.23 to $1.30	$1.47 to $1.58	$1.69 to $1.86	$1.87 to $2.01
			Acres			
Soil Group I-II						
Sorghum	133.0	133.0	133.0	133.0	133.0	
Summer Fallow, Winter Wheat						133.0
Soil Group III						
Barley	132.0	132.0	132.0	132.0		
Summer Fallow, Winter Wheat					132.0	132.0
Soil Group IV						
Grass	23.3					
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	101.7	93.5				
Summer Fallow, Spring Wheat, Barley, Barley Oats		31.5				
Summer Fallow, Winter Wheat, Barley, Oats			125.0	125.0		
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley					125.0	125.0

Table 23. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $ .81	$ .82 to $1.00	$1.24 to $1.33	$1.51 to $1.66	$1.67 to $1.91	$1.92
			Acres			
Soil Group I-II						
Sorghum	152.0	152.0	152.0	152.0	152.0	
Summer Fallow, Winter Wheat						152.0
Soil Group III						
Barley	12.1	13.7				
Corn, Barley	139.9	138.3	137.7			
Summer Fallow, Winter Wheat, Corn			14.4			
Summer Fallow, Winter Wheat				152.0	152.0	152.0
Soil Group IV						
Grass	47.9					
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	95.1	143.0	143.0			
Summer Fallow, Winter Wheat, Barley, Oats				143.0		
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley					143.0	143.0

Table 24. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Cropland at the Following per Bushel Wheat Prices: $ .36 to $ .96	$1.25 to $1.35	$1.36 to $1.61	$1.62 to $1.70	$1.71 to $1.89	$1.98
			Acres			
Soil Group I-II						
Sorghum	158.0	158.0	158.0	158.0	158.0	
Summer Fallow, Winter Wheat						158.0
Soil Group III						
Corn, Barley	158.0					
Summer Fallow, Winter Wheat, Corn		158.0				
Summer Fallow, Winter Wheat			158.0	158.0	158.0	158.0
Soil Group IV						
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	148.0	148.0	148.0			
Summer Fallow, Winter Wheat, Barley, Oats				148.0		
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley					148.0	148.0

With the wheat price continuing to rise, from $1.24 to $1.51 per bushel, the net returns from summer fallow-winter wheat became increasingly more competitive with the other crop combinations; summer fallow-winter wheat returned $11.70 per acre. The sorghum-barley rotation which would return $14.45 per acre was the most profitable crop combination, but it, too, would shift to summer fallow-winter wheat at a wheat price of $1.74 per bushel, at which price it would return $14.50 per acre.

The conditions which existed on the 1,280-acre farm also existed on the 2,240-acre farm. Corn and barley are shown in Table 24 as being grown on the Group III soils. With sorghum being far more profitable than corn, the rotation of sorghum and barley (returning a net of $13.08 per acre) would be grown until wheat reached a price of $1.74 per bushel. At this price, summer fallow and winter wheat returned $13.10 per acre.

Crop Production—Soils Group IV. Even with an additional rise in the price of corn, a substantial portion of the Group IV soils was used for feed production at low wheat prices. However, this does represent some adjustment since some feed grain was raised for the cash market at the lower wheat prices.

When corn was priced at 83 cents per bushel, all of the Group IV soils on the 640-acre farm were used as tame pasture at wheat prices up to $1 per bushel. With a rise in the corn price, to $1.10, about 40% of these soils were devoted to summer fallow, winter wheat, corn, and oats. Tame pasture and alfalfa hay occupied the remaining 60% of the Group IV soils. As wheat rose to 90 cents per bushel, tame pasture and a few acres of alfalfa hay, corn, and oats shifted to a 5-year rotation of summer fallow-winter wheat-barley-barley-oats. This shift in acreage was accompanied by a change in the livestock enterprise, from purchased calves to a small stock-cow herd. The 5-year rotation of summer fallow-winter wheat-barley-barley-oats returned $5.31 per acre compared with $5.19 from summer fallow-winter wheat-barley-oats. The summer fallow-winter wheat-corn-oats-alfalfa (4-years) rotation returned nearly $4 per acre, but the alfalfa hay was needed for the livestock enterprise. The summer fallow-winter wheat-barley-oats rotation became more profitable than the 5-year rotation, which included an additional year of barley, as the wheat price rose to $1.23 per bushel; net returns were $7.11 versus $6.72 per acre. The summer fallow-winter wheat-barley-oats rotation occupied this soils group until the wheat price reached $1.69 per bushel. At this price, spring wheat became competitive with oats and the acreage shifted to spring wheat. The rotation of summer fallow-winter wheat-spring wheat-spring wheat-barley provided for the greatest possible wheat acreage and production on the Group IV soils.

The cropping system on Soils Group IV of the 1,280-acre farm was nearly identical to that of the 640-acre farm except that the net returns were different and the rotation shifted at different wheat prices. Some grain and hay production and tame pasture existed at wheat prices as high as 81 cents. As the wheat price rose to 82 cents, tame pasture shifted to summer fallow-winter wheat-corn-oats-alfalfa (4 years) which returned a per acre net of $6.53. This remained the most profitable rotation through a wheat price of $1.33 per bushel, and, at a price of $1.24, returned $7.75 per acre. However, with a continued rise in wheat price to $1.51 per bushel, the acreage in corn and alfalfa shifted to a summer fallow-winter wheat-barley-oats rotation which returned about $9.20 per acre, the most profitable rotation allowable on the Group IV soils at these prices. The livestock enterprise was reduced in accordance with the feed production. A further rise in wheat, to $1.67 per bushel, brought the returns from spring wheat to a much higher level than oats, and the oat acreage shifted to spring wheat. The rotation of summer fallow-winter wheat-spring wheat-spring wheat-barley achieved the maximum wheat acreage and production possible on the Group IV soils.

Tame pasture was not used in the cropping system on the 2,240-acre farm as the corn price rose to $1.10 per bushel. Half of the acreage was used for hay production up to a wheat price of $1.62 per bushel and the remainder for summer fallow, winter wheat, corn and oats. This rotation, similar to that on the 1,280-acre farm, shifted to summer fallow-winter wheat-barley-oats at a wheat price of $1.62 and then to maximize wheat production to a rotation of summer fallow-winter wheat-spring wheat-spring wheat-barley as wheat rose to a price of $1.71 per bushel.

Grain sorghum returned a net of less than $2 per acre more than corn on the Group IV soils. Although it would be substituted for corn in the crop rotations, the increased per acre returns would have little effect on the wheat prices at which the rotational changes occurred. The reason the 8-year rotation (with 4 years of alfalfa) remained more profitable at higher wheat prices on the 1,280- and 2,240-acre farms was the reduced costs of production on the larger farms.

Livestock Production. The livestock enterprise became almost wholly supplementary in nature with an increase in corn price of 27 cents per bushel. The effect of an increase in corn price, without an increase in livestock price, is one of reduced net returns on the grain which is fed. Consequently, fewer cropland acres were used for feed crops and the size and nature of the stock-cow herd was adjusted accordingly.

Table 25. Resident Labor Use by Periods for the Optimum Farm Plan at Specified Wheat and Corn Prices, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Labor Periods	Corn Price per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $ .64	$ .84 to $ .92	$ .93 to $1.01	$1.16 to $1.21	$1.23 to $1.26	$1.27 to $1.83
			Hours					
Nov. 16 to March 15	69¢	836	289.2	202.5	202.5	168.1	107.0	41.9
March 16 to April 30	69¢	393	113.4	67.9	67.9	64.1	52.4	41.2
May 1 to July 15	69¢	873	532.9	422.6	210.6	220.4	213.7	249.3
July 16 to Sept. 30	69¢	918	255.9	346.8	485.1	475.6	494.8	513.7
Oct. 1 to Nov. 15	69¢	366	279.2	253.7	87.0	41.1	26.2	10.2
			Hours					
Total Annual	**69¢**	**3386**	**1470.6**	**1293.5**	**1053.1**	**969.3**	**894.1**	**856.3**

			Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $ .87	$ .89 to $ .90	$ .91 to $1.00	$1.01 to $1.20	$1.25 to $1.26	$1.29
			Hours					
Nov. 16 to March 15	83¢	836	253.1	242.2	171.7	132.4	113.7	41.9
March 16 to April 30	83¢	393	128.8	92.6	64.6	58.7	58.5	41.2
May 1 to July 15	83¢	873	527.9	498.6	463.4	482.4	231.3	249.3
July 16 to Sept. 30	83¢	918	275.9	294.1	314.6	340.7	505.3	513.7
Oct. 1 to Nov. 15	83¢	366	354.4	244.1	229.1	220.7	27.8	10.2
			Hours					
Total Annual	**83¢**	**3386**	**1540.1**	**1371.6**	**1243.4**	**1234.9**	**936.6**	**856.3**

			Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $ .59	$ .90 to $ .98	$1.23 to $1.30	$1.47 to $1.58	$1.69 to $1.86	$1.87 to $2.01
			Hours					
Nov. 16 to March 15	$1.10	836	138.7	107.0	41.9	41.9	41.9	41.9
March 16 to April 30	$1.10	393	145.6	152.9	147.6	57.8	41.6	41.6
May 1 to July 15	$1.10	873	499.1	508.8	503.4	466.5	494.0	249.2
July 16 to Sept. 30	$1.10	918	337.1	360.4	375.5	355.7	355.7	515,3
Oct. 1 to Nov. 15	$1.10	366	250.0	218.6	200.1	200.1	200.1	7.6
			Hours					
Total Annual	**$1.10**	**3386**	**1370.5**	**1347.7**	**1268.5**	**1122.0**	**1133.3**	**855.6**

A stock-cow herd was maintained on all model farms at all wheat prices, but in general it was somewhat smaller than when corn was priced at 83 cents per bushel. Some 430-pound calves were purchased for the 640-acre farm at wheat prices below 90 cents. The biggest change in the livestock enterprise operations was marketing 430-pound calves at the high prices in contrast to the marketing of 700-pound yearlings at the lower corn price levels. The change of selling 430-pound calves rather than 700-pound yearlings conserved the pasture and feed supply which enabled the carrying of a larger number of stock cows.

Very little difference occurred in grains and roughages fed. Wheat was still fed at the lowest range of wheat prices but the quantity was greatly reduced from the quantities fed at the lower corn price levels.

Labor

Labor was not expected to be a limiting factor. As farms either increase in size or become more intensively farmed, capital substitutes for labor at an increasing rate. In addition, farmers work longer days as well as on Sundays to make up for time 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 total annual labor needs were neither a crucial nor a limiting factor—total labor was in surplus. The minimum annual labor requirements on the 640-acre farm amounted to 25.3% of the labor available, compared with 24.4 and 37.2% on the 1,280- and 2,240-acre model farms, respectively. The maximum requirements amounted to 45.5%

Table 26. Resident Labor Use by Periods for the Optimum Farm Plan at Specified Wheat and Corn Prices, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Labor Periods	Corn Price per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $1.03	$1.04 to $1.05	$1.06	$1.07 to $1.29	$1.29 to $1.47	$1.50
			Hours					
Nov. 16 to March 15	69¢	1192	626.1	502.6	380.4	305.9	271.6	137.5
March 16 to April 30	69¢	608	263.7	205.8	145.3	109.5	102.8	130.7
May 1 to July 15	69¢	1246	372.1	265.7	220.8	227.4	227.3	228.7
July 16 to Sept. 30	69¢	1261	741.8	769.8	704.8	621.9	614.1	651.3
Oct. 1 to Nov. 15	69¢	521	165.2	122.8	93.0	83.6	71.5	33.6
			Hours					
Total Annual	**69¢**	4828	**2168.9**	**1866.7**	**1544.3**	**1348.3**	**1287.3**	**1181.8**

			Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $ .91	$ .92 to $1.10	$1.11 to $1.28	$1.30 to $1.286	$1.31 to $1.296	$1.50
			Hours					
Nov. 16 to March 15	83¢	1192	421.4	432.8	305.9	243.6	243.6	137.5
March 16 to April 30	83¢	608	164.5	168.6	109.5	100.1	100.1	130.7
May 1 to July 15	83¢	1246	522.1	516.2	478.1	534.4	270.3	228.7
July 16 to Sept. 30	83¢	1261	425.0	477.5	459.0	478.8	650.4	651.3
Oct. 1 to Nov. 15	83¢	521	335.2	324.3	285.1	283.7	71.3	33.6
			Hours					
Total Annual	**83¢**	4828	**1868.2**	**1919.4**	**1637.6**	**1640.6**	**1335.7**	**1181.8**

			Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $ .81	$ .82 to $1.00	$1.24 to $1.33	$1.51 to $1.66	$1.67 to $1.91	$1.92
			Hours					
Nov. 16 to March 15	$1.10	1192	257.5	237.2	237.2	137.6	137.6	137.6
March 16 to April 30	$1.10	608	158.0	155.6	147.8	100.4	131.8	131.8
May 1 to July 15	$1.10	1246	666.5	684.1	689.2	522.2	502.2	228.6
July 16 to Sept. 30	$1.10	1261	1261.0	1261.0	1261.0	464.4	478.7	656.5
Oct. 1 to Nov. 15	$1.10	521	335.2	333.7	321.7	245.0	245.0	25.1
			Hours					
Total Annual	**$1.10**	4828	**2678.2**	**2671.6**	**2656.9**	**1469.6**	**1495.3**	**1179.6**

on the 640-acre farm and 55.5 and 56.2% on the 1,280- and 2,240-acre farms, respectively.

The labor available during the planting and harvesting seasons were also in surplus. The minimum labor needed on the 640-acre farm was 30.9% of that available, compared with 27.9% for the 1,280-acre farm and 40.5% on the 2,240-acre farm. Maximum labor requirements during the planting and harvesting seasons on the 640-acre farm were 50.5% of that available, compared with 67 and 58.7% for the 1,280-acre and 2,240-acre farms.

Labor use by periods for the various wheat and feed grain price levels for each model farm is shown in Tables 25 through 27.

Capital

Short-term capital and credit was assumed to be ample and, thus, was not a critical factor. The annual capital requirements varied between a low of $9,863 and $24,929 on the 640-acre farm, compared with $19,660 and $41,491 for the 1,280-acre farm and $36,556 and $53,630 for the 2,240-acre farm **when corn was priced at 69 cents.** As the price of corn was increased, first to 83 cents and then to $1.10, the maximum capital decreased on all three model farms while the minimum requirements were virtually unchanged. The principal reason for this was simply that as both wheat and feed grain prices rose, farm production increasingly shifted toward cash grain and income from livestock thus became less significant.

Table 27. Resident Labor Use by Periods for the Optimum Farm Plan at Specified Wheat and Corn Prices, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Labor Periods	Corn Price per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $1.02	$1.03 to $1.05	$1.08 to $1.34	$1.36 to $1.58	$1.62 to $2.44
			Hours				
Nov. 16 to March 15	69¢	1117	816.1	718.2	474.9	433.0	309.0
March 16 to April 30	69¢	550	309.5	269.7	170.0	158.9	141.7
May 1 to July 15	69¢	1078	296.0	268.3	280.4	287.4	314.2
July 16 to Sept. 30	69¢	1121	799.1	784.9	707.0	746.6	774.6
Oct. 1 to Nov. 15	69¢	463	212.1	178.5	143.6	114.0	75.5
			Hours				
Total Annual	**69¢**	**4329**	**2432.8**	**2219.6**	**1775.9**	**1739.9**	**1615.0**

Labor Periods	Corn Price per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $1.09	$1.10 to $1.26	$1.27 to $1.35	$1.36 to $1.42	$1.61
			Hours				
Nov. 16 to March 15	83¢	1117	603.3	474.9	474.9	433.0	309.0
March 16 to April 30	83¢	550	222.3	170.0	170.0	158.9	141.7
May 1 to July 15	83¢	1078	558.6	522.3	280.4	287.4	314.2
July 16 to Sept. 30	83¢	1121	575.5	556.9	707.0	746.6	774.6
Oct. 1 to Nov. 15	83¢	463	388.8	344.8	143.6	114.0	75.5
			Hours				
Total Annual	**83¢**	**4329**	**2348.5**	**2068.9**	**1775.9**	**1739.9**	**1615.0**

Labor Periods	Corn Price per Bushel	Hours of Labor Available	Resident Labor Use at the Following Range of Wheat Prices: $ .36 to $1.24	$1.25 to $1.35	$1.36 to $1.61	$1.62 to $1.70	$1.71 to $1.89	$1.90
			Hours					
Nov. 16 to March 15	$1.10	1117	412.1	412.2	412.2	309.1	309.1	309.1
March 16 to April 30	$1.10	550	175.8	156.7	156.7	133.8	144.1	144.1
May 1 to July 15	$1.10	1078	749.8	673.6	582.0	588.9	588.9	313.9
July 16 to Sept. 30	$1.10	1121	570.1	576.1	600.8	615.3	615.3	786.0
Oct. 1 to Nov. 15	$1.10	463	389.8	349.5	316.0	285.0	285.0	56.3
			Hours					
Total Annual	**$1.10**	**4329**	**2297.6**	**2168.1**	**2067.7**	**1932.1**	**1942.4**	**1609.4**

SUMMARY

The purpose of this publication is to provide some results of a research study in which optimum farm plans were determined for 640-acre, 1,280-acre, and 2,240-acre model wheat farms in Buffalo, Hand, and Hyde Counties.

Variable price and linear programming techniques were used to determine the optimal farm plans at alternative price combinations of wheat and feed grains. Optimal farm plans were determined at three levels of corn prices from a low of 69 cents to a high of $1.10 per bushel, while wheat prices were varied from zero to $3 per bushel.

Soils Groups I-II and III, each, comprised about 34% of the cropland leaving the Group IV soils with about 32% of the cropland on each of the model farms. Both continuous small grain and continuous row crops could be grown on Soils Group I-II, but neither continuous small grain nor continuous row cropping was allowed on the Group IV soils.

Results of the programming analysis indicate net returns would be greatest with the model farms oriented toward the production of cash grain. A cattle enterprise was maintained on all three model farms, but it was largely supplementary in nature, using labor, native hay, and range which might not otherwise have been used. Cropland was used to produce grain, silage, hay, and tame pasture for the livestock enterprise. A stock-cow herd constituted the main part of the enterprise.

The main cash crops were spring and winter wheat, barley, corn, and grain sorghum, each having a different break even price, depending upon the yield ratios and production costs on the three 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 soils group.

Corn and grain sorghum were the two competing row crops. Grain sorghum due to the comparative yield and cost of production, was the more profitable crop and, thus, had a lower break even price.[4]

Grain sorghum was the most profitable crop on all three model farms when wheat was at low or medium prices. An exception to this, however, occurred on the Group I-II soils of the 1,280- and 2,240-acre model farms at a corn price of 69 cents per bushel. Grain sorghum was more profitable on the 640-acre farm and was grown until it became competitive with winter wheat. Alfalfa was more profitable than winter wheat on the 1,280- and 2,240-acre model farms. With the assumed grain and livestock prices, livestock was relatively more profitable because the costs of growing and harvesting alfalfa hay, on both larger farms, were from $4 to $5 per ton less than on the 640-acre model farm. An increase to 83 cents in corn price raised the net returns from corn and sorghum on the Group I-II soils of the two larger farms to a level at which the only two competing crops were winter wheat and grain sorghum. Grain sorghum was produced on the Group I-II soils as a cash grain until wheat reached prices of $1.25 to $1.30 per bushel on the three model farms. At these wheat prices, continuous grain sorghum shifted to summer fallow-winter wheat. As the price for corn rose to $1.10 per bushel, grain sorghum could compete for cropland at much higher wheat prices and, thus, was produced until wheat prices reached $1.87 per bushel on the 640-acre farm, $1.92 on the 1,280-acre farm, and $1.98 on the 2,240-acre farm.

Group III soils were used for production of both cash grain and alfalfa hay on all three model farms when corn and wheat prices were at relatively low levels. A crop rotation of summer fallow-winter wheat-corn-oats-alfalfa (4-years) was followed, until wheat rose to a price at which the net returns from summer fallow-winter wheat equaled or exceeded returns from the 8-year rotation. The wheat prices at which the rotation shifted to summer fallow-winter wheat varied from 84 cents on the 640-acre farm to $1.03 and $1.04 on the two larger model farms. As the corn price rose to 83 cents, the 8-year rotation became even more profitable and the wheat prices at which the rotation shifted to summer fallow-winter wheat also became higher, ranging from 89 cents on the 640-acre farm to about $1.10 on the two larger model farms. When corn reached a price of $1.10, feed grain crops became far more profitable than alfalfa and wheat at low wheat prices. Consequently, barley and corn occupied the Group III soils at the lower wheat prices, rather than the 8-year rotation. The feed grains then shifted to summer fallow-winter wheat at relatively high wheat prices, $1.69 per bushel on the 640-acre farm, $1.51 on the 1,280-acre farm, and $1.36 on the 2,240-acre farm.

Although grain sorghum was the most profitable feed grain crop on the Group III soils, barley and corn, second and third most pofitable feed grains, were selected in the farm plans. Grain sorghum did not show up in the most profitable farm plans because: (1) Neither corn nor grain sorghum could be grown on Group III soils except when included in a rotation of small grains and/or alfalfa and (2) Grain sorghum was excluded as a crop alternative in order to shorten the procedures of computer programming. If grain sorghum were more profitable than corn, it was assumed that grain sorghum would be substituted for corn. With a substitution of grain sorghum for corn, a 2-year rotation of sorghum and barley would increase net returns by $2.43 per acre on the 640-acre farm, $1.84 on the 1,280-acre farm, and $2.97 on the 2,240-acre farm with corn priced at 83 cents per bushel. Net returns were increased by about $1.60 per acre on all three model farms with an increase in corn price to $1.10 per bushel.

The substitution of grain sorghum for corn and the resultant increase in per acre returns simply means that the wheat prices at which the feed grain crops would shift to winter wheat-summer fallow would be higher than those shown in the current farm plans. The increase in wheat price needed to induce a shift to winter wheat and summer fallow, with corn at 93 cents per bushel, would be 19 cents on the 640-acre farm and only 6 cents on the two other model farms; with corn at $1.10 per bushel, wheat would have to increase an additional 61 cents on the 640-acre farm and 58 cents on the two remaining model farms.

The maximum wheat acreage allowable amounted to approximately 53% of the cropland acreage—all the Group I-II and III soils could go to summer fallow and wheat as well as 60% of the Group IV soils. The maximum production possible was as follows: 4,457 bushels on the 640-acre farm, 5,109 bush-

[4] Corn only was used in crop rotations to reduce the number of allowable alternatives and, thus, facilitate computer programming. An assumption was made that grain sorghum would substitute for corn in rotations which appeared in the farm plans, provided grain sorghum is the more profitable crop. Grain sorghum returned from $2 to $8 per acre more than did corn, depending upon the soils group on each of the model farms.

els on the 1,280-acre farm, and 5,305 bushels on the 2,240-acre model farm. About 88% of the maximum wheat production on the 640-acre farm was realized at a wheat price of $1.24 per bushel and a corn price of 69 cents. With corn priced at $1.10 per bushel only 61% of the potential wheat production was realized at a wheat price of $1.69 per bushel. This situation was typified on the other two model farms also. As the price of corn increased, wheat production decreased at the intermediate wheat prices.

Some wheat was produced at all wheat prices, but at the lower prices it was fed to livestock. Whether feed grains or wheat was fed depended upon the relative prices. A part or all of the wheat production was fed to livestock, regardless of the price of corn, at wheat prices of less than 98 cents on the 640-acre farm and $1.10 or less on the two larger model farms. In general, as corn increased in price, wheat production at the lower wheat prices decreased. Winter wheat was somewhat more profitable than spring wheat on fallow. Winter wheat had a 3.2 bushel per acre advantage on the Group III soils, but only a 2 bushel advantage on the two other soil groups. Spring wheat in a continuous cropping pattern was considerably less profitable than wheat on summer fallow and would be profitable only at very high wheat prices.

The livestock enterprise consisted mainly of raising calves to 700-pound weights, although with corn priced at $1.10 per bushel, feeder calves were sold at the higher wheat prices on all three model farms. Most of the calves were raised from stock-cow herds on the three model farms, but some calves were purchased for the 640-acre farm when wheat prices were low.

The livestock enterprise was of greater importance to the two larger model farms, particularly when wheat was relatively low-priced. Alfalfa hay could be produced at greatly reduced costs on the 1,280- and 2,240-acre model farms. As evidence of the importance of livestock when wheat prices were low, the 1,280-acre and 2,240-acre farms produced and sold only 31 to 32% of the volume of feed grain sold from the 640-acre farm. Yet the net returns from the 1,280-acre farm were 55% greater and those of the 2,240-acre farm were 109% greater.

Total annual labor needs were neither crucial nor limiting, as total labor was in surplus. The labor available during the planting and harvesting seasons was also in surplus. The minimum annual labor requirements varied from 25.3% of that available on the 640-acre farm to 32.2% on the 2,240-acre farm, while the maximum labor utilization varied from 45.5% on the 640-acre farm to 56.2% on the 2,240-acre farm.

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, it cannot be construed as being representative of all 640-acre, 1,280-acre, and 2,240-acre farms or a specific farm in this three-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 plans under a similar cost and price structure.

APPENDIX

Appendix Table 1. Crops and Crop Rotations Allowed as Activities by Soils Group, Buffalo, Hand, and Hyde Counties

Rotation	Soils Groups I & II	III	IV
Corn	X		
Sorghum	X		
Oats—Alfalfa (3 years)	X		
Corn—Corn—Oats—Oats—Alfalfa (3 years)	X		
Spring Wheat	X	X	
Barley	X	X	
Oats	X	X	
Corn—Spring Wheat	X	X	
Corn—Barley	X	X	
Corn—Oats	X	X	
Summer Fallow—Spring Wheat	X	X	
Summer Fallow—Winter Wheat	X	X	
Corn—Barley—Corn—Oats—Alfalfa (2 years)	X	X	
Corn—Spring Wheat—Corn—Oats—Alfalfa (2 years)	X	X	
Summer Fallow—Spring Wheat—Spring Wheat—Corn	X	X	
Summer Fallow—Winter Wheat—Spring Wheat—Corn	X	X	
Summer Fallow—Winter Wheat—Corn		X	
Summer Fallow—Winter Wheat—Corn—Oats—Alfalfa (4 years)		X	X
Summer Fallow—Spring Wheat—Corn—Oats—Alfalfa (3 years)		X	X
Summer Fallow—Winter Wheat—Corn—Oats—Alfalfa (3 years)		X	X
Summer Fallow—Spring Wheat—Spring Wheat—Barley—Oats			X
Summer Fallow—Spring Wheat—Barley—Barley—Oats			X
Summer Fallow—Winter Wheat—Barley—Oats			X
Summer Fallow—Winter Wheat—Spring Wheat—Spring Wheat—Barley			X
Grass			X

Appendix Table 2. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices: $ .36 to $ .64	$ .84 to $ .92	$ .93 to $1.01	$1.16 to $1.21	$1.23 to $1.26	$1.27 to $1.83
Soil Group I-II						
Sorghum	133.0	133.0	17.8			
Summer Fallow			57.6	66.5	66.5	66.5
Winter Wheat			57.6	66.5	66.5	66.5
Total Acres	**133.0**	**133.0**	**133.0**	**133.0**	**133.0**	**133.0**
Soil Group III						
Corn	16.5					
Oats	16.5					
Alfalfa	66.0					
Summer Fallow	16.5	66.0	66.0	66.0	66.0	66.0
Winter Wheat	16.5	66.0	66.0	66.0	66.0	66.0
Total Acres	**132.0**	**132.0**	**132.0**	**132.0**	**132.0**	**132.0**
Soil Group IV						
Grass	125.0	125.0	125.0	81.8	58.1	
Oats				5.4		
Alfalfa				21.6		
Corn				5.4		
Summer Fallow				5.4	13.4	25.0
Winter Wheat				5.4	13.3	25.0
Spring Wheat					26.8	50.0
Barley					13.4	25.0
Total Acres	**125.0**	**125.0**	**125.0**	**125.0**	**125.0**	**125.0**

Appendix Table 3. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices: $ .36 to $ .87	$ .89 to $ .90	$ .91 to $1.00	$1.01 to $1.20	$1.25 to $1.26	$1.29
Soil Group I-II						
Sorghum	133.0	133.0	133.0	133.0	2.5	
Summer Fallow					65.3	66.5
Winter Wheat					65.3	66.5
Total Acres	**133.0**	**133.0**	**133.0**	**133.0**	**133.0**	**133.0**
Soil Group III						
Barley	44.5					
Corn	10.9	8.3				
Oats	10.9	8.3				
Alfalfa	43.7	33.1				
Summer Fallow	10.9	41.2	66.0	66.0	66.0	66.0
Winter Wheat	10.9	41.2	66.0	66.0	66.0	66.0
Total Acres	**131.8**	**132.1**	**132.0**	**132.0**	**132.0**	**132.0**
Soil Group IV						
Grass	125.0	125.0	90.1			
Corn			4.4	15.6	12.4	
Oats			4.4	15.6	18.9	
Alfalfa			17.4	62.5	49.4	
Summer Fallow			4.4	15.6	18.9	25.0
Winter Wheat			4.4	15.6	18.9	25.0
Barley					6.5	25.0
Spring Wheat						50.0
Total Acres	**125.0**	**125.0**	**125.1**	**124.9**	**125.0**	**125.0**

Appendix Table 4. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices					
	$ .36 to $ .59	$ .90 to $ .98	$1.23 to $1.30	$1.47 to $1.58	$1.69 to $1.86	$1.87 to $2.01
Soil Group I-II						
Sorghum	133.0	133.0	133.0	133.0	133.0	
Summer Fallow						66.5
Winter Wheat						66.5
Total Acres	**133.0**	**133.0**	**133.0**	**133.0**	**133.0**	**133.0**
Soil Group III						
Barley	132.0	132.0	132.0	132.0		
Summer Fallow					66.0	66.0
Winter Wheat					66.0	66.0
Total Acres	**132.0**	**132.0**	**132.0**	**132.0**	**132.0**	**132.0**
Soil Group IV						
Grass	23.3					
Corn	12.7	11.7				
Alfalfa	50.8	46.7				
Oats	12.7	18.0	31.3	31.3		
Summer Fallow	12.7	18.0	31.3	31.3	25.0	25.0
Winter Wheat	12.7	11.7	31.3	31.3	25.0	25.0
Barley		12.6	31.3	31.3	25.0	25.0
Spring Wheat		6.3			50.0	50.0
Total Acres	**124.9**	**125.0**	**125.2**	**125.2**	**125.0**	**125.0**

Appendix Table 5. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices					
	$ .36 to $1.03	$1.04 to $1.05	$1.068	$1.07 to $1.29	$1.293 to $1.47	$1.50
Soil Group I-II						
Oats	38.0	38.0	13.5			
Alfalfa	114.0	114.0	40.4			
Sorghum			8.3	12.7		
Summer Fallow			45.0	69.6	76.0	76.0
Winter Wheat			45.0	69.6	76.0	76.0
Total Acres	**152.0**	**152.0**	**152.2**	**151.9**	**152.0**	**152.0**
Soil Group III						
Corn	19.0					
Oats	19.0					
Alfalfa	76.0					
Summer Fallow	19.0	76.0	76.0	76.0	76.0	76.0
Winter Wheat	19.0	76.0	76.0	76.0	76.0	76.0
Total Acres	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**
Soil Group IV						
Grass	143.0	143.0	143.0	143.0	81.1	
Corn					7.7	
Oats					7.7	
Alfalfa					30.9	
Summer Fallow					7.7	28.6
Winter Wheat					7.7	28.6
Barley						28.6
Spring Wheat						57.2
Total Acres	**143.0**	**143.0**	**143.0**	**143.0**	**142.8**	**143.0**

Appendix Table 6. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices					
	$ .36 to $ .91	$ .93 to $1.10	$1.11 to $1.28	$1.30 to $1.286	$1.31 to $1.296	$1.50
Soil Group I-II						
Sorghum	152.0	152.0	152.0	152.0	5.3	
Summer Fallow					73.4	76.0
Winter Wheat					73.4	76.0
Total Acres	**152.0**	**152.0**	**152.0**	**152.0**	**152.1**	**152.0**
Soil Group III						
Corn	19.0	19.0				
Oats	19.0	19.0				
Alfalfa	76.0	76.0				
Summer Fallow	19.0	19.0	76.0	76.0	76.0	76.0
Winter Wheat	19.0	19.0	76.0	76.0	76.0	76.0
Total Acres	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**
Soil Group IV						
Grass	143.0	143.0	143.0			
Corn				17.9	17.9	
Oats				17.9	17.9	
Alfalfa				71.5	71.5	
Summer Fallow				17.9	17.9	28.6
Winter Wheat				17.9	17.9	28.6
Barley						28.6
Spring Wheat						57.2
Total Acres	**143.0**	**143.0**	**143.0**	**143.1**	**143.1**	**143.0**

Appendix Table 7. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices					
	$ .36 to $ .81	$ .82 to $1.00	$1.24 to $1.33	$1.51 to $1.66	$1.67 to $1.91	$1.92
Soil Group I-II						
Sorghum	152.0	152.0	152.0	152.0	152.0	
Summer Fallow						76.0
Winter Wheat						76.0
Total Acres	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**
Soil Group III						
Barley	82.0	82.8	68.8			
Corn	70.0	69.2	73.6			
Summer Fallow			4.8	76.0	76.0	76.0
Winter Wheat			4.8	76.0	76.0	76.0
Total Acres	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**	**152.0**
Soil Group IV						
Grass	47.9					
Corn	11.9	17.9	17.9			
Oats	11.9	17.9	17.9	35.7		
Alfalfa	47.5	71.5	71.5			
Summer Fallow	11.9	17.9	17.9	35.7	28.6	28.6
Winter Wheat	11.9	17.9	17.9	35.7	28.6	28.6
Barley				35.7	28.6	28.6
Spring Wheat					57.2	57.2
Total Acres	**143.0**	**143.1**	**143.1**	**142.8**	**143.0**	**143.0**

Appendix Table 8. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices: $ .36 to $1.02	$1.03 to $1.05	$1.08 to $1.34	$1.36 to $1.58	$1.62 to $2.44
Soil Group I-II					
Oats	39.5	39.5			
Alfalfa	118.5	118.5			
Sorghum			19.0		
Summer Fallow			69.5	79.0	79.0
Wheat			69.5	79.0	79.0
Total Acres	**158.0**	**158.0**	**158.0**	**158.0**	**158.0**
Soil Group III					
Corn	19.8	4.7			
Oats	19.8	4.7			
Alfalfa	79.0	18.8			
Summer Fallow	19.8	64.9	79.0	79.0	79.0
Wheat	19.8	64.9	79.0	79.0	79.0
Total Acres	**158.2**	**158.0**	**158.0**	**158.0**	**158.0**
Soil Group IV					
Corn				12.3	
Grass	148.0	148.0	148.0	49.3	
Barley					29.6
Summer Fallow				12.3	29.6
Wheat				12.3	88.8
Oats				12.3	
Alfalfa (4 years)				49.3	
Total Acres	**148.0**	**148.0**	**148.0**	**147.8**	**148.0**

Appendix Table 9. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices: $ .36 to $1.09	$1.10 to $1.26	$1.27 to $1.35	$1.36 to $1.42	$1.61
Soil Group I-II					
Sorghum	158.0	158.0	19.0		
Summer Fallow			69.5	79.0	79.0
Wheat			69.5	79.0	79.0
Total Acres	**158.0**	**158.0**	**158.0**	**158.0**	**158.0**
Soil Group III					
Corn	19.8				
Oats	19.8				
Alfalfa	79.0				
Summer Fallow	19.8	79.0	79.0	79.0	79.0
Wheat	19.8	79.0	79.0	79.0	79.0
Total Acres	**158.2**	**158.0**	**158.0**	**158.0**	**158.0**
Soil Group IV					
Corn				12.3	
Grass	148.0	148.0	148.0	49.3	
Barley					29.6
Summer Fallow				12.3	29.6
Wheat				12.3	88.8
Oats				12.3	
Alfalfa (4 years)				49.3	
Total Acres	**148.0**	**148.0**	**148.0**	**147.8**	**148.0**

Appendix Table 10. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop	Crop Acres at the Following Wheat Prices: $ .36 to $1.24	$1.25 to $1.35	$1.36 to $1.61	$1.62 to $1.70	$1.71 to $1.89	$1.90
Soil Group I-II						
Sorghum	158.0	158.0	158.0	158.0	158.0	
Summer Fallow						79.0
Wheat						79.0
Total Acres	**158.0**	**158.0**	**158.0**	**158.0**	**158.0**	**158.0**
Soil Group III						
Corn	79.0	52.7				
Barley	79.0					
Summer Fallow		52.7	79.0	79.0	79.0	79.0
Wheat		52.7	79.0	79.0	79.0	79.0
Total Acres	**158.0**	**158.1**	**158.0**	**158.0**	**158.0**	**158.0**
Soil Group IV						
Corn	18.5	18.5	18.5			
Oats	18.5	18.5	18.5	37.0		
Alfalfa	74.0	74.0	74.0			
Summer Fallow	18.5	18.5	18.5	37.0	29.6	29.6
Wheat	18.5	18.5	18.5	37.0	88.8	88.8
Barley				37.0	29.6	29.6
Total Acres	**148.0**	**148.0**	**148.0**	**148.0**	**148.0**	**148.0**

Appendix Table 11. Crop Rotations on all Soil Groups at Specified Wheat and Corn Prices, 640-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel: $ .36 to $ .64	$ .84 to $ .92	$ .93 to $1.01	$1.16 to $1.21	$1.23 to $1.26	$1.27 to $1.83
		Acres					
Summer Fallow, Winter Wheat, Corn Oats, Alfalfa (4 years)	69¢	132.0			43.2		
Sorghum	69¢	133.0	133.0	17.8			
Grass	69¢	125.0	125.0	125.0	81.8	58.1	
Summer Fallow, Winter Wheat	69¢		132.0	247.2	265.0	265.0	265.0
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley	69¢					66.9	125.0

		Range of Wheat Prices per Bushel: $ .36 to $ .87	$ .89 to $ .90	$ .91 to $1.00	$1.01 to $1.20	$1.25 to $1.26	$1.29
		Acres					
Barley	83¢	44.5					
Grass	83¢	125.0	125.0	90.1			
Sorghum	83¢	133.0	133.0	133.0	133.0	2.5	
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	83¢	87.5	66.2	34.9	125.0	98.8	
Summer Fallow, Winter Wheat	83¢		65.8	132.0	132.0	262.5	265.0
Summer Fallow, Winter Wheat, Barley, Oats	83¢					26.2	
Summer Fallow, Winter Wheat, Spring Wheat Spring Wheat, Barley	83¢						125.0

		Range of Wheat Prices per Bushel: $ .36 to $ .59	$ .90 to $ .98	$1.23 to $1.30	$1.47 to $1.58	$1.69 to $1.86	$1.87 to $2.01
		Acres					
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	$1.10	101.7	93.5				
Grass	$1.10	23.3					
Barley	$1.10	132.0	132.0	132.0	132.0		
Sorghum	$1.10	133.0	133.0	133.0	133.0	133.0	
Summer Fallow, Spring Wheat, Barley, Barley, Oats	$1.10		31.5				
Summer Fallow, Winter Wheat, Barley, Oats	$1.10			125.0	125.0		
Summer Fallow, Winter Wheat	$1.10					132.0	265.0
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley	$1.10					125.0	125.0

Appendix Table 12. Crop Rotations on All Soil Groups at Specified Wheat and Corn Prices, 1,280-Acre Model Farm, Buffalo, Hand, and Hyde Counties

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel: $ .36 to $1.03	$1.04 to $1.05	$1.06	$1.07 to $1.29	$1.293 to $1.47	$1.50
				Acres			
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	69¢	152.0				61.9	
Oats, Alfalfa (3 years)	69¢	152.0	152.0	53.8			
Grass	69¢	143.0	143.0	143.0	143.0	81.1	
Summer Fallow, Winter Wheat	69¢		152.0	241.9	291.3	304.0	304.0
Sorghum	69¢			8.3	12.7		
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley	69¢						143.0

		Range of Wheat Prices per Bushel: $ .36 to $ .91	$ .93 to $1.10	$1.11 to $1.28	$1.30 to $1.286	$1.31 to $1.296	$1.50
				Acres			
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	83¢	152.0	152.0		143.0	143.0	
Grass	83¢	143.0	143.0	143.0			
Sorghum	83¢	152.0	152.0	152.0	152.0	5.3	
Summer Fallow, Winter Wheat	83¢			152.0	152.0	298.7	304.0
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley	83¢						143.0

		Range of Wheat Prices per Bushel: $ .36 to $ .81	$ .82 to $1.00	$1.24 to $1.33	$1.51 to $1.66	$1.67 to $1.91	$1.92
				Acres			
Grass	$1.10	47.9					
Summer Fallow, Winter Wheat, Corn, Oats, Alfalfa (4 years)	$1.10	95.1	143.0	143.0			
Barley	$1.10	12.1	13.7				
Corn, Barley	$1.10	139.9	138.3	137.7			
Sorghum	$1.10	152.0	152.0	152.0	152.0	152.0	
Summer Fallow, Winter Wheat, Corn	$1.10			14.4			
Summer Fallow, Winter Wheat, Barley, Oats	$1.10				143.0		
Summer Fallow, Winter Wheat	$1.10				152.0	152.0	304.0
Summer Fallow, Winter Wheat, Spring Wheat, Spring Wheat, Barley	$1.10					143.0	143.0

Table 13. Crop Rotations on All Soil Groups at Specified Wheat and Corn Prices, 2,240-Acre Model Farm, Buffalo, Hand, and Hyde Counties.

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel: $ .36 to $1.02	$1.03 to $1.05	$1.08 to $1.34	$1.36 to $1.58	$1.62 to $2.44
		Acres				
Oats, Alfalfa (3 years)	69¢	158.0	158.0			
Summer Fallow, Wheat, Corn, Oats, Alfalfa (4 years)	69¢	158.0	37.5		98.7	
Grass	69¢	148.0	148.0	148.0	49.3	
Sorghum	69¢			19.0		
Summer Fallow, Wheat	69¢		120.5	297.0	316.0	316.0
Summer Fallow, Wheat, Wheat, Wheat, Barley	69¢					148.0

		Range of Wheat Prices per Bushel: $ .36 to $1.09	$1.098 to $1.26	$1.27 to $1.35	$1.36 to $1.42	$1.61
		Acres				
Sorghum	83¢	158.0	158.0	19.0		
Grass	83¢	148.0	148.0	148.0	49.3	
Summer Fallow, Wheat, Corn, Oats, Alfalfa (4 years)	83¢	158.0			98.7	
Summer Fallow, Wheat	83¢		158.0	297.0	316.0	316.0
Summer Fallow, Wheat, Wheat, Wheat, Barley	83¢					148.0

		Range of Wheat Prices per Bushel: $ .36 to $1.24	$1.25 to $1.35	$1.36 to $1.61	$1.62 to $1.70	$1.71 to $1.89	$1.90
		Acres					
Summer Fallow, Wheat, Corn	$1.10		158.0				
Corn, Barley	$1.10	158.0					
Summer Fallow, Wheat, Corn, Oats, Alfalfa (4 years)	$1.10	148.0	148.0	148.0			
Sorghum	$1.10	158.0	158.0	158.0	158.0	158.0	
Summer Fallow, Wheat	$1.10			158.0	158.0	158.0	316.0
Summer Fallow, Wheat, Wheat, Wheat, Barley	$1.10					148.0	148.0
Summer Fallow, Wheat, Barley, Oats	$1.10				148.0		