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# Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Cetnral South Dakota: Brown and Spink Counties

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*Brown and Spink Counties*

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


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## PREFACE

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

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

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

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

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 enterprises, labor use, and labor availability.

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

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

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

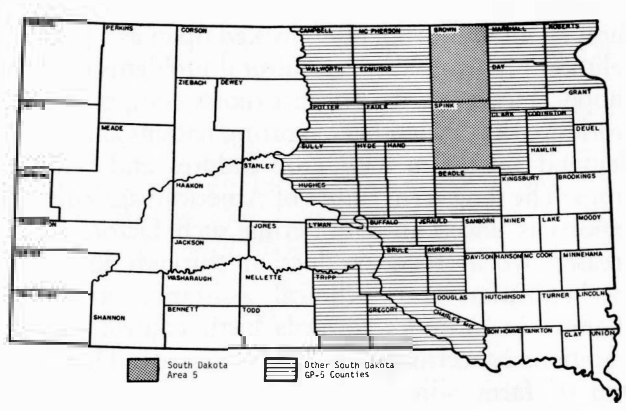


Figure 1. South Dakota GP-5 Study Area.

# Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Central South Dakota, Brown and Spink Counties

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

## INTRODUCTION

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

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

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

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

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

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

## TYPE OF AGRICULTURE IN AREA

The average farm size in Brown County was 764 acres, compared to 803 acres in Spink County, according to the 1964 census. There were 2,569 farms in the two counties in 1964, of which 29.5% were classified as cash grain, 47.8% were livestock, and 9.5% were general farms. The remaining 13.2% were poultry, dairy and miscellaneous farms.

Farms in Brown and Spink Counties were fairly well diversified, with cash grains, feed grains and livestock; however, wheat remained the most important crop. Other crops grown strictly as cash crops were flax and rye (accounting for about 7% of the harvested acreage). In addition to the cash crops, substantial amounts of corn grains, oats, and barley were sold.

About 72% of the corn harvested was picked for grain, and nearly 46% of the corn grain was sold in 1964. Almost 48% of the oats and 69% of the barley harvested were sold off the farm. The remaining feed grains were fed to livestock on the farm.

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

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

Table 1. Number and Percent of Farms That Raised and Harvested Major Grain Crops in 1964 in Brown and Spink Counties

| Crop | Number of farms | Percentage of farms | Acres Harvested | |
|---|---|---|---|---|
| | | | Number | Percent |
| Corn* | 1,950 | 75.9 | 238,123 | 28.0 |
| All Wheat † | 2,112 | 82.2 | 324,321 | 38.1 |
| Oats | 1,869 | 72.8 | 154,961 | 18.2 |
| Barley | 714 | 27.8 | 46,762 | 5.5 |
| Flax | 543 | 21.1 | 35,442 | 4.2 |
| Rye | 435 | 16.9 | 25,140 | 2.9 |
| Other‡ | — | — | 26,803 | 3.1 |

*Includes corn harvested for grain, silage and other purposes.
†Includes 5,728 acres of winter wheat and 19,044 acres of durum.
‡Includes proso, emmer and speltz, soybeans and sorghum.
Source: U. S. Census of Agriculture, 1964.

Livestock was very important in the Brown and Spink County area. Some type of livestock enterprise was found on about 95% of the farms, either for home consumption or commercial production. Beef cow herds, kept on about 80% of the farms, ranged between 30 and 75 cows. Some of the area's farmers also engaged in cattle or calf feeding enterprises.

Milk cows, kept on less than a third of the farms, averaged about 8 cows per farm. Many of the milk cows were kept for home consumption. Farms selling cream outnumered those selling whole milk more than 2 to 1.

Although only 1 in 3 farms kept sows to farrow in 1964, hog production was important in this area. Sows farrowed or to be farrowed averaged 20 per farm. Records show spring litters usually outnumered fall litters by 2 to 1.

Ewe flocks were maintained by slightly less than than a third of the farms in the area, although the average number in the flock was slightly larger than flocks in some of the other areas. The average flock consisted of 66 ewes in 1964.

## MODEL WHEAT FARM

### Description

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

The model farm size selected in Brown and Spink Counties was 640 acres, which consisted of 448 acres of cropland, 159 acres of native hay and pasture, and 33 acres of farmstead, roads, and wasteland. The size of model farm chosen does not represent an arithmetic average—rather it is intended to represent one size of wheat farm which will exist in the 1970's. Although farms are becoming larger, there is a relatively large percentage of farms with fewer than 640 acres. Many of these farms will survive and will be enlarged by land rental or purchase. The nature of farm adjustment and farm organization should not differ significantly for farms larger than 640 acres, provided the ratios of farmland, cropland, labor, and capital resources are about the same as for the 640-acre farm.

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

| Crop | Acres |
|---|---|
| Spring Wheat | 95 |
| Oats, Barley, Flax | 129 |
| Corn Grain | 73 |
| Corn Silage | 33 |
| Summer Fallow | 43 |
| Alfalfa | 68 |
| Other Tame Hay nad Pasture | 7 |
| Native Hay | 53 |
| Native Pasture | 106 |

### Soils

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

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

The Chernozem soils of the Hecla-Ulen association are nearly level to hummocky and somewhat excessively to moderately well drained. These grayish-brown soils, which developed from sandy fluvial-eolian materials, are slightly acid sandy loams. The Hecla-Ulen soils are low in organic matter, subject to wind erosion and to seasonal ponding and drainage

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

Table 2. Crop Yields per Planted Acre by Soils Groups, Average Management Area 5: Brown and Spink Counties

| Crop and Rotation | GROUP I & II SOILS—80.0% Projected Yield Bushels | Fertilizer* N Pounds | Fertilizer* $P_2O_5$ Pounds | Weed Spray Dollars | GROUP III & IV SOILS—20.0% Projected Yield Bushels | Fertilizer* N Pounds | Fertilizer* $P_2O_5$ Pounds | Weed Spray Dollars |
|---|---|---|---|---|---|---|---|---|
| Spring Wheat-Fallow | 21.1 | — | 14.0 | .41 | 19.2 | — | 13.0 | .41 |
| Spring Wheat-After Corn | 19.3 | 21.5 | 13.0 | .41 | 17.6 | 20.0 | 11.5 | .41 |
| Spring Wheat- After Small Grain | 15.7 | 18.0 | 10.5 | .41 | 14.3 | 16.0 | 10.0 | .41 |
| Oats-Continuous Crop | 40.1 | 18.0 | 14.0 | .12 | 36.5 | 16.0 | 13.0 | .12 |
| Barley-Continuous Crop | 28.2 | 18.5 | 13.5 | .34 | 24.7 | 16.0 | 10.5 | .34 |
| Rye-Continuous Crop | 18.7 | 11.0 | 11.5 | — | 16.8 | 10.0 | 11.0 | — |
| Flax-After Alfalfa or Row Crop | 12.6 | — | 11.0 | .20 | 10.4 | — | 9.0 | .20 |
| Corn-Grain After Small Grain | 29.4 | 30.0 | 9.5 | 3.00 | 26.5 | 27.5 | 9.0 | 3.00 |
| Corn-Silage After Small Grain | 5.75† | 33.0 | 10.5 | 3.00 | 5.20 | 30.0 | 10.0 | 3.00 |
| Alfalfa | 1.68† | — | — | — | 1.46 | — | — | — |
| Native Hay | 1.33 | — | — | — | — | — | — | — |

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

problems in low areas due to slow permeability. The major soil uses are livestock and general farming.

Each soil series and soil type, within the soil associations found in the two-county area, was classified in one of four groups on the basis of: (1) land use, (2) topography, (3) potential soil hazards and problems, and (4) management practices needed. Yield projections were developed under assumptions of normal weather conditions, recommended fertilizer usage, and specific management and rotation practices recommended for the productive capability of the soils. In cases where the soils of a particular group 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. For the Brown and Spink County area, soils groups I and II were combined, as were soils groups III and IV. The yield projections and fertilization rates, by crop, for each of the combined soils groups are shown in Table 2.

A total of 24 crop rotations or sequences, including continuous small grain, were selected for the two soils groups—14 rotations for soil Group I-II and 10 for soil Group III-IV (Appendix Table 1). These rotations, chosen from a wide range of alternatives, were within the requirements of the various soils within each group. For the model farm, the cropland designated as soil Group I-II amounted to 358 acres, and 90 acres were classified as Group III-IV soils.

## Crop Alternatives

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

Flax and rye were grown strictly as cash crops, while corn-grain, spring wheat, oats, and barley could either be used as livestock feed or sold off the farm. The corn silage and alfalfa, which may be produced on these farms, could be used only as feed for livestock on the farm, since sale of those crops was not allowed as an alternative. Native hay and pasture could either be used by the farm operator for cattle or left unused.

A cost summary of the crop enterprise budgets considered is shown in Table 3. Costs included in the budgets were: seed, fertilizer and spray materials, all fixed and variable machine costs, custom harvest

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

| Crop | Total Man Hours† | Costs Per Acre for Soil Group I-II | Costs Per Acre for Soil Group III-IV |
|---|---|---|---|
| | | Dollars | |
| Summer Fallow | 1.54 | 4.23 | 4.23 |
| Spring Wheat Following Fallow | 1.58 | 8.23 | 8.13 |
| Spring Wheat Following Corn | 1.94 | 12.71 | 12.41 |
| Spring Wheat Following Small Grain | 1.90 | 11.65 | 11.37 |
| Oats | 2.23 | 12.41 | 12.32 |
| Barley | 2.23 | 12.61 | 12.06 |
| Flax Following Row Crop | 1.94 | 10.08 | 9.89 |
| Rye | 2.11 | 13.48 | 13.31 |
| Flax Following Alfalfa | 2.72 | 10.08 | 9.89 |
| Corn Grain | 2.78 | 23.01 | 22.61 |
| Corn Silage | 3.82 | 31.38 | 30.73 |
| Alfalfa (2 cuttings—1 baled) | 2.22 | 15.18 | 14.88 |
| Native Hay, loose | .95 | 4.06 | 4.06 |

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

costs for corn grain and silage, crop hauling to storage, and interest on operating capital—an interest charge on land was not included.

### Livestock Alternatives

The livestock activities allowed included: (1) a cow-calf operation producing 430 lb. calves, (2) wintering and summer grazing calves produced on the farm for sale as 700 lb. stockers or feeders, and (3) buying 430 lb. calves for the wintering and grazing enterprise. Fattening activities such as cattle feeding or raising hogs were excluded as enterprise alternatives; these livestock activities are not primarily land based and are somewhat independent of wheat production.

Stocker feeding systems which were allowed as alternatives included: (1) a stocker ration with corn-silage and (2) a stocker ration without corn-silage. A summary of budget items for the cow-calf and stocker calf enterprises is shown in Table 4.

### Prices Received

Optimal farm plans were determined for various combinations of crop and livestock product prices. The market prices were held constant for flax at $2.35 per bushel, rye at 80 cents per bushel, feeder calves at $25.28 cwt., and 700 lb. stockers and feeders at $23.08 cwt. Wheat prices were varied from 36 cents to $3.30 per bushel at corn price levels of 71 cents, 85 cents, and $1.12 per bushel. Oat and barley prices were converted to a corn equivalent value based on feed value.

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

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

| Item | Cow-calf herd | Stocker Calves Wintered and Grazed with silage | Stocker Calves Wintered and Grazed without silage |
|---|---|---|---|
| Percent Calf Crop | 92% | | |
| Purchase Weight | | 430 lbs. | 430 lbs. |
| Sales Weight | 430 lbs. | 700 lbs. | 700 lbs. |
| Purchase Cost | | $108.70 | $108.70 |
| Pasture | 6.5 aum. | 3.25 aum. | 3.25 aum. |
| Hay Equivalent | 2.60 ton | .40 ton | .64 ton |
| Corn Silage | | 1.20 ton | |
| Corn Grain Equivalent | 2.70 cwt. | | 3.60 cwt |
| Variable Cash Costs* | $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.

### Labor

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

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

The resident labor used for livestock and field crops could not exceed the number of hours alloted to each period:

| Time Period | Hours |
|---|---|
| November 16 to March 15 | 982 |
| March 16 to April 30 | 570 |
| May 1 to July 15 | 956 |
| July 16 to September 30 | 983 |
| October 1 to November 15 | 377 |

Labor could be hired in any or all periods but was restricted to the average amounts used on sample farms. The hired labor wage rate 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, and product prices. This method of analysis was used to determine wheat and feed grain production which would maximize net income at various price combinations. Because linear programming solutions were obtained for a wide range of wheat prices, a large number of optimum farm plans resulted. Many of the optimal plans indicated insignificant changes in production or net income.

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

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

**Table 5. Crop and Livestock Production, Labor, Capital, and Net Returns for the Optimum Farm Plans at Various Levels of Wheat Prices and 71 Cents per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| | Price of Wheat | | | | |
|---|---|---|---|---|---|
| Item | $.36 to $.60 | $.92 to $1.07 | $1.57 to $1.60 | $1.61 to $1.94 | $2.22 to $2.67 |
| **Crops (in acres):** | | | | | |
| Spring Wheat | 105 | 100 | 284 | 373 | 393 |
| Flax | 105 | 109 | 45 | 15 | * |
| Corn | 15 | 24 | 15 | 15 | * |
| Barley | — | — | — | — | 18 |
| Oats | — | — | — | — | 18 |
| Summer Fallow | — | — | — | — | 17 |
| Tame Hay or Pasture | 223 | 215 | 104 | 45 | 1 |
| **Crop Production (in bushels):** | | | | | |
| Spring Wheat | 1,859† | 1,779 | 4,146 | 5,274 | 5,579 |
| Flax | 2,581 | 2,701 | 946 | 141 | 4 |
| Feed Grain (corn equivalent) | 396 | 656 | 396 | 396 | 613 |
| Corn Silage (in tons) | — | — | — | — | 2 |
| Tame Hay | 117 | 173 | 90 | 46 | 2 |
| Native Hay | 36 | 36 | 36 | 36 | 36 |
| **Livestock (head):** | | | | | |
| Beef Cows | — | 68 | 41 | 27 | — |
| Stockers Sold‡ | 239 | 52 | 31 | 20 | 60 |
| Total Labor Use (hours) | 2,096 | 2,091 | 1,700 | 1,495 | 1,352 |
| Total Capital Used | $51,382 | $42,654 | $29,688 | $22,926 | $20,448 |
| Net Returns§ | $ 4,200 | $ 4,759 | $ 5,917 | $ 6,068 | $ 9,330 |

*Less than 1 acre.
†The amout of wheat fed to livestock was 1,363 bushels.
‡Includes calves raised and purchased.
§The net returns are for the lower wheat price and include returns to land and the operator's labor and management.

## Farm Plans With Corn Priced at 71 Cents

With feed grain prices at the low level of 71 cents per bushel corn equivalent, results of the programming analysis indicate that optimal organizations and the general type of operation for the model farm would change substantially with changes in wheat prices. With wheat prices at the lowest levels (36 cents to 60 cents per bushel), net returns were greatest with a stocker calf enterprise as the major source of income and flax as the major cash crop. Only small amounts of feed grains and wheat were sold, and all livestock grain requirements were provided by wheat. As wheat prices rose to $2.22 per bushel and above, the farm became primarily a cash grain farm with stocker calves as a supplementary enterprise to utilize available labor, hay, and native pasture.

With the prices of flax and yearling feeder cattle held constant at $2.22/bu. and $23.08/cwt., respectively, the stocker calf enterprise and flax production are the two most profitable enterprises with wheat prices in the lowest range (36 cents to 60 cents per bushel). The relatively high profitability of the stocker calf enterprise causes tame hay production to also become relatively profitable. Thus, the most profitable cropping system include rotations which maximized alfalfa and flax production while providing the feed grain requirements for the stocker enterprise. These rotations include wheat and corn at levels somewhat in excess of total feed grain requirements for the calves that could be carried with the forage produced. Based upon the price of corn, the corn equivalent value of wheat as a feed grain was approximately 80 cents per bushel (1.12 times $.71), 20 cents above the highest cash wheat price in the range. As a result, wheat was utilized as a feed for the total livestock feed grain requirement (approximately 73% of total wheat production). All corn produced and the remainder of the wheat were sold as cash grain.

As wheat increased to 92 cents, the cash price was above its value as a feed grain (based on the price of corn) and all wheat was sold. However, wheat continued to be a less profitable crop than flax and wheat acreage and production declined somewhat, with the acreage of flax increasing by a like amount. The number of stockers was reduced by approximately 78%, since it was no longer profitable to utilize wheat as a feed grain for the stocker calf enterprise. All calves for the stocker enterprise were produced by a beef cow herd, rather than being purchased. The livestock system consisting of a beef cow-calf herd and stocker calves required proportionately more roughage in relation to grain in the ration, than the system including only the stocker calf enterprise; therefore, tame hay and pasture acreage declined by only 4%. Corn production was increased by nearly 66% to supply the feed grain requirements for cattle.

**Table 6. Crop and Livestock Production, Labor, Capital and Net Returns for the Optimum Farm Plans at Various Levels of Wheat Prices and 85 Cents per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| | Price of Wheat | | | | | |
|---|---|---|---|---|---|---|
| Item | $.36 to $.94 | $.95 to $1.01 | $1.17 to $1.56 | $1.57 to $1.58 | $1.80 to $2.27 | $2.28 to $2.75 |
| **Crops (in acres):** | | | | | | |
| Spring Wheat | 15 | 15 | 100 | 284 | 384 | 393 |
| Flax | 194 | 194 | 109 | 45 | 7 | * |
| Corn | 194 | 194 | 24 | 15 | 7 | * |
| Barley | — | — | — | — | 10 | 18 |
| Oats | — | — | — | — | 10 | 18 |
| Summer Fallow | — | — | — | — | 10 | 17 |
| Tame Hay or Pasture | 45 | 45 | 215 | 104 | 20 | 10 |
| **Crop Production (in bushels):** | | | | | | |
| Spring Wheat | 244† | 244 | 1,779 | 4,146 | 5,442 | 5,578 |
| Flax | 5,021 | 5,021 | 2,701 | 946 | 66 | 4 |
| Feed Grain (corn equivalent) | 5,659 | 5,659 | 656 | 396 | 521 | 623 |
| Tame Hay (in tons) | 45 | 46 | 173 | 90 | 31 | 2 |
| Native Hay | 36 | 36 | 36 | 36 | 36 | 36 |
| **Livestock (head):** | | | | | | |
| Beef Cows | 25 | 27 | 68 | 41 | 22 | — |
| Stockers Sold‡ | 24 | 20 | 52 | 31 | 16 | 60 |
| Total Labor Use (hours) | 1,622 | 1,622 | 2,091 | 1,700 | 1,419 | 1,352 |
| Total Capital Used | $28,211 | $28,067 | $42,654 | $29,688 | $20,458 | $20,443 |
| Net Returns§ | $ 4,908 | $ 4,913 | $ 5,195 | $ 5,917 | $ 7,114 | $ 9,702 |

*Less than 1 acre.
†Wheat fed to livestock.
‡Includes calves raised and purchased.
§The net returns are for the lower wheat price and include returns to land and the operator's labor and management.

**Table 7. Crop and Livestock Production, Labor, Capital, and Net Returns for the Optimum Farm Plans at Various Levels of Wheat Prices and $1.12 per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| | Price of Wheat | | | | | |
|---|---|---|---|---|---|---|
| Item | $.36 to $1.03 | $1.25 to $1.58 | $1.61 to $1.70 | $1.71 to $1.82 | $1.83 to $2.41 | $2.94 to $3.30 |
| **Crops (in acres):** | | | | | | |
| Spring Wheat | 12 | 15 | 195 | 205 | 384 | 393 |
| Flax | 194 | 194 | 14 | 7 | 7 | * |
| Corn | 194 | 194 | 193 | 186 | 7 | * |
| Barley | 15 | 15 | 15 | 10 | 10 | 18 |
| Oats | 3 | — | 1 | 10 | 10 | 18 |
| Summer Fallow | — | — | 1 | 10 | 10 | 17 |
| Tame Hay or Pasture | 30 | 30 | 29 | 20 | 20 | 1 |
| **Crop Production (in bushels):** | | | | | | |
| Spring Wheat | 202† | 244 | 3,489 | 3,644 | 5,442 | 5,579 |
| Flax | 5,021 | 5,021 | 135 | 66 | 66 | 4 |
| Feed Grain (corn equivalent) | 5,976 | 5,933 | 5,932 | 5,784 | 521 | 613 |
| Corn Silage (in tons) | — | — | — | — | — | 2 |
| Tame Hay | 36 | 42 | 42 | 31 | 31 | 2 |
| Native Hay | 36 | 36 | 36 | 36 | 36 | 36 |
| **Livestock (head):** | | | | | | |
| Beef Cows | 23 | 30 | 30 | 22 | 22 | — |
| Stockers Sold‡ | 18 | — | — | 16 | 16 | 60 |
| Feeder Calves Sold | — | 23 | 23 | — | — | — |
| Total Labor Use (hours) | 1,584 | 1,582 | 1,624 | 1,593 | 1,419 | 1,352 |
| Total Capital Used | $26,828 | $26,058 | $25,824 | $25,492 | $20,458 | $20,448 |
| Net Returns§ | $ 6,457 | $ 6,468 | $ 6,556 | $ 6,915 | $ 7,317 | $13,440 |

*Less than 1 acre.
†Wheat fed to livestock.
‡Includes calves raised and purchased.
§The net returns are for the lower wheat price and include returns to land and the operator's labor and management.

As the price of wheat increased to $1.57 and above, wheat, as a cash grain, became increasingly competitive with cattle and flax in the farming system. Wheat acreage and production increased with rising prices, and flax and tame hay production decreased. Feed grain production was maintained at, or near, levels necessary to supply the grain requirements for livestock. With wheat prices at $2.22 per bushel or higher, the most profitable plans included the maximum wheat acreage permitted by the crop rotations considered. Flax and tame hay were virtually eliminated from the cropping system, and beef production was limited to the stocker calf enterprise (purchased calves) at a level to utilize available native hay and pasture.

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

**Crop Production—Soils Group I-II.** The cropping alternatives considered on Group I-II soils were spring wheat, flax, barley, oats, corn-grain, corn-silage, alfalfa (for hay or pasture), and summer fallow in 14 cropping systems, or rotations. Soils in this group are somewhat more productive than those in Group III-IV. Yields of wheat, corn, oats, and rye are approximately 10% higher, while those of barley and alfalfa are about 14% to 15% higher. The greatest difference is in flax, with yields approximately 21% higher than on Group III-IV soils.

The cropping systems that were competitive on Group I-II soils, over the range of wheat prices considered, were the wheat-flax-alfalfa (2 years) and corn-flax rotations and continuous wheat. With the corn and flax prices held constant at 71 cents and $2.35 per bushel, respectively, the corn-flax rotation yielded a net return of $8.04 per acre at all wheat prices. Since all wheat was fed to livestock with wheat prices of 36 cents to 60 cents per bushel, the effective value of wheat (based on feed value and the price of corn) over that range was 80 cents per bushel. Using 80 cents as the wheat price, the wheat-flax-alfalfa (2 years) rotation was more profitable than the corn-flax rotation, as long as alfalfa was worth more than $10.25 per ton as feed for livestock. With wheat at 92 cents per bushel, the break even price for alfalfa was $9.85 per ton. Net returns for continuous wheat were only $1.57 and $3.26 per acre at wheat values of 80 cents and 92 cents, respectively. Because of the relatively high profitability of cattle, and the resulting high value of hay, the total acreage of Group I-II soils was utilized for the wheat-flax-alfalfa (2 years) rotation with wheat prices in the range from 30 cents to 60 cents, and 95% was devoted to that use when wheat prices increased to the 92 cents to $1.07 range. With wheat prices in the range from 92 cents to $1.07, it was more profitable to sell wheat than to feed it, and a small acreage of the corn-flax rotation entered the plan to provide corn for livestock grain requirements.

**Table 8. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 71 Cents per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| Crop Rotation | Range of Wheat Prices per Bushel | | | | |
|---|---|---|---|---|---|
| | $.36 to $.60 | $.92 to $1.07 | $1.57 to $1.60 | $1.61 to $1.94 | $2.22 to $2.67 |
| | | | Acres | | |
| **Soil Group I-II** | | | | | |
| Spring wheat, Flax, Alfalfa (two years) | 358.0 | 340.0 | 118.2 | — | — |
| Corn, Flax | — | 17.7 | — | — | — |
| Spring wheat | — | — | 239.8 | 358.0 | 358.0 |
| **Soil Group III-IV** | | | | | |
| Spring wheat, Corn, Flax, Alfalfa (three years) | 90.0 | 90.0 | 90.0 | 90.0 | 2.4 |
| Summer fallow, Spring, Wheat | — | — | — | — | — |
| Spring wheat, Barley Oats | — | — | — | — | 87.6 |

With an increase in the price of wheat to $1.57, net returns for continuous wheat increased to $12.39 per acre, exceeding net returns for the corn-flax rotation ($8.04), and the break even value for alfalfa in the wheat-flax-alfalfa (2 years) rotation became $11.54 per ton. As a result, approximately two thirds of the cropland on Group I-II soils was devoted to continuous wheat, and the remainder was utilized for the wheat-flax-alfalfa (2 years) rotation.

At a wheat price of $1.61, the net return from continuous wheat increased to $12.95 per acre, and the break even value for alfalfa increased to $11.99 per ton. Since the tame hay requirements for livestock could be be produced on Group III-IV soils at a lower break even price ($10.36 per ton), it was most profitable to utilize all of the Group I-II soils for continuous wheat. With a wheat price of $2.22 per bushel, net returns from continuous wheat increased to $20.78 per acre, and the break even value of alfalfa in the wheat-flax-alfalfa (2 years) rotation became $17.73 per ton. Thus, at all wheat prices above $1.61 per bushel, the most profitable use of the Group I-II soils would be continuous wheat, unless the price of corn or flax, or the value of alfalfa for feed, increased sufficiently to make one of those crops competitive with wheat.

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

Only two cropping systems were competitive on Group III-IV soils, over the range of wheat prices considered. These were the wheat-corn-flax-alfalfa (3 years) and summer fallow-wheat-wheat-barley-oats rotations. With the price of wheat in the 36 cents to 60 cents range (where the value of wheat for feed was 80 cents per bushel), the net return for the summer fallow-wheat-wheat-barley-oats rotation was only $1.61 per acre. At that wheat value, the break even value for alfalfa in the wheat-corn-flax-alfalfa (3 years) rotation was only $6.49 per ton. Net returns for the summer fallow-wheat-wheat-barley-oats rotation were $2.35, $6.38, and $6.63 per acre at wheat prices of 92 cents, $1.57, and $1.61 per bushel, respectively. Break even values for alfalfa in the wheat-corn-alfalfa (3 years) rotation at those wheat prices were $7.05, $10.16, and $10.36 per ton, respectively. Since alfalfa was worth more as feed for cattle than those break even values, the most profitable use of the Group III-IV soils was the wheat-corn-flax-alfalfa (3 years) rotation over the range of wheat prices from 36 cents through $1.94 per bushel.

There was no significant change until the wheat price was increased to $2.22 per bushel. At the $2.22 per bushel wheat price, the net return from the summer fallow-wheat-wheat-barley-oats rotation increased to $10.19 per acre, and the break even price for alfalfa in the wheat-corn-flax-alfalfa (3 years) rotation increased to $12.77. Thus, at wheat prices of $2.22 per bushel, and higher, it became most profitable to devote nearly all (87.6 acres) of the Group III-IV soils to the summer fall-wheat-wheat-barley-oats rotation. Only 2.4 acres were utilized for the wheat-corn-flax-alfalfa (3 years) rotation, primarily to provide small amounts of corn silage and hay to supplement native hay and pasture in meeting the forage requirements for the relatively small stocker calf enterprise. Wheat acreage on these soils was 35.4 acres, only 0.6 acre less than the maximum of 36 acres permitted by the cropping systems considered.

**Livestock Production.** The primary livestock enterprise in the most profitable farm plans, at all levels of wheat prices considered, was the stocker calf enterprise, in which 430-pound calves were wintered and grazed, with only supplementary grain feeding, and sold at the end of a 12-month period as 700-pound yearling feeders. With wheat prices low in relation to the constant price of $23.08 per cwt. for 700-lb. yearlings, it was most profitable to purchase all calves for the stocker enterprise, and to maintain that enterprise at a relatively high level. As the wheat price increased, the profitability of tame hay and pasture, and feed grain (including feed wheat), declined relative to cash wheat. As a result, the number of calves in the stocker enterprise decreased, and all calves were produced by a beef cow herd, which utilized available native hay and pasture. However, at the highest wheat prices ($2.22 to $2.67 per bushel), it was most profitable to utilize all of the limited forage production for stockers, and calves were purchased.

With the prices of $25.28 and $23.08 for calves and yearlings, respectively, both the cow-calf and stocker enterprises were profitable at a corn price of 71 cents per bushel. Actually, such a high beef-corn price ratio would rarely, if ever, occur, and if it did, it would exist only for a brief time period, since the demand for corn for livestock feeding would soon force corn prices to rise. However, as evidenced by the size of the stocker enterprise with wheat prices of $2.22 to $2.67 per bushel, it generally would be profitable for a farm with a resource combination similar to that of the model farm to maintain a cow herd or stocker enterprise at a level to utilize available native hay and pasture. Livestock used labor that otherwise would have been unused, since most of the livestock labor requirements occurred in the fall and winter months, and thus did not compete with crop enterprises for available labor.

Aside from protein supplement, minerals, and salt, feed was homegrown and consisted primarily of hay and pasture, with a small amount of grain. The grains used for feed depended on the price of wheat in relation to the price of corn. Wheat was used as feed when the wheat price was below 92 cents per bushel. As the wheat price increased, corn replaced wheat in the livestock ration. Further increases in the wheat price resulted in a crop rotation that included barley and oats, which were used as livestock feed. The amount of cropland used for livestock feed production varied from 299.6 acres (66.9% of total cropland), at the lowest wheat price, to 22.9 acres (5.1% of total cropland), at wheat prices of $2.22 to $2.67 per bushel.

### Farm Plans With Corn Priced at 85 Cents

The most profitable type of farming operation consisted primarily of cash grain production at all levels of wheat prices considered when the price of corn increased to 83 cents per bushel. The cow-calf herd and stocker calves became relatively minor enterprises over all wheat prices considered, except the range from $1.17 to $1.56 per bushel. Over the lowest range of wheat prices only 13.4% of total cropland was used for livestock feed production, in contrast to 66.9% with corn at 71 cents per bushel. These differences reflected the greater profitability of corn production for cash sale relative to the production of tame hay and pasture as feed for beef cattle.

At wheat prices below $1.17 per bushel, corn and flax were more profitable than either wheat or hay, and the most profitable cropping system was one which included maximum acreages of corn and flax for cash sale. As the price of wheat increased beyond $1.17 per bushel, wheat became more competitive and the acreage increased. At prices of $2.28 per bushel and above, wheat acreage reached the maximum permitted by the cropping systems considered.

At all wheat prices the beef cow and stocker calf enterprises were maintained at levels great enough to utilize available native forage and tame hay included in the cropping systems allowed. Grain requirements were provided by feed grains or wheat, depending upon price relationships. The cost of a bushel corn equivalent of grain in the form of wheat, at a wheat price of 94 cents per bushel, was 84 cents per bushel as compared to a corn price of 85 cents per bushel. Thus, at wheat prices of 94 cents per bushel or less, it was most profitable to utilize wheat to provide livestock grain requirements. For wheat prices of 95 cents per bushel and above, the cash price for wheat was greater than its feed value in relation to corn. At prices of 95 cents plus per bushel, all wheat was sold for cash, and livestock grain requirements were provided by corn or other feed grains.

With wheat prices ranging from $1.17 to $1.56 per bushel, a cropping system including wheat, flax, and alfalfa became more profitable on Group I-II soils, than either a corn-flax rotation or continuous wheat. This resulted in an increase in the acreage of alfalfa, along with an increase in wheat acreage. At the same time, there was a substantial increase in the numbers of beef cows and stocker calves utilizing the increased roughage supplies. As the wheat price increased beyond $1.56 per bushel it become more profitable to produce continuous wheat on Group I-II soils. Further increases in wheat acreage were accomplished largely through reductions in the acreage of tame hay and pasture, which resulted in reductions in the beef cow-calf and stocker calf enterprises.

Cropping patterns on the two soil groups with corn priced at 85 cents per bushel were somewhat different than those with corn priced at 71 cents per bushel, especially on Group I-II soils. Shifts in cropping patterns also occurred at different wheat price levels. Crop rotations by soil groups in the most profitable plans at the different levels of wheat prices and 85 cents per bushel corn prices are shown in Table 9.

**Crop Production—Soils Groups I-II.** The principal effect, on the most profitable cropping systems on soils of Groups I-II resulting from an increase in the corn price to 85 cents per bushel, was the shift to the

**Table 9. Crop Rotations by Soil Groups at Varoius Levels of Wheat Prices and 85 Cents per Bushel for Corn, 640-Acre Model Farm, Brown and Sprink Counties**

| | Range of wheat prices per bushel | | | | | |
|---|---|---|---|---|---|---|
| Crop Rotation | $.36 to $.94 | $.95 to $1.01 | $1.17 to $1.56 | $1.57 to $1.58 | $1.80 to $2.27 | $2.28 to $2.75 |
| | Acres | | | | | |
| **Soil Group I-II** | | | | | | |
| Corn, flax | 358.0 | 358.0 | 17.7 | — | — | — |
| Spring wheat, flax, alfalfa (two years) | — | — | 340.3 | 118.2 | — | — |
| Spring wheat | — | — | — | 239.8 | 358.0 | 358.0 |
| **Soil Group III-IV** | | | | | | |
| Spring wheat, corn, flax, alfalfa (three years) | 90.0 | 90.0 | 90.0 | 90.0 | 42.0 | 2.9 |
| S. fallow, Spring wheat | — | — | — | — | — | — |
| Spring wheat, barley, oats | — | — | — | — | 48.0 | 87.1 |

corn-flax rotation at the two lowest ranges of wheat prices. Net returns from the corn-flax rotation increased from $8.04 to $10.10 per acre. Based on corn price, wheat was worth 95 cent per bushel as livestock feed. At that wheat value, net returns from the wheat-flax- alfalfa (2 years) rotation would be less than those from the corn-flax rotation with alfalfa values of less than $12.13 per ton as livestock feed. It was most profitable to devote all of the cropland on Group I-II soils to the corn-flax rotation, since livestock hay requirements could be provided at a lower break even price on Group III-IV soils ($7.64 per ton).

With wheat priced at $1.17, the break even value for alfalfa in the wheat-flax-alfalfa (2 years) rotation was reduced to $10.95 per ton; it became profitable to increase beef cattle numbers and devote 95% of the Group I-II soils to the wheat-flax-alfalfa rotation. The remaining acreage continued to be utilized in the corn-flax rotation. This continued to be the most profitable use of these soils until the wheat price reached $1.57 per bushel. At that price, net returns from continuous wheat were $12.39 per acre, $2.29 more than returns from the corn-flax rotation, and it became profitable to utilize two-thirds of the cropland on Group I-II soils in continuous wheat. As the wheat price increased to $1.80 and above, there were further increases in the relative profitability of continuous wheat and the total acreage of these soils was devoted to that crop.

**Crop Production—Soils Group III-IV.** The increase in the price of corn from 71 cents to 85 cents per bushel had very little effect upon most profitable cropping systems on Group III-IV soils. However, the summer fallow-wheat-wheat-barley-oats rotation became competitive with the wheat-corn-flax-alfalfa

(3 years) rotation at a lower wheat price ($1.80) than with the corn price at 71 cents ($2.67). This difference reflects the higher net returns from barley and oats, resulting from the higher feed grain price, and the lower value of alfalfa which resulted from the smaller numbers of beef cattle. The maximum wheat acreage on these soils (35.4 acres) was reached at a wheat price of $2.28 per bushel, in contrast to $2.22 with corn priced at 71 cents per bushel.

### Farm Plans With Corn Priced at $1.12

An increase in the price of corn to $1.12 per bushel further increased the emphasis on cash grain production in most profitable farm plans. At all wheat prices, the beef cow-calf and stocker calf enterprises were limited to levels that would utilize available native forage and tame hay. The proportion of cropland used for livestock feed production varied from 5.1% to 9.5%. Supplementary grain requirements for livestock were provided by wheat at the lowest wheat prices (36 cents to $1.03 per bushel), but at higher wheat prices, all wheat was sold for cash and small amounts of feed grains were used for feed.

Because greater emphasis was placed on cash grain production in the most profitable plans with corn priced at $1.12, there were changes in the cropping systems which were competitive over the range of wheat prices considered. Crop rotations on the two groups of soils in the most profitable plans at the various levels of wheat prices and $1.12 corn are shown in Table 10.

**Crop Production—Soils Groups I-II.** It became most profitable to utilize the total acreage of cropland on Groups I-II soils for grain crop production at all levels of wheat prices with corn price at $1.12 per bushel. The corn-wheat rotation replaced the wheat-flax-alfalfa (2 years) rotation as a competitive cropping system. Net returns from the corn-flax rotation, which were not affected by wheat price changes, increased to $14.07 per acre. With wheat at $1.25 per bushel, net returns from continuous wheat and the corn-wheat rotation were $7.89 and $10.79 per acre, respectively. At a wheat price between $1.61 and $1.62 per bushel, net returns from the corn-wheat rotation became greater than those from corn-flax, and with wheat at $1.71 net returns were $14.95 per acre. When wheat increased to $1.83 per bushel, net returns from continuous wheat were $16.04 per acre, compared to $16.03 for the corn-wheat rotation. Wheat price increases resulted in further increases in net returns from both continuous wheat and the corn-wheat rotation; continuous wheat being greatest. As a result of the above changes in net return relationships, it was most profitable to utilize all of the Group I-II soils for one cropping system over each wheat price range as follows: (1) corn-flax rotation, with wheat prices below $1.61; (2) corn-wheat rotation, with wheat from $1.61 to $1.82; and (3) continuous wheat, with wheat prices of $1.83 and above.

**Crop Production—Soils Groups III-IV.** With an increase in the corn price to $1.12 per bushel, several rotations became more profitable on group III-IV soils and replaced the wheat-corn-flax-alfalfa (3 years) rotation. One rotation, flax-barley-corn-oats-alfalfa (2 years) occupied 15.4 acres at wheat prices which ranged from 36 cents to $1.03, while wheat-barley-corn-flax-alfalfa (2 years) occupied the remaining 74.6 acres. Alfalfa and wheat were produced as livestock feed, while corn, barley, oats and flax were sold. As the wheat price increased to $1.25 per bushel, wheat became somewhat more profitable than oats which caused a shift in oats acreage to wheat, flax, corn, barley and alfalfa. Wheat was now sold, and the grain for livestock was supplied by feed grains. A slight additional increase in wheat prices increased wheat acreage by less than an acre. These changes in the cropping system resulted from the greater profitability of feed grains for cash sale relative to alfalfa for livestock feed when the corn price was increased from 85 cents to $1.12 per bushel.

At a wheat price of $1.71 per bushel, wheat became relatively more profitable then feed grains and more than half the acreage of Group III-IV soils was utilized for the summer fallow-wheat-wheat-barley-oats

**Table 10. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.18 per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| Crop Rotation | Range of Wheat Prices per Bushel | | | | | |
|---|---|---|---|---|---|---|
| | $.36-$1.03 | $1.25-$1.58 | $1.61-$1.70 | $1.71-$1.82 | $1.83-$2.41 | $2.94-$3.30 |
| | Acres | | | | | |
| **Soil Group I-II** | | | | | | |
| Corn, Flax | 358.0 | 358.0 | — | — | — | — |
| Corn, Spring Wheat | — | — | 358.0 | 358.0 | — | — |
| Spring Wheat | — | — | — | — | 358.0 | 358.0 |
| **Soil Group III-IV** | | | | | | |
| Flax, Barley, Corn, Oats, Alfalfa (two years) | 15.4 | — | — | — | — | — |
| Spring Wheat, Barley, Corn, Flax, Alfalfa, (two years) | 74.6 | 90.0 | 86.4 | — | — | — |
| Spring Wheat, Corn, Flax, Alfalfa (three years) | — | — | — | 42.0 | 42.0 | 2.4 |
| Summer Fallow, Spring Wheat | — | — | — | — | — | — |
| Spring Wheat, Barley, Oats | — | — | 3.6 | 48.0 | 48.0 | 87.6 |

rotation. This rotation includes the highest proportion of wheat (40%) of any of the rotations considered for these soils. Livestock hay requirements, in addition to native hay, were provided by devoting the remainder of the Group III-IV soils to the wheat-corn-flax- alfalfa (3 years) rotation. With wheat prices of $2.94 per bushel and above, nearly all (97%) of the cropland on these soils was used for the summer fallow-wheat-wheat-barley-oats rotation.

## Labor

Hours of resident labor used in each of the labor periods, and total annual labor use, for the various feed grain and wheat price levels are shown in Table 11. Resident labor refers to operator and family labor.

The amount of resident labor available assumed that the operator would work longer days, as well as on Sundays, to make up for working time lost due to inclement weather conditions, which is the usual practice of farmers. Thus, it was assumed that 60 hours (6-10 hour days) of operator labor would be available each week. Some family labor, in addition to the operator, often is available also, if only for emergency needs. With the amount of resident labor available, labor was not expected to be a limiting resource on a farm of this size, since labor-intensive livestock fattening enterprises were excluded from the plans.

Results of the analysis indicated that labor was not a limiting resource. The proportion of available total annual labor used in the most profitable plans varied from a low of 34.9% to a high of only 54.2%. Variation among labor periods in the proportion of available labor used was much greater than for total annual labor, ranging from 13.5% to 83.6%. Thus, excess resident labor supplies ranged from 16.4% to 86.5% in individual labor periods.

The level of corn and wheat prices affected total annual labor use as expected through the effects on the combination of enterprises included in the plans. In nearly all cases, annual labor requirements declined as the wheat price increased with the price of corn held constant. This was a result of level reductions of enterprises with higher labor requirements (livestock, corn and tame hay) as wheat became more profitable. In most instances annual labor require-

**Table 11. Resident Labor Use by Periods for the Optimum Farm Plans at Specified Wheat and Corn Prices, 640-Acre Model Farm, Brown and Spink Counties.**

| Labor period | Corn Price of per Bushel | Hours Labor Available | Resident Labor Use at the Following Range of Wheat Prices: $.36 to $.60 | $.92 to $1.07 | $1.57 to $1.60 | $1.61 to $1.94 | $2.22 to $2.67 |
|---|---|---|---|---|---|---|---|
| | | | Hours | | | | |
| Nov. 16 to March 15 | .71 | 982 | 563.4 | 546.7 | 330.1 | 214.8 | 140.8 |
| March 16 to April 30 | .71 | 570 | 294.6 | 302.5 | 332.1 | 342.8 | 343.1 |
| May 1 to July 15 | .71 | 956 | 409.3 | 506.5 | 315.4 | 221.9 | 140.1 |
| July 16 to Sept. 30 | .71 | 983 | 550.4 | 571.5 | 623.2 | 644.5 | 663.4 |
| Oct. 1 to Nov. 15 | .71 | 377 | 278.4 | 163.8 | 98.9 | 70.7 | 65.0 |
| **Total Annual** | .71 | 3868 | 2096.1 | 2091.0 | 1699.7 | 1494.7 | 1352.4 |

| Labor period | Corn Price | Hours Labor Available | Range of Wheat Prices: $.36 to $.94 | $.95 to $1.01 | $1.17 to $1.56 | $1.57 to $1.58 | $1.80 to $2.27 | $2.28 to $2.75 |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | | | | | |
| Nov. 16 to March 15 | .85 | 982 | 214.8 | 214.8 | 546.7 | 330.1 | 174.1 | 140.8 |
| March 16 to April 30 | .85 | 570 | 152.8 | 153.1 | 302.5 | 332.1 | 345.0 | 342.9 |
| May 1 to July 15 | .85 | 956 | 528.0 | 529.8 | 506.5 | 315.4 | 190.3 | 140.6 |
| July 16 to Sept. 30 | .85 | 983 | 411.3 | 411.8 | 571.5 | 623.2 | 658.1 | 661.7 |
| Oct. 1 to Nov. 15 | .85 | 377 | 315.0 | 312.0 | 163.8 | 98.9 | 51.0 | 65.6 |
| **Total Annual** | .85 | 3868 | 1621.9 | 1622.3 | 2091.0 | 1699.7 | 1418.5 | 1351.6 |

| Labor period | Corn Price | Hours Labor Available | Resident Labor Use at the Following Range of Wheat Prices: $.36 to $1.03 | $1.25 to $1.58 | $1.61 to $1.70 | $1.71 to $1.82 | $1.83 to $2.41 | $2.94 to $3.30 |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | | | | | |
| Nov. 16 to Mar.15 | 1.12 | 982 | 188.7 | 188.8 | 186.8 | 174.1 | 174.1 | 140.8 |
| Mar. 16 to April 30 | 1.12 | 570 | 154.1 | 154.2 | 218.8 | 219.7 | 345.0 | 343.1 |
| May 1 to July 15 | 1.12 | 956 | 515.3 | 523.2 | 464.1 | 440.9 | 190.3 | 140.1 |
| July 16 to Sept. 30 | 1.12 | 983 | 419.0 | 420.9 | 461.0 | 464.7 | 658.1 | 663.4 |
| Oct. 1 to Nov. 15 | 1.12 | 377 | 306.4 | 294.7 | 293.6 | 293.1 | 51.0 | 65.0 |
| **Total Annual** | 1.12 | 3868 | 1583.5 | 1581.5 | 1624.3 | 1592.5 | 1418.5 | 1352.4 |

ments also declined somewhat with increases in the price of corn. This decrease in labor use resulted from reductions in the livestock enterprises and tame hay production, when production of corn for cash sale became more profitable than livestock. However, the decline in livestock labor requirements was partially offset by the greater requirements for corn, relative to other grain crops and the net decrease was small.

The distribution of labor use among periods of the year also was affected by changes in price relationships. Labor requirements in the winter period (Nov. 16 to Mar. 15) were highest with corn and wheat prices both at low levels, as a result of greater livestock production at those prices. Labor use in that period declined as the price of either corn or wheat increased. At the lowest levels of wheat prices, the greatest proportion of available labor used was in the fall period (Oct. 1 to Nov. 15), the period in which corn-grain was harvested. Labor use in that period generally increased with increasing corn prices, and declined as the price of wheat increased. Labor use in the spring and late summer periods (March 16 to April 30 and July 16 to Sept. 30)—the spring wheat seeding and harvesting periods—increased as wheat prices increased in relation to the price of corn.

### Capital

Ample short-term capital was assumed to be available, either owned or through credit. Thus, the only limitation on the quantity of short-term capital used was the requirement that it earn an annual rate of return of not less than 7 percent, the assumed market rate of interest. Total short-term capital use varied from $20,443 to $51,382, a range of $30,939. The maximum requirement for short-term capital occurred at the lowest combination of corn at 71 cents per bushel and wheat at 36 cents to 60 cents per bushel. At that price combination, $35,503 was invested in the stocker calf enterprise.

At all three levels of corn prices, the general pattern was a decrease in capital requirements as the price of wheat increased, with the minimum requirement of approximately $20,450 as wheat prices rose above $1.80 per bushel. This decrease in capital requirements reflected the shift from the high capital stocker calf and beef cow-calf enterprises to major emphasis on cash wheat production at the higher wheat prices. At the lower wheat prices, capital requirements also declined as the price of corn increased, again reflecting a shift in major emphasis from beef production to cash grain.

## SUMMARY

The purpose of this publication is to provide some results of a research study in which optimum farm plans under different price situations were determined for a representative 640-acre wheat farm in Brown and Spink Counties.

Linear programming techniques were used to determine optimal organizations for the representative farm at alternative combinations of wheat and feed grain prices, while beef cattle, flax, and rye prices were held constant. The assumed prices for beef cattle were $25.28 per cwt. for 430-lb. feeder calves and $23.08 per cwt. for 700-lb. yearling feeders. Prices used for flax and rye were $2.35 per bushel and $.80 per bushel, respectively. Most profitable farm plans were determined at three levels of corn prices, ranging from 71 cents to $1.12 per bushel, while wheat prices were varied from 36 cents to $3.30 per bushel.

Results of the analysis indicate that the most profitable organization, and general type of operation, for the model farm would change substantially with changes in feed grain and wheat prices, over the price ranges considered in this study. With both feed grain and wheat prices at the lowest levels, it was most profitable for the farm to be primarily a livestock farm, with a stocker calf enterprise as the major source of income, and flax as the major cash crop. At the lowest prices, only small amounts of feed grains and wheat were sold, and all of the livestock grain requirements were provided by wheat. With corn and wheat prices at the highest levels, the most profitable organization emphasized cash grain production with a cow-calf herd and stocker calves becoming supplementary enterprises which utilized pasture, hay, and labor that otherwise would not have been used.

At each level of corn prices the acreage of wheat increased with successive increases in the wheat price. Wheat became competitive with flax, as a cash crop, at wheat prices of $1.57 to $1.61 per bushel, and at higher wheat prices, nearly all the flax acreage was replaced by wheat. As would be expected, the price at which wheat became competitive with corn depended upon the corn price level. At the lowest corn price (71 cents per bushel), corn acreage was small, and was exceeded by wheat acreage, at all wheat prices. With corn at 85 cents per bushel, wheat became competitive at a wheat price of $1.17 per bushel, and with corn at $1.12 per bushel, wheat did not replace a significant proportion of the corn acreage until the wheat price reached $1.83 per bushel. The minimum wheat price at which wheat acreage reached the maximum permitted by the cropping systems considered (393 acres) also varied with the price of corn. With corn at 71

cents per bushel, the optimal plan included the maximum wheat acreage at a wheat price of $2.22 per bushel. With corn at 85 cents per bushel, wheat acreage reached the maximum at a wheat price of $2.28, but with corn at $1.12, a wheat price of $2.94 was necessary for it to be profitable to produce the maximum acreage.

The proportion of cropland utilized for production of feed for livestock on the farm varied from a high of 66.9% (300 acres), with corn and wheat prices at the lowest levels, to a low of 5.1% (23 acres), with corn and wheat prices at the highest levels considered. This reflected changes in the relative profitability of livestock production associated with changes in corn and wheat prices. Variation in the acreage of tame hay (from 1 to 223 acres) accounted for the major portion of the changes in the proportion of cropland utilized for feed production. However, shifts in the use of wheat, from livestock feed to cash grain were important also. Wheat provided all the livestock grain requirements at the lowest levels of wheat prices. The price at which it became more profitable to utilize wheat as a cash grain depended on the corn price level. With corn prices of 71 cents and 85 cents per bushel, it was profitable to feed wheat at wheat prices below 92 cents and 95 cents per bushel. With corn at $1.12 per bushel, it was most profitable to utilize wheat as feed until the wheat price reached $1.25 per bushel.

Labor was not a limiting resource. Annual labor requirements varied from a low of 34.9% of available labor to a high of only 54.2%. Ample labor was available in all labor periods at all price combinations considered. However, there were wide variations in the distribution of labor requirements among labor periods, as a rseult of changes in optimum farm organization in response to changing price relationships. The more pronounced changes occurred as a result of changes in major enterprises from livestock to cash grain production.

Total non-land capital requirements varied from $20,443 to $51,382. Capital requirements were greatest with low feed grain and wheat prices, when the investment in livestock enterprises was large, and declined as the farm organization shifted toward cash grain production in response to increasing feed grain and wheat prices.

The optimal farm plans presented in this publication are the results of computer programming using specific assumptions with regard to farm size and cropland acreage, crop yields, costs, commodity market prices, and other related factors. Consequently, the details of these results cannot be construed as being directly applicable to all 640-acre farms in this two-county area. The results, however, do present the most profitable farm organizations under the stated assumptions and should be useful as a general guide for determining profitable farm enterprise combinations under similar cost and price relationships.

# APPENDIX

**Appendix Table 1. Crops and Crop Rotations Allowed as Activities by Soils Group, Brown and Spink Counties**

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

**Appendix Table 2. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 71 Cents per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties.**

| Crop | Soil Group | Crop Acres at the Following Wheat Prices: $.36 to $.60 | $.92 to $1.07 | $1.57 to $1.60 | $1.61 to $1.94 | $2.22 to $2.67 |
|---|---|---|---|---|---|---|
| | | | | Acres | | |
| Flax | I-II | 89.5 | 93.9 | 29.5 | — | — |
| Alfalfa | I-II | 179.0 | 170.2 | 59.1 | — | — |
| Spring Wheat | I-II | 89.5 | 85.1 | 269.4 | 358.0 | 358.0 |
| Corn | I-II | — | 8.8 | — | — | — |
| **Total** | I-II | 358.0 | 358.0 | 358.0 | 358.0 | 358.0 |
| Corn | III-IV | 15.0 | 15.0 | 15.0 | 15.0 | .4 |
| Flax | III-IV | 15.0 | 15.0 | 15.0 | 15.0 | .4 |
| Alfalfa | III-IV | 45.0 | 45.0 | 45.0 | 45.0 | 1.2 |
| Spring Wheat | III-IV | 15.0 | 15.0 | 15.0 | 15.0 | 35.5 |
| Summer Fallow | III-IV | — | — | — | — | 17.5 |
| Oats | III-IV | — | — | — | — | 17.5 |
| Barley | III-IV | — | — | — | — | 17.5 |
| **Total** | III-IV | 90.0 | 90.0 | 90.0 | 90.0 | 90.0 |

**Appendix Table 3. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 85 Cents per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| Crop | Crop Acres at the Following Wheat Prices: $.36 to $.94 | $.95 to $1.01 | $1.17 to $1.56 | $1.57 to $1.58 | $1.80 to $2.27 | $2.28 to $2.75 |
|---|---|---|---|---|---|---|
| | | | Acres | | | |
| **Soil Group I-II** | | | | | | |
| Corn | 179.0 | 179.0 | 8.8 | — | — | — |
| Flax | 179.0 | 179.0 | 93.9 | 29.5 | — | — |
| Alfalfa | — | — | 170.2 | 59.1 | — | — |
| Spring Wheat | — | — | 85.1 | 269.4 | 358.0 | 358.0 |
| **Total** | 358.0 | 358.0 | 358.0 | 358.0 | 358.0 | 358.0 |
| **Soil Group III-IV** | | | | | | |
| Corn | 15.0 | 15.0 | 15.0 | 15.0 | 7.0 | .5 |
| Flax | 15.0 | 15.0 | 15.0 | 15.0 | 7.0 | .5 |
| Alfalfa | 45.0 | 45.0 | 45.0 | 45.0 | 21.0 | 1.5 |
| Spring Wheat | 15.0 | 15.0 | 15.0 | 15.0 | 26.2 | 35.3 |
| Summer Fallow | — | — | — | — | 9.6 | 17.4 |
| Oats | — | — | — | — | 9.6 | 17.4 |
| Barey | — | — | — | — | 9.6 | 17.4 |
| **Total** | 90.0 | 90.0 | 90.0 | 90.0 | 90.0 | 90.0 |

**Appendix Table 4. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.12 per Bushel for Corn, 640-Acre Model Farm, Brown and Spink Counties**

| Crop | Crop Acres at the Following Wheat Prices: $.36 to $1.03 | $1.25 to $1.58 | $1.61 to $1.70 | $1.71 to $1.82 | $1.83 to $2.41 | $2.94 to $3.30 |
|---|---|---|---|---|---|---|
| | | | Acres | | | |
| **Soil Group I-II** | | | | | | |
| Flax | 179.0 | 179.0 | — | — | — | — |
| Corn | 179.0 | 179.0 | 179.0 | 179.0 | — | — |
| Spring Wheat | — | — | 179.0 | 179.0 | 358.0 | 358.0 |
| **Total** | 358.0 | 358.0 | 358.0 | 358.0 | 358.0 | 358.0 |
| **Soil Group III-IV** | | | | | | |
| Corn | 15.0 | 15.0 | 14.4 | 7.0 | 7.0 | .4 |
| Oats | 2.6 | — | .7 | 9.6 | 9.6 | 17.5 |
| Flax | 15.0 | 15.0 | 14.4 | 7.0 | 7.0 | .4 |
| Alfalfa | 30.0 | 30.0 | 28.8 | 21.0 | 21.0 | 1.2 |
| Barley | 15.0 | 15.0 | 15.1 | 9.6 | 9.6 | 17.5 |
| Spring Wheat | 12.4 | 15.0 | 15.8 | 26.2 | 26.2 | 35.4 |
| Summer Fallow | — | — | .7 | 9.6 | 9.6 | 17.5 |
| **Total** | 90.0 | 90.0 | 89.9 | 90.0 | 90.0 | 89.9 |

**Appendix Table 5. Crop Rotations on All Soil Groups at Specified Wheat and Corn Prices, 640-Acre Model Farm, Brown and Spink Counties**

| Crop Rotation | Corn Price per bushel | Range of Wheat Prices per Bushel: $.36 to $.60 | $.92 to $1.07 | $1.57 to $1.60 | $1.64 to $1.94 | $2.22 to $2.67 |
|---|---|---|---|---|---|---|
| | | Acres | | | | |
| Spring Wheat, Flax, Alfalfa (two years) | .71 | 358.0 | 340.3 | 118.2 | — | — |
| Spring Wheat, Corn, Flax, Alfalfa (three years) | .71 | 90.0 | 90.0 | 90.0 | 90.0 | 2.4 |
| Corn, Flax | .71 | — | 17.7 | — | — | — |
| Spring Wheat | .71 | — | — | 239.8 | 358.0 | 358.0 |
| Summer Fallow, Spring Wheat | .71 | — | — | — | — | — |
| Spring Wheat, Barley, Oats | .71 | — | — | — | — | 87.6 |

| | | Range of Wheat Prices per Bushel: $.36 to $.94 | $.95 to $1.01 | $1.17 to $1.56 | $1.57 to $1.58 | $1.80 to $2.27 | $2.28 to $2.75 |
|---|---|---|---|---|---|---|---|
| Corn, Flax | .85 | 358.0 | 358.0 | 17.7 | — | — | — |
| Spring Wheat, Corn, Flax, Alfalfa (three years) | .85 | 90.0 | 90.0 | 90.0 | 90.0 | 42.0 | 2.9 |
| Spring Wheat, Flax, Alfalfa (two years) | .85 | — | — | 340.3 | 118.2 | — | — |
| Spring Wheat | .85 | — | — | — | 239.8 | 358.0 | 358.0 |
| Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats | .85 | — | — | — | — | 48.0 | 87.1 |

| | | Range of Wheat Prices per Bushel: $.36 to $1.03 | $1.25 to $1.58 | $1.61 to $1.70 | $1.71 to $1.82 | $1.83 to $2.41 | $2.94 to $3.30 |
|---|---|---|---|---|---|---|---|
| Flax, Barley, Corn, Oats, Alfalfa (two years) | 1.12 | 15.4 | — | — | — | — | — |
| Corn, Flax | 1.12 | 358.0 | 358.0 | — | — | — | — |
| Spring Wheat, Barley, Corn, Flax, Alfalfa (two years) | 1.12 | 74.6 | 90.0 | 86.4 | — | — | — |
| Corn, Spring Wheat | 1.12 | — | — | 358.0 | 358.0 | — | — |
| Spring Wheat, Corn, Flax, Alfalfa (three years) | 1.12 | — | — | — | 42.0 | 42.0 | 2.4 |
| Summer Fallow, Spring Wheat, Spring Wheat, Barley, Oats | 1.12 | — | — | 3.6 | 48.0 | 48.0 | 87.6 |
| Spring Wheat | 1.12 | — | — | — | — | 358.0 | 358.0 |