SHORT RUN ADJUSTMENT OPPORTUNITIES FOR OKLAHOMA PANHANDLE FARMERS

By

HARRY HALE HALL

Bachelor of Science

University of Missouri

Columbia, Missouri

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Thesis Approved:

Odell L. Walker
Thesis Adviser

L. A. Fercher

Dean of the Graduate School

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CHAPTER I

INTRODUCTION

Adjustments it will pay firms to make and adjustments which firms are likely to make in their production organizations are of great importance to both farm managers and policy makers. Such adjustments are made in response to current or prospective economic, technical, and institutional conditions. An adjustment in farm organization by a farm manager to take advantage of changed conditions may materially increase the profits of the firm. The adjustment of farmers in the aggregate to existing or prospective conditions will determine the effectiveness of proposed programs in achieving objectives of those programs. To determine the most profitable farming organizations, alternative uses for resources along with relevant economic and other conditions must be specified and choice criteria applied.

This study is part of a project designed to specify the most profitable, and perhaps the most probable, adjustments of Oklahoma Panhandle farmers. This portion of the project provides estimates of the most profitable farm organizations for Panhandle farmers under existing resource positions and a wide range of price and cost conditions. Because present resource control patterns for selected resources are assumed to remain essentially constant, the study provides information most appropriate for short or intermediate term adjustments. That is, somewhat typical complements of land, machinery and equipment, and family labor

are assumed to be given. The task of the farm manager in such a setting is to allocate these fixed resources, along with variable quantities of other resources, among the alternative uses so as to maximize returns to the fixed resources.

Objective of Study

The over-all objective of this study is to provide information and guides to farmers and policy makers about optimum farm adjustments under both present and alternative economic and institutional conditions. Specifically, the objective is to determine optimum farm organizations for a variety of price, resource availability, and allotment conditions.

Resource situations considered are not entirely representative of any particular farming situation in the Panhandle. However, the resource situations were selected in a manner as to approximate the typical resource combinations in the area. Minor adjustments in yields, prices, resources, etc., should make these results useful on a large number of Panhandle farms. The results should also prove useful to agricultural policy makers for estimating expected responses to proposed agricultural programs or alternative economic conditions.

Area of Study

The results of this study are applicable to dryland crop farms of the Oklahoma Panhandle (Figure 1). Irrigated cropland and land in areas which are largely range are excluded. Adjustment problems on irrigated cropland are considerably different from those on dryland. Moreover, irrigated cropland constitutes only 3 percent of Panhandle cropland.[1]

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[1]See Appendix Table III.

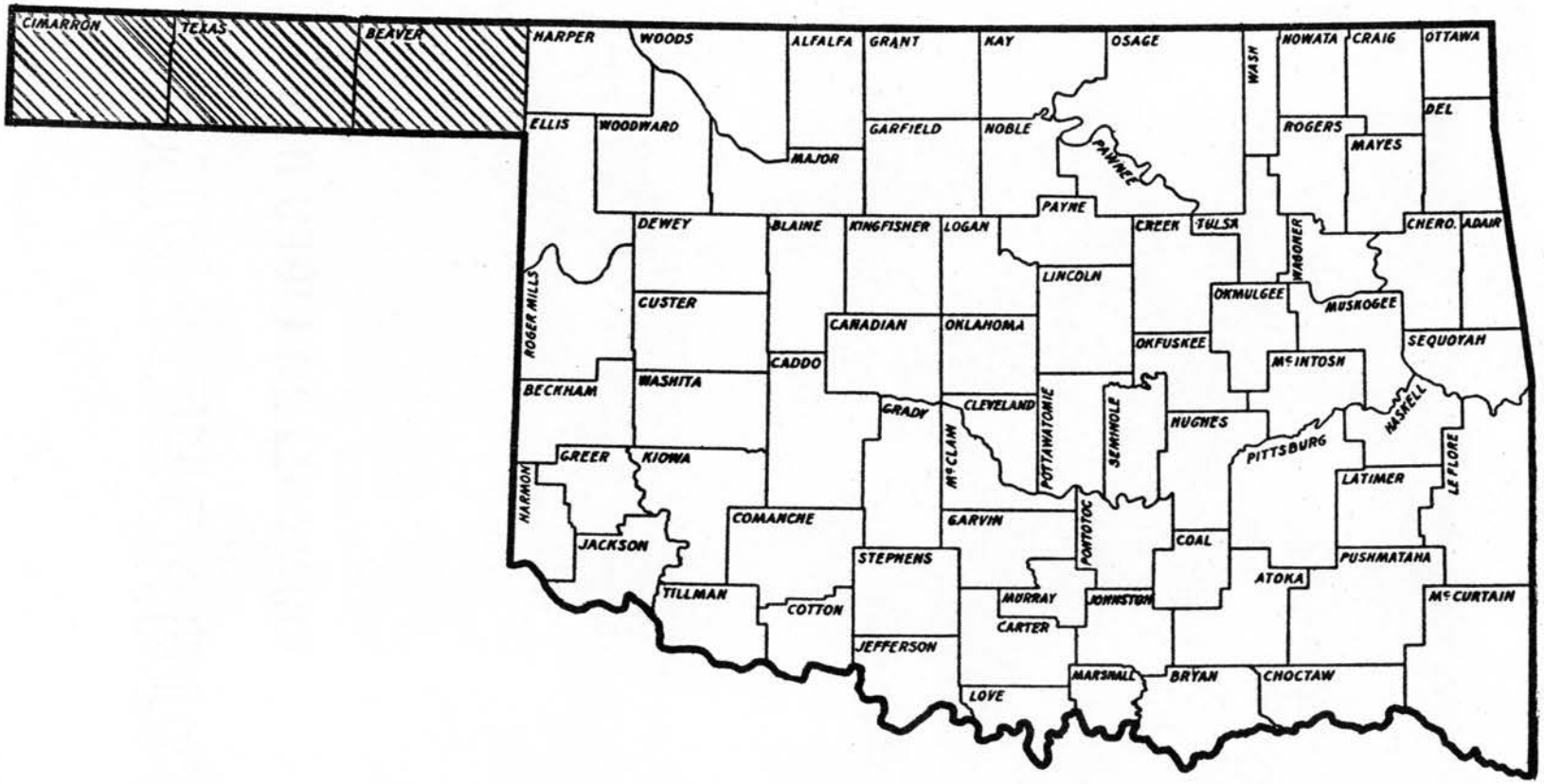

Figure 1. Map of Oklahoma Showing Area of Study.

Excluding the range land essentially eliminates large cow herds or ranching operations as economic alternatives.

The Panhandle includes about 10.2 per cent of the land in farms in Oklahoma but only about 4 per cent of the commercial farms.[2] Nearly 16.1 per cent of the state wheat acreage and 12.8 per cent of the state wheat production are located in the Panhandle.[3] About 25 per cent of the state grain sorghum acreage and 25 per cent of the harvested yield are found in the Panhandle.[4] In 1959, almost 161 thousand head of cattle, approximately 5 per cent of the state total, were on Panhandle farms and ranches.[5] Of course, many of these cattle were on ranches excluded from this study.

Rainfall in the Panhandle is relatively limited but the growing season is fairly long. Long term average annual rainfall at Beaver, in the eastern end of the Panhandle, is 18.5 inches.[6] At Boise City in the western end, the average is 16.5 inches and at Goodwell, near the center of the Panhandle, the average is 17.0 inches.[7] The three stations averaged 195 days with temperatures above 32 degrees in 1962.[8] The rainfall pattern and amount not only limit crop yields but also present

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[2]U. S. Bureau of the Census, U. S. Census of Agriculture: 1959, Vol. 1, Counties, Part 36, Oklahoma (Washington, 1961), pp. 180-186.

[3]Ibid., pp. 226-231.

[4]Ibid.

[5]Ibid., pp. 206-211.

[6]U. S. Department of Commerce, Climatological Data Oklahoma, Annual Summary 1962, Vol. 71, No. 13 (Washington, 1963), pp. 194-196.

[7]Ibid.

[8]Ibid., pp. 197-198.

serious management problems to Panhandle farmers. Machinery operations must be performed in a shorter time period than would otherwise be the case and, quite often, extra machine operations are required for no other reason than to prevent wind erosion.

Method of Analysis

This is primarily a short run analysis with some resources--land, machinery, and operator labor--assumed to be fixed to the farm. Costs associated with these fixed resources are assumed to be constant regardless of the farm organization or the level of output for any single activity. Variable resources such as hired labor or borrowed capital are assumed to be available and attainable in any amounts to be combined with the fixed resources. Emphasis throughout this study is given to farm organizations which combine the fixed and variable resources in a manner which permits maximum returns above total variable costs.

Optimum farm organizations are ascertained for each set of conditions by means of linear programming. As a technique, linear programming is not without limitations. Yields, rates of production, production requirements, prices, etc., must be specified accurately if the results are to be worthwhile. However, the same can be said for other techniques which consider various alternatives and result in the selection of an optimum organization. Linear programming has the distinct advantage over the other methods in that a much larger number of activities and resource restrictions can be considered and results obtained in only a fraction of the time required by the others. In addition, the programming technique provides a large amount of useful information about the

stability of the final solution.[9] That is, linear programming provides information about the ranges over which product prices and activity costs or returns can vary without resulting in changes in the optimum organization. In addition, it presents information on the reduction in net returns (Zj-Cj values) which would result from increasing or decreasing an activity by one unit and the number of units of the activity over which these costs are constant (linear).[10]

Organization for Remainder of Thesis

The discussion in the remainder of the thesis will follow the organization below. In general, Chapter II contains the over-all problem setting, Chapters III, IV, and V the results, and Chapter VI the summary and conclusions.

Chapter II - Problem Setting. Assumptions about the fixed resources and the availability of variable resources are explained in Chapter II. Characteristics of the assumed crop and livestock activities are also considered in this chapter.

Chapter III - Optimum Farm Organizations for Current Prices and Allotments. In Chapter III, optimum farm organizations are determined for the assumed current prices and allotments with fixed machinery and land resources. Several interest rates on borrowed capital and alternative sets of livestock activities are considered.

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[9] For a detailed explanation and interpretation of linear programming see Earl O. Heady and Wilfred Candler, Linear Programming Methods (Ames, 1958).

[10] A more detailed discussion of stability ranges and shadow prices is presented in Chapter III.

Chapter IV - Optimum Farm Organizations for Alternative Prices. Optimum farm organizations are determined for a variety of wheat, grain sorghum, and livestock prices. Allotments are excluded.

Chapter V - Optimum Farm Organizations for Land Expansion Alternatives and Alternative Amounts of Capital. In the first part of this chapter, optimum farm organizations are determined for both buy-land and rent-land alternatives. In the latter part of the chapter, optimum organizations are ascertained for alternative levels of capital.

Chapter VI - Summary and Conclusions. A summary of the study is given and some of the more significant conclusions implied by the results are discussed.

CHAPTER II

PROBLEM SETTING

The purpose of this chapter is to examine in some detail, resource characteristics and alternative activities which can be produced using these resources in the Oklahoma Panhandle. First, characteristics of the fixed resources such as land, machinery, and operator labor will be explained. Second, availability characteristics of variable resources such as hired labor and borrowed capital will be considered. Finally, characteristics of the assumed crop and livestock activities will be discussed.

Sources of Data

Input, output, and cost data for the crop and livestock activities used are reported in Processed Series P-459.[1] Crop and livestock budgets in that publication show the expected outputs of the various activities for given resource inputs. In addition, information on the groupings of Panhandle soils, machinery costs, current resource and product prices, and estimated overhead costs appear. The data reported are taken from experiment station research, farmer experience, estimates by scientists, and other sources.

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[1]Harry H. Hall et al., Resource Requirements, Costs and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle, Oklahoma Agricultural Experiment Station Processed Series P-459 (Stillwater, 1963).

Soil Resource Situations

As a first step in specifying soil resource situations, nonirrigated cropland soils of the Panhandle were divided into two large groups: (1) clay loam soils and (2) sandy soils. Within each group, soils with similar physical characteristics, yield capabilities, and management requirements were combined into productivity classes. Four clay loam productivity classes: C_a, C_b, C_c, and C_d and three sandy productivity classes: S_a, S_b, and S_c were specified. Estimated crop yields derived from long-time average expected yields on harvested land using "improved practices" were assigned to each productivity class. Improved practices are those employing the latest technology currently available and are generally associated with current experiment station recommendations. The assumed yields for the different crops by productivity class are presented in Table I.[2]

Not all the nonirrigated cropland involved in the classification described above is included in this study. All of the S_a cropland, which is found in Beaver and Texas counties, is excluded. Part of the C_c and most of the C_d cropland in Beaver County is also excluded. The original classification included 1.6 million acres of nonirrigated cropland representing approximately 2.2 million acres of land in farms. This compares to totals in the Panhandle of 2.4 million acres of cropland and 3.3 million acres of land in farms.[3] Approximately, 1.3 million

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[2]Representative soils for each of the productivity classes can be found in Appendix Tables I and II. Distribution of soils by productivity class within counties appears in Appendix Table IV.

[3]U.S. Bureau of the Census, U.S. Census of Agriculture: 1959, Vol. 1, Counties, Part 36, Oklahoma (Washington, 1961), pp. 156-161.

TABLE I

CROP AND GRAZING YIELDS BY PRODUCTIVITY CLASS, OKLAHOMA PANHANDLE

Crop	Unit	Productivity Class					
		Clay Loam Soils				Sandy Soils	
		C_a	C_b	C_c	C_d	S_b	S_c
Crop:							
Wheat	bu.	14	12	10	8	7	5
Grain sorghum	cwt.	9.0	5.5	8.0	5.5	10.0	9.0
Forage sorghum	ton	1.6	1.2	1.4	1.1	1.6	1.4
Grazing:[a]							
Grain sorghum stubble	AUM	.20	.12	.15	.10	.20	.00
Fall wheat grazing	AUM	.30	.25	.20	.15	.20	.18
Grazed out wheat	AUM	2.10	1.90	1.70	1.50	1.50	1.20
Grazed out forage sorghum	AUM	1.10	.90	1.00	.80	1.10	.80
Reseeded cropland[b]	AUM	1.00	.90	.80	.70	.80	.70

[a]Native range grazing is .6 AUM per acre of range.

[b]Grazing beginning with the third year. No yield is available the first two years.

Source: Harry H. Hall et al., Resource Requirements, Costs and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle, Oklahoma Agricultural Experiment Station Processed Series P-459.

acres of nonirrigated cropland representing 1.6 million acres of land in farms are included in this study. The cropland included in this study constitutes approximately 80 per cent of the cropland in the original classification and about 55 per cent of the Panhandle cropland. About 70 per cent of the land in farms in the original classification and 50 per cent of the land in farms in the Panhandle are represented by this study.

Panhandle soils were divided into two soil resource situations. The Panhandle Clay Loam soil resource situation accounts for slightly over 1.1 million acres of cropland, some in each of the three Panhandle counties. The Cimarron Sandy soil resource situation accounts for nearly 118 thousand acres of cropland, most of it in Cimarron County. Based on available records, the amounts of range land, roads, etc., associated with each of these resource situations were also specified. For the Panhandle Clay Loam resource situation, the distribution is as follows: 84.1 per cent cropland, 12.8 per cent native range, and 3.1 per cent in farmsteads and roads. For the Cimarron Sandy situation, the distribution is: 81.6 per cent cropland, 15.3 per cent native range, and 3.1 per cent in farmsteads and roads.[4]

Representative farms for each of the soil resource situations were specified on the basis of the 1959 agricultural census and ASCS records. Both farms are typical in size of many in the Panhandle. The representative farm for the Panhandle Clay Loam situation has a total of 880 acres including 740 acres of cropland. There are 960 acres in the representative farm for the Cimarron Sandy situation including 783 acres of

[4]Distribution of soils by productivity class among the various use groups appears in Appendix Table IV.

cropland. Acres of cropland by productivity class and acres of native range, wheat allotment, etc., comprising the two representative farms are presented in Table II.

TABLE II

LAND CLASSIFICATION AND WHEAT ALLOTMENTS FOR REPRESENTATIVE FARMS, OKLAHOMA PANHANDLE

	Panhandle Clay Loam		Cimarron Sandy	
	Total Land	Harvested Land[a]	Total Land	Harvested Land[a]
	-acres-			
Soil productivity class				
a	39	31	--	--
b	414	331	521	417
c	149	119	262	210
d	138	110	--	--
Total cropland	740	591	783	627
Native pasture land	113	--	147	--
Other land[b]	27	--	30	--
Total farmland	880	--	960	--
Wheat allotment[c]	376	--	268	--

[a]Twenty per cent nonharvested cropland excluded.

[b]Includes farmsteads, roads, waste, etc.

[c]Base allotments for 1959-1961.

Nonharvested Cropland

Typically, the relatively low amounts of rainfall in the Panhandle along with the erratic distribution in some years forces the abandonment of relatively large amounts of crops. In addition, some of the cropland

is intentionally fallowed or left idle at regular intervals. For purposes of this study, it is assumed that an average of 20 per cent of the cropland is not harvested each year because of either idleness, fallow, or crop failure. Thus for planning purposes, crops are harvested from only 80 per cent of the cropland each year. Amounts of harvested cropland by productivity class for each of the representative farms are shown in Table II.

Generally, some costs are incurred on nonharvested cropland. Machinery and seed costs are incurred on failure acres and machinery costs are involved in fallowing land. Such costs cannot be properly charged to any particular crop activity, however. For this reason, costs associated with nonharvested cropland are assumed to be whole farm rather than activity costs in this study. They have been deducted from the programmed returns in order to arrive at estimates of returns to land, labor, management, and risk. Assumed nonharvested cropland costs are $193.70 for the Panhandle Clay Loam farm and $202.80 for the Cimarron Sandy farm.[5]

Machinery Costs

In order to make specific cost estimates for crop activities it is necessary to assume a specific complement of machinery. A complement consisting of one four-plow tractor and auxiliary equipment is assumed for each representative farm. Items constituting this set of machinery along with the average annual investment, per acre annual fixed costs, and per acre variable costs for each item are shown in Table III. This

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[5]Per acre estimates of nonharvested cropland costs can be found in Appendix Table V.

TABLE III

ESTIMATED COSTS AND INVESTMENT REQUIREMENTS FOR ONE-FOUR PLOW TRACTOR AND EQUIPMENT, OKLAHOMA PANHANDLE

Machine	Average Annual Investment	Annual Fixed Costs Per Acre	Machine Variable Cost Per Acre
		-dollars-	
Tractor, 4 plow	2,344.20	0.408[a]	0.897[a]
Chisel, 15 ft.	579.60	0.112	0.057
Cultivator, 4 row	295.80	0.047	0.131
Drill, 16-10	511.20	0.167	0.202
Harrow, 4 section	121.20	0.014	0.003
Lister, 4 row	414.00	0.157	0.143
Oneway, 15 ft.	697.20	0.148	0.096
Total	4,963.20		

[a]Cost per hour of use.

Source: Harry H. Hall et al., Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle, Oklahoma Agricultural Experiment Station Processed Series P-459.

set of equipment has a capacity of 1,200 acres of cropland.[6]

Machinery variable costs including gas, oil, grease, and repairs can be easily allocated to crop activities and were included as a part of the costs for the respective crop activites. The amount of machine use for each crop (shown in Appendix Table IX) along with the cost estimates in Table III can be used to estimate the machine costs with the exception of harvesting costs, for any of the crop activities. All harvesting including grain combining, hay cutting and hauling, etc., are assumed to be custom hired. Machine fixed costs are constant for the year regardless of how much the machine is used. If machinery fixed costs were to be allocated among the various crop activities, an annual usage rate for each machine on each activity would have to be specified. In this study, fixed machinery costs are classed as overhead costs. A disucssion of overhead costs appears later in the chapter.

Labor Availability

Labor requirements for the various activities and the amount of operator labor available have been grouped in four periods within the year: (1) January-April, (2) May-July, (3) August-September, and (4) October-December. Amounts of operator nonmanagement time by periods available for performing labor tasks are shown in Table IV. Nonmanagement time is that time for performing tasks for which only labor is required such as tractor driving, feeding livestock, etc. A certain amount of management time for making cropping plans, business trans-

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[6]Odell L. Walker, unpublished data on machinery practices, Oklahoma Panhandle, Oklahoma Agricultural Experiment Station (Stillwater).

actions, etc., is required in addition to the nonmanagement time. The nonmanagement time in Table IV represents that part of the manager's time not required for management jobs. It is assumed that any amount of additional labor can be hired for $1.25 per hour.

TABLE IV

AVAILABILITY OF OPERATOR LABOR FOR FARMING PURPOSES, OKLAHOMA PANHANDLE[a]

Period of Year	Hours of Nonmanagement Time
Jan - Apr	538
May - Jul	506
Aug - Sep	352
Oct - Dec	462

[a]Assumes 22 working days per month excluding February when there are 20 days. Allows six hours per day Dec - Mar; seven hours per day Apr, May, and Nov; and eight hours per day Jun - Oct for nonmanagement time.

Capital Availability

Throughout most of the analysis, it is assumed that any amount of capital can be borrowed at the specified rate of interest. The specified rate of interest is constant over all amounts of capital. In the fixed capital portion of Chapter V, however, the amount of capital is fixed at alternative levels. No interest charge is made on those fixed amounts of capital.

At various points in the analysis, reference is made to total capital requirements and annual capital requirements. Total capital

represents the total amount of capital used by an activity or a combination of activities (organization). Annual capital is the average amount of capital used over a year's time. For example, the total capital requirement for buying a steer is the full cost of the steer. If the steer is carried for a year before being sold, the average amount of capital is the same as the total amount. However, if the steer is sold after six months, the average (annual) capital requirement is only one-half of the total capital requirement. Thus, total capital requirements are always equal to (or greater than) annual capital requirements. All interest charges are made on the basis of annual capital.

Crop Activities

Crop activities considered as alternatives include most of those produced on nonirrigated cropland in the Panhandle.[7] Of these, only wheat and grain sorghum are marketed directly; all the others are marketed indirectly through livestock. In addition to grain, wheat provides fall and winter grazing in most years and grain sorghum provides stubble grazing after the grain is harvested, except on S_c cropland. Grain sorghum residue must be left on S_c cropland as a preventive against wind erosion if the assumed yields are to be maintained over time. It is assumed that wheat can be grazed as late as March 1 without reducing grain yields.[8]

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[7] According to the 1959 census of agriculture, 16,432 acres of broomcorn were harvested in 1959 and 14,848 acres in 1954. Because the amount of broomcorn is so small, the market limited, and the large amount of migratory labor required, broomcorn is not included in this study.

[8] For further discussion of wheat pasture for the Panhandle see Odell L. Walker and James S. Plaxico, A Survey of Production Levels and Variability of Small Grain Pastures in Oklahoma, Processed Series P-336 (Stillwater, 1959).

Crops with indirect markets include forage sorghum, grazed out wheat, and reseeded cropland. Forage sorghum can either be harvested for hay or grazed out during the fall and early winter. Grazed out wheat requires no allotment since it is grazed out by May 15. The reseeded cropland activity permits cropland to be reseeded to native pasture. Grazing and grain yield coefficients for the crop activities appear in Table I.

Livestock Activities

Eight buy-sell feeder activities and seven cow-calf activities are included for consideration. Each feeder activity assumes the purchase of "good to choice" steers and the sale of "good" steers. Feeder heifers were not considered as alternatives. However, by adjusting the initial weights, the selling weights, and the prices used, activities including heifers or other grades of livestock can be considered. All feeder activities assume a death loss equivalent to one per cent of the selling weight. Essential features of the eight buy-sell activities are shown in Appendix Table XI.

Spring as well as fall calving cow-calf activities are considered. Both a fall and a spring calving activity in which the calves are creep fed are included. It is assumed that all calves are sold as good-choice feeders. A death loss among cows and heifers of 3.25 per cent is assumed. A summary of the characteristics of the cow-calf activities appears in Appendix Table XII. All requirements are averages per cow for a 25 cow herd including bull and replacement heifer expenses. All crop and livestock activities along with their identifying numbers are shown in Table V.

TABLE V

PROGRAMMED ACTIVITIES AND IDENTIFYING NUMBERS

Type of Activity	Activity Number	
	Panhandle Clay Loam	Cimarron Sandy
	(P_j)	(P_j)
Real activities:[a]		
Buy-sell feeders	1-8	1-8
Cow-calf	9-15	9-15
Wheat for grain	16-19	16,17
Grain sorghum	20-23	18,19
Forage sorghum for hay	24-27	20,21
Grazed out wheat	28-31	22,23
Grazed out forage sorghum	32-35	24,25
Reseeded cropland	36-39	26,27
Hire labor[b]	40-43	28-31
Borrow capital	44	32
Buy hay	45	33
Sell wheat	46	34
Sell grain sorghum	47	35
Buy land	48	36
Rent land	49	37
Disposal activities:[a]		
Land disposal	101-104	101,102
Wheat allotment	105	103
Native range	106	104
Labor[b]	107-110	105-108
Total capital	111	109
Annual capital	112	110
Small grain grazing		
Oct 1-Mar 1	113	111
Mar 1-May 30	114	112
Stubble grazing (Oct 1-Mar 1)	115	113
Wheat	116	114
Grain sorghum	117	115
Land (buy or rent)	118	116

[a]There is a crop activity and a disposal activity for each class of land. The first number of a series is for class "a" land, the second for class "b", etc.

[b]There is a labor hiring activity and an operator labor disposal activity for each period of the year. The first number of a series is for the Jan-Apr period, the second for May-Jul, etc.

Price Assumptions

Prices for all factors of production, with the exception of livestock and capital, are constant throughout all phases of this analysis. Ignoring the cost of purchased livestock and borrowed capital, the cost of production for each activity is constant as a result of this assumption. Assumed prices paid by farmers are presented in Appendix Table VI.

Product prices, on the other hand are not held constant. For much of the analysis, however, essentially current prices for livestock and crops are assumed. Livestock prices approximate the 1950-1961 average price level. Wheat and grain sorghum prices approximate the 1960-1961 support prices. For the alternative price analysis in Chapter IV, current livestock prices are associated with a grain sorghum price of $1.56. From that point, livestock prices are assumed to vary directly with grain sorghum prices. Variations in wheat prices are independent of either grain sorghum or livestock prices. Assumed prices received by farmers are presented in Appendix Tables VI and VII.

Overhead Costs

It is difficult to allocate some costs to specific activities because they are essentially constant regardless of the combination of activities or the level of output for each. Items in this category are depreciation and maintenance on buildings, fences, and livestock equipment; machinery fixed costs such as depreciation, interest on investment, and insurance; and land taxes. These costs have no influence on decisions relative to combinations of activities or the level of any particular activity. They do, however, affect the amount of returns

from any combination of activities. Consequently, overhead costs are considered to be whole farm costs and deducted from the net returns estimates of each optimum organization. Estimated annual overhead costs for the two representative farms are $3,517 for Panhandle Clay Loam and $3,583 for Cimarron Sandy.[9]

[9] Cost items constituting these estimates are found in Appendix Table X.

CHAPTER III

OPTIMUM FARM ORGANIZATIONS FOR CURRENT PRICES AND ALLOTMENTS

Optimum organizations under present price and allotment conditions for the resource situations described in Chapter II are presented in this chapter. Alternative sets of production activities and a variety of capital costs (interest rates) are considered. The results provide a bench mark with which optimum systems for other economic and resource conditions in later chapters can be compared.

The set of production alternatives considered clearly affects the optimum organization and the level of returns. Since most of the crop and livestock activities assumed are widely used in the Panhandle, choices of most farmers are expected to come from this set. However, buy-sell feeder activities utilizing grazed out small grain are not widely used and would be excluded by some farmers. In order to provide information both for farmers who would include grazed out small grain and those who would exclude it, optimum organizations are derived with grazed out wheat included as well as excluded.

The availability or cost of capital also affects the optimum organization and the level of returns. If capital is relatively expensive (external rationing) or if the farmer has a high reservation price on his own capital (internal rationing), capital conserving enterprises tend to be chosen. For example, as capital becomes more expensive, cows which

are moderate capital users tend to be substituted for steers which are high capital users. In order to illustrate the effects of both external and internal capital rationing, interest rates of 6, 12, and 15 per cent are considered with grazed out wheat included. Interest rates of 6 and 12 per cent are considered with grazed out wheat excluded. Optimum organizations for 6 per cent interest are estimated and then the changes resulting from the higher interest rates considered.

Panhandle Clay Loam, Grazed Out Wheat Included

Wheat has a marked yield advantage over grain sorghum on all four productivity classes of clay loam soils.[1] In addition, wheat furnishes more fall grazing than grain sorghum on the clay soils.[2] As a consequence, current prices which also favor wheat result in the maximum allotment of wheat for each of the three interest rates considered in this section.[3] The optimum organizations for this set of conditions showing the activities included and the level of each along with a returns estimate are presented in Table VI.

Six Per Cent Interest. A 6 per cent interest rate reflects very little capital rationing, either internal or external. Either the manager has a low reservation price on his own capital or he can borrow additional capital at a relatively low rate. The optimum organization

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[1]The marginal rates of substitution of wheat for grain sorghum in hundredweight of grain sorghum per bushel of wheat are: 0.64 on C_a, 0.46 on C_b, 0.80 on C_c, and 0.69 on C_d.

[2]See Table I.

[3]Assumed current prices are $1.65 per bushel of wheat and $1.56 per hundredweight of grain sorghum.

TABLE VI

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE INTEREST RATES, GRAZED OUT WHEAT INCLUDED, PANHANDLE CLAY LOAM RESOURCE SITUATION[a]

Item	Unit	Interest Rate		
		Six Percent	Twelve Percent	Fifteen Percent
Wheat	acre	376	376	376
Wheat	bu.	4,546	4,546	4,533
Grain Sorghum	acre	109	111	112
Grain Sorghum	cwt.	863	874	894
Forage sorghum for hay	acre	27	25	25
Grazed out wheat	acre	79	79	79
Feeder P_5	head	60	60	59
Feeder P_6	head	16	16	17
Cow-calf P_9	head	-	2	2
Cow-calf P_{11}	head	3	-	-
Total capital	dol.	10,435	10,354	10,326
Annual capital	dol.	6,685	6,606	6,591
Returns to land, labor, management and risk[b]	dol.	4,730	4,332	4,132
Land Use:				
C_a Land				
Wheat	acre	31	31	31
C_b Land				
Wheat	acre	331	331	331
C_c Land				
Wheat	acre	14	14	7
Grain sorghum	acre	105	105	112
C_d Land				
Wheat	acre	-	-	7
Grain sorghum	acre	4	6	-
Forage sorghum	acre	27	25	25
Grazed out wheat	acre	79	79	79

[a]Current prices and allotments are assumed.

[b]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517).

for 6 per cent interest includes the full allotment of wheat (376 acres). The balance of the cropland is in grain sorghum except for enough forage sorghum and grazed out wheat to satisfy the livestock requirements. The livestock activities include two feeder activities and a cow-calf activity. All the feeder P_6 permitted by the grain sorghum stubble grazing is produced along with all the feeder P_5 which can be produced with the fall wheat grazing not utilized by P_6. Cow-calf P_{11} is added to the point that the native range grazing not used by P_5 and P_6 is utilized. Total capital requirements for this organization are $10,435 and returns to land, labor, management, and risk are $4,730.

This organization is optimum over a rather wide range of price and cost conditions. For example, the interest rate can rise to 9 per cent, the price of wheat can fall to $1.51, or the price of grain sorghum can vary between $1.36 and $1.65 without causing a change in organization.[4] Outside these ranges, the changes in organization are relatively minor. For wheat prices below $1.51 or grain sorghum prices above $1.65, some of the wheat now on C_c cropland would be shifted to C_d cropland and replaced by grain sorghum. There would likely be other minor changes as a result of this change. For grain sorghum prices below $1.36, at least some of the C_d cropland now in grain sorghum would be reseeded to native pasture.

A comparison between this optimum organization and an average organization in the Panhandle is presented in Table VII. The optimum organization contains more wheat but less grain sorghum than the average

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[4]These and all subsequent references to prices for wheat and grain sorghum are prices per bushel of wheat and per hundredweight of grain sorghum.

one. The average organization is based on a sample of Panhandle farms and it may be that some of the farms sampled are more like the sandy situation treated later in this chapter than like the clay loam situation. An average organization based on both Panhandle Clay Loam and Cimarron Sandy type farms would not be expected to have an organization exactly like the optimum for either.

TABLE VII

COMPARISON OF PRESENT AND OPTIMUM CROPPING SYSTEMS, OKLAHOMA PANHANDLE

Activity	Average Organization Percent of Cropland[a]	Optimum Organization Percent of Cropland[b]
Wheat	46.8	50.8
Grain sorghum	32.4	14.7
Other crops	-	14.3
Fallow	20.8	20.0
Total	100.0	99.8

[a]From: Odell L. Walker, unpublished data on machinery practices, Oklahoma Panhandle, Oklahoma Agricultural Experiment Station, Stillwater.

[b]Based on Table VI, 6 per cent interest.

Twelve and Fifteen Per Cent Interest. Each of these interest rates yields a unique organization but the changes from the organiztion for 6 per cent interest are only minor. Furthermore, the organization for 15 per cent interest is optimum for all interest rates between 12.5 and 24 per cent. The principal change resulting from the increased capital costs is the decrease in returns to land, labor, management, and risk. Returns for 12 per cent interest are $398 less and those for 15 per cent

interest are $598 less than those for 6 per cent interest. Most of the decrease is due to the higher capital charge on the relatively constant amount of capital. The organization for 15 per cent interest would yield returns of $4,725 if the interest rate were only 6 per cent compared to $4,730 returns for the optimum organization at 6 per cent interest.

As the interest rate rises from 9 per cent, the amount of forage sorghum decreases and the amount of grain sorghum increases. Along with the increase in grain sorghum, feeder P_6, which utilizes grain sorghum stubble, increases and feeder P_5 decreases. Cow-calf P_9, which utilizes more range and less forage sorghum hay, is substituted for cow-calf P_{11}. As illustrated above, the practical effects of these changes in terms of their effect on returns are almost negligible.

Panhandle Clay Loam, Grazed Out Wheat Excluded

Many farmers have an aversion to buy-sell type livestock due to expected price risk, lack of experience in buying and selling steers, high capital requirements, and other reasons arising from personal preference. In addition, spring wheat grazing used by some buy-sell activities is a highly variable and uncertain crop. Activities utilizing wheat pasture are especially suspect to those farmers averse to buy-sell activities anyway. Because activities utilizing grazed out wheat would not be used by some farmers, optimum organizations with graze out alternatives excluded have been determined.

Excluding the grazed out wheat alternative results in feeder activities P_5 and P_6 being eliminated. Both activities are relatively profitable, partly because the gains are quite high and partly because the cost per unit of gain is low. Returns for the two activities and

their requirements for wheat pasture, cottonseed cake, and grazed out wheat are exactly the same. However, the cost for P_6 is slightly lower since it utilizes grain sorghum stubble in place of some of the hay required by P_5. When wheat pasture and grazed out wheat are available one of these feeder activities enters the solution. P_6 enters if grain sorghum stubble is available; P_5 enters if only wheat pasture is available.

Only two interest rates, 6 and 12 per cent, are considered in this part of the analysis. Optimum organizations for both are presented in Table VIII. Compared to the organizations in which grazed out wheat is included, the changes are quite marked. There are fewer livestock, capital requirements are lower (due largely to the decrease in the number of livestock), and returns to land, labor, management, and risk are lower. Grain sorghum has increased, significantly so at 12 per cent interest. At 6 per cent interest, 79 acres of cropland are reseeded to native pasture. However, the full allotment of wheat is included in both organizations.

Six Per Cent Interest. Compared to the organization for 6 per cent interest in which grazed out wheat is included, there are several significant changes. There are now only 26 head of feeder livestock compared to 76 before. The number of cows is greater, 11 instead of 3. However, from a practical standpoint, the number of cows is still probably below the minimum a farm manager would be willing to include in an activity. The amount of wheat produced is the same (376 acres) but the amount of grain sorghum has increased by 15 acres. Total capital requirements have decreased by $3,844 and returns to land, labor, management, and risk

TABLE VIII

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE INTEREST RATES, GRAZED OUT WHEAT EXCLUDED, PANHANDLE CLAY LOAM RESOURCE SITUATION[a]

Item	Unit	Interest Rate	
		Six Percent	Twelve Percent
Wheat	acre	376	376
Wheat	bu.	4,518	4,518
Grain sorghum	acre	124	212
Grain sorghum	cwt.	982	1,465
Forage sorghum for hay	acre	12	3
Reseeded cropland	acre	79	-
Feeder P_7	head	26	-
Cow-calf P_{13}	head	11	8
Total capital	dol.	6,591	2,985
Annual capital	dol.	4,510	2,823
Returns to land, labor, management, and risk[b]	dol.	3,243	2,648
Land Use:			
C_a Land			
Wheat	acre	31	31
C_b Land			
Wheat	acre	331	331
C_c Land			
Grain sorghum	acre	119	119
C_d Land			
Wheat	acre	14	14
Grain sorghum	acre	5	93
Forage sorghum	acre	12	3
Reseeded cropland	acre	79	-

[a]Current prices and allotments are assumed.

[b]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517).

have decreased by $1,487, a decrease of almost one-third.

This organization is optimum over a relatively wide range of prices and costs. The interest rate can rise as high as 10.5 per cent without causing a change, the price of wheat can fall to $1.08, or the price of grain sorghum can rise to $1.60. Above an interest rate of 10.5 per cent, the organization for 12 per cent is optimum. For wheat prices below $1.08 or grain sorghum prices above $1.60, wheat would decrease, leaving some allotment unused, and grain sorghum would increase. Reseeded cropland would probably be dropped also because grain sorghum would be relatively more profitable.

Twelve Per Cent Interest. As a result of increasing the interest rate from 6 to 12 per cent, several changes in organization take place, some of them rather minor. Feeder activity P_7 and reseeded cropland are dropped from the organization. The number of cows decreases from 11 to 8. The amount of grain sorghum increases by 88 acres on the C_d cropland, replacing the reseeded cropland and most of the forage sorghum. Total capital requirements are $3,606 less and returns are $595 less than those for 6 per cent interest. If the interest rate were only 6 per cent, this organization would yield returns of $2,817 which is $426 less than the returns for the optimum organization for 6 per cent interest.

Excluding grazed out wheat when the interest rate is 12 per cent causes rather significant changes from the organization in which grazed out wheat is included. First, there are no feeder livestock compared to 76 head of feeders when grazed out wheat is included. There is nearly twice as much grain sorghum, 212 acres compared to 112 acres. Finally, total capital requirements are $7,369 less and returns are

$1,684 less ($2,648 compared to $4,332) than when grazed out wheat is permitted.

The interest rate must rise above 34 per cent before a change from the organization for 12 per cent interest is profitable. For interest rates above 34 per cent, cow-calf P_{12} would replace cow-calf P_{13} and there would likely be a decrease in the amount of forage sorghum. When the interest rate is 12 per cent, the price of wheat can fall to $1.10 or the price of grain sorghum rise to $2.36 without causing a change in organization. For prices outside these ranges, grain sorghum will replace wheat on C_d cropland and some of the wheat allotment will not be used. A decrease in the price of grain sorghum below $1.53 will result in reseeded cropland replacing grain sorghum on C_d cropland.

Regardless of a manager's risk preferences, these results indicate that returns are enhanced by producing all the wheat permitted by the allotment. All of the C_a and C_b cropland should first be used for wheat and any remaining allotment used on C_c or C_d cropland. Much of the cropland not used for wheat can best be used for grain sorghum, the exact amount depending on requirements of the livestock activities. Including grazed out wheat in the organization may increase returns by as much as $1,500 to $1,700.

Cimarron Sandy, Grazed Out Wheat Included

The yield advantage between wheat and grain sorghum on the Cimarron Sandy soils is just reversed from that on the Panhandle Clay Loam soils. Grain sorghum has a decided advantage on both Cimarron Sandy productivity

classes.[5] Grain sorghum and wheat both provide 0.2 AUM of fall and winter grazing on S_b cropland but the grazing values are not likely to be equal. Grain sorghum provides no grazing on S_c cropland but wheat furnishes 0.15 AUM.[6] Thus, the yields of grain sorghum and wheat cannot be compared directly on S_b cropland and the advantage of grain sorghum is reduced on S_c cropland by the grazing coefficient of wheat. However, the yield advantage of grain sorghum, as indicated by the marginal rates of substitution, is such that it is a more profitable alternative than wheat unless wheat commands a big price premium. The advantage is reduced somewhat by the inclusion of grazed out wheat, along with P_5 and P_6. Optimum organizations and levels of returns for interest rates of 6, 12, and 15 per cent are presented in Table IX.

Some broomcorn is produced on the Cimarron Sandy soils in the Panhandle. However, because of its limited market and the large amount of migratory labor it requires, broomcorn is excluded from the study.[7]

Six Per Cent Interest. Once again, a 6 per cent interest rate may reflect either a low reservation price on the part of the manager or a relatively low rate of interest on borrowed capital. For this rate, grain sorghum is the principal crop in the optimum organization, utilizing all the S_c cropland and part of the S_b cropland. Some wheat is produced on the S_b cropland but the amount is less than that permitted by the wheat allotment. The optimum organization includes 35 head of feeder P_6 and 5 head of cow-calf P_9. Total capital requirements are

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[5]The marginal rates of substitution of wheat for grain sorghum in hundredweight of grain sorghum per bushel of wheat are: 1.43 on S_b cropland and 1.80 on S_c cropland.

[6]See Table I.

[7]See footnote 7, page 17.

TABLE IX

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE INTEREST RATES, GRAZED OUT WHEAT INCLUDED, CIMARRON SANDY RESOURCE SITUATION[a]

Item	Unit	Interest Rate		
		Six Percent	Twelve Percent	Fifteen Percent
Wheat	acre	206	156	-
Wheat	bu.	1,439	1,093	-
Grain sorghum	acre	383	440	625
Grain sorghum	cwt.	3,624	4,193	6,039
Forage sorghum for hay	acre	1	2	2
Grazed out wheat	acre	37	28	-
Feeder P_6	head	35	26	-
Cow-calf P_9	head	5	-	-
Cow-calf P_{15}	head	-	7	8
Hire labor, May-Jul.	hour	214	266	424
Total capital	dol.	6,782	6,294	3,857
Annual capital	dol.	4,824	4,688	3,380
Returns to land, labor management, and risk[b]	dol.	1,838	1,535	1,269
Land Use:				
S_b Land				
Wheat	acre	206	156	-
Grain sorghum	acre	173	230	415
Forage sorghum	acre	1	2	2
Grazed out wheat	acre	37	28	-
S_c Land				
Grain sorghum	acre	210	210	210

[a]Current prices and allotments are assumed.

[b]Programmed returns less nonharvested cropland cost ($202.80) and overhead costs ($3,583).

$6,782 and returns to land, labor, management, and risk are $1,838.

The optimum organization for 6 per cent interest is relatively unstable because only small changes in prices or the interest rate cause changes in the organization. For example, the solution is stable only for interest rates between 5.6 per cent and 6.2 per cent. Below 5.6 per cent, there would be an increase in forage sorghum and this change implies an increase in the number of livestock and the amount of wheat also. Above 6.2 per cent interest, the organization for 12 per cent interest is optimum. It involves a decrease in wheat and feeder livestock and an increase in grain sorghum and the number of cows. Increasing the price of wheat to $1.66 or decreasing the price of grain sorghum to $1.55 results in an increase in the amounts of wheat and forage sorghum and a partial subsitution of P_5 for P_6. Decreasing the price of wheat to $1.64 or increasing the price of grain sorghum to $1.57 results in a substitution of grain sorghum for wheat and P_{15} for P_9. P_{15} substitutes grain sorghum stubble for some of the native range required by P_9.

Twelve and Fifteen Per Cent Interest. As the interest rate rises from 6 per cent, P_6 is less able to pay the higher interest charge and at the same time, overcome the yield advantage of grain sorghum over wheat. That is, P_6 is profitable enough at lower interest rates that it can hold wheat in the organization even though grain sorghum is more profitable than wheat. P_6 becomes relatively less profitable as the interest rate rises and is less able to hold wheat in the organization. Above 6.2 per cent interest, both wheat and P_6 decrease in amount and above 13.2 per cent interest, they are dropped from the organization entirely. As the amount of wheat decreases, forage sorghum and grazed

out wheat also decrease and all three are replaced by grain sorghum. Above 13.2 per cent interest, all but two acres of the cropland are in grain sorghum. Because grain sorghum is a heavy user of May-July labor, the amount of labor hired in this period increases along with the increase in grain sorghum.

Compared to the organization for 6 per cent interest, the organization for 12 per cent requires $488 less total capital and returns are $303 less. If the interest rate were only 6 per cent, returns for this organization would be $1,816 which is only $22 less than the returns for the optimum organization for 6 per cent interest.

The organization for 15 per cent interest has no feeder livestock and all but two acres of the cropland are in grain sorghum. Compared to the optimum organization for 6 per cent interest, total capital requirements are $2,925 less ($3,857) and returns are $569 less ($1,269). If the interest rate were only 6 per cent, returns for this organization would be $265 less ($1,573) than for the optumum organization at 6 per cent interest. This organization is optimum for interest rates between 13.2 and 23 per cent. An increase in the price of wheat to $1.69 or a decrease in the price of grain sorghum to $1.53 would result in P_6, wheat, and grazed out wheat entering the organization again. In order to determine the effects on the optimum organization of prices outside these ranges, a wide range of prices needs to be considered. Such an analysis is reported in Chapter IV.

Cimarron Sandy, Grazed Out Wheat Excluded

The rationale for determining the optimum organization with the grazed out wheat alternative excluded was explained in the Panhandle

Clay Loam section. The same reasons apply here. With grazed out wheat excluded, only two interest rates, 6 and 12 per cent, are considered. Optimum organizations for both rates of interest are reported in Table X. In contrast to the organizations including grazed out wheat, there is now no wheat at all. All but two acres of the cropland are in grain sorghum; the remaining two acres are used to produce forage sorghum for the livestock activities.

Six Per Cent Interest. In addition to 625 acres of grain sorghum and 2 acres of forage sorghum, the optimum organization for 6 per cent interest includes 20 head of feeder P_8 and 7 head of cow-calf P_{15}. P_8 involves buying steers in the fall and feeding them through the winter on grain sorghum stubble and cottonseed cake.[8] Gains as well as returns are quite low. Compared to the organization for 6 per cent interest in which grazed out wheat is included, total capital requirements are $785 less ($5,997 compared to $6,782) and returns are $153 less ($1,685 compared to $1,838).

Interest rates between 0 and 7.1 per cent yield the same optimum organization. For interest rates above 7.1 per cent, the organization for 12 per cent interest is optimum. Wheat prices between 0 and $1.84 or grain sorghum prices between $1.42 and $3.12 yield the same organization. For wheat prices above $1.84 or grain sorghum prices below $1.42, wheat would enter the organization on S_b cropland. For grain sorghum prices above $3.12, the hay requirements would be purchased for $20 per ton and the two remaining acres of cropland would be used to

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[8] See Appendix Table XI.

TABLE X

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE INTEREST RATES, GRAZED OUT WHEAT EXCLUDED, CIMARRON SANDY RESOURCE SITUATION[a]

Item	Unit	Interest Rate	
		Six Percent	Twelve Percent
Grain sorghum	acre	625	625
Grain sorghum	cwt.	6,038	6,039
Forage sorghum for hay	acre	2	2
Feeder P_8	head	20	-
Cow-calf P_{15}	head	7	8
Hire labor, May-Jul.	hour	423	424
Total capital	dol.	5,997	3,850
Annual capital	dol.	4,020	3,377
Returns to land, labor, management, and risk[b]	dol.	1,685	1,408
Land Use:			
S_b Land			
Grain sorghum	acre	415	415
Forage sorghum	acre	2	2
S_c Land			
Grain sorghum	acre	210	210

[a]Current prices and allotments are assumed.

[b]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583).

produce grain sorghum. Thus, in contrast to the organization for 6 per cent interest in which grazed out wheat is included, this organization is quite stable over a wide range of prices and costs.

Twelve Per Cent Interest. Compared to the organization for 6 per cent interest, the changes are minor and returns are reduced only slightly. At 12 per cent interest, P_8 is excluded entirely and P_{15} is increased from 7 to 8 head. These are the only activity changes. Total capital requirements are reduced by $2,147 (from $5,997 to $3,850) and returns to land, labor, management, and risk are reduced by $277. For an interest charge of 6 per cent, returns from this organization would be only $74 ($1,611 compared to $1,685) less than for the optimum organization for 6 per cent interest.

Compared to the organization for 12 per cent interest in which the graze out alternative is included, there are now no feeder livestock and no wheat. Total capital requirements are $2,444 less but returns are only $127 less. As a matter of interest, if only a 6 per cent interest charge is made on the capital requirements of this organization, returns would be only $227 less ($1,611 compared to $1,838) than the returns for the optimum organization for 6 per cent interest in which grazed out wheat is included. Thus, farmers with soils similar to the Cimarron Sandy soils do not sacrifice a large amount of income as a result of excluding grazed out wheat.

This organization is optimum for interest rates between 7.1 and 25 per cent. Above 25 per cent, cow-calf P_9 would be substituted for cow-calf P_{15}. Since P_9 requires less forage sorghum than P_{15}, an increase in the amount of grain sorghum is probably implied by this

substitution. The organization is optimum for wheat prices between 0 and $1.84 and for grain sorghum prices between $1.42 and $3.32. For wheat prices above $1.84 or grain sorghum prices below $1.42, wheat would enter the organization on S_b cropland. For grain sorghum prices above $3.32, forage sorghum hay would be purchased and the two acres now used to produce forage sorghum would be used for grain sorghum.

Stability Ranges and Shadow Prices

The linear programming solution provides information about the stability ranges of cost and returns coefficients, the marginal value product of resources (shadow prices) and the ranges of linearity for Zj - Cj values. "The implication of the limits of the cost /or returns/ coefficients is that if all other cost coefficients remain fixed, the cost coefficient of the variable in question may change to any value within the stated range without affecting optimality."[9] In this study, these limits of the cost coefficients will be termed 'stability ranges'. Selected stability ranges for the organizations reported in this study can be found in Appendix Tables XIII and XIV.

> The range of activity over which the shadow price applies simply defines the limits of linearity. Thus, if an upper limit of a range turns out to be say, 12, then the variable in question can replace portions of one or many other items in the final solution at a cost penalty per unit indicated by the shadow price up to a limit of 12 units. The shadow price beyond that range cannot be predicted.[10]

Actually, the term shadow price is usually reserved for the Zj - Cj

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[9] O. R. Perry and J. S. Bonner, Linear Programming Code for the Augmented 650, File No. 10.1.006, 650 Program Library (Los Angeles, 1958), p. 8.

[10] Ibid.

values of resources. They represent the marginal value products of the resources.[11] No special name has been given to the other $Z_j - C_j$ values. In this study, unstable $Z_j - C_j$ values and some others of interest are reported in Appendix Tables XV and XVI. A $Z_j - C_j$ value less than one dollar is arbitrarily assumed to be unstable.

Interpretation of Returns Estimates

The estimates of returns to land, labor, management, and risk reported for the optimum organizations in this study are residual returns. That is, they are the returns remaining after paying some, but not all, costs. Costs for items such as seed, feed, interest on borrowed capital, and variable machine costs were deducted from total returns. Then an allowance was deducted for overhead costs including: machinery fixed costs, building depreciation and maintenance, land taxes, etc.[12] The residual is the amount remaining to pay family living expenses, pay for the use of land and labor resources, and provide a reserve for saving or growth. Of course, if capital is owned, the residual is greater than if interest must be paid on borrowed capital. For $7,000 of annual capital and 6 per cent interest, the residual returns would be increased by $420 if the capital resources are owned.

It is not absolutely essential that a deduction for overhead costs be made every year unless the manager is currently paying for the resources for which these charges are made. In a particular year, this amount can be used for family living, etc. However, if the overhead cost

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[11] Heady and Candler, p. 85.

[12] Detailed estimates of overhead costs appear in Appendix Table X.

deductions are suspended indefinitely, it will be impossible to replace resources from earnings as those resources wear out or become obsolete. If the overhead costs are not paid from earnings, they must be paid from past savings or from other sources if the farm firm it to remain in business over the long run.

Income Opportunities Implied by Results

On the basis of the results in this chapter, some generalizations can be made about the income opportunities for various owner-renter positions. Three positions will be considered: (1) owner of all resources, (2) renter who owns all resources except land, and (3) renter who owns all resources except land and operating capital. The income estimates are long run normal returns. That is, they are average expected returns over time. The organizations for 6 per cent interest presented in Tables VI and IX will be used as the bases for the inferences in this section. Aggregate land prices assumed are $100 per acre for Panhandle Clay Loam and $60 per acre for Cimarron Sandy. Results are presented in Table XI. To make the comparisons, a 6 per cent interest charge was made on all borrowed operating capital. A rental charge equal to 5 per cent of the land value is assumed.

As might be expected, residual returns are greatest to the operator owning the most resources. For both Panhandle Clay Loam and Cimarron Sandy situations, returns are highest to the owner of all resources, lower for the renter and lowest for the operator who rents and borrows operating capital as well. Income opportunities are higher on Panhandle Clay Loam situations than on Cimarron Sandy situations according to these results.

TABLE XI

INCOME OPPORTUNITIES FOR ALTERNATIVE OWNER POSITIONS, OKLAHOMA PANHANDLE[a]

Resource Situation	Owner Position		
	Owner, All Resources[b]	Renter, Land[c]	Part Owner, Renter[d]
	(net returns to owned resources)		
Panhandle Clay Loam	$5,131	$1,776	$1,375
Cimarron Sandy	$2,127	$ 291	$ 2

[a]Returns shown are residual returns. It is assumed that the land owner pays land taxes and depreciation and maintenance on buildings.

[b]Owns all resources including land and operating capital.

[c]Rents land but owns all other resources including operating capital.

[d]Rents land, borrows operating capital but owns other resources.

CHAPTER IV

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE PRICES

Alternative capital availability conditions, current prices and allotments, and managerial preferences as to acceptable livestock activities were considered in Chapter III. In this chapter, optimum organizations for a wide variety of wheat, grain sorghum, and livestock prices are ascertained. Allotments have been eliminated in order to determine the unrestricted response to the various price conditions. To further emphasize the effects of the price variations, an unlimited amount of capital is assumed to be available at 6 per cent interest and no activities are excluded.

Prices received by farmers vary rather widely over time and cannot be predicted in advance with exactness. As a result, decisions by farm managers must be based on expected prices. Changes in expected prices may call for changes in the farm organization if returns to the fixed resources are to be maximized. There is a need on the part of farm managers, then, for information about the effects of alternative prices on returns from various combinations of activities. If an organization is available which is optimum over a variety of price conditions, the decision-making problems of the manager are reduced.

Farm policy makers have a need for information about the response farmers can be expected to make to various agricultural programs and economic conditions. For example, what production response can be

expected to a proposed wheat or grain sorghum support price? What effect, if any, is the proposed price likely to have on the production of livestock and, subsequently, on livestock prices? Will controls be necessary in order to maintain production within desired limits? The analysis of this chapter is directed toward providing useful information for both the farmer and the policy maker.

Two major simplifying assumptions have been made. First, allotments have been excluded entirely to obtain information about the unrestricted response to various conditions. The results of Chapter III provide information relative to the effects of allotments. Second, livestock prices are assumed to vary in direct proportion to grain sorghum prices. Livestock prices in Appendix Table VII are assumed to be associated with a grain sorghum price of $1.56 for this purpose. On this basis, the October price for a 450 lb. steer associated with a grain sorghum price of $1.56 is $23.42 per hundredweight. When the grain sorghum price is $1.00, the steer price is $15.01 and when the grain sorghum is $1.70 the steer price is $25.52. Other livestock prices associated with the grain sorghum prices assumed in this chapter are presented in Appendix Table VIII.

According to economic theory, "Maximum profits are attained, with costs or resources fixed in quantity, when the marginal rate of product substitution is inversely equal to the product price ratio."[1] For two products Y_1 and Y_2 this can be restated: $\Delta Y_1/\Delta Y_2 = Py_2/Py_1$ where $\Delta Y_1/\Delta Y_2$ refers to the marginal rate of substitution of Y_2 for Y_1, and Py_1 and Py_2

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[1]Earl O. Heady, Economics of Agricultural Production and Resource Use (New York, 1952), pp. 239, 240.

refer to the prices of Y_1 and Y_2 respectively. Some resources, primarily land and machinery, are assumed to be fixed in this analysis and the marginal rates of substitution are useful in explaining some of the results. However, it is difficult to apply the marginal rates of subsitution directly because of the difficulty in specifying them exactly. For example, both wheat and grain sorghum provide fall grazing in addition to grain. It is very difficult to account for both the grazing and grain production in a single marginal rate of subsitution. The problem is further complicated by the difficulty of assigning a value to the grazing. As a consequence, the marginal rates of subsitution in terms of grain only will be referred to in discussing the results which follow. In spite of their shortcomings for explaining the programmed results, they provide some interesting comparisons and they indicate general directions if not exact amounts.

Panhandle Clay Loam Resource Situation

For this portion of the analysis, three grain sorghum prices and five wheat prices were selected on a somewhat arbitrary basis. Grain sorghum prices selected are: $1.00, $1.35, and $1.70 and wheat prices are: $1.00, $1.15, $1.20, $1.35, and $1.65.[2] Wheat prices of $1.00 and $1.15 are used in combination with a grain sorghum price of $1.70 only but all other combinations of these prices are considered. Certainly, not all of these price combinations are relevant for either current or prospective conditions. A bushel of wheat is approximately equivalent to 0.66 hundredweight of grain sorghum for feeding purposes. Conse-

[2]Once again, these are prices per bushel for wheat and per hundredweight for grain sorghum.

quently, the price ratio (P_w/P_{gs}) is not likely to fall below 0.66.[3] With a premium such as that proposed in the defeated 1964 wheat program ($2.00 wheat and $1.56 grain sorghum), the price ratio (P_w/P_{gs}) is only 1.29 and a higher ratio seems unlikely. Clearly, some of the price combinations considered here fall outside these ranges. However, this portion of the analysis constitutes a rough price-mapping attempt to determine the ranges over which different organizations are optimum without regard to the practical relevance of a particular price combination. Not every combination considered yielded a unique organization but the unique ones found are presented in Table XII.

In general, for any wheat price above $1.05 among the price combinations considered, no grain sorghum is produced and most of the cropland is in wheat. When the price of wheat is $1.05, the ratio between this price and the highest grain sorghum price considered, $1.70, is 0.62. As this ratio increases, that is, as the price of wheat increases relative to the price of grain sorghum, the program attempts to increase the amount of wheat. There are other minor changes as the price ratio increases but their significance is almost negligible.

On C_c cropland, the clay loam with the highest marginal rate of subsitution ($\Delta GS/\Delta W = 0.80$), the price ratio must fall below 0.62 in order for grain sorghum to be produced. The programming solution for $1.00 wheat and $1.70 grain sorghum indicates that a fall in the price ratio to 0.51 would result in grain sorghum being produced on C_d cropland. Lower price ratios were not considered in this section. However, if

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[3] Frank B. Morrison, Feeds and Feeding (twenty-second edition; New York, 1957), pp. 438, 454, 455.

TABLE XII

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE PRICES OF GRAIN SORGHUM AND WHEAT, NO ALLOTMENTS, PANHANDLE CLAY LOAM RESOURCE SITUATION[a]

Grain Sorghum Price / Wheat Price		$1.70 / $1.00	$1.70 / $1.15	$1.00[b] / $1.20	$1.00 / $1.65
Item	Unit				
Wheat	acre	369	467	468	474
Wheat	bu.	4,461	5,426	5,436	5,482
Grain sorghum	acre	119	-	-	-
Grain sorghum	cwt.	952	-	-	-
Forage sorghum for hay	acre	26	30	29	28
Grazed out wheat	acre	78	94	94	89
Feeder P_5	head	57	90	90	86
Feeder P_6	head	18	-	-	-
Cow-calf P_9	head	-	-	2	-
Cow-calf P_{11}	head	3	2	-	-
Cow-calf P_{12}	head	-	-	-	2
Total capital	dol.	10,291	11,844	11,798	11,422
Annual capital	dol.	6,608	7,442	7,391	7,221
Returns to land, labor, management, and risk[c]	dol.	2,255	3,065	1,300	3,747
Land Use:					
C_a Land					
Wheat	acre	31	31	31	31
C_b Land					
Wheat	acre	331	331	331	331
C_c Land					
Wheat	acre	-	89	90	91
Grain sorghum	acre	119	-	-	-
Forage sorghum	acre	-	30	29	28
C_d Land					
Wheat	acre	7	16	16	21
Forage sorghum	acre	26	-	-	-
Grazed out wheat	acre	78	94	94	89

[a]Livestock prices are assumed to vary in direct proportion to the grain sorghum price.

[b]Several other price combinations yield the same combination of enterprises but different returns. Some of those prices and associated returns follow:

Grain Sorghum Price	Wheat Price	Returns[c]
$1.00	$1.35	$2,116
$1.70	$1.20	$3,337
$1.35	$1.65	$4,763

[c]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517).

these same general relationships hold, the price ratio (P_w/P_{gs}) would have to drop to 0.46 on C_a cropland and 0.28 on C_b cropland before grain sorghum would replace wheat. With $1.70 grain sorghum, a price ratio of 0.28 implies a wheat price of $0.48 and a price ratio of 0.46 implies a wheat price of $0.78. In view of such facts, it is no surprise that C_a and C_b cropland is used to produce wheat for all price combinations considered. It should be emphasized, however, that these results are somewhat exaggerated by the inclusion of the grazed out wheat alternative. The price ratios probably would not have to fall so low in order to substitute grain sorghum for wheat if the graze out alternative (and thus P_5 and P_6) were excluded. Marginal rates of substitution of wheat for grain sorghum on the various clay loam productivity classes are reported in Table XIII.

TABLE XIII

MARGINAL RATES OF SUBSTITUTION OF WHEAT FOR GRAIN SORGHUM, PANHANDLE CLAY LOAM RESOURCE SITUATION[a]

Productivity Class	Marginal Rate of Substitution[b]
C_a	0.64
C_b	0.46
C_c	0.80
C_d	0.69

[a]Based on yields reported in Table I.

[b]These marginal rates of substitution are in hundredweight of grain sorghum per bushel of wheat.

A discussion of the optimum organizations for the different price combinations follows. Particular characteristics and some of the stability ranges for each organization will be considered.

Wheat $1.00, Grain Sorghum $1.70. The price ratio ($P_w/P_{gs}$) for this combination of prices is 0.59. As noted above, all of the C_c cropland is used to produce grain sorghum for price ratios below 0.62. Thus, for this combination of prices, the C_c cropland is in grain sorghum. All the C_a and C_b cropland is used for wheat and the C_d cropland is used to produce forage sorghum and grazed out wheat for the livestock. Feeder P_6 is added to the limit of the grain sorghum stubble grazing and feeder P_5 is added to the limit of the fall wheat grazing not utilized by P_6. Total capital requirements are $10,291 and returns to land, labor, management, and risk are $2,255. These returns are lower than those for a very similar organization reported in Chapter III, primarily because of the lower wheat price.[4] That is, a wheat price of $1.00 rather than one of $1.65 results in a reduction in returns of approximately $2,500.

With the grain sorghum price fixed at $1.70, the price of wheat can vary between $0.87 and $1.05 without causing changes in the optimum organization. For wheat prices below $0.87 ($P_w/P_{gs} < 0.51$), grain sorghum would replace at least some of the wheat on C_d cropland. For wheat prices above $1.05, the organization for $1.15 wheat and $1.70 grain sorghum is optimum. In that organization, grain sorghum is dropped entirely and wheat and forage sorghum take over the C_c cropland formerly used for grain sorghum. There is also an increase in the number of feeder livestock.

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[4]See Table VI, p. 24.

With the wheat price fixed at $1.00 and livestock prices fixed at those associated with $1.70 grain sorghum, the price of grain sorghum can vary between $1.68 and $1.86 without causing a change in organization. Above $1.86, grain sorghum would replace at least part of the wheat on C_d cropland. For prices below $1.68, at least part of the C_c cropland now in grain sorghum would be shifted to wheat.

Wheat $1.15 and $1.20, Grain Sorghum $1.70. Now, the price ratio (P_w/P_{gs}) has risen to 0.68. Grain sorghum is excluded from the optimum organization and, in its place, wheat and forage sorghum are produced. Since no grain sorghum stubble grazing is available, feeder P_6 is replaced by feeder P_5. There are now 90 feeder animals compared to 75 for the preceding combination of prices ($1.70 grain sorghum and $1.00 wheat). Largely as a result of the increase in the number of livestock, total capital requirements have increased by $1,553 (from $10,291 to $11,844). Returns have increased by $810 (from $2,255 to $3,065). This organization would return $2,251 to land, labor, management, and risk if the price of wheat were only $1.00, other prices constant. This is only $4 less than for the optimum organization for $1.00 wheat and $1.70 grain sorghum. Thus, most of the increase in returns can be attributed to the increase in the price of wheat rather than to the change in the combination of activities.

This specific organization is stable only within relatively narrow price ranges. It is optimum only for price ratios (P_w/P_{gs}) between 0.62 and 0.70. For price ratios above 0.70, the substitution of P_9 for P_{11} permits the substitution of wheat for forage sorghum but on only one acre. As the price ratio rises above 1.37, a shift from

P_9 to P_{13} (P_{13} utilizes some fall wheat pasture) results in a decrease in P_5, grazed out wheat, and forage sorghum and an increase in wheat of 6 acres. Capital requirements decrease as the amount of wheat increases and the number of livestock decreases. Returns, on the other hand, depend more on the absolute level of prices than on price ratios. Thus, when the prices of wheat and livestock are high, returns are high and vice versa. Obviously, the price of wheat has a greater effect on returns than does the price of grain sorghum since there is no grain sorghum in the organization.

To summarize the results of this section, the organization for \$1.00 wheat and \$1.70 grain sorghum (\$1.00/\$1.70 = 0.59) is optimum for price ratios (P_w/P_{gs}) between 0.51 and 0.62. The organization for \$1.15 wheat and \$1.70 grain sorghum (\$1.15/\$1.70 = 0.68) is optimum for price ratios between 0.62 and 0.70. The organization for \$1.20 wheat and \$1.00 grain sorghum (\$1.20/\$1.00 = 1.2) is optimum for price ratios between 0.70 and 1.37. Finally, the organization for \$1.65 wheat and \$1.00 grain sorghum (\$1.65/\$1.00 = 1.65) is optimum for price ratios above 1.37. All of these ranges of optimality assume the inclusion of the grazed out wheat alternative. The price ratios at which changes from one organization to another occur would be somewhat higher if grazed out wheat were excluded but the exact values of these higher ratios were not determined in this study.

Cimarron Sandy Resource Situation

Three prices each for both grain sorghum and wheat are considered for the Cimarron Sandy situation. Grain sorghum prices are: \$1.20, \$1.45, and \$1.65 and wheat prices are: \$1.25, \$1.60, and \$1.75. Optimum

farm organizations for all nine price combinations were ascertained. Had the 1964 wheat program passed, price ratios as high as 1.29 (wheat $2.00 and grain sorghum $1.56) might have been relevant. For prospective prices for 1964, a price ratio of approximately 0.78 (wheat $1.25, grain sorghum $1.60) appears to be relevant. However, the prices used in this section were not selected on the basis of any particular program. They were selected in an attempt to illustrate the effects of a wide range of price conditions. Again, not every price combination selected yielded a unique organization but the unique ones found are presented in Table XIV.

Compared to the results for the Panhandle Clay Loam resource situation, smaller changes in the ratio of wheat and grain sorghum prices are necessary to cause changes in organization. For a price ratio (P_w/P_{gs}) of 1.33, the highest ratio considered in this part of the analysis, all of the S_b cropland is in wheat, and grain sorghum occupies only a part of the S_c cropland. Feeder activities P_5 and P_6 also appear in the optimum organization since both wheat and grain sorghum appear. As the price ratio falls from 1.33, wheat is gradually replaced by grain sorghum. Feeder P_6 increases at first as it is substituted for feeder P_5, and then decreases. Capital requirements decrease along with the decrease in the number of livestock. Finally, when the price ratio falls below 0.91, wheat and feeder livestock disappear from the organization and grain sorghum occupies all but two acres of the cropland. Returns to land, labor, management, and risk depend more on the absolute level of prices than on price ratios. Thus, no generalizations can be made about the change in returns associated with changes in the price ratio (P_w/P_{gs}). However, these results do make it possible to make inferences about the effects of alternative agricultural programs, among them the 1964 wheat

TABLE XIV

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE PRICES OF GRAIN SORGHUM AND WHEAT, NO ALLOTMENTS, CIMARRON SANDY RESOURCE SITUATION[a]

Wheat Price / Grain Sorghum Price		$1.60[b] / $1.20	$1.75 / $1.45	$1.25[c] / $1.20	$1.75 / $1.65	$1.25 / $1.45	$1.25[d] / $1.65
Item	Unit						
Wheat	acre	417	396	223	156	-	-
Wheat	bu.	2,919	2,772	1,561	1,093	-	-
Grain sorghum	acre	88	116	350	440	625	625
Grain sorghum	cwt.	787	1,064	3,345	4,193	6,039	6,038
Forage sorghum for hay	acre	23	21	1	2	2	2
Grazed out wheat	acre	99	94	53	29	-	-
Feeder P_5	head	72	65	-	-	-	-
Feeder P_6	head	-	4	39	26	-	-
Feeder P_8	head	-	-	-	-	-	20
Cow-calf P_9	head	4	4	5	-	-	-
Cow-calf P_{15}	head	-	-	-	7	8	7
Hire labor, May-Jul.	hour	-	-	185	266	424	423
Total capital	dol.	10,361	9,990	7,156	6,294	3,857	6,000
Annual capital	dol.	6,778	6,577	5,029	4,688	3,380	4,022
Returns to land, labor, management, and risk[e]	dol.	429	1,682	-519	2,411	860	2,294
Land Use:							
S_b Land							
Wheat	acre	417	396	223	156	-	-
Grain sorghum	acre	-	21	193	230	415	415
Forage sorghum	acre	-	-	1	2	2	2
Grazed out wheat	acre	-	-	-	29	-	-
S_c Land							
Grain sorghum	acre	88	95	157	210	210	210
Forage sorghum	acre	23	21	-	-	-	-
Grazed out wheat	acre	99	94	53	-	-	-

[a]Livestock prices are assumed to vary in direct proportion to the grain sorghum price.

[b]Wheat $1.75 and grain sorghum $1.20 gives the same solution but $867 returns.

[c]Wheat $1.60 and grain sorghum $1.45 gives the same solution but $1,234 returns.

[d]Wheat $1.60 and grain sorghum $1.65 gives the same solution and returns.

[e]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583).

program. The implications of these results for wheat programs similar to the 1964 program will be discussed in a later section of this chapter.

Some of the price ratios between 1.33 and 0.91 result in changes of organization which are of interest and some which are of considerable significance. When the ratio falls below 1.23 ($1.75/$1.45 = 1.21), grain sorghum is substituted for wheat but only to the point that all available operator labor in the May-July period is used. For this ratio of prices, grain sorghum is relatively more profitable than wheat but not enough so to pay for hiring labor. When the price ratio falls below 1.05 ($1.25/$1.20 = 1.04), P_6 is the only feeder activity remaining. Grain sorghum and wheat are divided on S_b cropland in a manner permitting the maximum amount of P_6. As noted above, grain sorghum replaces wheat entirely when the price ratio falls below 0.91. Marginal rates of substitution ($\Delta GS/\Delta W$) for the two Cimarron Sandy productivity classes are presented in Table XV. They cannot be compared directly to the price ratios because they do not take account of the grazing furnished by wheat and grain sorghum.

TABLE XV

MARGINAL RATES OF SUBSITUTION OF WHEAT FOR GRAIN SORGHUM, CIMARRON SANDY RESOURCE SITUATION[a]

Productivity Class	Marginal Rate of Substitution[b]
S_b	1.43
S_c	1.80

[a]Based on yields reported in Table I.

[b]These marginal rates of substitution are in hundredweight of grain sorghum per bushel of wheat.

In the final organization of this group ($1.25 wheat and $1.65 grain sorghum), 20 head of feeders P_8 have been added compared to the organization for $1.25 wheat and $1.45 grain sorghum. Returns to land, labor, management, and risk increase by $1,434 between the two organizations. However, approximately $1,208 of the increase is due to the increase in the grain sorghum price. The feeders have added only $226 to returns but have increased annual capital requirements by $642 and total capital requirements by $2,143. Thus, if only a limited amount of capital is available, the feeders likely would not be included in the organization.

Following are some of the stability ranges for some of the optimum organizations found in this part of the analysis. Only those price combinations which appear to have some relevance now or in the near future are discussed.

Wheat $1.75, Grain Sorghum $1.65. Any higher wheat price would cause a change in organization but wheat prices down to $1.62 cause no change. Any lower grain sorghum price would cause a change in organization but the price of grain sorghum can rise to $1.73 without causing a change. For wheat prices above $1.75 or grain sorghum prices below $1.65, cow-calf P_9 would be substituted for cow-calf P_{15}. This substitution would make more stubble grazing available and would likely result in an increase in P_6. Wheat prices below $1.62 or grain sorghum prices above $1.73 would result in the substiution of P_8 for P_6. Since P_8 utilizes stubble but no wheat grazing, this substitution implies the substitution of grain sorghum for some wheat.

Wheat $1.25, Grain Sorghum $1.45. All but two acres of the cropland are in grain sorghum for this organization. Wheat prices between zero

and $1.37 or grain sorghum prices between $1.37 and $2.66 yield the same optimum organization. For wheat prices above $1.37 or grain sorghum prices below $1.37, wheat would re-enter the organization on S_b cropland. Feeder activity P_6 would also enter along with the wheat. For grain sorghum prices above $2.66, feeder P_1 enters the organization in place of cow-calf P_{15}. Feeder P_1 utilizes large amounts of native range as does P_{15} but requires less forage sorghum hay. The substitution of P_1 for P_{15} implies, in addition, the substitution of grain sorghum for forage sorghum.

Wheat $1.25, Grain Sorghum $1.65. The principal change in this organization from the preceding one is the addition of feeder P_8. Differences in relative returns for P_8 and P_{15} as the grain sorghum price increases from $1.45 to $1.65 are responsible for the addition of P_8 at the expense of one unit of P_{15}. Amounts of both grain sorghum and forage sorghum are the same. Wheat prices between zero and $1.62 or grain sorghum prices between $1.43 and $3.03 yield the same optimum organization. Wheat prices above $1.62 or grain sorghum prices below $1.43 result in wheat re-entering the organization on S_b cropland. For grain sorghum prices above $3.03, grain sorghum would replace forage sorghum on the remaining two acres of cropland and hay for the livestock activities would be bought for $20 per ton rather than produced. Returns for this organization ($1.25 wheat, $1.65 grain sorghum) are $1,434 greater than for $1.25 wheat and $1.45 grain sorghum although the only significant change in the organization is the addition of P_8. Only $226 of this can be credited to the livestock, however; the other $1,208 is due to the increase in the price of grain sorghum.

Additional stability ranges can be found in Appendix Table XIV.

Implications of Results for 1964 Wheat Program

Whether legislation will be passed before 1964, establishing a wheat program different from the present one is open to speculation. In the absence of new legislation, the price of wheat in 1964 is uncertain. However, the support price will be approximately $1.25 for those farmers who comply with their allotments. The results of this chapter and the previous one provide information of use to farmers in making their planting plans for the coming year. Implications of these results for farms on Panhandle Clay Loam type soils are quite different from those for farms on Cimarron Sandy soils and will be treated separately. The generalizations relative to both types of farms assume a grain sorghum price near $1.56.

A problem which managers must consider in making their decisions is that of maintaining allotments. In the past, it has been necessary to plant all the alloted wheat in order to maintain an allotment. Underplanting meant losing some wheat history and some allotment. Overplanting, on the other hand, has entailed rather severe penalties on the amount of overplanting. Whether these consequences of overplanting and underplanting will be in effect in 1964 will have a bearing on farmers' decisions. If underplanting will not involve losing wheat history, farmers on Cimarron Sandy soils may underplant in 1964. Even if overplanting involves penalties, but no loss of history, farmers on Panhandle Clay Loam soils are likely to overplant in 1964 or in any year with conditions similar to those in prospect for 1964.

Panhandle Clay Loam. The results of this chapter indicate that, even for $1.25 wheat, farmers would maximize net returns by producing

wheat on nearly all the cropland, leaving only enough cropland to produce feed for livestock. When the price of wheat is $1.25 and the price of grain sorghum is $1.56, the ratio of the prices (P_w/P_{gs}) is 0.80. In the results, grain sorghum did not replace wheat on any class of land until the price ratio fell below 0.62. With a grain sorghum price of $1.56, a wheat price below $0.97 would have to be expected before it would be profitable to underplant the wheat allotment in favor of grain sorghum. Even then, only the C_c cropland could profitably be used for grain sorghum. Of course, if the amount of wheat is limited by an allotment, grain sorghum is the most profitable alternative on the remaining land.

The results in Chapter III along with those in this chapter provide guide lines for using cropland not planted to wheat and for the inclusion of livestock. Those results indicate that it is profitable to produce all the P_6 possible with the available grain sorghum stubble and to use the remainder of the wheat grazing for P_5. If the 1964 wheat price is $1.25 and if the farmer plants within his allotment as in Table VI, p. 24. returns of approximately $2,912 appear likely. Because of the advantage of wheat over grain sorghum on the clay loam soils at these prices ($1.25 wheat, $1.56 grain sorghum), there is no incentive to underplant the allotment. Unless severe penalties are involved, there is an incentive to overplant wheat on the clay loam soils. If only bushel penalties are enforced, a farmer can afford to pay the following per bushel penalties on wheat to overplant the allotment: $0.28 on C_c cropland, $0.45 on C_d, $0.53 on C_a and $0.81 on C_b. These penalties include no allowance for the cost of sacrificing allotment acres, however. Because of the advantage of wheat over grain sorghum, it may be unwise to overplant the allotment if allotment acres are sacrificed as a result.

Cimarron Sandy. The optimum strategy on Cimarron Sandy type soils depends on the manager's expectations about future prices and his preferences as to livestock activities. Whether prices are expected to remain low, return to approximately their present levels, or move up near $2.00 as the result of agricultural programs has a bearing on the optimum strategy. Whether the grazed out wheat alternatives are acceptable to the manager also affects the combinations of activities and the returns which can be expected.

If wheat prices are expected to remain at a low level, the wheat allotment is of no particular value and a manager would not be concerned with maintaining his wheat history. The optimum organization is very similar to those reported in Table X. Almost all of the cropland is used to produce grain sorghum. Twenty units of feeder P_8 will add about $200 to returns compared to excluding feeders altogether, when the interest rate on borrowed capital is less than 7 per cent. A few cows also increase the returns somewhat.

If wheat prices are expected to return to present levels after 1964, a manager might be interested in maintaining at least part of his allotment. For wheat prices near $1.65, including wheat in the organization increases returns if feeder livestock such as P_5 and P_6 are also included. The optimum organization in this case is similar to that presented in Table IX. In this case, a manager will be interested in maintaining at least 225 acres of his wheat allotment. By producing 225 acres of wheat and using the majority of the remainder of the cropland for grain sorghum, returns will be approximately $300 less than if grain sorghum is produced on all the cropland. A wheat history of 225 acres will be maintained however. If a manager has a preference against feeder livestock

such as P_5 and P_6, the wheat allotment is of no value even when the price of wheat is $1.65. In that case, grain sorghum is the most profitable alternative on almost all of the cropland.

Finally, if future wheat prices of $2.00 or higher are expected, the maximum possible allotment is profitable if P_5 and P_6 are acceptable activities. With P_5 and P_6 included, it is profitable to produce wheat on all the S_b cropland for all price ratios (P_w/P_{gs}) greater than 1.30. The amount of S_b cropland is greater than even the present wheat allotment (417 acres of S_b cropland but only 268 acres of allotment). Planting the full allotment (268 acres) when the anticipated wheat price is $1.25 would result in returns approximately $400 less than those for which all cropland is used to produce grain sorghum. However, if P_5 and P_6 are unacceptable activities, $1.56 grain sorghum is a more profitable alternative than $2.00 wheat.

Price relationships similar to those anticipated for 1964 ($1.25 wheat and $1.56 grain sorghum) appear to provide little incentive for decreasing the production of wheat in the Panhandle. Production might be reduced on Cimarron Sandy farms unless managers are concerned about maintaining their wheat histories. However, production of wheat on Panhandle Clay Loam farms is likely to increase in the absence of severe penalties on overproduction. Panhandle Clay Loam soils constitute approximately 72 per cent of the nonirrigated cropland in the Panhandle. The consequence of all the conditions combined is likely to be an increase in aggregate wheat production in the Panhandle unless production restraints are imposed.

The optimum adjustment (and the response which can be expected) from farms with a combination of Panhandle Clay Loam and Cimarron Sandy soils

was not considered in this study. There is a need for such information however, both on the part of the farmer and the policy maker. On the basis of the results in this study, the most profitable alternatives would be wheat on the Panhandle Clay Loam soils and grain sorghum on the Cimarron Sandy soils. It appears likely that price relationships such as those anticipated for 1964 would still result in an increase in the production of wheat in the Panhandle in the absence of production controls.

CHAPTER V

OPTIMUM FARM ORGANIZATIONS FOR LAND EXPANSION ALTERNATIVES AND ALTERNATIVE AMOUNTS OF CAPITAL

In the two previous chapters, the analysis has been marked by the assumptions that only a fixed amount of land is available and that an unlimited amount of capital can be borrowed at a given interest rate. In the first part of this chapter, the fixed land assumption is dropped. The opportunity to either buy or rent additional land is presented and the effect of this alternative on the farm organization and the level of returns is determined. In the second part of the chapter, the amount of capital and the amounts of land and machinery are assumed to be fixed to the farm. The amount of capital is fixed at alternative levels, however, and the optimum organization determined for each different level. Current prices and allotments are assumed in both parts of the analysis in this chapter. However, the stability ranges and shadow prices permit the interpretation of results for certain other prices.

The land expansion alternative reflects an intermediate rather than a short-run situation. Given enough time, a farm manager is often able to find land for rent or for sale. Assuming that he has the machinery resources to handle the additional land, the manager needs to know whether handling the land will be profitable and, if so, what changes in organization are necessary in order to maximize returns. The fixed capital alternatives may reflect either of two situations. First, the manager

may have only a given amount of owned capital available which he cannot (or will not) increase by borrowing. Second, because of his equity situation or for other reasons, capital may be available above certain amounts only at prohibitive rates of interest.

Buy Land and Rent Land Alternatives

It is assumed that each additional acre whether rented or bought has the same distribution of soils among productivity classes, native range, etc., as the respective resource situations. The addition of only sandy soils to the sandy resource situation and only clay loam soils to the clay loam situation is considered. In this study, items constituting the cost per acre of buying land are: (1) a land payment amortized over 33 years at five per cent interest,[1] (2) nonharvested cropland costs, and (3) land taxes. The land rent charge per acre consists of: (1) six per cent interest on the land value and (2) nonharvested cropland costs. In effect, the six per cent interest charge on rented land forces the renter to pay five per cent interest on the value of the land plus most of the land tax. Assumed costs per acre of land, both for renting and for buying appear in Table XVI.

Since both purchased and rented land add the same amounts to the available land and allotment resources, the one with the lower cost enters the solution first. Consequently, rented land always enters the solution before bought land for both resource situations. In the

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[1]Land prices on which the land payments are based were estimated by Larry J. Connor, Ph.D. manuscript in progress (Oklahoma State University, Stillwater).

programming process, both the buy-land and the rent-land activities were included at first. Then, with the rent-land activity excluded, the program was run a second time to determine whether or not the buy-land activity would enter the solution.

TABLE XVI

ASSUMED ANNUAL PER ACRE COSTS FOR BUYING AND RENTING LAND, BY RESOURCE SITUATION, OKLAHOMA PANHANDLE

	Panhandle Clay Loam		Cimarron Sandy	
	Buy Land	Rent Land	Buy Land	Rent Land
	-dollars-			
Interest and principal payment[a]	6.25	6.00	3.75	3.60
Land taxes[b]	.78	--	.76	--
Nonharvested cropland cost	.22	.22	.21	.21
Total cost per acre	7.25	6.22	4.72	3.81

[a]Five per cent interest plus principal payment for buy-land. Six per cent interest only for rent-land.

[b]Based on $0.88 per acre of cropland and $0.24 per acre of range and other land.

A restriction of 320 acres was placed on the amount of land which could be added by either renting, buying, or both. It was noted in Chapter II that the assumed machinery complement can handle up to 1,200 acres of cropland. An additional 320 acres of land brings the total acres of cropland to approximately 1,010 acres on Panhandle Clay Loam and 1,044 acres on Cimarron Sandy, both well within the 1,200 acre limit. Without the 320 acre restriction, there might have been no other effective limit on the solution since labor can be hired and capital can be borrowed.

Since the organizations for the present sizes of farms reported in Chapter III show positive net returns, it is not surprising that returns can be increased by expanding the farms. In fact, by either buying or renting, both farms are expanded by the full 320 acres permitted. When both buying and renting are permitted, the additional land is rented. When renting land is excluded, the additional land is bought. The 320 acre restriction is the only effective limit on land expansion for the assumed costs of buying and renting. The composition of each of the representative farms after adding 320 acres of land is presented in Table XVII. Total amounts of land and the amounts of cropland which can be harvested each year are tabulated by productivity class.

TABLE XVII

LAND CLASSIFICATION AND WHEAT ALLOTMENTS FOR REPRESENTATIVE FARMS AFTER ADDING 320 ACRES TO THE ORIGINAL LAND RESOURCES, OKLAHOMA PANHANDLE

Item	Panhandle Clay Loam		Cimarron Sandy	
	Total Land	Harvested Cropland[a]	Total Land	Harvested Cropland[a]
	-acres-			
Soil Productivity Class				
a	53	42	--	--
b	565	452	695	556
c	203	162	349	280
d	188	150	--	--
Total cropland	1,009	806	1,044	836
Native pasture land	154	--	196	--
Other land[b]	37	--	40	--
Total farmland	1,200	--	1,280	--
Wheat allotment[c]	513	--	357	--

[a]Twenty per cent nonharvested cropland excluded.

[b]Includes farmsteads, roads, waste, etc.

[c]Base allotments for 1959-1961.

Panhandle Clay Loam. The optimum organization for the Panhandle Clay Loam farm, after the land is added, is very similar to the organization for the original set of resources presented in Chapter III.[2] In general, the same activities appear, increased in proportion to the increase in the amount of land. All of the C_a and C_b cropland is used to produce wheat and enough additional wheat is added on C_c cropland to utilize the remainder of the wheat allotment. Feeder activities P_5 and P_6 and cow-calf P_{11} are the livestock activities in the new organization and each is increased by the percentage increase in the amount of land. In contrast to the results in Chapter III, this organization includes a small amount of reseeded cropland. Five acres of C_d cropland are reseeded rather than being used for grain sorghum. Grain sorghum is a less profitable alternative than reseeded cropland on C_d land when the grain sorghum must pay for the May-July labor it requires. Additional May-July labor would have to be hired if the amount of grain sorghum were increased. Labor is hired in two periods, May-July and August-September but none was hired in either period in the original organization. Total capital requirements are now $14,487 compared to $10,435 in the initial organization, an increase of $4,052. Results for the land expansion alternatives for the Panhandle Clay Loam situation are presented in Table XVIII.

It was noted earlier that both the rent-land and the buy-land activities add the same amounts of land and allotment resources to the organization. Thus, the optimum farm organization is the same for either activity if the same amount of land is added. Only the estimates of

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[2]See Table VI, p. 24.

TABLE XVIII

OPTIMUM FARM ORGANIZATIONS FOR BUY LAND AND RENT LAND ALTERNATIVES, PANHANDLE CLAY LOAM RESOURCE SITUATION[a]

Item	Unit	Buy Land or Rent Land	Buy Land Only
Wheat	acre	513	513
Wheat	bu.	6,199	6,199
Grain sorghum	acre	144	144
Grain sorghum	cwt.	1,148	1,148
Forage sorghum for hay	acre	37	37
Grazed out wheat	acre	108	108
Reseeded cropland	acre	5	5
Feeder P_5	head	82	82
Feeder P_6	head	22	22
Cow calf P_{11}	head	4	4
Hire labor, May-Jul.	hour	161	161
Hire labor, Aug.-Sep.	hour	3	3
Buy land	acre	-	320
Rent land	acre	320	-
Total capital	dol.	14,487[c]	14,487[c]
Annual capital	dol.	9,267[c]	9,267[c]
Returns to land, labor management, and risk[b]	dol.	5,593	5,263
Land Use:			
C_a Land			
Wheat	acre	42	42
C_b Land			
Wheat	acre	452	452
C_c Land			
Wheat	acre	19	19
Grain sorghum	acre	143	143
C_d Land			
Forage sorghum	acre	37	37
Grazed out wheat	acre	108	108
Reseeded cropland	acre	5	5

[a]Current prices and allotments are assumed.

[b]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517).

[c]Capital required for either renting or buying land was included in the cost of the respective activities and is not a part of these estimates.

returns to land, labor, management, and risk differ because of the difference in cost between buy-land and rent-land. In these results, 320 acres of rent-land appear first and, when rent-land is excluded, 320 acres of buy-land enter the solution. Returns to land, labor, management, and risk are $5,593 when the land is rented and $5,263 when the land is bought. These estimates compare to the returns estimate of $4,730 for the original land resources.

The returns for buying and renting land are not entirely comparable. On the surface, it appears that the returns are greater for renting than for buying land. However, the buy-land alternative forces the accumulation of capital in addition to meeting annual land costs. The capital accumulated amounts to slightly more than one dollar per acre per year for the Panhandle Clay Loam situation. Whether accumulating the capital is preferable to increasing current income depends somewhat on the current capital position of the manager and on his own preferences. If the amount of available capital is limited, a manager may be forced to rent rather than to buy. Similarly, if he values present income higher than a future equity position, he may voluntarily choose to rent rather than to buy.

For the current price and allotment situations used in this part of the analysis, some land will be added so long as the cost per acre is less than $8.20. When the cost of adding land is $6.22 as with the rent-land activity, it is profitable to add land for all wheat prices above $1.27. When the cost of adding land is $7.25, as with the buy-land activity, the price of wheat must be $1.47 or greater for land expansion to be profitable.

The statements regarding the ranges in wheat prices over which these

results apply assume present allotment conditions. However, some generalizations can be made about some of the effects of no allotments by using the results of Chapter IV. With no allotments in Chapter IV, it was profitable to increase the amount of wheat above that permitted by the allotment in Chapter III for all price ratios (P_w/P_{gs}) greater than 0.62. The price ratio for $1.27 wheat and $1.56 grain sorghum is greater than 0.62 ($1.27/$1.56 = 0.81). Thus, with wheat unrestricted by allotments, it seems likely that renting land would be profitable for wheat prices somewhat lower than $1.27. A lower cost of renting would have the same effect. Conversely, higher wheat prices would be required for renting land to be profitable if more restrictive allotments are invoked.

Cimarron Sandy. The organization for the Cimarron Sandy situation after adding 320 acres of land is essentially the same as the organization for the original set of land resources.[3] The principal change is that individual activities have been increased in proportion to the increase in the amount of land. Part of the wheat allotment is still not utilized but wheat occupies the same percentage of the S_b cropland as before. Grain sorghum occupies all of the S_c cropland and most of the S_b cropland not used by wheat. Feeder P_6 and cow-calf P_9 livestock activities appear in this organization also. As a result of increasing the amount of land, total capital requirements increased by $2,467 (from $6,782 to $9,249). Optimum organizations for both the buy-land and the rent-land activities are presented in Table XIX.

Once again, the buy-land and rent-land alternatives add the same

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[3]For comparison purposes, see Table IX, page 33.

TABLE XIX

OPTIMUM FARM ORGANIZATIONS FOR BUY LAND AND RENT LAND ALTERNATIVES, CIMARRON SANDY RESOURCE SITUATION[a]

Item	Unit	Buy Land or Rent Land	Buy Land Only
Wheat	acre	274	274
Wheat	bu.	1,919	1,919
Grain sorghum	acre	511	511
Grain sorghum	cwt.	4,832	4,832
Forage sorghum for hay	acre	1	1
Grazed out wheat	acre	50	50
Feeder P_6	head	46	46
Cow-calf P_9	head	7	7
Hire labor, May-Jul.	hour	454	454
Buy land	acre	-	320
Rent land	acre	320	-
Total capital	dol.	9,249	9,249
Annual capital	dol.	6,536	6,536
Returns to land, labor management, and risk[b]	dol.	2,274	1,983
Land Use:			
S_b Land			
Wheat	acre	274	274
Grain sorghum	acre	231	231
Forage sorghum	acre	1	1
Grazed out wheat	acre	50	50
S_c Land			
Grain sorghum	acre	280	280

[a]Current prices and allotments are assumed.

[b]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583).

amounts of land and allotment resources to the original set of resources. Thus the optimum organization is the same for both activitits. Only the returns to land, labor, management, and risk differ because of the difference in costs. Returns for the land renting alternative are $2,274 and those for the land buying alternative are $1,983. These returns estimates compare with the estimates of $1,838 for the initial land resources. The increases over the initial returns ($436 for renting land and $145 for buying land) are actually returns to labor, management, and risk since the land costs were deducted in the programming process. A manager might question whether the returns which result from buying land justify the risk of the investment. However, in addition to the returns, approximately $0.91 of capital per acre per year is being accumulated. There is no accumulation, of course, for renting land.

The additional land will be added to the organization as long as the cost per acre is below $5.03, an increase of only $0.31 from the present cost of buying land. However, only minor changes in the prices of wheat and grain sorghum will cause changes in the organization. For example, a decrease in the price of wheat to $1.64 or an increase in the price of grain sorghum to $1.57 results in the substitution of cow-calf P_{15} for cow-calf P_9. Since cow-calf P_{15} utilizes grain sorghum stubble, this change implies a substitution of grain sorghum for wheat and a decrease in feeder P_6. An increase in the price of wheat above $1.66 or a decrease in the price of grain sorghum below $1.55 would result in the substitution of forage sorghum for grain sorghum on S_c cropland. This change implies the substitution of wheat for grain sorghum and of feeder P_5 for feeder P_6. The larger the changes in price, the more extensive the changes in organization can be expected to be, generally.

Comparison of Assumed and Institutional Rental Rates

Institutional (or conventional) rental rates are those commonly accepted in an area. Quite often, they are based on a crop sharing arrangement and once established they tend to remain fixed (instituionalized). It was impossible to determine institutional rates for renting land before programming without imposing a predetermined cropping plan on the rented land. Since optimum cropping plans generally are not known a priori before programming, a predetermined plan would not likely have been the optimum one. However, as a check on the assumed rental rates, the institutional rates for the optimum plans were estimated. Rental rates of one third of the harvested yield for cropland crops and $1.50 per acre for native pasture were assumed.

Based on the optimum cropping plan and the distribution of soils among classes for the two soil resource situations, a typical rented acre was determined for each situation. A composite rental rate per typical acre was then determined using the above rates for cropland and native range. Institutional rental rates computed in this manner are lower than the assumed rates. Institutional rates per typical acre are $4.12 on Panhandle Clay Loam and $3.43 on Cimarron Sandy compared to the assumed rates of $6.22 and $3.81, respectively, which were used in the analysis. The institutional rental rates are itemized in Table XX.

It appears from these results that instutitional rental rates are not a deterrent to renting land for those farmers who have machinery with sufficient capacity to handle additional land. Renting land increased returns to owned resources on both Panhandle Clay Loam and Cimarron Sandy soils when the assumed rental rates were used although the assumed rates

are higher than institutional rates. Whether renting additional land justifies buying larger machinery for those farmers using their present sets of machinery to capacity was not investigated, however.

TABLE XX

INSTITUTIONAL LAND RENTAL RATES FOR SELECTED RESOURCE SITUATIONS, OKLAHOMA PANHANDLE

Item	Resource Situation	
	Panhandle Clay Loam	Cimarron Sandy
	-dollars-	
Cropland rental charge[a]	3.71	2.99
Nonharvested cropland cost[b]	.22	.21
Native range rental charge[c]	.19	.23
Total rental charge	4.12	3.43

[a]Based on one-third of the harvested yield.

[b]Assumes 20 per cent nonharvested cropland.

[c]Based on a rate of $1.50 per acre.

Farmers who have excess machinery capacity can afford to rent additional land as long as the marginal value product of the land exceeds the renting cost. That is, additional land will increase net returns as long as the added returns are greater than the cost of renting. When the cost of renting rises high enough, or when the prices of crops fall low enough, renting will no longer be profitable. Renting Panhandle Clay Loam land at the assumed rate would not be profitable under present allotment conditions for wheat prices below $1.27. With no allotments, however, renting at the assumed rate would likely be profitable for wheat prices of $1.25 or even somewhat lower. In either case, renting at the

estimated institutional rate would be profitable. Programming results for the Cimarron Sandy situation do not permit similar inferences about alternative wheat prices. However, based on the results of Chapter III, it appears that wheat prices of $1.25 or even lower would be no deterrent to renting Cimarron Sandy land when the price of grain sorghum is $1.56 or higher. In Chapter III, eliminating wheat from the organization entirely, reduced returns by only $153, an average of $0.16 per acre of farm land.[4] It was noted above that it is profitable to add land to the Cimarron Sandy situation for all costs below $5.03. This is $0.31 above the assumed cost of buying and $1.22 above the assumed cost of renting.

Fixed Capital Programming

As more and more units of a variable resource are added to a given complement of fixed resources, a point is reached beyond which the addition to total revenue per unit of variable resource (marginal value product) decreases. If enough units of variable resource are added to the fixed resources, the marginal value product (MVP) approaches zero and may eventually become negative. A hypothetical marginal value product curve for a resource, X, is shown in Figure 2.

To maximize profits, additional units of the variable resource should be employed until the marginal value product of the resource equals its price ($MVP_X = P_X$). To that point, the additions to total revenue are greater than the additions to total cost and profits are increasing. Beyond that point, the additions to total revenue are less than the

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[4] See Table IX, page 33, and Table X, page 37.

additions to total costs and profits are decreasing. Even when the variable resource can be obtained at no cost, there is no incentive to add units of the resource beyond the point at which the marginal value product is zero (MVP = 0).

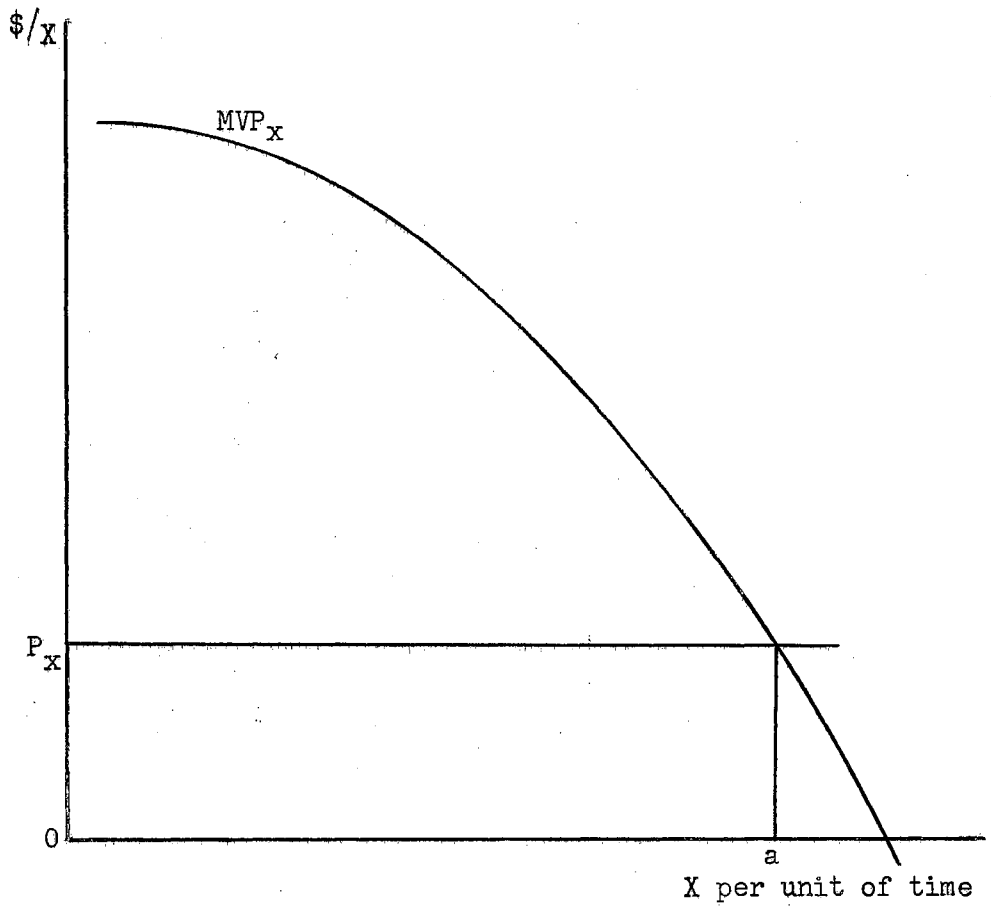

Figure 2. Hypothetical Marginal Value Product Curve.

For some resources, the marginal value product may be constant (the MVP curve has horizontal segments) over several units of the resource. To take an example from this study, the number of acres of C_a cropland planted to wheat may increase as the amount of capital is increased from zero. Each acre adds the same amount of wheat to output

and requires the same amount of capital. Thus the marginal value product of capital used on C_a cropland is constant. Similarly, the marginal value product of capital used in the production of wheat on C_b cropland is constant over all the C_b cropland though it is less than on C_a cropland. An MVP curve for such a situation consists of a series of horizontal segments. A hypothetical MVP curve of this type for a resource, X, is shown in Figure 3.

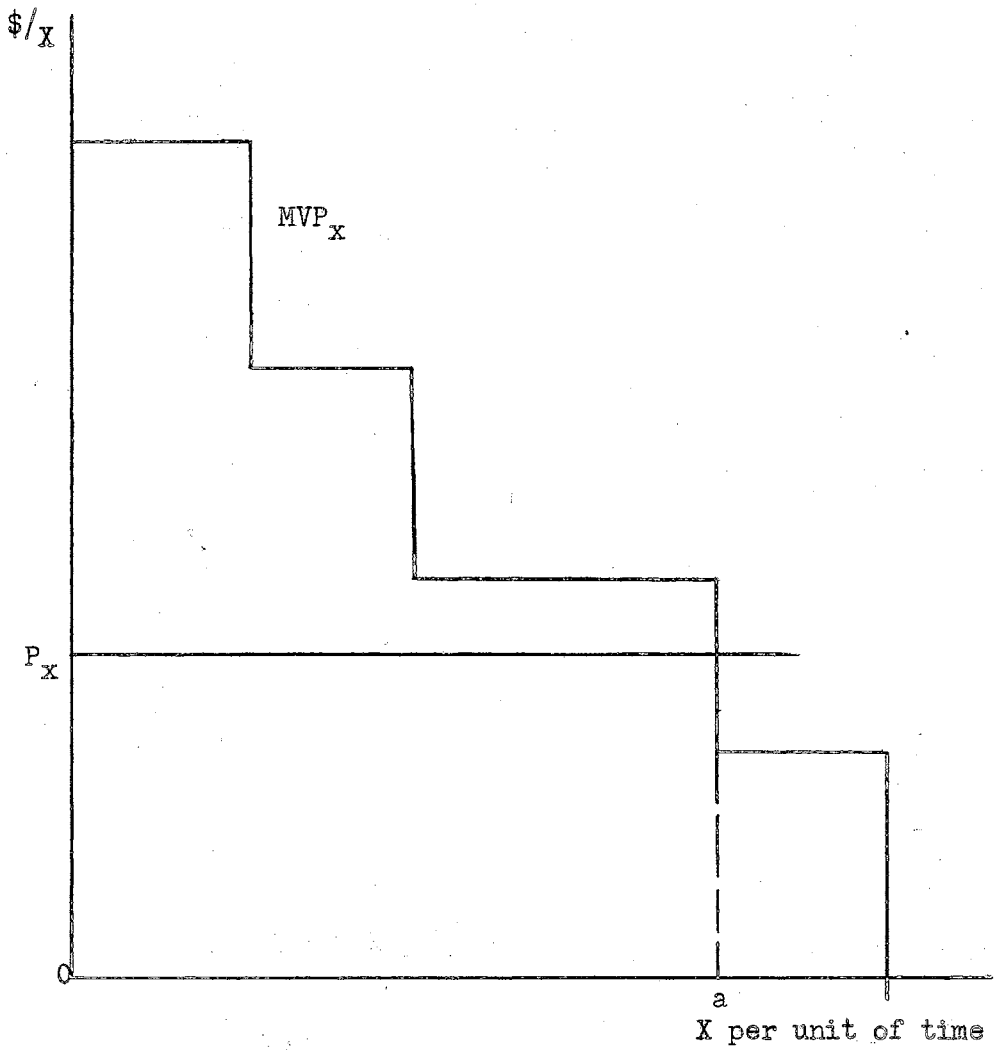

Figure 3. Hypothetical Marginal Value Product Curve With Horizontal Segments.

In effect, the analysis in this section allows description of a capital MVP curve such as the one shown in Figure 3 when other resources such as land and labor are fixed in quantity. Optimum organizations are determined for alternative amounts of capital and the marginal value product of capital is constant over particular capital ranges. The programming results show the marginal value products (shadow prices) for the different amounts of capital and, in addition, the ranges over which the shadow prices are constant (linear). For this part of the analysis, prices, resource availability, and allotment conditions are identical to those in Chapter III. Present prices and allotments are assumed and land and machinery resources are fixed. A range of capital levels from a minimum of $2,000 for both resource situations to maximums of $14,000 for the Panhandle Clay Loam situation and $12,000 for the Cimarron Sandy situation are considered.

Panhandle Clay Loam. The $2,000 minimum amount of capital is sufficient for all the cropland to be utilized. With the exception of one acre, the cropland is used to produce either wheat or grain sorghum. As the amount of capital increases, the amount of grain sorghum and the number of livestock increase also. At first, cow-calf activities enter the organization, then feeder livestock enter, and finally the number of cow-calf units decreases. Returns to land, labor, fixed capital, management, and risk increase along with the increase in the amount of capital. Finally, beyond $10,435 of capital, capital is in disposal (the marginal value product of capital is zero) and returns are maximum. In Chapter III, the same amount of capital is borrowed when the interest rate is 6 per cent.[5] There, it was noted that this amount of capital would be borrowed

[5]See Table VI, page 24.

for interest rates as high as 9 per cent. Those results along with these, indicate that the marginal value product of capital falls from 9 per cent for $10,435 of capital to zero for all amounts beyond that. Optimum organizations for the different levels of capital along with residual returns estimates and the marginal value product of capital are presented in Table XXI.

For all levels of capital, all of the C_a and C_b cropland is used to produce wheat. Grain sorghum occupies most of the C_c cropland and varying amounts of C_d cropland. As the amount of capital increases from $2,000, forage sorghum and grazed out wheat (to meet the livestock requirements) are substituted for grain sorghum on C_d cropland. Feeder P_6 is the first buy-sell activity to enter the organization but as the amount of capital increases, feeder P_5 also enters. As capital becomes relatively less limiting, and land relatively more limiting, returns are increased by satisfying feeder livestock requirements with forage sorghum hay rather than with grain sorghum stubble. Consequently, P_5 is substituted for P_6 and wheat is substituted for grain sorghum.

As the amount of capital increases, the marginal value product of capital decreases. For example, increasing the amount of capital from $2,000 to $3,000 increases returns to land, labor, fixed capital, management, and risk by $370, or an average of 37 per cent. By contrast, the increase in capital from $10,000 to $12,000 adds only $90 to returns, an average of only 4.5 per cent. These percentage returns are averages over the ranges indicated and not estimates for particular amounts of capital. The marginal value product of capital does not decrease at a constant rate but decreases by steps. The stated ranges above may contain two or more step decreases in the marginal value product of capital.

TABLE XXI

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE AMOUNTS OF FIXED CAPITAL, PANHANDLE CLAY LOAM RESOURCE SITUATION[a]

Item	Unit	Amount of Capital (dollars)						
		2,000	3,000	5,000	6,000	8,000	10,000	12,000[b]
Wheat	acre	376	376	376	376	376	376	376
Wheat	bu.	4,518	4,518	4,518	4,518	4,518	4,522	4,546
Grain sorghum	acre	214	212	190	176	147	117	109
Grain sorghum	cwt.	1,477	1,464	1,344	1,266	1,106	935	863
Forage sorghum for hay	acre	1	3	2	5	14	23	27
Grazed out wheat	acre	--	--	23	34	54	75	79
Feeder P_5	head	--	--	--	9	31	55	60
Feeder P_6	head	--	--	22	24	21	18	16
Cow-calf P_9	head	--	--	--	--	--	1	--
Cow-calf P_{11}	head	--	--	--	--	--	--	3
Cow-calf P_{12}	head	3	--	4	5	4	2	--
Cow-calf P_{13}	head	--	8	2	--	--	--	--
Returns to land, labor, fixed capital, management, and risk[c]	dol.	2,622	2,992	3,644	3,934	4,493	5,042	5,132
MVP of capital[d]	dol.	0.38	0.33	0.32	0.28	0.28	0.24	0.00
Land use:								
C_a Land								
Wheat	acre	31	31	31	31	31	31	31
C_b Land								
Wheat	acre	331	331	331	331	331	331	331
C_c Land								
Wheat	acre	--	--	--	--	--	2	14
Grain sorghum	acre	119	119	119	119	119	117	105
C_d Land								
Wheat	acre	14	14	14	14	14	12	--
Grain sorghum	acre	95	93	71	57	28	--	4
Forage sorghum	acre	1	3	2	5	14	23	27
Grazed out wheat	acre	--	--	23	34	54	75	79

[a]Assuming present prices and allotments.

[b]$1,565 of this are in disposal. Thus the estimates actually apply to $10,435 of capital rather than to $12,000.

[c]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517). No charge has been made for the fixed amount of capital.

[d]These are the shadow prices shown by the program.

Cimarron Sandy. For the Cimarron Sandy situation, the $2,000 minimum amount of capital is insufficient for all the cropland to be utilized. Thirty-one acres of S_c cropland are idle. The balance of the cropland is used to produce grain sorghum, the only activity in this organization. These results again point to the significance of the yield advantage possessed by grain sorghum over wheat on the Cimarron Sandy soils. When capital is available in quantities large enough that livestock can be produced, some wheat will also be produced. But when the amount of capital is so limited that there are no livestock, only grain sorghum is produced.

The first use for additional capital is to produce grain sorghum on the remainder of the cropland. With further increases in the amount of capital, livestock enter the organization and wheat is substituted for some of the grain sorghum. Returns also increase as the amount of capital increases. Beyond $8,071 of capital, however, capital is in disposal (the marginal value product of capital is zero) and the maximum returns for the assumed fixed resources are achieved.

The results for the Cimarron Sandy situation illustrate the importance of using capital to produce crops when only limited amounts of capital are available. The rate of return on capital is 136 per cent to the point that all the cropland is utilized. All the cropland would be utilized if $2,137 of capital were available. By way of comparison, the average rate of return between $2,000 and $4,000 is 38.7 per cent. Between $7,000 and $8,000, returns increase by only $22, an average of 2.2 per cent. These rates of return are averages over the indicated ranges. Each range may contain several step decreases in the marginal value product of capital.

TABLE XXII

OPTIMUM FARM ORGANIZATIONS FOR ALTERNATIVE AMOUNTS OF FIXED CAPITAL, CIMARRON SANDY RESOURCE SITUATION[a]

Item	Unit	Amount of Capital (dollars) 2,000	4,000	6,000	7,000	8,000	10,000[b]
Wheat	acre	--	9	137	207	264	268
Wheat	bu.	--	64	961	1,448	1,845	1,876
Grain sorghum	acre	596	614	463	378	291	286
Grain sorghum	cwt.	5,780	5,931	4,416	3,574	2,781	2,723
Forage sorghum for hay	acre	--	2	2	4	9	9
Grazed out wheat	acre	--	2	25	38	63	64
Feeder P_5	head	--	--	--	--	15	17
Feeder P_6	head	--	2	23	35	31	30
Cow-calf P_9	head	--	--	--	6	--	--
Cow-calf P_{11}	head	--	--	--	--	6	6
Cow-calf P_{15}	head	--	8	7	--	--	--
Hire labor, May-Jul	hour	--	415	285	213	143	138
Returns to land, labor, fixed capital, management, and risk[c]	dol.	1,019	1,794	2,058	2,138	2,160	2,161
MVP of capital[d]	dol.	1.36	0.13	0.13	0.04	0.01	0.00
Land use:							
S_b Land							
Wheat	acre	--	9	137	207	264	268
Grain sorghum	acre	417	404	253	175	153	149
Forage sorghum	acre	--	2	2	--	--	--
Grazed out wheat	acre	--	2	25	35	--	--
S_c Land							
Grain sorghum	acre	179	210	210	203	138	137
Forage sorghum	acre	--	--	--	4	9	9
Grazed out wheat	acre	--	--	--	3	63	64

[a]Assuming present prices and allotments.

[b]$1,929 are in disposal. Thus the estimates actually apply to $8,071 of capital rather than $10,000.

[c]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583). No charge has been made for the fixed amount of capital.

[d]These are the shadow prices shown by the program.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study is part of a project designed to specify the most profitable, and perhaps the most probable, adjustments of Oklahoma Panhandle farmers over time. In this part of the project, most profitable farm organizations for Panhandle farmers under existing resource positions and a wide range of price and cost conditions were determined. The overall objective of this phase of the project is to provide information to farmers and policy makers about optimum farm adjustments under present and alternative economic and institutional conditions. Optimum farm organizations were ascertained for each of the several sets of conditions considered by means of linear programming. The study is applicable to nonirrigated crop farms of the Oklahoma Panhandle. Irrigated cropland and range land areas are excluded.

The Oklahoma Panhandle is characterized by relatively limited and erratically distributed rainfall and by relatively large farms, compared to other areas of Oklahoma. Because of the rainfall distribution and amount, the Panhandle is often thought of as a "high risk" farming area and, as a matter of fact, crop failures are quite common. Ten and two-tenths per cent of the land in farms in Oklahoma is found in the Panhandle but only four per cent of the commercial farms are found there. The Panhandle accounts for approximately 12.8 per cent of the wheat harvest and 25 per cent of the grain sorghum harvest in Oklahoma.

This study is applicable to nonirrigated soils of the Oklahoma Panhandle as follows: (1) Panhandle Clay Loam and (2) Cimarron Sandy. A representative farm containing cropland, native pasture, etc., in the same proportions they appear in the respective soil resource situations was specified for each situation. The representative farm for the Panhandle Clay Loam situation contains 880 total acres including 740 acres of cropland. There are 960 total acres in the Cimarron Sandy farm including 783 acres of cropland. For planning purposes, 20 per cent of the cropland is assumed to be nonharvested because of either idleness, fallow, or crop failure.

Fixed resources in addition to land, including machinery and operator labor, were specified for both representative farms. A set of crop and livestock activities suitable for each farm was developed. The crop activities include wheat, grain sorghum, forage sorghum for hay, grazed out wheat, grazed out forage sorghum, and reseeded cropland. Eight buy-sell feeder activities and seven cow-calf activities were available for inclusion in farm plans. The fixed machinery resources assumed include one 4-plow tractor and auxiliary equipment such as a lister, oneway, chisel, and grain drill. Custom harvesting was assumed for all except the grazing crops. Amounts of available operator labor was specified by period for four periods: (1) January through April, (2) May through July, (3) August and September, and (4) October through December.

Optimum activity combinations for a variety of price, allotment, and resource availability conditions were ascertained. In Chapter III, optimum organizations were determined for present prices and allotments with several alternative interest rates on capital. In Chapter IV, optimum organizations were determined for alternative combinations of

prices of wheat, grain sorghum, and livestock with allotments excluded. Two separate problems were treated in Chapter V. First, the effects on the optimum organization and the level of returns of the opportunity to either rent or buy additional land was considered. Second, optimum organizations were determined for alternative amounts of capital.

Summary of Results for Present and Alternative Prices

In the analysis, it was found that the optimum adjustments on Panhandle Clay Loam soils were quite different from those on Cimarron Sandy soils. As a result, the two will be summarized separately.

Panhandle Clay Loam Results. It was found that wheat has a marked yield advantage over grain sorghum on the Panhandle Clay Loam soils. The advantage is such that wheat was a more profitable alternative than grain sorghum for price ratios (P_w/P_{gs}) greater than 0.62. Such a ratio occurs, for example, when the price of wheat is \$1.15 and the price of grain sorghum is \$1.70 (\$1.15/\$1.70 = 0.68). When there was an allotment, all the wheat permitted by the allotment was produced. Grain sorghum was produced on much of the remaining cropland. When there was no allotment, nearly all of the cropland was used to produce wheat. Only enough cropland was kept out of wheat to produce forage sorghum and grazed out wheat for livestock. When the wheat/grain sorghum price ratio was below 0.62, grain sorghum replaced wheat on C_c cropland and some of the wheat allotment, if there was one, was unused. All of these generalizations assume that grazed out wheat is an acceptable alternative. The indicated price ratios would be somewhat higher if grazed out wheat (and feeder activities P_5 and P_6) is not an acceptable alternative.

Farmers who have an aversion to the grazed out wheat alternative are not likely to include it in their farm organizations. In the study, two optimum organizations were determined with the grazed out wheat alternative excluded. Excluding grazed out wheat when present prices and allotments were in effect reduced returns significantly. When the interest rate was six per cent, excluding grazed out wheat reduced returns to land, labor, management, and risk by almost $1,500. Returns were reduced by nearly $1,700 when the interest rate was 12 per cent. Excluding grazed out wheat (and feeder activities P_5 and P_6) reduced total capital requirements significantly in addition to reducing returns. Total capital requirements were reduced $3,844 for the six per cent interest rate and $7,400 for the 12 per cent interest rate.

Cimarron Sandy Results. On the Cimarron Sandy soils, grain sorghum has a significant yield advantage over wheat. Results of this study indicate that the price ratio (P_w/P_{gs}) must rise above 1.1 before it is profitable to use all the wheat allotment (268 acres). Of the price combinations considered, a wheat price of $1.75 and a grain sorghum price of $1.45 give a price ratio in this range ($1.75/$1.45 = 1.2). Such a high wheat price relative to the price of grain sorghum appears to be unlikely, at least in the immediate future. For price ratios below 0.91 ($1.25/$1.45 = 0.86), the optimum organizations include no wheat. Whether excluding wheat entirely is the strategy to follow, however, even in the short run, depends on a manager's attitude toward maintaining his wheat history. A manager's desire to maintain his wheat history will be strongly influenced by his expectations about the future prices of wheat and grain sorghum and about agricultural programs.

Including grazed out wheat (and feeders P_5 and P_6) in the organization will increase returns under some conditions. With current prices for wheat and grain sorghum ($1.65 wheat and $1.56 grain sorghum) it was profitable to produce some wheat and, consequently some P_5 and P_6. This, despite the fact that grain sorghum was more profitable when the two crops were compared on a grain yield basis only. For current prices and allotments, excluding grazed out wheat reduced returns $153 when the interest rate was six per cent and $127 when the interest rate was 12 per cent. Some managers may feel that the added returns from including the grazed out wheat alternative do not justify the added effort and risk involved. For price ratios (P_w/P_{gs}) below 0.91, there was neither any wheat for grain nor grazed out wheat. All but two acres of the cropland was used for grain sorghum. Even for such low wheat/grain sorghum price ratios, some managers may prefer to plant all or part of their wheat allotments in order to maintain their wheat histories.

Summary of Results for Land Expansion Alternatives

When the costs for an additional acre of land were below $8.20 on Panhandle Clay Loam soils and $5.03 on Cimarron Sandy soils, returns were increased by adding more land. The assumed annual costs of adding land were $7.25 for buying and $6.22 for renting Panhandle Clay Loam land. They were $4.72 for buying and $3.81 for renting Cimarron Sandy land. Institutional (conventional) rental rates based on the optimum cropping systems were estimated and compared with the assumed rental rates. The estimated institutional rental rates were $4.12 on Panhandle Clay Loam and $3.43 on Cimarron Sandy, both lower than the assumed rental rates.

Optimum organizations after the land was added were essentially the

same as those for the initial soil resource situations. Each activity was increased in proportion to the increase in the amount of land. Returns and total capital requirements were increased as a result of adding more land.

Summary of Fixed Capital Results

A minimum of $2,000 of capital was assumed for both resource situations and other levels to maximums of $14,000 for the Panhandle Clay Loam resource situation and $12,000 for the Cimarron Sandy resource situation were considered. Optimum organizations for alternative amounts of capital between and including the extremes were considered. In addition, the most profitable uses for increments to capital were ascertained. Crop activities yielded higher percentage returns than did the livestock activities. Thus, crop capital requirements were met first and remaining amounts of capital used for livestock. As capital became less limiting, cow-calf livestock activities were first added to the organization. When the number of cows was limited by the available native range grazing, feeder activities were added to the organization. For amounts of capital beyond $10,435 on Panhandle Clay Loam and $8,071 on Cimarron Sandy, capital was in disposal and returns were maximum.

Limitations of the Study and Suggestions for Further Research

In relating the results of this study to specific farm situations, differences between the specific situations and the representative ones reported here must be considered. The results presented here can be adjusted for differences in yields (especially different relative yields),

costs, the complement of fixed resources, etc. In addition, the whole farm results must be adjusted to apply to combination clay and sandy situations since the two situations were considered separately in this study. On the other hand, the range of product prices considered in the study includes most price relationships of interest at this time.

All results of this study assume ownership of the initial land and machinery resources. However, at least some generalizations can be obtained about the effects on organizations and returns of both partial ownership and renting. For example, in Chapter III, the implications of the results for expected returns to full owners, part owners, and renters were explored, though rather briefly. A renter-owner tenure situation is the most common one in the Panhandle. Thus, further analysis of the effects of renting on organizations and returns may be justified.

The effects of alternative prices of factors other than capital were not considered in this study. However, additional information about the effects of changes in factor prices on activity costs or returns and whole farm organizations might be obtained from further analysis of the programming results. For example, a more complete analysis of the stability ranges and $Z_j - C_j$ values should provide many useful inferences about the effects of changes in activity costs resulting from alternative factor prices or yields. Such an analysis may reveal that additional programming using alternative factor costs may be necessary.

An analysis of the effects of year to year variations in yields on returns, capital positions, income variability, etc., is much needed. Such a study would need to consider fluctuations in yields resulting from variable weather conditions. Also, any changes in product or factor prices resulting from alternative yields need to be considered.

One objective of such a study might be to specify optimum organizations for the alternative conditions and to determine whether a single organization exists which is optimum over a range of conditions.

Other potentially useful studies include the analyses of: (1) income opportunities for land expansion alternatives not limited to 320 acres; (2) optimum organizations with the grazed out wheat alternative excluded and no allotments; and (3) the effects on returns, capital requirements, etc., of including broomcorn and/or some of the summer grazing crops or speciality crops (guar for example) in the organization. These and the other studies mentioned no doubt will indicate other areas where additional knowledge would be useful.

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A P P E N D I X

APPENDIX TABLE I

DEFINITIONS OF LAND RESOURCE SITUATIONS AND YIELD LEVELS BY PRODUCTIVITY CLASS: CLAY-LOAM SOILS, OKLAHOMA PANHANDLE

Dry Land

Management Group I. This group includes the clay-loam soils which have slight erosion hazards, but are primarily limited by the climate (low rainfall).

C_a - Productivity Class "a". Richfield loam soils, thick surface, Beaver County (or other equivalents).
C_b - Productivity Class "b". Richfield clay-loam soils, Texas County (or other equivalents).

Management Group II. This group includes the clay-loam soils which have some erosion hazards and benefit greatly from terracing and contour production.

C_c - Productivity Class "c". Ulysses-Richfield complex, Beaver County (or other equivalents).
C_d - Productivity Class "d". Mansker loam soils, Cimarron County (or other equivalents).

Crop	Unit	Productivity Class			
		C_a	C_b	C_c	C_d
		(Yield Per Acre)			
Crop:[1]					
Wheat	bu.	14	12	10	8
Grain sorghum	cwt.	9.0	5.5	8.0	5.5
Forage sorghum	ton	1.6	1.2	1.4	1.1
Grazing:[2]					
Grain sorghum stubble	AUM	.20	.12	.15	.10
Fall wheat grazing	AUM	.30	.25	.20	.15
Grazed out wheat	AUM	2.10	1.90	1.70	1.50
Grazed out forage sorghum	AUM	1.10	.90	1.00	.80
Reseeded cropland[3]	AUM	1.00	.90	.80	.70

[1]Yields are expected values based on harvested acreages. A fallow, failure or idle acreage of 20 percent of the total cropland is assumed.

[2]Native range grazing yield is .6 AUM per acre of range.

[3]Grazing beginning with the third year. No yield is available the first two years.

APPENDIX TABLE II

DEFINITIONS OF LAND RESOURCE SITUATIONS AND YIELD LEVELS BY PRODUCTIVITY CLASS: SANDY SOILS, OKLAHOMA PANHANDLE

Dry Land

Management Group I. This group includes all sandy soils which possibly need terracing and contour production for erosion control and water conservation.

S_a - Productivity Class "a". Sandy soils of Beaver and Texas Counties (with the exception of the Dalhart loamy fine sand and Otero fine sandy loam soils in Texas County).

S_b - Productivity Class "b". Sandy soils of Cimarron County (with the exception of the Dalhart loamy fine sand and Dalhart fine sandy loam soils, 0 to 3% slopes, eroded).

Management Group II. This group includes the sandy soils which require specific measures to limit erosion, particularly wind erosion.

S_c - Productivity Class "c". Dalhart loamy fine sand soils in Texas and Cimarron Counties (or other equivalents).

Crop	Unit	Productivity Class		
		S_a	S_b	S_c
		(Yield Per Acre)		
Crop:[1]				
Wheat	bu.	11	7	5
Grain sorghum	cwt.	12	10	9
Forage sorghum	ton	2.0	1.6	1.4
Grazing:[2]				
Grain sorghum stubble	AUM	.25	.20	.00
Fall wheat grazing	AUM	.30	.20	.18
Grazed out wheat	AUM	1.70	1.50	1.20
Grazed out forage sorghum	AUM	1.30	1.10	.80
Reseeded cropland[3]	AUM	.90	.80	.70

[1]Yields are expected values based on harvested acreages. A fallow, failure or idle acreage of 20 percent of the total cropland is assumed.

[2]Native range grazing yield is .6 AUM per acre of range.

[3]Grazing beginning with the third year. No yield is available the first two years.

APPENDIX TABLE III

ACRES OF DRYLAND CROPLAND BY PRODUCTIVITY CLASS, ACRES OF IRRIGATED CROPLAND, AND TOTAL CROPLAND BY COUNTIES, OKLAHOMA PANHANDLE[1]

Item	Area			
	Beaver County	Texas County	Cimarron County	Panhandle
	(acres)	(acres)	(acres)	(acres)
Dryland cropland	467,347	724,777	421,824	1,613,948
Sandy cropland	82,369	79,669	112,750	274,788
S_a	82,369	74,605	0	156,974
S_b	0	0	78,356	78,356
S_c	0	5,064	34,394	39,458
Clay-loam cropland	384,978	645,108	309,074	1,339,160
C_a	31,111	29,000	0	60,111
C_b	6,000	367,810	273,843	647,653
C_c	234,936	67,769	6,000	308,705
C_d	112,931	180,529	29,231	322,691
Irrigated cropland	5,857	31,675	12,116	49,648
Sandy cropland	1,000	9,675	4,116	14,791
Clay-loam cropland	4,857	22,000	8,000	34,857
Total cropland	473,204	756,452	433,940	1,663,596
Sandy cropland	83,369	89,344	116,866	289,579
Clay-loam cropland	389,835	667,108	317,074	1,374,017
No. dryland farms	981	867	421	2,269
No. irrigated farms	61	107	58	226

[1]The totals are based on the 1959 Census and the distribution among classes on the County Soil Survey Reports and Soil Conservation Service N-2 Soil Inventory Forms.

APPENDIX TABLE IV

ACRES AND PERCENT OF EACH SOIL PRODUCTIVITY CLASS, TOTAL CROPLAND, WHEAT ALLOTMENT, NATIVE PASTURE AND TOTAL FARM LAND BY RESOURCE SITUATION, OKLAHOMA PANHANDLE[1]

Item	Resource Situation			
	Panhandle Clay Loam		Cimarron Sandy	
	(acres)	(percent)	(acres)	(percent)
Soil productivity class:				
a	60,111	4.4	0	0.0
b	647,653	47.1	78,356	54.3
c	231,984	16.9	39,458	27.3
d	215,760	15.7	-	-
Total cropland[2]	1,155,508	84.1	117,814	81.6
Native pasture[3]	175,868	12.8	22,090	15.3
Total farmland[4]	1,373,969	100.0	144,380	100.0
Wheat allotment[5]	586,998	42.7	40,292	27.9
Number of farms[6]	1,259	-	112	-

[1]These estimates are based on Soil Survey Reports, Soil Conservation Service N-2 Soil Inventory Forms, Agricultural Stabilization and Conservation Service Records, and the 1959 Census. Irrigated cropland and land in range situations is excluded from these estimates.

[2]Total dryland cropland in the two resource situations is 1,273,322 acres. Total dryland cropland in the original four resource situations is 1,613,948 acres.

[3]Total native pasture in the two situations is 197,958 acres. In the original four situations, there are 489,842 acres.

[4]Total farmland in the two resource situations is 1,518,349 acres. In the original four resource situations, there are 2,172,732 acres.

[5]Total wheat allotments are 627,290 acres. Originally, there were 799,430 acres.

[6]Based on the 1959 Census and sample surveys. The total number of dryland farms is 2,269.

APPENDIX TABLE V

ESTIMATED PER ACRE REQUIREMENTS AND CASH COSTS FOR NONHARVESTED CROPLAND, OKLAHOMA PANHANDLE[1]

Item	Unit	Price or Cost Per Unit	Quantity	Value or Cost
		(dollars)		(dollars)
(1) Inputs:				
Seed	dollar	-	-	.22
Power	hour	.88	.39	.34
Other machinery	hour	.66	.32	.21
Capital requirements:				
Total operating capital	dollar	-	.77	-
Annual operating capital	dollar	.06	.39	.02
(2) Total specified costs above land, fixed capital, labor, management, and risk				.79
(3) Labor	hour	1.25	.41	.51
(4) Total specified costs above land, fixed capital, management, and risk				1.30

[1] Approximately 20 percent of the total cropland in the Oklahoma Panhandle consists of fallow, failure or idle acreage. These are estimates of the costs involved in fallow and crop failures on nonharvested cropland.

APPENDIX TABLE VI

ASSUMED PRICES PAID AND RECEIVED BY FARMERS, OKLAHOMA PANHANDLE[1]

Item	Unit	Price
		(dollars)
Prices Paid		
Seed and Feed:		
Wheat seed	bushel	2.05
Grain sorghum seed	cwt.	15.00
Forage sorghum seed	cwt.	7.00
Clay-loam land grass mixture seed	pound	1.17
Sandy land grass mixture seed	pound	1.13
Cottonseed cake	ton	76.00
Salt	cwt.	1.00
Custom Rates:		
Combining wheat	acre	3.00
Combining grain sorghum	acre	2.50
Hauling wheat and grain sorghum	bushel	.07
Binding forage sorghum	acre	3.00
Shocking forage sorghum	acre	1.00
Hauling and stacking forage sorghum	ton	1.50
Fuel and Lubricants:		
Gasoline	gallon	.22
L. P. gas	gallon	.08
Diesel oil	gallon	.14
Motor oil	gallon	1.04
Lubricant	pound	.20
Labor	hour	1.25
Prices Received		
Wheat	bushel	1.65[2]
Grain sorghum	cwt.	1.56
Beef	cwt.	[3]

[1] These price assumptions are not to be interpreted as predictions of prospective prices.

[2] Approximate 1960-61 support prices.

[3] See Appendix Table VII.

APPENDIX TABLE VII

ASSUMED PRICES FOR CALVES, STEERS, AND CULL COWS BY MONTHS, OKLAHOMA PANHANDLE[1]

Class and Grade	Monthly Average												YEARLY Average
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
	(price in dollars per cwt.)												
Calves													
Good and choice steers, 500 lbs. and less	23.64	24.37	25.02	25.26	24.97	24.73	24.20	24.12	24.03	23.42	23.23	23.08	24.17
Heifers, 500 lbs. and less	21.64	22.37	23.02	23.26	22.97	22.73	22.20	22.12	22.03	21.42	21.23	21.08	22.17
Steers													
Good													
500-800 lbs.	21.13	21.75	22.12	22.42	22.29	21.86	21.35	21.24	21.05	20.23	20.47	20.58	21.37
Cows													
Utility													
All weights	13.83	14.09	14.53	14.87	14.94	14.55	13.95	13.49	13.35	13.13	13.06	13.43	13.94

[1]Approximate current price levels adjusted for commodity cycle.

Source: Blakley, Leo V. and Odell L. Walker, Unpublished Data, Department of Agricultural Economics, Oklahoma State University, 1962.

APPENDIX TABLE VIII

ASSUMED MONTHLY AVERAGE PRICES FOR CALVES, STEERS, AND CULL COWS ASSOCIATED WITH ALTERNATIVE GRAIN SORGHUM PRICES FOR SELECTED MONTHS, OKLAHOMA PANHANDLE[1]

Class, Grade, and Month	Grain Sorghum Price						
	1.56	1.00	1.20	1.35	1.45	1.65	1.70
	(price in dollars per cwt.)						
Calves:							
Good and choice steers, 500 lb. and less							
April	25.26	16.19	19.43	21.86	23.48	26.72	27.53
July	24.20	15.51	18.62	20.94	22.49	25.60	26.37
October	23.42	15.01	18.02	20.27	21.77	24.77	25.52
Heifers, 500 lbs. and less							
July	22.20	14.23	17.08	19.21	20.63	23.48	24.19
October	21.42	13.73	16.48	18.54	19.91	22.66	23.34
Steers:							
Good, 500-800 lbs.							
March	22.12	14.18	17.01	19.14	20.56	23.40	24.10
May	22.29	14.29	17.15	19.29	20.72	23.58	24.29
October	20.23	12.97	15.56	17.51	18.80	21.40	22.05
Cows:							
Utility, all weights							
July	13.95	8.94	10.73	12.07	12.97	14.75	15.20
October	13.13	8.42	10.10	11.36	12.20	13.89	14.31

[1]The livestock prices in Appendix Table VII are assumed to be associated with a grain sorghum price of $1.56.

APPENDIX TABLE IX

ESTIMATED ANNUAL MACHINE, POWER, AND LABOR REQUIREMENTS FOR SPECIFIED ENTERPRISES, OKLAHOMA PANHANDLE[1]

Crop and Operations	Dates	Times Over	Machine Time	Power	Labor
			(hour)	(hour)	(hour)
Wheat and Grazed Out Wheat:					
Chisel	Jul.	1	.20	.22	.24
Oneway	Jul.-Aug.	3	.58	.63	.69
Drill (2 drills)	Sep.	1	.09	.10	.11
Total time requirements[2]			.87	.95	1.04
Grain Sorghum, Forage Sorghum, and Grazed Out Forage Sorghum:					
Blank list	Apr.-May	1	.19	.21	.23
Oneway	May	2	.38	.42	.46
Plant	May-Jun.	1.5	.33	.36	.39
Harrow	Jun.	1	.12	.13	.14
Cultivate	Jul.	2	.31	.34	.37
Total time requirements[2]			1.33	1.46	1.59
Reseeded Cropland (Establishment):					
Chisel	May	1	.20	.22	.24
Oneway	May-Jun.	2	.38	.42	.46
Drill (2 drills-sorghum)	Jun.-Jul.	1	.09	.10	.11
Seeding (grass)	Mar.-Apr.	1	.10	.10	.11
Total time requirements[2]			.77	.84	.92

[1]The estimates do not include operations custom hired.

[2]Total time requirements for operations included.

APPENDIX TABLE X

ESTIMATED ANNUAL OVERHEAD COSTS FOR TWO REPRESENTATIVE FARMS, OKLAHOMA PANHANDLE[1]

Item	Panhandle Clay Loam (dollars)	Cimarron Sandy (dollars)
A. Depreciation and Maintenance		
Buildings	360.00	360.00
Livestock equipment		
Permanent fencing	151.00	165.00
Temporary fencing	48.00	53.00
Salt boxes, corrals, water tanks, etc.	21.00	21.00
B. Machinery Fixed Costs		
One 4-plow tractor and equipment	943.00	943.00
Shop tools	50.00	50.00
Pickup truck - 1/2 ton		
Interest on investment	75.00	75.00
Depreciation	305.00	305.00
Gas, oil, lubrication	405.00	405.00
Repairs	105.00	105.00
Insurance (liability only)	25.00	25.00
Butane storage tank	8.00	8.00
Grain auger and 4 wheel trailer	70.00	70.00
C. Taxes		
Land	685.00	732.00
Pickup truck (licence)	13.00	13.00
D. Miscellaneous		
Telephone	75.00	75.00
Bookkeeping and tax service	40.00	40.00
Insurance on buildings and workers	138.00	138.00
Total Annual Overhead Costs	3517.00	3583.00

[1]These estimates include the annual costs only. Estimates of the investment requirements may be obtained from the source.

Source: Harry H. Hall et al., Resource Requirements, Costs, and Expected Returns: Alternative Crop and Livestock Enterprises; Oklahoma Panhandle, Oklahoma Agricultural Experiment Station Processed Series, P-459 (Stillwater, 1963).

APPENDIX TABLE XI

CHARACTERISTICS OF ALTERNATIVE FEEDER LIVESTOCK ACTIVITIES, OKLAHOMA PANHANDLE

Activity Number	Handling System	Purchase Date	Initial Weight (lbs.)	Selling Date	Final Weight (lbs.)	Requirements Per Head: Labor (hrs.)	Total Capital (dol.)	Annual Capital (dol.)	Cj Value[1] (dol.)
P_1	Native range + C.S.C. + (hay in bad weather)	Oct. 15	450	Oct. 15	775	7.6	118.10	114.07	32.27
P_2	Native range + C.S.C. + hay	Oct. 15	450	Oct. 15	775	8.5	118.10	114.07	32.27
P_3	Native range + C.S.C. + stubble[2] + (hay in bad weather)	Oct. 15	450	Oct. 15	775	7.6	118.10	114.07	32.27
P_4	Native range only	Apr. 15	500	Oct. 15	775	3.6	129.18	64.37	23.13
P_5	Winter wheat pasture + C.S.C. + hay; grazed out wheat	Oct. 15	450	May 15	715	3.66	110.17	63.17	42.94
P_6	Winter wheat pasture + stubble[2] + C.S.C. + (hay in bad weather); grazed out wheat	Oct. 15	450	May 15	715	3.26	110.17	63.17	42.94
P_7	Wheat pasture + C.S.C. + hay	Oct. 15	450	Mar. 1	600	2.76	109.42	40.08	17.79
P_8	Stubble[2] + C.S.C. + (hay in bad weather)	Oct. 15	450	Mar. 1	600	4.42	116.11	41.36	11.10

[1]Assumes a grain sorghum price of $1.56.

[2]Grain sorghum stubble.

APPENDIX TABLE XII

CHARACTERISTICS OF ALTERNATIVE COW-CALF LIVESTOCK ACTIVITIES, OKLAHOMA PANHANDLE

Activity Number	Handling System[1]	Calving Date	Selling Date	Selling Weight		Requirements Per Cow			C_j Value[2]
				Steers (lbs.)	Heifers (lbs.)	Labor (hrs.)	Total Capital (dol.)	Annual Capital (dol.)	(dol.)
P_9	Winter cows on range + C.S.C.	Mar. 1	Oct. 1	485	460	11.16	205.27	201.03	74.48
P_{10}	Winter cows on range + C.S.C.; creep feed calves	Mar. 1	Oct. 1	520	495	14.52	212.85	204.82	72.50
P_{11}	Winter cows on range + C.S.C. + hay	Mar. 1	Oct. 1	485	460	12.59	205.27	201.03	74.48
P_{12}	Winter cows on range + C.S.C. + winter wheat pasture	Mar. 1	Oct. 1	485	460	11.16	200.47	197.43	79.29
P_{13}	Winter cows on range + winter wheat pasture + stubble[3] + hay + C.S.C.	Nov. 1	Jul. 20	500	460	12.76	200.47	197.43	79.26
P_{14}	Winter cows on range + winter wheat pasture + stubble[3] + hay + C.S.C.; creep feed calves	Nov. 1	Jul. 20	560	520	14.72	215.11	204.75	74.00
P_{15}	Winter cows on range + stubble[3] + hay + C.S.C.	Nov. 1	Jul. 20	500	460	13.10	205.27	201.03	74.46

[1]All calves are sold directly from native range pasture.

[2]Assumes a grain sorghum price of $1.56.

[3]Grain sorghum stubble.

APPENDIX TABLE XIII

STABILITY RANGES FOR SELECTED ACTIVITIES, PANHANDLE CLAY LOAM PROGRAMMING SOLUTIONS

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
I. Present prices and allotments								
A. Grazed out wheat included								
1. Six per cent interest	44	dol.	$0.06	10,435	$0.00	111	$0.09	9
	6	head	42.94	16	41.39	15	46.05	35
	5	head	42.94	60	40.22	19	44.49	15
	46	bu.	1.65	4,546	1.52	19	--[3]	--
	47	cwt.	1.56	863	1.37	39	1.65	19
2. Twelve per cent interest	44	dol.	0.12	10,354	0.09	11	0.13	19
	22	acre	6.08	105	6.06	19	7.22	26
	5	head	42.94	60	42.73	19	45.02	15
	6	head	42.94	16	40.85	15	43.30	19
	46	bu.	1.65	4,546	1.64	19	--[3]	--
	47	cwt.	1.56	874	1.34	11	1.57	19
3. Fifteen per cent interest	44	dol.	0.15	10,326	0.13	23	0.24	12
	22	acre	6.08	112	3.41	26	6.18	23
	5	head	42.94	59	39.35	35	43.99	23
	6	head	42.94	17	41.16	23	46.37	35
	46	bu.	1.65	4,533	1.29	26	1.70	23
	47	cwt.	1.56	894	1.52	23	1.89	26
B. Grazed out wheat excluded								
1. Six per cent interest	44	dol.	0.06	6,591	0.00	111	0.10	114
	7	head	17.79	26	13.19	114	20.55	8
	46	bu.	1.65	4,518	1.08	105	1.85	18
	47	cwt.	1.56	982	1.39	12	1.60	8

APPENDIX TABLE XIII (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
2. Twelve per cent interest	44	dol.	$0.12	2,985	$0.11	39	$0.34	12
	23	acre	5.77	93	5.34	18	5.92	39
	13	head	79.26	8	72.24	14	81.67	39
	46	bu.	1.65	4,518	1.10	105	1.87	18
	47	cwt.	1.56	1,465	1.53	39	2.36	105
II. Alternative prices, no allotments								
A. Wheat $1.00, grain sorghum $1.70	44	dol.	0.06	10,291	0.05	26	0.09	9
	5	head	47.31	57	43.35	35	47.94	26
	6	head	47.31	18	46.16	26	51.62	35
	46	bu.	1.00	4,461	0.87	23	1.02	26
	47	cwt.	1.70	952	1.68	26	1.86	23
B. Wheat $1.15, grain sorghum $1.70	44	dol.	0.06	11,844	0.00	111	0.07	9
	18	acre	6.13	89	5.79	27	6.97	22
	5	head	47.31	90	44.58	22	49.45	15
	46	bu.	1.15	5,426	1.05	22	1.19	9
	47	cwt.	1.70	0.1	0.00	118	1.80	22
C. Wheat $1.20, grain sorghum $1.00	44	dol.	0.06	11,798	0.00	111	0.08	12
	5	head	25.48	90	23.65	12	29.54	15
	18	acre	6.13	90	5.65	27	7.66	30
	46	bu.	1.20	5,436	0.70	39	1.37	12
	47	cwt.	1.00	0.1	0.00	118	1.51	22
D. Wheat $1.65, grain sorghum $1.00	44	dol.	0.06	11,422	0.03	9	0.07	114
	5	head	25.48	86	24.84	114	28.40	9
	18	acre	6.13	91	5.54	27	8.15	30
	46	bu.	1.65	5,482	1.37	9	1.71	114
	47	cwt.	1.00	0.1	0.00	118	1.96	22

APPENDIX TABLE XIII (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
III. Land expansion alternatives								
A. Rent land	44	dol.	$0.06	14,487	$0.03	26	$0.07	9
	41	hour	1.25	161	0.75	23	1.36	9
	49	acre	6.22	320	--[3]	--	7.25	48
	39	acre	0.49	5	0.31	9	1.20	23
	6	head	42.94	22	40.92	26	46.36	35
	46	bu.	1.65	6,199	1.27	119	--[3]	--
	47	cwt.	1.56	1,148	1.52	26	1.67	19
	5	head	42.94	82	39.52	35	44.96	26
B. Buy land	44	dol.	0.06	14,487	0.03	26	0.07	9
	41	hour	1.25	161	0.75	23	1.36	9
	48	acre	7.25	320	--[3]	--	8.20	119
	39	acre	0.49	5	0.31	9	1.20	23
	6	head	42.94	22	40.92	26	46.36	35
	46	bu.	1.65	6,199	1.47	119	--[3]	--
	47	cwt.	1.56	1,148	1.52	26	1.67	19
	5	head	42.94	82	39.52	35	44.96	26
IV. Fixed capital alternatives								
A. Two thousand dollars	22	acre	6.08	119	--[3]	--	6.51	18
	23	acre	5.77	95	5.34	18	7.59	104
	19	acre	5.99	14	1.54	20	6.42	18
	12	head	79.29	3	77.86	13	80.48	115
	46	bu.	1.65	4,518	1.09	105	1.87	18
	47	cwt.	1.56	1,477	1.39	18	2.37	105

APPENDIX TABLE XIII (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
B. Three thousand dollars	13	head	$79.26	8	$78.69	12	$119.66	39
	23	acre	5.77	93	5.34	18	7.68	104
	19	acre	5.99	14	1.54	20	6.42	18
	22	acre	6.08	119	--[3]	--	6.51	18
	46	bu.	1.65	4,518	1.09	105	1.87	18
	47	cwt.	1.56	1,464	1.39	18	2.37	105
C. Five thousand dollars	12	head	79.29	4	72.84	5	80.00	116
	6	head	42.94	22	39.93	5	44.49	116
	46	bu.	1.65	4,518	1.10	105	1.88	18
	47	cwt.	1.56	1,344	1.38	18	2.35	105
	22	acre	6.08	119	--[3]	--	6.53	18
	19	acre	5.99	14	1.58	20	6.44	18
	23	acre	5.77	71	5.31	18	7.70	104
D. Six thousand dollars	23	acre	5.77	57	5.11	18	8.12	104
	5	head	42.94	9	39.84	35	46.77	13
	6	head	42.94	24	39.93	13	46.04	35
	46	bu.	1.65	4,518	1.15	105	1.98	18
	47	cwt.	1.56	1,266	1.31	18	2.26	105
E. Eight thousand dollars	22	acre	6.08	119	--[3]	--	6.73	18
	5	head	42.94	31	39.84	35	46.77	13
	31	acre	2.94	54	3.38	115	5.74	30
	6	head	42.94	21	39.93	13	46.04	35
	46	bu.	1.65	4,518	1.15	105	1.98	18
	47	cwt.	1.56	983	1.31	18	2.26	105

APPENDIX TABLE XIII (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
F. Ten thousand dollars	5	head	$42.94	55	$39.15	35	$47.02	13
	22	acre	6.08	117	4.40	26	6.60	23
	19	acre	5.99	12	5.62	26	6.51	23
	6	head	42.94	18	39.69	13	46.76	35
	46	bu.	1.65	4,522	1.46	26	1.91	23
	47	cwt.	1.56	935	1.36	23	1.77	26
G. Twelve thousand dollars	22	acre	6.08	105	5.57	19	7.22	26
	5	head	42.94	60	39.83	35	44.21	15
	6	head	42.94	16	41.67	15	46.05	35
	46	bu.	1.65	4,546	1.39	19	--[3]	--
	47	cwt.	1.56	863	1.47	39	1.73	19
	18	acre	6.13	14	0.92	29	6.64	19

[1]See page 39 for a discussion of stability ranges.

[2]Activity costs which would appear as negative values in the linear programming tableau have been changed to positive values and the upper and lower bounds adjusted accordingly.

[3]Unbounded.

APPENDIX TABLE XIV

STABILITY RANGES FOR SELECTED ACTIVITIES, CIMARRON SANDY PROGRAMMING SOLUTIONS

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
I. Present prices and allotments								
A. Grazed out wheat included								
1. Six per cent interest	18	acre	$6.33	173	$6.31	15	$7.01	5
	29	hour	1.25	214	1.23	15	1.31	21
	32	dol.	0.06	6,782	0.056	21	0.062	15
	19	acre	6.21	210	--[3]	--	6.23	21
	16	acre	5.92	206	5.86	21	5.94	15
	6	head	42.94	35	42.81	15	43.27	21
	22	acre	2.94	37	2.63	21	3.06	15
	34	bu.	1.65	1,439	1.64	15	1.66	21
	35	cwt.	1.56	3,624	1.55	21	1.57	15
2. Twelve per cent interest	18	acre	6.33	230	6.17	114	6.82	9
	29	hour	1.25	265	1.07	114	1.80	9
	32	dol.	0.12	6,294	0.062	9	0.13	114
	16	acre	5.92	156	5.35	9	6.11	114
	6	head	42.94	26	41.83	114	46.31	9
	34	bu.	1.65	1,093	1.62	114	1.73	9
	35	cwt.	1.56	4,193	1.51	9	1.58	114
3. Fifteen per cent interest	18	acre	6.33	415	5.72	21	6.58	22
	32	dol.	0.15	3,857	0.13	22	0.23	113
	6	head	42.94	0.1	38.11	5	44.61	22
	34	bu.	1.65	0.1	1.49	113	1.69	22
	35	cwt.	1.56	6,039	1.54	22	1.67	113

APPENDIX TABLE XIV (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
B. Grazed out wheat excluded								
1. Six per cent interest	19	acre	$6.21	210	$ --[3]	--	$6.68	21
	32	dol.	0.06	5,997	0.00	109	0.07	114
	8	head	11.10	20	9.88	114	18.42	9
	29	hour	1.25	423	0.07	106	2.64	16
	34	bu.	1.65	0.1	0.00	115	1.85	16
	35	cwt.	1.56	6,038	1.42	16	3.12	33
2. Twelve per cent interest	29	hour	1.25	424	0.15	106	2.61	16
	32	dol.	0.12	3,850	0.07	8	0.25	9
	19	acre	6.21	210	--[3]	--	6.74	21
	15	head	74.46	8	68.84	9	89.02	112
	34	bu.	1.65	0.1	0.00	115	1.84	16
	35	cwt.	1.56	6,039	1.43	16	3.32	33
II. Alternative prices, no allotments								
A. Wheat $1.60, grain sorghum $1.20	23	acre	2.94	99	-1.62	17	3.19	22
	5	head	31.70	72	30.75	18	33.88	15
	32	dol.	0.06	10,361	0.02	11	0.08	22
	6	head	31.70	0.1	29.52	15	33.47	18
	16	acre	5.92	417	--[3]	--	6.27	18
	19	acre	6.21	87	5.97	22	6.98	17
	34	bu.	1.60	2,919	1.55	18	1.80	17
	35	cwt.	1.20	787	1.11	17	1.23	18
B. Wheat $1.75, grain sorghum $1.45	23	acre	2.94	94	0.32	106	2.99	22
	5	head	39.51	64	37.39	29	39.74	22
	32	dol.	0.06	9,990	0.004	11	0.11	29
	18	acre	6.33	21	5.54	29	6.38	22
	6	head	39.51	4	39.27	22	43.47	29
	34	bu.	1.75	2,772	1.64	29	1.78	22
	35	cwt.	1.45	1,064	1.42	22	1.51	29

APPENDIX TABLE XIV (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
C. Wheat $1.25, grain sorghum $1.20	29	hour	$1.25	185	$1.13	22	$1.38	21
	32	dol.	0.06	7,156	0.05	21	0.07	22
	18	acre	6.33	193	6.17	21	6.51	22
	6	head	21.70	39	30.81	15	32.48	21
	16	acre	5.92	223	5.79	21	6.07	15
	19	acre	6.21	157	6.14	22	6.27	21
	34	bu.	1.25	1,561	1.23	15	1.27	21
	35	cwt.	1.20	3,345	1.19	21	1.21	22
D. Wheat $1.75, grain sorghum $1.65	22	acre	2.94	28	2.91	9	3.17	23
	29	hour	1.25	265	0.37	8	1.26	9
	32	dol.	0.06	6,294	0.059	9	0.14	114
	18	acre	6.33	230	6.30	21	6.34	9
	15	head	79.19	7	79.15	9	159.70	27
	6	head	45.78	26	42.16	5	45.81	9
	34	bu.	1.75	1,093	1.62	8	1.76	9
	35	cwt.	1.65	4,193	1.645	9	1.73	8
E. Wheat $1.25, grain sorghum $1.45	32	dol.	0.06	3,857	0.055	8	0.20	13
	15	head	68.68	8	64.92	8	120.78	27
	6	head	39.51	0.1	34.96	5	44.89	16
	18	acre	6.33	415	5.77	23	7.10	16
	19	acre	6.21	210	--[3]	--	6.63	23
	34	bu.	1.25	0.1	0.00	115	1.38	16
	35	cwt.	1.45	6,039	1.37	16	2.66	13
F. Wheat $1.25, grain sorghum $1.65	32	dol.	0.06	6,000	0.00	109	0.08	114
	18	acre	6.33	415	5.85	21	8.54	16
	15	head	79.19	7	72.99	3	130.11	114
	8	head	12.50	20	10.11	114	19.47	9

APPENDIX TABLE XIV (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
	19	acre	$6.21	210	$ --[3]	--	$6.63	21
	35	cwt.	1.65	6,038	1.43	16	3.03	13
III. Land expansion alternatives								
A. Rent land	18	acre	6.33	231	6.31	15	7.01	5
	29	hour	1.25	454	1.23	15	1.31	21
	32	dol.	0.06	9,249	0.056[3]	21	0.062	15
	19	acre	6.21	280	--[3]	--	6.23	21
	16	acre	5.92	274	5.86	21	5.94	15
	9	head	74.48	7	74.27	15	167.48	27
	6	head	42.94	46	42.81	15	43.27	21
	34	bu.	1.65	1,919	1.64	15	1.66	21
	35	cwt.	1.56	4,832	1.55[3]	21	1.57	15
	37	acre	3.81	320	--[3]	--	4.72	36
B. Buy land	18	acre	6.33	231	6.31	15	7.01	5
	29	hour	1.25	454	1.23	15	1.31	21
	32	dol.	0.06	9,249	0.056[3]	21	0.062	15
	19	acre	6.21	280	--[3]	--	6.23	21
	16	acre	5.92	274	5.86	21	5.94	15
	9	head	74.48	7	74.27	15	167.48	27
	6	head	42.94	46	42.81	15	43.27	21
	34	bu.	1.65	1,918	1.64	15	1.66	21
	35	cwt.	1.56	4,832	1.55[3]	21	1.57	15
	36	acre	4.72	320	--[3]	--	5.03	117

APPENDIX TABLE XIV (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
IV. Fixed capital alternatives								
A. Two thousand dollars	18	acre	$6.33	417	$ --[3]	--	$6.82	16
	29	hour	1.25	370	1.24	32	2.17	16
	19	acre	6.21	179	6.19	32	9.45	17
	34	bu.	1.65	0.1	0.00	115	1.72	16
	35	cwt.	1.56	5,780	1.49	16	1.56	32
B. Four thousand dollars	29	hour	1.25	415	0.31	8	2.67	13
	19	acre	6.21	210	--[3]	--	6.75	21
	18	acre	6.33	404	5.72	21	7.74	13
	15	head	74.46	8	69.46	9	146.18	27
	6	head	42.94	2	38.10	5	53.93	9
	34	bu.	1.65	64	1.51	8	1.85	13
	35	cwt.	1.56	5,930	1.42	13	1.64	8
C. Six thousand dollars	19	acre	6.21	210	--[3]	--	6.75	21
	18	acre	6.33	253	5.72	21	7.74	13
	29	hour	1.25	285	0.31	8	2.67	13
	6	head	42.94	23	38.10	5	53.93	9
	16	acre	5.92	137	4.51	13	6.87	17
	34	bu.	1.65	961	1.51	17	1.85	13
	35	cwt.	1.56	4,416	1.42	13	1.64	8
D. Seven thousand dollars	29	hour	1.25	213	0.70	109	1.29	9
	19	acre	6.21	203	5.94	5	6.24	9
	18	acre	6.33	175	6.26	9	6.61	5
	22	acre	2.94	35	2.61	5	2.98	9
	11	head	74.48	6	74.36	9	145.04	27

APPENDIX TABLE XIV (continued)

Program	Activity Number	Unit	Cost or Returns[2]	Units in Solution	Stability Ranges[1] Lower Bound[2]	Entering Activity	Upper Bound[2]	Entering Activity
	6	head	$42.94	35	$41.52	5	$43.29	9
	16	acre	5.92	207	5.84	9	6.49	15
	34	bu.	1.65	1,448	1.57	15	1.66	9
	35	cwt.	1.56	3,574	1.55	9	1.62	109
E. Eight thousand dollars	29	hour	1.25	142	1.09	109	1.76	9
	19	acre	6.21	138	5.94	22	7.32	17
	18	acre	6.33	153	6.16	109	6.61	22
	23	acre	2.94	63	0.45	9	3.20	22
	6	head	42.94	31	41.52	22	43.79	109
	5	head	42.94	15	42.48	109	44.37	22
	16	acre	5.92	264	5.33	9	6.09	109
	34	bu.	1.65	1,845	1.63	109	1.73	9
	35	cwt.	1.56	2,780	1.50	21	1.57	109
F. Ten thousand dollars	6	head	42.94	30	41.24	15	43.79	103
	19	acre	6.21	137	5.93	22	7.39	17
	18	acre	6.33	149	6.16	103	6.68	22
	29	hour	1.25	138	1.09	103	3.64	27
	23	head	2.94	64	2.26	113	3.21	22
	5	head	42.94	17	42.48	103	44.64	15
	16	acre	5.92	268	--[3]	--	6.09	103
	34	bu.	1.65	1,876	1.63	103	--	--
	35	cwt.	1.56	2,723	1.20	27	1.57	103

[1]See page 39 for a discussion of stability ranges.

[2]Activity costs which would appear as negative values in the linear programming tableau have been changed to positive values and the upper and lower bounds adjusted accordingly.

[3]Unbounded.

APPENDIX TABLE XV

UNSTABLE Z_j-C_j VALUES FOR SELECTED ACTIVITIES NOT APPEARING IN PROGRAMMED SOLUTIONS, PANHANDLE CLAY LOAM RESOURCE SITUATION

Program	Activity	Z_j-C_j Value[1]	Lower Limit	Upper Limit
		(dollars)		
I. Current prices and allotments				
A. Grazed out wheat included				
1. Six per cent interest	P_{19}	.27	-105	4
	P_9	1.11	-5	2
	P_{26}	1.14	-3	21
2. Twelve per cent interest	P_{11}	.93	-32	3
	P_{19}	.02	-105	7
3. Fifteen per cent interest	P_{26}	1.00	-5	5
	P_{23}	.11	-7	6
B. Grazed out wheat excluded				
1. Six per cent interest	P_{18}	.40	-4	14
2. Twelve per cent interest	P_{39}	.15	-4	70
	P_{18}	.43	-93	14
II. Alternative prices, no allotments				
A. Wheat $1.00, grain sorghum $1.70	P_9	.91	-4	2
	P_{23}	.88	-173	5
	P_{26}	.17	-4	22
	P_{18}	.47	-6	28
B. Wheat $1.15, grain sorghum $1.70	P_{27}	.26	-113	16
	P_9	.24	-122	2
	P_{22}	.77	0	97
C. Wheat $1.20, grain sorghum $1.00	P_{27}	.37	-115	16
D. Wheat $1.65, grain sorghum $1.00	P_{27}	.46	-116	21
	114	.48	-27	115
III. Land expansion[2]	P_9	.15	-6	3
	P_{26}	.30	-5	32
	P_{23}	.66	-123	6
	P_{19}	.85	-133	6

APPENDIX TABLE XV (continued)

Program	Activity	Z_j-C_j Value[1]	Lower Limit	Upper Limit
		(dollars)		
IV. Fixed capital programming				
A. Two thousand dollars	P_{44}	.12	-453	711
	111	.38	-153	453
	P_{18}	.43	-95	14
B. Four thousand dollars	P_{44}	.17	-1,008	418
	111	.33	-418	1,008
	P_{12}	.71	-3	6
	P_{18}	.43	-83	14
C. Five thousand dollars	P_{44}	.18	-582	220
	116	.44	-6	2
	111	.32	-220	582
	P_{18}	.45	-72	14
D. Six thousand dollars	P_{44}	.22	-780	3,693
	111	.28	-3,146	780
	P_{18}	.65	-58	14
E. Ten thousand dollars	P_{44}	.26	-131	326
	P_{35}	.48	-9	2
	111	.24	-326	131
	P_{23}	.52	-2	18
F. Twelve thousand dollars	P_{39}	.51	-8	4
	P_{19}	.51	-105	4

[1]See page 39 for an explanation of Z_j-C_j values.

[2]Z_j-C_j values are the same for both rent-land and buy-land.

APPENDIX TABLE XVI

UNSTABLE Z_j-C_j VALUES FOR SELECTED ACTIVITIES NOT APPEARING IN PROGRAMMED SOLUTIONS, CIMARRON SANDY RESOURCE SITUATION

Program	Activity	Z_j-C_j Value[1]	Lower Limit	Upper Limit
		(dollars)		
I. Current prices and allotments				
A. Grazed out wheat included				
1. Six per cent interest	P_{15}	.16	-2	7
	P_{11}	.38	-1	6
	P_{23}	.12	-463	53
	P_{21}	.02	-476	1
2. Twelve per cent interest	P_{23}	.55	-333	41
	114	.49	-43	60
	P_{21}	.45	-342	3
3. Fifteen per cent interest	P_{21}	.54	-342	2
B. Grazed out wheat excluded				
1. Six per cent interest	114	.41	-462	60
	P_{21}	.47	-342	2
2. Twelve per cent interest	P_{21}	.54	-342	2
II. Alternative prices, no allotments				
A. Wheat $1.75, grain sorghum $1.65	P_{23}	.16	-333	41
	P_{11}	.19	-9	6
	P_9	.05	-17	5
B. Wheat $1.25, grain sorghum $1.45	P_{23}	.42	-4	0
	P_{16}	.91	0	156
	P_{21}	.51	-342	2
	P_8	.18	-6	20
C. Wheat $1.25, grain sorghum $1.65	P_{23}	.48	-4	0
	P_{21}	.42	-342	2
	114	.81	-464	60
III. Land expansion alternatives[2]	P_{15}	.16	-3	9
	P_{11}	.38	-2	8
	P_{23}	.12	-617	71
	P_{21}	.02	-635	1
IV. Fixed capital programming				
A. Two thousand dollars	P_{32}	.004	-790	137
	P_{16}	.49	0	98
	109	1.356	-137	790

APPENDIX TABLE XVI (continued)

Program	Activity	Z_j-C_j Value[1] (dollars)	Lower Limit	Upper Limit
B. Four thousand dollars	P_{32}	.37	-143	2,294
	109	.13	-1,012	143
	P_{23}	.64	-314	2
	P_{21}	.54	-322	2
C. Six thousand dollars	P_{32}	.37	-2,143	294
	109	.13	-294	2,143
	P_{23}	.64	-40	32
	P_{21}	.54	-41	3
D. Eight thousand dollars	P_{32}	.49	-649	71
	109	.01	-71	649
	P_{22}	.33	-66	30
	P_{20}	.39	-75	8
E. Ten thousand dollars	P_{32}	.50	-1,929	-[3]
	103	.17	-119	45
	P_{22}	.35	-95	49
	P_{20}	.39	-83	9

[1]See page 39 for an explanation of Z_j-C_j values.

[2]Z_j-C_j values are the same for both rent-land and buy-land.

[3]No limit.

APPENDIX TABLE XVII

LINEAR PROGRAMMING TABLEAU FOR AN 880 ACRE PANHANDLE CLAY LOAM FARM, OKLAHOMA PANHANDLE

Item	Unit	Row	P_0	Feeder Activities						
				P_1	P_2	P_3	P_4	P_5	P_6	P_7
Cropland:[1]										
C_a	acre	101	31							
C_b	acre	102	331							
C_c	acre	103	119							
C_d	acre	104	110							
Wheat allotment	acre	105	376							
Native pasture	AUM	106	67.8	6.70	4.90	4.90	4.25	.50	.50	.50
Operator labor:										
Jan-Apr	hour	107	538	2.80	3.60	2.80	.55	1.50	1.20	1.62
May-Jul	hour	108	506	1.50	1.50	1.50	1.50	1.02	1.02	
Aug-Sep	hour	109	352	1.00	1.00	1.00	1.00			
Oct-Dec	hour	110	462	2.30	2.40	2.30	.55	1.14	1.04	1.14
Total capital	dol.	111	.1	118.10	118.10	118.10	129.18	110.17	110.17	109.42
Annual capital	dol.	112	.1	114.07	114.07	114.07	64.37	63.17	63.17	40.08
Hay	ton	113	.1	.025	.80	.025		.45	.025	.33
Grazing:										
Wheat										
Oct 1-Mar 1	AUM	114	.1					1.40	1.40	2.40
Mar 1-May 30	AUM	115	.1					1.40	1.40	
Stubble										
Oct 1-Mar 1	AUM	116	.1			1.80			1.00	
Wheat	bu.	117	.1							
Grain sorghum	cwt.	118	.1							
Land restriction	acre	119	320							
Returns per unit (C_j)	dol.			32.27	32.27	32.27	23.13	42.94	42.94	17.79

APPENDIX TABLE XVII (continued)

Row	Cow-Calf Activities								Wheat		
	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}	P_{15}	P_{16}	P_{17}	P_{18}
101									1.0		
102										1.0	
103											1.0
104											
105									1.0	1.0	1.0
106	.50	13.44	13.44	11.40	11.00	8.96	8.96	10.64			
107	2.12	8.10	9.42	9.53	8.10	4.94	6.50	5.28			
108		1.12	1.92	1.12	1.12	1.04	1.44	1.04	.47	.47	.47
109		.36	.96	.36	.36	1.00	1.00	1.00	.57	.57	.57
110	2.30	1.58	2.22	1.58	1.58	5.78	5.78	5.78			
111	116.11	205.27	212.85	205.27	200.47	200.47	215.11	205.27	2.43	2.43	2.43
112	41.36	201.03	204.82	201.03	197.43	197.43	204.75	201.03	2.22	2.22	2.22
113	.025	.028	.028	.84	.28	.42	.42	.42			
114					2.80	2.80	2.80		-.30	-.25	-.20
115											
116	3.10					1.68	1.68	2.80			
117									-14	-12	-10
118											
119											
C_j	11.10	74.48	72.50	74.48	79.29	79.26	74.00	74.46	-6.41	-6.27	-6.13

APPENDIX TABLE XVII (continued)

Row	Grain Sorghum					Forage Sorghum				Grazed Out Wheat	
	P_{19}	P_{20}	P_{21}	P_{22}	P_{23}	P_{24}	P_{25}	P_{26}	P_{27}	P_{28}	P_{29}
101		1.0				1.0				1.0	
102			1.0				1.0				1.0
103				1.0				1.0			
104	1.0				1.0				1.0		
105	1.0										
106											
107		.12	.12	.12	.12	.12	.12	.12	.12		
108	.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	.47	.47
109	.57									.57	.57
110											
111	2.43	2.58	2.58	2.58	2.58	2.55	2.55	2.55	2.55	2.94	2.94
112	2.22	2.30	2.30	2.30	2.30	2.26	2.26	2.26	2.26	2.49	2.49
113						-1.6	-1.2	-1.4	-1.1		
114	-.15									-.30	-.25
115										-1.80	-1.65
116		-.20	-.12	-.15	-.10						
117	-8										
118		-9.0	-5.5	-8.0	-5.5						
119											
C_j	-5.99	-6.20	-5.77	-6.08	-5.77	-8.95	-8.35	-8.65	-8.20	-2.94	-2.94

APPENDIX TABLE XVII (continued)

Row	Grazed Out Wheat		Grazed Out Forage Sorghum				Reseeded Cropland			
	P_{30}	P_{31}	P_{32}	P_{33}	P_{34}	P_{35}	P_{36}	P_{37}	P_{38}	P_{39}
101			1.0				1.0			
102				1.0				1.0		
103	1.0				1.0				1.0	
104		1.0				1.0				1.0
105										
106							-.80	-.72	-.64	-.56
107			.12	.12	.12	.12				
108	.47	.47	1.47	1.47	1.47	1.47				
109	.57	.57								
110										
111	2.94	2.94	2.55	2.55	2.55	2.55	2.90	2.90	2.90	2.90
112	2.49	2.49	2.27	2.27	2.27	2.27	1.65	1.65	1.65	1.65
113										
114	-.20	-.15								
115	-1.50	-1.35								
116			-1.10	-.90	-1.00	-.80				
117										
118										
119										
C_j	-2.94	-2.94	-2.55	-2.55	-2.55	-2.55	-.49	-.49	-.49	-.49

APPENDIX TABLE XVII (continued)

Row	Hire Labor Jan-Apr P_{40}	Hire Labor May-Jul P_{41}	Hire Labor Aug-Sep P_{42}	Hire Labor Oct-Dec P_{43}	Borrow Capital P_{44}	Buy Hay P_{45}	Sell Wheat P_{46}	Sell Grain Sorghum P_{47}	Buy Land[1] P_{48}	Rent Land[1] P_{49}
101									-.0352	-.0352
102									-.3768	-.3768
103									-.1352	-.1352
104									-.1256	-.1256
105									-.4270	-.4270
106									-.0768	-.0768
107	-1.0									
108		-1.0								
109			-1.0							
110				-1.0						
111	1.25	1.25	1.25	1.25	-1.00	20.00				
112	.63	.63	.63	.63	-1.00	20.00				
113						-1.0				
114										
115										
116										
117							1.0			
118								1.0		
119									1.0	1.0
C_j	-1.25	-1.25	-1.25	-1.25	-.06	-20.00	1.65	1.56	-7.25	-6.22

[1]Twenty per cent nonharvested cropland is excluded.

APPENDIX TABLE XVIII

LINEAR PROGRAMMING TABLEAU FOR A 960 ACRE CIMARRON SANDY FARM, OKLAHOMA PANHANDLE

Item	Unit	Row	P_0	Feeder Activities P_1	P_2	P_3	P_4	P_5	P_6	P_7
Cropland:[1]										
S_a	acre	101[1]	417	---	---	---	---	---	---	---
S_b	acre	102	210							
Wheat allotment	acre	103	268							
Native pasture	AUM	104	88.2	6.70	4.90	4.90	4.25	.50	.50	.50
Operator labor:										
Jan-Apr	hour	105	538	2.80	3.60	2.80	.55	1.50	1.20	1.62
May-Jul	hour	106	506	1.50	1.50	1.50	1.50	1.02	1.02	
Aug-Sep	hour	107	352	1.00	1.00	1.00	1.00			
Oct-Dec	hour	108	462	2.30	2.40	2.30	.55	1.14	1.04	1.14
Total capital	dol.	109	.1	118.10	118.10	118.10	129.18	110.17	110.17	109.42
Annual capital	dol.	110	.1	114.07	114.07	114.07	64.37	63.17	63.17	40.08
Hay	ton	111	.1	.025	.80	.025		.45	.025	.33
Grazing:										
Wheat										
Oct 1-Mar 1	AUM	112	.1					1.40	1.40	2.40
Mar 1-May 30	AUM	113	.1					1.40	1.40	
Stubble										
Oct 1-Mar 1	AUM	114	.1			1.80			1.00	
Wheat	bu.	115	.1							
Grain sorghum	cwt.	116	.1							
Land restriction	acre	117	320							
Returns per unit (C_j)	dol.			32.27	32.27	32.27	23.13	42.94	42.94	17.79

APPENDIX TABLE XVIII (continued)

Row	Cow-Calf Activities								Wheat	
	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}	P_{15}	P_{16}	P_{17}
101									1.0	
102										1.0
103									1.0	1.0
104	.50	13.44	13.44	11.40	11.00	8.96	8.96	10.64		
105	2.12	8.10	9.42	9.53	8.10	4.94	6.50	5.28		
106		1.12	1.92	1.12	1.12	1.04	1.44	1.04	.47	.47
107		.36	.96	.36	.36	1.00	1.00	1.00	.57	.57
108	2.30	1.58	2.22	1.58	1.58	5.78	5.78	5.78		
109	116.11	205.27	212.85	205.27	200.47	200.47	215.11	205.27	2.43	2.43
110	41.36	201.03	204.82	201.03	197.43	197.43	204.75	201.03	2.22	2.22
111	.025	.028	.028	.84	.28	.42	.42	.42		
112					2.80	2.80	2.80		-.20	-.18
113										
114	3.10					1.68	1.68	2.80		
115									-7.0	-5.0
116										
117										
C_j	11.10	74.48	72.50	74.48	79.29	79.26	74.00	74.46	-5.92	-5.78

APPENDIX TABLE XVIII (continued)

Row	Grain Sorghum		Forage Sorghum		Grazed Out Wheat		Grazed Out Forage Sorghum		Reseeded Cropland	
	P_{18}	P_{19}	P_{20}	P_{21}	P_{22}	P_{23}	P_{24}	P_{25}	P_{26}	P_{27}
101	1.0		1.0		1.0		1.0		1.0	
102		1.0		1.0		1.0		1.0		1.0
103										
104									-.64	-.56
105	.12	.12	.12	.12			.12	.12		
106	1.47	1.47	1.47	1.47	.47	.47	1.47	1.47		
107					.57	.57				
108										
109	2.58	2.58	2.55	2.55	2.94	2.94	2.55	2.55	2.87	2.87
110	2.30	2.30	2.26	2.26	2.49	2.49	2.27	2.27	1.64	1.64
111			-1.60	-1.40						
112					-.20	-.18				
113					-1.30	-1.02				
114	-.20						-1.10	-.80		
115										
116	-10.0	-9.0								
117										
C_j	-6.33	-6.21	-8.95	-8.65	-2.94	-2.94	-2.55	-2.55	-.49	-.49

APPENDIX TABLE XVIII (continued)

Row	Hire Labor Jan-Apr P_{28}	Hire Labor May-Jul P_{29}	Hire Labor Aug-Sep P_{30}	Hire Labor Oct-Dec P_{31}	Borrow Capital P_{32}	Buy Hay P_{33}	Sell Wheat P_{34}	Sell Grain Sorghum P_{35}	Buy Land[1] P_{36}	Rent Land[1] P_{37}
101									-.4344	-.4344
102									-.2184	-.2184
103									-.2790	-.2790
104									-.0918	-.0918
105	-1.0									
106		-1.0								
107			-1.0							
108				-1.0						
109	1.25	1.25	1.25	1.25	-1.00	20.00				
110	.63	.63	.63	.63	-1.00	20.00				
111						-1.0				
112										
113										
114										
115							1.0			
116								1.0		
117									1.0	1.0
C_j	-1.25	-1.25	-1.25	-1.25	-.06	-20.00	1.65	1.56	-4.72	-3.81

[1]Twenty per cent nonharvested cropland is excluded.

VITA

Harry Hale Hall

Candidate for the Degree of

Master of Science

Thesis: SHORT RUN ADJUSTMENT OPPORTUNITIES FOR OKLAHOMA PANHANDLE FARMERS

Major Field: Agricultural Economics

Biographical:

Personal Data: Born near Cassville, Missouri, August 14, 1934, the son of Bert L. and Cynthia Jane Hall.

Education: Attended grade schools near Cassville, Missouri and in Exeter, Kansas City, and Springfield, Missouri; attended high school in Springfield, Cassville, and Aurora, Missouri; graduated from Aurora High School in 1952; received the Bachelor of Science degree from the University of Missouri, with a major in general agriculture, in June, 1956; completed requirements for the Master of Science degree in August, 1963.

Professional experience: Assistant County Agent, Missouri Agricultural Extension Service, July, 1956 to March, 1957; Associate County Agent, Missouri Agricultural Extension Service, April, 1959 to September, 1961; research assistant, Oklahoma State University, September, 1961 to August, 1963.