Short-Run Adjustment Opportunities For Oklahoma Panhandle Farmers

Harry H. Hall
Larry J. Connor
Odell L. Walker
William F. Lagrone

Technical Bulletin T-112
December, 1964

Agricultural Experiment Station
Oklahoma State University, Stillwater
and
Farm Production Economics Division
Economic Research Service
U. S. Department of Agriculture

CONTENTS

Short-Run Adjustment Opportunities For Oklahoma Panhandle Farmers

by

Harry H. Hall,* Larry J. Connor,** Odell L. Walker,***
William F. Lagrone**

This bulletin reports results of a study made to estimate the most profitable farm organizations for Oklahoma Panhandle farmers under existing resource positions and under a wide range of price and cost conditions. 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 this setting is to allocate the fixed resources, along with variable quantities of other resources, among the alternative uses to maximize returns to the fixed resources.

Objective of Study

The major objective of this study was 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 so as to approximate the typical resource combinations in the area. Minor adjustments in yields, prices, resources, etc., can make these results useful to most Panhandle farms.

Area of Study

Dryland crop farms in the three counties of the Oklahoma Panhandle were studied. Irrigated cropland and land in range areas are excluded.

Research reported herein was done under Oklahoma Station Project Number 1164. This is a contributing study to Regional Project GP-5, "Economic Problems in the Production and Marketing of Great Plains Wheat."

*Formerly Graduate Assistants, Oklahoma State University.
**Farm Production Economics Division, Economics Research Service, U. S. Department of Agriculture.
***Professor, Agricultural Economics Department, Oklahoma State University.

The Panhandle includes about 10.2 percent of the land in farms in Oklahoma but only about 4 percent of the commercial farms (*10*).[1] Nearly 16.1 percent of the state wheat acreage and 12.8 percent of the State wheat production are located in the Panhandle. About 25 percent of the State grain sorghum acreage and 25 percent of the harvested yield are found in the Panhandle. In 1959, almost 161 thousand head of cattle, approximately 5 percent of the State total, were on Panhandle farms and ranches. 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. The rainfall pattern and amount not only limit crop yields but also present 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 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 and borrowed capital are assumed to be available and attainable in any amounts to be combined with the fixed resources. Emphasis is given to farm organizations which combine the fixed and variable resources to obtain maximum returns above total variable costs.

Optimum farm organizations were ascertained for each set of conditions by linear programming (*4*).

Input, output, and cost data for the crop and livestock activities used are reported in Okla. Agri. Exp. Sta. Processed Series P-459 (*2*). The data reported are taken from experiment station research, farmer experience, estimates by scientists, and other sources.

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

[1]Numbers in parenthesis and italicized refer to References on p. 55.

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 are long-time average expected yields on harvested land using "improved practices". 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 1.[2]

Not all nonirrigated cropland involved in the classification described above is included in this study. All S_a cropland, which is found in Beaver and Texas Counties, is excluded. Part of C_c and most of 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 (*10*). Approximately 1.3 million acres of nonirrigated cropland representing 1.6 million acres of land in farms are included in this study.

[2]Representative soils for each of the productivity classes can be found in Appendix Tables 1 and 2. Distribution of soils by productivity class within counties appears in Appendix Table 3.

Table 1—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:[1]							
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[2]	AUM	1.00	.90	.80	.70	.80	.70

[1]Native range grazing is 0.6 AUM per acre of range.
[2]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,* Okla. Agr. Expt. Sta. Proc. Ser. P-459, July 1968.

The cropland included in this study constitutes approximately 80 percent of the cropland in the original classification and about 55 percent of the Panhandle cropland. About 70 percent of the land in farms in the original classification and 50 percent of the land in farms in the Panhandle are represented by this study.

Two soil resource situations were developed for the area. 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 118,000 acres of cropland, most of it in Cimarron County. Based on available records, the amounts of rangeland, 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 percent cropland, 12.8 percent native range, and 3.1 percent in farmsteads and roads. For the Cimarron Sandy situation, the distribution is 81.6 percent cropland, 15.3 percent native range, and 3.1 percent in farmsteads and roads.[3]

Representative farms for each of the soil resource situations were specified on the basis of the 1959 Census of Agricultural Stabilization and Conservation Service (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 cropland. Acres of cropland by productivity class and acres of native range, wheat allotment, etc., comprising the two representative farms are presented in Table 2.

Nonharvested Cropland

Typically, the relatively low amounts of rainfall in the Panhandle along with the erratic distribution in some years force the abandonment of relatively large amounts of crops. In addition, some of the cropland is intentionally fallowed or left idle at regular intervals. For this study, it is assumed that 20 percent of the cropland is not harvested each year because of either idleness, fallow, or crop failure. Amounts of harvested cropland by productivity class for each of the representative farms are shown in Table 2.

Generally, some costs are incurred on nonharvested cropland. Machinery and seed costs are incurred on failure acres and machinery

[3]Distribution of soils by productivity class among the various use groups appears in Appendix Table 3.

Table 2—Land Classification and Wheat Allotments for Representative Farms, Oklahoma Panhandle

	Panhandle Clay-Loam		Cimarron Sandy	
	Total land	Harvested land[1]	Total land	Harvested land[1]
Soil productivity class		— Acres —		
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[2]	27	--	30	--
Total farmland	880	--	960	--
Wheat allotment[3]	376	--	268	--

[1]Twenty percent nonharvested cropland excluded.
[2]Includes farmsteads, roads, waste, etc.
[3]Base allotments for 1959-1961.

costs are involved in fallowing land. Costs associated with nonharvested cropland are assumed to be whole farm rather than enterprise costs and are deducted from programmed returns to estimate returns to land, labor, management, and risk.

Machinery Costs

One 4-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 3. This set of equipment has a capacity of 1,200 acres of cropland.[4]

Machinery variable costs including gas, oil, grease, and repairs were included as a part of the costs for the respective 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. In this study, fixed machinery costs are classed as overhead costs.

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

Table 3—Estimated Costs and Investment Requirements for One 4-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[1]	0.897[1]
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		

[1]Cost per hour of use.

Labor Availability

Labor requirements for the various activities and the amount of operator labor available were grouped in four periods: (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 4. Nonmanagement time is that time for performing tasks for which only labor is required such as tractor driving and feeding livestock. A certain amount of management time for making cropping plans, business transactions, etc. is required in addition to the nonmanagement time. It is assumed that any amount of additional labor can be hired for $1.25 per hour.

Capital Availability

It is assumed that any amount of capital can be borrowed at the specified rate of interest. As one phase of this study, the amount of capital is fixed at alternative levels and no interest charge is made on this fixed 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. All interest charges are made on the basis of annual capital.

Table 4—Availability of Operator Labor for Farming Purposes, Oklahoma Panhandle[1]

Period	Hours of nonmanagement time
Jan.-Apr.	538
May-July	506
Aug.-Sept.	352
Oct.-Dec.	462

[1]Assumes 22 working days per month excluding February when there are 20 days. Allows 6 hours per day, Dec.-March; 7 hours per day, April, May, and Nov.; and 8 hours per day, June-Oct. for nonmanagement time.

Crop Activities

Crop activities considered as alternatives include most of those produced on nonirrigated cropland in the Panhandle. Of these, only wheat and grain sorghum are marketed directly; all 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.[5]

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.

Livestock Activities

Eight buy-sell feeder activities and seven cow-calf activities are included (see Appendix Tables 4 and 5). Each feeder activity assumes the purchase of "good to choice" steers and the sale of "good" steers. All feeder activities assume a death loss equivalent to 1 percent of the selling weight.

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. All calves are sold as good-choice feeders. A death loss among cows and heifers of 3.25 percent is charged. All requirements are averages

[5]For further discussion of wheat pasture for the Panhandle, see Odell L. Walker and James S. Plaxico (*9*).

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 5.

Price Assumptions

Prices for all factors of production, with the exception of livestock and capital, are constant throughout all phases of this analysis. Assumed prices paid by farmers are shown in Appendix Table 6.

Table 5—Programmed Activities and Identifying Numbers

Activity	Activity number	
	Panhandle Clay-Loam	Cimarron Sandy
Real activities:[1]	(P_j)	(P_j)
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[2]	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:[1]		
Land disposal	101-104	101,102
Wheat allotment	105	103
Native range	106	104
Labor[2]	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

[1]There is a crop activity and a disposal activity for each class of land.
[2]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.

Product prices, on the other hand, are not held constant. For much of the analysis, essentially current prices for livestock and crops are used. For the alternative price analysis, 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 6 and 7.

Overhead Costs

Overhead costs are considered to be whole farm costs and deducted from the net-returns estimates of each optimum organization. Estimates of overhead costs for the two representative farms are shown in Appendix Table 8.

Optimum Farm Organizations For Current Prices And Allotments

The set of production alternatives clearly affects the optimum organization and level of returns. Since most of the assumed crop and livestock activities 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. Optimum organizations are therefore derived with and without grazed-out wheat.

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 percent are considered with grazed-out wheat included. Interest rates of 6 and 12 percent are considered with grazed-out wheat excluded.

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.[6] In addition, wheat furnishes more fall grazing than grain sorghum on the clay soils. As a consequence, current prices which also favor wheat result in the maximum allotment

[6]The marginal rates of substitution of wheat for grain sorghum in hundredweight of grain sorghum per bushel of wheat are presented in Table 13.

of wheat for each of the three interest rates considered. The optimum organizations for this set of conditions are presented in Table 6.

Six Percent Interest. A 6-percent 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 for 6 percent

Table 6—Optimum Farm Organizations for Alternative Interest Rates, Grazed Out Wheat Included, 880 Acre Panhandle Clay Loam Farm[1]

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[2]	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

[1]Current prices and allotments are assumed.
[2]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517). The returns represent those remaining after all factors except operator labor and land have been paid.

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 feeders 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 percent, 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.[7] 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. 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 7. The optimum organization contains more wheat but less grain sorghum than the aver-

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

Table 7—Comparison of Present and Optimum Cropping Systems, Oklahoma Panhandle

Activity	Average organization Percent of cropland[1]	Optimum organization Percent of cropland[2]
Wheat	46.8	50.9
Grain sorghum	32.4	14.7
Other crops	--	14.4
Fallow	20.8	20.0
Total	100.0	100.0

[1]From: Odell L. Walker, unpublished data on machinery practices, Oklahoma Panhandle, Oklahoma Agricultural Experiment Station, Stillwater.
[2]Based on Table 6, 6 percent interest.

age. 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 than the clay-loam situation.

Twelve and Fifteen Percent Interest. Each of these interest rates yields a unique organization but the changes from the organization for 6 percent interest are only minor. Furthermore, the organization for 15 percent interest is optimum for all interest rates between 12.5 and 24 percent. The principal change resulting from the increased capital costs is the decrease in returns to land, labor, management, and risk. Returns for 12 percent interest are $398 less and those for 15 percent interest are $598 less than those for 6 percent interest. Most of the decrease is due to the higher capital charge on the relatively constant amount of capital.

Panhandle Clay-Loam, Grazed-Out Wheat Excluded

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 hay required by P_5. When wheat pasture and grazed-out wheat are available, P_6 enters if grain sorghum stubble is available; P_5 enters if stubble is not available.

Optimum organizations for 6 and 12 percent interest rates are presented in Table 8. 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 at 12 percent interest. At 6 percent interest, 79 acres of cropland are reseeded to native pasture. However, the full allotment of wheat is included in both organizations.

Six Percent Interest. There are only 26 head of feeder livestock compared to 76 with grazed-out wheat included. The number of cows is greater, 11 instead of 3. 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 have decreased by $1,487.

Table 8—Optimum Farm Organizations for Alternative Interest Rates, Grazed Out Wheat Excluded, 880 Acre Panhandle Clay-Loam Farm[1]

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[2]	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	..

[1]Current prices and allotments are assumed.
[2]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517). The returns represent those remaining after all factors except operator labor and land have been paid.

This organization is optimum over a relatively wide range of prices and costs. The interest rate can rise as high as 10.5 percent without causing a change, the price of wheat can fall to $1.08, or the price of grain sorghum can rise to $1.60. For wheat prices below $1.08 or grain sorghum prices above $1.60, wheat would decrease, leaving some allotment land unused, and grain sorghum would increase.

Twelve Percent Interest. 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 percent interest. If the interest rate were only 6 percent, this organization would yield returns of $2,817, which is $426 less than the returns for the optimum organization for 6 percent interest.

Excluding grazed-out wheat when the interest rate is 12 percent causes rather significant changes from the organization in which grazed-out wheat is included. There are no feeder livestock. There are nearly twice as much grain sorghum, total capital requirements are $7,369 less and returns are $1,684 less than when grazed-out wheat is permitted.

The interest rate must rise above 34 percent before a change from 12 percent interest plan is profitable. When the interest rate is 12 percent, wheat prices can fall to $1.10 or the price of grain sorghum can 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.

Cimarron Sandy, Grazed-Out Wheat Included

The yield advantage between wheat and grain sorghum on the Cimarron Sandy soils is the reverse of that for the Panhandle Clay-Loam soils. Grain sorghum has a decided advantage on both Cimarron Sandy productivity classes.[8] 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 (Table 1). 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 percent are presented in Table 9.

Six Percent Interest. For this rate, grain sorghum is the principal

[8]The marginal rates of substitution of wheat for grain sorghum in hundredweight of grain sorghum per bushel of wheat are presented in Table 15.

Table 9—Optimum Farm Organizations for Alternative Interest Rates, Grazed Out Wheat Included, 960-Acre Cimarron Sandy Farm[1]

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-July	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[2]	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

[1]Current prices and allotments are assumed.
[2]Programmed returns less nonharvested cropland cost ($202.80) and overhead costs ($3,583). The returns represent those remaining after all factors except operator labor and land have been paid.

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

The optimum organization for 6 percent 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 percent and 6.2 percent. Below 5.6 percent, 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 percent interest, the organization for 12 percent 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 substitution 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 Percent Interest. As the interest rate rises from 6 percent, 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 percent interest, both wheat and P_6 decrease in amount and above 13.2 percent 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 percent interest, all but 2 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 6 percent interest, the organization for 12 percent requires $488 less total capital and returns are $303 less. If the interest rate were only 6 percent, returns for this organization would be $1,816 which is only $22 less than the returns for the optimum organization for 6 percent interest.

The organization for 15 percent interest has no feeder livestock and all but two acres of the cropland are in grain sorghum. Compared to the optimum organization for 6 percent interest, total capital requirements are $2,925 less ($3,857) and returns are $569 less ($1,269). If the interest rate were only 6 percent, returns for this organization would be $265 less ($1,573) than for the optimum organization at 6 percent interest. This organization is optimum for interest rates between 13.2 and 23 percent. 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.

Cimarron Sandy, Grazed-Out Wheat Excluded

With grazed-out wheat excluded, only two interest rates, 6 percent and 12 percent, are considered. Optimum organizations for both interest rates are reported in Table 10. In contrast to the organizations including grazed-out wheat, there is now no wheat.

Six Percent Interest. In addition to 625 acres of grain sorghum and forage sorghum for cattle, the optimum organization for 6 percent 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. Gains as well as returns are quite low. Compared to the organization for 6 percent 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).

Table 10—Optimum Farm Organizations for Alternative Interest Rates, Grazed Out Wheat Excluded, 960 Acre Cimarron Sandy Farm[1]

Item	Unit	Interest rate	
		Six percent	Twelve percent
Grain sorghum	Acre	625	625
Grain sorghum	Cwt.	6,038	6,038
Forage sorghum for hay	Acre	2	2
Feeder P_8	Head	20	
Cow-calf P_{15}	Head	7	8
Hire labor, May-July	Hour	423	423
Total capital	Dol.	5,997	3,850
Annual capital	Dol.	4,020	3,377
Returns to land, labor, management, and risk[2]	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

[1]Current prices and allotments are assumed.
[2]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583). The returns represent those remaining after all factors except operator labor and land have been paid.

Interest rates between 0 and 7.1 percent yield the same optimum organization. For interest rates above 7.1 percent, the organization for 12 percent interest is optimum. Wheat prices to $1.84 or grain sorghum prices between $1.42 and $3.12 yield the same organization. Thus, in contrast to the organization for 6 percent interest in which grazed-out wheat is included, this organization is quite stable over a wide range of prices and costs.

Twelve Percent Interest. At 12 percent 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, and returns to land, labor, management, and risk are reduced by $277. With an interest charge of 6 percent, returns from this organization would be only $74 less than for the optimum organization for 6 percent interest.

Compared to the organization for 12 percent 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.

This organization is optimum for interest rates between 7.1 and 25 percent. 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.

Income Opportunities Implied by Results

Some generalizations can be made about the income opportunities for various owner-renter positions. Three positions considered are: (1) an owner of all resources, (2) a renter who owns all resources except land, and (3) a renter who owns all resources except land and operating capital. The income estimates are average expected returns over time. The organizations for 6 percent interest presented in Tables 6 and 9 are used as the bases for the inferences in this section. Aggregrate land prices assumed are $100 per acre for Panhandle Clay-Loam and $60 per acre for Cimarron Sandy. Results are presented in Table 11. A 6 percent interest charge was made on all borrowed operating capital. A rental charge equal to 5 percent 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 11—Income Opportunities for Alternative Owner Positions, Oklahoma Panhandle[1]

Resource situation	Owner Position		
	Owner, all resources[2]	Renter, land[3]	Part owner, renter[4]
	(net returns to owned resources)		
Panhandle Clay Loam	$5,131	$1,776	$1,375
Cimarron Sandy	$2,127	$ 291	$ 2

[1]Returns shown are residual returns. It is assumed that the land owner pays land taxes and depreciation and maintenance on buildings.
[2]Owns all resources including land and operating capital.
[3]Rents land but owns all other resources including operating capital.
[4]Rents land, borrows operating capital but owns other resources.

Optimum Farm Organizations For Alternative Prices

Two major simplifying assumptions have been made in determining the optimum farm organizations. First, allotments have been excluded to obtain information about the unrestricted response to various conditions. Second, livestock prices are assumed to vary in direct proportion to grain sorghum prices. Livestock prices in Appendix Table 5 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-pound 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 section are presented in Appendix Table 9.

Panhandle Clay-Loam Resource Situation

For this portion of the analysis, three grain sorghum prices and five wheat prices were selected. Grain sorghum prices are $1.00, $1.35, and $1.70, and wheat prices are $1.00, $1.15, $1.20, $1.35, and $1.65. 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 and results reported in Table 12. However, only price combinations most relevant for either current or prospective conditions are discussed in detail. A bushel of wheat is approximately equivalent to 0.66 hundredweight of grain sorghum for feeding purposes. Consequently, the price ratio (P_w/P_{gs}) is not likely to fall below 0.66 (5).

Table 12—Optimum Farm Organizations for Alternative Prices of Grain Sorghum and Wheat, No Allotments, 880 Acre Panhandle Clay-Loam Farm[1]

Grain sorghum price wheat price		$1.70 $1.00	$1.70 $1.15	$1.00[2] $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[3]	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

[1]Livestock prices are assumed to vary in direct proportion to the grain sorghum price.
[2]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[3]
$1.00	$1.35	$2,116
$1.70	$1.20	$3,337
$1.35	$1.65	**$4,763**

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

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 (Table 12). 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 substitution ($\Delta GS/\Delta W = 0.80$), 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 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 13.

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

Table 13—Marginal Rates of Substitution of Wheat for Grain Sorghum, Panhandle Clay-Loam Resource Situation[1]

Productivity class	Marginal rate of substitution[2]
C_a	0.64
C_b	0.46
C_c	0.80
C_d	0.69

[1]Based on yields reported in Table 1.
[2]These marginal rates of substiution are in hundredweight of grain sorghum per bushel of wheat.

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.

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.

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 and returns by $810.

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 price combinations are presented in Table 14.

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

Table 14—Optimum Farm Organizations for Alternative Prices of Grain Sorghum and Wheat, No Allotments, 960-Acre Cimarron Sandy Farm[1]

Wheat price Grain sorghum price		$1.60[2] $1.20	$1.75 $1.45	$1.25[3] $1.20	$1.75 $1.65	$1.25 $1.45	$1.25[4] $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-July	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[5]	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	-	-	-

[1]Livestock prices are assumed to vary in direct proportion to the grain sorghum price.
[2]Wheat $1.75 and grain sorghum $1.20 gives the same solution but $867 returns.
[3]Wheat $1.60 and grain sorghum $1.45 gives the same solution but $1,234 returns.
[4]Wheat $1.60 and grain sorghum $1.65 gives the same solution and returns.
[5]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583).

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 2 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}).

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 15.

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.

Table 15—Marginal Rates of Substitution of Wheat for Grain Sorghum, Cimarron Sandy Resource Situation[1]

Productivity class	Marginal rate of substitution[2]
S_b	1.43
S_c	1.80

[1]Based on yields reported in Table 1.
[2]These marginal rates of substitution are in hundredweight of grain sorghum per bushel of wheat.

Following are stability ranges for some of the optimum organizations found in this part of the analysis.

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 substitution of P_8 for P_6. Since P_8 utilizes stubble but no wheat grazing, this implies the substitution of grain sorghum for some wheat.

Wheat $1.25, Grain Sorghum $1.45. All but 2 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.

Optimum Farm Organizations For Land Expansion Alternatives And Alternative Amounts Of Capital

In the previous sections, 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 section, the fixed land assumption is dropped. In the second part, 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.

The land expansion alternative reflects an intermediate rather than a short-run situation. The fixed capital alternatives may reflect either of two situations. First, a 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. In this study, items constituting the cost per acre of buying land are: (1) a land payment amortized over 33 years at five percent interest, (2) nonharvested cropland costs, and (3) land taxes. The land rent charge per acre consists of: (1) six percent interest on the land value, and (2) nonharvested cropland costs. Assumed costs per acre of land, both for renting and for buying, appear in Table 16.

A restriction of 320 acres was placed on the amount of land which could be added by either renting, buying, or both. 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.

The composition of each of the representative farms after adding 320 acres of land is presented in Table 17. Total amounts of land and the amounts of cropland which can be harvested each year are tabulated by productivity class.

Results for the land expansion alternatives for the Panhandle Clay-Loam situation are presented in Table 18. Both the rent-land and the

Table 16—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[1]	6.25	6.00	3.75	3.60
Land taxes[2]	.78	--	.76	--
Nonharvested cropland cost	.22	.22	.21	.21
Total cost per acre	7.25	6.22	4.72	3.81

[1]Five percent interest plus principal payment for buy-land. Six percent interest only for rent-land.

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

Table 17—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[1]	Total land	Harvested cropland[1]
	— 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[2]	37	--	40	--
Total farmland	1,200	--	1,280	--
Wheat allotment[3]	513	--	357	--

[1]Twenty percent nonharvested cropland excluded.
[2]Includes farmsteads, roads, waste, etc.
[3]Base allotments for 1959-1961.

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 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. The buy-land alternative forces the accumulation of capital in addition to meeting annual land costs. The capital accumulated amounts to slightly more than $1.00 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

Table 18—Optimum Farm Organizations for Buy Land and Rent Land Alternaitves, Panhandle Clay Loam Resource Situation[1]

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-July	Hour	161	161
Hire labor, Aug.-Sept.	Hour	3	3
Buy land	Acre	-	320
Rent land	Acre	320	-
Total capital	Dol.	14,487[3]	14,487[3]
Annual capital	Dol.	9,267[3]	9,267[3]
Returns to land, labor, management, and risk[2]	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

[1]Current prices and allotments are assumed.
[2]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517).
[3]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.

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 marginal value of land to some operators can, of course, influence these results.

Cimarron Sandy. Optimum organizations for the buy-land and the rent-land activities are presented in Table 19. Again, the buy-land and rent-land alternatives add the same amounts of land and allotment resources to the original set of resources. Thus the optimum organization is the same for both activities. 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 return estimates compare with the estimates of $1,838 for the initial land resources. 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.

Table 19—Optimum Farm Organizations for Buy Land and Rent Land Alternatives, Cimarron Sandy Resource Situation[1]

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-July	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[2]	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

[1]Current prices and allotments are assumed.
[2]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583).

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, minor changes in the prices of wheat and grain sorghum will cause changes in the organization.

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 (institutionalized). It was impossible to determine institutional rates per acre for renting land before programming without imposing a predetermined cropping plan on the rented land. Since optimum cropping plans generally are not known 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 calculated rates of $6.22 and $3.81, respectively, which were used in the analysis. The institutional rental rates are itemized in Table 20.

Table 20—Institutional Land Rental Rates for Selected Resource Situations, Oklahoma Panhandle

Item	Resource situation	
	Panhandle Clay-Loam	Cimarron Sandy
	— Dollars/Acre —	
Cropland rental charge[1]	3.71	2.99
Nonharvested cropland cost[2]	.22	.21
Native range rental charge[3]	.19	.23
Total rental charge	4.12	3.43

[1]Based on one-third of the harvested yield.
[2]Assumes 20 percent nonharvested cropland.
[3]Based on a rate of $1.50 per acre.

It appears from these results that institutional rental rates are not a deterrent to renting land for those farmers who have machinery with sufficient capacity to handle additional land. Clearly the supply of land to rent is the limiting factor. 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.

Variable Capital Programming

For this part of the analysis, 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. Optimum organizations and residual returns estimates for the different levels of capital are shown in Table 21. The $2,000 minimum amount of capital is sufficient for all the cropland to be utilized. As the amount of capital increases, the amount of grain sorghum decreases and the number of livestock increases. 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, returns are maximum.

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.

Cimarron Sandy. Optimum organizations and residual returns estimates for the different levels of capital are shown in Table 22. 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

Table 21—Optimum Farm Organizations for Alternative Amounts of Fixed Capital, 880 Acre Panhandle Clay-Loam Farm[1]

Item	Unit	Amount of capital (dollars)						
		2,000	3,000	5,000	6,000	8,000	10,000	12,000[2]
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[3]	Dol.	2,622	2,992	3,644	3,934	4,493	5,042	5,132
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

[1]Assuming present prices and allotments.
[2]$1,565 of this are in disposal. Thus the estimates actually apply to $10,435 of capital rather than to $12,000.
[3]Programmed returns less nonharvested cropland costs ($193.70) and overhead costs ($3,517). No charge has been made for the fixed amount of capital.

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.

Table 22—Optimum Farm Organizations for Alternative Amounts of Fixed Capital, 960 Acre Cimarron Sandy Farm[1]

Item	Unit	Amount of capital (dollars)					
		2,000	4,000	6,000	7,000	8,000	10,000[2]
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-July	Hour	--	415	285	213	143	138
Returns to land, labor, fixed capital, management, and risk[3]	Dol.	1,019	1,794	2,058	2,138	2,160	2,161
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

[1]Assuming present prices and allotments.
[2]$1,929 are in disposal. Thus the estimates actually apply to $8,071 of capital rather than $10,000.
[3]Programmed returns less nonharvested cropland costs ($202.80) and overhead costs ($3,583). No charge has been made for the fixed amount of capital.

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, maximum returns are achieved.

Summary

This study was concerned with the most profitable farm organizations for Panhandle farmers under existing resource positions and a wide range of price and cost conditions. Optimum farm organizations were ascertained for each of the several sets of conditions considered by means of linear programming.

This study is applicable to nonirrigated soils of the Oklahoma Panhandle as follows: (1) Panhandle Clay-Loam and (2) Cimarron Sandy. The representative farm for the Panhandle Clay-Loam situation contained 880 total acres, including 740 acres of cropland. There were 960 total acres in the Cimarron Sandy farm, including 783 acres of cropland.

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 included 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 included one 4-plow tractor and auxiliary equipment such as a lister, one-way, chisel, and grain drill.

Summary of Results for Present and Alternative Prices

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 are summarized separately.

Panhandle Clay-Loam Results. Wheat had 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.

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 6 percent, 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 percent. 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 6 percent interest rate and $7,369 for the 12 percent 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.

Including grazed-out wheat (and feeders P_5 and P_6) in the organization increases 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.

For current prices and allotments, excluding grazed-out wheat reduced returns $153 at 6 percent interest and $127 with a 12 percent interest rate. 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 2 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 estimated. 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 were 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, returns were at a maximum.

References

1. Connor, Larry J. "Long-Run Adjustment Hypotheses for Farm Operators in the Oklahoma Panhandle." (Unpublished Ph.D. dissertation, Oklahoma State University, Stillwater, 1964.)
2. Hall, Harry H., et al. *Resource Requirements, Costs and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle.* Proc. Ser. P-459. Stillwater: Okla. Agri. Expt. Sta.; July, 1963.
3. Heady, Earl O. *Economics of Agricultural Production and Resource Use.* New York: Prentice-Hall, Inc., 1952.
4. _____ and Wilfred Candler. *Linear Programming Methods.* Ames: The Iowa State College Press, 1958.
5. Morrison, Frank B. *Feeds and Feeding.* Twenty-second edition. Ithaca: The Morrison Publishing Company, 1957.
6. Perry, O. R. and J. S. Bonner. *Linear Programming Code for the Augmented 650.* File Number 10.1.006, 650 Program Library. Los Angeles: International Business Machines Incorporated, 1958.
7. Plaxico, James S. and Daniel Capstick. *Wheat-Beef Farming Systems in North Central Oklahoma.* Bulletin B-532. Stillwater: Okla. Agri. Expt. Sta., 1959.
8. Walker, Odell L. Unpublished data on machinery practices, Oklahoma Panhandle. Stillwater: Okla. Agri. Expt. Sta.
9. _____ and James S. Plaxico. *A Survey of Production Levels and Variability of Small Grain Pastures in Oklahoma.* Proc. Ser. P-336. Stillwater: Okla. Agri. Expt. Sta., 1959.
10. U.S. Bureau of the Census. *U.S. Census of Agriculture:1959.* Vol. 1, Counties. Part 36 Oklahoma. Washington: United States Government Printing Office, 1961.
11. U. S. Department of Commerce. *Climatological Data Oklahoma.* Vol. 71, No. 13. Washington: United States Government Printing Office, 1963.

Appendix Table 1—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 2—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 3—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. Only two of four separate resource situations studied in the Panhandle are included in this report.

[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. There were 799,430 acres of wheat allotments in the Panhandle area.

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

Appendix Table 4—Characteristics of Alternative Feeder Livestock Activities, Oklahoma Panhandle

Activity number	Handling system	Purchase date	Initial weight	Selling date	Final weight	Requirements Per Head: Labor	Total capital	Annual capital	C_j value[1]
			(Lbs.)		(Lbs.)	(Hrs.)	(Dol.)	(Dol.)	(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]Returns to Land, Labor, Capital and Management.
[2]Grain sorghum stubble.

Appendix Table 5—Characteristics of Alternative Cow-Calf Livestock Activities, Oklahoma Panhandle

Activity number	Handling system[1]	Calving date	Selling date	Selling weight		Requirements Per Cow			
				Steers	Heifers	Labor	Total capital	Annual capital	C_j value[2]
				(Lbs.)	(Lbs.)	(Hrs.)	(Dol.)	(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]Returns to Land, Labor, Capital and Management.
[3]Grain sorghum stubble.

Appendix Table 6—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:		
L. P. gas	Gallon	.08
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 7.

Appendix Table 7—Assumed Prices for Calves, Steers, and Cull Cows by Months, Oklahoma Panhandle[1]

Class and Grade	Monthly average												Yearly average
	Jan.	Feb.	Mar.	April	May	June	July	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 8—Estimated Annual Overhead Costs for Two Representative Farms, Oklahoma Panhandle[1]

Item	Panhandle Clay Loam	Cimarron Sandy
	(Dollars)	(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 — ½ 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 (license)	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: Harry H. Hall, et al., *Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle,* Okla. Agr. Expt. Sta. Proc. Ser. P-459, July 1963.

Appendix Table 9—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 lbs. 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 7 are assumed to be associated with a grain sorghum price of $1.56.

12-64/2M