ANALYSIS OF THE REPRESENTATIVE FARM CONCEPT AS A TOOL IN AREA SUPPLY RESPONSE RESEARCH AND FARM MANAGEMENT EDUCATION

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PREFACE

Much of the research reported in this dissertation is part of a larger study being conducted by a Great Plains Regional Committee (GP 5). The GP 5 study is concerned with the development of estimated area supplies of agricultural commodities for the Great Plains Area.

The Oklahoma Extension Service gave both moral and financial assistance over a period of many years, making my graduate program possible. I am very grateful to the Farm Foundation, Chicago, Illinois, which extended financial support to me during my graduate program.

Several people have provided assistance and made substantial contributions throughout the entire period of study. Dr. Odell L. Walker, chairman of my graduate advisory committee, is due special acknowledgement for his counsel and patience. Dr. James S. Plaxico, Head of the Department of Agricultural Economics, offered much encouragement before and during my period of residence. Other members of my graduate advisory committee, consisting of Dr. John W. Goodwin, Dr. Daniel D. Badger, Dr. Julian H. Bradsher and Dr. Carl E. Marshall, offered many helpful suggestions throughout my graduate program.

Other people who made significant contributions to this study are: Dr. Larry Connor, Economic Research Service, who developed the basic data; Pat Cundiff and Martha Hurst, Statistical Laboratory of the Agricultural Economics Department, who assisted in the linear programming process; Linda Patterson, Biddy Sumners, and Barbara Butler, who typed the several preliminary drafts; and Margaret Morrison, who typed the final version of the thesis.

Any accomplishment represented by the completion of this thesis should be considered a tribute to the support and special considerations extended me by my wife Beverly, my children Bill, Nancy and Gayle, and by my parents Mr. and Mrs. John Brant.

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

LIST OF FIGURES

Figure | Page

CHAPTER I

INTRODUCTION

This study is concerned with increasing the uses of data obtained from area agricultural supply function research studies. Usually, research studies concerned with area supply functions are conducted for the purpose of providing information to use in anticipating macroadjustments and in making policy decisions. However, this study emphasizes the use of data obtained from agricultural area supply research in improving individual farmer decision making.

The development and use of area supply functions have been the subject of considerable research and ample literature.[1] An area supply function may be developed through the use of time series or cross sectional data.[2] When the supply functions are determined by time series

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[1]Production and Resource Response Group, Production Adjustments Branch, FPED, ERS, USDA, National Model Study Guide (Washington, D. C., Revised August, 1964).

S-42 Technical Committee, Cotton: Supply, Demand, and Farm Resource Use (Southern Cooperative Series Bulletin, No. 110, Fayetteville, November, 1966).

W. B. Sundquist et al., Equilibrium Analysis of Income-Improving Adjustments on Farms in the Lake States Dairy Region (Univ. of Minn. Agr. Exp. Sta. Tech. Bull. No. 246, October, 1963).

James S. Plaxico and John W. Goodwin, "Adjustments for Efficient Organization of Farms in Selected Areas of the South," Southern Agriculture - Its Problems and Policy Alternatives (Raleigh, 1961).

[2]James S. Plaxico, "Aggregation Supply Concepts and Firm Supply Functions," Farm Size and Output Research (Southern Cooperative Series Bulletin 56, Stillwater, 1958), p. 85.

data, the researcher assumes that the magnitude and importance of the variables will continue for the period under study as in the past. Because of rapid changes in technology these variable conditions are not always continuous in nature and internal adjustments are made by the firm to meet these changes.

The impact of technology and the adjustments made by the firm are more readily discernable when supply functions are obtained through the use of aggregated firm responses. This procedure requires the development of the typical or representative firm which can be used to represent the area under study. The information obtained by studying the representative firm is then expanded to determine the area supply response.

Several difficulties are encountered in aggregating representative farms for area supply purposes. Most of the problems can be grouped together as contributing to "aggregation bias." This study will use Frick and Andrews' definition of aggregation bias as being the "difference between the area supply function as developed from the summation of linear programming solutions for each individual farm in the area, and summations for a smaller number of 'typical' or 'benchmark' farms."[3]

Representative farms may be identified according to various characteristics such as type of farm (crop or livestock), resource restrictions (capital or land), size of farm, or a combination. The problem becomes one of which characteristics are to be identified by the representative farm to give the minimum amount of aggregation bias.

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[3] George Frick and Richard A. Andrews, "Aggregation Bias and Four Methods of Summing Farm Supply Functions," Journal of Farm Economics, Vol. 47, No. 3 (August, 1965), p. 696.

In developing a representative farm for linear programming, it is necessary to determine the relevant input-output coefficients for each of the farm enterprises or activities.[4] If incorrect input-output coefficients are used, aggregation bias may occur through specification error even though the representative farm is defined appropriately.[5]

When the expense, time and resources used in developing and appropriately defining representative farms are considered, it is only prudent that any information obtained should be used as extensively as possible. Information obtained in aggregation studies involving linearly programmed representative farms can be utilized for making managerial decisions concerning economic adjustments for actual farms in the area under study. Since few actual farm situations would be identical with the defined representative farm, interpreting the programmed results such that the interpretation can be applied to other situations presents a problem. Thus, it is important in establishing studies for area supply response that attention be given to the complementary aspect of data use.

Objectives

The major purpose of this study is to examine the use of the representative farm concept as a research technique in developing area

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[4]Richard Day, "On Aggregating Linear Programming Models of Production," Journal of Farm Economics, Vol. 45, No. 4 (November, 1963), pp. 797-813.

[5]Randolph Barker and Bernard F. Stanton, "Estimation and Aggregation of Firm Supply Functions," Journal of Farm Economics, Vol. 47, No. 3 (August, 1965), p. 704.

agricultural supply response and as a means of applying such research results in farm management education.

The specific objectives of the study are to:

1. Demonstrate the use of representative farms and illustrate the effect of different methods of defining representative farms on area agricultural supply estimates in the Panhandle of Oklahoma.
2. Develop techniques for adapting programmed representative farm solutions to different farm resource situations with minimum loss of optimality.

Area of Study

The study area is the High Plains, dryland cropland area of the Oklahoma Panhandle. It includes all of the three-county Panhandle area (Cimarron, Texas, and Beaver Counties) except the Rolling Red Plains of eastern Beaver County (Figure 1). Due to the differences in problems of adjustment, the irrigated cropland and the land areas which are predominantly range have specifically been excluded from this study. The excluded irrigated acreage would account for approximately 5 per cent of the total High Plains cropland in the Oklahoma Panhandle. The excluded range acreage would amount to approximately 20 per cent of the total native pasture and range land in the area.

Thornthwaite classified the Oklahoma Panhandle area as semi-arid according to his average annual precipitation effectiveness index.[6] The

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[6]C. W. Thornthwaite, "An Approach Toward A Rational Classification of Climate," Geographic Review, 38 (1) (1948), pp. 55-94.

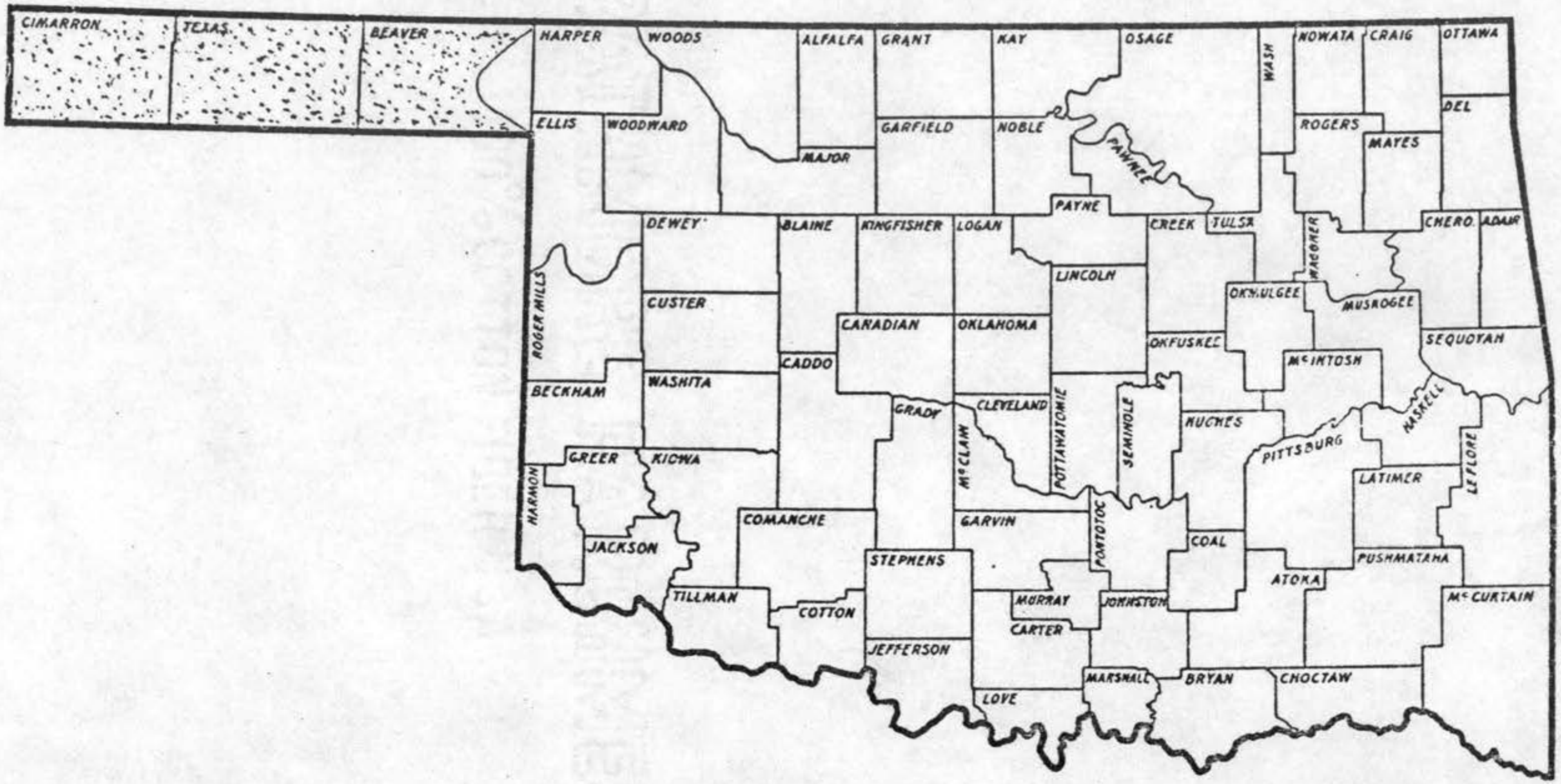

Figure 1 - Map of Oklahoma Showing Panhandle Area Included in the Study

annual rainfall varies from approximately 16 inches at the western edge of the area to approximately 19 inches at the eastern edge. Considerable variation may occur in the year-to-year amounts of rainfall received.

The growing season is approximately 180 days in length for the Oklahoma Panhandle. The first killing frost can be expected about October 20 and the last killing frost about April 25.

CHAPTER II

RESEARCH PROCEDURE

The study objectives require that (1) optimum organizations for farm resources in a given farming area be determined and (2) the optimum organization results be projected into area aggregates and techniques be devised for adapting these organizations back to specific farm units. It is anticipated that the two steps will interact, because the set of farm resources for which optimum organizations are obtained will affect the aggregate and individual farm results.

Research procedures, hypotheses and assumptions to be discussed in this chapter provide a background for operational techniques introduced in succeeding chapters. Major attention is given to:

1. The concept of representative farms.
2. The use of linear programming as a research tool.
3. The operational limitations imposed by institutional restraints, economic conditions, and the availability of resources and activity alternatives.

The Representative Farm Concept

The representative farms in this study are identified six different ways on the basis of soil capabilities and type of farm organization. The linearly programmed optimum solution for each set of representative farms is then used to obtain aggregate area supply estimates for wheat, grain sorghum and beef. These aggregated area supplies are examined to determine their sensitivity to price changes as reflected by changes in farm organization. The comparison and discussion of the aggregated area supply estimates are presented in Chapter III.

Adaptation techniques are applied to the optimum solution of linearly programmed representative farms in an attempt to produce optimum solutions for alternative resource situations. The adaptation techniques are discussed in Chapters IV and V.

The farm firm's objectives and planning horizon are included in the representative farm concept. It is assumed that the farm firm's objective is profit maximization. The planning horizon is assumed to be long enough to allow investment in intermediate term assets, such as machinery, required to carry out individual plans. A family-type farm operation is envisioned with most, if not all, the labor being supplied by members of that family.

Although it is assumed that the representative farm is owner-operated, it is recognized that this condition does not necessarily hold now or in the future. The assumption of owner-operated farms is a convenient, rather than a necessary, assumption for this study. Equilibrium theory under perfect competition posits that returns to factors of production must be equal within and between firms for general economic equilibrium to be achieved. Therefore, returns to management and land are assumed the same regardless of whether the tenure situation is owner-operated or renter-managed.

The Linear Programming Tool

The solutions obtained in this study are derived through the maximization process of the linear programming technique. Monetary returns to land, labor, capital and management are maximized for the representative farms studied, subject to the restrictions imposed.

Although profit is maximized, other family goals and objectives are included in obtaining the optimum solution through the use of restrictions in the problem. In this case, the goals and objectives include limitations of the farm enterprises that are considered and the amount of labor that is available for the farm operation.[1]

In this study, use is made of a parametric pricing feature available in some linear programming systems. This feature permits the changing of one product price by specifying increments over a given price range while holding the other product prices constant. Thus, the stability of a given farm organization can be observed over a range of product prices.

Operational Limitations

The operational limitations imposed upon this model are in the form of (1) institutional constraints, (2) economic conditions, (3) availability of resources and (4) activity alternatives.

These limitations determine the type and size of farm organization possible in this study. The representative farm concept requires that

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[1]The terms "enterprise" and "activity" were used interchangeably throughout this study.

these limitations permit the formation of organizations actually in or suited to the area.

The institutional framework assumes that no restraints are placed on the amount of capital that may be borrowed, the amount of labor hired, the quantity of hay purchased, or the number of livestock handled. Restraints are placed on farm size and only land-based livestock enterprise alternatives are considered. Government controls and allotments are not included. Crop enterprise acreages are limited only by the amount of available cropland. Firms are assumed to operate within this institutional framework to maximize returns under the assumption of perfect competition.

In projecting economic conditions to 1970, it is assumed that current agricultural adjustment conditions will prevail. These conditions are typified by constant pressure on the farm operator to adopt new technology which is usually labor-saving and capital-using, to carry on enterprises under the hazardous production conditions of the semi-arid climate of the area and to improve management and decision-making skills.

The prices used are those expected to prevail in 1970. Prices are based on the 1961-63 average price projected to 1970 (Appendix Table IV). The projection procedure is outlined in the GP 5 Price Appendix.[2] Prices for factors of production are considered constant throughout this analysis. Prices paid and received by farmers are shown in Appendix Tables V and VI.

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[2] M. D. Skold, D. O. Anderson, and J. S. Wehrly, "Prices Paid and Received," Procedural Manual for a Regional Supply-Response Study (January, 1965), Appendix A.

Through the use of parametric programming, the effect of different product prices can be observed. Wheat prices were varied over a $2 per bushel price range (from 50 cents per bushel to $2.50 per bushel) while holding grain sorghum price constant at $1.74 per hundredweight. Livestock prices are not varied but are adjusted for seasonal variation and market classes (Appendix Table VI).

To estimate the enterprise machinery costs, it is assumed that the machinery complement consists of one four-plow tractor plus auxiliary equipment. This complement of machinery and the associated cost estimates are shown in Table 1. The four-plow machinery complement is considered adequate for the size of farm considered.[3] Variable costs associated with machinery use are included in the enterprise budgets. Total machinery costs per unit of an enterprise may be obtained by utilizing the estimates in Table VI and Appendix Table III. Since custom harvesting is assumed, all machinery harvest costs are included in the custom charge.

Certain enterprise machinery and equipment costs, once incurred, become fixed to the farm whether the enterprise is continued or not. For the purpose of this study, however, it is assumed that these costs will not be incurred unless the enterprise is to be continued. This is not a stringent assumption since it is common in this area for machinery and equipment to be used over a wide range of enterprises. Further, machine services are available from sources other than ownership and at approximately the same cost. These costs are shown as allocable fixed

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[3]Odell L. Walker, Machinery Combinations for Oklahoma Panhandle Grain Farms (Oklahoma State University Experiment Station Bulletin B-630, Stillwater, 1964).

TABLE I

ESTIMATED 1970 COSTS AND INVESTMENT REQUIREMENTS FOR ONE FOUR-PLOW TRACTOR MACHINERY COMPLEMENT, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Machine	Average[1] Annual Investment	Annual[2] Fixed Costs Per Acre	Machine[3] Variable Costs Per Acre
	Dollars		
One Four-Plow Tractor Machinery Complement			
Tractor, four-plow	2,344.20	0.408[4]	0.897[5]
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		

Source: Based on Harry H. Hall et al., Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle, (Oklahoma State Univ. Exp. Sta. Proc. Series P-459, Stillwater, 1963) and M. D. Skold, D. O. Anderson, and J. S. Wehrly, "Prices Paid and Received," (Procedural Manual for a Regional Supply-Response Study, January, 1965), Appendix A.

[1]The average annual investment is the projected 1970 price divided by two.

[2]It is assumed that machines will be used enough to wear out during their useful life.

[3]Machine variable costs figures do not include any power costs.

[4]Tractor annual fixed costs are computed on per hour of use basis. Assumes the tractor will be used enough to wear out during its useful life.

[5]Tractor variable costs are computed on per hour of use basis. (Includes gas, oil and repairs.)

costs in the enterprise budgets. Any fixed cost that cannot be assigned to a given enterprise(s) is considered as part of general overhead cost attributed to the whole farm.

The soil characteristics of the High Plains area of the Oklahoma Panhandle were determined during the Tertiary geologic period, when extensive erosion of the Rockies left a surface covering of about 50 to 300 feet over the old terrain. Subsequent erosion along the Beaver and Cimarron River has removed much of the covering down to bedrock.[4]

The cropland soils were categorized into two broad classifications, (1) clay loam soils which were subdivided into four productivity classes and (2) sandy soils which were subdivided into three productivity classes. Soils within a given productivity class have similar yield capabilities and physical characteristics and require the same general management practices.

The clay loam soil productivity classes are Ca, Cb, Cc, and Cd. The Ca soil consists primarily of the Richfield loam soil series. The Cb soil consists principally of the Richfield clay loams of Texas County. The Cc and Cd soils are associated with the shallower, droughtier Mansker soils.

The sandy soil productivity classes are Sa, Sb and Sc. The Sa soils are primarily the Beaver and Texas County sandy soils that do not require intensive management to prevent wind erosion. The Sb soils are essentially the same soils series as the Sa soils but are found in Cimarron County where there is lower rainfall. The Sc soils are subject

[4]Fenton Gray and H. M. Galloway, Soils of Oklahoma (Oklahoma Experiment Station Misc. Publ. MP-56, Stillwater, 1959), p. 49.

to severe wind erosion and include the Dalhart loamy, fine sand soils of Texas and Cimarron County. The number of acres of each productivity class is presented in Table II. Extensive ranching areas and the irrigated cropland acres are excluded from this study.

Soil resource data used were the current data available from the Soil Conservation Service and the Economic Research Service of the United States Department of Agriculture.

Crop and grazing yields were derived for each of the productivity classes and represent expected yields for 1970 (Table III). Projected 1970 yields are based on long-time average yields on harvested acres using the improved practices expected to prevail at that time.

The large variation in amount and distribution of rainfall in the study area often forces abandonment of a relatively large acreage of crops. Sizeable additional acreages are intentionally fallowed as a means of storing soil moisture. Because of these factors, 20 per cent of the available cropland is considered as not being harvested each year.

The various resource combinations used in defining the different representative farms in this study are designated as RHS (Right Hand Side) and assigned an identification number during the linear programming process. For the sake of brevity, this method of identification of the different representative farms is used throughout the study. Thus, RHS 6 designates a specific representative farm with a given resource situation, while RHS 5 identifies another representative farm with a different resource situation.

The data used for the input, output and cost information in the crop and livestock budgets were based on two Oklahoma Experiment Station

TABLE II

ESTIMATED ACRES OF DRYLAND CROPLAND AND NATIVE RANGE AND PASTURE BY PRODUCTIVITY CLASSES, HIGH PLAINS AREA OF OKLAHOMA PANHANDLE[1]

Clay Loan Soils		Sandy Soils		
Class	Acres	Class	Acres	Total
Ca	101,640	Sa	107,613	
Cb	698,366	Sb	49,091	
Cc	212,923	Sc	42,151	
Cd	324,196			
Total Cropland	1,337,125	Total Cropland	198,855	1,535,980
Native Range and Pasture	567,347	Native Range and Pasture	616,039	1,183,386

Source: Based on Oklahoma Conservation Needs Committee, Oklahoma Soil and Water Conservation Needs Inventory (Stillwater, 1962).

[1]Includes only the High Plains dryland cropland and native pasture and range; excluded are the Rolling Red Plains of Beaver County and irrigated cropland and livestock ranches.

TABLE III

ESTIMATED 1970 DRYLAND CROP AND GRAZING YIELDS BY SOIL PRODUCTIVITY CLASS, HIGH PLAINS, OKLAHOMA PANHANDLE

Crop	Unit	Productivity Class: Clay Loam Soils Ca	Cb	Cc	Cd	Sandy Soils Sa	Sb	Sc
Crop[1]								
Wheat	bu.	15.4	13.2	11.0	8.8	12.1	7.7	5.5
Grain Sorghum	cwt.	11.0	6.6	9.5	6.6	14.5	12.0	11.0
Forage Sorghum	ton	2.3	1.7	2.0	1.5	2.9	2.3	2.0
Grazing[2]								
Grain Sorghum Stubble	AUM	.2	.12	.15	.1	.25	.2	0.0
Grazed Out Wheat	AUM	2.1	1.9	1.7	1.5	1.7	1.5	1.2
Fall Grazed Wheat	AUM	.3	.25	.2	.15	.3	.2	.18
Forage Sorghum Stubble	AUM	.1	.1	.1	.1	.1	.1	0.0
Grazed Out Forage Sorghum	AUM	1.7	1.4	1.5	1.2	2.0	1.6	1.2
Reseeded Cropland[3]	AUM	1.0	.9	.8	.7	.9	.8	.7

[1]The 1970 expected yields are based on harvested acres. Twenty per cent of total cropland is assumed to be abandoned or in fallow.

[2]Native Pasture and Range Grazing yield is estimated at .6 AUM per acre.

[3]Grazing yield is assumed to begin with third year after reseeding. No yield is assumed the first two years after reseeding.

publications.[5] The data contained in these publications were revised and projected to obtain a 1970 estimate, which is the relevant date for the material contained in this study. The revisions are justified in view of more recent research and statistical information available at this time. The final revisions were made in consultation with personnel of the Oklahoma State University Agronomy Department, Agricultural Economics Department, Cooperative Extension Service and the Economic Research Service of the United States Department of Agriculture.

The amount of operator's labor available and the enterprise requirement for labor are grouped into four time periods: (1) January - April, (2) May - July, (3) August - September and (4) October - December. The periods were specified in this manner to coincide with labor use periods of the various activities.

Operator labor used in management time is not included in either the available labor shown in Table IV or in the enterprise requirements. Labor is considered to be that used in tractor driving, feeding of livestock, etc. Additional operator labor is required for making management decisions. Limitations upon the availability of this type of labor depends principally on farm size, the production alternatives selected and managerial skill of the operator. These factors are not considered limiting for this type and size of representative farm.

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[5]Harry H. Hall et al., Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle (Oklahoma State University Experiment Station Processed Series P-459, Stillwater, 1963). Also, Walker, pp. 4-34.

TABLE IV

AVAILABLE OPERATOR'S LABOR ASSUMED IN THE HIGH PLAINS AREA OF THE OKLAHOMA PANHANDLE BY PERIODS OF YEAR

Period	Hours of Available Operator's Labor[1]
January - April	538
May - July	506
August - September	352
October - December	462
Yearly Total	1858

[1]Assumes that the labor available in other than management requirements is 22 working days per month except February when there are 20 working days. Length of day is considered to be 6 hours per day during December - March; 7 hours per day during April, May and November; and 8 hours per day during June - October.

Activity requirements for harvesting labor were included in the custom harvesting operation. Any additional labor required was assumed available without limit at $1.50 per hour.

It is assumed throughout this study that capital is available without limit at an interest rate of seven per cent. Although such things as equity ratio and operator's experience might ordinarily have an effect on capital availability, it was felt that the operator manager could always obtain needed capital for any profitable enterprise.

Capital requirements were specified in two ways: (1) total capital and (2) annual capital. Total capital represents the total amount of capital needed to carry out an activity and includes items such as the full purchase price of a steer. Annual capital is the amount of capital used on an annual basis, i. e., the amount for which interest would logically be charged. If the steer was kept only six months the annual capital requirement would be half of the total capital requirement. Total capital requirements will always be equal to or greater than annual capital requirements. Interest charges for capital used were computed on the annual capital requirement.

The crop activities considered are typical of those grown under dryland conditions in the Oklahoma Panhandle. Specialty crops, such as broom corn, were not considered as relevant alternatives due to the relatively small acreage planted and the atypical labor and market situation. Of the cropping alternatives included, hard red winter wheat and grain sorghum were considered produced only for sale.

Those crops grown for intermediate purposes, such as livestock feed, included forage sorghum (both baled and grazed out), wheat grazed out and reseeded native grass. Grazing was permitted until March 1 on wheat grown for grain without a reduction in yield. Grazing also was permitted on grain and forage sorghum stubble except for class Sc land which requires the stubble for wind erosion control. Crop yields are shown in Table II.

The livestock production alternatives considered include nine buy-sell feeder steer activities and five cow-calf activities. All feeder steer enterprise budgets assume the purchase of "good to choice" steers and the sale of "good" feeder steers. A one per cent death loss was used based on selling weight. Characteristics of the feeder calf enterprises are shown in Appendix Table I.

The cow-calf activities include both fall and spring calving alternatives. All calves sold were assumed to grade "good to choice."

Allowances were made in the enterprise budgets for normal herd replacements. Cow-calf enterprise characteristics are shown in Appendix Table II.

CHAPTER III

AGGREGATION OF AREA SUPPLY ESTIMATES

Area supply aggregates of wheat, grain sorghum, feeder cattle and income are estimated for the dryland cropland of the High Plains area of the Oklahoma Panhandle. These estimates were obtained by aggregating linear programming optima for the representative farm situations. Three broad classifications of representative farm situations are identified on the basis of (1) soil differences, (2) type of farm and (3) soil differences plus type of farm. These classifications are used to obtain six different methods of defining the representative farms to represent the area resources. The effects of the different methods on area aggregates are then observed. Although the analysis in this chapter is oriented to objective one, the representative farms developed are used in the succeeding chapters to estimate the organization for "actual farms."

Area supplies of different commodities are determined by the enterprise organization of the individual farm units. Given the farm unit objectives, the organization of enterprises will depend upon the relative prices of the products sold (wheat, grain sorghum and beef cattle) and the resources available. The criteria for identifying representative farms used in estimating area supplies and in farm management education are:

1. The representative farms should typify actual farm situations as to size, type and soil characteristics as indicated by direct knowledge of the area and data from the agricultural census and other sources.
2. The representative farms should produce an aggregate production which reflects responsiveness to changes in the prices of the major products.

The farm size selected for the representative farms used in the aggregation phase is 960 acres. This size of farm will utilize the one four-plow tractor and machinery complement common to this area. An exception to this size is made when the area commodity aggregates are determined by programming the whole area as one farm. Representative farm size is also varied when used in some of the adaptation techniques discussed in the succeeding chapters.

Soil Differences Classification of Representative Farms

Representative farms are identified on the basis of soil differences by four methods:

1. Two farms, (a) a clay farm designated RHS 2 and (b) a sand farm designated RHS 3. RHS 2 consists of 286 acres of native range and 539.1 acres of clay cropland. RHS 3 consists of 187.4 acres of sand cropland and 725.8 acres of native pasture. The individual soil productivity classes for each RHS designa-are shown in Table V.
2. One farm, a sand and clay farm designated RHS 1. RHS 1 consists of 417.6 acres of native range, 377.51 acres of clay cropland, and 56.41 acres of sand cropland.

TABLE V

ALTERNATIVE RESOURCE SITUATIONS (RHS) INCLUDED IN THE STUDY HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

	Resource Designations RHS												
	1	2	3	4	5	6	7	8	9	14	15	23	24
						Acres							
Clay													
Cropland	377.51	539.1		1,069,042	457.01	262.0	525.3		262.52	523.9	1,050.6		
Ca	28.64	41.0		81,100	34.67	19.9	39.9		19.93	39.7	79.8		
Cb	197.00	281.4		557,868	238.49	136.7	274.2		136.47	273.4	548.4		
Cc	60.31	85.7		170,801	73.01	41.9	83.5		41.89	83.7	167.0		
Cd	91.56	131.0		259,273	110.84	63.5	127.7		63.73	127.1	255.4		
Sand													
Cropland	56.41		187.4	159,742	68.29	39.2		525.3	188.1	78.3		433.92[2]	262.65
Sa	30.37		101.4	86,015	36.77	21.1		284.7	101.9	42.2			142.35
Sb	13.89		46.3	39,321	16.81	9.7		129.8	46.5	19.3			64.9
Sc	12.15		39.7	34,406	14.71	8.4		110.8	39.7	16.8			55.4
Native Pasture	417.6	286.0	725.8	1,183,386.6	303.3	583.7	303.3	303.3	396.78	1,117.3	606.6	417.6	151.65

[1]Labor resources for all resource designations except RHS 4 are as indicated in Table IV. RHS 4 has unlimited, free labor resources.

[2]It is assumed that RHS 23 includes only average cropland not designated as sand or clay.

3. Whole area as one farm, a sand and clay farm designated RHS 4. RHS 4 consists of 1,069,042 acres of clay cropland, 159,742 acres of sand cropland and 1,183,386.6 acres of native range. This farm also differs from others in the group because labor restrictions are not made effective.

4. One farm, designated RHS 23 with just one crop soil productivity class. RHS 23 consists of 433.92 acres of cropland and 417.6 acres of native range.

<u>Two Farms, RHS 2 and RHS 3</u>

The two-farm method (RHS 2 and RHS 3) delineates the sand resources of the area into 848.848 representative farm units. The procedure to determine the number of units required dividing the entire sand cropland and associated pasture acres by 960 acres.

$$\frac{\text{814,894 sand acres}}{\text{960 A. rep. farm size}} = \text{848.848 sand farms in the study area}$$

A similar procedure was used to determine the 1,983.825 representative farm units for the clay resources.

The relative size of the soil productivity classes in the study area is maintained for the representative farms. For instance, the 814,894 acres of sand soils in the study area are composed of 13.2 per cent Sa cropland (107,613 acres), 6 per cent Sb cropland (49,091 acres), 5.2 per cent Sc cropland (42,151 acres) and 75.6 per cent pasture (616,039 acres). Thus the 960 acre representative farm representing the sandy loam farm is composed of 126.7 acres of Sa cropland (.132 x 960), 57.6 acres of Sb cropland (.06 x 960), 49.9 acres of Sc cropland (.052 x 960) and 725.8 acres of pasture (.756 x 960). All resource situations (RHS) reflect a 20 per cent reduction in cropland acres to allow for the acres fallowed and abandoned.

The RHS 2 and 3 method of defining the representative farms created two different types of farming situations due to the amount of pasture associated with the sand and clay resources. The clay farm cropland and pasture percentages are 70.2 per cent and 29.8 per cent, respectively. This ratio is close to that normally found for actual crop farms in the area. The sand farm was made up of 24.4 per cent cropland and 75.6 per cent pasture, which is more nearly akin to a livestock farm or ranch situation. Thus, using the RHS 2 and 3 method to identify the representative farm by soil differences has the partial effect of identifying the farms on the basis of type of farm. However, the method probably incorrectly implies the sand farms are primarily livestock farms.

One Farm, RHS 1

The second method (RHS 1) used to identify representative farms by soil differences includes both the sand and clay resources in the same farm unit. The different soil productivity classes are maintained in the same proportion as found in the whole study area. There are 2832.673 representative farm units defined by this method.

Whole Area as One Farm, RHS 4

The third method (RHS 4) is similar to the second method (RHS 1) except that the total area resources are considered as a single representative farm unit. Available labor is established in the linear programming resource column at a high enough level to permit estimation of all except the custom labor portion of total agricultural labor demand.

<u>One Farm, One Productivity Class, RHS 23</u>

The fourth method (RHS 23) used to identify representative farms on the basis of soil differences utilized an average soil productivity class. That is, a weighted average production was established for each soil based enterprise and the linear programming solution using these enterprises is obtained.

Type of Farm Classification of Representative Farms

<u>Type of Farm, RHS 5 and RHS 6</u>

The second general technique used to identify the representative farm operation is based on the type of farm. Two farm types are considered, a cropland farm (RHS 5) and a livestock farm (RHS 6). RHS 5 consists of 457.01 acres of clay cropland, 68.29 acres of sand cropland and 350.2 acres of native range. RHS 6 consists of 262 acres of clay cropland, 39.2 acres of sand cropland and 583.7 acres of native range. The difference between the two types is determined by the ratio of cropland to pasture land. In the crop farm (RHS 5), 68.4 per cent of the total farm acreage is in cropland and 31.6 per cent in pasture. The livestock farm (RHS 6) has a ratio of 39.2 per cent cropland to 60.8 per cent pasture. The cropland soil in both farms is subdivided into sand and clay productivity classes in the same proportion as found in the area. Thus, some of the same effect as identification by soil differences is to be expected in this method.

Soil Differences and Type of Farm Classification of Representative Farm

Soil Differences and Type of Farm, RHS 6, RHS 7 and RHS 8

The third general technique of identifying the representative farm situation incorporates both soil differences and type of farms. The area crop farm resources represented by RHS 5 are separated into a sand crop farm (RHS 8) and a clay crop farm (RHS 7). RHS 7 consists of 525.3 acres of clay cropland and 303.3 acres of native range. RHS 8 consists of 525.3 acres of sand cropland and 303.3 acres of native range. The linear programming optima for the two crop farms (RHS 7 and RHS 8) are aggregated with the livestock farm RHS 6 to reflect the combined influence of soil differences and type of farm on adjustments.

Analysis of Results

The results of this study illustrate the influence on aggregated area supply estimates when different methods are used to identify the representative farm situation. Theoretically, the larger the number of identifiable characteristics that can be incorporated into representative farms, the more nearly derived aggregative area estimates will approach the actual area supplies. This is apparently true in this study as the area supply estimates obtained from RHS 6, 7, and 8 in particular, and RHS 2 and 3, and RHS 5 and 6 to a lesser degree, show more regular but gradual adjustments in organizations as price changes than do RHS 1, RHS 4 and RHS 23. The aggregated area supply estimates for the different methods of defining the representative farms can be compared in Tables VI through IX.

TABLE VI

ESTIMATED AREA WHEAT PRODUCTION AGGREGATES, BY ALTERNATIVE METHODS OF DEFINING THE REPRESENTATIVE FARMS, DRYLAND FARMS, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Wheat Price[1] per Bu.	Alternative Method of Identifying the Representative Farm					
	Soil Difference				Type Farm	Soil Diff. Type Farm
	RHS 1	RHS 2,3	RHS 4	RHS 23	RHS 5,6	RHS 6,7,8
			Million Bu.			
.50	0	0	0	0	0	0
.52	0	.434	0		0	0
.54	1.405	1.231	1.405		1.404	1.280
.57	1.626	1.231	1.626		1.625	1.344
.60		2.422			1.625	2.197
.65	1.626		1.626		2.578	2.197
.66	4.971	2.422	4.970		3.527	3.146
.69		4.898				4.951
.70		4.973			3.527	4.951
.72		4.973			4.968	5.075
.73		5.187			4.968	5.120
.86	4.971		4.970		5.678	5.120
.88	6.419	5.187	7.084		6.278	5.720
.89		5.199				5.720
.90	6.419	5.618				6.301
.91	7.715	5.618	7.084		6.278	6.301
.94	8.295	8.189	8.293		8.290	8.134
.96		8.302				8.134
.98					8.290	8.299
1.08					8.337	
1.09					9.214	8.299
1.12		8.302				8.430
1.13		8.363				8.430
1.17	8.295	8.705	8.293		9.214	8.467
1.21	8.363		8.360		9.234	8.486
1.23	9.831	8.705	9.828		9.824	8.902
1.25		9.700				9.738
1.27		9.700				9.968
1.42		10.023				9.968
1.75						10.416
1.81				0		10.419
1.83	9.831		9.828	5.577	9.824	10.419
1.86	10.353	10.023	10.350	7.500	10.346	10.567
1.88		10.652				
1.89				7.500		
1.93	10.353			11.554	10.346	10.567
1.95	10.670		10.350		10.662	10.657
2.03	10.718		10.715		10.711	10.671
2.09		10.652				10.673
2.15		11.047				10.956
2.35	10.718	11.047	10.715		10.711	10.976
2.37	10.833	13.195	10.830		10.826	12.570
2.42	12.950	13.195	12.946		12.941	13.170
2.50	12.950	13.195	12.946	11.554	12.941	13.170

[1]Grain sorghum price is held at $1.74 per cwt., while the wheat price varies.

TABLE VII

ESTIMATED AREA GRAIN SORGHUM PRODUCTION AGGREGATES, BY ALTERNATIVE METHODS OF DEFINING THE REPRESENTATIVE FARMS, DRYLAND FARMS, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Wheat Price[1] per Bu.	Alternative Method of Identifying the Representative Farm					
	Soil Difference				Type Farm	Soil Diff. Type Farm
	RHS 1	RHS 2,3	RHS 4	RHS 23	RHS 5,6	RHS 6,7,8
			Million Cwt.			
.50	4.827	5.538	4.826	0	4.824	5.384
.52	4.827	5.543	4.826		4.824	5.384
.54	4.604	5.417	4.603		4.601	5.180
.60		4.597			4.601	4.594
.65	4.604		4.603		4.554	
.66	4.443	4.597	4.442		4.509	
.70		4.573			4.509	
.72		4.573			4.440	4.594
.73		4.486			4.440	4.530
.86	4.443		4.442		3.905	4.530
.88	4.406	4.486	4.388		3.739	4.381
.89		4.387				4.381
.90	4.406	4.375				4.367
.91	3.888	4.375	4.388		3.739	4.367
.94	3.426	3.375	3.425		3.423	4.093
.96		3.371				4.093
.98					3.423	3.381
1.08					3.377	
1.09					2.389	3.381
1.12		3.371				3.376
1.13		3.312				3.376
1.17	3.426	3.159	3.425		2.389	3.360
1.21	3.361		3.360		2.372	2.444
1.23	1.707	3.159	1.707		1.706	1.974
1.25		2.088				1.974
1.27		2.088				1.472
1.42		1.386				1.472
1.75						.750
1.81	1.707		1.707		1.706	.746
1.86	.850	1.386	.850		.383	.503
1.88		.371				
1.89	.850	.370			.383	.503
1.95	.378		.850		.386	.368
2.03	.284		.283			.343
2.09						.194
2.35						.153
2.37						.138
2.50	.284	.370	.283	0	.386	.138

[1]Grain sorghum price is held at $1.74 per cwt., while the wheat price varies.

TABLE VIII

ESTIMATED AREA FEEDER CALF PRODUCTION AGGREGATES, BY ALTERNATIVE METHODS OF DEFINING THE REPRESENTATIVE FARMS, DRYLAND FARMS, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Wheat Price[1] per Bu.	Alternative Method of Identifying the Representative Farm					
	Soil Difference				Type Farm	Soil Diff. Type Farm
	RHS 1	RHS 2,3	RHS 4	RHS 23	RHS 5,6	RHS 6,7,8
			Thousand Head			
.50	377	366	377	1,269	377	367
.52	377	362	377		377	367
.54	371	360	373		375	364
.57	372	360	371		374	364
.60		372			374	373
.65	372				370	373
.66	360				365	367
.69		372				358
.70		358			365	358
.72		358			359	357
.73		360			359	358
.86	360		371		370	358
.88	347	360	341		365	355
.89		362				355
.90	347	358				351
.91	348		341		365	351
.94	354	358	354		353	353
.96		354				353
.98					353	356
1.08					355	
1.09					365	356
1.12		354				354
1.13		356				354
1.17					365	353
1.21	354		354		366	354
1.23	373	356	374		375	360
1.25		366				370
1.27		366				371
1.42		368				371
1.75						378
1.81				1,269		379
1.83	373		374	1,257	375	379
1.86	383	368	383	1,087	383	380
1.88		378		1,087		
1.93	383			1,110	383	380
1.95	386		383		386	381
2.03			387			381
2.09		378				383
2.15		384				385
2.35	386	384	387		386	386
2.37	390	380	390		391	384
2.42	386		385		386	383
2.50	386	380	385	1,110	386	383

[1]Grain sorghum price is held at $1.74 per cwt., while the wheat price varies.

TABLE IX

ESTIMATED AREA AGGREGATES OF STOCKER CALF SALES, BY ALTERNATIVE METHODS OF DEFINING THE REPRESENTATIVE FARMS, DRYLAND FARMS, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Wheat Price[1] per Bu.	Alternative Method of Identifying the Representative Farm					
	Soil Difference				Type Farm	Soil Diff. Type Farm
	RHS 1	RHS 2,3	RHS 4	RHS 23	RHS 5,6	RHS 6,7,8
	Million Dollars					
.50	$11.005	$10.215	$11.008	$35.950	$10.964	$10.347
.52	11.005	10.119	11.008		10.964	10.347
.54	10.869	9.991	10.845		10.901	10.292
.57	10.800	9.991	10.805		10.856	10.292
.60		10.676			10.856	10.647
.65	10.800		10.805		10.998	10.647
.66	11.351	10.676	11.350		11.118	10.756
.69		11.303				10.971
.70		10.841			11.118	10.971
.72		10.841			11.283	10.947
.73		10.884			11.283	11.003
.86	11.351		11.350		11.745	11.003
.88	11.192	10.884	11.126		11.663	10.945
.89		10.991				10.945
.90	11.192	10.948				10.904
.91	11.405	10.948	11.126		11.663	10.904
.94	11.685	11.311	11.679		11.657	11.257
.96		11.204				11.257
.98					11.657	11.383
1.08					11.721	
1.09					12.183	11.383
1.12		11.204				11.360
1.13		11.279				11.360
1.17	11.685	11.268	11.679		12.183	11.320
1.21	11.742		11.707		12.227	11.364
1.23	12.471	11.268	12.465		12.479	11.553
1.25		11.742				11.901
1.27		11.742				12.284
1.42		12.250				12.284
1.75						12.567
1.81				35.950		12.575
1.83	12.471		12.465	25.351	12.479	12.575
1.86	12.831	12.250	12.835	24.469	12.777	12.663
1.88		12.655		24.469		
1.93	12.831			18.139	12.777	12.663
1.95	12.953		12.835		13.023	12.719
2.03	12.977		12.981			12.719
2.09		12.655				12.778
2.15		12.881				12.944
2.35	12.977	12.881	12.981		13.023	12.960
2.37	13.111	8.081	13.114		13.130	9.554
2.42	8.594		8.590		8.596	8.245
2.50	8.594	8.081	8.590	18.139	8.596	8.245

[1]Grain sorghum price is held at $1.74 per cwt., while the wheat price varies.

RHS 2 and 3 produced an aggregate supply of wheat, grain sorghum and feeder calves reflecting more sensitivity to price changes than any of the other three methods of identifying by soil differences. This sensitivity of RHS 2 and 3 may be attributed to identification not only by soil differences and further delineation by sand and clay characteristics, but also by the indirect identification by type of farm.

The optimum farm organization for RHS 1 and RHS 4 produced similar aggregative supply estimates except at the 88-cent per bushel wheat price. Purchase of additional May - June labor ($1.50 per hour) for RHS 1 is not profitable once the available labor is utilized. Thus, the optimum organization for RHS 4 with an ample supply of May - July labor includes more wheat and less grain sorghum than RHS 1, as shown in Tables VI and VII. Thus, the potential impact of restriction other than land is illustrated.

The total labor requirement for RHS 4 does not exceed the assumed available supply during the May - July period, except at the 88-cent per bushel wheat price. The area labor demand at this wheat price and for this period exceeds available labor an average of 9 hours per 960 acre farm. The comparative labor requirements for RHS 1 and RHS 4 when wheat is 88 cents per bushel and grain sorghum is $1.74 per cwt. are presented in Table X.

The linear programming solution for RHS 23 produces very unrealistic results as indicated by Tables VI through IX. The entire organization is oriented toward feeder calf production for all wheat prices below $1.83 per bushel. Wheat grain production enters the organization when wheat price is $1.83 and higher. Grain sorghum production does not enter the organization at any of the prices considered. Thus, identification of soil acreages with major productivity differences appears important when developing the representative farm situation.

In comparing the adjustments produced by identifying representative farm by type of farm (RHS 5 and RHS 6) with the soil difference methods of identification, it can be seen in Tables VI and VII that a more regular and gradual organizational change occurs as price changes. Thus, a higher degree of sensitivity to price changes apparently is obtained when representative farms are identified by type of farms than by the soil difference methods.

TABLE X

LABOR REQUIREMENTS FOR FARM ORGANIZATION COMPARING RESTRICTED LABOR SUPPLY (RHS 1) AND UNRESTRICTED LABOR SUPPLY (RHS 4), HIGH PLAINS AREA OKLAHOMA PANHANDLE[1]

Period of Use	RHS 4 Total Area Labor Req. Hrs.	RHS 4 Labor Req. per 960 A. Farm Basis[2] Hrs.	RHS 1 Labor Req. Per 960 A. Farm Hrs.
Jan. - April	643,524	227	217
May - July	1,460,178	515	506
Aug. - Sept.	297,262	105	106
Oct. - Dec.	292,761	103	103

[1]Labor required when wheat is 88 cents per bushel and grain sorghum is $1.74 per cwt.

[2]The total land resources in the area divided by 960 acre units results in 2,832.673 farm units in the area.

The soil difference plus type of farm method of identifying representative farms (RHS 6, RHS 7 and RHS 8) indicates a high degree of sensitivity to price changes as shown by Tables VI through IX. The resource situation of RHS 7 and 8 approximate actual crop farms in the area, which consists of either sand soil or clay soil with little intermingling of the two soils. Thus, RHS 6, RHS 7 and RHS 8 are considered to "better" meet the criteria established for identifying representative farms than do the other identification methods.

Results obtained from RHS 6, 7 and 8 (Table VI) show many adjustments in wheat supplies for changes in wheat price below $1.25 per bushel. A need is indicated for flexibility in the farm organization when wheat price is this low. However, an almost stable wheat supply is obtained from $1.25 to $1.75 per bushel. At $1.75, another sizeable adjustment occurs followed by a relatively stable supply through $2.35 per bushel. Thus, throughout a rather wide range of wheat prices, $1.25 to $1.75 and from $1.75 to $2.35 per bushel, farm operators in this study area could expect to maintain a rather stable organization. Sizeable adjustment in organization should be considered only when wheat price reaches the $1.75 level. Historically, actual market price usually has been within these two ranges as shown by Table XI.

Actual production in the study area has been erratic as shown by Table XII. The wide fluctuation in production can be attributed to variation in climatic conditions, primarily in annual rainfall received. The aggregated estimated supply of wheat shown in Table VI can be compared with the estimated historical dryland production shown in Table XII.

It should be noted that farmer intentions cannot be accurately observed from the actual production figures. Favorable or unfavorable climatic conditions after planting may greatly alter the level of the actual production from what the farmers originally anticipated.

The soil differences and type of farm method of identifying the representative farms produced adjustments in grain sorghum supplies which inversely followed adjustment in wheat supplies as wheat price changed (Table VII). Variation in the number of feeder calves produced is rather small throughout the range of wheat prices studied. Area production of feeder calves varied from a low of 351,000 head to a high

TABLE XI

OKLAHOMA AVERAGE WHEAT PRICE, 1940 - 1965

Year	Price Per Bu.	Year	Price Per Bu.
1940	$0.62	1953	$2.13
1941	.93	1954	2.13
1942	1.11	1955	2.05
1943	1.38	1956	1.97
1944	1.39	1957	1.93
1945	1.45	1958	1.75
1946	1.80	1959	1.76
1947	2.17	1960	1.74
1948	1.98	1961	1.80
1949	1.87	1962	2.04
1950	2.02	1963	1.90
1951	2.20	1964	1.50
1952	2.12	1965	1.33

Source: Odell L. Walker and Cecil D. Maynard, "Wheat Production Costs and Returns," Oklahoma State University Extension Facts No. 116, (September, 1965).

TABLE XII

WHEAT PRODUCTION, HIGH PLAINS AREA, OKLAHOMA PANHANDLE, 1947-1965

Year	Total Area Prod.[1]	Estimated Dryland Prod.[2]
	1,000 Bu.	1,000 Bu.
1947	18,494	18,494
1948	15,544	15,544
1949	16,619	16,619
1950	2,533	2,533
1951	3,447	3,447
1952	9,875	9,875
1953	2,240	2,240
1954	4,574	4,339
1955	1,888	1,678
1956	1,799	1,519
1957	3,136	2,766
1958	16,687	16,188
1959	12,433	11,850
1960	14,422	13,819
1961	16,488	15,746
1962	8,114	7,340
1963	1,630	823
1964	5,291	4,474
1965	9,512	8,512

Source: Oklahoma Crop and Livestock Reporting Service, "Oklahoma Wheat: Average Yield and Production."

[1]Total production for Cimarron, Texas and Beaver Counties.

[2]Estimated irrigated acreage production is removed for the years 1954-65. It was assumed that no wheat was irrigated prior to 1954.

of 386,000 head (Table VIII). The variation over the $1.25 to $2.35 wheat price range is 16,000 head. Thus, feeder calf production is a sizeable and rather stable part of the linearly programmed farm organization in the study area.

At wheat prices below $2.37 per bushel, the feeder calf enterprises included in the organization are those designated FMWF, FMWS and AFRN (Appendix Table I). The AFRN feeder calves are purchased April 15, grazed through the summer on native range and sold October 15. Both FMWF and FMWS feeder calves are bought October 15, grazed on winter wheat pasture and sold May 15 off grazed out small grain pasture. The FMWS enterprise utilizes some sorghum stubble during the winter months.

When wheat prices are below $2.37 per bushel, the fall feeder calf enterprises (FMWF and FMWS) in effect become competitive enterprises to wheat grown for grain. That is, the small grain grazeout competes for land. For wheat prices above $2.37 per bushel, the feeder calf enterprise FMSF is included in the organization instead of FMWF and FMWS. FMSF is similar to FMWS except the feeder calves are sold off of winter wheat pasture on March 1, rather than off grazed out small grain pasture on May 15. Consequently, at wheat prices above $2.37 feeder calf (FMSF) enterprises are supplementary to wheat for grain.

CHAPTER IV

EXTENSION FARM MANAGEMENT EDUCATION PROGRAMS UTILIZING THE REPRESENTATIVE FARM

Effective Extension farm management education involves the application of research information to actual farm conditions. Developing and using techniques for adapting research data to a new situation is the second study objective. These techniques will be discussed in this and the succeeding chapter.

A recent report of the North Central Regional Farm Management Extension Committee to the Extension directors emphasized an urgent need for trained personnel to interpret economic research information into a form readily usable by farm operators.[1]

The four principal areas of educational needs for commercial farmers and ranchers cited by the report are basic principles, economic climate, production technology and farm business management and over-all farm business organization. This chapter is concerned primarily with the area of over-all farm business organization.

The Extension farm management education program in farm business organization basically must be oriented around the commercial farm. Commercial farms are assumed to be those farm units of sufficient size

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[1]N. S. Hadley, Charles Beer, and E. G. Stoneberg, Farm Management in the Years Ahead, (Purdue, 1965).

to meet at least potentially the economic needs of the farm family and farm firm. Anything less than an optimum organization may mean the difference between economic survival and bankruptcy to the firm. Thus, it is imperative that the commercial farmer strive to operate at or near the optimum organization and to adjust as necessary with changing prices or other conditions.

Extension farm management personnel have utilized research information from representative farms in their educational programs. This information has usually been in the form of enterprise budgets and cost-returns estimates. Although potentially valuable information has been available in the form of optimum organizations from programmed representative farms, little use has been made of it. This apparent shortcoming can be attributed largely to the lack of specific adaptation techniques for translating an optimum organization for the representative farm into optimum organizations for different resource situations. Formulations of adaptation techniques will greatly enlarge the scope and depth of farm management education.

Extension farm management personnel can use representative farm research information in several ways. However, due to the nature of the material, educational efforts dealing with the farm business organization will probably be most productive when presented at workshops or by personal contact. Close personal contact is deemed necessary to allow evaluation of existing versus proposed farm organizations.

Representative Farm Studies

It is realized that the "ideal" way to obtain an optimum solution for a given resource situation is actually to use the linear programming technique, assuming that suitable data are available. Unfortunately, this procedure is not always practical. Factors such as the unavailability of a computer, the expense connected with using the computer and the time involved limit linear programming analysis for specific farm situations. Alternative ways of obtaining optimum solutions are needed if most resource owners are to obtain the most efficient use of their resources. One alternative is to make use of an optimum organization for representative farms in such a way that the result obtained is an optimum organization for an alternative resource situation. The implied hypothesis is that recognizable causal relationships between resources (the basis for representative farm delineation) and the farm organizations can be identified.

One generally recognized method of adapting from the optimum solution obtained from linear programming to an alternative situation is the budgeting technique. However, a step by step procedure for using budgets in this manner is not available. The result has been that although budgets are a recognized tool in this field they seldom are used.

If adaptations are to be made from a resource situation and its linearly programmed solution, the techniques must be relatively simple, quick and reliable. Different approaches considered in studying possible adaptation procedures are (1) budgeting, (2) linear relationships and (3) simplified programming of combined organization, which is discussed in the next chapter.

Budgeting

Budgeting provides a systematic approach for comparing alternatives and making adjustment decisions. Budgeting also provides farm management personnel with a flexible analytical tool. Comparisons may be made between enterprises, parts of farm operations, or whole farm operations. The comparisons may be made in a short run or long run framework. This high degree of flexibility enables budgets to be adapted to many varied situations.

The principal shortcoming of budgeting is that it involves a trial and error process. Indicators of desirable directions of change only are provided by comparisons. Thus, it is sometimes difficult to ascertain the change necessary to produce the optimum solution or to know if the optimum has been obtained.

Since budgeting is primarily a comparison technique, an initial farm organization first must be determined. A second organization incorporating specific changes is then compared to the first organization by budgeting. Through the budget comparison, the most profitable organization is then selected. The difficulty encountered in using budgets is that the first organization is determined by a series of rough estimates. The second organization is developed by analyzing the first organization from which changes are made with the hope of increasing the profitability of the organization. Successive changes in the organization followed by budget comparison to the previous organization may eventually produce the optimum or near optimum organization for a particular resource situation. It is this trial and error process associated with budgeting which generally prevents it from being used more widely.

The comparison capability of budgeting makes it advantageous to use in connection with the other adaptation techniques which will be discussed later. All of these other adaptation techniques provide a direct procedure for determining a farm organization. Farm management personnel can utilize these adaptation techniques to determine an organization for actual farm situations. Unfortunately, there is no absolute guarantee that the organization obtained is the most profitable for a given resource situation. Through the use of budgets, however, any possibility of farm management personnel actually recommending an unprofitable organizational change can be eliminated. In most cases an enterprise organization will already be in operation on the farm in question. The farm management personnel can develop an alternate organization through the use of one of the adaptation techniques. Then, budgets can be used to compare the existing organization with the derived organization.

Budgeting is most useful where few resources and activities are considered. As the number of different resources and alternative activities increases, the budgeting process becomes more complex.

Budget Adaptation Technique

A budget adaptation technique is used to determine the optimum farm organization for the resource situation of RHS 6 by adapting from the linear programming solutions of RHS 7 and RHS 8. RHS 6 includes both sand and clay cropland, while RHS 7 does not include any sand cropland and RHS 8 does not include clay cropland (Table XIII).

The enterprises found in the optimum organizations for RHS 7 and RHS 8 are included in the initial trial organization for RHS 6 (Table XIV). The optimum organizations for RHS 7 and RHS 8 also indicate the magnitude of the enterprises. From these linearly programmed optimum solutions information, such as which crop is grown on each of the soil productivity classes, may be obtained. Using this information as guides, the crop activities are specified at a given level for each of the two major soil categories found in the resource situation of RHS 6.

TABLE XIII

AVAILABLE RESOURCES OF RHS 6, RHS 7, AND RHS 8 USED IN BUDGETING FARM ORGANIZATION FOR RHS 6 FROM OPTIMUM ORGANIZATIONS OF RHS 7 AND RHS 8, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Available Resource	Unit	Clay Crop Farm (RHS 7)	Sand Crop Farm (RHS 8)	Livestock Farm (RHS 6)
Sand Cropland	acre		525	39.2
Clay Cropland	acre	525		262.0
Native Range	AUM	182	182	350.2
Labor[2]	hours			
Jan. - April		538	538	538
May - July		506	506	506
Aug. - Sept.		352	352	352
Oct. - Dec.		462	462	462

[1]Assume capital may be borrowed in any quantity at seven per cent interest.

[2]Assume additional labor may be hired in any amount for any period.

TABLE XIV

OPTIMUM ORGANIZATIONS OF RHS 7 AND RHS 8 USED BY BUDGETING TECHNIQUE TO ESTIMATE FARM ORGANIZATION FOR RHS 6, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Optimum Organization Clay Crop Farm (RHS 7)		Optimum Organization Sand Crop Farm (RHS 8)		Estimated Organization Livestock Farm (RHS 6)				
				Crops			Livestock	
Activity	Level	Activity	Level	Activity	Level	Livest. Feed	Act.	Level
Wheat	380 A.	Wheat	91 A.	Wheat	175 A.	65.5 AUM	FMWF	36 Hd.
		Gr. Sorghum	351 A.	Gr. Sorghum	31 A.	7.7 AUM	FMWS	7 Hd.
Forage	21 A.	Forage	.5 A.	Forage	8.2 A.	16.4 Ton	AFRN	86 Hd.
Small Grain Grazeout	124 A.	Small Grain Grazeout	82 A.	Small Grain Grazeout	87 A.	117 AUM		
Feeder Calves		Feeder Calves						
FMWF	94 Hd.							
FMWS	2 Hd.	FMWS	58 Hd.					
AFRN	34 Hd.	AFRN	39 Hd.					

[1]See Table XIII for available resources of RHS 6, RHS 7, and RHS 8.

Once the level of the crop activities is determined, the amount of available livestock grazing and feed is calculated. This establishes the resource restrictions on the type and level of livestock activities that may be included (Table XIV). Again, by using the representative farms linearly programmed solutions and a priori knowledge as guides, the livestock activities are specified at a given level (Table XIV). Costs and returns are then computed for each activity as specified by the respective enterprise budgets, and the net return (return to land, labor, management and capital) is computed for the alternative farm organization (Table XV, Organization 1).

To make adjustments in the trial organization which will increase the net returns requires careful analysis of the farm organization. When the resource requirements for the feeder calf activities of organization 1 are compared with the available small grain grazing, an excess of small grain planted for grazeout is found to exist. Thus, a decrease in the number of acres of small grain grazeout and an increase in the level of the small grain grazing feeder calf activities appear profitable. An additional level of forage would also be required if the feeder calf activity levels are increased.

In the second farm organization the crop activities are adjusted to allow more complete resource utilization by livestock. The result is a higher net return than the first organization (Table XV). Continued adjustments can be made that might further increase net returns, as indicated by the actual programmed return of $6,047.36 (Table XV, Organization 3). It is conceivable that the actual optimum organization might never be obtained with any reasonable number of adjustments except by chance.

TABLE XV

ACTIVITY LEVELS, COSTS AND RETURNS OF RHS 6 ORGANIZATION OBTAINED BY BUDGETING FROM OPTIMUM SOLUTIONS OF RHS 7 AND RHS 8 COMPARED WITH LINEAR PROGRAMMING ORGANIZATION FOR RHS 6, HIGH PLAINS AREA OKLAHOMA PANHANDLE[1]

	Activity	Level	Costs	Returns
	Grain Sorghum	31 A.	$ 334.80	$ 738.98
	Wheat	175 A.	1,277.50	3,062.50
Organi-	Forage	8.2 A.	187.20	
zation	Sm. Gr. Grazing	87 A.	331.47	
1	FMWS	7 Hd.		297.15
	FMWF	36 Hd.		1,535.40
	AFRN	86 Hd.		2,722.76
	Capital[2]	$11,079.22	775.55	
	Totals		$2,906.52	$8,356.79
	Returns - Costs			$5,450.27
	Grain Sorghum	29.2 A.	$ 315.36	$ 696.07
	Wheat	193.0 A.	1,408.90	3,377.50
Organi-	Forage	10.0 A.	228.30	
zation	Sm. Gr. Grazing	61.0 A.	232.41	
2	FMWS	7 Hd.		297.15
	FMWF	44 Hd.		1,876.60
	AFRN	83 Hd.		2,627.78
	Capital[2]	$11,370.84	795.96	
	Totals		$2,980.93	$8,875.10
	Returns - Costs			$5,894.17
	Grain Sorghum	32.6 A.	$ 294.50	$ 728.12
	Wheat	192.4 A.	1,405.23	3,371.56
Organi-	Forage	6.6 A.	174.17	
zation[3]	Sm. Gr. Grazing	69.6 A.	265.02	
3	FMWS	12.0 Hd.		509.40
	FMWF	42.0 Hd.		1,791.30
	AFRN	83.0 Hd.		2,627.78
	Capital[2]	$11,614.87	813.04	
	Totals		$2,951.96	$9,028.16
	Returns - Costs			$6,076.62

[1]The organizations are based on a wheat price of $1.40 per bushel and a grain sorghum price of $1.74 per cwt.

[2]Capital charge is the annual capital cost at seven per cent interest.

[3]The linearly programmed optimum solution for the resource situation of RHS 6.

Linear Adaptation

Three adaptation techniques based on linear relationships will be developed in this section. These techniques may be used by farm management specialists and farmers to make adjustments from the optimum organization of representative farms to alternative resource situations.

The linear adaptation technique is a relatively simple procedure which may be presented in many forms. Basically, it is assumed that a linear relationship exists between levels of activities and the level of associated resources. The relationship or ratio of activity level to resource level may be observed from the solution of a linearly programmed representative farm. This ratio factor is then applied to a different resource situation to produce an expected optimum organization for the new situation. For example, for each acre of clay cropland included in RHS 7, the optimum organization included .72 acres of wheat. If a new land resource situation included only 10 acres of clay cropland the wheat activity level in the expected optimum organization for the new resource situation would be 10 times the level indicated above, i.e., 10 x .72 = 7.2 acres of wheat. The linear adaptation technique will give an indication of the direction and the magnitude of changes necessary to approach the optimum solution for the new resource situation. The technique may be used in conjunction with budgeting.

The data for interpretation may be presented in several ways, each of which offers some advantages over the others. The linear presentation methods in this study include (1) arithmetic, (2) graphic and (3) charts and tables.

Arithmetic Adaptation

The arithmetic technique was used to adapt from the linearly programmed optima for a sand crop farm (RHS 8) and a clay crop farm (RHS 7) to an alternative resource situation of a sand and clay livestock farm (RHS 6). As in all adaptation techniques, the available resources must be specified for both the programmed representative farms and the alternative farm situations (Table XIII).

The first step in the arithmetic adaptation of the linearly programmed optimum solutions of resource situations RHS 7 and RHS 8 to the alternative resource situation of RHS 6 is to convert the activity levels for RHS 7 and RHS 8 to a per acre basis. All of the activities are converted to a per acre of cropland basis except for the feeder calf activity AFRN. The AFRN activity is converted to a per acre of native range basis since it utilizes native range.

The conversion procedure to obtain the activity level per acre of resource is as follows:[1]

$$\frac{\text{level of activity in optimum solutions}}{\text{acres of soil resource in optimum solution}} = \begin{array}{l}\text{activity level per acre}\\ \text{of soil resource}\end{array}$$

The optimum organization for the new resource situation RHS 6 is obtained by multiplying the per acre activity levels by the acres of soil resources in the new farm situation. This procedure is shown below and the results are presented in Table XVI.

$$\begin{array}{l}\text{Activity level per}\\ \text{acre of resource}\end{array} \times \begin{array}{l}\text{acres of soil resource}\\ \text{in new situation}\end{array} = \begin{array}{l}\text{level of activity}\\ \text{in new organization}\end{array}$$

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[1]May be any unit of measure depending upon limiting resource involved.

TABLE XVI

COMPARISON OF THE LINEAR PROGRAMMING ORGANIZATION FOR RHS 6, WITH THE ORGANIZATIONS OBTAINED BY ARITHMETIC ADAPTATION TECHNIQUE, UTILIZING THE OPTIMUM ORGANIZATIONS OF RHS 7 AND RHS 8, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Activity	Associated Resource[2]	Act. Level per Unit of Resource	Act. Level in New Organization[3]	Activity Level in Linearly Programmed Organization RHS 6
		Acres		
Wheat	clay	.723	189.4	
	sand	.175	6.9	
Total			196.3	192.4
Grain Sorghum	sand	.666	26.1	
Total			26.1	32.6
Forage	clay	.04	10.4	
	sand	insig.		
Total			10.4	6.6
Small Grain Grazeout	clay	.236	61.8	
	sand	.156	6.1	
Total			67.9	69.6
		Head		
Feeders				
FMWF	clay (wheat)	.179	46.8	
Total			46.8	42.0
FMWS	clay (wheat)	insig.		
	sand (wheat)	.110	4.3	
Total			4.3	12.0
AFRN	native range	.120	70.0	
Total			70.0	83.0

[1]Organization determined for RHS 6 resource situation at a wheat price of $1.40 per bushel and a grain sorghum price of $1.74 per cwt.

[2]The activities are associated with the clay cropland of RHS 7, sand cropland of RHS 8 and the native range of RHS 7 and RHS 8.

[3]Activity levels in the new organization are obtained by the activity level per unit of resource multiplied by the level of the associated resource of RHS 6 (262 clay acres, 39.2 sand acres and 584 native range acres).

If both the sand and clay soils of RHS 7 and RHS 8 produce the same activity, the activity level for RHS 6 is obtained by summing the two as shown for wheat in Table XVI, column four.

The principal advantage of the arithmetic technique is that, where causal relationships are assumed between resource use and activities included in the farm organization, only simple arithmetic is used to find the expected optimum organization of a new resource situation. The organization obtained by the arithmetic technique is compared with the linearly programmed solution in columns four and five of Table XVI.

Graphic Adaptation

The graphic adaptation technique is based on all of the same assumptions as the other linear adaptation techniques. However, the adjustment and summations are accomplished graphically. The level of relevant activities to be included in the organization of the new resource situation (RHS 6) is obtained through a set of iso-activity curves superimposed on either one or two dimensional graphs. The axes of the graphs measure units of the resources associated with the particular activity. The axes are scaled to reflect the amount of resources needed, in this case the sand or clay cropland, to obtain the level of activity obtained in the optimum organization of the two resource situations (RHS 7 and RHS 24). The graphs may be either one or two dimensional depending upon whether the activity is produced by both the sand and clay resource or by only one. A separate graph is necessary for each activity included in the optimum solution of the linearly programmed farms (Figures 2 through 8). A separate set of

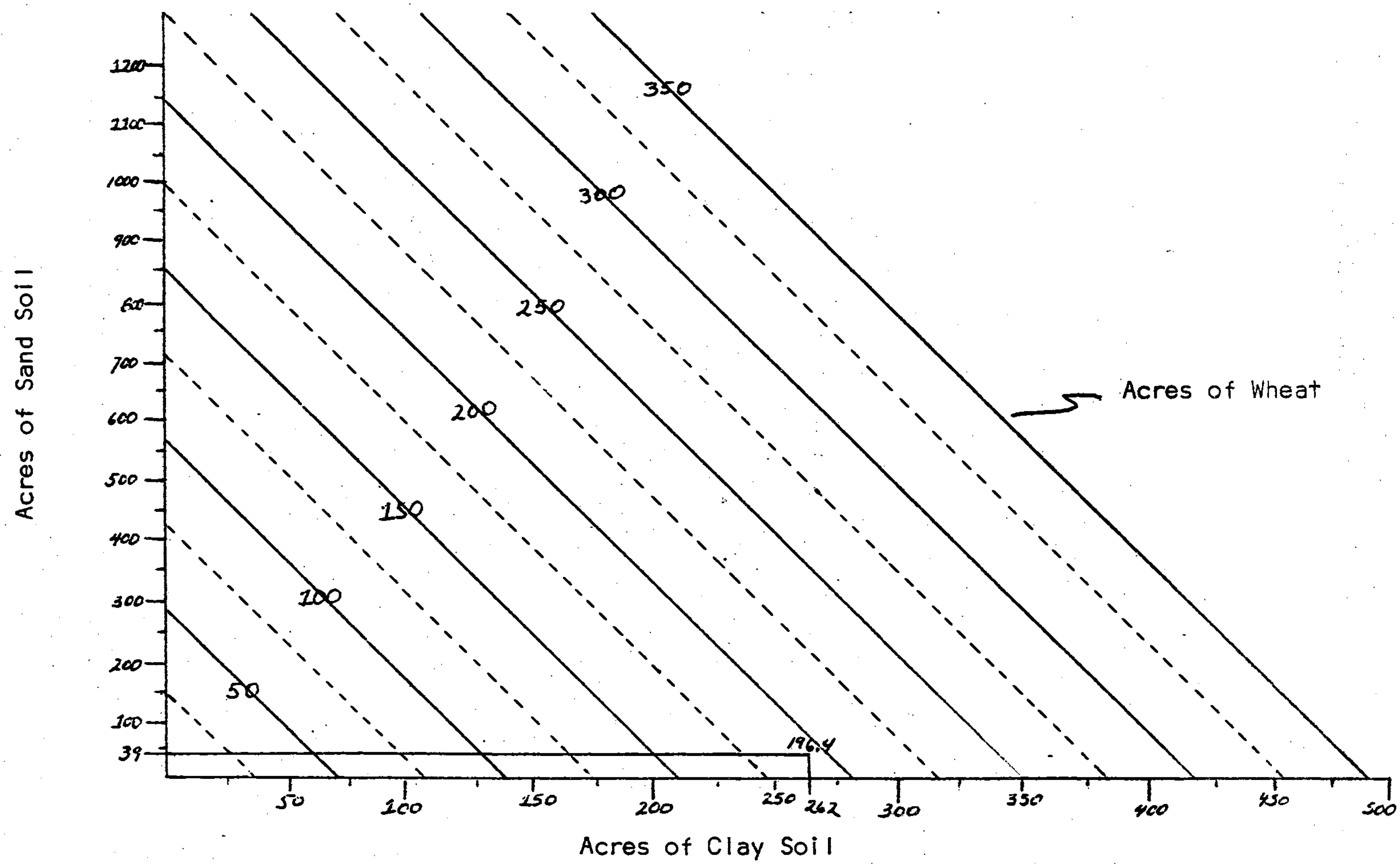

Figure 2. Wheat Acres Associated with Clay and Sand Cropland, Graphically Adapted From the Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price \$1.50 Bushel and Grain Sorghum Price \$1.74 Cwt.

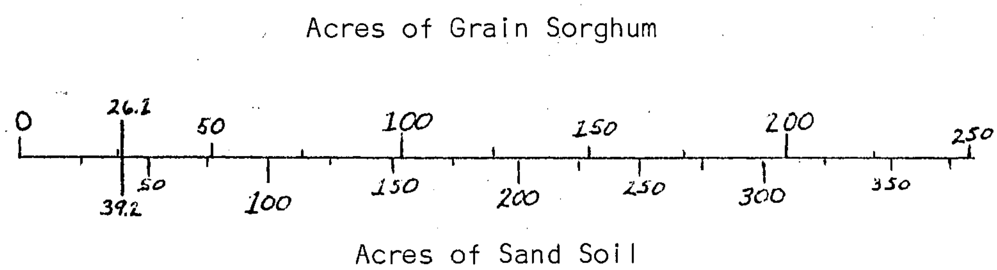

Figure 3. Grain Sorghum Acres Associated with Sand Cropland, Graphically Adapted From Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel and Grain Sorghum Price $1.74 Cwt.

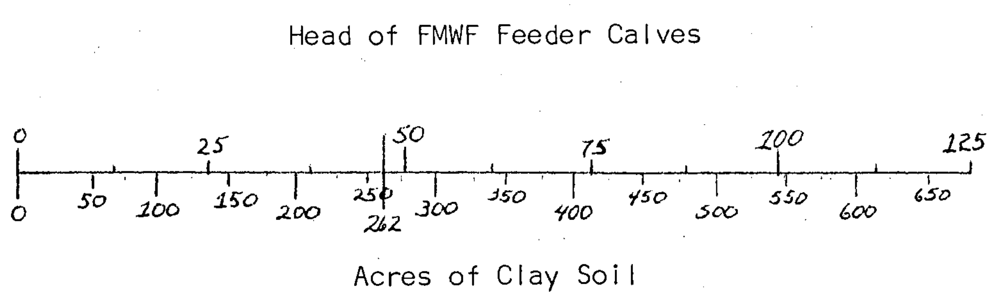

Figure 4. Number of FMWF Feeder Calves Associated with Wheat on Clay Soil, Graphically Adapted From Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel and Grain Sorghum Price $1.74 Cwt.

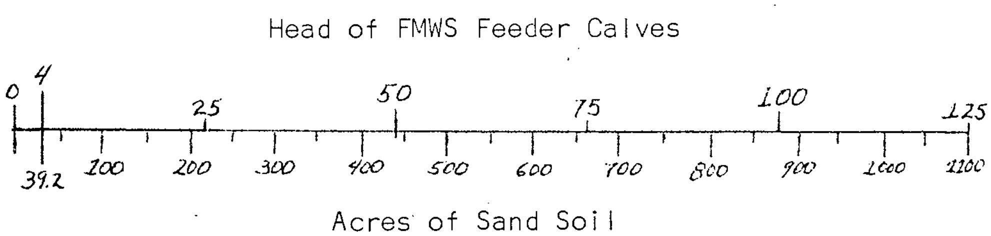

Figure 5. Number of FMWS Feeder Calves Associated with Wheat on Sand Soil, Graphically Adapted from Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel and Grain Sorghum Price $1.74 Cwt.

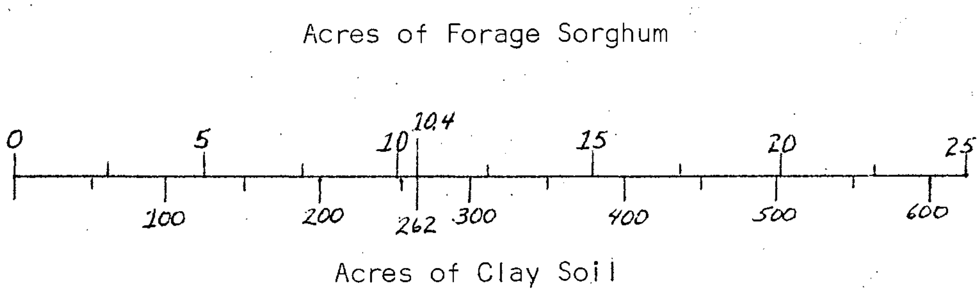

Figure 6. Forage Sorghum Acres Associated with Clay Cropland, Graphically Adapted From Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel and Grain Sorghum Price $1.74 Cwt.

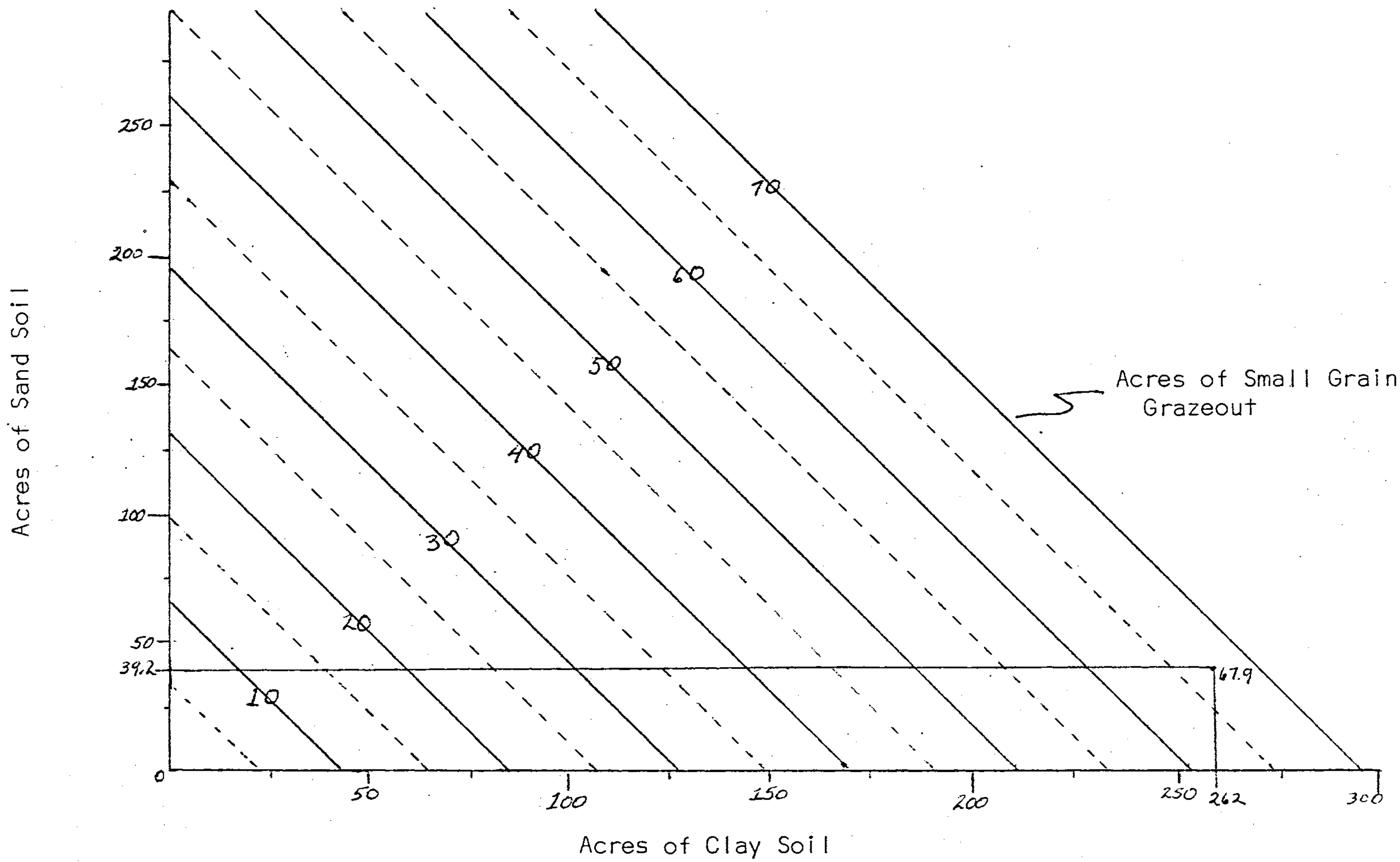

Figure 7. Small Grain Grazeout Acres Associated with Clay and Sand Cropland, Graphically Adapted From the Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel and Grain Sorghum $1.74 Cwt.

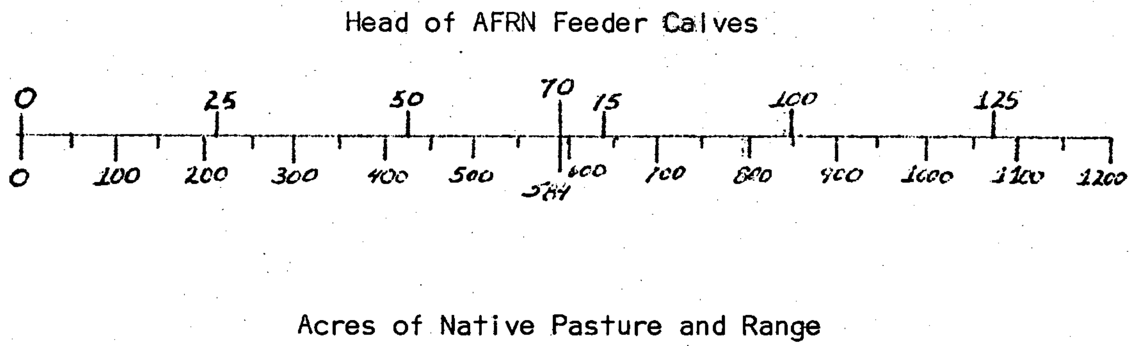

Figure 8. Number of AFRN Feeder Calves Associated With Native Range, Graphically Adapted from Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel, Grain Sorghum Price $1.74 Cwt.

graphs is needed each time the optimum organization of the representative farm changes due to a change in price.

To obtain the expected organization, locate the point on each of the activity graphs that corresponds to the combination of clay and sand cropland found in the new resource situation. The activity level is then read from the iso-activity scale. Pasture-based activities such as the feeder calf activity AFRN would depend upon the pasture level of the new resource situation instead of the cropland. The expected organization of RHS 6 as determined by the graphic technique is summarized as follows:

Wheat	196.4 acres	Feeders AFRN	70.0 head
Grain Sorghum	26.1 acres	FMWF	46.8 head
Small Grain Grazeout	67.9 acres	FMWS	4.3 head
Forage	10.4 acres		

The graphic presentation possesses certain advantages over the other linear techniques in that summation is already completed. Also, the graphs may be developed from the optimum organization of just one linearly programmed resource situation. The graphs can be reused for more than one resource combination without any additional computation. The method does have the disadvantage of requiring both arithmetic and graphic work before it can be utilized.

Chart and Tabular Adaptation

Linear adaptations may also be presented in a chart or in tabular form. The basic assumptions of the linear adaptation technique hold when the adaptations are presented in this manner. The charts are developed by scaling the level of activities included in the optimum solution of the linearly programmed farms (RHS 7 and RHS 24) to the corresponding level of resource input (sand or clay cropland or native range) as shown in Figure 9. To obtain the expected optimum organization for a new resource situation such as RHS 6, locate the input level of the limiting resource (sand or clay cropland or native range) on the acre scale. Then read the level of activities from the respective scales directly below the point on the acre scale.

The AFRN feeder calf activity level depends upon whether the pasture is associated with the sand cropland or clay cropland. In resource situations such as RHS 6 which includes both sand and clay cropland, results closest to actual programmed values were obtained for the expected level of AFRN by averaging the values obtained from the sand and clay.

The organizations obtained for the new resource situations will be identical for all methods of linear adjustment since they are based on the same principles and merely present the solution in different forms.

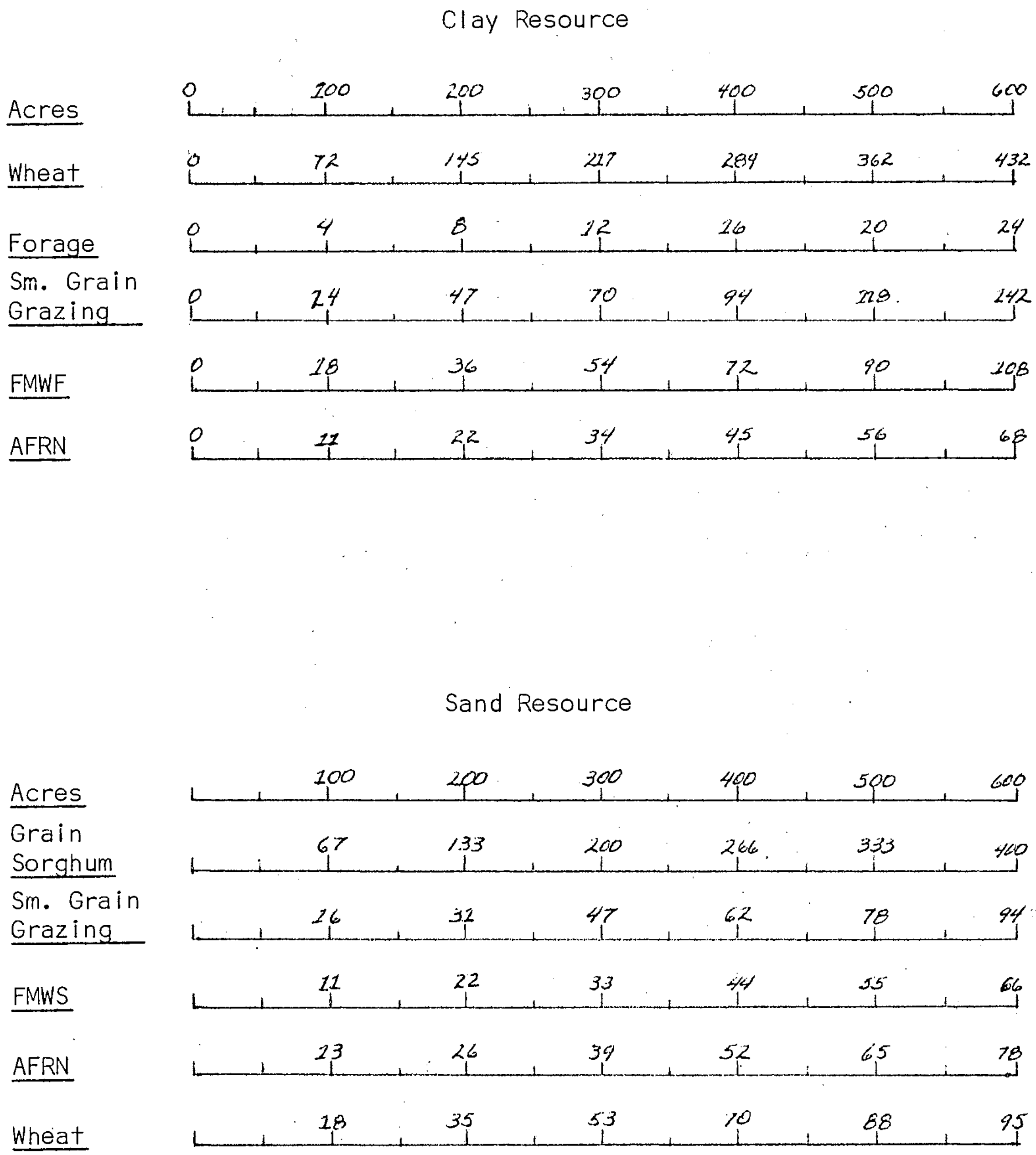

Figure 9. Adaptation Chart Used to Determine Enterprises and Levels Associated with Soil Resources, Based on Optimum Farm Organizations of RHS 7 and RHS 24, High Plains Area, Oklahoma Panhandle - Wheat Price $1.50 Bushel and Grain Sorghum Price $1.74 Cwt.

The computation for several limiting resource combinations may be completed at one time and the results presented in tabular form. Table XVII is the expected optimum level of wheat for RHS 6 developed from ten-acre increments of clay and sand resources of RHS 7 and RHS 24. The procedure permits the results to be obtained directly from tables for a new resource situation.

Summary and Limitations

The linear adaptation techniques offer farm management personnel a valuable educational tool within certain limits. It is important that these limitations be recognized in order to assure a reasonable degree of validity.

Any given farm organization is usually stable only over a certain commodity price range. When computing an expected optimum organization at or near the extremities of price stability ranges, caution should be exercised in accepting the results. Careful scrutiny of the results becomes particularly important if different activities are involved in the optimum organizations on either side of the price break. For example, the organizations of RHS 7 and RHS 8 are used in a linear adaptation to compute an organization for RHS 14 (523.9 acres of clay cropland, 78.3 sand cropland acres and 1,117.3 native range acres). At a wheat price of $1.25 per bushel, the RHS 7 organization is at the low end of the price stability range, $1.25 to $2.15 (Table XVIII). Thus, it is necessary to examine the RHS 7 organization below the $1.25 wheat price. In this case, grain sorghum is included in the $1.17 to $1.24 organization for RHS 7 but is not in the $1.25 to $2.15 organization. Similarly, the RHS 8 organization is at the upper end of its price

TABLE XVII

WHEAT ACRES ASSOCIATED WITH SPECIFIED ACRES OF CLAY AND SAND CROPLAND, ADAPTED FROM OPTIMUM FARM ORGANIZATION OF RHS 7 AND RHS 24, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

	Clay Resource										
Sand Resource Acres	0	10	20	30	40	50	60	70	80	90	100
0	0	7	14	22	29	36	43	51	58	65	72
10	2	9	16	24	31	38	45	53	60	67	74
20	4	11	18	26	33	40	47	55	62	69	76
30	5	12	19	27	34	41	48	56	63	70	77
40	7	14	21	29	36	43	50	58	65	72	79
50	9	16	23	31	38	45	52	60	67	74	81
60	11	18	25	33	40	47	54	62	69	76	83
70	12	19	26	34	41	48	55	63	70	77	84
80	14	21	28	36	43	50	57	65	72	79	86
90	16	23	30	38	45	52	59	67	74	81	88
100	18	25	32	40	47	54	61	69	76	83	90

[1]Wheat acres are based on a wheat price of $1.50 per bushel and a grain sorghum price of $1.74 per cwt.

TABLE XVIII

A COMPARISON OF OPTIMUM ORGANIZATIONS FOR RHS 7 AND RHS 8 FOR ALTERNATIVE WHEAT PRICE STABILITY RANGES, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

		Resource Situation			
		RHS 7		RHS 8	
		Stability Ranges		Stability Ranges	
Activity	Unit	$1.17-1.24	$1.25-2.15	$.85-1.26	$1.27-1.50
Wheat	Acres	327.7	380.5	--	91.9
Grain Sorghum	Acres	64.9	--	524.8	350.6
Forage Sorghum	Acres	17.6	21.2	.4	.5
Small Grain Grazeout	Acres	115.1	123.6	--	82.3
Feeders AFRN	Head	35	34	40	39
FMWS	Head	11	2	--	58
FMST	Head	--	--	51	--
FMWF	Head	78	94	--	--
Labor Hire May-July	Hour	--	-50[2]	326	219

[1]Organizations optained by linear programming when wheat price is allowed to change and grain sorghum price is $1.74 cwt.

[2]The organization for RHS 7 at wheat prices of $1.25 - 1.50 had 50 hours of unused May-July labor.

stability range, 85 cents to $1.26. A change occurs in the activities included in the $1.27 to $1.50 RHS 8 organization as compared to the 85-cent to $1.26 organization. The feeder calf activity FMST (buy in October, sell in March, winter on sorghum stubble and forage) is included at 85-cent to $1.27 wheat prices and is replaced by two new activities (small grain grazeout and feeder calves FMWS) for wheat prices $1.27 to $1.50.

To obtain an estimated organization for RHS 14 at the $1.25 wheat price requires computing four organizations, one each for every possible combination of RHS 7 and RHS 8 organizations for each side of their respective stability range price breaks (Table XIX). Careful examination of the estimated organizations is necessary to determine if any resource restrictions have been violated. The available small grain pasture restriction is violated by the organization (estimated organization 2, Table XVIII) obtained by using the $1.17 to $1.24 RHS 7 organization and the $1.27 to $1.50 RHS 8 organization. Thus, this organization is not valid and should be ignored unless the budgeting technique is to be applied in order to obtain a feasible solution. Of the remaining organizations, the estimated organization obtained by using the organization of $1.25 to $2.15 RHS 7 and $1.27 to $1.50 RHS 8 is the most profitable.

Resources that are not normally restrictive may become so as price or size of operation changes. For instance, the organization for RHS 24 has an excess supply of May-July labor when wheat price is $1.30 per bushel and grain sorghum is $1.74 per cwt. (Table XX). However, when the soil resources are increased to twice that of RHS 24, as is the

TABLE XIX

A COMPARISON OF THE LINEAR PROGRAMMING ORGANIZATION AND THE ESTIMATED ORGANIZATIONS FOR RHS 14 AS LINEARLY ADAPTED FROM OPTIMUM ORGANIZATIONS OF RHS 7 AND RHS 8, EFFECT OF USING ADAPTATION TECHNIQUES NEAR EXTREMITIES OF THE ORGANIZATIONAL PRICE STABILITY RANGE, HIGH PLAINS, OKLAHOMA PANHANDLE[1]

Activity	Unit	Est. Org. 1	Est. Org.[2] 2	Est. Org. 3	Est. Org. 4	Linear Progr. Org.[3]
		Activity Level				
Wheat	Acre	379.	341.	327.	393.	384.
Grain Sorghum	Acre	78.	117.	78.	52.	65.
Forage Sorghum	Acre	21.	18.	18.	21.	13.
Small Grain Grazeout	Acre	121.	127.	115.	135.	139.
Feeder Calves						
AFRN	Head	136	136	136	136	158
FMWF	Head	94	78	78	94	84
FMWS	Head	2	20	11	10	25
FMST	Head	8	--	8	--	--
Labor Hire May-July	Hour	87	108	139	60	240
Value	Dol.	$10,016.	$10,343.	$9,371.	$10,137.	$10,836.

[1]The wheat price stability range (grain sorghum price $1.74 cwt.) for the optimum organizations of RHS 7 and RHS 8 used to obtain the estimated organizations are as follows: Est. Org. 1, RHS 7, range $1.25-2.15 and RHS 8, $0.85-1.26; Est. Org. 2, RHS 7, range $1.17-1.24 and RHS 8, $1.27-1.50; Est. Org. 3, RHS 7, range $1.17-1.24, RHS 8, $0.85-1.26; Est. Org. 4, RHS 7, range $1.25-2.15, RHS 8, $1.27-1.50.

[2]Estimated organization 2 is not a valid solution. The amount of small grain grazing required for the feeder calves exceeds the available supply.

[3]Linear programming organization for RHS 14 is stable when wheat prices are $1.09-1.74 per bushel, grain sorghum price $1.74 cwt.

TABLE XX

EFFECT OF FARM SIZE ON OPTIMUM ORGANIZATION ALTERNATIVE RESOURCE SITUATIONS, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Activity	Linear Programmed Level for RHS 8[2]	Linear Programmed Level for RHS 24[2]
Wheat	92 A.	
Grain Sorghum	351 A.	262.7 A.
Forage Sorghum	.5 A.	.22 A.
Small Grain Grazeout	82.3 A.	
Feeder Calf AFRN	39 Hd.	20 Hd.
FMWS	58 Hd.	
FMST		26 Hd.
Labor Hire May-July	219 Hrs.	-90 Hrs.[3]

[1]Activity levels obtained from linear programmed resource situations, wheat price \$1.30 per bushel, grain sorghum \$1.74 cwt.

[2]RHS 8 included 525 acres cropland, 303 acres pasture. RHS 24 included 262.5 acres cropland, 151.5 acres pasture (one half of RHS 8).

[3]Indicates 90 hours available labor unused.

case with RHS 8, additional May-July labor is required. This change in the labor situation, brought about by changes in sizes of operation, also changed the activities included in the organizations. The organization for RHS 24 includes grain sorghum, forage sorghum and feeder calves AFRN and FMST. The FMST activity is dropped from the RHS 8 organization and wheat, small grain grazeout, May-July labor hire and feeder calf FMWS are added.

The expected optimum organization will not indicate any activities other than those included in the optimum organization of the programmed farms. However, different activities may be indicated if resource use, including the use of internally generated resources, is examined.

In actual field use farm management personnel would be utilizing the adaptation techniques to improve upon existing farm organizations. Therefore, the farm management personnel can always rely upon a budget comparison of the existing organization versus the proposed adjusted organization to insure that they suggest only more profitable organizational changes.

CHAPTER V

SIMPLIFIED PROGRAMMING

The simplified programming adjustment technique systematically selects both the particular alternative to be included in the farm organization and the level of that alternative.[1] Farm management personnel can utilize simplified programming as an effective supplement to budgeting in that it provides the desired direction and level necessary in making adjustment decisions.

The simplified programming technique requires the following information, (1) identification of available resources and resource quantity and (2) establishment of enterprise budgets.

The basic steps in simplified programming are:

1. Determine restrictive resources.
2. Develop a table of per unit resource requirements for enterprises considered.
3. Determine the net return per unit of the most restrictive resource for enterprises considered.
4. Select enterprise with highest net return per unit of the most restrictive resource (e.g., land).

[1]For a more complete discussion of the simplified programming technique, see Donald C. Huffman, Programmed Budgeting - A Tool for Complete Farm Planning, AEA Information Series No. 2, 1965.

5. Determine the level at which the selected enterprise may enter the organization.
6. Determine resources used by the selected enterprise at level it entered the organization and the resources remaining for other enterprises.
7. Select the enterprise with next highest per unit net return.
8. Determine the level that the selected enterprise may enter the organization to utilize the remaining resources.
9. Repeat steps 6, 7, and 8 until no further enterprise remains that can utilize the remaining available resources.
10. Test to determine if the included enterprises should be included at specified level and if any excluded enterprise should be included in the organization.[2]

In the strictest sense, "simplified programming" is one method of linear programming analysis, as opposed to the "simplex" method described by Heady and Candler and incorporated in computer linear programming analysis.[3] A distinction will be made between "simplified programming" and "linear programming" in this study, with "linear programming" referring only to computer analysis.

Enterprises are selected for inclusion in the farm organization one at a time in simplified programming as in linear programming. The choice criterion for simplified programming is the same as linear programming in that enterprise selection is based on the highest net return

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[2] Ibid, p. 21.

[3] Earl O. Heady and Wilfred Candler, Linear Programming Methods, (Ames, 1958), pp. 53-150.

per unit of resource. Operationally, however, the simplified programming procedure initially selects enterprises on the basis of highest net return per unit of the most restrictive resource (land). Subsequent steps in the simplified programming procedure refine the selection.

Proper consideration of enterprises that produce an intermediate product, such as small grain grazing from wheat grown for grain, is difficult in simplified programming. Some method is necessary to reflect the value of the intermediate product in the Cj value of the enterprise. This must be done without distorting the enterprise value if the subsequent enterprises utilizing the intermediate product cannot profitably be included in the organization.

The innovation of employing complete farm organizations as alternative activities is used in this study to overcome the intermediate product difficulty with simplified programming. The individual activities within the complete farm organization are not considered at first. For example, the optimum organization for RHS 5 included several different activities (Table XXI). However, consideration is given only to the solution value and resources used, i. e., 457 acres of clay cropland, 68.3 acres of sand cropland, 303 acres of native pasture and 497 hours of May-July labor and the $7,993.96 return. In order that the complete farm organization may be considered in small increments during the simplified programming process, the resources used in the organization are divided by the total land acreage in the farm. This puts the resources used by the complete farm organization on a per unit (acre) of land basis. In the example above each level of resource used would be divided by 828.3 acres of total land (column 3, Table XXI). Thus, one

TABLE XXI

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 5
HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Resource	Quantity Used	Level Per Unit of Land[2]	Activities Included in Opt. Org.	Level of Activity	Level Per Unit of Land[2]
Total Land	828.3 A.	1 A.	Wheat	335.7 A.	.405 A.
Clay Cropland	457.0 A.	.551 A.	Grain Sorghum	56.8 A.	.068 A.
Sand Cropland	68.3 A.	.082 A.	Forage	11.5 A.	.013 A.
Native Pasture	303.0 A.	.365 A.	Small Grain Grazing	121.4 A.	.146 A.
Labor May-July	497 Hr.	.6 Hr.	Feeders		
			AFRN	35.0 Hd.	.042 Hd.
			FMWF	73.0 Hd.	.088 Hd.
			FMWS	21.0 Hd.	.025 Hd.
Value	$7,993.96	$9.65			

[1]Linear programming solution using the following prices: wheat $1.50 per bu, grain sorghum $1.74 cwt.

[2]The level of activity (quantity) divided by 828.3.

unit of the complete farm organization on a total land basis may be considered as an individual activity. The regular simplified programming procedure is then used to obtain the new farm organization.

The resulting simplified programming solution is actually a composite of different organizations. The final farm organization is obtained by multiplying the level of the included organization (the one used as activities) by the enterprise levels per unit of organization.

The computational efforts of simplified programming are reduced by the use of optimum organizations as activities, if a large number of enterprises are to be considered. Any number of different enterprises may be considered when included in the alternative organizations. Thus, three or four optimum organizations used as possible activities may result in numerous enterprises being included in the final farm organization. Special circumstances or enterprises may be considered by including individual enterprises with the optimum organizations as possible activities. For example, if none of the complete farm organizations used as activities includes a cow-calf enterprise, this enterprise may be considered as one of the alternative activities along with several organization activities. A particular enterprise can be forced into the program at a given level, if desired, by including the activity in the organization before other alternatives.

Simplified Programming Adaptation Technique

Simplified programming is used to determine the optimum organization for RHS 6. Several optimum farm organizations as determined by linear programming of different resource situations are used as possible alternative activities along with single enterprises. Although the final selection of the alternative activities is arbitrarily made, the selection is based on:

1. Similarity of available resources when optimum organizations are used as activities, considering the quantity and mix of resources.
2. The special resource requirements of certain activities to enable utilization of resources that might otherwise go unused.

Using these criteria, RHS 5 optimum organization is selected as one alternative on the basis of being comparable to RHS 6 in the mixture and quantity of resources (Table V). That is, both RHS 5 and RHS 6 include a clay to sand cropland ratio of approximately seven to one. Also, the acreage of cropland is small enough not to require hiring May-July labor. RHS 7 and RHS 24 optimum organizations and enterprise AFRN are selected as utilizing special resource differences, i.e., RHS 7 includes only clay cropland and pasture resources, RHS 24 includes only sand cropland and pasture resources and AFRN utilizes only the pasture resource. RHS 24 is selected over RHS 8 as being more profitable per unit of available resources and nearer to the RHS 6 level of sand resources. RHS 8 would have been used instead of RHS 24 if the acreage of sand cropland had been approximately 350 acres or larger, thus requiring the hiring of May-July labor.

Step 1

Land is considered to be the restricting resource, as purchase of additional land or land rental is not permitted in this model. Other resources such as capital and labor may be purchased in any amount and would not be considered restrictive. However, simplified programming is a general technique, and under different conditions resources such as labor, capital, or buildings may be more restrictive than land.

Step 2

To develop the table of per unit resource requirements for enterprises considered (Table XXV), the coefficients for single enterprises included as alternatives may be obtained from the enterprise budgets. The relevant coefficients from the enterprise budgets for the feeder calf enterprise AFRN are presented in Table XXII. The only land used by the AFRN activity is native range, requiring 3.9 AUM per feeder calf. This native range requirement may be specified as AUM's or converted to an acre basis as done in this study. Since the native range carrying capacity is .6 AUM per acre, the AFRN native range acreage requirement is $\frac{3.9}{.6}$ or 6.5 acres.

The coefficients of the organizations used as activities are obtained by dividing the level of resource used in the linearly programmed optimum organization by the number of acres included in that organization. RHS 5 used 457 acres of clay, 683 acres of sand and 303 acres of native grass for a total land acreage of 828.3. The amounts of resources used by the optimum solution for RHS 5 are thus divided by 828.3 to obtain the per unit resource coefficients as indicated in Table XXI.

Coefficients for the other organizations used as activities are obtained in the same way and are shown in Tables XXIII and XXIV. The table of per unit resource requirements for enterprises considered is then developed and presented in Table XXV.

Step 3

The net return per unit of resource for enterprises considered

TABLE XXII

ENTERPRISE BUDGET FOR AFRN GOOD FEEDER CATTLE, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Item	Unit	Amount	Price	Value
Capital Requirement				
Investment (calf)	cwt.	5.00	$25.54	$127.70
Total Operating	dollar			131.56
Total Annual	dollar			65.78
Production				
Feeder, Sold	cwt.	7.75	21.98	170.35
Less 1% death loss				168.65
Total Specified Costs	dollar			135.28
Allocable Fixed Costs	dollar			1.71
Returns to Land, Labor Mgt. and Non-Allocable Fixed Cost	dollar			31.66
Resource Requirement				
Native Range	AUM	3.9		
Labor				
Jan. - April	hr.	.55		
May - July	hr.	1.50		
Aug. - Sept.	hr.	1.00		
Oct. - Dec.	hr.	.55		

[1]The method of handling the AFRN enterprise is, spring buy, April 15, graze through the summer on native range and sell off of grass October 15.

TABLE XXIII

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 24, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Resource	Quantity	Level Per Unit of Land[2]	Activities Included in Optimum Organization	Level Of Activity	Level Per Unit of Land[2]
Total land	414.4 A.	1 A.	Wheat	46.0 A.	.111 A.
Clay cropland			Grain Sorghum	175.3 A.	.423 A.
Sand cropland	262.7 A.	.653 A.	Forage	.25 A.	.0006 A.
Native pasture	151.7 A.	.366 A.	Small Grain Grazing	41.1 A.	.099 A.
Labor			Feeders		
May-July	362.6 Hr.	.875 Hr.	AFRN	20.0 Hd.	.0482 Hd.
			FMWS	29.0 Hd.	.699 Hd.
Value	$4,032.00	$9.73			

[1]Linear Programming solutions using the following prices: wheat $1.50 per bu., grain sorghum $1.74 cwt.

[2]Level of activity (quantity) divided by 414.4.

TABLE XXIV

RESOURCE AND OPTIMUM ORGANIZATION RHS 7, HIGH PLAINS AREA, OKLAHOMA PANHANDLE[1]

Resource	Quantity	Level Per Unit of Land[2]	Activities Included in Optimum Organization	Level of Activity	Level Per Unit of Land[2]
Total land	828.6 A.	1 A.	Wheat	380.5 A.	.459 A.
Clay cropland	525.3 A.	.634 A.	Forage	21.2 A.	.026 A.
Sand cropland			Small Grain Grazing	123.6 A.	.149 A.
Native Pasture	303.3 A.	.366 A.			
			Feeders		
Labor			AFRN	34.3 Hd.	.041 Hd.
May-July	456.0 Hr.	.550 Hr.	FMWF	94.3 Hd.	.114 Hd.
			FMWS	2.1 Hd.	.003 Hd.
Value	$7,722.88	$9.32			

[1]Linear programming solution using the following prices: wheat $1.50 per bu., grain sorghum $1.74 cwt.

[2]Level of activity (quantity) divided by 828.6.

TABLE XXV

SIMPLIFIED PROGRAMMING WORK TABLE SHOWING THE RESOURCE REQUIREMENTS FOR ENTERPRISES CONSIDERED IN THE FARM ORGANIZATION

Resource	RHS 6 Amount Available	RHS 5 Org.	RHS 7 Org.	RHS 24 Org.	AFRN Enterprise
Total land	884.9 A.	1	1	1	6.5
Clay cropland	262.0 A.	.551	.634		
Sand cropland	39.2 A.	.082		.633	
Native pasture	583.7 A.	.365	.366	.366	6.5
Labor May - July	506 Hr.	.6	.55	.875	1.5
Net return[1]		$9.65	$9.32	$9.37	$27.06

[1]All values adjusted for cost of annual capital borrowed.

TABLE XXVI

SIMPLIFIED PROGRAMMING WORK TABLE SHOWING THE NET RETURNS PER UNIT OF RESOURCE FOR ENTERPRISES CONSIDERED IN THE FARM ORGANIZATION

Resource	RHS 5 Org.	RHS 7 Org.	RHS 24 Org.	AFRN Enterprise
Total land	$ 9.65	$ 9.32	$ 9.37	$4.16
Clay cropland	17.51	14.70		
Sand cropland	117.68		14.80	
Native pasture	26.44	25.46	25.60	4.16
Labor May - July	16.08	16.95	10.71	18.04

is determined by dividing the net return per unit of activity (line 6, Table XXV) by the per unit of resource requirement coefficients (lines 1 through 5, Table XXV). This permits easy evaluation as to the dollar efficiency of each enterprise in the use of each resource (Table XXVI).

Step 4

The selection of the most profitable enterprise in terms of return to the most restrictive resource (land) is made from Table XXVI. The RHS 5 activity has a total land resource use value of $9.65, compared to $9.37, $9.32 and $4.16 for RHS 24, RHS 7 and AFRN, respectively. Thus, RHS 5 is chosen for use in step 5.

Step 5

Once the most profitable enterprise is selected, a secondary work table (Table XXVII) is constructed to determine the maximum level that the enterprise may enter the solution. The maximum level is determined by dividing per unit resource coefficients (column 3, Table XXV) for the selected enterprise, RHS 5 organization, into the quantity of the respective available resources (column 2, Table XXV). This table must be updated each time a new activity is added to the organization.

The resource which restricts the enterprise to its lowest level determines the maximum level the enterprise may enter the organization. The RHS 5 organization is restricted most by the clay cropland resource, thus the maximum level at which it can enter the organization is 475.4 units.

Step 6

Using the Primary Work Table, Table XXVI, as a resource accounting table, the resources used by 475.4 units of RHS 5 organization are

TABLE XXVII

SECONDARY WORK TABLE FOR SIMPLIFIED PROGRAMMING SHOWING THE MAXIMUM LEVEL OF NEW ACTIVITIES THAT CAN ENTER THE FARM ORGANIZATION

Activity	Total Land	Clay Cropland	Sand Cropland	Native Pasture	Labor May-July
RHS 5 org.	884.9	475.4	478.0	1,599.2	843.3
RHS 24 org.	309.5	0	.3	1,120.8	401.5
AFRN enterprise	62.9			63.0	147.0

TABLE XXVIII

PRIMARY WORK TABLE FOR SIMPLIFIED PROGRAMMING SHOWING THE LEVEL AT WHICH NEW ACTIVITIES ENTERED THE FARM ORGANIZATION AND THE REMAINING RESOURCES AVAILABLE FOR OTHER ACTIVITIES

Activity	No. of Units	Total Land	Clay Crop-land	Sand Crop-land	Native Pas-ture	Labor May-July	Net Returns
Resources Available		884.9	262	39.2	583.7	506	
RHS 5 Organization	475.4	475.4	262	39.0	173.5	285.2	$4,587.61
Resources Available		409.5	0	.2	410.2	220.8	4,587.61
RHS 24 Organization	.3	.3	0	.2	.1	.3	2.92
Resources Available		409.2	0	0	410.1	220.5	4,590.53
AFRN Enterprise	62.9	408.9	0	0	408.9	94.4	1,702.07
		.3	0	0	1.3	126.1	$6,292.60

deducted from the total available resources of RHS 6 (column 2, Table XXV). The unused resources are available for use by the other enterprises to be included in the organization.

Steps 7 and 8

To utilize the remaining resources available after the RHS 5 activity is included, the activity with the next highest net return per unit of land resource is selected for Table XXVI. In this case activity RHS 24 is selected and the level that it may enter depends on the remaining resources shown by Table XXVIII. Using the secondary work table, Table XXVII, the level at which RHS 24 may enter the organization is determined by the most restrictive resource. In this case, sand cropland restricts the RHS 24 entry to .3 unit.

Step 9

Repeating steps 6, 7 and 8, the final activity to be selected for inclusion in the organization is activity AFRN. The level at which the AFRN activity may enter the organization is restricted to 62.9 units by total land and by pasture. After including activity AFRN the remaining resources are of insignificant size and no more activities are included.

Step 10

The check on returns per unit of resource used shows that the value for the last activity included, AFRN, is less than for the other included activities. Returns per unit of resource for the excluded activity, RHS 7, are lower than for the included activities, indicating that the optimum plan has been reached.

The optimum enterprise organization for RHS 6 is determined by the level of the included activities. The actual enterprise levels for the organizations used as activities, RHS 5 and RHS 24, are obtained by the level at which these activities entered the final organizations, multiplied by the respective enterprise level per unit of land (column 6, Tables XXI and XXIII) as shown in Table XXIX. The resulting enterprise levels are compared in Table XXIX with those of the linearly programmed optimum organizations obtained for RHS 6.

Evaluation of the Simplified Programming Adaptation Technique

Simplified programming could be utilized extensively in farm management education. It provides a relatively simple hand calculation approach to linear programming.

The information necessary for farm management specialists to utilize simplified programming can be readily supplied by the researcher. If only individual enterprises are considered as possible alternative activities, no special skill is required to make use of the simplified programming technique. However, when intermediate products are included in the program, more skill and a priori knowledge must be used in setting up the program.

The use of optimum organizations from linearly programmed resource situations appear promising as alternative activities. Each organization chosen must be carefully selected to meet one or more distinguishing characteristics of the resource situation in question. Organizations from dissimilar resource situations must not be included as alternatives. For instance, the simplified programming procedure is used to compute the farm organization for RHS 9, using farm organizations as alternative activities. The activities considered for

TABLE XXIX

SIMPLIFIED PROGRAMMING AND LINEAR PROGRAMMING OPTIMUM ORGANIZATION FOR RHS 6

Enterprise	Activity RHS 5 Organization Enterprise Level[1]	Activity RHS 24 Organization Enterprise Level[1]	Activity AFRN Enterprise Level	Simplified Program Solution	Linear Program Solution
Wheat	.405 x 475.4 = 192.5	.111 x .3 = .033		192.5	192.4
Grain Sorghum	.068 x 475.4 = 32.3	.423 x .3 = .13		32.4	32.6
Forage	.013 x 475.4 = 6.2	.0006 x .3 = .002		6.2	6.6
Small Grain Grazing	.146 x 475.4 = 69.4	.099 x .3 = .029		69.4	69.6
Feeders					
AFRN	.042 x 475.4 = 20.0	.0482 x .3 = .014	62.9	82.9	82.9
FMWF	.088 x 475.4 = 41.8			41.8	41.8
FMWS	.025 x 475.4 = 11.9	.699 x .3 = .2		12.1	12.1
Value	$9.65 x 475.4 = $4,587.61	$9.73 x .3 = $2.92	62.9 x $27.06 = $1,702.07	$6,292.60[2]	$6,287.86

[1] Enterprise level per unit of organization multiplied by the number of units of organization used in the simplified programming solution.

[2] The actual value of the simplified programming organization cannot exceed the value of the linear programming organization. The apparent discrepancy in this example is caused by the need to keep the arithmetic simple during the simplified programming process, thus creating rounding errors.

RHS 9 included the linear programming solutions for RHS 7, 8, 5 and 1 and enterprise AFRN. RHS 7 and 8 and the AFRN enterprise are selected in order to handle special resource differences. RHS 5 and 1 are included as alternative because of similar size.

The simplified programming solution involving the farm organizations of RHS 5 and 8 and enterprise AFRN is compared with the linear programming solution for RHS 9 in Table XXX. The discrepancy between the two methods of analysis apparently is due to a failure to account for a special resource characteristic when selecting alternative activities for the simplified programming. The inclusion of an organization with a sand to clay cropland ratio more nearly approximating the RHS 9 resource situation might have improved upon the solution. It is important that step 10 of the simplified programming procedure (check on the value of resource used) be completed. The importance of step 10 is illustrated by applying the simplified programming procedure to RHS 14. The alternative activities selected for inclusion in the linear programming solutions are RHS 4, 1, 15 and 24 and enterprise AFRN. The organization for RHS 15 and 24 and enterprise AFRN are selected as alternative activities to handle special resource differences and the organizations of RHS 5 and 1 are chosen because of the ratio of clay and sand cropland.

The RHS 24 organization is included as one activity until the "value of resource use" check is applied for the excluded activities. Although the net return per unit of resource for total land is slightly higher for RHS 24 than RHS 5, \$9.74 compared to \$9.65, the value for sand cropland is much lower, \$15.36 compared to \$117.68. Therefore, the

TABLE XXX

SIMPLIFIED PROGRAMMING AND LINEAR PROGRAMMING FARM ENTERPRISE ORGANIZATIONS FOR RHS 9

Enterprise	Simplified Programming[1] Level	Linear Programming Level
Wheat	218.7 A.	179.7 A.
Grain Sorghum	131.7 A.	183.9 A.
Forage Sorghum	6.2 A.	4.3 A.
Small Grain Grazeout	92.7 A.	82.8 A.
Feeders		
AFRN	52 Hd.	52.9 Hd.
FMWF	42 Hd.	25.5 Hd.
FMWS	28 Hd.	38. Hd.
Labor Hire May - July	16.7 Hr.[2]	
Net Returns	$7,306.84	$7,527.91

[1]Based on RHS 5, RHS 8 organizations and enterprise AFRN as activities.

[2]The labor required to utilize land resources as determined by Primary Work Table.

RHS 5 organization replaced RHS 24 and the resulting organization yielded a higher return. Table XXXI shows the organization that would have resulted by including RHS 24 as compared to RHS 5 and the linear programming solution for RHS 14.

When optimum organizations of differing resource situations are used as alternative activities, research with linear programming actually serves as a data generating technique. It provides specific information that can be regrouped to meet a special need. Different farm organizations may be obtained through the linear programming process by identifying representative farms within an area by several methods. These organizations can then be used by farm management educators as alternative activities in the simplified programming process. Thus a relatively small sample of farm enterprise organizations obtained by linear programming may provide the basis for developing optimum organizations for many resource owners.

As with other adaptation procedures, the organization obtained through the use of simplified programming needs to be carefully checked before being recommended. The organization always can be compared by budgeting with the existing farm organization to see if it is profitable to reorganize.

Enterprise use of resources must be checked to ascertain that no resource limitation is violated. Only then can the organization obtained be recommended by the farm management specialist to the farmer as being a profitable undertaking.

TABLE XXXI

SIMPLIFIED PROGRAMMING AND LINEAR PROGRAMMING FARM ENTERPRISE ORGANIZATIONS FOR RHS 14

Enterprise	Simplified Programming[1] (Using RHS 24) Level	Simplified Programming[2] (Using RHS 5) Level	Linear Programming Level
Wheat	392.8 A.	385 A.	385 A.
Grain Sorghum	51.9 A.	64.7 A.	65 A.
Forage Sorghum	20.8 A.	12.4 A.	13 A.
Small Grain Grazeout	135.5 A.	138.8 A.	139 A.
Feeders AFRN	158 Hd.	158 Hd.	158 Hd.
FMWF	93 Hd.	83.7 Hd.	83 Hd.
FMWS	10 Hd.	23.8 Hd.	24 Hd.
Labor Hire May - July	233.5 Hr.[3]	242.3 Hr.[3]	240 Hr.
Net Returns	$11,331.00	$12,010.84	$12,029.47

[1]Based on RHS 24, RHS 15 organizations and enterprise AFRN as activities.

[2]Based on RHS 5 organization and enterprise AFRN as activities.

[3]The labor required to utilize land resources as determined by Primary Work Table.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The objectives of this study were to (1) demonstrate the use of representative farms and illustrate the effect of different methods of defining representative farms on area agricultural supply estimates in the Panhandle of Oklahoma and (2) develop techniques for adapting linearly programmed representative farm plans to different farm resource situations with minimum loss of optimality. Much expense and time and many resources are used in developing and appropriately defining representative farms for agricultural economic research. The intent of this study is to extend the use of the information obtained as far as possible.

Although the study area is specifically defined as the dryland cropland of the High Plains area of the Oklahoma Panhandle, it is anticipated that the findings of this study are equally applicable to other areas. The linearly programmed organizations for representative farm siutations are available for many areas throughout Oklahoma and the United States. Thus, adaptation techniques developed in this study can be used by farm management personnel to estimate enterprise organizations for actual farm situations in these areas.

Objective one of this study is considered in the analysis of the area supply estimates. Representative farm situations are identified by different methods and linearly programmed to obtain the optimum enterprise organization. The commodity supplies for the representative farms are aggregated to obtain area supply estimates of wheat, grain sorghum and feeder calves. The results indicate that the method of identification of representative farms does have considerable effect on the aggregated area supply estimates.

Three general methods of identifying the representative farm were examined for their effect on aggregate area commodity supply. The characteristics identified by the representative farms included soil differences, type of farm and a combination of soil differences and type of farm. In general the more characteristics identified by the representative farm, the more the enterprise organization was affected by changes in major commodity prices. These changes in organization in turn create changes in the area agricultural supply estimates. The soil difference and type of farm method identified more characteristics in the representative farm situation than did the other identification methods. Area commodity supplies derived from the representative farm situations identified by the above method also exhibited the most sensitivity to change in wheat prices.

Adaptation techniques and procedures were developed to provide means of determining the most profitable enterprise combination for specific resource situations without requiring a linearly programmed analysis. The three different types of adaptation techniques were budgets, linear, and simplified programming. The linear adaptation technique was presented in four different forms, the arithmetic, graphic, chart and tabular.

Budgeting alone can be used in adjusting farm organizations, however, it usually requires several attempts before satisfactory results are obtained. Therefore, budgeting probably has a more important role when used with the linear or simplified programming techniques as an organization profitability check against existing farm organizations. Intermediate type enterprises were effectively considered in the simplified programming process through the use of optimum organizations as activities. Simplified programming and linear adaptation techniques do provide practical methods for adapting optimum organizations to new resource situations if certain limitations and precautions are observed. These adaptation techniques are suitable for use in general farm management education programs. Thus, the farm operators are offered some of the advantages of linear programming without most of the associated expense and difficulties.

Research conducted by public institutions such as Oklahoma State University is usually justified on the basis that it yields beneficial returns to taxpaying sponsors. Although there is no question that the returns to the general public have exceeded the cost of research, a potentially larger return has not been reached. Additional economically important information still can be channeled to the farm public by more fully utilizing research information already acquired. This information is in the form of linearly programmed solutions of representative farm situations that are developed in connection with many varied research studies.

Efforts were made in this study to develop procedures that can be utilized in adapting linear programming solutions to the different resource situations of the real world. Undoubtedly, still more procedures can and should be developed to aid the general farm public in making wise adjustment decisions based on known research data. Future work in this general area can be encouraged if researchers and farm management personnel accept the responsibilities discussed in the next two sections.

The Research Responsibility

The researcher is under obligation to disseminate his research data in such a way that maximum usage can be made of his findings. In this respect, the following information should be made available to farm management educators upon the completion of representative farm studies:

1. Enterprise budgets are necessary so that farm management educators may observe the alternatives considered, the level of management assumed, input cost estimates, yield estimates and product prices assumed. This will enable adjustments to be made in the interpretation of the results so that values other than those assumed in the study may be considered.
2. Specification of the resource situation of the representative farm is necessary so that a basis exists for understanding the significance of the resulting organization. Farm management personnel can then adapt the organization to different resource situations than those studied.
3. Optimum solution values for the linearly programmed resource situation are required before intelligent adjustment decisions

can be made. When possible, these solutions should be obtained for several resource situations and/or factor and product price combinations. Stability ranges of farm organizations obtained through linear programming are highly desirable.

In Oklahoma the processed series type publication adequately fulfills the requirements of point one above.[1] The information required by points two and three could generally be obtained with little additional effort or expense if carried out at the same time and along with area supply research studies. The data could be published as a supplement to the relevant processed series bulletin. Printing expense would probably prevent the publishing of every organization change as the price changed. However, the price at which enterprises enter or leave the organization should be identified along with the major organizational price stability range.

The Extension Responsibility

Personnel responsible for farm management education must accept the obligation of applying research findings to actual farm conditions. This requires an educational program which would accomplish the following:

1. Create farmer awareness of the value of developing and increasing skills in farm management decision making. The economic conditions relating to farming dictate that farm resources be

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

utilized in an economically efficient farm organization. Farmers must constantly evaluate existing and alternative organizational structure for continued farming efficiency. This education may be accomplished through the use of mass media, group meetings and workshops and personal contacts.

2. Teach farmers adaptation techniques which may be used to obtain optimum use of their resources in the farm organization. The adaptation techniques discussed in this study may be used. Because of the more detailed analysis required, the educational process would probably dictate a relatively close personal contact with the farm audience. Thus, small group meetings of the workshop type or personal contact would probably be the most logical educational setting.

Both the researcher and farm management educators must constantly strive to find new ways of applying research findings to farm situations in a meaningful way. For instance, more work is needed to explore the alternative ways of providing farm operators with procedures for determining the optimum organization for their farm situation.

Jointly, the researcher and farm management educator need to explore means of developing organizational and operational methods of bringing linear programming within the reach of individual farmers. Using the optimal organizations obtained from linearly programmed representative farm as alternative activities, as discussed in the simplified programming section of this study, may provide a practical way of making the benefits of linear programming available to the general farm public. The linear programming results from using organizations as activities produced identical solutions to the simplified programming process reported in this study. The linear programming matrix for these problems was quite small and required only minutes of computer time. Thus as a by-product of aggregation studies the possibility exists for developing several organizations obtained from linearly programmed representative farm situations which would reflect different management and production levels. Farmers could then submit their resource situations to a data processing service organization and in turn receive the linear programming optimum organization for their farm at a nominal cost.

This study has shown a need for research studies to consider possible alternative uses of the research data obtained in past or potential studies. The application of these data can provide farm management personnel with an educational tool capable of aiding farmers in the maximization of the economic return to their farm units. The latter step is needed to further bring about the enhancement and fulfillment of the role of agriculture in the nation's economy.

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APPENDIX

APPENDIX TABLE I

CHARACTERISTICS OF ALTERNATIVE FEEDER LIVESTOCK ACTIVITIES, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Activity Designation	Handling System	Purchase Date	Initial Wt.	Selling Date	Final Wt.	Requirements Per Head Labor	Total Capital	Annual Capital	Cj Value
			(lb.)		(lb.)	(hr.)	(dol.)	(dol.)	(dol.)
FFRN	Native Range + C.S.C. + (hay in bad weather)	Oct. 15	450	Oct. 15	775	7.6	127.73	126.09	33.06
FFRF	Native Range + C.S.C. + hay	Oct. 15	450	Oct. 15	775	8.5	127.73	126.09	33.65
FFRS	Native Range + C.S.C. + Sorghum Stubble + (hay in bad weather)	Oct. 15	450	Oct. 15	775	7.6	127.73	126.73	33.69
AFRN	Native Range	Apr. 15	500	Oct. 15	775	3.6	131.56	65.78	31.66
FMWF	Wheat Pasture + hay + C.S.C. + Grazeout Sm. Gr.	Oct. 15	450	May 15	715	3.66	119.98	69.99	42.65
FMWS	Wheat Pasture + Sorghum Stubble + C.S.C. + Grazeout Small Grain + (hay in bad weather)	Oct. 15	450	May 15	715	3.36	119.98	69.99	42.45
FMST	Sorghum Stubble + C.S.C. + (hay in bad weather)	Oct. 15	450	Mar. 1	600	4.42	135.42	45.30	10.57
AFRF	Native Range + Forage Sorghum	Apr. 15	500	Oct. 15	775	3.60	131.56	65.78	31.93
FMSF	Wheat Pasture + hay + C.S.C.	Oct. 15	450	Mar. 1	600	2.76	119.28	44.74	17.44

APPENDIX TABLE II

CHARACTERISTICS OF ALTERNATIVE COW-CALF LIVESTOCK ACTIVITIES, OKLAHOMA PANHANDLE

Activity Desig- nation	Handling System[1]	Calving Date	Selling Date	Selling Weight Steers	Selling Weight Heifers	Requirements Per Cow Labor	Requirements Per Cow Total Capital	Requirements Per Cow Annual Capital	Requirements Per Cow Cj Value
MFRN	Winter cows on native range + C.S.C.	Mar. 1	Oct. 1	450	420	11.16	208.27	206.44	65.31
MFRF	Winter cows on native range + hay + C.S.C.	Mar. 1	Oct. 1	450	420	12.59	208.27	206.44	65.94
MFFW	Winter cows on native range + hay + C.S.C. + small grain pasture	Mar. 1	Oct. 1	450	428	11.16	203.87	202.96	69.73
NJWS	Winter cows on native range + small grain pasture + sorghum stubble + hay + C.S.C.	Nov. 1	July 20	465	441	12.76	203.87	202.96	69.40
NJSF	Winter cows on native range + sorghum stubble + hay + C.S.C.	Nov. 1	July 20	465	441	13.10	208.27	204.60	63.71

[1]All calves sold off of native range.

APPENDIX TABLE III

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

Crop and Operations	Dates	Times Over	Machine Time (Hour)	Power (Hour)	Labor (Hour)
Wheat & Grazed Out Wheat					
Chisel	July	1	.20	.22	.24
Oneway	July-Aug.	3	.58	.63	.69
Drill (2 drills)	Sept.	1	.09	.10	.11
Total			.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-June	1.5	.33	.36	.39
Harrow	June	1	.12	.13	.14
Cultivate	July	2	.31	.34	.37
Total			1.33	1.46	1.59
Reseeded Cropland (Establishment)					
Chisel	May	1	.20	.22	.24
Oneway	May-June	2	.38	.42	.46
Drill (2 drills-sorghum)	June-July	1	.09	.10	.11
Seeding (grass)	Mar.-Apr.	1	.10	.10	.11
Total			.77	.84	.92

Source: Harry H. Hall et al., Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises; Oklahoma Panhandle (Oklahoma State University Exp. Sta. Proc. Series P-459, Stillwater, 1963), p. 44.

[1]Estimates do not include custom hired harvest operations.

APPENDIX TABLE IV

TRENDS IN INDEX OF UNITED STATES PRICES PAID FOR SELECTED PRODUCTION ITEMS WITH LINEAR PROJECTION TO 1970[1]

Production Item	1950-63 Average	1970 Estimate	1961-63 Average	1970 Projection 1961-63 Average
Motor Supplies	99[2]	107	101	106
Farm Machinery	96	133	111	120
Building & Fence Material	98[1]	110	101	109
Wage Rates	96	137	113	121
Feed	106	86	101	85
Cottonseed Meal 41%	117	103	112	92

Source: M. D. Skold, D. O. Anderson, and J. S. Wehrly, GP-5 Price Subcommittee unpublished mimeo Prices Paid and Received. 1966.

[1]The index period is 1957-59 = 100.

[2]The base period used for motor supplies and building and fence material was 1954 to 1963 instead of 1950 to 1963.

APPENDIX TABLE V

ASSUMED 1970 PROJECTED PRICES PAID AND RECEIVED BY FARMERS, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Item	Unit	Price
Seed and Feed		
Wheat Seed	Bu.	$1.86[2] and .50[1]
Grain Sorghum Seed	Cwt.	20.00[3] and $10.00[4]
Forage Sorghum Seed	Cwt.	17.00
Grass Seed	Lb.	1.17
Cottonseed Meal (41%)	Cwt.	3.49
Salt and Mineral	Lbs.	.03
Custom Rates		
Combining Wheat	Acre	3.60
Hauling Wheat	Bu.	.08
Combining Grain Sorghum	Acre	3.60
Hauling Grain Sorghum	Cwt.	1.48
Forage Sorghum		
Mow and Rake	Acre	1.50
Bale and Haul	Bale	.20
Fuel and Lubricants		
L. P. Gas	Gal.	.085
Motor Oil	Gal.	1.10
Lubricant	Lb.	.21
Labor	Hr.	1.50
Prices Received		
Wheat	Bu.	.50-2.50[5]
Grain Sorghum	Cwt.	1.05-2.20[6]
Beef	Cwt.	[7]

[1]Seed wheat used for grain enterprise - allowance for differences between market wheat price and seed wheat price purchased every three years plus clean and treat.

[2]Seed wheat used for grazeout enterprise - assumed market wheat price $1.61 per bu. plus 25 cents.

[3]Grain sorghum planted for harvest.

[4]Grain sorghum planted as residue for wind erosion control when reseeding native range.

[5]Wheat prices were varied over $.50-2.50 per bu. range at five different grain sorghum prices.

[6]Base grain sorghum prices established for variable wheat prices is $1.74 cwt.

[7]See Appendix Table VI.

APPENDIX TABLE VI

ASSUMED 1970 LIVESTOCK PRICES, ADJUSTED FOR SEASONAL VARIATIONS, HIGH PLAINS, OKLAHOMA PANHANDLE

Market Grade of Beef	Market Date	Annual Average Price[1] (dol./cwt.)	Seasonal Variation[2]	Adjusted Budget Price (dol./cwt.)
Good Feeder Steers				
450 lb.	Oct. 15	26.06	97.7	25.46
465 lb.	July 20	26.06	99.6	25.96
600 lb.	Mar. 1	23.01	103.3	23.77
715 lb.	May 15	22.94	103.4	23.72
775 lb.	Oct. 15	22.94	95.8	21.98
Good Stocker Steers				
500 lb.	Apr. 15	23.01	104.4	24.02
775 lb.	Oct. 15	22.94	95.8	21.98
Good Feeder Heifers				
428 lb.	Oct. 1	23.23	97.7	22.70
441 lb.	July 20	23.23	99.6	25.96
Heifers over 1 year				$125.00[3]
Brood Cows				$160.00[3]
Cull Cows		10.57		10.57
Bulls				$360.00[3]

[1]Computed on basis of $24.00 per cwt., good sl. st. prices at Oklahoma City and adjustment procedure outlined by GP-5 Price Subcommittee.

[2]Leo V. Blakley, Odell L. Walker and John G. McNeeley, Jr., <u>Monthly Variations of Beef Cattle Prices in Oklahoma</u>, (Oklahoma State University Experiment Station Bulletin B-642, October, 1965).

[3]Per head value instead of dollars per cwt.

APPENDIX TABLE VII

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 1, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Resource	Quantity Used	Activities Included in Opt. Org. [1]	Activity Level
Clay Cropland	377.5 Acres	Wheat	277 Acres
Sand Cropland	56.4 Acres	Grain Sorghum	46.9 Acres
Native Pasture	417.6 Acres	Forage Sorghum	9.5 Acres
Solution Value	$7,296.40	Small Grain Grazeout	100.2 Acres
		Feeder Calves AFRN	54 Head
		FMWF	60 Head
		FMWS	17 Head

[1] Linear programming solution using the following prices, wheat $1.50 per bushel, grain sorghum $1.74 cwt.

APPENDIX TABLE VIII

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 2, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Resource	Quantity Used	Activities Included in Opt. Org.[1]	Activity Level
Clay Cropland	539.1 Acres	Wheat	390.4 Acres
Native Pasture	286.0 Acres	Forage Sorghum	21.8 Acres
Solution Value	$7,820.58	Small Grain Grazeout	126.8 Acres
		Feeder Calves AFRN	31 Head
		FMWF	97 Head
		FMWS	2 Head

[1]Linear programming solution using the following prices, wheat $1.50 per bushel, grain sorghum $1.74 cwt.

APPENDIX TABLE IX

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 3, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Resource	Quantity Used	Activities Included in Opt. Org.[1]	Activity Level
Sand Cropland	187.4 Acres	Wheat	32.7 Acres
Native Pasture	725.8 Acres	Grain Sorghum	125.1 Acres
Solution Value	$5,446.59	Forage Sorghum	.2 Acres
		Small Grain Grazeout	29.3 Acres
		Feeder Calves AFRN	109 Head
		FMWS	21 Head

[1]Linear programming solution using the following prices, wheat $1.50 per bushel, grain sorghum $1.74 per cwt.

APPENDIX TABLE X

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 4, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Resource	Quantity Used	Activities Included in Opt. Org.[1]	Activity Level
Clay Cropland	1,069,042 Acres	Wheat	785,164 Acres
Sand Cropland	159,742 Acres	Grain Sorghum	132,831 Acres
Native Pasture	1,183,386 Acres	Forage Sorghum	26,910 Acres
Solution Value	$20,672,743	Small Grain Grazeout	283,877 Acres
		Feeders AFRN	153,826 Head
		FMWF	170,669 Head
		FMWS	49,550 Head

[1]Linear programming solution using the following prices, wheat $1.50 per bushel, grain sorghum $1.74 per cwt.

APPENDIX TABLE XI

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 15, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Resource	Quantity Used	Activities Included in Opt. Org.[1]	Activity Level
Sand Cropland	1,050.6 Acres	Wheat	760.9 Acres
Native Pasture	606.6 Acres	Forage Sorghum	42.5 Acres
Solution Value	$14,683.80	Small Grain Grazeout	247.2 Acres
		Labor Hire May - July	405 Hours
		Feeder Calves AFRN	69 Head
		FMWF	188 Head
		FMWS	4 Head

[1]Linear programming solution using the following prices, wheat $1.50 per bushel, grain sorghum $1.74 per cwt.

APPENDIX TABLE XII

RESOURCE USE AND OPTIMUM ORGANIZATION RHS 23, HIGH PLAINS AREA, OKLAHOMA PANHANDLE

Resource	Quantity Used	Activities Included in Opt. Org.[1]	Activity Level
Cropland	433.9 Acres	Native Pasture	56.4 Acres
Native Pasture	417.6 Acres	Small Grain Grazeout	274.7 Acres
Solution Value	$10,337.79 Acres		
		Forage Sorghum Grazeout	102.8 Acres
		Labor Hire Jan.-April	85 Hours
		May-July	125 Hours
		Feeder Calves AFRF	82 Head
		FMWF	223 Head
		FMSF	142 Head

[1]Linear programming solution using the following prices, wheat $1.50 per bushel, grain sorghum $1.74 per cwt.

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