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I am submitting herewith a dissertation written by Donald Layne Williams entitled "An Economic Analysis of Beef Production in the Delta and Brown Soil Area of Tennessee." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Agricultural Economics.

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AN ECONOMIC ANALYSIS OF BEEF PRODUCTION IN THE DELTA AND BROWN SOIL AREA OF TENNESSEE

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee

Donald Layne Williams

August 1975

1229469

ACKNOWLEDGMENTS

The author wishes to express his appreciation to all individuals who have made this study possible.

The author is especially grateful to Dr. Luther H. Keller for the guidance, patience, encouragement, and constructive criticism which he contributed during the entire course of graduate study. Appreciation is also extended to Dr. Billy J. Trevena, Dr. Larry Bauer, and Dr. Keith Phillips for their assistance and for reviewing this manuscript.

The author also expresses his gratitude to Dr. Joe A. Martin and the Department of Agricultural Economics and Rural Sociology for obtaining financial assistance which made the graduate study possible.

Gratitude is also extended to the author's parents for their support and encouragement throughout the graduate program.

Without question, the deepest appreciation is extended to the author's wife, Reva, for her enumerable material and mental sacrifices occurring during the course of graduate study.

ABSTRACT

The purpose of this study was to determine the competitiveness of various beef and associated feed systems in the optimum use of farm resources and to determine the combination of livestock, forage, and row crop enterprises and resource utilization which will maximize net returns under various resource and pricing conditions. Analysis was conducted on a 450 acre representative farm in the Brown Soil and Delta area of west Tennessee. Alternative situations included in the basic analysis were: four farm labor situations; four investment and operating capital situations; three livestock price situations; inclusion and deletion of the 1972 Farm Program; four levels of calf crop efficiency; and four levels of weaning weights for feeder steers. Additional analysis was obtained with: variation of the risk level associated with the beef enterprises; elimination of specific feeds for forage and concentrate consumption for beef enterprises; and successive reduction of the various livestock alternatives considered.

Standard budgetary techniques were utilized in developing costs and returns, and investment and operating capital requirements for 12 beef-feeding systems, four beef stocker systems, two cow-calf systems, three hog systems, and various row crop and forage crops suitable for the area.

Feed requirements for each livestock enterprise were developed in terms of the TDN, DP, and DM required per month for maintenance and expected growth rate. Amounts of grain and forage produced per month

were also expressed in TDN, DP, and DM terms. Adjustments were made for feed wastage and nutrient losses due to delayed grazing.

Linear programming techniques were utilized to determine the optimum resource allocation and enterprise combinations that would maximize net returns to land, operator labor, and management for each resource and pricing modification when beef enterprises competed against the swine and row crop enterprises and when beef and associated feed enterprises were the only alternatives included in the model.

Generally, the light weight stocker steer enterprise produced on permanent and bermuda pasture was the major beef enterprise in the optimal enterprise mix when all enterprises were considered. The production of both feeder pigs and slaughter hogs, utilizing farm produced corn, and cotton production were the other major income generating enterprises in most situations.

The number of beef brood cows included in the optimal solution was about 30 head when an average weaning weight of 525 pounds and a 95 percent calf crop was assumed. Other modifications resulted in 20 or less brood cows in the solution.

The number of beef animals to be fed was generally low in the various solutions when hog enterprises were also considered. The deletion of the 1972 Farm Program provisions resulted in a considerable increase in beef feeding numbers. The relationship between the number of cattle fed and the quantity of hogs included in the optimal solution was very sensitive to the beef-hog price ratio.

When all enterprises were considered, the only beef feeding system included in the various optimal solutions utilized corn silage

as the primary ration component. The corn silage was supplemented with protein and a limited amount of corn grain.

Considerable net returns were foregone (55 percent) when alternatives were limited to only beef and associated feed enterprises as compared to the situation when row crop and hog enterprises were also included in the model. When the model was limited to beef alternatives, beef feeding and light stocker steers grazing pasture in the spring and summer months were the major beef enterprises in every optimal solution.

In most situations, corn silage was the major ration component for the beef feeding enterprises. However, with a relatively limited labor supply, the beef feeding systems which included a period of grazing in the spring and early summer became more profitable. Generally, steers were more profitable to feed than heifers.

When row crop and hogs were deleted as alternatives, land utilizaiton increased but total labor required declined. When feed requirements were specified only in nutrient terms, beef feeding became a much more profitable alternative.

When the cow-calf enterprises were the only income generating alternative allowed, net returns were negative, i.e., net returns were not large enough to cover all of the estimated farm overhead expenses.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
	The Tennessee Beef Industry	
	Competitive Position of Tennessee in the Production of Beef	
II.	THE PROBLEM AND OBJECTIVES	23
	The Problem	
	Objective	
	Procedure	
	The Study Area	
III.	FRAMEWORK FOR ANALYSIS	29
	Introduction	
	Resource Availability and Assumptions	
IV.	ALTERNATIVE ENTERPRISES	42
	Introduction	
	Livestock Enterprises	
	Crop-Pasture Enterprises	
V.	RESULTS OF THE ANALYSIS	71
	Base Situation	
	Changes in Labor Costs and Availability	
	Change in Cost and Conditions of Capital	
	Livestock Price Variations	
	Deletion of the 1972 Farm Program	
	Change in Level of the Calf Crop of the Cow-Calf Systems	
VI.	RESULTS OF SPECIAL ANALYSIS	140
	Variation in the Risk Associated With Different Beef Enterprises	
	Removal of the Specific Forage Restrictions on Beef Enterprises	
	Removal of All Feed Specifications on Beef Enterprises	
	Variation in the Livestock Enterprises Considered	
VII.	SUMMARY AND CONCLUSIONS	147
	Summary	
	Conclusions	
BIBLIOGRAPHY		198

CHAPTER PAGE

APPENDICES 203
Appendix A
Appendix B

VITA 215

LIST OF TABLES

TABLE		PAGE
1.	Farms, Land in Farms, and Land Use in Tennessee, 1959-1969	2
2.	Changes in Numbers of Forage Consuming Livestock on Tennessee Farms, 1959-1969	3
3.	Comparison of Feed Ingredients for Typical Rations for Finishing Beef for Selected States, 1965	14
4.	Nutrient Cost Per Hundredweight of Gain, Ratio of Nutrients Fed to National Research Council's Estimates of Minimum Requirements for Selected States, 1965	15
5.	Estimated Feed Cost Per Hundredweight of Gain, Quantities Fed Per Pound of Gain, and Average Daily Gain for Selected States, 1965	18
6.	Average Size Farm of Class I-V Farms in the Study Area, 1969	30
7.	Summary of Cropland and Pasture Acreage by Soil Groups for the Study Area	32
8.	Description of Soil Groups of Representative Farm in the Study Area	33
9.	Soil and Land Use Restrictions of Representative Farm, Delta and Brown Soil Area of West Tennessee	36
10.	Maximum Labor Availability by Months for Three Labor Situations	37
11.	Investment and Operating Capital Charges for the Four Capital Situations Used in the Study	40
12.	Estimated Annual Overhead Cost for Representative Farm in the Delta and Brown Soil Area of West Tennessee	41
13.	Types of Feeding Systems, by Ration, Length of Feeding Period, and Rate of Gain, for the Twelve Feeding Systems Analyzed in the Study	44
14.	Nutrient Requirements Per Animal by Months for Six Beef Steer Finishing Systems	45

TABLE PAGE

15. Nutrient Requirements Per Animal by Months for Six Beef Heifer Systems 46

16. Estimated Total Feed Requirements Per Head for the Twelve Cattle Finishing Systems 47

17. Livestock Price Variations 49

18. Labor Requirements Per Head for Twelve Beef Feeding Systems by Months 50

19. Estimated Nutrient Requirements for Cow-Calf System Including Bull and Replacements (25 Brood Cows, One Bull) . . 52

20. Requirements, Per Head, for Specified Beef Systems, by Months 54

21. Nutrient Requirements Per Animal by Months for Four Beef Stocker Systems 56

22. Nutrient Requirements by Months for the Different Hog Systems 58

23. Labor Requirements by Months for the Different Hog Systems . 60

24. Estimated Crop Yields by Soil Groups and Estimated Net Nutrients Supplied Per Acre for Alternative Feed Enterprises 62

25. Estimated Pasture Production and Seasonal Distribution by Soil Groups Per Acre 63

26. Estimated Monthly and Total Amount of Feed Nutrients Produced from Aftermath Grazing by Soil Groups Per Acre . . . 65

27. Assumed Forage Transfer Rates for Delayed Grazing (TDN Equivalents) 67

28. Crop Price Assumptions With and Without a Government Program 69

29. Labor Requirements for Crop Enterprises by Months 70

30. Optimal Enterprise Organization for the 450 Acre Representative Farm, Base Situation, With All Enterprises and Only Beef and Associated Feed Enterprises Considered . . 73

31. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, Base Situation, With All Enterprises and Only Beef and Associated Feed Enterprises Considered . . 76

TABLE PAGE

32. Optimal Enterprise Organization for the 450 Acre Representative Farm, All Enterprises Considered, by Labor Situation 79

33. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, All Enterprises Considered, by Labor Situation 82

34. Optimal Enterprise Organization for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Labor Situation 86

35. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Labor Situation 89

36. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm with All Enterprises and Only Beef and Associated Feed Enterprises Considered by Labor Situation 92

37. Optimal Enterprise Organization for the 450 Acres Representative Farm, All Enterprises Considered, by Capital Situation 97

38. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, All Enterprises Considered, by Capital Situation 100

39. Optimal Enterprise Organization for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Capital Situation 103

40. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Capital Situation 106

41. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Capital Situation 109

42. Optimal Enterprise Organization for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Livestock Price Situation 113

43. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Livestock Price Situation 115

TABLE PAGE

44. Estimated Land Value and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Livestock Price Situation . 120

45. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Beef Feed Enterprises Considered With and Without the 1972 Farm Program 122

46. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed nterprises Considered With and Without the 1972 Farm Program 125

47. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With and Without the 1972 Farm Program 128

48. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered with Variation in Weaning Weight and Calving Percentage 132

49. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With Variations in Weaning Weight and Calving Percentage 133

50. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With Variations in Calving Percentage and Weaning Weights 137

51. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Risk Situation on Beef Systems 142

52. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Risk Situation on Beef Systems 144

53. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Feed Specification 146

TABLE PAGE

54. Net Returns and Optimal Resource Use on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Feed Specifications 150

55. Estimated Land Values for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Feed Specification 155

56. Optimal Enterprise Organization on the 450 Acre Representative Farm, All Enterprises Considered, by Specified Deletions of Livestock Alternatives 157

57. Net Returns and Optimal Resource Use on the 450 Acre Representative Farm, All Enterprises Considered, by Specified Deletions of Livestock Alternatives 159

58. Optimal Enterprise Organization on the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Specified Deletion of Beef Alternatives . . 161

59. Net Returns and Optimal Resource Use on the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Specified Deletion of Beef Alternatives 163

60. Estimated Land Values for the 450 Acre Representative Farm, All Enterprises Considered, by Specified Deletion of Livestock Alternatives 164

61. Estimated Land Values for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Specified Deletion of Beef Alternatives 166

62. Optimal Beef Enterprise Organization for the 450 Acre Representative Farm, All Enterprises Considered, for the Base Situation and Specified Modification of the Base Situation 171

63. Percentage of Openland Utilized for the Production of Feed for the Various Beef Systems, All Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation 174

64. Net Returns and Non-Land Capital Requirements, All Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation 178

TABLE		PAGE
65.	Optimal Beef Enterprise Organization for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, for the Base Situation and Specified Modifications of the Base Situation	182
66.	Percentage of Openland Utilized for the Production of Feed for the Various Beef Systems, Only Beef and Associated Feed Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation	185
67.	Net Returns and Non-Land Capital Requirements, Only Beef and Associated Feed Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation	188
A-1.	Summary of Revenue, Costs, Net Returns, and Operating and Investment Capital Per Head for the Twelve Beef Finishing Systems	204
A-2.	Revenue, Costs, Net Returns, and Operating and Investment Capital for the Two Cow-Calf Enterprises	207
A-3.	Revenue, Costs, Net Returns, and Operating and Investment Capital for Four Stocker Systems Per Head	209
A-4.	Revenue, Costs, Net Returns, and Operating and Investment Capital Per Unit for the Swine Enterprises	210
B-1.	Operating and Investment Capital Required and Cost of Production Per Acre of Feed Producing Enterprise	212
B-2.	Estimated Yields, Capital Requirements, and Net Returns Per Acre Per Soil Group, Under 1972 Farm Program and Under a Free Market Situation	213

CHAPTER I

INTRODUCTION

I. The Tennessee Beef Industry

The nature of the agricultural industry in Tennessee has changed rapidly over the past 15 years. The trend in the U.S. toward larger and fewer farms holds also for Tennessee. The number of farms in Tennessee having cropland decreased from 150,350 farms in 1959 to 115,086 farms in 1969. However, during the same time period, total cropland decreased only 1.1 percent or 95,702 acres (Table 1) while the average size farm increased from 102 acres to 124 acres (36).

Within this same period (1959-1969), Tennessee had a decrease in harvested cropland of 15.6 percent and an increase in cropland used only for pasture or grazing of 17.5 percent or 564,176 acres. Between 1964 and 1969, cropland used for pasture increased 23.5 percent (Table 1).

With this change in land use in Tennessee from crops to pasture, one would expect changes in inventories of forage consuming animals in the state. This change can be seen in Table 2. From 1959-1969, the inventory of cattle and calves increased 28.7 percent on Tennessee's farms. This change reflects both adjustments in beef and dairy cattle numbers. Tennessee (like the rest of the United States) has had a decrease in the number of milk cows (39.8 percent from 1959-1969) while keeping milk production at a fairly stable level (33) because

Table 1. Farms, Land in Farms, and Land Use in Tennessee, 1959-1969[a]

Land Use	Number of Farms[a]			Number of Acres[b]			Percentage Change in Acres[f]	
	1959	1964	1969	1959	1964	1969	1959-1969	1964-1969
I. Total cropland	150.4	128.0	115.1	8,499.2	7,855.2	8,403.5	1.1%	+6.9%
A. Harvested cropland	136.6	115.8	97.0	4,116.4	3,618.0	3,472.0	-15.6%	-4.0%
B. Cropland used only for pasture or grazing	97.7	75.3	80.2	3,216.8	3,059.1	3,780.9	+17.5%	+23.5%
C. All other cropland[c]	46.8	47.6	40.6	1,166.0	1,178.1	1,150.5	-1.3%	-2.3%
II. Woodland including woodland pasture	104.2	89.4	77.2	5,201.3	4,859.2	4,375.2	-15.8%	-9.9%
III. All other land[d]	NA[e]	NA	88.2	2,380.8	2,551.8	2,278.2	4.3%	-10.7%

[a]For all farms. [b]In thousands.

[c]Includes cropland used for soil improvement crops, crop failure, cultivated summer fallow, and idle cropland.

[d]Includes pastureland, other than cropland and woodland pastures, rangeland, and land in house lots, barn lots, roads, ponds, etc.

[e]Not available. [f]Derived from unrounded numbers.

Source: United States Bureau of the Census, United States Census of Agriculture: 1969, Tennessee, Vol. 1, Washington, D.C. (1971), p. 2.

Table 2. Changes in Numbers of Forage Consuming Livestock on Tennessee Farms, 1959-1969[a]

Type	Inventory[b]			Percentage Change[c]	
	1959	1964	1969	1959-1969	1964-1969
Cattle and calves	1,742.66	2,136.0	2,243.8	+28.7%	+ 5%
Milk cows	456.5	370.0	274.4	-39.8%	-25.8%
Cattle and calves other than milk cows	1,286.1	1,766.1	1,969.3	+53%	+11.5%
Sheep and lambs	260.5	98.1	59.9	-77%	-38.9%
Horses and ponies	139.4	N.A.	79.9	-44.8%	N.A.

[a]For all farms.

[b]In thousands.

[c]Derived from unrounded numbers.

Source: United States Bureau of the Census, United States Census of Agriculture: 1969, Tennessee, Vol. 1, Washington, D.V., (1971), p. 5.

of technological advances in the dairy industry. Therefore, between 1959 and 1969, cattle and calves used for beef production increased 53 percent amounting to 683,238 head.

Since the number of sheep and horses have declined greatly during the past decade (Table 2), it seems obvious that the increase in cropland used for pasture is being utilized primarily for beef cattle production.

The number of cattle and calves on feed in Tennessee has never been very great and actually decreased from 42,000 head to 29,000 head from 1960-1969 or 30.9 percent. Cattle on feed in the southern states (which include Texas and Oklahoma) increased 147.1 percent and the 11 southeastern states (excluding Texas and Oklahoma) increased 9.9 percent during this period (43, 44, 31)[1]

Changes in beef cattle numbers have been the result of many factors (12, 17, 32). Considerable farm acreage in Tennessee is suited only for forage production, and beef cattle are the principal means of utilizing this land. With decreasing cotton and tobacco allotments and the ability to transfer these allotments within the county, farm consolidation, and increased mechanization of the production of crops, beef cattle operators have been able to acquire larger acreages of pasture.

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[1]Cattle and calves on feed are defined as animals being fattened for the slaughter market on grain or other concentrates which are expected to produce carcasses that will grade good or better. Therefore, cattle fed primarily roughage, pasture, or silage, or stocker cattle operations are not counted in cattle on feed statistics.

The increased scarcity and cost of farm labor and the increased importance of part-time farming have resulted in a shift to labor extensive cow-calf production from more labor intensive crop production. Cow-calf production requires small and relatively flexible hours of labor as compared to other crop and livestock enterprises.

Probably one of the most important factors which has contributed to the increase in beef inventories is the increase in technology of forage production. More widespread use of fescue and bermuda species, increased fertilization rates on pasture acreages, and the use of improved pasture management practices have greatly increased the potential for forage production and related livestock enterprises.

Beef cow inventories have been increasing despite relatively low returns and high land prices, a seeming paradox to production economists. Numerous costs and returns estimates of cow-calf production from production economists in the South nearly always show returns to land, labor, and management which are lower than their opportunity costs (for example, 32, pp. 7 and 8).

Stovall and Thompson (32) discussed other possible explanations for the increase in beef production. These ranged from nonmonetary benefits, personal likes and dislikes of farm operators, and social esteem or "psychic income" from producing beef, to capital limitation of the farm firm. Southern farms have historically been short of needed capital. If livestock enterprises of the South are ranked accordingly to the returns to land, labor, management, and farm produced feed per dollar of capital required, the forage consumers will rank well below the grain consumers. In this respect, beef cows producing

calves are generally less efficient in capital use than are feeding operations.

Stovall and Thompson suggested that farmers with a severe capital constraint may view capital differently from the traditional view of researchers. Since beef herds are often developed by retaining heifers for breeding stock, no capital outlay of cash or credit is required. If this is the case, then beef breeding stock would rank very high in return to cash investment.

The low income variability and risk of feeder calf production is another factor which must be considered. Total revenue derived from feeder calf production tends to be much more stable than feeding operations, especially those operations which must buy both grain and calves (32). The risk factor may also explain the rather insignificant quantity of cattle on feed in Tennessee even though beef feeding has been shown to be a relatively profitable alternative in many farm situations (2).

II. Competitive Position of Tennessee in the Production of Beef

Introduction

Climatic conditions and soil types in Tennessee favor the production of pasture, hay, and forage crops. The average rainfall is around 50 inches, occurring mostly in the spring and summer months. The growing season ranges from fewer than 170 days in the higher altitudes of the Unaka Mountains to more than 225 days in the Mississippi bottoms near Memphis. The average temperature of the state is 60° F (19).

The climatic conditions in Tennessee, the types of land available, and labor needs of beef production favor the production of beef in the state. If pasture land can be used only for grazing, cattle production has an obvious natural advantage. Many different beef alternatives are available to Tennessee beef cattle producers. For simplicity, these can be classified into three main groups: (1) cow-calf operation, (2) stocker or backgrounding,[2] and (3) finishing beef for slaughter.

Cow-Calf Operations

The cow-calf operation is rather labor extensive as compared to the production of finished beef, milk, hogs, and crop production. Since nearly half of the farm operators in Tennessee worked off the farm 100 days or more in 1969, many operators would be more likely to prefer labor extensive enterprises.

The productivity of pasture utilized by a cow-calf operation is difficult to quantify. Although little research has been done in this area, Anderson and Safley (3) obtained some data on the productivity of pasture[3] in terms of pounds gained per day per calf. They recorded adjusted daily gains of calves at the Highland Rim Experiment Station ranging from 1.54 pounds/day on old stand fescue to 2.15

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[2]A stocker operation will be defined for this study as an operation dealing with the utilization of pasture or other forages with supplemental feeding if necessary for stocker or feeder cattle (either purchased or "home grown") up to 550-800 lb. liveweight before entering into a feedlot to be finished for slaughter on a primarily concentrate ration.

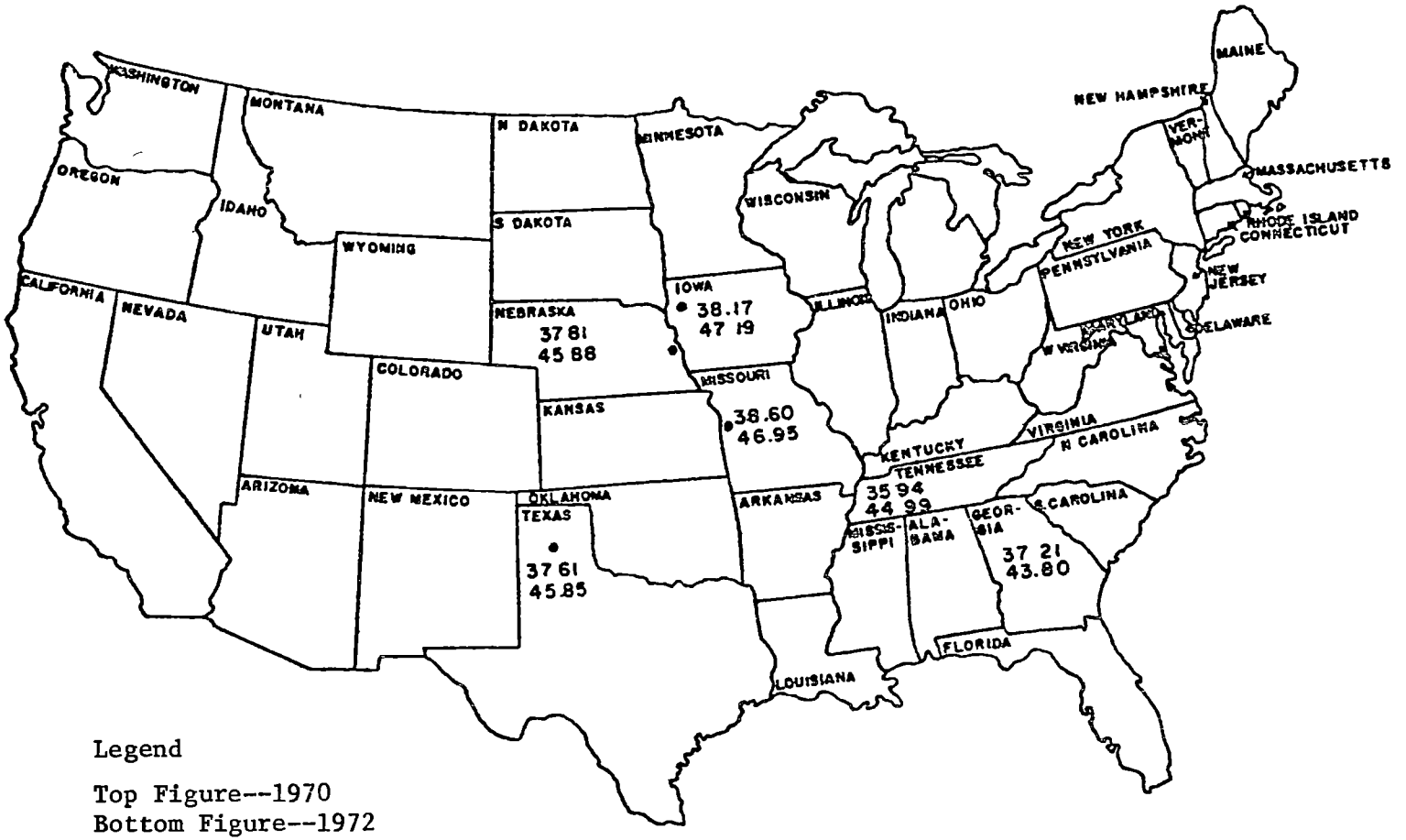
[3]When discussing pasture and forage production, one must keep in mind that yields vary greatly from many factors. These include different soil types, topography, types of weather from year to year, etc.

pounds/day on new stand fescue pastures. Orchardgrass-ladino pasture showed gains of 2.09 pounds/day in 1963. However, in 1964, calves on the same pasture gained only 1.46, 1.53, and 1.68 for old stand fescue, orchardgrass-ladino, and new stand fescue, respectively. Anderson stated that the change in the rate of gain for the two years could be partly explained by the decrease in rainfall for specified periods of 1964 which decreased total forage production as well as decreased the amount of legumes present in the pasture.

One of the main factors affecting the competitive position of feeder calf operations (i.e., cow-calf operations) is the price which Tennessee producers receive for their feeder cattle. Traditionally, the price of feeder cattle has been lower in the Southeast (including Tennessee) than in the Corn Belt and southwestern markets (27).

The price of feeder steers of a particular grade and weight category for Tennessee and two large feeding areas of the United States can be seen in Figure 1. In both 1970 and 1972, the price of feeder steers were lower in Tennessee than in the Amarillo or the Corn Belt areas for the same weight and grade of feeder steers. This price difference is expected since Tennessee is a deficit feeding area and a surplus producer of feeder cattle. In 1962, 34,650 head of Tennessee calves were transported to the Corn Belt for feeding. By 1968, 48,650 head were shipped to the Corn Belt--an increase of 40.4 percent (41).

Goodwin states that the price differential of feeder calves between areas reflects little other than the cost of moving these animals from surplus producing areas (Tennessee) to deficit or large feeding areas (Southwest, Corn Belt) (11).



Legend

Top Figure--1970
Bottom Figure--1972

Figure 1. Average price for choice 300-550 pound steers in 1970 and choice 400-500 pound steers in 1972 for selected markets, dollars per cwt.

Sources: United States Department of Agriculture, Consumer and Marketing Service, Livestock Division, Livestock Meat and Wool Market News, Weekly Summary and Statistics, Washington, D.C. (1970 and 1972); and United States Department of Agriculture, Consumer and Marketing Service, Livestock Division, unpublished Livestock Detailed Quotations for Tennessee Markets (1970 and 1972).

Stocker Operation

The stocker program competes directly with cow-calf operations for pasture and roughages. Stocker operations are usually more labor extensive than cow-calf operations and can complement established cow-calf operations with respect to feed utilization during periods of "excess" pasture.

Prices for stocker-feeder calves are generally lower in Tennessee than in the deficit areas of the country. Although not enough price data is available for heavier steers and heifers which have come off grass and/or roughage, it is expected that the price of these cattle would also be lower than comparable grades and weights in major feeding areas because a majority of these cattle are transported to the large feeding areas for finishing.

Tennessee has a natural advantage in the production of pasture suitable for stocker cattle production. High and others conducted a study on producing yearling steers on bluegrass clover and orchardgrass clover at the Tennessee Tobacco Experiment Station at Greenville, Tennessee (16). Over a seven year period, animal grazing days per acre ranged from 173 for non-irrigated bluegrass clover with .91 acres per steer carrying capacity to 272 animal grazing days per acre on irrigated orchardgrass-clover with .56 acres per steer carrying capacity. At the Middle Tennessee Station at Spring Hill, pasture production ranged from 132 grazing days per acre for fescue and ladino clover overseeded with lespedeza with 1.25 acres per steer carrying capacity to 170 grazing days per acre and carrying capacity of .91 acres per steer for orchardgrass-ladino clover clipped to 4-6 inches (15, 5).

Although these stocker operations can complement cow-calf operations to some extent in periods of "excess" pasture, they compete with the cow-calf operation for pasture and forage during other seasons of the year.

Finishing Operations

Since consumer demand has indicated a preference for grain fed beef in recent years, beef cattle produced for slaughter have normally been fed a high concentrate ration for some period of time to enable them to bring a "satisfactory" price and to meet the standards of consumers' tastes and preferences. The number of cattle on feed is relatively small and has been decreasing somewhat in the state. Most of the beef calves produced in Tennessee have been shipped to other areas for finishing. Previous studies have indicated that beef feeding can result in increased farm income in many farm situations in Tennessee (1, 2). If this is true, then what is the competitive position of cattle feeding in Tennessee?

One major factor in determining the competitive position of cattle feeding in an area is the price and availability of feeder animals. Since a large quantity of feeders are produced relative to the number to be fed, lower prices for feeder calves are expected. With respect to the cost of the feeder animals, Tennessee has a competitive advantage over the Corn Belt and other major beef finishing areas.

Another important area which must be considered in evaluating the competitive position of any area for cattle feeding is the costs

and availability of feed grains. Tennessee is a deficity producer of feed grains. In 1967 (the last date from which data is readily available), Tennessee was deficit 766,000 tons of feed grain (40).

This does not mean that Tennessee does not produce feed grains, but that on the whole the state must ship in grain for its livestock needs. Some areas of the state are surplus grain areas. Also, Tennessee (especially west Tennessee) has a locational advantage over most southeastern states because it is much closer to the Corn Belt and relatively cheap grain.

Comparison of interstate or interregional costs of feed grains must be on a realistic basis in order to compare the costs of different areas. Purcell (27) stated that it is important to use the same base for each region. To do this, he used corn and grain sorghum, converted to corn equivalents, and the average prices were weighted by the levels of production of the two important feed grains in each state. Purcell (27, p. 12) estimated prices for the Southern Plains of $1.01 to $1.15 per bushel. For the selected states for which this analysis was done, California had the highest price of $1.34 per bushel with Arizona at $1.29 per bushel.

Purcell's data sources (45, 43) can be used to show that the calculated weighted average prices received by farmers in Tennessee in 1969 was $1.29 per bushel of corn equivalent. According to this analysis, Tennessee is at a major disadvantage in the area of feed grain costs in terms of beef feeding of corn and grain sorghum.

The preceding analysis of feed cost, although useful, does not consider one important aspect in the cost of feed utilized in cattle

feeding. Each state or region will utilize that feed which is in greatest supply (i.e., least cost) for their particular area.

Smith and Free (31) asked representatives from 35 states to submit a "typical ration" for feeding beef in their state. A comparison of typical rations for five states is shown in Table 3. Each state in Table 3 represents a different geographical feeding area in the United States. It can be noted that feed ingredients do vary with the available supply of a particular feed in each area. For example, the ration for Tennessee is largely composed of corn silage, mixed hay, and corn, while the Texas ration contains no corn and no corn silage. California and Florida rations also include feeds (dry beet pulp and citrus pulp) which are not generally available in other geographical areas.

Smith and Free requested for their research that each state use a standard gain of beef from 700 to 1,050 pounds. Thirty of the states complied with this request while the other five states used different weight classifications. Therefore, to make an accurate cost comparison between states, Smith and Free broke down the ration costs into (a) constant nutrient costs (in terms of total digestible nutrients and digestible protein) and (b) feed costs which take into consideration regional price differentials.

The ranking of states according to their "typical ration" costs in terms of a constant price for total digestible nutrients (TDN) and digestible protein (DP) are shown in Table 4.[4] Using this type of

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[4]The constant price was $0.0242 and $0.0547 per pound of TDN and DP, respectively. These prices were obtained by solving simultaneous

Table 3. Comparison of Feed Ingredients for Typical Rations for Finishing Beef for Selected States, 1965[a]

	Tennessee	Texas	California	Iowa	Florida
	lbs.				
Grain					
Corn (shelled)	1890	----	----	2315	675
Corn and cob meal	----	----	----	300	675
Grain sorghum	----	2022	597	----	----
Barley	----	----	1680	----	---
Protein supplement					
Cottonseed meal	375	178	130	----	100
Soybean meal	----	----	----	110	65
Urea	----	20	4	8	22
Alfalfa meal	----	----	----	----	13
Silage					
Corn	4000	----	----	----	455
Sorghum	----	561	----	----	---
Grass	----	----	39	----	---
Hay					
Alfalfa	----	120	437	400	---
Mixed hays	724	----	90	----	300
Other	----	352[b]	547[c]	12[d]	700[e]

[a]For a standard gain of 350 lbs. for each state (from 700 lbs. to 1050 lbs.) except for Tennessee which represents a gain of 450 lbs. (from 475 lbs. to 925 lbs.).

[b]Cottonseed hulls (199 lbs.), molasses (123 lbs.), fat (30 lbs.).

[c]Cottonseed hulls (31 lbs.), molasses (6 lbs.), dry beet pulp (420 lbs.), mill feeds (90 lbs.).

[d]Molasses

[e]Citrus pulp-molasses.

[f]Excluding minerals and vitamins.

Source: Smith, Wesley G., and Free, W. Joe, Estimates of Feedstuffs Fed and Costs of Feeding Beef, Southern Cooperative Series Bulletin No. 171, (1971) p. 11-15.

Table 4. Nutrient Cost Per Hundredweight of Gain, Ratio of Nutrients Fed to National Research Council's Estimates of Minimum Requirements for Selected States, 1965

State	Nutrient Cost/cwt. of gain	Ratio of Feed Fed to NRC Minimum Requirement		
		Total Digestible Nutrients	Digestible Protein	Feed (90% Dry Matter)
	($)	Percent		
First Quartile				
Ohio (limited corn)	15.04	90.7	108.8	84.3
Florida	15.53	95.7	104.5	87.5
Ohio (no corn)	15.91	98.9	104.1	92.8
New Mexico[a]	17.08	108.9	142.2	99.9
Virginia[b]	17.83	109.7	105.4	95.9
Missouri	17.99	115.6	106.3	108.3
Second Quartile				
Maryland	18.65	117.8	114.6	105.5
Ohio (medium corn)	18.82	117.0	122.8	122.9
Tennessee[c]	19.24	131.5	137.1	122.9
Ohio (limited silage)	19.26	117.6	133.8	108.6
Pennsylvania	19.27	114.8	144.9	108.8
Texas	19.47	116.3	145.0	99.1
North Carolina	19.48	121.5	125.4	106.5
Third Quartile				
Alabama	19.67	124.5	119.6	105.7
Oklahoma	19.71	120.7	135.4	104.7
Indiana	20.40	126.4	133.9	120.3
Iowa	20.53	127.9	132.6	106.6
Nebraska	20.63	130.9	124.5	108.8
Mississippi	20.69	126.9	141.4	114.3
Georgia	20.81	131.0	129.6	123.3
Fourth Quartile				
West Virginia[d]	21.30	128.4	121.6	110.9
California	21.87	129.3	168.0	123.7
Colorado	21.88	138.4	133.8	117.3
Kentucky	21.89	139.0	131.7	129.0
Arkansas	21.91	134.8	148.0	122.2
Nevada	22.53	130.7	182.9	130.8
Kansas	22.75	136.3	167.8	113.3
South Dakota (without silage)	24.83	155.9	156.3	149.9
NRC Minimum	15.94	100.0	100.0	100.0

Table 4 (continued)

[a]500-950 lbs.-NRC minimum requirements: Feed (90% dry matter), 3,320 lbs.; TDN, 2,171 lbs.; D.P., 253 lbs., digestible energy, 4,336,600 kcal.

[b]700-1,000 lbs.-NRC minimum requirements: Feed (90% dry matter), 3,296 lbs.; TDN, 2,145 lbs.; D.P., 248 lbs.; digestible energy, 3,799,000 kcal.

[c]475-925 lbs.-NRC minimum requirements: Feed (90% dry matter), 3,262 lbs.; TDN, 2,134 lbs.; D.P., 249 lbs., digestible energy, 4,263,600 kcal.

[d]800-1,050 lbs.-NRC minimum requirements: Feed (90% dry matter), 2,141 lbs.; TDN, 1,392 lbs.; D.P., 162 lbs.; digestible energy, 2,784,400 kcal.

Source: Smith, Wesley G., and Free, W. Joe, Estimates of Feedstuffs Fed and Costs of Feeding Beef, Southern Cooperative Series Bulletin No. 171, (1971) p. 19.

comparison, Tennessee is not at a nutrient cost disadvantage as compared to large feeding states (e.g., Texas, Iowa, California).

If regional differences in the cost of ration components are considered, production cost relationships between states are altered considerably (Table 5). Ration cost estimates for each state were obtained by using a constant price for silage, prices received by farmers for grain prices, and prices paid by farmers for other feedstuffs as determined in each state.

The rankings of the various states changed from Table 4 to Table 5. One major reason behind this change is that in high grain producing areas, the prices received for these feeds are generally less than in deficit producing areas. Therefore, feed cost per pound of gain, according to this analysis, would be quite different from the ration cost formulated by use of constant nutrient cost. This also explains why Tennessee, being a deficity feed grain state, would drop in the rankings to most states in the corn and grain sorghum belts. It should also be noted that in both Table 4 and 5 the lowest cost rations were those which were near the National Research Council's minimum requirements.[5]

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equations for corn (1965 average price of No. 3 yellow corn at Chicago of $2.27/cwt.) and soybean meal (average 1965 price of 44 percent soybean meal at Decatur, Illinois, at $4.07/cwt.).

[5]It is possible that some of the difference in ration costs are due to how the particular rations were established for each state. Rations were developed in some states by agricultural economists and in others by animal scientists and extension livestock specialists. This in itself could result in variations in rations as different specialists can look at the same problem and obtain different solutions.

Table 5. Estimated Feed Cost Per Hundredweight of Gain, Quantities Fed Per Pound of Gain, and Average Daily Gain for Selected States, 1965

State	Feed Cost/cwt. of gain	TDN Fed/lb. of gain	DP Fed/lb. of gain	Feed Fed/lb. of gain (90% dry matter)	Feed Fed/day (normal moisture)	Urea in Ration	Average Daily Gain
First Quartile							
Ohio (no corn)	11.51	5.16	0.63	7.44	43.9	30	2.33
Virginia[a]	11.77	5.90	0.65	7.79	53.2	40	2.50
Ohio (limited corn)	12.96	4.73	0.66	6.75	36.3	--	2.33
New Mexico[b]	13.80	5.25	0.80	7.37	20.6	17	2.76
Florida	14.46	4.99	0.63	7.01	23.1	22	2.69
Texas	15.11	6.07	0.87	8.09	27.1	20	2.92
Ohio (medium corn)	15.13	6.10	0.74	8.68	27.6	--	2.33
Missouri	15.77	5.63	0.80	7.10	30.5	30	2.92
Ohio (limited silage)	15.81	6.13	0.81	8.71	26.1	--	2.33
Second Quartile							
Oklahoma	16.41	6.29	0.82	8.39	29.2	--	2.50
Iowa	16.67	6.67	0.80	8.54	21.0	8	2.33
Maryland	17.55	6.14	0.69	8.45	36.0	--	2.00
Indiana	17.85	6.60	0.81	9.64	41.0	--	2.33
Nebraska	17.87	6.60	0.76	9.08	28.4	7	2.50
North Carolina	18.07	6.34	0.76	8.54	43.2	--	2.33
Third Quartile							
Tennessee[c]	18.29	6.24	0.76	8.91	31.1	--	2.00
Pennsylvania	18.60	5.99	0.87	8.72	34.1	--	2.19
Kansas	18.89	7.11	1.01	9.08	26.0	--	2.33
Mississippi	19.65	6.62	0.85	9.16	22.2	28	2.30
Arkansas	19.73	7.03	0.89	9.80	25.7	--	2.33

Table 5 (continued)

State	Feed Cost/cwt. of gain	TDN Fed/lb. of gain	DP Fed/lb. of gain	Feed Fed/lb. of gain (90% dry matter	Feed Fed/day (normal moisture	Urea in Ration	Average Daily Gain
Fourth Quartile							
Alabama	20.42	6.49	0.72	8.47	25.0	--	2.78
Georgia	20.37	6.83	0.78	9.88	23.1	--	2.26
Colorado	20.37	7.22	0.81	9.40	30.0	--	2.50
Kentucky	20.52	7.25	0.79	10.34	33.5	--	2.33
South Dakota (without corn silage)	20.87	8.58	0.98	12.55	29.1	--	2.33
West Virginia[d]	21.30	8.18	0.88	9.68	36.2	--	2.22
California	23.18	6.75	1.01	9.91	23.5	4	2.33
Nevada	23.39	6.81	1.11	10.48	23.3	--	2.19

[a]For a gain of 700-1,100 lbs. [b]For a gain of 500-950 lbs.

[c]For a gain of 475-925 lbs. [d]For a gain of 800-1,050 lbs.

Source: Smith, Wesley G., and Free, W. Joe, Estimates of Feedstuffs Fed and Costs of Feeding Beef, Southern Cooperative Series Bulletin No. 171 (1971), p. 21.

Although these results only consider feed costs, the results are an improvement over Purcell's analysis in terms of the competitive position of feed ration costs for Tennessee because of the use of corn silage as a major component of the ration.

Economies of size are an important aspect when discussing advantages of beef feeding. Williams (48) found significant cost savings are available up to a 2,000 head capacity lot using the cost conditions which approximated that of Oklahoma in 1960. Although economies of size are present for larger sized operations, these were found to be minor compared to the cost savings from very small to 2,000 head lots.

Using a continuous fenceline bunk system for 700 pound feeder steers, Williams estimated that increasing size from 300 head to 2,000 head reduced fixed cost 1.11 cents per pound of gain and reduced nonfeed variable cost .84 cents per pound of gain for a total reduction of 1.95 cents per pound of gain. The cost savings associated with an increase from 2,000 head to 15,000 head resulted in a .32 cents per pound savings in fixed cost, a .38 cents per pound savings in nonfeed variable cost for a total savings of .7 cents per pound of gain.

Large scale feedlots have not been developed in Tennessee. One of the major reasons limiting the growth of large feedlots stems from the climate of the state. A high rainfall promotes pasture production but causes a mud problem for feedlot operators. Also, insects thrive in a warm, humid climate. Other factors which limit large scale feedlot operations in the state are the lack of well-trained managers and capital availability not only to build the feedlot, but also to procure a large amount of feed and cattle.

Fixed cost will generally be higher per pound of gain for the small feeder in Tennessee and the Corn Belt than for the larger commercial feedlots of Texas and California which have achieved economies of size. Thus, those locational areas which can achieve economies of size in cattle feeding tend to have a competitive advantage; however, this may be offset by such locational disadvantages as a deficiency in the availability of replacement cattle and feed grains (10).

Representative prices for different grades and weights of slaughter animals are not readily available for Tennessee because of the lack of volume to reflect a true price situation. However, it is known that prices of fed beef are generally higher in deficit feeding areas of the country such as the South, Northeast, California, and the Northwest (9, 10). Therefore, Tennessee has a locational advantage in being relatively close to a deficit fed beef area of the South and Southeast as compared to some of the large feedlot areas (e.g., Texas, Kansas) of the country.

Deitrich (10) combined Kentucky and Tennessee into one area for his analysis of interregional competition in cattle feeding. In his summary of the competitive position of Tennessee and Kentucky in fed beef production, he concluded that:

> With the exception of Kentucky-Tennessee, cattle feeders in the South face severe disadvantages resulting primarily from deficit feed grain production and diseconomies of size in feedlot operations. Competitive advantage accruing to Kentucky-Tennessee in the cattle feeding-fed-beef economy compared to other states in the South stem primarily from locational advantages in obtaining feed grain from the Corn Belt. However, compared to other major cattle feeding regions, Kentucky-Tennessee is faced with competitive disadvantages as a result of diseconomies of size in feedlot

operations. Yet it enjoys a locational advantage in obtaining feeder cattle from nearby Southeastern States and in shipping fed beef to the deficit fed-beef markets in the South (10, p. 34).

CHAPTER II

THE PROBLEM AND OBJECTIVES

I. The Problem

The sale of cattle and calves is the number one agricultural commodity in terms of cash receipts in Tennessee (33, 34). Producers of cattle and calves utilize a considerable amount of land, labor, capital, and other production resources, many of which could be utilized in other productive alternatives. The efficiency in resource utilization will affect the prosperity of individual producers as well as society as a whole.

Previous work has indicated that beef cow-calf production provides a relatively low return on the farmers' resources in comparison to most other alternatives. Finishing systems generally have a higher return than cow-calf systems, but involve much higher risk to the entrepreneur, require higher managerial skills, and necessitate rather large amounts of both investment and operating capital.

An intensive study of beef-feed systems in competition with other agricultural alternatives available to producers is needed and should be beneficial to producers as well as policy makers, financial institutions, and others.

II. Objective

The principle objective of this study was to determine the competitiveness of various beef-forage-concentrate systems in the optimum

use of farm resources and to determine the enterprise combinations which will maximize returns to land, operator labor, and management under various resource conditions on a representative farm situation in the Brown Soil and Delta area of west Tennessee. The specific objectives of the study were:

1. To determine the optimum resource allocation and enterprise combinations that will maximize net returns for a representative farm in the study area.

2. To determine how resource usage, enterprise combinations, and net returns change with variations of the following economic variables:

   a. labor costs and availability,

   b. interest rates on operating and investment capital,

   c. livestock prices,

   d. government farm programs.

3. To determine how resource usage, enterprise combinations, and net returns change with variations of the following technical relationships:

   a. calving percentage,

   b. weaning weight of calves.

The preceding objectives will be analyzed with various beef and associated feed systems in competition with other agricultural enterprises and also with only beef production alternatives in competition for the limited resources.

III. Procedure

The following procedures were used to accomplish the preceding objectives:

1. A 450 acre representative farm was assumed for the study. The openland available on the representative farm was divided into categories characteristic of the soil classifications and limitations of use of the soils in the study area. Analysis was completed under three levels of labor availability. Capital was assumed unlimited and was charged at four alternative rates.

2. Standard budgetary techniques were utilized in developing costs and returns, and investment and operating capital requirements for 12 beef feeding systems, four beef stocker systems, two cow-calf systems, five hog systems, and the following crops and forage activities: alfalfa hay, corn, corn silage, cotton, lespedeza hay, midland bermuda hay, midland bermuda pasture, permanent pasture, permanent pasture-hay, red clover hay-wheat, soybeans, soybeans-wheat (doublecropped), and wheat. Crop budgets, and tractor and machinery budgets were developed by Keller and Burney (7).

3. Total digestable nutrients (TDN), digestable protein (DP), and dry matter (DM) required for the feed consuming enterprises were estimated in terms of monthly requirements using standards developed by the National Research Council of the National Academy of Science. Estimates of feed production were also developed in terms of TDN, DP, and DM. For pasture enterprises, the biological nature of production of the forage was reflected in the monthly variations of TDN, DP, and DM produced.

4. The linear programming technique was used to determine the optimum resource allocation, enterprise combinations, and net returns for all the situations evaluated.

IV. The Study Area

The study area includes the 12 most western counties of the state--Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Lake, Lauderdale, Madison, Obion, Shelby, and Tipton. This area is commonly called the Delta and Brown Soil Area of Tennessee (Figure 2). This area has historically been the major cotton producing area in the state. While cotton is still grown extensively in the area, soybeans have become the major crop in recent years both in acreage and income terms. Other important crops produced in the area include corn, wheat, and hay (34, 37). Beef production has expanded in recent years as farmers have diversified their operations. Pork production is a major source of income on many farms in the area, with Obion and Gibson counties producing a large quantity of hogs in past years (34).

This area was chosen for this analysis because of the following reasons:

1. The wide diversity in topography, elevation, climate, resource availability, and agricultural production alternatives within the state.

2. The relatively homogeneous farming region of the Brown Soil and Delta area both by type of farms and the availability of resources.

3. The relatively large amount of corn produced in the area with the prices received for corn usually being the lowest in the state (6).

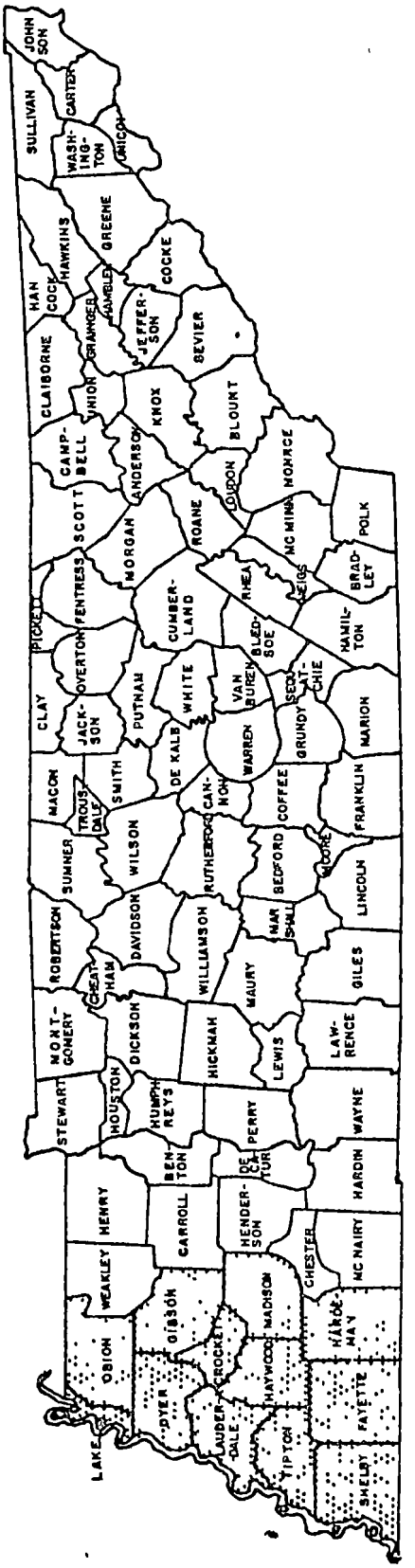


Figure 2. The location of the area of study.

4. The geographical advantage of being a relatively short distance from the Corn Belt.

Within the study area, the topography ranges from nearly level in the western part to rolling in the eastern sections. The elevation of the area ranges from a low of approximately 250 feet near Memphis to around 600 feet in the eastern part.

Soils of the study area are generally of a deep loessial type in the west but are thinner in the east. Generally, the Memphis Loring and Grenada-Memphis-Loring Soil Associations predominate east of the Delta area. These soils range from deep, fertile, loessial soils in the west to sand, clay, and gravel of coastal plains origin in the east. A relatively large proportion of these soils can be utilized for row crop production but care must be taken to prevent erosion on many of the soils of these associations. Soils of the Delta area are predominately of the Shorky-Robinsonville-Yazoo Soil Association. These soils, formed from alluvium, are normally high in natural fertility (4, 19).

CHAPTER III

FRAMEWORK FOR ANALYSIS

I. Introduction

Linear programming is a mathematical technique which can be used to estimate the optimal allocation of limited factors of production among alternative uses to achieve a specified goal.[1] This technique was utilized in this study to obtain the optimal allocation of a representative farm's resources to maximize returns to land, operator labor, and management. Use of this technique requires that resource constraints, enterprises to be analyzed, and the amount of resource needed per unit of a particular enterprise must be explicitly and rigorously specified.

II. Resource Availability and Assumptions

Land

The average size of the Class I-V farms[2] for each of the 12 counties in the study area is shown in Table 6. The average size Class I-V farm for the entire area was 336 acres. Since this study was based on a large farm, 450 acres was chosen as the base size farm,

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[1] See Heady and Candler (1960) for a detailed discussion on the assumptions and limitations of linear programming.

[2] Class I-V farms are defined as farms with gross sales in excess of $2,500 per year.

Table 6. Average Size Farm of Class I-V Farms in the Study Area, 1969

County	Average Size Farm[a]
	------acres------
Crockett	212
Dyer	289
Fayette	493
Gibson	209
Hardeman	450
Haywood	291
Lake	552
Lauderdale	299
Madison	302
Obion	265
Shelby	377
Tipton	296
Average	336

[a]Class I-V farm (over $2,500 gross).

Source: United States Bureau of the Census, United States Census of Agriculture: 1969, Tennessee, Vol. 1, Washington, D.C., (1971).

which was generally larger than the average size of the Class I-V farms in the area.

Seventy-four percent of the land in the representative farm situation was classified as openland. The remaining land consisted of woodland and land used for farm roads, houses, barns, and other uses not suited for production of any of the enterprises considered in this study (4).

Soils

The openland soils were classified in four soil groups based upon the similarity of the soil capability classes in the production of crops and forage in the area.

A description of the soil groups found on the representative farm is shown in Tables 7 and 8. Generally, soils of Groups I, II, and III correspond with the Soil Conservation Services' soil capability groups of Classes I, II, and III, respectively, with the exception of Soil Group I which contains Class II e-1 of the Memphis and Loring (B slope) soil series, Class II w-1 and II w-2 of the Collins soil series, and Class III w-2 of the Falaya series. These are included in Soil Group I because of the similarity in production of crops and forages with Class I soils of the area.

Class I soils have the widest range of use, are level or nearly level, possess a very low risk of damage, are well drained, and easy to till. These soils can be intensively cultivated with essentially no risk of erosion.

Class II soils have a few limitations which might require

Table 7. Summary of Cropland and Pasture Acreage by Soil Groups[a] for the Study Area

Soil Group	Capability Classes	Major Series	(Openland)
I	I-I, I-2	Memphis, Loring, Shannon	.8
	IIe-1	Memphis, Loring (B slope)	15.8
	IIw-1, IIw-2	Collins	13.9
	IIIw-2	Falaya	15.6
		Total	(46.1)
II	IIe-2	Grenada (B slope)	10.1
		Total	(10.1)
III	IIIe-1	Memphis, Loring (C slope)	9.5
	IIIe-2	Grenada	4.1
	IIIw-1	Galloway (B slope)	3.4
		Total	(17.0)
IV	IVe-1	Memphis, Loring (D slope)	3.5
	IVe-2	Grenada (C & D slope)	3.2
	IVw-1	Henry	2.7
	IVw-2	Waverly	3.0
	IVe-1	Memphis, Loring (E slope)	3.6
	IVc-2	Grenada (C, D, & E slopes)	3.0
		Total	(19.0)

[a]Excludes soil groups which comprise less than 1 percent of total.

Source: United States Department of Agriculture and Tennessee Conservation Needs Committee, Tennessee Soil and Water Conservation Needs Inventory, Nashville, Tennessee, (1971).

Table 8. Description of Soil Groups of Representative Farm in the Study Area

Soil Group	Predominant Soil Capability Groupings	Proportion of Openland (%)	Maximum Percent of Openland for:	
			Row Crops	Alfalfa
I	I-I, I-2, IIe-1 IIw-1, IIw-2, IIIw-2	48.2	80	40
II	IIe-2.	10.8	33	100
III	IIIe-1, IIIe-2, IIIw-1, IIIw-3	19.4	20	75
IV	IVe-1, IVe-2, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2	21.6	0	0

Source: United States Department of Agriculture and Tennessee Conservation Needs Committee, Tennessee Soil and Water Conservation Needs Inventory, Nashville, Tennessee, (1971).

moderate conservation measures or restrict the choice of certain enterprises. Most of the Class II soils in the study area have a fragipan at a depth of 20 to 30 inches.

Class III soils have more severe limitations on the choice of plants or conservation practices or both. Limitations may occur with respect to time of planting, cultivation, and choice of cover. Both Class II and Class III soils may be used for many enterprises with Class III being the more restrictive soil class of the two.

Soil Group IV is composed of the Soil Conservation Service Classes IV and VI.[3] Class IV of the Soil Conservation Service is a marginal class for cultivation, and regular cultivation is not recommended. These soils have severe limitations but are generally suited for pasture. Class VI soils are not suited for cultivation and their use is restricted to pasture, woodland, and cover crops, although on some soils within this class, field and vegetable crops, and sodded orchards can be produced with strict conservation and management (46).

Each soil group has limitations imposed upon it for the production of certain crops resulting from the soil series contained in the particular soil group. Soil Group I contains soils from the Soil Conservation Classes I, II, and III (Table 7). Soils of Class II and III have limitations of either erosion or wetness. Therefore, not all available land of Soil Group I can be used for row crops or alfalfa in any one year. A maximum percentage of each soil group which could be

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[3]SCS Classes V and VIII are not used in Tennessee. Class VII is excluded from the analysis because of the soil's major limitations on pasture production.

used in any particular year for the production of row crops or alfalfa was estimated as shown in Table 8. Only 80 percent of the available openland of Soil Group I could be used for the production of row crops, and only 40 percent could be used for the production of alfalfa while Soil Group IV could not be used for either row crops or alfalfa because of the severe limitations of the soils contained in the group.

The total acreage and acreage suitable for now crop and alfalfa production of each soil group available on the 450 acre representative farm is shown in Table 9. The maximum amount of allotment acreage of corn (feed grain), cotton, and wheat are also included in Table 8.[4]

No additional land could be obtained, and slack or unused land could not be leased out.

Labor

Three levels of labor availability were considered in this study. The hours of labor available by months for the three labor situations are shown in Table 10.

In Situation A, labor was restricted to that of the farm operator, and no extra labor could be hired. The hours of labor available by the farm operator were obtained by assuming the operator will work 50 hours per week for 50 weeks of the year. Two weeks of vacation per

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[4]The acreage allotments were obtained by dividing the total acreage in allotments in the study area by the total land in farms in the study area. These ratios of allotments per acre of land were: 0.138 acre of feed grain base per acre of land; .003 acre of wheat allotment per acre of land; and 0.98 acre of cotton allotment per acre of land.

Table 9. Soil and Land Use Restrictions of Representative Farm, Delta and Brown Soil Area of West Tennessee

Land Use	Acres
Total Land	450.0
Openland	334.0
Soil I	161.0
Row crop	128.0
Alfalfa	64.0
Soil II	36.0
Row crop	12.0
Alfalfa	36.0
Soil III	65.0
Row crop	13.0
Alfalfa	49.0
Soil IV	72.0
Row crop	0.0
Alfalfa	0.0
Feed Grain Base	62.1
Cotton Allotment	44.1
Wheat Allotment	1.4

Table 10. Maximum Labor Availability by Months for Three Labor Situations

Month	Labor Situation A	B	C
	hours		
January	221.5	411	582
February	200.0	371	529
March	221.5	411	582
April	214.5	398	562
May	221.5	411	582
June	214.5	398	562
July	221.5	411	582
August	221.5	411	582
September	214.5	398	562
October	221.5	411	582
November	214.5	398	562
December	221.5	411	582
Total available[a]	2508.5	4650	6746

[a]The total labor available for each situation is less than the sum of the monthly availability because of vacation time taken in the slack labor months.

year were assumed to be taken in slack labor periods.[5]

The hours of labor available for the various months were obtained by using the conversion factors of 4.43 weeks for 31 day months, 4.29 weeks for 30 day months, and four weeks for February.

In Situation B, the labor supply included one full time hired man plus the farm operator. The hired man was assumed to be available to work 50 45-hour weeks a year with two weeks vacation taken in slack periods. One full time hired man was assumed to cost $4,500 per year. Operator labor availability was decreased one hour for every 20 hours of hired labor for supervision.

Labor Situation C was used as the base labor situation for this study and was based on one farm operator plus a maximum amount of seasonal labor equal to two full time hired men in any one month. In this situation, seasonal workers could be hired at a wage rate of $1.75 per hour. Operator labor was reduced one hour for every 10 hours of seasonal labor hired to account for time needed for supervision of seasonal labor.

Where possible, overhead labor was included in the specific crop and livestock budgets. Other overhead labor, such as record keeping, attending meetings, obtaining information, etc., for each labor situation was assumed to be done in slack labor periods of the year.

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[5]The total amount of labor for the year exceeds 2,500 hours (50 hours per week times 50 weeks per year) because of 365 days in a year instead of 364.

Capital

It was assumed that all capital needed for the farm could be obtained, either internally or externally, at a cost specified in Table 11. No capital charge was made for land. Four different capital charge situations were used in the analysis.

Management

An above average level of managerial ability for 1972 was assumed. These management practices should be widely adopted by 1975.

General Overhead

All direct costs were included in each enterprise budget. However, in any farm operation, certain costs are incurred which cannot be allocated to particular enterprises. These costs include such expenses as insurance, truck expenses, tools, and accounting services. These costs are grouped together as annual overhead costs and were deducted from the returns obtained in the different linear programming solutions to obtain net returns to land, operator labor, and management. A summary of the annual overhead costs for the representative farm is shown in Table 12.

Table 11. Investment and Operating Capital Charges for the Four Capital Situations Used in the Study

Situation	Capital Investment	Capital Operating
	% rate[a]	
A	6	7
B	8	10
C	10	18
D	6[b]	7

[a]Percent computed on simple annual basis.

[b]Zero capital charge on breeding stock in cow-calf enterprises.

Table 12. Estimated Annual Overhead Cost for Representative Farm in the Delta and Brown Soil Area of West Tennessee

Item	Cost		Salvage Value	Years Life	Annual Depre-ciation	Annual Repair	Interest @ 6%	Taxes and Insurance[b]	Fuel and Other	Annual Total Cost
	New	Average[a]								
Machine Shed	$1500.00	$ 750.00	$ 0.00	20	$ 75.00	$ 7.50	$ 45.00	$ 10.00		$137.50
Wagon	480.00	264.00	48.00	15	28.80	21.60	15.84	1.94		68.18
Manure Spreader	1000.00	550.00	100.00	15	60.00	30.00	33.00	4.05		127.05
Truck (one ton)	4000.00	2200.00	400.00	10	360.00	150.00	132.00	90.00	$250.00	982.00
Auto (farm share)[c]									192.00	192.00
Telephone									48.00	48.00
Electricity[d]									36.00	36.00
Liability Insurance								45.00		45.00
Bookkeeping, legal fees, miscellaneous									50.00	50.00
Elevator	300.00	165.00	30.00	15	18.00	9.00	9.90	.75		37.65
Farm tools		500.00				60.00	30.00			90.00
Land								1350.00[e]		1350.00
Total					541.80	278.10	265.74	1501.74	576.00	$3163.38

[a]The average cost is computed by adding salvage value to initial cost and dividing by two.

[b]May be property tax, truck insurance, license fee, etc.

[c]Farm share, 1,600 miles at $0.12 mile.

[d]Monthly rate assumed to be $3.00. Charges for electricity were included in both swine and beef budgets.

[e]Property tax @ $3.00 per acre of land.

Source: Burney, Robert, unpublished data, Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville, (1974).

CHAPTER IV

ALTERNATIVE ENTERPRISES

I. Introduction

The enterprises which can be produced in a particular area depend upon such factors as the climatic and soil conditions, management ability, likes and dislikes of farmers, and marketing facilities in the area.

Enterprises used in this analysis include the major crops and livestock systems of the study area but exclude speciality enterprises which are not general production alternatives for a large number of farms in the area primarily because of market limitations.

II. Livestock Enterprises

The feed consuming enterprises (cattle feeding, cow-calf, stocker, and hog systems) require a certain amount of basic nutrients for maintenance, reproduction, and/or growth. In this study, nutrient requirements for livestock were specified in terms of total digestible nutrients (TDN), digestible protein (DP), and dry matter (DM). The amount of these nutrients required per month for the beef and swine enterprises considered were obtained from the Nutrient Requirements of Beef Cattle (22) and Nutrient Requirements of Swine (23).

Beef Finishing Systems

Twelve finishing systems were analyzed in this study. The rates of gain, length of the feeding period, and the major source of feed for

each system are shown in Table 13. The first five of these heifer and steer feeding systems were obtained from Anderson's work and involved the use of urea as a protein source whenever possible to reduce the cost of the ration (1, 2). Feeder system VI, both steers and heifers, is a combination of the systems III and V and is based on multiple use of the same feeding facility. In this system, fixed investment per animal was considerably lower than for the other systems. The primary difference between the other systems is in terms of the primary feed ingredients--corn, corn silage, and pasture, and the magnitude and order in which these feeds were fed.

In each of the 12 systems, the animal was assumed to be obtained (either by direct procurement or from the cow-calf herd of the farm) on October 16, fed an adjustment ration until November, and then placed on their respective ration. The steers would be procured at 500 pounds and fed to 1,000 pounds liveweight, grading high good to low choice. The heifers were assumed to weight 450 pounds on October 16 and fed to a liveweight of 850 pounds, grading high good to low choice.

The amount of TDN, DP, and DM required per animal unit per month for the particular rate of gain and weight is shown in Tables 14 and 15 for the six steer and six heifer systems, respectively.

The amount of feedstuffs needed to fulfill the requirements shown in Tables 14 and 15 is shown in Table 16. These were obtained by "balancing" the rations utilizing corn silage, corn grain, pasture, and alfalfa hay equivalent as the main components of the ration and using urea to balance the protein needs where possible. Cottonseed meal was used in place of urea in the limited feeding phases of systems IV and V

Table 13. Types of Feeding Systems, by Ration, Length of Feeding Period, and Rate of Gain, for the Twelve Feeding Systems Analyzed in the Study

System	Ration by Feeding Period	Heifers			
		Length of Feeding Period (days)	Daily Gain (pounds)	Length of Feeding Period (days)	Daily Gain (pounds)
I	Full feeding corn silage	234	1.75	177	1.75
	Full feeding corn grain	36	2.50	40	2.25
II	Full feeding corn silage, plus 5 lbs. corn grain per head per day	227	2.20	190	2.10
III	Full feeding corn grain	208	2.40	182	2.20
IV	Limited feeding corn silage	150	1.00	150	1.00
	Pasture only	105	1.50	112	1.40
	Full feeding corn grain	70	2.75	41	2.25
V	Limited feeding corn grain	150	1.00	150	1.00
	Pasture with supplemental grain	146	1.85	120	1.75
	Full feeding corn grain	32	2.50	18	2.25
VI[a]	Group A - Full feeding corn grain	208	2.40	182	2.20
	Group B - Limited feeding corn grain	150	1.00	150	1.00
	Pasture with supplemental grain	146	1.85	120	1.75
	Full feeding corn grain	32	2.50	18	2.25

[a]System VI is a combination of systems III and V.

Source: Anderson, James M. "The Effects of Alternative Beef Cattle Finishing Systems on Farm Income Potential and Resource Utilization in Tennessee," Unpublished Ph.D. dissertation, The University of Tennessee, (1969).

Table 14. Nutrient Requirements Per Animal by Months for Six Beef Steer Finishing Systems

Month	Systems																	
	I			II			III			IV			V			VI[a]		
	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM
	Pounds																	
October	134	14.2	200	139	15.2	188	149	15.8	194	112	12.5	187	112	12.5	187	261	28.3	381
November	288	30.8	432	301	32.7	407	308	33.8	417	233	25.8	392	233	25.8	392	541	59.6	809
December	324	35.3	495	342	37.1	462	349	38.4	472	253	27.8	431	253	27.8	431	602	66.2	903
January	351	39.0	549	370	39.1	500	379	40.0	512	267	29.0	458	267	29.0	458	645	68.9	970
February	336	34.5	524	356	36.2	481	367	37.0	496	252	27.1	436	252	27.1	436	619	64.1	932
March	391	37.4	611	417	41.1	564	434	42.0	587	313	34.3	523	328	35.4	533	762	77.4	1120
April	399	35.4	623	427	40.9	577	445	42.8	602	338	35.8	545	369	37.9	568	814	80.7	1170
May	433	35.6	677	462	44.4	624	185	17.8	250	366	36.4	590	405	38.0	623	590	55.8	873
June	445	41.1	622	15	1.5	21	--	--	--	375	35.4	599	414	36.0	637	414	36.0	637
July	200	19.3	270	--	--	--	--	--	--	481	48.1	678	451	36.3	672	451	36.3	672
August	--	--	--	--	--	--	--	--	--	513	51.3	722	479	43.9	674	479	43.9	679
September	--	--	--	--	--	--	--	--	--	103	10.3	144	142	14.0	197	142	14.0	197
Totals	3301	322.6	5003	2829	288.2	3825	2612	267.6	3530	3606	373.8	5705	3705	363.7	5808	6320	631.2	9343
Per lb. Gain	6.60	.65	10.01	5.66	.58	7.65	5.23	.54	7.06	7.21	.75	11.41	7.41	.73	11.62	632	.63	9.34

[a]Two animals.

Table 15. Nutrient Requirements Per Animal by Months for Six Beef Heifer Systems

	Systems																	
	I			II			III			IV			VK			VI[a]		
	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDP	DP	DN
	Pounds																	
October	133	13.7	191	134	14.8	181	140	15.1	187	104	11.9	170	104	11.9	170	244	27.0	357
November	287	30.3	424	289	31.7	390	300	33.3	402	219	24.8	361	219	24.8	361	519	58.1	763
December	326	35.3	492	327	35.8	442	337	36.6	454	241	27.0	403	241	27.0	403	578	63.5	857
January	355	39.4	546	356	38.8	481	365	39.7	493	256	28.4	433	256	28.4	433	621	68.1	926
February	345	38.6	539	343	39.7	463	363	38.5	491	271	26.9	418	245	26.9	418	608	65.4	909
March	403	41.7	629	401	49.7	541	440	45.3	595	308	34.2	507	320	35.3	517	760	80.6	1112
April	420	42.8	593	325	42.7	440	243	24.4	329	350	38.2	544	365	41.1	570	608	65.5	889
May	319	32.8	422	--	--	--	--	--	--	361	38.5	592	400	41.8	625	400	41.8	625
June	--	--	--	--	--	--	--	--	--	365	37.0	598	408	39.4	637	408	39.4	637
July	--	--	--	--	--	--	--	--	--	438	42.5	623	442	42.1	646	442	42.1	646
August	--	--	--	--	--	--	--	--	--	227	22.0	315	--	--	--	--	--	--
Totals	2588	274.8	3836	2175	253.0	2938	2188	232.9	2951	3061	249.3	4879	2890	269.4	4640	5078	460.4	7591
Per lb. Gain	6.47	.68	9.59	5.44	.63	7.34	5.47	.58	7.37	7.85	.82	12.41	7.50	.79	11.95	6.48	.68	9.66

[a]Two animals.

Table 16. Estimated Total Feed Requirements Per Head for the Twelve Cattle Finishing Systems

Feed	Systems											
	Steer						Heifer					
	I	II	III	IV	V	VI[f]	I	II	III	IV	V	VI[f]
Corn grain, bushels[a]	11.43	20.36	57.82	26.00	50.50	108.32	12.91	16.96	44.83	13.12	39.57	84.45
Corn silage, tons[b]	6.18	4.18	--	2.90	--	--	4.45	3.03	--	2.85	--	--
Alfalfa hay equivalent, tons[c]	.27	.23	.21	.07	.42	.63	.31	.19	.27	.04	.40	.67
Cottonseed meal, lbs.[a]	--	--	--	75.00	150.00	150.00	--	--	--	75.00	150.00	150.00
Urea, lbs.[d]	40.00	40.00	20.00	10.00	10.00	30.00	30.00	40.00	20.00	25.00	--	20.00
Pasture, cow acre days (CAD)[e]	--	--	--	94.00	80.00	80.00	--	--	--	101.00	68.00	68.00
Dicalcium phosphate, lbs.	20.00	20.00	20.00	40.00	40.00	60.00	20.00	20.00	20.00	20.00	40.00	60.00
Salt, lbs.	60.00	40.00	40.00	80.00	60.00	100.00	40.00	40.00	40.00	60.00	60.00	100.00

[a]Assume wastage of 1 percent. [b]Silage computed as fed, 5 percent wastage.

[c]Assumes wastage of 15 percent. [d]281 percent feed grade, 80 percent digestible (20).

[e]One CAD is equal to the equivalent of 25 lbs. of 2/3 orchardgrass, 1/3 ladino clover in air dry hay form.

[f]Two head.

"because the relatively low energy level of the rations prevents efficient conversion of urea to a usable form" (1, p. 27). The nutrient composition of these feeds was obtained from United States-Canadian Tables of Feed Composition (24).

The purchase and selling prices of livestock were varied to meet part of the objectives of this study. Three livestock price situations were used in this study (Table 17). These prices were adapted from the recommended livestock prices from the Procedural Guide for Objective II of the S-67 regional project study of beef-forage systems in the South (26).

Labor requirements for the 12 feeding systems are shown in Table 18. Labor coefficients were adapted from Anderson (1) and adjusted upward by 20 percent to include overhead labor (18). Labor requirements are based on a 250 head size feedlot. Since steer and heifer feeding system VI involved dual use of the feedlot, 500 head could be finished during the year. Cattle were assumed to be fed in the open without shelter.

Other costs, capital requirements, revenues, and returns associated with the 12 beef finishing systems are included in the Appendix.

Cow-Calf Systems

Two beef cow-calf systems were analyzed in the study. In cow-calf system I, the cows were wintered on hay while on system II, the animals were wintered on silage. Calves produced by either system can be sold at weaning, go into one of 12 finishing systems, or be wintered on silage and sold off grass in the early summer.

Table 17. Livestock Price Variations

Livestock Product	Price Per Hundredweight		
	Base	Low	High
	Dollars		
Finished steers	29.00	26.00	32.00
Finished heifers	27.50	24.50	30.50
Feeder steers	32.50	27.50	37.50
Feeder heifers	30.25	24.25	36.25
Cull cows	22.00	18.00	26.00
Buy light stocker steers[a]	34.00	29.00	39.00
Stocker steers (light)[a]	29.50	25.50	33.50
Buy light stocker heifers[a]	31.25	26.25	37.25
Stocker heifers (light)[a]	27.00	23.00	31.00
Stocker steers (heavy)[b]	28.75	24.75	32.75
Stocker heifers (heavy)[b]	26.25	22.25	30.25
Slaughter hogs	21.00	15.00	27.00
Feeder pigs	37.00	26.00	43.00
Cull sows	17.00	11.00	23.00

[a]Light stockers refer to the spring and summer grazing of stocker systems I and II.

[b]Heavy stockers refer to the winter feeding and spring grazing program of stocker systems III and IV.

Source: Adapted from unpublished Procedural Guide for Objective II Southern Regional Project S-67, "Evaluation of Beef Production in the South " (1971).

Table 18. Labor Requirements Per Head for Twelve Beef Feeding Systems by Months

Month	Systems											
	Steer						Heifer					
	I	II	III	IV	V	VI[b]	I	II	III	IV	V	VI[b]
	Hours											
January	.62	.62	.62	.62	.62	1.25	.62	.62	.62	.62	.62	1.25
February	.56	.56	.56	.56	.56	1.13	.56	.56	.56	.56	.56	1.13
March	.83	.83	.83	.37	.33	1.20	.83	.83	.83	.37	.37	1.20
April	.70	.70	.68	.31	.37	1.06	.70	.59	.59	.31	.37	.77
May	.61	.61	.28	.28	.41	.68	.43	--	--	.28	.41	.41
June	.84	.05	--	.38	.36	.36	--	--	--	.3	.44	.44
July	.36	--	--	.54	.37	.37	--	--	--	.58	.58	.58
August	--	--	--	.65	.58	.58	--	--	--	.36	--	--
September	--	--	--	.16	.23	.23	--	--	--	--	--	--
October	.48	.48	.48	.48	.48	.96	.48	.48	.48	.48	.48	.96
November	.48	.48	.48	.48	.48	.96	.48	.48	.48	.48	.48	.96
December	.62	.62	.62	.62	.62	1.25	.62	.62	.62	.62	.62	1.25
Total	6.10	4.95	4.55	5.45	5.41	10.03	4.72	4.18	3.99	4.96	4.93	8.95

[a]Includes overhead labor

[b]Two head.

Source: Adapted from Anderson, James M., "The Effects of Alternative Beef Cattle Finishing Systems on Farm Income Potential and Resource Utilization in Tennessee," unpublished Ph.D. dissertation, University of Tennessee (1969); James, Sydney C., editor, Midwest Farm Planning Manual, Third edition, Ames, Iowa (1973).

Costs and resource requirements were estimated on the basis of a 25 cow herd. Calves were assumed to be born around March 1 with an average weight at birth of 72.5 pounds. Calves were to be weaned on October 16 with an average weight of 500 pounds for the steer calves and 450 pounds for the heifer calves for an average daily rate of gain of 1.75 pounds per animal per day.

An 88 percent calf crop was assumed for the base situation. To analyze the effects of changing technical conditions, the percentage calf crop was varied from the base situation of 88 percent to 90 percent, and 95 percent. Weaning weights for calves were also varied from the 500 (450) pound steers (heifers) base situation to 515 (465) pounds, 525 (475) pounds, and 550 (500) pound weaning weights for steers (heifers) to analyze the effects on resource allocation, enterprise selection, and net returns.

A death loss of 2 percent of the cows per year was assumed. All cow replacements were derived from keeping "home grown" heifers with an annual replacement rate of 16 percent. For the 25 cow herd, four heifers were retained each year while 3-1/2 cull cows, 11 steer calves, and seven heifer calves would be sold at prices shown in Table 17. Replacement heifers were assumed to calf at two years of age.

The nutrient requirements for the cow-calf system are shown in Table 19. The nutrient requirements are the same for both systems. These requirements include the 25 brood cows and calves, one bull, and the replacement heifers (both first year and second year). Dry matter may vary from the specified requirements in Table 19 by plus or minus 15 percent without any detrimental effects (20).

Table 19. Estimated Nutrient Requirements for Cow-Calf System Including Bull and Replacements (25 Brood Cows, One Bull)

Month	TDN	DP	DM
		Pounds	
October	9,692	812	17,637
November	8,231	570	15,725
December	8,564	595	16,368
January	8,624	601	16,491
February	7,947	548	14,998
March	12,129	1,176	21,132
April	11,943	1,159	20,664
May	10,889	1,055	18,932
June	10,600	1,021	18,421
July	11,017	1,053	19,142
August	11,083	1,052	19,250
September	10,787	1,018	18,729
Total	121,506	10,660	217,489
Pounds per cow unit	4,860	426	8,700

Labor requirements for the cow-calf system were based upon three sources (25, 29, 18) and include overhead labor of 20 percent (included in Table 20). The winter months, as expected, require more labor than other months with silage feeding being more labor extensive than hay feeding. March requires a rather large amount of labor to reflect calving time.

Other costs, capital requirements, revenues, and returns associated with the cow-calf enterprises are included in the Appendix.

Beef Stocker Systems

Four beef stocker programs were analyzed in this study. Stocker systems I and II were a spring and summer grazing program of light steer and heifer stocker calves, respectively. The stockers would be purchased by March 15 and sold off pasture on September 30. The steer calves would be purchased weighing 350 pounds and sold weighing 647 pounds for a rate of gain of 1.5 pounds per head per day. The heifer calves weighed 300 pounds when procured and were sold at 577 pounds for a daily rate of gain of 1.4 pounds per head per day.

Stocker systems II and IV would more commonly be referred to as backgrounding systems. System III was developed for steers weighing 500 pounds on October 16. These steers would be placed on an adjustment ration until November 1 and would be wintered for 150 days on a limited amount of corn silage at a daily rate of gain of 1 pound per head. Steers would then be placed on pasture for 105 days with a rate of gain of 1.5 pounds per head per day and would be sold off grass in late June at a weight of 807 pounds.

System IV was essentially the same type of system as III, but

Table 20. Requirements, Per Head, for Specified Beef Systems, by Months[a]

Month	System					
	Cow-Calf		Stocker			
	I	II	I	II	III	IV
	Hours					
January	1.06	1.00	----	----	.62	.62
February	1.06	1.00	----	----	.56	.56
March	1.20	1.16	.50	.50	.37	.37
April	.75	.75	.30	.30	.31	.31
May	.60	.60	.30	.30	.28	.28
June	.50	.50	.30	.30	.42	.30
July	.50	.50	.30	.30	----	.24
August	.50	.50	.30	.30	----	----
September	.60	.60	.45	.45	----	----
October	.75	.75	----	----	.48	.48
November	.95	.90	----	----	.48	.48
December	1.06	1.00	----	----	.62	.62
Total	9.53	9.16	2.45	2.45	4.14	4.47

[a]Includes overhead labor.

this system was for backgrounding heifers. The heifers would be obtained October 16, fed an adjustment ration for 15 days, and then wintered on corn silage for 150 days at a rate of gain of 1 pound per day. Animals would then be placed on pasture for 112 days with a rate of gain of 1.4 pounds per day. The heifers would be sold the first of July weighing 757 pounds.

The nutient requirements for each stocker system are shown in Table 21. The labor requirements per head, including overhead labor, are shown in Table 20.

Other costs, revenues, capital requirements, and net returns are shown in the Appendix.

Hog Systems

Three hog systems were considered in this study. These systems were feeder pig production, farrow to finish, and a hog finishing system of feeding out purchased feeder pigs. For the feeder pig and farrow to finish systems, 1/4 acre of land was required per sow.

In the feeder pig and farrow to finish enterprises, four farforwing dates were assumed: one group of sows would farrow in March and September, and the other group would farrow in June and December. Eight pigs were assumed to be weaned per sow for both litters per year. Replacement sows would come from the herd, and sows would be replaced after four litters. One boar would be sufficient for 20 sows with the staggered farrowing time. The death loss on sows was assumed to be 2 percent. Pigs in both systems would obtain all their requirements until weaning from their dams and creep feed (200 pounds per litter).

Table 21. Nutrient Requirements Per Animal by Months for Four Beef Stocker Systems

Month	System I			II			III			IV		
	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM
	Pounds											
January	----	----	----	----	----	----	267	29.0	458	256	28.4	433
February	----	----	----	----	----	----	252	27.1	436	245	26.9	418
March	90	10.0	122	80	9.0	105	313	34.3	523	308	34.2	507
April	198	21.4	279	169	19.0	229	338	35.8	545	350	38.2	544
May	229	23.9	338	201	22.0	287	366	36.4	590	361	38.5	592
June	243	26.0	368	219	23.8	330	346	32.5	557	365	37.0	598
July	272	29.6	423	250	27.0	385	---	----	---	63	6.2	102
August	293	32.5	466	272	30.0	430	---	----	---	---	----	---
September	304	34.3	493	284	31.4	456	---	----	---	---	----	---
October	---	----	---	---	----	---	112	12.5	187	104	11.9	170
November	---	----	---	---	----	---	233	25.8	392	219	24.8	361
December	---	----	---	---	----	---	253	27.8	431	241	27.0	403
Total	1629	178	2489	1475	162	2222	2480	261.2	4119	2512	273.1	4128
Per pound gain	5.48	.60	8.38	5.34	.59	8.02	8.08	.85	13.42	8.18	.90	13.45

Feeder pigs would be sold at 45 pounds in the feeder pig enterprises at six weeks old. Finishing systems would also be started at this weight. Hogs in the farrow to finish system would be sold weighing 220 pounds with a death loss of 2 percent.

For the hog finishing operation, a continuous feeding operation of buying feeder pigs and selling finished hogs each month was assumed. This type of system would allow for a minimum amount of fixed investment per hog fed. This system also assumed purchasing feeder pigs at 45 pounds and selling finished hogs weighing 220 pounds. The assumed death loss of this system was 3 percent. The prices assumed for hogs, feeder pigs, and cull sows are shown in Table 17, page 49. Since livestock prices tend to move together, a base price and high and low prices for hogs were varied simultaneously with beef prices.

Since the farrow to finish and hog finishing systems require a larger volume of feed, feed grinding and mixing facilities were included. For the feeder pig enterprises, however, feed was assumed to be custom ground and mixed.

Capital requirements, costs, revenues, and net returns for the hog enterprises are shown in the Appendix.

The nutrient requirements needed for the hog systems are included in Table 22. For the feeder pig and farrow to finish enterprises, the nutrient requirements during lactation were weighted .75 for sows and .25 for gilts, reflecting the difference in requirements during lactation at the assumed rate of replacement (23). The amount of nutrients specified in Table 22 include the prorated share of requirements for replacements and boars. The nutrient requirements for the hog finishing

Table 22. Nutrient Requirements by Months for the Different Hog Systems

Month	Hog System								
	Feeder Pig Production[ac]			Farrow to Finish[ac]			Finishing System[b]		
	TDN	DP	DM	TDN	DP	DM	TDN	DP	DM
January	332	56.0	412	2180	306.6	2355	145	21.8	167
February	216	36.3	276	1355	205.9	1518	131	19.7	151
March	420	71.0	514	1451	232.8	1762	145	21.8	167
April	319	53.8	398	1893	294.2	2261	140	21.1	162
May	238	40.0	306	1610	244.2	1813	145	21.8	167
June	407	68.8	496	1415	227.6	1717	140	21.1	162
July	332	56.0	412	2180	306.6	2359	145	21.8	167
August	238	40.0	306	1489	222.6	1676	145	21.8	167
September	407	68.8	496	1415	227.6	1717	140	21.1	162
October	332	56.0	412	2180	306.6	2355	145	21.8	167
November	231	38.8	296	1482	226.0	1668	140	21.1	162
December	420	71.0	514	1475	236.8	1790	145	21.8	167
Total	3892	656.5	4838	20125	3037.5	22991	1706	256.7	1971

[a]Two sow units, including replacements and prorated boar requirements.

[b]From 45 to 220 lbs.; 3.5 batches per year.

[c]Includes hog requirements from the pigs produced by the two sows.

systems were based on the required level of nutrients of various size hogs as defined by the National Academy of Sciences (23).

Protein requirements are specified in crude protein terms in Swine (23). Digestible protein requirements were estimated for this study be taking 85 percent of the stated required crude protein needs (20).

Labor required per month (including overhead labor) per unit of the different hog enterprises is shown in Table 23.

III. Crop-Pasture Enterprises

Feed producing activities in this study included the production of hay, pasture, silage, and corn. With the exception of corn, these products could not be sold, and their production in the optimal solution would be as an intermediate product(s) used as an input in a livestock system(s).

Feed Producing Activities

Feed production alternatives included in the analysis were corn grain, corn silage, alfalfa hay, lespedeza hay, red clover hay (grown with wheat), midland bermuda hay, permanent pasture-hay,[1] permanent pasture,[1] midland bermuda pasture, and pasture from aftermath grazing

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[1]Permanent pasture and permanent pasture hay in this study are considered to be either two-thirds orchardgrass and one-third ladino clover or two-thirds fescue and one-third ladino clover. The use of fescue or orchardgrass would depend on the soild characteristics. Bermuda pasture is also a permanent sod. However, in this study, permanent pasture will refer only to the orchardgrass (clover) and fescue (clover) species to distinguish it from bermuda pasture.

Table 23. Labor Requirements by Months for the Different Hog Systems[a]

Month	Hog System		
	Feeder Pig[b]	Farrow to Finish[c]	Finishing Only[d]
January	6.76	10.60	.24
February	5.88	9.24	.21
March	8.76	12.60	.24
April	6.68	10.28	.225
May	6.00	9.84	.24
June	8.68	12.28	.225
July	6.76	10.60	.24
August	6.00	9.84	.24
September	8.68	12.28	.225
October	6.76	10.60	.24
November	5.96	9.56	.225
December	8.76	12.60	.24
Total	85.68	130.32	2.79

[a]Includes overhead.

[b]Two sows.

[c]Two sows plus offspring to finishing.

[d]3.5 head fed during year.

from all hay crops (with the exception of lespedza hay) and grazing of corn stalks (corn stover). Corn grain, corn silage, and alfalfa hay, and red clover-wheat can only be produced on Soil Groups I, II, and III while other hay and pasture alternatives can be produced on all four soil groups. Thirty-two different feed producing activities were included in the linear programming model.

The yields per acre of the feed producing activities and the amount of the basic nutrients supplied are shown in Table 24. These yields are stated in actual projected yields of the various crops (with corn weighing 56 pounds to the bushel). The nutrients supplied, however, are stated in actual amounts minus wastage in livestock feeding. This wastage of the various feedstuffs assumed for the study were 15 percent for hay, 5 percent for silage, 1 percent for corn grain fed to cattle, and 2 percent for corn grain fed to hogs. A distinction between corn for cattle and corn for hogs was made because of the wastage difference and also because of the difference in the nutrient utilization of corn grain by the different animal species (24).

Because of the biological nature of grass and clover species, considerable seasonality of pasture production exists. As shown in Table 25, a large proportion of the nutrients supplied by permanent pasture occurs in the spring, although some growth does occur in other months. Midland bermuda grass, on the other hand, produces forage only in the April through October period, with the largest production occurring during the hot summer months.

Aftermath grazing of hay crops was assumed to be available after hay has been cut except for lespedeza. The amount of nutrients supplied

Table 24. Estimated Crop Yields by Soil Groups and Estimated Net Nutrients Supplied per Acre for Alternative Feed Enterprises

Enterprise	Soil Group	Yield	Nutrients Available for Feeding[a] TDN	DP	DM
		(Unit)	--------Pounds--------		
Corn[b]	I	90 bu.	4041	333	4441
Corn[b]	II	75 bu.	3368	228	3701
Corn[b]	III	60 bu.	2694	222	2960
Corn[c]	I	90 bu.	4044	351	4396
Corn[c]	II	75 bu.	3370	293	3663
Corn[c]	III	60 bu.	2696	234	2930
Corn silage	I	17.5 tons	7242	428	10973
Corn silage	II	14.8 tons	6125	362	9280
Corn silage	III	11.9 tons	4925	291	7461
Alfalfa hay	I	3.0 tons	2639	491	4549
Alfalfa hay	II	2.3 tons	2023	377	3488
Alfalfa hay	III	2.8 tons	2463	458	4256
Lespedeza hay	I	1.8 tons	1568	242	2852
Lespedeza hay	II	1.6 tons	1394	215	2535
Lespedeza hay	III	1.3 tons	1133	175	2060
Lespedeza hay	IV	1.0 tons	871	134	1584
Red clover hay[d]	I	1.85 tons	1628	246	2758
Red clover hay[d]	II	1.5 tons	1320	199	2236
Red clover hay	III	1.65 tons	1451	219	2460
Midland bermuda hay	I	5.5 tons	3633	852	8518
Midland bermuda hay	II	5.0 tons	3329	774	7744
Midland bermuda hay	III	4.1 tons	2730	635	6350
Midland bermuda hay	IV	3.3 tons	2198	511	5111
Permanent pasture hay	I	1.0 ton	910	132	1518
Permanent pasture hay	II	0.9 ton	819	119	1366
Permanent pasture hay	III	0.75 ton	683	100	1139
Permanent pasture hay	IV	0.6 ton	547	79	911

[a]Actual amount of nutrients supplied per acre minus 15 percent wasteage on hay, 5 percent wasteage on silage, 1 percent wasteage on corn for cattle, 2 percent wasteage of corn for hogs.

[b]Supplied for cattle. [c]Supplied for hogs. [d]Grown with wheat.

Table 25. Estimated Pasture Production and Seasonal Distribution by Soil Groups Per Acre

Grazing Activity	Soil Group	Nutrient	Month												Total
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
			lbs.												
Permanent pasture	I	TDN	40	67	296	606	606	229	148	148	202	229	81	40	2693
		DP	7	11	50	103	103	30	25	25	34	39	14	7	458
		DM	60	100	442	904	904	342	221	221	301	342	121	60	4019
Permanent pasture	II	TDN	36	60	263	538	538	203	132	132	179	203	72	36	2393
		DP	6	10	45	92	92	35	22	22	31	35	12	6	407
		DM	54	89	393	804	804	304	196	196	268	304	107	54	3572
Permanent pasture	III	TDN	31	52	230	471	471	178	115	115	157	178	63	31	2094
		DP	5	9	39	80	80	30	20	20	27	30	11	5	356
		DM	47	78	344	703	703	266	172	172	234	266	94	47	3125
Permanent pasture	IV	TDN	25	41	181	370	370	140	91	90	123	140	49	25	1646
		DP	4	7	31	63	63	24	15	15	21	24	8	4	280
		DM	37	61	270	553	553	209	135	135	184	209	74	37	2456
Bermuda pasture	I	TDN				145	292	583	729	583	437	145			2915
		DP				30	59	118	148	118	90	30			592
		DM				228	455	911	1139	911	683	228			4555
Bermuda pasture	II	TDN				130	260	520	650	520	390	130			2595
		DP				26	53	106	132	106	79	26			527
		DM				203	405	810	1013	810	608	203			4054
Bermuda pasture	III	TDN				108	216	432	540	432	324	108			2157
		DP				22	44	88	110	88	66	22			438
		DM				168	337	674	843	674	504	168			3371
Bermuda pasture	IV	TDN				86	173	346	433	346	259	86			1734
		DP				17	35	70	88	70	52	17			352
		DM				135	271	542	677	542	406	135			2710

Source: Unpublished manuscript, Department of Agricultural Economics and Rural Sociology, The University of Tennessee, Knoxville.

by pasture after the hay has been cut for the various hay enterprises is shown in Table 26. Most of the aftermath grazing of hay crops occurs in the fall except for the cool season grasses (permanent pasture). Corn stover can be grazed but is essentially a dry roughage and was considered as a hay substitute in the linear programming matrix.

Pasture production, unlike the harvested crops, cannot be "stored" over a long period of time to be used in a later production period. Transfer of pasture between time periods is possible, however, by delayed grazing of pasture forage. With delayed grazing, nutrient loss occurs because of decomposition of the forage and/or palatability problems (8). Delayed grazing of pasture was permitted in the model for specific months and with varying rates of nutrient loss as shown in Table 27. Delayed grazing was permitted only for specific months because of the dormancy of the permanent pasture in the hot summer months and because of the palatability problems of bermuda pasture in maximum growth periods.

The degree of nutrient loss due to delayed grazing is indicated in Table 27. For example, delaying grazing from April to May would result in a 10 percent TDN loss (90 percent transferred). The transfer rate from May to June was 70 percent (a 30 percent loss). Thus, to delay grazing pasture from April to June would result in a 37 percent nutrient loss measured in TDN terms.

The amount of operating and investment capital required and cost of production per acre for the various feed producing enterprises is shown in the Appendix.

Table 26. Estimated Monthly and Total Amount of Feed Nutrients Produced from Aftermath Grazing by Soil Groups Per Acre

Grazing Activity	Soil Group	Nutrient	Month												
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
			lbs.												
Alfalfa hay	I	TDN									119	71	48		238
		DP									31	19	13		63
		DM									198	119	79		396
Alfalfa hay	II	TDN									91	55	37		183
		DP									24	15	10		49
		DM									153	91	61		305
Alfalfa hay	III	TDN									111	67	45		223
		DP									30	18	12		60
		DM									186	112	74		372
Bermuda hay	I	TDN									368	246			614
		DP									75	50			125
		DM									575	384			959
Bermuda hay	II	TDN									335	223			558
		DP									68	45			113
		DM									523	349			872
Bermuda hay	III	TDN									275	183			458
		DP									56	37			93
		DM									429	286			715
Bermuda hay	IV	TDN									241	160			401
		DP									49	32			81
		DM									376	250			626
Permanent pasture hay[a]	I	TDN	27	45	197	404	404	152	99	99	135	152	54	27	1795
		DP	4	7	34	68	68	35	17	17	23	25	9	4	305
		DM	40	67	295	603	603	228	147	147	201	228	80	40	2679

Table 26 (continued)

Grazing Activity	Soil Group	Nutrient	Month												Total
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
			lbs.												
Permanent pasture hay[a]	II	TDN	24	40	176	360	360	136	88	88	120	136	48	24	1600
		DP	4	7	30	61	61	23	15	15	20	23	8	4	272
		DM	36	60	263	537	537	203	131	131	179	203	72	36	2389
Permanent pasture hay[a]	III	TDN	21	35	155	316	316	120	77	77	105	120	42	21	1406
		DP	4	6	26	54	54	20	13	13	18	20	7	4	239
		DM	31	52	231	472	472	178	115	115	157	178	63	31	2099
Permanent pasture hay[a]	IV	TDN	17	28	122	249	249	94	61	61	61	83	33	17	1106
		DP	3	5	21	42	42	16	10	10	14	16	6	3	188
		DM	25	41	181	371	371	140	91	91	124	140	50	25	1650
Red clover hay	I	TDN									180	54	35		269
		DP									39	12	7		58
		DM									257	77	50		384
Red clover hay	II	TDN									146	44	28		218
		DP									32	9	6		47
		DM									208	62	40		311
Red clover hay	III	TDN									160	48	31		239
		DP									35	10	7		52
		DM									229	68	44		342
Corn stover[b]	I, II, III	TDN											450	465	915
		DP											17	17	34
		DM											763	788	1551

[a]With one cutting of hay harvested yielding 1, .9, .75, and .6 tons for Soil Groups I, II, III, and IV, respectively.

[b]Data obtained by assuming that 1 acre of corn stover will provide enough TDN and DM for one dry cow for 2 months (8). Hence, the nutrients supplied by 1 acre of corn stover are equal to the nutrient requirements for a dry cow in this period.

Source: Unpublished manuscript, Department of Agricultural Economics and Rural Sociology, The University of Tennessee, Knoxville.

Table 27. Assumed Forage Transfer Rates for Delayed Grazing (TDN Equivalents)

Month		
From	To	Transferred (%)
April	May	90
May	June	70
June	July	60
September	October	95
October	November	95
November	December	95
December	January	95

Cash Row Crop Enterprises

Other enterprise alternatives on the representative farm included the production of cash crops. These included corn (which can be fed or sold), cotton, wheat, soybeans, and wheat double cropped with soybeans, and as a joint product with red clover.

The assumed selling prices of these crops are shown in Table 28. To fulfill the objective of comparing the 1972 government program with a "free market" situation, two price situations were used. For those commodities under domestic allotment in 1972 (corn, cotton, and wheat), a direct payment of 15 cents per pound of lint cotton, 20 cents per bushel of corn, and $1.71 per bushel of wheat is added to the returns. For acreages of these crops above the farm domestic allotment, only the market price is received. As specified in the 1972 Farm Program, an acreage set aside of .2, .25, and .83 acres was required for each acre produced of cotton, corn, and wheat, respectively.

Prices assumed without supply controls or price supports are somewhat lower than with the 1972 Farm Program.

Estimated labor requirements per month for each crop enterprise are shown in Table 29. This data was developed by Burney and Keller (7) and includes both machinery performance time and direct overhead labor associated with producing the crop.

The amount of operating and investment capital required and the net returns per acre for the various cash crop alternatives are included in the Appendix.

Table 28. Crop Price Assumptions With and Without a Government Program

Crop	Unit	With Government Program	Without Government Program
Corn	bushel	1.20[a]	1.05
Cotton			
Lint	pound	.24[b]	.22
Seed	pound	.025	.02
Wheat	bushel	1.30[c]	1.15
Soybeans	bushel	2.75	2.20

[a]Plus an additional 20¢ per bushel payment for corn grown under allotment.

[b]Plus an additional 15¢ per pound payment for cotton grown under allotment.

[c]Plus an additional $1.71 per bushel payment for wheat grown under allotment.

Source: Adapted from unpublished Procedural Guide for Objective II Southern Regional Project S-67, "Evaluation of Beef Production in the South," (1971).

Table 29. Labor Requirements for Crop Enterprises by Months[a]

Enterprise	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Alfalfa	--	.26	--	.32	3.06	3.38	3.18	.20	3.09	--	--	--	13.49
Conserving base	--	--	--	--	.03	.03	--	.38	.03	--	--	--	.47
Corn	--	--	.17	1.67	.51	.45	.45	--	--	.69	.36	--	4.30
Corn (gov. program)	--	--	.17	1.67	.51	.46	.45	.34	.02	.69	.36	--	4.67
Corn silage	--	--	.67	1.67	.51	.54	.54	--	--	--	--	--	3.93
Cotton	--	--	.80	1.26	1.25	1.71	1.85	--	--	.20	--	--	7.07
Cotton (gov. program)	--	--	.80	1.26	1.25	1.71	1.85	.27	.02	.20	--	--	7.36
Lespedeza	--	--	.87	.09	--	.32	--	3.80	--	--	--	--	5.08
Midland bermuda hay	--	--	.02	.35	.35	4.04	3.98	3.80	3.98	--	--	--	16.70
Midland bermuda pasture	--	--	.02	.35	.35	.06	.32	--	--	--	--	--	1.10
Permanent pasture	--	.29	--	--	--	.45	--	.36	.02	--	--	--	1.12
Permanent pasture and hay	--	.29	--	--	3.98	.45	--	.36	.02	--	--	--	5.10
Soybeans	--	--	.17	.63	1.25	.84	.81	.35	--	.53	.53	--	5.11
Soybean-wheat	--	.32	--	--	--	2.15	.41	.42	--	1.92	1.11	--	6.33
Wheat	--	.32	--	--	--	.98	--	--	.68	.68	--	--	2.66
Wheat (gov. program)	--	.32	--	--	--	1.02	--	1.12	.75	.68	--	--	3.89
Wheat-red clover	--	.24	--	--	--	2.12	--	3.23	.29	.29	--	--	6.17

[a]Includes overhead labor.

Source: Burney, Robert and Keller, Luther, unpublished manuscript, Department of Agricultural Economics and Rural Sociology, The University of Tennessee, Knoxville (1974).

CHAPTER V

RESULTS OF THE ANALYSIS

The optimal allocation of resources and enterprise combinations for various assumed economic and technical conditions are discussed in this chapter. The first section of this chapter presents the optimal results for the base situation with all enterprises considered and with only beef and associated feed enterprises allowed to enter the optimal solution.

The second, third, fourth, and fifth sections of this chapter analyze the effects on the optimal combination of enterprises, resource use, and net returns with variations of: (1) labor costs and labor availability, (2) operating and investment capital rates, (3) livestock prices, and (4) government programs, respectively. Each section analyzes the changes in the optimal system when beef and associated feed systems compete against all other enterprises for the limited resources and also when only beef and associated feed enterprises are included in the model.

The sixth and seventh sections of the chapter examine the effects of changes in calving rates and weaning weights for the cow-calf systems on net returns, resource utilization, and enterprise combinations.

I. Base Situation

The base situation included the following resource conditions:

1. Labor--Available labor supply included the farm operator

plus a maximum amount of hired seasonal labor equivalent to two full time hired men in any one month with a wage rate of $1.75 per hour. (Labor Situation C)

2. Capital--No limitations were placed on internal or external capital. Interest was charged at 6 percent for non-land investment capital and 7 percent for operating capital. Since no interest charge was made for land capital, computed net returns will include the return to land.

3. Land--The representative farm consisted of 450 acres of total land with 334 acres classified as openland.

4. Prices--Base prices are shown in Table 17 (page 49) for livestock and in Table 28 (page 69) for crops.

5. The provisions of the 1972 government Farm Program were included.

Enterprise Combinations

All enterprises. The optimal combination of enterprises to maximize net returns for the conditions specified in the base situation is shown in Table 30. The major production activities included cotton, hog finishing, feeder pigs, corn, stocker steers on spring and summer pasture, and both permanent and bermuda pasture. All allotments of cotton, feed grain, and wheat were fully utilized with an additional 15.9 acres of corn produced beyond the feed grain allotment. All corn produced would be fed, and an additional 419.2 bushels would be purchased. Corn was utilized mostly by the hogs (6,859 bushels) with a relatively small quantity fed to steers (240 bushels).

Table 30. Optimal Enterprise Organization for the 450 Acre Representative Farm, Base Situation, with All Enterprises and Only Beef and Associated Feed Enterprises Considered

Enterprise	Unit	Enterprise Considered	
		All	Beef-Feed
Beef			
Feeder steer II	hd.	11.8	298.5
Stocker steer I	hd.	88.7	157.5
Cow-calf I	cow	13.0	-----
Other Livestock			
Hog finishin[a]	3.5 hd.	100.0	N.A.
Feeder pig	2 sows	42.1	N.A.
Livestock Feed			
Pasture:			
Permanent pasture	ac.	48.4	77.0
Bermuda pasture	ac.	60.6	92.8
Other Forage:			
Corn silage	ac.	4.1	75.4
Bermuda hay	ac.	-----	11.2
Corn stover	ac.	78.0	62.1
Concentrate:			
Corn (gov. program)	ac.	62.1	62.1
Corn (other)	ac.	15.9	-----
Buy corn	bu.	419.2	632.6
Cash Crops			
Cotton (gov. program)	ac.	44.1	N.A.
Wheat (gov. program)	ac.	1.4	N.A.

[a]Continuous feeding of purchased feeder pigs, 3.5 batches per year. A limit of 100 units was set.

Cow-calf production was a supplementary enterprise with only 13 cows. All steers from the cow-calf herd were fed out, and a few additional feeder animals were purchased. A small amount of corn silage was produced (4.1 acres) to be utilized for the feeder steers.

Forty-eight acres of permanent pasture and 70.6 acres of bermuda pasture furnished the nutrients for the small cow herd and the stocker steers during the spring and summer. The seasonal nature of production of both pasture species parallels very well the nutrient requirements of the stocker enterprise. That is, with permanent pasture, the largest amount of production occurs at the time when the steers are put on pasture. The production of nutrients from permanent pasture decreases considerably with warmer weather, but production of bermuda increases with warmer weather and reaches its maximum in the hot summer months.

Beef and associated feed enterprises. When only beef and associated feed enterprises were considered, feeder steer II was the main production activity and was included in the optimal solution at a level of almost 300 head (Table 30). Corn silage (the principal feed ingredient of this system) was included in the optimal solution at 75.4 acres. Corn grain production was 62.1, the limit of allotment acres, and 633 bushels of corn would be purchased. Bermuda hay and corn stover would be utilized as dry roughages for the steers.

Stocker steer I production was 78 percent higher than when all enterprises were considered. Pasture acreage was correspondingly higher to meet the nutrient requirements of these steers. No cow-calf production was included in the optimal solution.

Resource Allocation

All enterprises. When beef enterprises competed with all other enterprises for the limited resources, all available row crop and soil groups were utilized with the exception of 51 acres of Soil Group IV. The 21 acres of Soil Group IV was to be used for pasture for the swine breeding herd (Table 31).

The maximum amount of operator labor available (2,509 hours) was utilized.[1] Over 2,887 hours of seasonal labor was hired, but only in two months (April and June) was the maximum allowable amount of hired labor utilized. Some seasonal labor was hired in each month but the amount hired was lowest in November, January, and February with 117, 120, 114 hours of seasonal labor hired, respectively.

No restriction was placed on the amount of capital available on the benchmark farm. Thus, the capital requirements shown in Table 31 are the amounts needed for maximum returns. Net returns to land, operator labor, and management were $20,216 after a $3,163.38 deduction for general farm overhead costs.

Beef and associated feed enterprises. When cash row crops and the hog enterprises were not considered as alternatives, all available acreage was utilized including the use of row crop land at its maximum level (Table 31). Labor use was considerably lower because beef cattle

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[1] It was assumed a priori that the unspecified overhead labor of the operator would be done in his slack periods. In the base situation, this overhead labor could result in more seasonal labor being hired to free the operator to accomplish the overhead labor needed. The magnitude of this is unknown and depends upon such factors as family participation, involvement of the entrepreneur in outside activities, and so forth.

Table 31. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, Base Situation, with All Enterprises and Only Beef and Associated Feed Enterprises Considered

Item	Unit	Resources Utilized	
		All Enterprises	Beef Feed Only
Land			
Soil I	ac.	161	161
Row crop I	ac.	128	128
Soil II	ac.	36	36
Row crop II	ac.	12	12
Soil III	ac.	65	65
Row crop III	ac.	13	13
Soil IV	ac.	21	72
Total openland	ac.	283	334
Total openland available	ac.	334	334
Labor			
Operator labor available	hr.	2,509	2,509
Operator labor used	hr.	2,509	2,231
Hired seasonal	hr.	2,887	614
Total used	hr.	5,396	2,845
Capital[a]			
Operating capital	$	23,659	56,605
Investment capital (non-land)	$	32,298	24,842
Net returns[b]	$	20,216	11,052

[a]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[b]Returns to land, operator labor, and management.

are more labor extensive compared to row crops and hogs. A total of 2,845 hours of labor was required. Only 614 hours of seasonal labor was hired, mostly in March, April, and May. Except for June (2.7 hours), no extra labor was required in other months.

The amount of operating capital was 139 percent higher for the optimal systems when enterprises were restricted because operating capital requirements are considerably higher for finishing and stocker beef enterprises than for crops. The amount of investment capital required to maximize returns was $7,455.57 lower than when all enterprises were considered, because the amount of investment capital required was lower for beef than for hog enterprises.

Net returns to land, operator labor, and management were $11,052, or about 55 percent of the estimated income level when all enterprises were considered (Table 31). The difference between the two income levels is an estimate of the income that the operator would forgo if he considered only beef production alternatives.

II. Changes in Labor Costs and Availability

Variations from the base situations were made to determine the effects on resource allocation and enterprise combinations when: (1) the wage rate paid to seasonal hired labor was increased from $1.75 per hour to $2.65 per hour, (2) the option of hiring seasonal labor was deleted and one full time hired man was added to the labor supply (Labor Situation B), and (3) the labor supply was restricted to the operator (Labor Sitation A).

All Enterprises--Enterprise Combination

High Wage Rate. The quantity of a resource demanded would be expected to vary inversely with its price. An increase in the wage rate paid to seasonal hired workers resulted in less labor hired and a shift in production to more labor extensive enterprises (Table 32). The increase in the seasonal farm worker wage rate from $1.75 to $2.65 per hour resulted in a reduction in the number of beef animals finished to slaughter weight and an increase in the more labor extensive stocker and cow-calf enterprises. Feeder pig production was 38 percent lower, while hog finishing, which requires a relatively small amount of labor per unit, remained at its upper limit of 100 units.

Pasture production, of both permanent and bermuda species, was larger with the combined acreage in pasture accounting for 1/2 of the openland of the benchmark farm. The remaining 167 acres were utilized as pasture for the 52.2 sows for feeder pig production, row crops, and set aside acres. All corn produced would be utilized for the hog production. No corn was purchased or sold. Cotton was produced on 64 acres of land with 44 acres produced under the government program and 20 acres produced without a cotton price support or loan program.

Labor Situation B. Deletion of the hired seasonal labor option and the addition of a full time hired man reduced the potential labor supply and made it necessary to adapt the farm organization to a fixed, year-around labor supply. This change in the supply of labor available resulted in a change in the magnitude of beef produced in the various systems from the base situation, although the same beef systems were included in both solutions (Table 32). Stocker steer I production,

Table 32. Optimal Enterprise Organization for the 450 Acre Representative Farm, All Enterprises Considered, by Labor Situation

Enterprise	Unit	Labor Situation[a]			
		Base	Base (High Wage)	B	A
Beef					
Feeder steer II	hd.	11.8	-----	1.5	-----
Stocker steer I	hd.	88.7	117.8	42.6	28.7
Cow-calf I	cow	13.0	20.0	19.3	13.0
Other Liverstock					
Hog finishing[b]	3.5 hd.	100.0	100.0	100.0	100.0
Feeder pig	2 sows	42.1	26.1	24.5	2.5
Livestock Feed					
Pasture:					
Permanent pasture	ac.	48.4	79.7	34.0	20.7
Bermuda pasture	ac.	60.6	88.3	35.7	23.9
Other forage:					
Corn silage	ac.	4.1	-----	.4	-----
Corn stover	ac.	78.0	62.1	60.8	40.5
Concentrate:					
Corn	ac.	15.9	-----	-----	-----
Corn (gov. program)	ac.	62.1	62.1	60.8	40.5
Buy corn	bu.	419.2	-----	-----	-----
Cash Crops					
Cotton (gov. program)	ac.	44.1	44.1	44.1	44.1
Cotton	ac.	-----	20.0	-----	-----
Wheat (gov. program	ac.	1.4	1.4	1.4	1.4
Soybeans	ac.	-----	-----	21.2	40.0
Wheat-Soybeans	ac.	-----	-----	-----	7.0

[a]Labor situations were: Base--operator plus a maximum of two seasonal men in any month paid a wage of $1.75 per hour; Base high wage--hired men paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[b]Continuous feeding of purchased feeder pigs, 2.5 patches per year. A limit of 100 units was set.

which requires labor in the spring and summer months (in direct competition with row crop production for the limited labor supply), was over 50 percent lower than in the base solution. The cow-calf enterprise, which requires a fairly constant amount of labor over the year, was included in the optimal solution at 19.3 cows, 6.3 head more than in the base situation. The rather labor intensive beef feeding operations were in the solution at an impractical level of 1.5 head.

Pasture acreage was lower in the solution for Labor Situation B than in the solution for the base situation reflecting the lower numbers of stocker steers. Acreage of bermuda pasture was reduced more than permanent pasture. A significant amount of roughage for the cow-calf enterprise was provided by corn stover.

Other livestock enterprises in the optimal solution included the maximum level of 100 units of hog finishing and 49 sows used for feeder pig production.

Cotton produced under the government program was again the principal cash crop and was produced up to its maximum allotable acres. Soybean production, which required only 50 percent as much labor as corn and cotton in April, and only 50 percent as much labor as cotton in June, was in the optimal solution at 21 acres.

Labor Situation A. The effects of a decreased labor supply on the optimal enterprise mix are even more pronounced when labor was limited to that supplied by the farm operator, as shown in Table 32. Soybean production became one of the major income producing activities. Forty-seven acres were produced (seven of which were double cropped with wheat). Cotton production, under the government program, and

the hog finishing were the other major income producing enterprises. Forty-and-one-half acres of corn were produced under the feed grain base and all corn was fed. Beef enterprises in the solution were of a supplementary nature and included 28.7 head of stocker steer I and 13 brook cows under system I. Feed for the beef animals would be supplied from 44.6 acres of pasture and aftermath grazing of corn stalks.

The more limited labor supply also resulted in a large decline in the labor intensive feeder pig enterprise. Over 82 sows were in the optimal solution in the base labor situation, but only five sows were in the solution for Labor Situation A. Thus, removal of the hired labor option reduced significantly the number of sows and stocker steers and resulted in a significant expansion of soybeans as a cash crop. Finishing feeder pigs remained at the same level for all labor situations.

All Enterprises--Resource Allocation and Net Returns

High Wage Rate. When the wage rate for hired seasonal labor was increased from $1.75 per hour to $2.65 per hour, substitution of land for labor occurred (Table 33). The 51 acres of Soil IV which was left idle in the solution for the base situation was fully utilized (as well as all other land) with the higher wage rate, while the amount of seasonal labor hired was 45 percent (or 1,301 hours) lower than for the base situation. All operator labor was fully utilized at both wage levels. Even at the higher wage level, labor would be hired in every month except January but the amount of labor to be hired in any one

Table 33. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, All Enterprises Considered, by Labor Situation

Item	Unit	Labor Situation[a]			
		Base	Base (High Wage)	B	A
Land					
Soil I	ac.	161	161	161	161
Row crop I	ac.	128	128	128	128
Soil II	ac.	36	36	36	24
Row crop II	ac.	12	12	12	12
Soil III	ac.	65	65	38	14
Row crop III	ac.	13	13	13	13
Soil IV	ac.	21	72	---	---
Total openland	ac.	283	334	235	199
Total openland available	ac.	334	334	334	334
Labor					
Operator labor available	hr.	2,509	2,509	4,650[c]	2,509
Operator labor used	hr.	2,509	2,509	3,473[b]	1,506
Hired seasonal	hr.	2,887	1,586	N.A.	N.A.
Total used	hr.	5,396	4,095	3,473	1,506
Capital[d]					
Operating capital	$	23,659	23,307	16,075	9,339
Investment capital (non-land)	$	32,298	30,179	27,138	17,432
Net Returns	$	20,216	17,687	15,642	13,895

[a]Labor situations were: Base--operator plus a maximum of two seasonal men in any month paid a wage of $1.75 per hour; Base high wage--hired men paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[b]Includes amount of full time hired man utilized.

[c]Total amount of fixed labor supply available (full time hired man included).

[d]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

month was, in every case, less than the maximum hired labor allowed (two full time men).

The higher wage rate had little effect on the amount of operating capital required for the optimal system while the amount of investment capital required was actually $2,119 lower for the higher wage rate due primarily to the reduction in brood sow numbers (Table 32, page 79).

With the $2.65 per hour wage rate, net returns to land, operator labor, and management were $17,687 or $2,529 lower than for the base situation. Thus, an increase in the wage rate from $1.75 per hour to $2.65 per hour resulted in a 12.5 percent reduction in net returns.

Labor Situation B. Resource allocation in the optimal system with Labor Situation B is shown in Table 33. Almost 100 acres of open-land was not utilized. In the optimal solution for Labor Situation B, all of Soil Group IV (72 acres) and part of Soil Group III (27 acres) was left idle. All of Soil Groups I and II and allowable row crop acreages were completely utilized. The lower utilization of land resulted, in part, from a more limited amount of labor available in the critical farm labor months of April and June. All available labor was utilized in these months. Slack labor in other months varied from a low of 61 hours in July to 199 hours in January.

The amount of operating and investment capital required was $16,075 and $27,138, respectively. This represents a decline of 32 percent in the amount of operating capital required and a 16 percent decline in the amount of investment capital required as compared to the base situation.

The deletion of the option to hire seasonal farm workers and

adding one full time hired man who must be paid his regular salary even in slack periods had a considerable effect on net returns to land, operator labor, and management. Net returns were $4,574 lower than the base situation--a reduction of almost 23 percent.

Labor Situation A. For Labor Situation A, the only labor available was that supplied by the farm operator. The effects of this labor restriction are shown in Table 33. Only 199 acres of openland were utilized, and 135 acres were left idle. Obviously, this labor supply is not adequate to utilize fully the land resource available. More stress was placed on labor in critical periods. April and June were again the only months in which the maximum available hours of labor were utilized, and only 60 percent of the available operator labor for the year was utilized.

For the optimal system with only the operator furnishing labor, $9,339 would be required for operating capital and $17,432 for investment capital.

Net returns to land, operator labor, and management were 31 percent lower in Labor Situation A than for the base situation. Net returns were also $1,747 (11 percent) lower in Labor Sitaution A than when the farm could obtain one full time hired man (at a cost of $4,500 per year). Although a large amount of labor was left idle in Labor Situation B, the farm operator could still justify obtaining a full time hired man (if seasonal labor was not available) if his goal was maximizing net returns.

Beef and Associated Feed Enterprises Only--Enterprise Combinations

High Wage Rate. An increase in the wage rate from $1.75 to $2.65 per hour had little effect on the optimal combination of enterprises on the representative farm when alternatives were limited to beef and associated feed enterprises (Table 34). Feeder steer II and stocker steer I were the only income producing activities in the solution for the base situation, and the increase in the wage rate reduced slightly the total number of beef animals from 456 to 448 head. Forage and grain production was virtually unchanged. The amount of purchased corn was reduced approximately 300 bushels. The impact of a higher wage rate had a lesser effect on the organization of the beef-feed representative farm than when all enterprises were considered. This is not surprising, however, because only 614 hours of labor were hired in the base situation on the beef and associated feed representative farm while almost 2,900 hours of seasonal labor were hired in the base situation when all enterprises were considered (Table 31, page 76).

Labor Situation B. In the solution for the base situation, labor was hired in only four months. In April, 341 hours of extra labor was hired. With the change in labor availability to Labor Situation B, the number of cattle fed was 16 percent lower than for the base situation (Table 34). However, with the more restrictive labor supply, feeder steer system II was reduced by 132 head while feeder steer system IV was included at a level of 85 head. Labor required per animal for feeder steer IV in April, a critical month, is only 44 percent of the labor requirement for feeder steer II.

Table 34. Optimal Enterprise Organization for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Labor Situation

Enterprise	Unit	Labor Situation[a] Base	Base (High Wage)	B	A
Beef					
Feeder steer II	hd.	298.5	290.1	166.2	-----
Feeder steer III	hd.	-----	-----	-----	5.3
Feeder steer IV	hd.	-----	-----	84.8	130.3
Stocker steer I	hd.	157.5	157.6	140.3	154.5
Cow-calf I	cow	-----	-----	-----	6.0
Beef Feed					
Pasture:					
Permanent pasture	ac.	77.0	77.0	140.0	183.3
Bermuda pasture	ac.	92.8	93.3	51.1	44.1
Other forage:					
Corn silage	ac.	75.4	75.4	55.2	21.6
Bermuda hay	ac.	11.2	10.7	-----	-----
Wheat-red clover hay	ac.	-----	-----	10.1	-----
Corn stover	ac.	62.1	62.1	62.1	41.1
Concentrate:					
Corn (gov. program)	ac.	62.1	62.1	62.1	41.1
Buy corn	bu.	632.6	330.6	-----	-----

[a]Labor situations were: Base-operator plus a maximum of two seasonal men in any month paid a wage of $1.75 per hour; Base high wage--hired man paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

The shift in beef enterprises was accompanied by changes in the amount and kind of pasture produced. Total pasture production was 191 acres for Labor Situation B as compared to 170 acres for the base situation. The shift from feeder steer system II to feeder steer system IV also required a large expansion in permanent pasture acreage and a reduction in bermuda pasture. Feeder steer system IV involves a 105 day pasture period in the spring and early summer while no pasture is required for feeder system II. Aftermath grazing of red clover hay also furnished pasture nutrients in September. Corn stover and 10.1 acres of red clover hay furnished the dry roughage for the feeding systems. Fifty-five acres of corn was grown for silage, and the maximum allotable acres of corn was produced for grain on Soil I. Thus, as labor availability declines, more nutrients for beef production were produced from pasture and less from silage. All corn produced was fed, and no corn was purchased.

Labor Situation A. When the labor supply was restricted to only the operator, beef production was shifted almost completely to a combination of feeder steer IV and stocker steer I (Table 34). As the labor supply decreased, a shift in the feed sources from silage and corn to the utilization of more pasture forage also occurred. Feeder steer IV requires 105 days of grazing per unit while the stocker steer system I requires 198 days of grazing per unit.

The decrease in the labor availability had little effect on the optimal amount of stocker steer I to produce because the stocker enterprises and its feed (pasture enterprises) are fairly labor extensive as

compared to many other systems. Cow-calf I was in the optimal solution at a level of six cows.

One-hundred-eighty-three acres of permanent pasture were in the optimal solution along with 44.1 acres of bermuda pasture. Other feed produced included 21.6 acres of silage on Soil I and 41.1 acres of corn for grain and aftermath grazing of corn stalks.

Beef and Associated Feed Enterprises Only--Resource Allocation and Net Returns

High Wage Rate. As shown in Table 35, very little change in resource use occurred on beef farms when the wage rate increased from $1.75 per hour to $2.65 per hour. The amount of both hired seasonal and operator labor used was slightly lower than for the base situation.

Since the beef and associated feed representative situation utilized only a small amount of hired labor, the reduction in net returns resulting from an increased wage rate was considerably smaller than when all enterprises were considered. When all enterprises were considered, net returns to land, operator labor, and management declined 12.5 percent with the higher wage but net returns were only 5 percent lower when only beef and associated feed enterprises were considered.

Labor Situation B. When only one full time hired man was available for extra labor, all openland was utilized. Row crop usage was less than the maximum allowed on Soil II and Soil III (Table 35). The total amount of labor utilized was less than the yearly total supplied by the farm operator. Only in March, April, May, and June did the optimal amount of labor usage exceed the amount of operator labor

Table 35. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Labor Situation

Item	Unit	Labor Situation[a]			
		Base	Base (High Wage)	B	A
Land					
Soil I	ac.	161	161	161	161
Row crop I	ac.	128	128	128	73
Soil II	ac.	36	36	36	36
Row crop II	ac.	12	12	10	-----
Soil III	ac.	65	65	65	65
Row Crop III	ac.	13	13	-----	-----
Soil IV	ac.	72	72	72	38
Total openland	ac.	334	334	334	300
Total openland available	ac.	334	334	334	334
Labor					
Operator labor available	hr.	2,509	2,509	4,650[c]	2,509
Operator labor used	hr.	2,231	2,204	2,380[b]	1,685
Hired seasonal	hr.	614	593	N.A.	N.A.
Total used	hr.	2,845	2,797	2,380	1,685
Capital[d]					
Operating capital	$	56,605	55,737	55,298	41,790
Investment capital (non-land)	$	24,842	24,439	21,175	16,280
Net Returns[e]	$	11,052	10,498	5,894	5,516

[a]Labor situations were: Base--operator plus a maximum of two seasonal men in any month paid a wage of $1.75 per hour; Base high wage--hired men paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[b]Includes amount of full time hired man utilized.

[c]Total amount of fixed labor supply available (full time hired man included).

[d]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[e]Returns to land, operator labor, and management.

available. April was the only month in which the total amount of labor available was fully utilized.

The amount of operating capital required was $55,298, only slightly lower than for the base situation. The optimal amount of investment capital required was, however, 15 percent lower than for the base situation.

Net returns to land, operator labor, and management were 45 percent lower than the base situation. This compares to a decline of 23 percent in net returns when all enterprises were considered. Thus, it seems that although beef only type farms will not hire a large amount of seasonal labor, the availability of this extra labor in critical farm labor months is very important to the returns associated with the farm.

Labor Situation A. When only a one man labor supply was available for the beef only representative farm, 34 acres of openland were left idle, and only 73 acres of row crop land (with 153 acres available) were utilized in the optimal solution (Table 35). Only 1,684 hours of labor were used, and only in April and June was the maximum amount of operator labor utilized.

The amount of operating capital required in this labor situation was $41,790, or $14,815 less than for the base situation. Investment capital required was also considerably lower.

Net returns to land, operator labor, and management were $5,516 as compared to $11,052 for the base situation. If the amount of operator labor and management required were valued at $3.00 per hour, the residual net return to land would be only $461 or $1.02 per acre on the 450

acre farm. The difference in net returns between Labor Situation A and B was $378. Thus, the addition of a full time hired man at a salary of $4,500 per year had a very small effect on net returns to the operator.

Value of Restricting Resources

The marginal value product, MVP, as used in conventional production theory, is the addition total revenue by increasing the use of the variable input by one unit, ceteris paribus. The solving of the income maximization primal results in a simultaneous solution of the maximization dual. The dual solution provides estimates of the MVP value ("shadow" price) of one more unit of a restricting resource. Resources that are not completely utilized will have a "shadow" price of zero.

Estimates of the marginal value products of restricting resources (labor and government allotments) and estimated land values for the eight optimal farm organizations discussed in the two previous sections are shown in Table 36. The marginal value product of one more hour of June operator labor in the base situation with all enterprises considered is $9.34. This means that an increase in the availability of one more hour of operator labor in June, ceteris paribus, will result in an increase of the objective function (increase the annual net returns to land, operator labor, and management) by $9.34. An additional hour of seasonal hired labor in June would increase net returns by $6.60. The dual solution does not determine, however, over what range this "shadow" price will hold.

The MVP for one more acre of Soil I in the base situation, all enterprises considered, was $7.81. In the same situation, the "shadow"

Table 36. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm with All Enterprises and Only Beef and Associated Feed Enterprises Considered by Labor Situation

Resource	Unit	Labor Situation[a]							
		Base		Base (High Wage)		B		A	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
		Dollars							
Land Value[b]									
Soil I	ac.	739	1009	763	822	507	317	458	88
Soil II	ac.	267	458	292	368	144	141	127	68
Soil III	ac.	108	265	128	204	29	114	31	9
Soil IV	ac.	---	96	8	69	---	60	---	--
Representative acre[c]	ac.	300	450	315	363	196	151	178	43
Labor									
Operator[d]									
April	hr.	4.33	2.01	3.05	3.05	16.01[e]	20.37[e]	24.00	31.20
June	hr.	9.34	2.01	3.05	3.05	17.74[e]	----	11.10	3.78
Seasonal									
April	hr.	2.09	----	----	----	N.A.	N.A.	N.A.	N.A.
June	hr.	6.60	----	----	----	N.A.	N.A.	N.A.	N.A.
Government Allotments									
Feed grain base	ac.	7.99	5.04	4.32	19.52	-----	24.85	-----	-----
Cotton allotment	ac.	89.07	N.A.	95.23	N.A.	88.6	N.A.	93.36	N.A.
Wheat allotment	ac.	4.31	N.A.	4.79	N.A.	25.44	N.A.	31.17	N.A.

Table 36 (continued)

[a]Labor situations were: Base--operator plus a maximum of two seasonal men in any month paid a wage of $1.75 per hour; Base high wage--hired men paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[b]Value of land which could be justified (income approach) by a 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[c]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

[d]Includes those months in which the operator and seasonal labor were fully utilized. In months where the operator labor was fully utilized and hired labor was not, the MVP was equal to $2.01 per hour in the base situation and $3.05 in the high wage rate situation.

[e]Includes the monthly hours of labor supplied by the full time hired hand.

price for another acre of Row Crop I was estimated to be $45.67. The MVP estimates for soil and row crop groups were capitalized, using a 6 percent capitalization rate, to estimate the approximate value the operator could afford to pay for an additional acre of land. Since an additional acre of Soil I included the equivalent of eight-tenths of an acre of Row Crop I (Table 8, page 33), the estimated value in Table 36 includes the potential earning rate of the row crop land. For example, an additional acre of Soil I would add $7.81 (its "shadow" price) plus eight-tenths of the "shadow" price of one more acre of Row Crop I ($45.67). Thus, one more acre of Soil I would actually return a total of $44.35. Using a capitalization rate of 6 percent a land value of $739 per acre could be justified for Soil I. Other estimates of land values were obtained in the same manner.

Additional land values were obtained for a representative acre of land in the study area. These were obtained by multiplying the "shadow" price of each soil and row crop group in each solution by the percentage makeup of a representative acre of land (see Table 9, page 36) and summing to get a representative marginal value product for one acre of land. These MVP's were also capitalized at 6 percent to obtain a value which farm operators could pay for an additional representative acre.

Land values were greater when only beef and associated feed enterprises were considered than when all enterprises were included in the model when seasonal labor was available. However, a more limited supply of labor had the opposite effect. Generally, the marginal values of the soil and row crop goups and land values decreased as the

land:labor ratio increased, which is consistent with the work done by Anderson (1).

The available supply of operator labor was fully utilized in April for every labor situation and in June in most situations. The availability of labor in these months is critical to the farm operation which is reflected by the relatively large "shadow" prices in Labor Situations A and B.

A high "shadow" price was associated with the cotton allotment in every situation in which all enterprises were considered, and the highest marginal return to the cotton allotment occurred for the high wage rate situation. Expressed in terms of marginal value per pound of lint, the value ranged from 11.8 cents per pound in Labor Situation B to 12.7 cents in the high wage rate situation. These values are considerably larger than those found by Anderson (1) who obtained marginal values of 4.8-5.4 cents per pound and Trevena and Keller (37) who obtained lease values of 5.1 cents per pound.

The feed grain base was restrictive with the larger labor supply in all situations. The feed grain base was not restrictive for Labor Situation B when all enterprises were considered or for Labor Situation C for either enterprise assumption. Expressed in cents per bushel, the "shadow" price for the feed grain base ranged from 4.8 cents at the high wage rate--all enterprises considered--to 27.6 cents per bushel with the two men labor supply when only beef and associated feed enterprises were considered.

III. Change in Cost and Conditions of Capital

Both operating capital and investment capital was assumed to be unlimited for this study, and the amount of capital needed in the optimal solution could be obtained either internally or externally. Interest rates (capital charges) were varied in this section to determine the effects of such variations on enterprise combinations, net returns, and resource allocation. Interest rate variations could be alternatively interpreted to reflect various levels of risk, variations in the cost of capital, or variations in the farmer's equity position. Interest rates were varied from the base situation of 6 percent and 7 percent charge for investment and operating capital, respectively (Situation A), to 8 percent and 10 percent (Situation B), and to 10 percent and 18 percent (Situation C). An additional situation was considered with investment capital charged at 6 percent and operating capital charged at 7 percent but with no investment capital required on the brood cows of either cow-calf enterprise (Situation D).

All Enterprises--Enterprise Combinations

Capital Situation B. In Capital Situation B, operating capital was charged as a cost at 10 percent annually, and investment capital was charged at a rate of 8 percent annually as compared to 7 and 6 percent, respectively, for the base situation. This change in the cost of capital had very little effect on the optimal combination of enterprises when all enterprises were considered (Table 37). Pasture production, stocker steer I, and feeder steer II all declined somewhat

Table 37. Optimal Enterprise Organization for the 450 Acres Representative Farm, All Enterprises Considered, by Capital Situation

Enterprise	Unit	Capital Situation[a] A (Base)	B	C	D
Beef					
Feeder steer II	hd.	11.8	.9	----	11.8
Stocker steer I	hd.	88.7	83.3	----	88.7
Cow-calf I	cow	13.0	13.5	----	13.0
Other Livestock					
Hog finishing	3.5 hd.[b]	100.0	100.0	89.4	100.0
Feeder pig	2 sows	42.1	42.5	49.3	42.1
Livestock Feed					
Pasture:					
Permanent pasture	ac.	48.4	46.8	----	48.4
Bermuda pasture	ac.	60.6	57.0	----	60.6
Other forage:					
Corn silage	ac.	4.1	0.3	----	4.1
Corn stover	ac.	78.0	81.8	84.6	78.0
Concentrate:					
Corn (gov. program)	ac.	62.1	62.1	62.1	62.1
Corn (other)	ac.	15.9	19.7	22.5	15.9
Buy corn	bu.	419.2	----	----	419.2
Cash Crops					
Cotton (gov. program)	ac.	44.1	44.1	44.1	44.1
Wheat (gov. program)	ac.	1.4	1.4	1.4	1.4

[a]Capital charges for operating and investment capital respectively are: Situation A--7%, 6%; B--10%, 8%; C--18%, 10%; D--7%, 6% with no investment capital required on brood cows.

[b]Continuous feeding of purchased pigs, 3.5 batches per year. A limit of 100 units was set.

from the base situation. Operating capital requirements were relatively higher for the beef feeding alternatives. Cow-calf production, however, was slightly higher than for the base situation. Corn acreage was slightly larger, probably due to the higher amounts of operating capital required for purchased corn as compared to farm produced corn.

Other cash enterprises in the optimal solution included hog finishing (at its maximum level), feeder pig production, cotton, and wheat (both up to the maximum amount of allotment). Enterprise mix and levels were essentially the same as for the base situation.

Capital Situation C. The increase in interest rates to 18 percent and 10 percent for operating and investment capital, respectively, had a large effect on beef systems included in the optimal solution Table 37). Since the beef feeding and stocker systems require a relatively large amount of operating capital as compared to their returns and the cow-calf systems are rather large users of investment capital, no beef system was included in the optimal solution. Hog finishing was slightly lower than the base situation while feeder pig production was higher (14 sows). Corn production accounted for 84.6 acres--slightly higher than for the base situation. All corn produced would be fed with no corn being purchased. Neither cotton nor wheat production, under the government program, was affected.

Capital Situation D. Apparently many beef producers have accumulated breeding herds by retaining heifers from their own herds with no direct outlay of investment capital required (32). In Capital Situation D, no investment capital requirement was specified for brood cows for either of the cow-calf alternatives.

In the base situation, the investment capital requirement was $282 per brood cow (including the prorated share of the replacement heifers) for both cow-calf systems. Since investment capital was charged at 6 percent in the base situation, the elimination of the investment capital requirement had the net effect of increasing, by $15 per brood cow unit, the net returns to land, operator labor, and management for each of the cow-calf alternatives.

The elimination of the investment capital requirement for brood cows had no effect on the optimal combination (Table 37). Cow-calf system I was included at a level of 13 brood cows, which is the same level as for the base situation.

All Enterprises--Resource Allocation and and Net Returns

Capital Situation B. The effects of changes in capital situations on resource use and net returns are shown in Table 38. Increasing the capital charge to 8 and 10 percent (Situation B) resulted in slight decreases in use of available land, hired seasonal labor, and both operating and investment capital. With Capital Situation B, 56 acres of Soil IV would remain idle, slightly greater than the base situation. Hired labor was reduced by 36 hours, and total capital required was reduced by nearly $2300. June was the only month in which all available labor (both operator and allowable hired seasonal) would be utilized. Hired seasonal labor in April was only 8.5 hours less than the maximum allowable.

Net returns were $1319 lower (6.5 percent) than for the base situation.

Table 38. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, All Enterprises Considered, by Capital Situation

Item	Unit	Capital Situation[a] A (Base)	B	C	D
Land					
Soil I	ac.	161	161	128	161
Row crop I	ac.	128	128	128	128
Soil II	ac.	36	36	12	12
Row crop II	ac.	12	12	12	12
Soil III	ac.	65	65	38	65
Row crop III	ac.	13	13	13	13
Soil IV	ac.	21	16	---	21
Total openland	ac.	283	278	178	283
Total openland available	ac.	334	334	334	334
Labor					
Operator labor available	hr.	2,509	2,509	2,509	2,509
Operator labor used	hr.	2,509	2,509	2,509	2,509
Hired seasonal	hr.	2,887	2,851	2,970	2,887
Total used	hr.	5,396	5,360	5,479	5,396
Capital[b]					
Operating capital	$	23,659	21,626	13,127	23,659
Investment capital (non-land)	$	32,298	32,043	25,938	28,647
Net Returns[c]	$	20,216	18,897	17,033	20,435

[a]Capital charges for operating and investment capital respectively are: Situation A--7%, 6%; B--10%, 8%; C--18%, 10%; D--7%, 6% with no investment capital required on brood cows.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[c]Returns to land, operator labor, and management.

Capital Situation C. The change of the interest rates charged on operating and investment capital to 18 percent and 10 percent, respectively, had a much larger effect on resource utilization and net returns than did Capital Situation B (Table 38). Almost 45 percent less operating capital and 20 percent less investment capital was required than for the base situation.

For Capital Situation C, the optimal solution included 156 acres of idle land, most of which were non-row crop acres. All row crop acreage was utilized primarily for corn and cotton production. Nearly 25 acres would be required as pasture for thw sows. Seasonal hired labor was 2.9 percent higher than for the base situation apparently to handle the larger swine operation. June was the only month in which all labor available (operator and allowable hired) was fully utilized.

Net returns were $3,183 or 15.7 percent lower than for the base situation. Net returns were 9.8 percent lower than for Capital Situation B.

Capital Situation D. Removal of the investment capital charge for the brood cows affected only the amount of investment capital required and net returns to land, operator labor, and management (Table 38). Investment capital requirements were approximately $3,650 lower than for the base capital situation. Net returns to land, operator labor, and management were $219 greater.

Beef and Associated Feed Enterprises--Enterprise Combinations

Capital Situation B. When interest rates were changed to 8 percent

and 10 percent for investment and operating capital, respectively, the same feef-feed enterprises were included in the optimal solution as for the base situation (Table 39). The higher interest rates did, however, effect the quantity of beef fed. The relatively high capital requiring feeding operations were 16 head lower than for the base situation. The higher interest rates had no effect on the number of stockers produced.

Total acreage in corn silage was reduced only two acres as compared to the base situation, but 14 acres less silage would be grown on Soil I and 12 acres more would be grown on Soil II. Reduction of the level of feeder steer II decreased the amount of silage required. Operating capital requirements per acre for silage on Soil II was slightly lower than on Soil I.

No corn was purchased and all corn grown was fed. Bermuda hay and corn stover supplied the dry forage needs of the feeding operation.

Capital Situation C. As was the case when all enterprises were considered, an increase in the interest rates to 18 percent for operating capital and 10 percent for investment capital had a much greater effect on the beef systems than did Capital Situation B. Total beef animals in the optimal solution for Capital Situation C was 374 compared to 456 for the base situation. The solution included about six head of feeder steer III which require less operating capital than feeder steer II because of the shorter feeding period (Table 13, page 44).

Stocker steer I production was almost one third lower than for the base situation. Pasture production was also considerably lower.

Table 39. Optimal Enterprise Organization for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Capital Situation

Enterprise	Unit	Capital Situation[a] A (Base)	B	C	D
Beef					
Feeder steer II	hd.	298.5	282.8	258.1	268.6
Feeder steer III	hd.	-----	-----	5.8	-----
Stocker steer I	hd.	157.5	157.6	109.8	87.6
Cow-calf II	cow	-----	-----	-----	42.5
Beef Feed					
Pasture:					
Permanent pasture	ac.	77.0	77.0	42.7	94.7
Bermuda pasture	ac.	92.8	93.5	54.9	77.0
Other forage:					
Corn silage	ac.	75.4	73.5	63.9	75.4
Corn stover	ac.	62.1	64.0	62.1	62.1
Wheat-red clover hay	ac.	-----	-----	22.9	-----
Bermuda hay	ac.	11.2	10.5	-----	9.3
Concentrate:					
Corn (gov. program)	ac.	62.1	62.1	62.1	62.1
Corn (other)	ac.	-----	1.9	-----	-----
Buy corn	bu.	632.6	-----	-----	-----

[a]Capital charges for operating and investment capital respectively are: Situation A--7%, 6%; B--10%, 8%; C--18%, 10%; D--7%, 6% with no investment capital required on brood cows.

Corn was included in the solution at the maximum allotment acreage, and all corn would be fed. Corn silage, corn stover, and red clover hay (and aftermath grazing) made up the rest of the feed systems utilized in the production of beef. Red clover hay (double cropped with wheat) replaced bermuda hay as a dry roughage reflecting the lower amount of operating capital required for the hay double cropped with a small grain.[3]

Capital Situation D. When investment capital was not required for the brood cows in either cow-calf system, cow-calf II production was the optimal solution at 42.5 brood cows (Table 39). This was the only capital situation, when only beef and associated feed enterprises were considered, that any beef cows were included in the optimal solution.

Both feeder steer II and stocker steer I numbers were lower than the base situation. The number of stocker steers was 44 percent lower. All steers produced under the cow-calf II system were fed for slaughter.

The optimal feed enterprises also changed from the base situation. Over one half of the openland available was utilized for pasture production. Acreage in permanent pasture was larger while acreage in bermuda pasture was smaller than for the base situation, reflecting the nutrient needs of the brood cows in the spring and fall months in which bermuda pasture is dormant.

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[3]Hay from permanent pasture has lower operating capital requirements than red clover-wheat (Appendix Table B-1) but the nutrients produced by the permanent pasture in the spring are needed for grazing purposes by the stocker enterprise.

Bermuda hay, corn silage, corn grain (grown under the government program), and corn stover provided the other farm produced feed for the beef systems.

Beef and Associated Feed Enterprises--Resourse Allocation and Net Returns

Capital Situation B. Beef enterprises require a considerable amount of capital. Thus, the higher interest rates had a much greater effect on net returns (both in absolute and percentage terms) from the base situation (Table 40) than when all enterprises were considered (Table 38).

The higher interest rates resulted in some reduction in operating and investment capital requirements (Table 40). The amount of both operator and hired labor use was lower than for the base situation. March, April, and May were the only months in which all the operator labor available was exhausted.

Capital Situation C. The effect on net returns and resource allocation on beef farms when capital was charged at 18 percent for operating capital and 10 percent for investment capital is shown in Table 40. The optimal amount of both operating capital and investment capital required was about 16 percent lower than for the base situation and about 13 percent lower than for Situation B. However, the decline in the amount of capital required was much less on beef farms than when all enterprises were considered (Table 38). For example, the amount of operating capital was 17 percent lower than for the base situation on beef farms while the required quantity was 45 percent lower than for the base situation when all enterprises were considered.

Table 40. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Capital Situation

Item	Unit	Capital Situation[a] A (Base)	B	C	D
Land					
Soil I	ac.	161	161	161	161
Row Crop I	ac.	128	128	128	128
Soil II	ac.	36	36	36	36
Row Crop II	ac.	12	12	12	12
Soil III	ac.	65	65	65	65
Row Crop III	ac.	13	13	13	13
Soil IV	ac.	72	72	---	72
Total openland	ac.	334	334	262	334
Total openland available	ac.	334	334	334	334
Labor					
Operator labor available	hr.	2,509	2,509	2,509	2,509
Operator labor used	hr.	2,231	2,180	1,969	2,306
Hired seasonal	hr.	614	574	400	583
Total used	hr.	2,845	2,754	2,369	2,889
Capital[b]					
Operating	$	56,605	54,302	46,906	48,885
Investment (non-land)	$	24,842	24,095	21,283	25,966
Net Returns[c]	$	11,052	8,906	4,322	11,286

[a]Capital charges for operating and investment capital respectively are: Situation A--7%, 6%; B--10%, 8%; C--18%, 10%; D--7%, 6% with no investment capital required on brood cows.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[c]Returns to land, operator labor, and management.

The high interest rates also changed the amount of land and labor utilized. In the optimal solution for Capital Situation C, all of Soil IV was left idle, and only 400 hours of seasonal labor was hired.

Net returns to land, operator labor, and management were only $4,322 or lower than for the base situation. This compares to a decline of 15.7 percent in net returns for similar changes in capital charges when all enterprises were considered. Thus, higher interest rates viewed either as a higher charge for external capital or higher risk for internal capital had a much greater effect on net returns on beef farms than when the optimal farm organization included row crop and swine enterprises.

Capital Situation D. When no investment capital was required for brood cows, all land was fully utilized (Table 40). Some shift in labor utilization occurred with more operator labor and less hired labor utilized than for the base situation. Operator labor was fully utilized from February through June while all other months except August and September had less than 44 hours unused labor per month. In no month was all available hired labor utilized.

The optimal amount of operating capital was 14 percent lower while the amount of investment capital was 4.5 percent higher than for the base capital situation. Net returns, however, were only $234 higher than for the base situation (Table 40).

Value of Restricting Resources

The effects of variations in capital costs on estimated land values and the marginal values of restricting resources are shown in

Table 41. When the organization was limited to beef and associated feed enterprises, increases in capital costs resulted in a decline in estimated land values calculated from "shadow" prices for both the soil group and row crop land. When all enterprises were included in the model, the "shadow" prices declined for all soil groups but increased for row crop land. Estimated land values declined from the base situation to Capital Situation B but increased somewhat from Situation B to Situation C due to the relatively high "shadow" prices of row crop acreage. The changes reflect the decreasing profitability (with higher interest rates) of the relatively large capital requiring beef enterprises, which utilize considerable land.

The effects on the marginal returns of operator labor from increasing the cost of capital, is also shown in Table 41. The marginal returns on operator labor, for those months in which the available supply of hired labor was not exhausted, increased with higher interest rates because of the increased capital cost associated with each dollar necessary to pay the hired workers.

As the interest rates increased, the "shadow" prices decreased for the feed grain base and the wheat allotment. The marginal values per acre of the cotton allotment remained high, ranging from $88.15 to $92.30 per acre.

When investment capital was not charged against the brood cows, estimated land values declined when all enterprises were considered and also for Soil I on the beef representative situation. In both representative situations, however, the "shadow" prices increased for

Table 41. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Capital Situation.

Resource	Unit	Capital Situation[a] A (Base) All	A (Base) Beef-Feed	B All	B Beef-Feed	C All	C Beef-Feed	D All	D Beef-Feed
		Dollars							
Land Value[b]									
Soil I	ac.	739	1009	685	769	738	485	690	980
Soil II	ac.	267	458	219	349	219	158	248	458
Soil III	ac.	108	265	74	196	82	64	98	270
Soil IV	ac.	---	96	---	70	---	---	---	105
Representative acre[c]	ac.	300	450	272	342	292	195	288	442
Labor									
Operator[d]									
April	hr.	4.33	2.01	2.04	2.04	2.12	2.12	3.00	2.01
June	hr.	9.34	2.01	10.41	---	7.41	---	10.37	2.01
Seasonal									
April	hr.	2.09	---	---	---	---	---	.89	---
June	hr.	6.60	---	7.53	---	4.77	---	7.52	---
Government Allotments									
Feed grain base	ac.	7.99	5.04	5.65	24.24	2.14	13.48	19.77	5.87
Cotton allotment	ac.	89.07	N.A.	92.30	N.A.	88.15	N.A.	93.41	N.A.
Wheat Allotment	ac.	4.31	N.A.	3.76	N.A.	---	N.A.	10.10	N.A.

Table 41 (continued

[a]Capital charges for operating and investment capital respectively are: Situation A--7 percent, 6 percent; B--10 percent, 8 percent; C--18 percent, 10 percent; D-- 7 percent, 6 percent with no investment capital required on brood cows.

[b]Value of land which could be justified (income approach) by 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[c]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

[d]Includes those months in which operator and seasonal labor were fully utilized. In months where the operator labor was fully utilized and the hired labor was not, the MVP was equal to $2.01 in Situations A and D, $2.04 in Situation B, and $2.12 in Situation C.

the soil groups while declining for row crop land from their respective base situations. This indicates that as the cow-calf enterprises became more profitable, as compared to other alternatives, land utilized for pasture becomes relatively more valuable as compared to the value of row crop land.

IV. Livestock Price Variations

All livestock prices were varied from the base price situation to analyze the effect of such variations on beef and associated feed systems, net returns, and resource use. A high and low livestock price situation was compared to the base situation (See Table 17, page 49).

Since livestock prices tend to move together, both hog and cattle prices were varied simultaneously. At the time of this study, the price range variation for hogs tended to be greater than for beef cattle primarily due to the shorter and greater production response of hog producers to changes in cost and/or returns of production. Thus, the magnitude of the hog price variations was greater than the beef price variations from their respective base price situations.

Enterprise Combinations--All Enterprises

High Price Situation. The high livestock price situation resulted in a relatively large decrease in the number of beef cattle in the optimal solution with a relatively large increase in the number of hogs produced. This reflects, to some extent, the greater percentage increase in hog prices.

Increasing the livestock prices resulted in no fed beef animals and only 38 stocker steers in the optimal solution (Table 42). Cow-calf I was the only other beef enterprise in the solution (17.3 cows). Pasture production was lower than for the base situation with approximately 61 acres in the optimal solution. No silage was included.

With the higher hog prices, it became profitable to finish hogs produced on the farm as well as purchased feeder pigs for slaughter. Sixty-four sows were included in the optimal solution. All pigs would be finished to slaughter weight. Altogether, over 1,300 hogs would be finished for slaughter. Grain for the swine operation would be provided by a combination of the 70.6 acres of corn grown and 9,658 bushels of purchased corn.

Cotton produced under the government program remained an important cash crop with 44.1 acres produced--the same level as when the base livestock prices were used. Only a relatively small amount of wheat and soybeans were included in the optimal solution.

Low Price Situation. The low livestock price situation had a considerable effect on the optimal farm organization with the greater change in hog prices having a dominant effect on the optimal solution. Beef feeding and the stocker steer production replaced swine feeding as the major livestock enterprise (Table 43). Almost 200 heifers (under feeding system II) and 155 stocker steers were included in the optimal solution, while no hogs were finished for slaughter. Only 22.4 sows for feeder pig production were in the solution.

At the low livestock prices, pasture enterprises accounted for over

Table 42. Optimal Enterprise Organization for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Livestock Price Situation

Enterprise	Unit	Livestock Price Situation					
		Base		High		Low	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
Beef							
Feeder steer II	hd.	11.8	298.5	--	351.9	--	261.4
Feeder heifer II	hd.	--	--	--	--	198.5	--
Feeder heifer IV	hd.	--	--	--	--	--	43.1
Stocker steer I	hd.	88.7	157.5	38.1	151.2	155.0	143.3
Cow-calf I	cow	13.0	--	17.3	--	--	--
Cow-calf II	cow	--	--	--	3.3	--	--
Other Livestock							
Hog finishing	3.5 hd.[a]	100	N.A.	100	N.A.	--	N.A.
Feeder pig	2 sows	42.1	N.A.	--	N.A.	11.2	N.A.
Farrow-finish	2 sows	--	N.A.	32.1	N.A.	--	N.A.
Livestock Feed							
Pasture:							
Permanent pasture	ac.	48.4	77.0	29.3	78.0	74.8	103.6
Bermuda pasture	ac.	60.6	92.8	31.6	87.5	96.7	68.1
Other forage:							
Corn silage	ac.	4.1	74.5	--	84.5	34.3	75.4
Corn stover	ac.	78.0	62.1	70.6	54.8	52.6	62.1
Bermuda hay	ac.	--	11.2	--	15.5	3.9	9.3
Concentrate:							
Corn (gov. program)	ac.	62.1	62.1	62.1	54.8	52.6	62.1
Corn (other)	ac.	15.9	--	8.5	--	--	--
Buy corn	bu.	419.2	632.6	9658.4	2686.6	--	297.1

Table 42 (continued)

Enterprise	Unit	Livestock Price Situation					
		Base		High		Low	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
Cash Crops							
Cotton (gov. program)	ac.	44.1	N.A.	44.1	N.A.	44.1	N.A.
Wheat (gov. program)	ac.	1.4	N.A.	1.4	N.A.	1.4	N.A.
Soybeans	ac.	--	N.A.	1.0	N.A.	--	N.A.

[a]Continuous feeding of purchased pigs, 3.5 batches per year. A limit of 100 units was set.

Table 43. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Livestock Price Situation

Resource	Unit	Livestock Price Situation					
		Base		High		Low	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
Land							
Soil I	ac.	161	161	161	161	161	161
Row Crop I	ac.	128	128	128	128	128	128
Soil II	ac.	36	36	36	36	36	36
Row Crop II	ac.	12	12	12	12	12	12
Soil III	ac.	65	65	6	65	65	65
Row Crop III	ac.	13	13	3	13	13	13
Soil IV	ac.	21	72	16	72	72	72
Total openland	ac.	283	334	219	334	334	334
Total openland available	ac.	334	334	334	334	334	334
Labor							
Operator labor available	hr.	2509	2509	2509	2509	2509	2509
Operator labor used	hr.	2509	2231	2509	2412	2482	2261
Hired seasonal	hr.	2887	614	3266	795	699	544
Total used	hr.	5396	2845	5775	3207	3181	2805
Capital							
Operating capital	$	23,659	56,605	28,802	71,245	32,049	49,962
Investment capital (non-land)	$	32,298	24,842	60,154	28,280	22,993	24,564
Net Returns[b]	$	20,216	11,052	32,714	12,895	13,458	9,312

[a]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[b]Returns to land, operator labor, and management.

one half the openland of the representative farm (172 acres). Over 34 acres of silage and 3.9 acres of bermuda hay were produced to meet the nutrient needs of the feeder heifers. Almost 10 acres of the feed grain base was not utilized. All corn produced would be fed with no corn being purchased.

Enterprise Combinations--Beef and Associated Feed Enterprises

High Price Situation. The high livestock price situation had little effect on the organization of the beef and associated feed representative farm when compared to the situation when all enterprises were considered (Table 42). The cow-calf II enterprise was the only enterprise in the optimal solution with high livestock prices which was not included in the base solution. Feeder steer II (351.9 head) and stocker steer (151.2 head) were the main income producing enterprises with only 3.25 brood cows in the solution.

Pasture production was slightly lower while acreage in corn silage and bermuda hay were greater than for the base situation. Fifty-five acres of corn would be produced under the government program. An additional 2,687 bushels of corn would be purchased for feed.

Low Price Situation. Cattle feeding and stocker steers were the only income generating enterprises for the low livestock price situation (Table 42). No brood cows were included in the solution. The total quantity of cattle fed was six head larger than the base situation although 14 percent of the cattle were heifers fed under system IV. Stocker steer I was included in the optimal solution at a level of

143 head--a decline of approximately 14 head from the base situation.

Pasture production utilized over one half of the total openland of the beef representative farm. Over 100 acres was utilized for permanent pasture. Other feeds produced included corn silage, corn, and bermuda hay. An additional 297 bushels of corn would be purchased.

Resource Allocation and Net Returns--All Enterprises

High Price Situation. High livestock prices, ceteris paribus, had a considerable effect on optimal resource use and net returns on the representative farm situation. With the shift from beef and feeder pig enterprises to swine feeding enterprises (Table 42), a corresponding shift in resource use occurred--from land to labor and capital, especially investment capital (Table 43). For the high livestock price situation, approximately 115 acres of openland were not used. The amount of land utilized was 23 percent lower than for the base situation. The amounts of hired labor, operating capital, and investment capital were 13 percent, 22 percent, and 86 percent higher, respectively, than for the base price situation. These changes in resource use reflect the relatively large amount of capital and labor required for the farrow to finish enterprise.

The higher livestock prices had a large effect on net returns to land, operator labor, and management. Net returns were $32,714 or 61.8 percent greater than the net returns for the base price situation.

Low Price Situation. The assumed prices for livestock had a large effect on the net returns of the representative farm (Table 23, p. 60).

Net returns to land, operator labor, and management with low livestock prices were $13,458. These returns are 33.4 percent lower than for the base situation and 58.8 percent ($19,256) lower than for the high price situation.

Generally, the low livestock price situation had an opposite effect on resource use as compared to the high price situation. All available land was utilized while lesser amounts of operator labor, investment capital, and the feed grain base were utilized. The amount of operating capital, however, was 35.5 percent larger, reflecting the large increase in beef feeding in the optimal solution for the low price situation. Seasonal labor was hired only in March, June, and December, and in no month was the maximum amount of available labor (operator and allowable hired) exhausted.

Resource Allocation and Net Returns--Beef and Associated Feed Enterprises

High Price Situation. Net returns to the representative beef farm situation were greater with higher livestock prices (16.7 percent) than for the base situation, but the change was much less than when all enterprises were considered (Table 42). All land was utilized in both the base and high livestock price situation. Larger amounts of operator and hired labor were utilized with higher livestock prices, and operator labor was fully utilized from February through June. April was the only month in which the maximum amount of allowable seasonal labor was hired.

The amount of operating capital required was $14,640 (26 percent) greater than for the base price situation, reflecting not only the

greater quantity of beef produced but also the higher prices for the feeder and stocker cattle purchased.

Low Price Situation. Net returns for the beef and associated feed representative farm situation with low livestock prices were $9,312. This represents a decline in net returns of $1,740 (15.7 percent) from the base beef-feed situation (Table 43).

Net returns were $4,146 less than when all enterprises were considered under the low livestock price situation. This compares to a difference of $9,165 in the base livestock price situation and $19,819 in the high livestock price situation.

Resource allocation changed very little from the base price situation except for the lower amount of operating capital required. Lower purchase price of feeder animals substantially lowered the operating capital requirements of the beef enterprises.

Value of Restricting Resources

The effect of variations in livestock prices and enterprise alternatives on the estimated land values and the marginal value products of restricting resources is shown in Table 44. The estimated land values increased from the base situation when only beef and associated feed enterprises were considered with the high livestock price assumption while declining with the low livestock price assumption.

When all enterprises were considered, the change in the livestock prices levels resulted in an opposite movement in estimated land values. When the livestock price level was increased, land values declined from the base situation while increasing from the base situation

Table 44. Estimated Land Value and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Livestock Price Situation

Resource	Unit	Livestock Price Situation					
		Base		High		Low	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
Land Value[a]							
Soil I	ac.	739	1009	389	1082	915	781
Soil II	ac.	267	458	92	548	354	311
Soil III	ac.	108	265	--	342	169	154
Soil IV	ac.	--	96	--	161	12	20
Representative acre[b]	ac.	300	450	146	505	380	328
Labor							
Operator[c]							
April	hr.	4.33	2.01	16.51	2.37	2.01	2.01
June	hr.	9.34	2.01	20.89	2.01	2.01	2.01
Seasonal							
April	hr.	2.09	--	13.05	.32	--	--
June	hr.	6.60	--	16.99	--	--	--
Government Allotments							
Feed grain base	ac.	7.99	5.04	13.99	--	--	23.87
Cotton allotment	ac.	89.07	N.A.	84.49	N.A.	89.84	N.A.
Wheat allotment	ac.	4.31	N.A.	32.54	N.A.	--	N.A.

[a]Value of land which could be justified (income approach) by 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[b]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

[c]Includes those months in which the operator and seasonal labor were fully utilized. In months where the operator labor was fully utilized and the hired labor was not, the MVP of the operator labor was equal to $2.01 per hour.

with the lower livestock price assumption. These changes in land values reflect the major shifts in the optimal livestock mix (Table 42). With the high livestock price level, the farrow to finish hog enterprise (which requires a relatively small amount of land) was the primary livestock enterprise. However, in the low price situation, feeder heifers, stocker steers and their associated farm produced feeds (which utilize a relatively large amount of land) were the primary enterprises.

Changing livestock prices had a considerable effect on the "shadow" prices for operator and seasonal labor and the feed grain base when all enterprises were considered (Table 45). At the high livestock price, the "shadow" price for April operator labor was $16.51 per hour as compared to only $4.33 per hour at base prices. "Shadow" prices for seasonal labor were somewhat lower for comparable time periods. One acre of feed grain base had an estimated value of $7.99 using base prices and $13.99 using high livestock prices. Feed grain base was not restrictive at the low livestock price level.

V. Deletion of the 1972 Farm Program

The base situation for this study included the assumption of the provisions of the 1972 Farm Program. This program was specified by the 1970 Agricultural Act and included government payments, allotments, and provisions for set aside acres for those producers wishing to participate in the cotton, wheat, and feed grain programs.

At the time this study was initiated, it was generally considered that the elimination of government farm programs would result in a

Table 45. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Beef Feed Enterprises Considered With and Without the 1972 Farm Program

Enterprise	Unit	With Farm Program		Without Farm Program	
		All	Beef-Feed	All	Beef-Feed
Beef					
Feeder steer II	hd.	11.8	298.5	64.6	433.8
Stocker steer I	hd.	88.7	157.5	110.1	174.6
Cow-calf I	cow	13.0	-----	-----	-----
Other Livestock					
Hog finishing	3.5 hd.[a]	100.0	N.A.	100.0	N.A.
Feeder pig	2 sows	42.1	N.A.	38.1	N.A.
Livestock Feed					
Pasture:					
Permanent pasture	ac.	48.4	77.0	43.1	83.6
Bermuda pasture	ac.	60.6	92.8	49.6	90.3
Other forage:					
Corn silage	ac.	4.1	75.4	15.4	103.5
Corn stover	ac.	78.0	62.1	87.2	-----
Bermuda hay	ac.	-----	11.2	-----	.9
Alfalfa hay	ac.	-----	-----	-----	6.6
Wheat; red clover hay	ac.	-----	-----	36.7	49.0
Concentrate:					
Corn (gov. program)	ac.	62.1	62.1	N.A.	N.A.
Corn (other)	ac.	15.9	-----	87.2	-----
Buy corn	bu.	419.2	632.6	-----	8832.2
Cash Crops					
Cotton (gov. program)	ac.	44.1	N.A.	N.A.	N.A.
Wheat (gov. program)	ac.	1.4	N.A.	N.A.	N.A.
Soybeans	ac.	-----	N.A.	30	N.A.

[a]Continuous feeding of purchased pigs, 3.5 batches per year. A limit of 100 units was set.

substantial reduction in the market prices of corn, cotton, wheat, and soybeans. This section analyzes the effect on beef production, net farm income, and resource use when the provisions for government payments, loan rates, allotments, and set aside acres are deleted and with "free market" prices, as listed in Table 28, p. 69. "Free market" prices used for this analysis were $1.05 per bushel for corn, $.22 per pound of lint cotton, $1.15 per bushel for wheat, and $2.20 per bushel for soybeans.

Enterprise Organization--All Enterprises Considered

With the deletion of the 1972 Farm Program, cattle feeding became a more competitive enterprise, and a much larger number of fed animals were included in the optimal system (Table 45). When all enterprises were considered, the deletion of the 1972 Farm Program options resulted in an increase in the feeder steer II enterprise from 11 to 65 head and an increase in stocker steer I from 89 to 110 animals. No cow-calf unit was included in the solution without the 1972 Farm Program.

Both permanent pasture and bermuda pasture production was lower without the government program while corn grain and silage production was greater. No corn was purchased. Almost 37 acres of wheat, double cropped with red clover hay, were included in the optimal solution. This enterprise not only furnished a cash crop (wheat) but also hay for the feeder steers and grazing in September for the stocker steer enterprise.

The deletion of the farm program had only minor effect on the

hog enterprises. The optimal solution included hog finishing at its maximum level of 100 units and 76.2 sows producing feeder pigs for sale. Soybeans replaced cotton as the principle cash crop.

Enterprise Organization--Beef and Associated Feed Enterprises

In the free market situation, beef feeding became a more competitive alternative as shown in Table 45. Without the farm program in effect, 434 head of feeder steer II were in the optimal solution. This represents an increase of 135 head (45 percent) from the solution which included the government program provisions. Stocker steer production was also approximately 11 percent larger.

With no government program in effect, all the corn needed for steer feeding was purchased. All available land was utilized for forage production--173.9 acres of pasture, 103.5 acres of silage, and 56.0 acres of hay. The large amount of hay, especially red clover, was needed as a dry roughage for the feeder steers since no corn stover was available. Aftermath grazing of the hay crops also supplied nutrients for the stocker enterprise in September.

Resource Allocation and Net Returns--All Enterprises

The deletion of the government farm program had a large effect on net returns to operator labor, management, and land (Table 46). Net returns in this situation were $7,470 (37 percent) lower than when the government payments and higher prices were in effect. Land utilization was slightly lower (two acres), and the amount of hired labor was 78 hours lower than for the base situation. The maximum amount of hired labor available was utilized in April and June.

Table 46. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With and Without the 1972 Farm Program

Resource	Unit	With Farm Program		Without Farm Program	
		All	Beef-Farm	All	Beef-Feed
Land					
Soil I	ac.	161	161	161	161
Row Crop I	ac.	128	128	128	128
Soil II	ac.	36	36	36	36
Row Crop II	ac.	12	12	12	---
Soil III	ac.	65	65	65	65
Row Crop III	ac.	13	13	11	---
Soil IV	ac.	21	72	19	72
Total openland	ac.	283	334	281	334
Total openland available	ac.	334	334	334	334
Labor					
Operator labor available	hr.	2,509	2,509	2,509	2,509
Operator labor used	hr.	2,509	2,231	2,509	2,446
Hired seasonal	hr.	2,887	614	2,809	1,179
Total used	hr.	5,396	2,845	5,318	3,625
Capital[a]					
Operating Capital	$	23,659	56,605	30,465	78,539
Investment Capital (non-land)	$	32,298	24,842	31,448	31,376
Net Returns[b]	$	20,216	11,052	12,746	9,718

[a]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[b]Returns to land, operator labor, and management.

The optimal amount of operating capital required was 28.8 percent larger while the amount of investment capital required was somewhat lower.

Resource Allocation and Net Returns--Beef and Associated Feed Enterprises

When the model was restricted to only beef and associated feed enterprises, all openland was utilized, but row crop soils of Groups II and III were used for pasture and hay crops and not row crops as in the base situation (Table 46). The amount of both operator and hired seasonal labor was higher. Operator labor was fully utilized inall months except July, September, and November. Total labor utilized was 27 percent larger than when the government program was included in the model.

With the relatively large amount of stocker and finishing cattle in the optimal solution, $78,589 of operating capital was required--about 29 percent greater than for the base situation. Investment capital required was 26.3 percent greater than for the base situation.

The deletion of the government farm program alternatives had a lesser effect on net returns on the beef-feed representative situation than when all enterprises were considered. With enterprise alternatives limited to beef and associated feed production, net returns were $9,718--12 percent lower than for the base situation.

Value of Restricting Resources

The effect on the marginal values of the limited resources and the estimated land values resulting from the eliminations of the

government program alternative is shown in Table 47. When all enterprises were considered, the deletion of the government program resulted in lower "shadow" prices for all soil groups with considerable larger declines for row crop land. These lower "shadow" prices are reflected in the estimated land values. The value of another acre of Soil I declined from $739 to $282 (62 percent) when all enterprises were considered. The value of a representative acre declined from $300 to $112 (63 percent). When only beef and associated feed enterprises were included in the model, the deletion of the government program alternative resulted in a decline of $637, or 63 percent, in the value of one acre of Soil I while the value of a representative acre declined by $255 (57 percent). Obviously, land values (especially land suited for row crop production) are directly affected by the presence of a supply control farm program and associated supplemental income payments.

VI. Change in Level of the Calf Crop of the Cow-Calf Systems

Calf crop refers to the percentage of cows in the breeding herd which produce weaning calves in a twelve month period. This percentage varies from farm to farm and from year to year on the same farm. Farm management specialists and extension personnel realize that the 88 percent calf crop, used as the base situation in this study, is a high goal for many farm operators to achieve. However, many farm operators can exceed this goal with improved management techniques such as pregnancy testing, proper brood cow culling, proper bull conditioning and use, artificial insemination,

Table 47. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With and Without the 1972 Farm Program

Resource	Unit	With Farm Program		Without Farm Program	
		All	Beef-Feed	All	Beef-Feed
		----------Dollars----------			
Land Values[a]					
Soil I	ac.	739	1009	282	372
Soil II	ac.	267	458	102	252
Soil III	ac.	108	265	24	178
Soil IV	ac.	---	96	---	103
Representative acre[b]	ac.	300	450	112	195
Labor					
Operator[c]					
April	hr.	4.44	2.01	8.90	8.54
June	hr.	9.34	2.01	7.44	2.01
Seasonal					
April	hr.	2.09	---	6.20	5.88
June	hr.	6.60	---	4.88	---

[a]Value of land which could be justified (income approach) by 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[b]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

[c]Includes those months in which the operator and seasonal labor were fully utilized. In months where the operator labor was fully utilized and the hired labor was not, the MVP of the operator was equal to $2.01 per hour.

disease prevention, and adequate shelter (especially for winter calving).

The purpose of this section was to analyze the effects on the optimal organization of enterprises, resource use, and net returns when the percentage calf crop changed to 90 percent, 92 percent, and 95 percent with no change in resource requirements. This analysis was conducted when all enterprises were considered and when only beef and their associated feed enterprises were considered.

All Enterprises Considered

When the percentage of calves weaned increased from the base situation of 88 percent to 90 percent, 92 percent, and 95 percent, no change occurred in resource useage or the optimal enterprise organization. The optimal amount of cow-calf I remained constant at 13 brood cows. Net returns were $38.65, $68.32, and $135.31 greater for the 90 percent, 92 percent, and 95 percent calf crop solutions, respectively, resulting from more calves being produced from the same number of cows. The amount of feeder steers purchased for feeding also declined as the calf crop increased with no feeder steers being sold.

Beef and Associated Feed Enterprises

Variations in the calf crop percentages had no effect on the optimal enterprise combination, resource use, or net returns when only beef and their associated feed enterprises were considered.

VII. Change in the Weaning Weights Of Calves Under the Cow-Calf Systems

An increase in the weaning weight of feeder claves ia an efficiency concept, as is a larger calf crop. In both cases more output per unit of input is obtained. An increase in weaning weight can be brought about from many factors, some with little or no extra cost. Larger weaning calves can result from such practices as earlier calves, crossbreeding, and selection and improvement of the milk producing ability of the brood cows through genetics and culling.

This section analyzes the effects on enterprise organization, resource allocation, and net returns by increasing the assumed weaning weight of the steers (heifers) from the base situation of 500 (450) pounds, to 515 (465) pounds, 525 (475) pounds, and 550 (500) pounds. All increases in weaning weights were assumed to be achieved at no additional cost.

All Enterprises Considered

The higher weaning weights had no effect on the optimal organization of the representative farm when all enterprises were considered. Cow-calf I production remained at a constant level of production (13 cows) in each situation. Net returns were $44.21, $73.69, and $147.39 greater than for the base situation when the average weaning weight was increased by 15, 25, and 50 pounds, respectively.

Beef and Associated Feed Enterprises--Enterprise Organization

The increase in the average weaning weights of the feeder

calves of 15 and 25 pounds had no effect on the optimal solution. Since no cow-calf enterprise was in the optimal solution, the increased weaning weights did not change the net returns to land, operator labor, and management.

With weaning weights averaging 525 pounds (550 pound steers and 500 pound heifers), a change occurred in the optimal enterprise mix from the base situation (Table 48). This solution included 19.3 cows under system II which replaced 19 finishing steers and 31.4 stocker steers which were included in the solution for the base situation. Stocker and cow-calf systems compete for pasture nutrients at the same time period.

Total acres planted to corn and corn silage changed very little from the base situation. Total pasture acreage remained fairly constant but included more acres of permanent pasture and fewer acres of bermuda pasture. One hundred thirty-seven bushels of corn would be purchased for the feeder steers.

Beef and Associated Feed Enterprises--Resource Allocation and Net Returns

The shift in beef enterprises from stocker and finishing operations to cow-calf production resulted in lesser amounts of seasonal hired labor and operating capital while increasing the amounts of operator labor and investment capital in the optimal solution (Table 49). Cow-calf enterprises require labor in every month and can utilize labor which would not be used for other beef systems. Cow-calf production requires a relatively large amount of investment capital but a relatively small amount of operating capital as compared

Table 48. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With Variation in Weaning Weight and Calving Percentage

Enterprise	Unit	Base[a]		525 lb. weaning wt.; 88% calf crop		525 lb. weaning wt.; 95% calf crop	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
Beef							
Feeder Steer II	hd.	11.8	298.5	11.8	279.6	12.2	268.6
Stocker Steer I	hd.	88.7	157.5	88.7	126.1	65.5	87.6
Cow-Calf I	cow	13.0	--	13.0	--	14.0	--
Cow-Calf II	cow	--	--	--	19.3	15.5	42.8
Other Livestock							
Hog finishing	3.5 hd.[b]	100.0	N.A.	100.0	N.A.	100.0	N.A.
Feeder pig	2 sow	42.1	N.A.	42.1	N.A.	41.4	N.A.
Livestock Feed							
Pasture:							
Permanent pasture	ac.	48.4	77.0	48.4	84.9	58.3	94.7
Bermuda pasture	ac.	60.6	92.8	60.6	86.0	57.0	77.0
Other forage							
Corn silage	ac.	4.1	75.4	4.1	75.3	8.0	75.4
Corn stover	ac.	78.0	62.1	78.0	62.1	74.2	62.1
Bermuda hay	ac.	--	11.2	--	10.0	--	9.3
Concentrate							
Corn (gov. program)	ac.	62.1	62.1	62.1	62.1	62.1	62.1
Corn (other)	ac.	15.9	--	15.9	--	12.1	--
Buy corn	bu.	419.2	632.6	419.2	137.0	600.2	--
Cash Crops							
Cotton (gov. program)	ac.	44.1	N.A.	44.1	N.A.	44.1	N.A.
Wheat (gov. program)	ac.	1.4	N.A.	1.4	N.A.	1.4	N.A.

[a]Base situation assumes 88% calf crop; 475 lb. average weaning weight.

[b]Continuous feeding of purchased pigs, 3.5 batches per year. A limit of 100 units was set.

Table 49. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With Variations in Weaning Weight and Calving Percentage

Resource	Unit	Base		525 lb. Weaning Wt.; 88% Calf Crop		525 lb. Weaning Wt.; 95% Calf Crop	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
Land							
Soil I	ac.	161	161	161	161	161	161
Row Crop I	ac.	128	128	128	128	128	128
Soil II	ac.	36	36	36	36	36	36
Row Crop II	ac.	12	12	12	12	12	12
Soil III	ac.	65	65	65	65	65	65
Row Crop III	ac.	13	13	13	13	13	13
Soil IV	ac.	21	72	21	72	27	72
Total openland	ac.	283	334	283	334	289	334
Total openland available	ac.	334	334	334	334	334	334
Labor							
Operator labor available	hr.	2509	2509	2509	2509	2509	2509
Operator labor used	hr.	2509	2231	2509	2256	2509	2307
Hired seasonal	hr.	2887	614	2887	575	2937	583
Total used	hr.	5396	2845	5396	2831	5446	2890
Capital[b]							
Operating capital	$	23,659	56,605	23,659	52,318	22,765	48,855
Investment capital (non-land)	$	32,298	24,842	32,298	30,349	37,929	38,004
Net Returns[c]	$	20,216	11,052	20,363	11,068	20,559	11,496

[a]Base situation assumes 88 percent calf crop; 475 lb. average weaning weight.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[c]Returns to land, operator labor, and management.

to stocker and finishing systems. Increasing the average weaning weight from 475 to 525 pounds increased net returns only $16 from the base situation.

A 95 percent Calf Crop with a 525 Pound Average Weaning Weight

This section was included to determine the effects on beef, especially cow-calf enterprises, and associated feed systems when a high level of efficiency in both the size of calf crop (95 percent) and average weaning weights (525 pounds) were assumed.

A 95 percent Calf Crop with a 525 Pound Average Weaning Weight--Enterprise Combinations

All enterprises considered. With the high efficiency level of the cow-calf systems, 29.5 brood cows were included in the optimal solution with slightly over one half of them wintered on silage with the remaining cows utilizing corn stover and pasture over the winter months (Table 48). The competitiveness between the stocker and cow-calf enterprises during the spring and summer pasture season is indicated by the 26 percent decline of stocker steers and the 127 percent increase in brood cow numbers.

The increase in efficiency had little effect on other enterprises of the farm organization. Permanent pasture and corn silage acreage and purchased corn was slightly larger while bermuda pasture and corn acreage and feeder pig production was slightly lower. Cotton and wheat acreage did not change from the base situation.

Beef and associated feed enterprises. Feeder calf production, under system II, became a major income producing enterprise when only

beef and associated feed enterprises were considered with almost 43 cows in the optimal solution (Table 48). The inclusion of the cow-calf enterprise resulted in 10 percent fewer head being fattened for slaughter and 44 percent fewer stocker steers than for the base situation. With the change in beef enterprises, the composition of pasture acreages changed with more permanent and less bermuda pasture included in the optimal solution. Total pasture acreage, however, changed very little. The change had no effect on the number of acres used for silage and corn production while bermuda pasture was slightly lower (1.9 acres). No corn was purchased.

A 95 percent Calf Crop with a 525 Pound Average Weaning Weight--Resource Allocation and Net Returns

All enterprises. With the large calf crop and heavy weaning weights, more land, labor, and investment capital was utilized, but less operating capital was required (Table 49). These changes reflect the shift from stocker steers to brood cows. Net returns were $43 (1.7 percent) larger than for the base situation.

Beef and associated feed enterprises. With the high efficiency level assumed for the cow enterprises, operator labor was more fully utilized and less seasonal labor was hired (Table 49). Total capital required was $5,412 larger than for the base situation. However, the optimal amount of operating capital was $7,750 (14 percent) lower while investment capital was $13,162 (53 percent) larger than for the base situation. This again reflects the relatively high investment capital requirements of the cow enterprises as compared to the stocker

enterprises which require large amounts of operating capital.

Net returns were $444 (3.6 percent) higher with the high efficiency level than for the base situation.

Value of Restricting Resources

As the cow-calf enterprises became more efficient in the production of pounds of beef produced per cow, the "shadow" prices for all soil groups increased in all situations while decreasing throughout for all row crop land. As the farage consuming enterprises become more efficient, the value of land utilized for forage production will increase relative to land suited for row crop enterprises.

The effects of declining "shadow" prices for row crop land and increasing "shadow" prices for soil groups resulted in a total decline of land values from the base situation for each soil group and for the representative acre when all enterprises were considered (Table 50). The changes in values were, however, relatively small.

When only beef and associated feeds were included in the model, land values increased from the base situation to the 525 pound average weaning weight and 88 percent calf crop situation. With a 525 pound average weaning weight and a 95 percent calf crop, all estimated land values were higher than for the base beef-feed situation except for Soil I and the representative acre.

The estimated value of additional units of both operator and seasonal labor in April became smaller with the higher cow-calf efficiency levels, while they increased for both sources of labor in June when all enterprises were considered. The change in efficiency

Table 50. Estimated Land Values and Marginal Value Products for Other Limiting Resources for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered With Variations in Calving Percentage and Weaning Weights

Resource	Unit	Base[a]		525 Lb. Weaning Wt.; 88% Calf Crop		525 Lb. Weaning Wt.; 95% Calf Crop	
		All	Beef-Feed	All	Beef-Feed	All	Beef-Feed
		Dollars					
Land Value[b]							
Soil I	ac.	739	1009	706	1016	691	986
Soil II	ac.	267	458	254	469	257	473
Soil III	ac.	108	265	101	274	112	285
Soil IV	ac.	---	96	---	106	---	120
Representative acre[a]	ac.	300	450	286	456	283	450
Labor							
Operator[d]							
April	hr.	4.33	2.01	3.44	2.01	2.92	2.01
June	hr.	9.34	2.01	10.03	2.01	10.43	2.01
Seasonal							
April	hr.	2.09	----	1.28	----	.82	----
June	hr.	6.60	----	7.22	----	7.57	----
Government allotments							
Feed grain base	ac.	7.99	5.04	15.92	4.61	20.46	5.78
Cotton allotment	ac.	89.07	N.A.	91.99	N.A.	93.67	N.A.
Wheat allotment	ac.	4.31	N.A.	8.15	N.A.	10.34	N.A.

[a]Base situation assumes 88 percent calf crops; 475 lb. average weaning weight.

Table 50 (continued)

[b]Value of land which could be justified (income approach) by 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[c]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

[d]Includes those months in which the operator and seasonal labor were fully utilized. In months where the operator labor was fully utilized and the hired labor was not, the MVP of operator labor was $2.01 per hour.

had no effect on the "shadow" price of the operator labor in these two months when only beef and associated feed enterprises were considered because slack seasonal labor was available in each situation.

CHAPTER VI

RESULTS OF SPECIAL ANALYSIS

Further analysis was made with the following modifications of the representative farm: (1) changing the level of risk associated with the different beef systems, (2) deletion of the specified quantities of particular forages required for the beef enterprises, (3) deletion of specified quantities of particular forages and concentrates for the beef enterprises, and (4) deletion of the various livestock alternatives considered.

The effects on resource use, net returns, and livestock-feed relationships were considered for each of the preceding modifications. Where appropriate, the results were obtained when all enterprises were considered and when only beef systems and associated feed production alternatives were considered.

I. Variation in the Risk Associated With Different Beef Enterprises

While the variation of interest rates discussed in Chapter V analyzed the risk element of the beef systems at various levels, all beef systems reflected the same level of risk. In the base situation operating capital of every beef system was charged at a rate of 7 percent. Generally, however, more risk is associated with feeding and stocker enterprises than cow-calf systems, with cattle feeding usually having a greater amount of risk than stocker cattle on pasture. The added risk from cattle feeding and stocker operations stems

primarily from price variability and death loss occurring in those beef operations. Since both operations require rather large amounts of operating capital, the greater risk associated with these enterprises was considered by increasing the cost of operating capital required as compared to the cow-calf systems. Operating capital was charged at 12 percent, 10 percent, and 7 percent for the finishing systems, stocker systems, and cow-calf systems, respectively. Finishing systems were charged at a higher rate than stockers because of the longer feeding period.

Enterprise Combinations

All enterprises. Very little change occurred in the optimal enterprise mix with the higher risk associated with the stocker and feeding enterprises (Table 51). Feeder steer II was in the solution at .9 head (a decrease of almost 11 head), and stocker steer I was slightly over 5 head lower than for the base situation. Cow-calf I was slightly higher.

These changes, although small, imply that as farmers discount returns to account for higher levels of risk (either real or "psychic") in cattle feeding and stocker enterprises, the production of feeder calves will become relatively more profitable (or closer to the goals of the farm operator).

In the optimal solution, less pasture and silage and more corn was produced for livestock feed than for the base situation. No corn was purchased.

Table 51. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Risk Situation on Beef Systems.

Enterprise	Unit	Base		High Risk[a]	
		All	Beef-Feed	All	Beef-Feed
Beef					
Feeder steer II	hd.	11.8	298.5	.9	282.8
Stocker steer I	hd.	88.7	157.5	83.3	157.6
Cow-calf I	cow	13.0	-----	13.5	-----
Other Livestock					
Hog finishing	3.5 hd.[b]	100	N.A.	100	N.A.
Feeder pig	2 sows	42.1	N.A.	42.5	N.A.
Livestock feed					
Pasture:					
Permanent pasture	ac.	48.4	77.0	46.8	77.0
Bermuda pasture	ac.	60.6	92.8	57.0	93.5
Other forage:					
Corn silage	ac.	4.1	75.4	.3	73.5
Corn stover	ac.	78.0	62.1	81.8	64.0
Bermuda hay	ac.	----	11.2	----	10.5
Concentrate:					
Corn (gov. program)	ac.	62.1	62.1	62.1	62.1
Corn (other)	ac.	15.9	----	19.7	1.9
Buy corn	bu.	419.2	632.6	----	----
Cash crops					
Cotton (gov. program)	ac.	44.1	N.A.	44.1	N.A.
Wheat (gov. program)	ac.	1.4	N.A.	1.4	N.A.

[a]Operating capital change at the following rates: Feeding systems 12 percent, stocker systems 10 percent, cow-calf systems 7 percent.

[b]Continuous feeding of purchased pigs, 3.5 batches per year. A limit of 100 units was set.

Beef and associated feed enterprises. Increasing the interest charge on operating capital to account for variations in risk associated with beef enterprises resulted in a decline in beef feeding but had no effect on the stocker system in the optimal solution (Table 51). All corn fed to livestock would be raised. Little change occurred in the optimal organization of other feed enterprises.

Resource Allocation and Net Returns

The inclusion of the higher interest rates on operating capital to reflect the greater risk associated with the stocker and feeding enterprises had the same general effect on resource use when all enterprises were considered as when the model included only beef and associated feed enterprises (Table 52). Total labor, investment capital, and operating capital were all lower than their respective base situations. Land utilization remained at its maximum level in the beef-feed analysis while slack land was five acres larger when all enterprises were considered, reflecting the lower profitability of the stocker enterprise in this situation.

Although net returns were reduced in both situations, the reduction was more extreme when alternatives were limited to beef and associated feed enterprises. Net returns were $2,220 (20 percent) lower than for the base situation. This compares to a decline in net returns of $240 (1.2 percent) when all enterprises were considered.

II. Removal of the Specific Forage Restrictions on Beef Enterprises

For all previous analysis, feed requirements for each livestock system were stated in terms of specific quantities of grain, hay, silage,

Table 52. Optimal Resource Use and Net Returns for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Risk Situation on Beef Systems

Resource	Unit	Base		High Risk[a]	
		All	Beef-Feed	All	Beef-Feed
Land					
Soil I	ac.	161	161	161	161
Row Crop I	ac.	128	128	128	128
Soil II	ac.	36	36	36	36
Row Crop II	ac.	12	12	12	12
Soil III	ac.	65	65	65	65
Row Crop III	ac.	13	13	13	13
Soil IV	ac.	21	72	16	72
Total openland	ac.	283	334	278	334
Total openland available	ac.	334	334	334	334
Labor					
Operator labor available	hr.	2,509	2,509	2,509	2,509
Operator labor used	hr.	2,509	2,231	2,509	2,180
Hired seasonal	hr.	2,887	614	2,851	574
Total used	hr.	5,396	2,845	5,360	2,754
Capital[b]					
Operating capital	$	23,659	56,605	21,626	54,302
Investment capital (non-land)	$	32,298	24,842	32,043	24,095
Net Returns[c]	$	20,216	11,052	19,976	8,832

[a]Operating capital charged at the following rates: Feeding systems 12 percent, stocker systems 10 percent, cow-calf systems 7 percent.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

[c]Returns to land, operator labor, and management.

and/or pasture (depending on the particular system) were required. Provisions for aftermath grazing of corn stalks and hay fields were included to substitute for the pasture or hay requirements. Also, each livestock system included specifications of the monthly amounts of TDN, DP, and DM required for the particular weight of the species and the rate of gain of the particular system. Accordingly, each forage producing activity was stated in the amount of the three categories of nutrients produced. This analysis deleted the specific forage constraints previously imposed (while not affecting the concentrate constraint). Thus, the model had to "balance" the rations of the various livestock systems with the various forage producing enterprises, given the specified quantity of concentrate (if any), to satisfy the monthly and total nutrient requirements of the beef enterprises.

Enterprise Combinations--All Enterprises

When the forage nutrient sources were not specified, beef enterprises became a major source of farm income rather than a supplementary source as in the base situation (Table 53). Over 76 head of feeder steer II and 177 head of stocker steer I were in the optimal solution, representing increases of 547 percent and 100 percent for feeding and stocker production, respectively.

The source of nutrients for these systems also changed. Since no system was required to consume any particular forage, all forage nutrients were obtained from 164.2 acres of permanent pasture and 91.7 acres of corn stover. Thus, the steers fed for slaughter (feeder steer II) would consume 5 pounds of corn per day, but instead of corn silage as the primary feed ingredient, pasture and stover would provide all

Table 53. Optimal Enterprise Organization on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Feed Specification

Enterprise	Unit	All Feed Specified		No Forage Specified		No Feed Specified
		All	Beef-Feed	All	Beef-Feed	Beef-Feed Only
Beef						
Feeder steer II	hd.	11.8	298.5	76.4	283.1	-----
Feeder steer III	hd.	-----	-----	-----	40.1	516.2
Stocker steer I	hd.	88.7	157.5	177.4	202.9	-----
Cow-calf I	cow	13.0	-----	-----	-----	-----
Other Livestock						
Hog finishing	3.5 hd.[a]	100	N.A.	100	N.A.	N.A.
Feeder pig	2 sows	42.1	N.A.	33.6	N.A.	N.A.
Livestock Feed						
Pasture:						
Permanent pasture	ac.	48.4	77.0	164.2	181.0	207.4
Bermuda pasture	ac.	60.6	92.8	-----	-----	-----
Other forage:						
Corn silage	ac.	4.1	75.4	-----	56.8	126.6
Corn stover	ac.	78.0	62.1	91.7	96.1	-----
Bermuda hay	ac.	-----	11.2	-----	-----	-----
Concentrate:						
Corn (gov. program)	ac.	62.1	62.1	33.5	-----	-----
Corn (other)	ac.	15.9	-----	58.2	96.1	-----
Buy corn	bu.	419.2	632.6	-----	-----	-----

Table 53 (continued)

Enterprise	Unit	All Feed Specified		No Forage Specified		No Feed Specified
		All	Beef-Feed	All	Beef-Feed	Beef-Feed Only
Cash Crops						
Cotton (gov. program	ac.	44.1	N.A.	44.1	N.A.	N.A.
Wheat (gov. program)	ac.	1.4	N.A.	----	N.A.	N.A.

[a]Continuous feeding of purchased pigs, 3.5 batches per year. A limit of 100 units was set.

other farm produced nutrients.[1]

This combination of feeders, stockers, permanent pasture, and corn stover results in a good balance in the requirements and availability of nutrients over the seasons. When the feeders are acquired in mid-October, all pasture is available for the feeder steers. In November and December, sufficient corn stubble is available for the feeders (supplemented with corn grain and protein supplement), and the utilization of the permanent pasture growth can be delayed until later months. In the first part of the calendar year, all pasture growth (plus delayed grazing from November and December) is available to provide nutrients for the feeding operation. When the stocker cattle are purchased in early spring, permanent pasture production in increasing rapidly (Table 25, page 63) and reaches its peak in April and May. During the peak pasture production period enough forage nutrients are available for both stockers and feeders (excluding the corn grain fed). When the production of nutrients from the cool season grass (with clover) decreases with the advent of hot weather, the feeder steers are ready for market. Sufficient pasture is then available for the stocker steers through the summer.

Corn production increased from the base situation when specific forage source was not specified. However, only 33.5 acres of corn were grown under the feed grain base. The reduction of the feed grain base utilized (from 62.1 to 33.5 acres), along with no wheat produced under the Farm Program, decreased the amount of land required to be left out

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[1]Urea would be used as a protein supplement for feeder steer II enterprises.

of production. This had a net effect of increasing the availability of "productive" land by 8.3 acres over the base situation.

Hog finishing and cotton enterprises were not affected. The optimal levels of production remained at 100 units and 44.1 acres for hog finishing and cotton (under allottment acres), respectively. Feeder pig production was 17 sows lower.

In this analysis the production of beef is accomplished by utilizing those feed ingredients (pasture) in which the study area has a competitive advantage over many other beef producing areas.

Enterprise Combinations--Beef and Associated Feed Enterprises

When specific forage requirements were deleted from the model on the beef-feed representative farm, steer feeding and stocker steer I were 25 and 45 head greater, respectively (Table 53). The composition of the feeding systems changed with 40 head full fed corn grain (system III) replacing 15 head fed 5 pounds of corn grain (96.1 acres) and corn silage (56.8 acres). The remaining openland was utilized by permanent pasture (181 acres). No corn was grown under the feed grain base--which released 15.5 acres of land which were required as set aside acreage in the base situation.

This combination of beef and associated feed enterprises shows much flexibility in that the f-eder steers, especially under system II, and the stocker steers could be fed corn silage, when needed, to supplement low cost pasture.

Resource Allocation and Net Returns--All Enterprises

As seen in Table 54, the removal of forage restrictions had a relatively large effect on net returns to land, operator labor, and

Table 54. Net Returns and Optimal Resource Use on the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Feed Specifications.

Item	Unit	All Feed Specified		No Forage Specified		No Feed Specified
		All	Beef-Feed	All	Beef-Feed	Beef Feed Only
Net returns[a]	$	20,216	11,052	25,359	16,994	21,161
Operating capital[b]	$	23,659	56,605	38,889	62,136	64,441
Investment capital[b] (non-land)	$	32,298	24,842	30,591	26,798	28,262
Operator labor used	hr.	2509	2231	2509	2239	2032
Unused operator labor	hr.	----	278	----	270	477
Seasonal hired labor	hr.	2887	614	2635	722	1089
Unused land	ac.	51	----	----	----	----

[a]Returns to land, operator labor, and management.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount needed in the optimal solution.

management. Net returns were $5,143 (25.4 percent) larger than when specific forages were designated for the beef system. The amounts of seasonal labor and investment capital required for the optimal system were lower. However, all openland was fully utilized, and operating capital was 56 percent larger than for the base situation, reflecting the larger number of feeders and stockers and the utilization of more pasture land.

Resource Allocation and Net Returns--Beef and Associated Feed Enterprises

Net returns were $5,492 (54 percent) greater on the beef-fed representative farm when the consumption of specific forages were not required (Table 54). This modification had little effect on the optimal usage of operator labor, but over 100 hours more seasonal labor was hired. Almost $90,000 of capital was required (excluding land capital). Approximately 70 percent of the capital required was for operating capital. Both feeder steers and stocker steers are relatively capital intensive.

III. Removal of All Feed Specifications on Beef Enterprises

The previous section analyzed the effects on net returns, resource allocation, and beef and associated feed enterprises when beef animals were not required to consume specific forage while still specifying certain quantities of concentrate (if applicable to the particular system) which must be consumed. Nutrients not satisfied by the concentrate constaint could be supplied by any other feed source.

This section describes the effects on net returns, resource allocation, and beef and associated feed enterprises when beef animals were not required to consume specific amounts of particular forage or concentrates. Each feed production activity was stated (in the linear programming matrix) in terms of the monthly and total quantities of TDN, DP, and DM produced, and each beef system was stated in the amounts of TDN, DP, and DM required per month. When the specific feed constraints (both forage and concentrate) previously imposed were removed, the model had to "balance" the amount of nutrients required for the livestock species with the quantity of nutrients produces from the various feed enterprises available.[2]

It was not feasible to delete the concentrate requirement for the hog enterprises because the biological nature of the nonruminents will allow only a relatively small amount of roughage utilization in order to maintain the rate of gain previously assumed. Thus, this analysis was conducted only with beef and associated feed enterprises in the model.

With the removal of the constraints on specific feed sources, feeder steer production under system III was the only beef enterprise in the optimal solution (516 head). The farm produced feed for these steers consisted of 207.4 acres of permanent pasture and 126.6 acres of corn silage produced on Soil Group I (Table 53).

Although feeder steers under system III require more nutrients per head per month while on feed than any other feeding system, the

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[2]With the exception of purchased protein supplements.

requirements of TDN and DP per pound of gain are lower than the other steer and heifer feeding systems (Tables 14 and 15, pp. 45 and 46). Also, because of the highest rate of gain of any system (Table 13, p. 44), these steers are on feed for a shorter length of time and, therefore, require operating capital for shorter periods of time than other systems.

Steers in this system would utilize as much pasture as possible in the fall and spring months and would be supplemented by corn silage in slack periods as needed (along with purchased protein supplements when needed).

The deletion of the particular feed constraints and utilization of low cost pasture and silage for the relatively large number of steers resulted in net returns of $21,161 (Table 54). This represents a 91 percent increase in net returns over the base beef and associated feed situation and a 25 percent increase from when no specific forage in the rations were specified. Almost $93,000 of operating and non-land investment capital was required. Nearly 70 percent was operating capital.

Since the steers in this system would be fed no concentrate, the previous assumptions of slaughter steer prices based on high good to low choice steers would not likely be achieved due to the lack of finish. These results do indicate, however, that beef feeding could become more competitive for farm resources in the study area by utilizing as much low cost pasture and silage as possible.

Estimated Land Values with Variations in Feed Specification

The effect on the estimated land values by the various feed specifications on the beef enterprises are shown in Table 55. When no specific forage source was specified, estimated land values increased for all soils from their respective base situation. When no feedstuff was specified for the beef representative farm, estimated land values declined. As the constraints on feedstuffs were removed, the marginal values increased for all soil groups and decreased for all row crop groups. When no feedstuff was specified for the beef representative farm, no row crop group was fully utilized.

IV. Variation in the Livestock Enterprises Considered

Some livestock enterprises are not practical or desirable in some farm situations, resulting from the capital structure of the farm, "likes and dislikes" of the farm operator, or management limitations. As a result, the base situation when all enterprises were considered was modified successively by: (1) deletion of all swine enterprises, (2) deletion of swine and beef feeding enterprises, and (3) deletion of swine, beef feeding, and beef stocker enterprises. Also, the beef and associated feed representative situation was modified successively by: (1) deletion of beef feeding enterprises and (2) deletion of beef feeding and stocker enterprises.

Particular attention was given to the effects on net returns, capital requirements and the beef-feed enterprises as the livestock systems considered were reduced to only the cow-calf enterprises.

Table 55. Estimated Land Values for the 450 Acre Representative Farm With All Enterprises and Only Beef and Associated Feed Enterprises Considered by Feed Specification

Land Value[a]	Unit	All Feed Specified		No Forage Specified		No Feed Specified
		All	Beef-Feed	All	Beef-Feed	Beef Feed Only
		----------Dollars----------				
Soil I	ac.	739	1009	970	1204	729
Soil II	ac.	267	458	599	805	639
Soil III	ac.	108	265	443	632	548
Soil IV	ac.	---	96	271	421	400
Representative Acre[b]	ac.	300	450	501	653	455

[a]Value of land which could be justified (income approach) by a 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[b]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

All Enterprises--Enterprise Combinations

Deletion of swine enterprises. With the deletion of all swine enterprises, cattle fed corn silage and a limited amount of corn grain and stocker steer I replaced hog finishing and feeder pig production as the major source of livestock income (Table 56). No cow-calf enterprise was included in the solution. Production of permanent pasture, bermuda pasture, and corn silage was 60, 61.5, and 94.6 percent larger, respectively. Also, bermuda hay production was included in the optimal solution at 5.7 acres. No corn was purchased, and all corn produced (45.7 acres) was grown in compliance with the government program.

Deletion of hog and beef feeding enterprises. The deletion of the beef feeding enterprises resulted in little change in the optimal amount of the stocker steers in the solution (Table 56). Although stocker production was 67.4 head larger than the base situation, it was 1.4 head less than when beef feeding alternatives were included. Both permanent and bermuda pasture production was slightly higher than the previous situation in order to supply nutrients for the 2.3 brood cows wintered on silage (.3 acres).

Cotton was the major income generating enterprise with 143.8 acres. Nearly 100 acres of cotton were grown without government program payment incentives.

Deletion of swine, beef feeding, and stocker enterprises. Some farm operators consider feeder calf production as their "only" livestock alternative and use beef cows to utilize available pasture land. When livestock production was limited only to cow-calf systems, the

Table 56. Optimal Enterprise Organization on the 450 Acre Representative Farm, All Enterprises Considered, by Specified Deletions of Livestock Alternatives

Enterprise	Unit	All Enterprises	Without Swine Enterprises	Without Swine and Beef Feeding Enterprises	Without Swine, Beef Feeding, and Stocker Enterprises
Beef					
Feeder steer II	hd.	11.8	179.8	N.A.	N.A.
Stocker steer I	hd.	88.7	158.5	156.1	N.A.
Cow-calf I	cow	13.0	-----	-----	-----
Cow-calf II	cow	----	-----	2.3	42.5
Other Livestock					
Hog finishing	3.5 hd.[a]	100.0	N.A.	N.A.	N.A.
Feeder pig	2 sows	42.1	N.A.	N.A.	N.A.
Livestock Feed					
Pasture:					
Permanent pasture	ac.	48.4	77.4	78.7	98.0
Bermuda pasture	ac.	60.6	97.8	102.3	11.0
Other forage:					
Corn silage	ac.	4.1	42.9	.3	6.8
Corn stover	ac.	78.0	45.7	-----	----
Bermuda hay	ac.	----	5.7	-----	----
Concentrate:					
Corn (gov. program)	ac.	62.1	45.7	-----	----
Corn (other)	ac.	15.9	----	-----	----
Buy corn	bu.	419.2	----	-----	----
Cash Crops					
Cotton (gov. program)	ac.	44.1	44.1	44.1	44.1
Cotton (other)	ac.	----	----	99.7	93.3
Wheat (gov. program)	ac.	1.4	----	----	----

[a]Continuous feeding of purchased pigs, 3.5 batches per year. a limit of 100 units was set.

optimal enterprise mix included 43 brood cows. Livestock feed would be provided by 98 acres of permanent pasture, 11 acres of bermuda pasture, and 6.8 acres of corn silage. Most of the farm income would be generated by 137 acres of cotton. Only 44 acres of cotton would be grown under government program provisions.

All Enterprises--Resource Requirements and Net Returns

Deletion of swine enterprises. The deletion of the swine alternatives of the representative farm resulted in a relative shift of resource use from labor and investment capital to land and operating capital (Table 57). With the larger quantities of finishing and stocker cattle in the optimal solution, all land was utilized, and 74 percent more operating capital was required while operator labor, seasonal hired labor, and investment capital utilization were 25 percent, 86 percent, and 42 percent lower, respectively. Labor was hired in March through July, but only in April was all available labor utilized.

Net returns to land, operator labor and management were $14,813 or $5,403 lower than when swine enterprises were included as alternatives. Thus, the $5,403 represents an estimate of the monetary value foregone if the farm operator chooses not to produce hogs.

Deletion of hogs and beef feeding enterprises. The deletion of both beef feeding and swine enterprises resulted not only in lower net returns, but also reduced requirements for operating and investment capital, and operator and seasonal hired labor (Table 57). Deletion of both swine and beef feeding alternatives reduced net returns by $6,787 as compared to the base situation (over 33 percent). Net returns were $1,384 lower than when only swine alternatives were deleted.

Table 57. Net Returns and Optimal Resource Use on the 450 Acre Representative Farm, All Enterprises Considered, by Specified Deletions of Livestock Alternatives

Item	Unit	All Enterprises	Without Swine Enterprises	Without Swine and Beef Feeding Enterprises	Without Swine, Beef Feeding, and Stocker Enterprises
Net returns[a]	$	20,216	14,813	13,429	11,671
Operating capital[b]	$	23,659	41,257	18,987	7,001
Investment capital[b] (non-land)	$	32,298	18,756	10,751	21,918
Operator labor used	hr.	2,509	1,891	1,290	1,362
Unused operator labor	hr.	-----	618	1,219	1,147
Seasonal hired labor	hr.	2,887	398	375	173
Unused land	ac.	51	------	------	72

[a]Returns to land, operator labor, and management.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount required in the optimal solution.

Available operator labor was exhausted in April through July. During the period from November through February, however, only 31 hours of the available supply were utilized. The amount of hired labor was 57, 46, 135, and 138 hours for April, May, June, and July respectively.

Deletion of swine, beef-feeding, and stocker enterprises. When livestock alternatives were limited only to feeder calf production (cow-calf systems), net returns were $11,671 (Table 57). Operating capital required was only $7,001, which was substantially lower than for the systems in which swine and beef feeding alternatives were considered. Approximately 89 percent of the labor utilized was supplied by the operator. All Soil IV land (72 acres) was left idle.

Beef and Associated Feed Enterprises--Enterprise Organization

Deletion of beef-feeding enterprises. When stocker and cow-calf enterprises were the only income producing enterprises considered, stocker steer I was the major beef production activity, and 326.6 head were included in the optimal solution (Table 58). The optimal system also included 4.3 brood cows. Since stocker steer production depends strictly on pasture as a feed source, almost all of the openland was utilized for pasture with approximately 56 percent bermuda and 44 percent permanent pasture. The .7 acre of silage was utilized for the production of winter feed for the small cow-calf herd.

Deletion of beef-feeding and stocker enterprises. When the two cow-calf systems were the only cash enterprises allowed to compete for the limited resources, 120 brood cows, wintered on silage, were included in the optimal solution (Table 58). Other sources of

Table 58. Optimal Enterprise Organization on the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Specified Deletion of Beef Alternatives

Enterprise	Unit	All Beef and Associated Feed Enterprises	Without Beef Feeding Enterprises	Without Beef Feeding and Stocker Enterprises
Beef				
Feeder steer II	hd.	298.5	N.A.	N.A.
Stocker steer I	hd.	157.5	326.6	N.A.
Cow-calf II	cow	-----	4.3	120.0
Beef Feed				
Pasture:				
Permanent pasture	ac.	77.0	146.4	283.7
Bermuda pasture	ac.	92.8	186.9	31.1
Other forage:				
Corn silage	ac.	75.4	.7	19.2
Bermuda hay	ac.	11.2	-----	-----
Concentrate:				
Corn (gov. program)	ac.	62.1	-----	-----
Buy corn	bu.	632.6	-----	-----

nutrients were 283.7 acres of permanent pasture (85 percent of the openland) and 31.1 acres of bermuda pasture to supplement the permanent pasture in the summer.

Beef and Associated Feed Enterprises--Resource Requirements and Net Returns

As the number of beef alternatives considered was reduced, net returns to land, operator labor, and management declined considerably (Table 59). With only stocker and cow-calf enterprises considered, net returns were 78 percent lower than when all beef enterprises were considered. When only the two cow-calf systems were included in the model, net returns were actually negative, i.e., were not great enough to cover estimated farm overhead costs.

Operating capital requirements declined as the beef alternatives were deleted. Only $9,299 of operating capital was needed when only the cow-calf enterprises were considered. Investment capital declined as feeding systems were deleted but was substantially higher when only cow-calf enterprises were considered because of the relatively large capital investment necessary for 120 brood cows. All available openland was utilized in every situation.

Estimated Land Values with Variations in Livestock Enterprises Considered--All Enterprises

With the deletion of the swine enterprises, estimated land values increased considerably from the base situation (Table 60). Estimated land values declined (from the solution when swine alternatives were deleted) as beef feeding and both beef feeding and stocker

Table 59. Net Returns and Optimal Resource Use on the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Specified Deletion of Beef Alternatives

Item	Unit	All Beef and Associated Feed Enterprises	Without Beef Feeding Enterprises	Without Beef Feeding and Stocker Enterprises
Net returns[a]	$	11,052	2,448	-888
Operating capital[b]	$	56,605	31,041	9,299
Investment capital[b] (non-land)	$	24,842	11,938	48,996
Operator labor	hr.	2,231	1,207	1,525
Unused operator labor	hr.	278	1,302	984
Seasonal hired labor	hr.	614	------	1
Unused land	ac.	------	------	------

[a]Returns to land, operator labor, and management.

[b]No limitations on operating and investment capital were assumed. Therefore, the amount shown is the amount required in the optimal solution.

Table 60. Estimated Land Values for the 450 Acre Representative Farm, All Enterprises Considered, by Specified Deletion of Livestock Alternatives

Land Value[a]	Unit	All Enterprises	Without Swine Enterprises	Without Swine and Beef Feeding Enterprises	Without Swine, Beef Feeding, and Stocker Enterprises
		----------	----------	Dollars ----------	----------
Soil I	ac.	739	1017	851	834
Soil II	ac.	267	455	420	297
Soil III	ac.	108	255	238	123
Soil IV	ac.	---	84	94	---
Representative Acre[b]	ac.	300	449	387	339

[a]Value of land which could be justified (income approach) by 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of row crop land.

[b]Value of a representative acre of land which could be justified by a 6 percent capitalization rate.

enterprises were not considered as alternatives. However, all estimated land values with limited livestock alternatives were greater than for the base situation.

Estimated Land Values with Variations in Livestock Enterprises Considered--Beef and Associated Feed Enterprises

The deletion of beef feeding alternatives resulted in a considerable decline in estimated land values (Table 61). With beef feeding excluded as a livestock alternative, the marginal values for all row crop groups were zero. The deletion of the stocker and beef feeding enterprises resulted in further declines in the estimated land values. When the cow-calf enterprises were the only income generating enterprises available, the estimated value of a representative acre was only $69--a reduction of $381 when all beef enterprises were considered.

Table 61. Estimated Land Values for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, by Specified Deletion of Beef Alternatives

Land Value[a]	Unit	All Beef and Associated Feed Enterprises	Without Beef Feeding Enterprises	Without Beef Feeding and Stocker Enterprises
		----------Dollars----------		
Soil I	ac.	1009	347	126
Soil II	ac.	458	288	103
Soil III	ac.	265	242	79
Soil IV	ac.	96	161	30
Representative Acre[b]	ac.	450	208	69

[a]Value of land which could be justified (income approach) by 6 percent capitalization rate derived from the marginal value products of the soil groups and appropriate equivalents of two crop land.

[b]Value of a representative acre of land which could be justified by a percent capitalization rate.

CHAPTER VII

SUMMARY AND CONCLUSIONS

I. Summary

The primary objective of this study was to determine the competitiveness of various beef and associated feed systems in the use of farm resources and to determine the combination of livestock, forage, and row crop enterprises and resource utilization which will maximize net returns to land, operator labor, and management. This analysis was conducted under various resource and pricing conditions on a representative farm situation in the Brown Soil and Delta area of West Tennessee. A 450 acre representative farm (334 acres of openland) was assumed, consisting of four soil and three row crop groups. The basic analysis was conducted with four labor conditions, four capital situations, three livestock price situations, inclusion and deletion of the 1972 Farm Program, four levels of calf crop percentage, and four levels of weaning weights for feeder calves.

Standard budgetary techniques were utilized in developing costs and returns, and investment and operating capital requirements for 12 beef feeding systems, 4 beef stocker systems, and 2 cow-calf systems. The beef feeding systems were adapted from work done by Anderson (1). Differences between the systems were in the primary feed ingredients (at various stages of feeding) and the rate of gain per head per day. The feeding systems included in the analysis were (with a heifer and steer feeding enterprise developed from each): (I) full

feeding corn silage followed by full feeding corn grain, (II) full feeding corn silage plus 5 pounds of corn per head per day, (III) full feeding corn grain, (IV) limited feeding corn silage followed by a pasture only phase and then a finishing phase of corn grain (full fed), (V) limited feeding corn grain followed by pasture with supplemental grain and the finishing phase of full feeding corn grain, and (VI) a combination of systems III and V utilizing a common feeding facility in different time periods.

Stocker systems included in the analysis were: (I) spring and summer grazing program of light stocker cattle and (II) stockers wintered on a limited amount of corn silage followed by a pasture only phase. Both stocker enterprises included a system for steers and heifers.

The only difference between the two cow-calf systems in the model was in the winter ration. Cows under system I were wintered on hay while cows under system II were wintered on corn silage.

Budgeting techniques were also utilized in estimating cost and returns of producing feed. Feed enterprises included corn, corn silage, permanent pasture, midland bermuda pasture, and aftermath grazing and hay from alfalfa, permanent pasture, midland bermuda pasture, lespedeza (with no aftermath grazing), red clover hay, and corn stover. With the exception of corn, corn silage, and alfalfa, which could only be produced on Soil Groups I, II, and III, all other feed production activities could be produced on any of the four soil groups. Thirty-two production budgets were developed.

Nutrients required for each beef enterprise were stated in terms

of the monthly amounts of TDN, DP, and DM for the particular weight, rate of gain, and sex of the animal for each system. Output from each feed enterprise was also specified in terms of the amounts of TDN, DP, and DM furnished by months (with limited pasture substitution between months and feed wastage considered).

Other enterprises included in the analysis were feeding out purchased feeder pigs, feeder pig production, farrow to finish hog systems, cotton, soybeans, wheat-soybeans double cropped, wheat-red clover, and wheat.

Linear programming techniques were utilized to determine the effects on the beef-forage-concentrate organization with other enterprises as well as net returns and resource requirements when all enterprises were considered and when alternatives were limited to beef and associated feed enterprises. Additional analysis was conducted with all enterprises and with only beef-feed enterprises in the model with the following variations from the base situation:[1] [1] Labor (a) increasing the wage rate paid to seasonal workers to $2.65 per hour, (b) deleting the seasonal labor option and including one full time hired man, and (c) deleting the option to obtain any extra labor; [2] Capital (a) increasing the charge on operating and investment capital to 10 percent and 8 percent, respectively, (b) increasing the charge on operating

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[1]The base situation assumed: (1) an unlimited amount of external or internal capital charged at a rate of 6 percent and 7 percent for investment and operating capital, respectively; (2) labor supply of farm operator plus a maximum amount of hired seasonal labor equivalent to two full time hired men paid $1.75 per hour; (3) 334 acres of openland consisting of four soil groups and three row crop groups; (4) base livestock price situation; (5) presence of the 1972 Farm Program; and (6) an 88 percent calf crop from beef brood cows with average weaning weight of 475 pounds.

and investment capital to 18 percent and 10 percent, respectively, and (c) deleting the investment capital required for brood cow stock; [3] Livestock price (a) high livestock prices, and (b) low livestock prices; [4] Deleting the 1972 Farm Program; [5] Increasing calf crop percentages to (a) 90 percent, (b) 92 percent, and (c) 95 percent; and [6] Increasing weaning weights of steers (heifers) to (a) 515 (465) pounds, (b) 525 (475) pounds, and (c) 550 (500) pounds.

All Enterprises

The major enterprises in the optimal farm organization for the base situation, with all enterprises considered, included hog finishing, feeder pig production, cotton, corn, and the grazing of light stocker steers on spring and summer pasture. Other beef enterprises were of a supplementary nature and included a small cow herd and a relatively few steers finished for slaughter under system II.

When variations were made from the base situation in resource and pricing conditions, stocker steer production remained the principal beef enterprise in almost every model situation (Table 62). A relatively small number of brood cows (13 to 20 head) were in the optimal organizations except for the highest capital cost, low livestock price situation, and the situation without government program. The number of brood cows increased to about 30 head with the high efficiency level of feeder calf production.

The only beef feeding system in the optimal solutions with the various resource and pricing modifications was that of full feeding corn silage supplemented with 5 pounds of corn grain per head per day (system II). With the exception of the low livestock price situation,

Table 62. Optimal Beef Enterprise Organization for the 450 Acre Representative Farm, All Enterprises Considered, for the Base Situation and Specified Modification of the Base Situation

Model Specification	Beef Enterprise				
	Cow-Calf		Stocker Steer	Feeding System II	
	I	II	I	Steers	Heifers
Base[a]	13.0	----	88.7	11.8	-----
Labor Situation[b]					
C (High wage)	20.0	----	117.8	----	-----
B	19.3	----	42.6	1.5	-----
A	13.0	----	28.7	----	-----
Capital Situation[c]					
B	13.5	----	83.3	----	-----
C	----	----	----	----	-----
D	13.0	----	88.7	11.8	-----
Price Situation					
High	17.3	----	38.1	----	-----
Low	----	----	155.0	----	198.5
Government Program Deletion	----	----	110.1	64.6	-----
Average Weaning Weight 525 Pounds with 95 Percent Calf Crop	14.0	15.5	65.5	12.2	-----

[a]The base situation included: Labor situation C (operator plus available seasonal labor equal to two full time hired men) at a wage of $1.75 per hour; operating capital and investment capital charged at 7 percent and 6 percent, respectively; base livestock price situation; presence of the 1972 Farm Program; and an 88 percent calf crop with an average weaning weight of 475 pounds for the cow-calf systems.

[b]Labor situations were: C (high wage)--same labor availability as the base but hired workers paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[c]Capital charges for operating and investment capital respectively are: B--10%, 8%; C--18%, 10%; D--7%, 6% with no investment capital required on brood cows.

steers were more profitable to feed than heifers although, in many cases, the number of cattle fed was relatively small.

Increasing the wage of seasonal labor resulted in a decline in beef feeding and an increase in the number of stocker animals and beef cows (Table 62). Deletion of the option to hire seasonal farm labor resulted in an increase in the brood cow numbers (when a full time hired man was available) while stocker and fed cattle numbers declined. This seems to indicate that cow-calf systems are somewhat more favorable as land-labor ratios increase.

Increasing the interest charge on capital had the greatest effect on the number of beef stocker and finishing animals (Table 62). The rather large levels of operating capital and greater risk associated with cattle and stocker enterprises are likely to be important factors in restricting these enterprises in Tennessee. This would be especially true for farm operators with severe restraints on capital and/or high aversion to risk. The lower risk and smaller operating capital requirements of the cow-calf enterprises favor this enterprise on many farms.

The production of beef was sensitive to the beef-swine price relationships. In the high livestock price situation, a relatively small number of stocker steers and brood cows were in the optimal farm organization. Hog finishing and farrow to finish swine enterprises were the major livestock enterprises. In the low livestock price situation, however, heifer feeding and stocker steers replaced hogs as the major livestock enterprise. Variation in livestock price involved both beef and hog price. Apparently, the hog price variation was dominant.

With the deletion of the 1972 Farm Program, beef feeding and stocker steer enterprises increased considerably. No cow-calf enterprise was included in the solution.

Increasing the technical efficiency level for the cow-calf enterprises resulted in an increase in the cow-calf herd and a decline in the number of stocker steers in the optimal organization.

In every model specification in which beef animals were in the optimal solution, the largest percentage of openland was utilized for pasture production (Table 63). The percentage of total openland used in the production of feed ranged from zero (with a capital charge of 10 percent and 18 percent for investment and operating capital, respectively) to 67.5 percent of the total openland available with the low livestock price situation. A combination of permanent and bermuda pasture was included in the optimal farm organization for every situation in which stocker steers were produced.

Hog production, both feeder pig and slaughter hogs, was the major livestock enterprises for most model specifications. Since a relatively large quantity of hogs were produced, a significant proportion of row crop land was utilized for corn grain production. No corn was sold in any model specification. Beef feeding was generally a minor livestock enterprise, and the only beef feeding systems included in the optimal farm organizations which utilized a limited amount of corn. Thus, the amount of openland utilized to produce corn for beef animals was generally very small (Table 63).

Only in the low livestock situation did the amount of openland

Table 63. Percentage of Openland Utilized for the Production of Feed for the Various Beef Systems, All Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation

Model Specification	Permanent Pasture[a]	Bermuda Pasture[a]	Corn Silage[a]	Hay[a]	Grain[ae]	Total
	----------	----------	Percent	----------	----------	----------
Base[b]	14.5	21.1	1.2	---	0.8	37.6
Labor Situation[c]						
C (high wage)	23.9	26.4	---	---	---	50.3
B	10.1	10.7	0.1	---	0.1	21.0
A	6.2	7.2	---	---	---	13.4
Capital Situation[d]						
B	14.0	17.1	0.1	---	0.1	31.3
C	---	---	---	---	---	0.0
D	14.5	21.1	1.2	---	0.8	37.6
Price Situation						
High	8.8	9.5	---	---	---	18.3
Low	22.4	29.0	10.3	1.2	12.4	67.5
Government Program Deletion	12.9	14.9	4.6	11.0	4.4	47.8
Average Weaning Weight 525 Pounds With a 95 Percent Calf Crop	17.5	17.1	2.4	---	0.8	37.8

[a]Includes all soil groups utilized in the production of the feed ingredients.

[b]The base situation included: Labor situation C (operator plus available seasonal labor equal to two full time hired men) at a wage of $1.75 per hour; operating capital and investment capital charged at 7 percent and 6 percent respectively; base livestock price situation; presence of the 1972 Farm Program; and an 88 percent calf crop with an average weaning weight of 475 pounds for the cow-calf systems.

[c]Labor situations were: C (high wage)--same labor availability as the base but hired workers paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

Table 63 (continued)

[d]Capital charges for operating and investment capital respectively are: B--10 percent, 8 percent; C--18 percent, 10 percent; D--7 percent, 6 percent with no investment capital required on brood cows.

[e]Obtained by assuming all corn for beef enterprises was grown and that the additional corn produced, along with purchased corn, was utilized by the swine enterprises.

used for corn silage and corn grain exceed 20 percent of the available openland. In this situation, almost 200 heifers were fed for slaughter (Table 62).

Hay production was included in only two model situations. However, aftermath grazing of corn stalks was utilized by the beef systems as a hay substitute.

Cotton was the principal cash crop in most farm organizations. In most cases cotton was produced in compliance with the government program. The estimated "shadow" prices for an additional acre of cotton allotment, in terms of cents per pound of lint, were relatively high compared to estimates from earlier studies. "Shadow" prices for cotton allotment expressed in cents per pound of lint ranged from 11.3 cents in the high livestock price situation to 12.8 cents in the high wage labor situation. This compares to estimates of 4.8 to 5.4 cents per pound by Anderson(1).

Soybean production was included in the optimal organization in less than one half of the model specifications. Soybeans replaced cotton when the "free market" situation was assumed. In addition, acreage of soybeans increased quite readily as the land-labor ratio increased.

When seasonal labor was available, the inclusion of row crop and swine alternatives with the beef-feed enterprises generally resulted in all available operator labor being utilized. When hiring of seasonal labor was not permitted, the hours of idle operator labor increased.

The production of feeder pigs was generally limited by the

available labor in April and June. When seasonal labor was available, the "shadow" prices for operator labor ranged from $2.01 to $20.89 per hour. When no hired labor was available, the "shadow" price for one more hour of operator labor in April was $24.00.

In most cases, land was not completely utilized when all enterprises were considered. Even though the cow-calf and stocker systems (which can utilize this land not suited for row crop production) are rather labor extensive, apparently the limited labor supply during the spring and early summer months restrict the expansion of these beef systems.

The estimated value of a representative acre (when the government program was included) ranged from $146 per acre with the high livestock price assumption to $380 per acre with the low livestock price assumption. The value of a representative acre for the base situation was $300 per acre. This compares to a value of only $112 per acre when the government program was deleted. Obviously, land values, especially for row crop land, are directly affected by the presence of a farm program and associated income payments.

Increasing the wage rate of seasonal labor from $1.75 to $2.65 per hour resulted in a decline in net returns to land, operator labor, and management of 12.5 percent (Table 64). Increasing the cost of capital also resulted in a reduction in net returns.

Net returns increased considerably (61.8 percent) from the base situation to the high livestock price situation but declined almost 34 percent from the base situation with the low livestock prices. The deletion of the investment capital requirement on brood cows and the high

Table 64. Net Returns and Non-Land Capital Requirements, All Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation

Model Specification	Net Returns[a]		Investment Capital[b]		Operating Capital	
	Amount	% Change from Base	Amount	% Change from Base	Amount	% Change from Base
Base[c]	$20,216	(N.A.)	$32,298	(N.A.)	$23,659	(N.A.)
Labor Situation[d]						
C (high wage)	17,687	(-12.5)	30,179	(- 6.6)	23,307	(- 1.5)
B	15,642	(-22.6)	27,138	(-16.0)	16,075	(-32.1)
A	13,895	(-31.2)	17,432	(-46.0)	9,339	(-60.1)
Capital Situation[e]						
B	18,897	(- 6.5)	32,043	(- 0.8)	21,626	(- 8.6)
C	17,033	(-15.7)	25,938	(-19.7)	13,127	(-44.5)
D	20,435	(+ 1.1)	28,647	(-11.3)	23,659	(0.0)
Price Situation						
High	32,714	(+61.8)	60,154	(+86.2)	28,802	(+21.7)
Low	13,458	(-33.4)	22,993	(-28.8)	32,049	(+35.5)
Government Program Deletion	12,746	(-36.9)	31,448	(- 2.6)	30,465	(+28.8)
Average Weaning Weight						
525 pounds with a 95% calf crop	20,559	(+ 1.7)	37,929	(+17.4)	22,765	(- 3.8)

[a]Returns to land, operator labor, and management. [b]Capital requirements for the optimal solution.

[c]The base situation included: Labor situation C (operator plus available seasonal labor equal to two full time hired men) at a wage of $1.75 per hour; operating capital and investment capital charged at 7 percent and 6 percent respectively; base livestock price situation; presence of the 1972 Farm Program; and an 88 percent calf crop with an average weaning weight of 475 pounds for the cow-calf system.

Table 54 (continued)

[d]Labor situations were: C (high wage)--same labor availability as the base but hired workers paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[e]Capital charges for operating and investment capital respectively are: B--10 percent, 8 percent; C--18 percent, 10 percent; D--7 percent, 6 percent with no investment capital required on brood cows.

efficiency level of production for the cow-calf enterprises resulted in relatively small increases in net returns.

The deletion of the 1972 Farm Program provisions of set aside acreage, allotments, and government payments had a considerable effect on net returns. Without governmental programs net returns were almost 37 percent lower than for the base situation. Given the assumptions of this study, a withdrawal of the government farm program would significantly reduce farm income and the value of farm land in the area.

As the wage rate for seasonal labor and capital charges increased and the availability of hired labor declined, both operating and investment capital declined (Table 64). Generally, operating capital declined considerably more than the investment capital requirements.

Capital required for the optimal systems was directly related to the livestock systems included. As swine numbers increased, the investment capital requirements increased considerably. As beef feeding and stocker enterprises increased, operating capital requirements increased. With the high livestock prices, swine enterprises were the major livestock production activities, and investment capital increased over 86 percent from the base situation. When cattle feeding and stocker steers were the major livestock enterprises (low livestock price situation), operating capital increased nearly 36 percent.

Only Beef and Associated Feed Enterprises

When only beef and associated feed enterprises were included in the model, steers full fed corn silage with a limited amount of corn grain and stocker steers grazing spring and summer pasture were the only income generating enterprises for the base situation. Both enterprises

were considerably larger than when all enterprises were included.

Feeding beef steers a constant amount of corn grain (five pounds per head per day) with full feeding silage (system II) occurred in the optimal organization most often as the model specifications varied (Table 65). With a more limited labor supply, however, the utilization of a pasture only phase in feeding beef occurred (system IV). This system utilizes permanent pasture as a feed source during the critical labor periods of the spring and early summer months. Since cattle on pasture require less labor than those fed grain, silage, or hay, this feeding system seems adapted to situations with a labor shortage during parts of the year and surplus labor in other parts (especially in the winter months).

For Capital Situation C, feeder steer III was included in the optimal solution. The higher charges for capital tended to give the feeding systems with a high rate of gain and a shorter feeding period (system III) a greater advantage in competing for the limited resources.

Stocker steer production was the other major beef enterprise in every solution with magnitude ranging from 88 to 175 head. Cow-calf enterprises were generally not an important source of income (Table 65).

The number of brood cows in the optimal solution did increase considerably when no investment capital was charged against the brood cows and with high efficiency levels of feeder calf production. The increase in brood cow numbers when no investment capital was required for brood cows is consistent with Stoval and Thompson's hypothesis that farmers may not consider investment requirements in making

Table 65. Optimal Beef Enterprise Organization for the 450 Acre Representative Farm, Only Beef and Associated Feed Enterprises Considered, for the Base Situation and Specified Modifications of the Base Situation

Model Specification	Cow-Calf		Stocker System	Feeding System			
	I	II	I	II	III	IV	
			Steers	Steers	Steers	Steers	Heifers
Base[a]	---	----	157.5	298.5	---	-----	----
Labor Situation[b]							
C (high wage)	---	----	157.6	290.1	---	-----	----
B	---	----	140.3	166.2	---	84.8	----
A	6.0	----	154.5	-----	5.3	130.3	----
Capital Situation[c]							
B	---	----	157.6	282.8	---	-----	----
C	---	----	109.8	258.1	5.8	-----	----
D	---	42.5	87.6	268.6	---	-----	----
Price Situation							
High	---	3.3	151.2	351.9	---	-----	----
Low	---	----	143.3	261.4	---	-----	43.1
Government Program Deletion	---	----	174.6	433.8	---	-----	----
Average Weaning Weight and Calf Crop of							
525 lbs; 88 percent	---	19.3	126.1	279.6	---	-----	----
525 lbs; 95 percent	---	42.8	87.6	268.6	---	-----	----

[a]The base situation included: Labor situation C (operator plus available seasonal labor equal to two full time hired men) at a wage of $1.75 per hour; operating capital and investment

Table 65 (continued)

capital charged at 7 percent and 6 percent, respectively; base livestock price situation; presence of the 1972 Farm Program; and an 88 percent calf crop with an average weaning weight of 475 pounds for the cow-calf systems.

[b]Labor situations sere: C (high wage)--same labor availability as the base but hired workers paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[c]Capital charges for operating and investment capital respectively are: B--10 percent, 8 percent; C--18 percent, 10 percent; D--7 percent, 6 percent with no investment capital required on brood cows.

decisions about expanding brood cow numbers, especially if no outlay of cash or credit is involved (32).

Stocker steer production was competitive with cow-calf production. As brood cow numbers increased, stocker steer production generally declined.

When all enterprises were included in the model, pasture accounted for almost all of the openland used for the production of feed for the beef enterprises. However, when the model was limited to only beef and their associated feed enterprises, considerable land was utilized for the production of both corn grain and silage (Table 66). These crops, along with hay, were the main feed ingredients for the cattle on feed.

Generally, the percentage of openland utilized for bermuda pasture declined as the number of stocker steers in the optimal organization declined. The percentage of openland used for permanent pasture, for the most part, increased as the number of brood cows or beef animals fed under system IV increased. As the land:labor ratio increased, permanent and total pasture production increased while bermuda pasture declined. When the labor supply was limited to only the farm operator, 68 percent of the openland was used for pasture.

Additional corn grain was purchased in half of the optimal organizations. The production of corn for feed was included in every solution except with deletion of the government program (Table 66). Without the additional government payment received for producing corn under allotment acreages (and a lower price associated for purchased corn), it became feasible to purchase all corn fed - over 8,800 bushels.

The consideration of only beef and associated feed alternatives

Table 66. Percentage of Openland Utilized for the Production of Feed for the Various Beef Systems, Only Beef and Associated Feed Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation

	Permanent Pasture[a]	Bermuda Pasture[a]	Corn Silage[a]	Hay[a]	Corn Grain[a]	Total
	----------Percent----------					
Base[b]	23.1	27.8	22.6	3.4	18.6[e]	95.5
Labor Situation[c]						
C (high wage)	23.1	27.9	22.6	3.2	18.6[e]	95.4
B	41.9	15.3	16.5	3.0	18.6	95.3
A	54.8	13.2	6.5	---	12.3	86.8
Capital Situation[d]						
B	23.1	28.0	22.0	3.1	19.2	95.4
C	12.8	16.4	19.1	6.9	18.6	73.8
D	28.4	23.1	22.6	2.8	18.6	95.5
Price Situation						
High	23.4	26.2	25.3	4.6	16.4[e]	95.9
Low	31.0	20.4	22.6	2.8	18.6[e]	95.4
Government Program Deletion	25.0	27.0	31.0	16.9	----[e]	99.9
Average Weaning Weight and Calf Crop						
525 lbs; 88 percent	25.4	25.7	22.5	3.0	18.6[e]	95.2
525 lbs; 95 percent	28.4	23.1	22.6	2.8	18.6	95.5

[a]Includes all soil groups utilized in the production of the feed ingredients.

[b]The base situation included: Labor situation C (operator plus available seasonal labor equal to two full time hired men) at a wage of $1.75 per hour; operating capital and investment capital charges at 7 percent and 6 percent respectively; base livestock price situation; presence of the 1972 Farm Program; and an 88 percent calf crop with an average weaning weight of 475 pounds for hte cow-calf systems.

[c]Labor situations were: C (high wage)--same labor availability as the base but hired workers paid $2.65 per hour; B-- operator and one full time hired man; and A--only operator labor available.

Table 66 (continued

[d]Capital charges for operating and investment capital respectively are: B--10 percent, 8 percent; C--18 percent, 10 percent; D--7 percent, 6 percent with no investment capital required on brood cows.

[e]With additional corn being purchased.

resulted in considerably less hired seasonal labor than when all enterprises were considered. The amount of seasonal labor hired ranged from only 400 hours in Capital Situation C to 1,179 hours without the 1972 Farm Program.

Only in the high livestock price and no governmental program situations was the upper limit imposed on hired labor effective. Hired labor was restrictive in April in both cases.

The deletion of row crop and swine alternatives resulted in lower utilization of operator labor in most cases. Generally, when the cow-calf enterprises was included in the optimal organization, a relatively higher proportion of the operator labor was utilized.

The amount of land utilized was considerably higher than when all enterprises were considered. Only in two solutions--Labor Situation A and Capital Situation C--was any land left idle.

Net returns were considerably lower when the model was restricted to only beef and associated feed enterprises (Table 67). If farm operators chose only to produce beef, they would forego an estimated 5 percent of the potential income which could be obtained if all enterprises are considered.

With the exception of the livestock price variations, government program deletion, and the high wage rate paid seasonal labor, variations from the base situation had a much greater effect on net returns on the beef representative farm than when all enterprises were considered. For example, with the highest level of capital charge, returns declined 15.7 percent from the base situation when all enterprises were considered while declining over 60 percent when only beef and associated feed

Table 67. Net Returns and Non-Land Capital Requirements, Only Beef and Associated Feed Enterprises Considered, for the Base Situation and by Specified Modifications of the Base Situation

Model Specification	Net Returns[a]		Investment Capital[b]		Operating Capital[b]	
	Amount	% Change from Base	Amount	% Change from Base	Amount	% Change from Base
Base[c]	$11,052	(N.A.)	$24,842	(N.A.)	$56,605	(N.A.)
Labor Situation[d]						
C (high wage)	10,498	(- 5.0)	24,439	(- 1.6)	55,737	(- 1.5)
B	5,894	(-46.6)	21,175	(-14.8)	55,298	(- 2.3)
A	5,516	(-50.1)	16,280	(-34.5)	41,790	(-26.2)
Capital Situation[e]						
B	8,906	(-19.4)	24,095	(- 3.0)	54,302	(- 4.1)
C	4,322	(-60.8)	21,283	(-14.3)	46.906	(-17.1)
D	11,286	(+ 2.1)	25,966	(+ 4.5)	48,885	(-13.6)
Price Situation						
High	12,895	(+16.6)	28,280	(+13.8)	71,245	(+25.9)
Low	9,312	(-15.7)	24,564	(- 1.1)	49,962	(-11.7)
Government Program Deletion	9,718	(-12.0)	31,376	(+26.3)	78,539	(+38.7)
Average Weaning Weight and Calf Crop of						
525 lbs; 88%	11,068	(+ 0.1)	30,349	(+22.2)	52,318	(- 7.6)
525 lbs; 95%	11,496	(+ 4.0)	38,004	(+53.0)	48,855	(-13.7)

[a]Returns to land, operator labor, and management.

[b]Capital requirements for the optimal solution.

[c]The base situation included: Labor situation C (operator plus available seasonal labor equal to two full time hired men) at a wage of $1.75 per hour; operating capital and investment capital charged at

Table 67 (continued)

7 percent and 6 percent, respectively; base livestock price situation; presence of the 1972 Farm Program; and an 88 percent calf crop with an average weaning weight of 475 pounds for the cow-calf systems.

[d]Labor situations were: C (high wage)--same labor availability as the base but hired workers paid $2.65 per hour; B--operator and one full time hired man; and A--only operator labor available.

[e]Capital charges for operating and investment capital respectively are: B--10 percent, 8 percent; C--18 percent; D--7 percent, 6 percent with no investment capital required on brood cows.

enterprises were considered (Tables 64 and 67). Thus, higher rates, viewed either as a higher charge for external capital or higher risk for internal capital, had a much greater effect on net returns on beef farms than on commercial farms with primarily row crop and swine enterprise systems.

Although a relatively small amount of labor was hired in the base situation, most of the seasonal labor was in the critical labor periods of April through June. Availability of seasonal labor was very critical to the net returns of the representative farm organization. When the option of hiring seasonal labor was deleted and an additional full time hired man was added, net returns declined considerable. Net returns were only slightly higher with a full time hired man than when available labor was limited to that of the operator.

Although net returns declined when the government program was deleted, the change was considerably less than when all enterprises were included in the model.

The deletion of the investment capital requirement on brood cows and higher efficiency levels for the production of feeder calves resulted in relatively small increases in net returns.

The optimal farm organizations, when alternatives were limited to beef and associated feed enterprises required rather substantial amounts of capital, especially operating capital (Table 67). The amounts of operating capital required ranged from $41,790 in labor Situation A to $78,539 with the government program deletion. The range of non-land investment capital required was from $16,280 in Labor Situation A to $38,004 with 525 pound average weaning weight calves and a 95 percent calf crop.

Limits on the availability of capital, either internal or external, could restrict the production of beef, particularly the capital intensive feeding and stocker operations.

Special Analysis

Additional analysis was conducted to determine the effects of: (1) differences in risk of beef feeding, stockers, and cow-calf production; (2) elimination of specific feeds for forage consumption for beef enterprises; (3) elimination of specific feeds for forage and concentrate consumption for beef enterprises; and (4) successive reduction of the various livestock alternatives considered.

Special Analysis--Risk

To account for risk variations among the various beef alternatives, operating capital was charged at 12 percent for finishing systems, 10 percent for stocker systems, and 7 percent for cow-calf systems. When all enterprises were considered as alternatives, these variations in interest charges had the following effects as compared to the base situation: (1) fewer stocker cattle on feed; (2) a slightly larger number of brood cows; (3) slight decline of pasture and silage acreage; (4) an increase in corn acreage, with no corn purchased; (5) an increase in unused land; (6) less labor hired; and (7) slight reductions in net returns, investment, and operating capital.

When the enterprise alternatives were restricted to only beef and associated feed enterprises, the variation in the risk level of the beef enterprises resulted in the following changes from the base situation: (1) a reduction in beef feeding; (2) a slight increase in the

production of corn; (3) a much greater reduction in net returns than when all enterprises were considered; (4) an increase in the proportion of available labor unused; and (5) a reduction in operating and investment capital requirements.

Special Analysis--Removal of specific forage consumption

The removal of the specific feeds for forage consumption for the beef enterprises when all enterprises were considered resulted in the following variations from the base situation: (1) relatively large increases in both the number of fed and stocker steer numbers; (2) no cow-calf enterprise in the optimal solution; (3) all forage supplied by permanent pasture and corn stover; (4) a reduction in the production of corn under compliance with the Farm Program; (5) no purchased corn; (6) reduction in the amount of seasonal labor hired; (7) all land utilized; (8) an increase in net returns of over 25 percent; (9) a large increase in the required amount of operating capital; and (10) an increase is estimated land values.

When only beef and associated feed enterprises were included in the model, the deletion of the specific forage consumption constraints resulted in the following changes from the base situation: (1) all row crop land utilized by corn silage and corn grain; (2) all other openland utilized for permanent pasture production; (3) an increase in stocker and cattle feeding numbers; (4) an increase of 54 percent in net returns; (5) an increase in labor utilization; and (6) relatively large increases in the "shadow" prices for soil groups but a decline in "shadow" prices for row crop land.

Special Analysis--Removal of specific forage and concentrate consumption

An additional variation in the analysis involved the removal of all specific feed ingredients as constraints on the beef enterprises (except for the purchased protein supplements). When this constraint was removed, steers were not required to consume corn grain as their primary ration component. When only beef and associated feed enterprises were considered, feeder steer III (516 head) was the only income generating enterprise in the optimal organization. Steers would utilize corn silage and permanent pasture (with protein supplement) for the sources of TDN, DP, AND DM. All openland was utilized for the production of these feeds. Other changes from the base situation were: (1) net returns increased 91 percent; (2) the amount of operating capital required was 14 percent larger; and (3) no row crop group was fully utilized.

This method of producing beef--pasture supplemented with corn silage (and protein supplements)--utilizes those feedstuffs in which the study area does have a competitive advantage over many other beef feeding areas.

Special Analysis--Deletion of swine enterprises

When swine enterprises were deleted from the "all enterprise" representative situation, the following changes from the base situation occurred: (1) cattle full fed corn silage with a limited amount of grain and stocker steers replace hog finishing and feeder pig production as the major livestock enterprises; (2) no cow-calf enterprise was included in the optimal enterprise mix; (3) a large decline in the

amount of hired seasonal labor occurred; (4) all available land was utilized; (5) operating capital requirements increased considerable, while investment capital requirements decreased; (6) estimated land values increased; and (7) net returns were reduced by almost 27 percent.

Special Analysis--Deletion of beef feeding enterprises

When both beef feeding and swine alternatives were excluded from the model, with all other enterprises remaining, the following variations occurred from the base situation: (1) the enterprise organization included substantially more cotton and stocker steers but practically no beef brood cows; (2) both operating and investment capital requirements were relatively smaller; (3) almost 50 percent of the operator labor was unused; (4) all land was used; and (5) net returns were substantially reduced. Net returns were also smaller than when beef feeding was allowed.

The exclusion of the beef alternatives from the beef and associated feed representative situation resulted in: (1) a large increase in stocker steer production; (2) utilization of most of the openland for pasture production; (3) a substantial reduction in net returns (78 percent), operating and investment capital, and the amount of operator labor utilized; and (4) no additional hired labor.

Special Analysis--Deletion of stocker enterprises

When swine, beef feeding, and stocker enterprises were deleted from the model, the cow-calf enterprises were the only livestock enterprises considered. When the cow-calf enterprises competed with all

other enterprises (except swine, beef feeding, and stocker), the following results occurred: (1) optimal organization included 43 brood cows and 137 acres of cotton; (2) net returns were further reduced; (3) only $7,000 operating capital was required; (4) a larger proportion of land was unused; (5) more operator labor was utilized than when stockers were also allowed in the model but a substantial amount of operator labor was unused; and (6) the "shadow" price for all row groups showed rather large increases.

When only the two cow-calf interprises were considered as income generating enterprises in the model, the following results were obtained: (1) net returns to land, operator labor, and management were negative; (2) a relatively large number of brood cows, wintered on silage was included in the optimal solution; and (3) considerably larger amounts of investment capital and considerably smaller amounts of operating capital were required than when other beef enterprises were also included in the model.

II. Conclusions

Based upon the assumptions and results of this study with all enterprises considered, feeder pig production and finishing out purchased feeder pigs are profitable livestock enterprises under most resource conditions in the study area. Generally, stocker steers, grazing permanent and bermuda pasture, appear to be the most profitable beef alternative under most resource situations. Cow-calf enterprises and beef feeding enterprises can provide additional net income on many farm organizations, but their inclusion in the optimal enterprise mix

is usually at a relatively low level.

Increasing cost of farm labor will result in a shift from the labor intensive feeder pig enterprises to the relatively labor extensive stocker and cow-calf enterprises.

If farm operators do not wish to consider their swine alternatives because of management limitations or personal reasons, beef feeding has the potential of becoming a major farm enterprise.

If enterprise alternatives are limited to the production of beef and associated feed enterprises, beef feeding and stocker enterprises appear to be the most profitable livestock alternatives. The cow-calf enterprises can compete at economical levels with beef feeding and stocker grazing systems with high efficiency levels in the production of feeder calves or if farmers disregard investment capital requirements for brood cows in decision making. Their inclusion in the optimal enterprise mix under these situations will add a rather small amount to net returns.

Grazing stocker steers on spring and summer pasture is more profitable than grazing stocker heifers. Feeding beef steers is more profitable, in most cases, than feeding beef heifers.

The utilization of corn silage as the major ration component supplemented with a limited amount of corn grain appears to be the most profitable method of feeding beef animals for slaughter. With a more limited supply of farm labor, those beef feeding systems, which incorporate a pasture only phase during the critical farm labor months, become a more profitable method of feeding beef animals.

As the charge for operating capital increases, the feeding

systems which incorporate a high rate of gain and shorter feeding periods become more competitive with other feeding systems, but the relatively profitability of beef feeding and stocker enterprises declines considerably.

Utilization of pasture as the major feed ingredient supplemented with corn silage and purchased supplements when necessary (with no concentrates fed) appears to be a profitable method of feeding beef in the study area.

Farm operators will forego substantial amounts of net income if the production of feeder calves is considered as their only enterprise alternative.

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APPENDICES

APPENDIX A

Table A-1. Summary of Revenue, Costs, Net Returns, and Operating and Investment Capital Per Head for the Twelve Beef Finishing Systems[a]

Item	I	II	III	IV	V	VI[k]
			Steers			
Total Revenue (less 3% shrinkage)	$281.30	$281.30	$281.30	$281.30	$281.30	$562.60
Cost (Variable)						
Feeder	162.50	162.50	162.50	162.50	162.50	325.00
Vet and medicine	1.25	1.25	1.25	1.25	1.25	2.50
Insecticide[b]	.50	.50	.50	.50	.50	1.00
Trucking (both ways)[cd]	3.38	3.38	3.38	3.38	3.38	6.75
Marketing fees[b]	3.75	3.75	3.75	3.75	3.75	7.50
Cattle insurance[ef]	.88	.88	.88	.88	.88	1.76
Electricity expense[e]	.60	.60	.60	.60	.60	1.20
Tractor operating expense	1.30	1.30	1.30	1.30	1.30	2.60
Death loss[j]	3.26	3.26	3.26	3.26	3.26	6.52
Purchased feeds[g]	4.24	3.94	3.06	8.43	11.22	14.28
Interest on operating capital @ 7%[h]	11.15	8.90	8.00	13.29	13.58	21.58
Total variable cost	192.81	190.26	188.48	199.14	202.22	390.70
Cost (Fixed)	10.76	10.76	10.76	10.76	10.76	17.68
Total specified costs	203.57	201.02	199.24	209.90	212.98	408.38
Net returns[i]	77.73	80.28	82.06	71.40	68.32	154.20
Operating capital[h]	159.26	127.14	114.30	189.86	193.97	308.27
Investment capital	45.12	45.12	45.12	45.12	45.12	76.98

Table A-1 (continued)

	I	II	III	IV	V	VI[k]
			Heifers			
Total Revenue (less 3% shrinkage)	$226.74	$226.74	$226.74	$226.74	$226.74	$453.48
Cost (Variable)						
Feeder	136.13	136.13	136.13	136.13	136.13	272.25
Vet and medicine[b]	1.25	1.25	1.25	1.25	1.25	2.50
Insecticide[b]	.50	.50	.50	.50	.50	1.00
Trucking (both ways)[cd]	2.93	2.93	2.93	2.93	2.93	5.85
Marketing fees[b]	3.75	3.75	3.75	3.75	3.75	7.50
Cattle insurance[ef]	.88	.88	.88	.88	.88	1.76
Electricity expense[e]	.60	.60	.60	.60	.60	1.20
Tractor operating expense	1.30	1.30	1.30	1.30	1.30	2.60
Death loss[j]	2.68	2.68	2.68	2.68	2.68	5.36
Purchased feeds[g]	3.50	3.94	3.06	7.33	10.78	13.84
Interest on operating capital @ 7%[h]	7.48	5.95	5.92	9.94	10.16	16.08
Cost (fixed)	10.76	10.76	10.76	10.76	10.76	17.68
Total specified costs	171.76	170.67	169.76	178.05	181.72	347.62
Net returns[i]	54.98	56.07	56.98	48.69	45.02	105.86
Operating capital[h]	106.79	84.96	84.58	141.95	145.15	229.73
Investment capital	45.12	45.12	45.12	45.12	45.12	76.98

Table A-1 (continued)

[a]Based on feeding 250 head and use of base price and capital charges.

[b]Adapted from Wade, Ken, unpublished data, University of Tennessee, Department of Agricultural Economics and Rural Sociology (1972).

[c]Adapted from Johnson, James M., and Keller, Luther H., Beef Feeding Systems and Optimum Farm Organization for Three Areas of Tennessee, Tennessee Agricultural Experimental Station Bulletin 480 (1971).

[d]Valued at 30¢/cwt./100 miles. Average market distance equals 75 miles.

[e]Adapted from McCoy, J. H., and Wakefield, H. D., Economies of Scale in Four Cattle Feedlots of Kansas--An Analysis of Nonfeed Costs, Kansas Agricultural Experiment Station Technical Bulletin 145 (1966).

[f]Insurance 50¢ per $100 valuation for one feeding period; 70¢ per $100 for system 6. Each head valued at $175.

[g]Salt, 1.5¢/lb., dicalcium phosphate 4¢/lb.; urea 4.4¢/lb. 30,000 I.U. of vitamin A, 18¢, growth implant 60¢, cottonseed meal $5.00/cwt.

[h]Feeder and farm produced feeds charged off for the length of feeding period. Farm produced feeds are charged at cost of production. Corn--50¢/bu.; silage--$5.35 ton; CAD--12¢; hay--$23.00/ton. Other items are charged for 1/2 the feeding period (with the exception of marketing fees and trucking).

[i]Return to land, labor, management, farm produced feeds, and general farm overhead.

[j]1.5% of average weight.

[k]Based on a combination of system III and IV; 2 head, 500 feedlot size.

Table A-2. Revenue, Costs, Net Returns, and Operating and Investment Capital for the Two Cow-Calf Enterprises[a]

Item	System I[b]	System II[c]
Returns		
Feeder steer calves[e]	$1,787.50	$1,787.50
Feeder heifer calves[e]	952.88	952.88
Cull cows[f]	763.40	763.40
Total revenue	3,503.78	3,503.78
Cost (Variable)		
Minerals and salt	15.00	15.00
Vet and medicine	60.00	60.00
Insecticide, cattle rubs, etc.	30.00	30.00
Marketing fees	80.63	80.63
Trucking calves[f]	19.46	19.46
Trucking cows[f]	7.81	7.81
Tractor operating expense	6.50	6.50
Interest on operating capital @ 7%	119.05	89.26
Urea	--	9.75
Total variable cost	338.90	318.41
Cost (Fixed)	958.99	1,026.59
Total specified costs	1,297.89	1,345.00
Net returns[h]	2,205.89	2,158.78
Operating capital[g]	1,700.75	1,275.13
Investment capital	9,310.00	9,570.00

[a]Based on 25 cow herd, 1 bull, and replacement heifers, base prices and capital charges.

[b]Wintered on hay. [c]Wintered on silage.

[d]Based on 88% calf crop (weaned), 16% replacement rate and 2% death loss on cows.

[e]Base price assumed: feeder steers $32.50/cwt.; feeder heifers $30.25/cwt.; cull cows $22.00/cwt.

[f]Adapted from Anderson (1). Assumes a rate of 30¢/cwt./100 miles and a market distance of 75 miles.

Table A-2 (continued)

[g]Operating capital figures at 1/2 year for cash expenses, full year for farm produced feed valued at cost of production: CAD-12¢ hay (alfalfa equivalent) $23.00 ton; silage $5.35 ton.

[h]Returns to land, labor, management and farm produced feeds, and general farm overhead

Table A-3. Revenue, Costs, Net Returns, and Operating and Investment Capital for Four Stocker Systems Per Head[a]

Item	System I	II	III	IV
Total Revenue (less 3% shrink)	$185.14	$151.16	$225.11	$192.68
Cost (Variable)				
Animal	119.00	93.75	162.50	136.13
Vet and medicine	1.50	1.50	1.25	1.25
Trucking (both ways)[b]	2.24	1.97	2.94	2.72
Marketing fees	3.00	2.75	3.75	3.75
Insecticide, cattle rubs, etc.	1.00	1.00	1.00	1.00
Cattle insurance	--	--	.88[g]	.88[g]
Tractor operating expense			1.30	1.30
Death loss	4.43[c]	3.51[c]	2.80[d]	2.39[d]
Purchased feeds[e]	.75	.75	5.56	5.56
Interest on operating capital @ 7%[f]	5.72	4.61	9.52	8.49
Total variable cost	137.64	109.84	191.50	163.47
Cost (Fixed)	3.27	3.27	8.38	8.38
Total specified cost	140.91	113.11	199.88	171.85
Net returns[h]	44.23	38.05	25.23	20.83
Operating capital[f]	81.68	65.84	135.94	121.32
Investment capital	23.06	23.06	39.00	39.00

[a]Base price assumed. Sell: I @ $29.50, II @ $27.00, III @ $28.75, IV @ 26.25; Buy: L $34.00, II $31.25, III $32.50, IV $30.25.

[b]Adapted from Anderson (1). Assumes a rate of 30¢/cwt./100 miles and a market distance of 75 miles.

[c]Based on 3% of average weight. [d]Based on 1 1/2% of average weight.

[e]Salt, 1.5¢/lb., dicalcium phosphate 4¢/lb., urea 4.4¢ lb., 30,000 I.U. of vitamin A, 18¢, cottonseed meal $5.00/cwt.

[f]Operating capital figured for length of feeding period on animal and farm produced feeds, one half the period for cash expenses. Farm produced feeds valued at cost of production; CAD 12¢; silage $5.35/ton.

[g]Adapted from McCoy and Wakefield (21). Based on 50¢ per $100 valuation for period.

[h]Returns to land, labor, management, and farm produced feeds and general farm overhead.

Table A-4. Revenue, Costs, Net Returns, and Operating and Investment Capital Per Unit for the Swine Enterprises

Item	System		
	Feeder Pig	Farrow to Finish[a]	Finishing[b]
Returns[c]			
Feeder pigs	$516.15	--	--
Slaughter hogs	--	$1,432.20	$46.20
Cull cows	76.50	76.50	--
Total Revenue	592.65	1,508.70	46.20
Cost (Variable)			
Feeder pig	--	--	16.65
Vet and medicine	16.00	32.00	.50
Marketing commission[d]	17.78	45.26	1.39
Trucking	8.75	13.40	.65
Electricity	3.00	4.60	.05
Tractor (operating expense)	5.20	5.20	.13
Boar replacement[e]	5.00	5.00	--
Death loss--pigs	--	28.65[f]	.57[g]
Death loss--sows[h]	1.53	1.53	--
Feed grinding-mixing	22.75	--	--
Purchased feeds[i]	90.04	251.02	5.18
Interest on operating capital @ 7%	7.81	23.92	.52
Total variable cost	176.33	410.58	25.64
Cost (Fixed)	51.10	316.64	3.72
Total specified costs	227.43	727.22	29.36
Net returns[k]	365.22	781.48	16.84
Operating capital[j]	111.62	341.76	7.39
Investment capital	321.25	1,317.38	50.19

[a]Two sow unit. [b]Unit is one hog.

[c]Assumes base price of $37/cwt. for feeder pigs, $21/cwt. for slaughter hogs, and $17/cwt. for cull sows.

[d]Calculated at 3% of sales.

[e]Boars replaced every year to prevent inbreeding.

[f]2% of gross returns. [g]3% of gross returns.

[h]2% of gross returns of cull sows.

Table A-4 (continued)

[i]Salt and minerals, $3.90/cwt.; soybean meal $5.00/cwt.; tankage $4.00/cwt.; creep feed $5.50/cwt.

[j]Operating capital charged on annual basis. Farm produced feeds and purchased animals were changed for length of feeding period; other expenses were changed for one half the period (with no change for marketing fees and trucking).

[k]Returns to land, labor, management, and farm produced feeds and general farm overhead.

APPENDIX B

Table B-1. Operating and Investment Capital Required and Cost of Production Per Acre of Feed Producing Enterprise

Enterprise	Soil Group	Operating Capital	Investment Capital	Cost of Production[a]
		Dollars		
Corn grain	I	18.65	47.86	52.25
	II	16.56	47.86	47.90
	III	13.95	47.86	42.52
Corn silage	I	23.36	26.14	99.19
	II	21.26	26.14	87.85
	III	18.37	26.14	74.34
Permanent pasture	I	8.90	8.00	20.13
	II	8.02	8.00	18.31
	III	7.22	8.00	16.65
	IV	6.33	8.00	14.83
Bermuda pasture	I	16.90	8.29	36.87
	II	15.60	8.29	34.18
	III	13.40	8.29	29.62
	IV	11.70	8.29	26.10
Alfalfa hay	I	18.12	101.70	89.81
	II	15.47	101.70	83.77
	III	17.27	101.70	87.89
Red clover (wheat) hay	I	12.03	58.57	55.85
	II	10.18	58.57	51.74
	III	11.23	58.57	54.03
Bermuda hay	I	22.73	120.29	109.17
	II	20.93	120.29	105.04
	III	18.58	120.29	99.46
	IV	15.48	120.29	92.40
Permanent pasture, hay	I	8.92	36.86	35.91
	II	8.02	36.86	34.01
	III	7.24	36.86	32.23
	IV	6.36	36.86	30.29
Lespedeza hay	I	7.22	40.43	32.40
	II	6.82	40.43	31.41
	III	6.42	40.43	30.34
	IV	6.02	40.43	29.28

[a]Excluding charges for labor, management, land, and general farm overhead.

Table B-2. Estimated Yields, Capital Requirements, and Net Returns Per Acre Per Soil Group, Under 1972 Farm Program and Under a Free Market Situation

Enterprise	Soil Group	Yield	Operating Capital		Investment Capital[c]		Net Returns[d]		
			Outside Allotment[a]	Allotment[b]	Outside Allotment[a]	Allotment[b]	For Allotment acres[e]	Above Allotment acres	Without Government program
Corn	I	90 bu.	18.65	19.06	47.86	48.90	72.66	55.75	42.25
Corn	II	75 bu.	16.56	16.97	47.86	48.90	55.61	42.10	30.85
Corn	III	60 bu.	13.95	16.97	47.86	48.90	37.61	29.48	20.48
Cotton	I	750#(lint) 250#(seed)	26.42	26.75	33.43	34.26	183.47	71.84	50.58
Cotton	II	675#(lint) 1000#(seed)	25.11	25.44	33.43	34.26	161.41	61.03	42.52
Cotton	III	500#(lint) 900#(seed)	22.50	22.83	33.43	34.26	125.55	43.91	29.41
Wheat	I	40 bu.	12.84	14.19	30.14	33.58	81.08	16.26	10.25
Wheat	II	35 bu.	10.80	12.15	30.14	33.58	70.27	14.00	8.75
Wheat	III	30 bu.	8.75	10.10	30.14	33.58	59.47	11.74	7.24
Soybeans	I	36 bu.	13.92	--	42.15	--	--	58.52	38.72
Soybeans	II	32 bu.	13.92	--	42.15	--	--	47.52	29.92
Soybeans	III	27 bu.	13.92	--	42.15	--	--	33.77	18.88
Wheat-Soybean double cropped	I	40 bu.(wheat) 27 bu.(beans)	23.52	--	71.44	--	--	56.88	36.03
	II	35 bu.(wheat) 24 bu.(beans)	21.47	--	71.44	--	--	46.39	27.94
	III	30 bu.(wheat)	19.41	--	71.44	--	--	33.14	17.64
Wheat(grown with red clover)[f]	I	20 bu.	12.03	--	58.57	--	--	-29.85	-32.85
	II	17.5 bu.	10.18	--	58.57	--	--	-28.99	-31.61
	III	15 bu.	11.23	--	58.57	--	--	-34.53	-36.78

Table B-2 (continued)

[a]Outside allotment refers to those acres above alloted acres under a government program and also to all acres without a government program.

[b]Capital charges are higher for acreages under allotment to reflect the amount of capital required for the set aside acres.

[c]Excluding land.

[d]Return to land, labor, management, and general overhead.

[e]Includes government payments.

VITA

Donald Layne Williams was born in Groom, Texas on December 27, 1947. He attended grade school in White Deer, Texas and graduated from White Deer High School in May of 1966. The following September he entered West Texas State University in Canyon, Texas and in May, 1970, received a Bachelor of Science degree in Agriculture Business. In June of 1970, he accepted a research assistantship at the University of Tennessee, Knoxville, and began study toward a Master's degree in Agricultural Economics. In September of 1970 he was awarded a National Defense Educational Act Fellowship. He received the Master of Science degree in August of 1972 and the Doctor of Philosophy degree in Agricultural Economics in August of 1975.

He is married to the former Reva Gayle Barnett of Skellytown, Texas, and they are the parents of two sons, Mark Ashley and Bradley Layne.