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August 1972

To the Graduate Council:

I am submitting herewith a thesis written by James A. Atchison entitled "A Study of Optimum Resource Use on Part-Time Farms in the Brown Soil and Delta Areas of Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Luther H. Keller
Major Professor

We have read this thesis
and recommend its acceptance:

Charles M Cuskaden

Frank O Lentfold

Accepted for the Council:

Hilton G. Smith
Vice Chancellor for
Graduate Studies and Research

A STUDY OF OPTIMUM RESOURCE USE ON PART-TIME FARMS IN THE BROWN SOIL AND DELTA AREAS OF TENNESSEE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

James A. Atchison

August 1972

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ABSTRACT

The purpose of this study was to determine net returns that could be earned by labor and management on part-time farms in West Tennessee. Alternative part-time farm situations used in the study were chosen as representative of the Brown Soil and Delta Areas of Tennessee. Representative farms of 70, 150, and 225 acres each with labor supplies of 1030, 1446 and 1755 hours per year were used in the analysis. In addition to these base situations, two interest rate levels were used and options were considered for acquiring of additional acreage and/or disposing of part or all of the current acreage. No restriction was placed on the amount of capital available. No hired labor was permissable.

Crop and livestock production coefficients used in the study were developed for use in Regional Project S-67. The linear programming technique was used to estimate the combinations and quantities of enterprises, the resource needs, and the net returns on land, labor, and management in each representative farm situation. Returns on labor and management were then estimated by deducting charges for land and overhead.

For the situations considered, returns to labor and management ranged from $2,610 to $17,672. Income increased with increases in the size of the farm and amount of labor available and with the inclusion of the option to acquire additional land.

The production of feeder pigs seemed to fit the labor situation on part-time farms and was included in most of the optimum systems derived. The feeding of heifers and/or steers was included in some systems especially on the larger farms and in the situation with the largest labor supply.

Under current farm programs cotton is a relatively profitable crop and in most cases the optimum system included cotton acreage to the limit of the base acreage. Corn, soybeans, and in some cases, wheat were also commonly included in the optimum enterprise combination. The production of hay for sale was a profitable alternative in some cases.

Increasing the interest charge from 6 percent on investment capital and 7 percent on operating capital to 10 percent on investment capital and 18 percent on operating capital had only minor effects on the optimum enterprise combination, but did reduce considerably the returns to labor and management in each case. Despite the labor restrictions, when the option to acquire additional land through purchase or lease was included considerable additional acreage was acquired in each case. With the lower interest rates land was acquired through purchase, while with the higher interest rate land was leased.

Net incomes resulting from the part-time farm situations studied were in many cases larger than incomes likely to be earned by the operators from off-farm sources. Under the conditions specified in this study it would appear that income potential from farming compares very favorably with most off-farm work alternatives. With the estimated magnitudes of part-time farm incomes, the incomes from off-farm work could be viewed as a supplement to the farm incomes, instead of vice versa, as is commonly assumed.

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CHAPTER I

THE PROBLEM AND OBJECTIVES

I. INTRODUCTION

Rapid changes in the numbers of farms and farm operators in Tennessee have occurred in the past two decades. Farm numbers estimated for the state in 1971 were only slightly more than half the number reported in 1950, as shown in Figure 1. During the same period, numbers of farm operators in Tennessee performing some type of off-farm work for 100 or more days per year and numbers of part-time farms in the state fluctuated somewhat, but 1969 levels were about the same as 1949 levels. This changing structure of farms in Tennessee creates a great deal of interest in the role of the part-time farm.

This study deals with the problem of how to organize farm production on different size part-time farms representative of the Brown Soil and Delta Areas of Tennessee. Resource needs, costs, and returns were developed for a number of livestock and crop production enterprises adaptable to the study area and through the use of linear programming, combinations of enterprises capable of generating the maximum net returns to land, labor, and management were determined. Also, under the specified assumptions, the level of maximum returns for the various farm situations was estimated.

Considerable research has been done in other Southeastern states dealing with both the current and future status of part-time farms. A study in South Carolina indicated that since the number of part-time

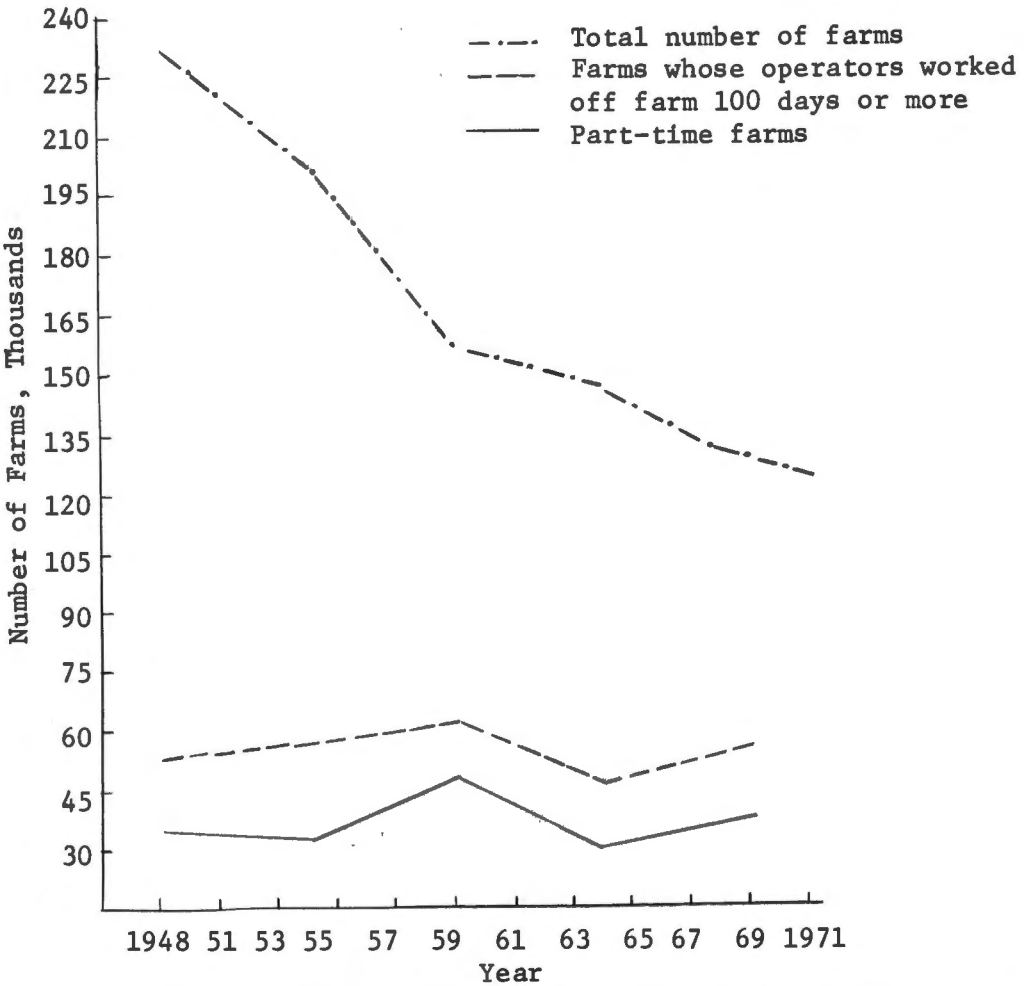

Figure 1. Number of farms, part-time farms, and farms whose operators worked off the farm 100 days or more annually in Tennessee from 1949-1971.

Sources: United States Bureau of the Census, United States Census of Agriculture: 1954, Tennessee, Vol. 1 (Washington: Government Printing Office, 1956), pp. and 194; U.S. Department of Agriculture, United States Census of Agriculture: 1964, Tennessee, Vol. 1 (Washington: Government Printing Office, 1967), p. 112; Tennessee Crop Reporting Service, Tennessee Agricultural Statistics Annual Bulletin 1971, Bulletin T-8, Nashville, Tennessee Crop Reporting Service (1971), p. 4; and Robert H. Hobson, Personal Communication, Tennessee Crop Reporting Service, Nashville, Tennessee (1972).

farms had remained about constant while the total number of farms declined sharply, part-time farming was being used as a transitional stage out of agriculture. If so, this condition is a reversal of the role previously played by the part-time farm in the once popular "farm ladder" (9). Martin and Southern reported low incomes on part-time farms in Texas and concluded that an optimum reorganization of the use of resources available would yield higher net returns while at the same time demanding less farm labor. Therefore, they suggested that part-time and possibly full-time farm operators might find off-farm work profitable and in harmony with maximum net returns from the farm (10). A 1961 Mississippi study showed the average net income per hour for part-time farm work was less than 20 percent of the average income from non-farm work and further stated that part-time farm resources were used less efficiently than those of other farms. Forty percent of the part-time farms in the study area had net farm incomes of less than $250 with one-third of the 40 percent having negative farm incomes in 1958 (6).

In 1964, 35 percent of all farm operators in Tennessee reported 100 or more days of work off the farm annually. Not all of the operators working off the farm 100 or more days were considered part-time farms by the 1964 Cencus of Agriculture due to the income constraint imposed on a part-time farm by the census definition. Since an operator who works off the farm 100 or more days per year is not devoting his full attention to the farm, the definition of the part-time farm was changed from that of the census for purposes of this study.

A part-time farm for this study was defined as a farm whose operator worked off the farm 100 or more days per year, regardless of the level of his farm income, his age, or comparisons of his incomes from farm and non-farm sources.

Southern Regional Research Project S-67 entitled "Evaluation of Beef Production in the South" was in progress at the time of this study. Objective II for Regional Project S-67 was to:

> Evaluate the micro and macro economic effects of selective aspects of alternative beef production systems (and associated feed production complements) in delineated areas of the region with specific attention given to the effects of selected levels of production technology, beef prices and competing product prices (1, p.2).

As stated in the Procedural Guide for Objective II of Regional Project S-67, one farming situation to be evaluated was a part-time farming situation.

This study was conducted in conjunction with partially fulfilling Objective II of Regional Project S-67. Many assumptions used were those developed for S-67 by the various sub-committees working on the project. More resource availability situations and a larger number of possible enterprises for the part-time farm were considered than suggested by S-67 in an attempt to make the results of the study adaptable to larger numbers of part-time farming situations existing in West Tennessee.

II. THE PROBLEM

Part-time farmers control a sizable quantity of the agricultural production resources in Tennessee. The efficiency with which those resources are used will affect the prosperity of the resource owner as

well as the economy as a whole. Therefore, obtaining the optimum utilization from agricultural resources would be of interest to both the part-time farmer and society.

Net farm incomes on many part-time farms are reported to be very low. As indicated above, some studies have reported low efficiency, low or negative income, and a transitional phase of employment to be associated with part-time farming. A study designed to demonstrate the maximum net returns obtainable from efficient resource utilization on part-time farms would be of value and help project the future status of the part-time farm not only to the 5,180 farm operators who worked off the farm 100 or more days annually in the study area* in 1964 but to others also. Results of this study may also be useful to full-time farmers considering part-time farming, non-farmers considering part-time farming, agricultural finance specialists, policy makers and others.

III. OBJECTIVES

The principal objective of this study was to determine maximum net returns to labor and management for part-time farm operators operating under a variety of different resource assumptions. A detailed statement of all objectives of the study is as follows:

1. To develop representative part-time farm situations that are applicable to the Brown Soil and Delta Areas of Tennessee.

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*The area of study included the sections of Western Tennessee commonly referred to as the Brown Soil and Delta regions.

2. To estimate the resources needed, costs, and returns for each unit of the livestock and crop enterprises considered for use on part-time farms in the study area.

3. To determine the combination of enterprises that would yield maximum net returns, and the amount of the returns, to part-time farmers of the study area with various levels of productive resources and adjustment situations.

Variations were made in farm size, available farm labor supply, interest rate, and in ability to buy or lease additional acreage or dispose of present acreage through sale or lease.

IV. PROCEDURE

The following procedures were used to accomplish the above objectives.

1. Three farm sizes were used. The smallest farm used was 70 acres--the approximate average size of part-time farms in the study area at the present time. Medium and large farm situations were also delineated, including 150 and 225 acres, respectively. Land was grouped into use categories typical of the soil distribution within the study area. Hours and seasonal distribution of labor were determined for three levels of off-farm work. Capital supply was assumed unlimited and was charged at two alternative levels.

2. Resource needs, costs, and returns were determined for 30 livestock and crop enterprise production systems. Crops and forages budgeted were alfalfa hay, corn, corn silage, cotton, lespedeza hay, Midland Bermuda hay, Midland Bermuda pasture, permanent pasture,

permanent pasture-hay, soybeans, soybeans-wheat doublecropped, wheat, and wheat-red clover hay doublecropped. Livestock enterprises budgeted were cow-calf on pasture and hay, cow-calk on pasture and silage, feeder heifers (six systems), feeder steers (six systems), feeder pigs (birth-45 pounds), and slaughter hogs (45-220 pounds). Budgets were also developed for purchasing and/or leasing land in or out. Livestock budgets used were developed by Keller and Wade (8). Tractor and machinery operation times and costs were estimated by Keller and Linton (7). The 1972 Government Farm Program was assumed with respect to allotted crops.

3. The linear programming technique was used to accomplish Objective 3 of this study, using enterprise budgets and assuming three sizes of farms, three quantities of labor, and two interest rates for both operating and investment capital.

CHAPTER II

AREA OF STUDY

I. LAND AREA

Tennessee is very diverse with respect to resources and conditions affecting agriculture. Because of this diversity, the area for this study was limited to the 12 most western counties of Tennessee. The counties included were Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Lake, Lauderdale, Madison, Obion, Shelby, and Tipton, what is commonly called the Delta and Brown Soils Areas of Tennessee (Figure 2).

Included in the study area, with very little exception, were areas identified by Martin and Luebke as 1, 2a, and 3 with respect to types of farming in Tennessee (11, pp. 57-68). Martin and Luebke referred to the above areas as the Mississippi Bottoms, a portion of the Northern Plateau, and the Southern Plateau. Historically, the study area has been the major cotton producing area of the state.

In 1964 the 3,001,057 acres in farms of the study area were reported to contain 22,381 farms with an average size of 134 acres per farm.* Over 74 percent of the acreage in farms was classified as openland. Cropland accounted for 68 percent of the openland while pasture occupied the remaining 32 percent of the openland area (18, pp. 258-267). A 1971 estimate of the number and average sizes of farms in Tennessee, available only for the entire state, showed farm numbers continuing to

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*The area also contains approximately 1,000,000 acres of nonfarm land.

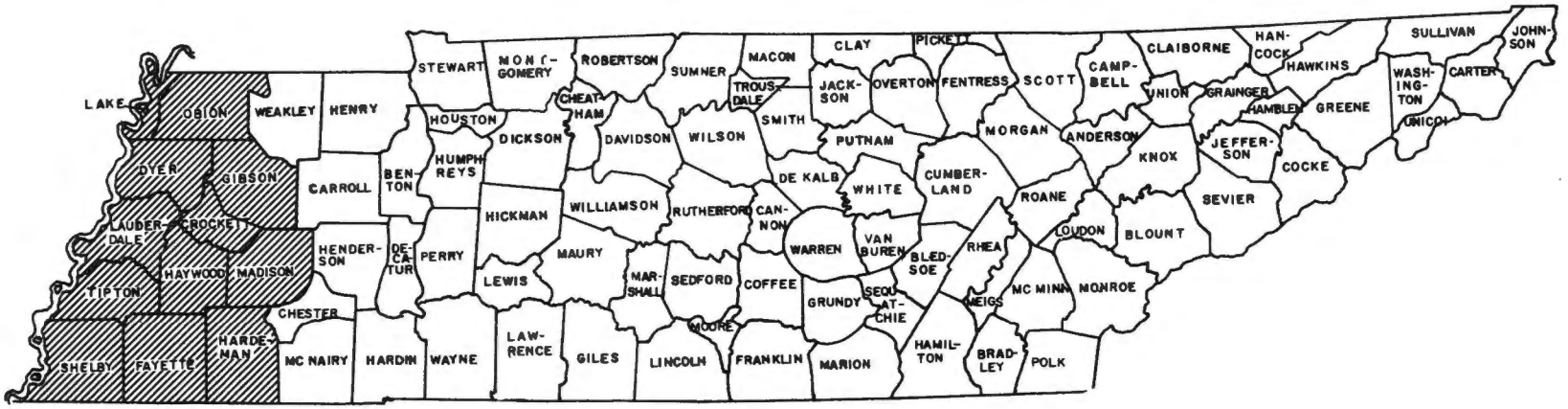

Figure 2. The location of the area of study.

decrease with an increase in the average size of farms in the state. In 1971, a total of 125,000 farms with an average size of 123 acres was reported (15, p. 4). The trend to fewer but larger farms has no doubt continued in the study area, as it has in the state as a whole.

II. SOILS

Considerable variation exists in soil type, topography, and elevation in the area of study. Soils are generally of a deep loessial type in the west but are thinner in the east. Soils of the Delta area along the western boundary of the study area form the Sharkey-Robinsonville-Yazoo Soil Association. The soils were formed from alluvium and bear high natural fertility. The Memphis-Loring and Grenada-Memphis-Loring Soil Associations predominate in the remainder of the area. Soils of these associations range from deep, fertile, loessial soils in the west to sand, clays, and gravel of coastal plains origin in the east. A relatively high proportion of these soils are well suited for row crops but precautions must be taken to avoid erosion on many of the soils of the associations (11, pp. 58-66).

Topography of the study area ranges from nearly level in the western part to rolling in the eastern portion. The highest elevation of the area is about 600 feet in the east while the lowest elevation of about 250 feet is found around Memphis.

CHAPTER III

RESOURCE ASSUMPTIONS

I. LAND AREA

Part-time farm sizes of 70, 150, and 225 acres, including woodland and openland, were assumed for the study. The average size part-time farm in Tennessee was 63.8 acres in 1964 (18, p. 37). Since 1964 the average size farm in Tennessee has increased by 11.8 percent (15, p. 4). Assuming the size of the part-time farm to have increased at the same rate as all farms, its average size was estimated to be 71.3 acres in 1971. For this reason, the 70 acre farm was chosen as one size farm for use in the study. The other farm sizes were chosen arbitrarily to provide a wide range of land and labor combinations for studying resource use on part-time farms.

A summary of openlands and woodlands in the 12 county area of study is shown in Table I. Seventy-four percent of the land in farms was classed as openland and the remaining 26 percent was classed as woodland and land devoted to homesteads, roads, and other uses (18, pp. 258-267). Thus, for the 70, 150, and 225 acre farms studied, acreages of openland were assumed to be 52, 111, and 167 acres, respectively.

II. SOILS

Soils of the study area were divided into four major groups based upon similarity of soil capability classes. The major groups are shown in Table II. Soils of Groups I and II are composed mostly of Capability

Table I. Estimated Acres of Openland in Various Uses in the Study Area, 1964

County	Acres Cropland Harvested	Acres Openland Pastured	Acres Woodland Grazed and Ungrazed	Acres Cropland Not Harvested and Not Pastured	Acres Other Land
Crockett	84,329	35,246	23,726	14,171	9,786
Dyer	143,854	52,967	25,411	10,687	12,184
Fayette	119,421	122,712	86,343	21,707	30,881
Gibson	163,782	84,151	32,008	26,165	24,770
Hardeman	57,206	59,025	114,658	20,284	19,224
Haywood	119,961	57,067	39,403	14,945	18,737
Lake	76,314	1,390	3,372	2,409	2,477
Lauderdale	113,517	39,189	46,469	13,740	14,891
Madison	81,440	62,531	64,089	22,601	20,787
Obion	128,678	77,437	45,805	19,448	11,420
Shelby	114,613	67,571	47,455	16,594	27,147
Tipton	124,851	48,918	34,304	9,356	17,206
Total	1,327,966	708,204	563,043	192,107	209,510
Percent of total farmland	44.3	23.6	18.9	6.4	7.0

Source: U.S. Department of Agriculture, United States Census of Agriculture: 1964, Tennessee, Vol. 1 (Washington: Government Printing Office, 1967).

Table II. Description of Soil Groups Found on Representative Farms of the Study Area

Soil Group	Predominant Soil Capability Classes	Proportion of Openland (%)	Maximum % of Openland for:	
			Row Crops	Alfalfa
I	I-1, 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: Tennessee Conservation Needs Committee, Tennessee Soil and Water Conservation Needs Inventory, Tennessee State Soil Conservation Committee, 1971.

Classes I and II, as recognized by the Soil Conservation Service. Class I soils can be used more intensively than other classes of soils with only minimal erosion risk. They are generally level, well drained, and productive. Class II soils present some limitations to use and require certain conservation practices. Soil Group III is made up of soils of SCS Capability Class III, which are soils with any of a number of severe limitations that reduce their uses and require special conservation practices, or both. Examples of limitations are: ". . . the amount of clean cultivation; time of planting, tillage, and harvesting; choice of crops; or a combination of these items" (20, p. 127). Soils of SCS Capability Classes IV and VI fall into Soil Group IV. Class IV soils are marginal for cultivation and require very restrictive conservation practices. Soils in Class VI are generally suited only for pasture, woodland, or wildlife feed and cover. Some soils of this class may be adapted for orchards or vegetable crops if conservation procedures are carefully followed (20).

Major soil series, proportions of openland and maximum percentages for use in various enterprises of the Soil Capability Classes are shown in Table III.

III. LAND IN REPRESENTATIVE FARMS

Part-time farms of 70, 150, and 225 acres were used in this study. Since about 74 percent of the farm land in the study area is open, openland acreages were assumed to be 52, 111, and 167 acres, respectively for the three farm sizes. The proportion of openland and the maximum percentages of openland for row crops and alfalfa in the various Soil

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

Soil Groups	Capability Classes	Major Series	Percent of Total Openland Soils
I	I-1, 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 (B slope)	9.5
	IIIe-2	Grenada	4.1
	IIIw-1	Calloway (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
	IVe-2	Grenada (C, D, & E slopes)	3.0
		Total	(19.0)

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

Source: Tennessee Conservation Needs Committee, Tennessee Soil and Water Conservation Needs Inventory, Tennessee State Soil Conservation Committee, 1971.

Groups are shown in Table II. The number of acres available for different uses on each of the part-time farms are shown in Table IV. Cotton allotments and feed-grain bases were determined by use of the average percentages of openland occupied by these acreages in the study area during 1970 (17).

IV. LAND VALUES

Considerable variation in land values exists within the Brown Soil and Delta Areas of Tennessee. Land value estimates were based upon correspondence with an appraiser of The Federal Land Bank in Tennessee (12). Estimates, shown in Table V, were assigned for land based upon representative values and locations and are considered to be for property without improvements.

V. LABOR SUPPLIES

All labor available on part-time farms in this study was assumed provided by the operator, with the exception of jobs which demand two men to achieve any degree of efficiency, for example, hauling hay. The different labor supplies were derived by using the remaining labor each week after assuming three different quantities of off-farm work. The farm labor supply varied inversely with amounts of non-farm work done.

The three labor supply situations studied were as follows:

Labor Supply A--The part-time farm operator was assumed to work off the farm eight hours per day, five days a week, year around, and to receive a two week vacation each year. Maximum hours of labor available for farm work was 1,030 hours per year.

Table IV. Estimated Acres in Various Soil Groups, Bases, Allotments, and Maximum Acreages for Use in Row Crops or Alfalfa by Farm Size

Land Use	Farm Size		
	Large	Medium	Small
Total land	225.0	150.0	70.0
Openland	167.2	111.5	52.0
Soil Group I	80.6	53.7	25.1
Row crop	64.5	43.0	20.1
Alfalfa	32.2	21.5	10.0
Soil Group II	18.1	12.0	5.6
Row crop	6.0	4.0	1.9
Alfalfa	18.1	12.0	5.6
Soil Group III	32.4	21.6	10.1
Row crop	6.5	4.3	2.0
Alfalfa	24.3	16.2	7.6
Soil Group IV	36.1	24.1	11.2
Row crop	0.0	0.0	0.0
Alfalfa	0.0	0.0	0.0
Cotton allotment	31.8	21.2	9.9
Feed grain base	32.2	21.4	10.0

Table V. Estimated Values and Costs of Owning Land, by Soil Groups

Soil Group	Estimated Value[a]	Annual Payment Amortized 30 yr. @ 6%
I	450.00	32.69
II	300.00	21.79
III	250.00	18.16
IV	175.00	12.71
Average acre	335.60[b]	24.38

[a]Estimated means for the four major soil groups were provided by Mr. Elihu Meador, a rural appraiser with The Federal Land Bank of Tennessee.

[b]Estimated values for an average acre was determined by weighting the estimated value of the four soil groups in the proportions in which they appear in the study area.

Labor Supply B--The operator was assumed to work five eight hour days per week off the farm, but only for nine months per year. The operator did not perform any off-farm work between June 1 and September 1 each year and would be available for full-time farm work during this period. Maximum hours of labor available for farm work was 1,446 hours per year.

Labor Supply C--The part-time farm operator was assumed to work the equivalent of three eight hour work days per week off the farm all year. His remaining time was then available for farm labor. Maximum hours of labor available for farm work was 1,755 hours per year.

One and one-half hours per day were allowed for lunch and travel to and from work in each situation. The farm labor supply available for use on the farm on days the operator worked off the farm was one hour per day during November through March; one and one-half hours per day in April, September, and October; and two hours per day for May through August. Ten hours of time were assumed available for farm work on Saturdays, holidays, and all other days fully devoted to farming.

A vacation allowance of 96 hours was added to the full-time off-farm operator's time available at the rate of eight hours per month rather than choosing a particular time period in which to add the entire vacation. No vacation allowance was considered for the operators working less than full-time off the farm. While the labor requirements outlined for this study were higher than for an average non-farm worker, the longest work days for any period of time were 11 and one-half hours per day.

This does not seem overly demanding for an operator devoted to carrying out a part-time farming operation. If we assume a full-time operator to be available 2,250 hours per year, the part-time farm labor supplies used here represent 46 percent, 64 percent and 78 percent of full-time labor supply for the A, B and C labor situations respectively.

Six labor periods of two months each were used to distribute the labor supply throughout the year. The amounts of farm labor available in each of the six labor periods and annually for the three labor supplies are shown in Table VI.

VI. AVAILABILITY AND COSTS OF CAPITAL

No restrictions were placed on the amounts of investment or operating capital available for use in either livestock or crop production. Two capital costs situations were considered. In one situation investment capital and operating capital were charged at 6 and 7 percent, respectively; while in the other case investment capital was charged at 10 percent and operating capital at 18 percent. The introduction of the higher capital charge was intended to reflect both risk considerations and a possible constraint on capital availability or willingness to borrow.

Operating capital was not used 12 months a year in most cases; thus charges for its use were made only for the length of time used. Since net returns to the part-time farm operator were calculated as returns to labor and management, no charges were made for operator labor.

Table VI. Estimated Labor Availability by Labor Periods and by Labor Situations

Labor	Period	Labor Situation A	B	C
I	January-February	142	126	270
II	March-April	164	148	289
III	May-June	196	348	308
IV	July-August	200	528	320
V	September-October	175	159	296
VI	November-December	153	137	272
	Totals	1,030	1,446	1,755

VII. OVERHEAD COSTS

As many costs as possible were included directly in the budgets for the various crop and livestock enterprises. However, some costs that exist for almost every farm could not be adequately subdivided for inclusion in individual enterprise budgets. Such costs were grouped together as an annual overhead cost for the entire farm and then were deducted from the farm's cash returns to determine returns remaining to land, labor, and management.

Such items as automobile expenses, truck expenses, machine sheds, wagons, fencing, tools, utilities, insurance, and legal services were included in the annual overhead costs. The costs of items not used exclusively by the farm were assumed shared by the farm and the household or family. Overhead costs were assumed to be the same for the small and medium size farms while a greater overhead cost was assumed for the large farm. A summary of overhead costs for the small and medium size farms is shown in Table VII while overhead costs for the large farms are shown in Table VIII.

Table VII. Estimated Annual Overhead Costs for the Small and Medium Size Farms

Item	Cost		Salvage Value	Years Life	Annual Depr.	Annual Repair	Interest @ 6%	Taxes and Insur.	Fuel and Other	Total Annual Cost
	New	Average								
Truck (1/2 ton)	2,800.00	1,260.00	280.00	10	252.00	84.00	75.60	60.00	160.00	631.60
Auto (farm share)	--	--	--	--	--	--	--	--	240.00	240.00
Machine shed	1,200.00	600.00	--	20	60.00	6.00	36.00	8.00	--	110.00
Wagon	400.00	180.00	40.00	15	24.00	18.00	10.80	1.20	--	54.00
Manure spreader	700.00	315.00	70.00	15	42.00	20.80	18.90	1.25	--	82.95
Elevator	300.00	135.00	30.00	15	18.00	9.00	8.10	.75	--	35.85
Fencing	927.00	463.50	--	20	46.35	18.60	27.81	2.00	--	94.76
Farm tools	--	500.00	--	--	--	60.00	30.00	--	--	90.00
Electricy	--	--	--	--	--	--	--	--	35.00	35.00
Telephone	--	--	--	--	--	--	--	--	30.00	30.00
Liability insurance	--	--	--	--	--	--	--	40.00	--	40.00
Fire insurance	--	--	--	--	--	--	--	60.00	--	60.00
Legal and miscellaneous	--	--	--	--	--	--	--	--	30.00	30.00
Total		3,453.50			442.35	216.40	207.21[a]	173.20	495.00	1,534.16[b]

[a]Total interest at 10% was $345.35.

[b]When 10% interest was charged, total annual cost increased to $1,672.30.

Table VIII. Estimated Annual Overhead Costs for the Large Size Farms

Item	Cost		Salvage Value	Years Life	Annual Depr.	Annual Repair	Interest @ 6%	Taxes and Insur.	Fuel and Other	Total Annual Cost
	New	Average								
Truck (1 ton)	3,400.00	1,530.00	340.00	10	306.00	102.00	91.80	70.00	200.00	769.80
Auto (farm share)	--	--	--	--	--	--	--	--	320.00	320.00
Machine shed	1,500.00	750.00	--	20	75.00	7.50	45.00	10.00	--	137.50
Wagon	400.00	180.00	40.00	15	24.00	18.00	10.80	1.20	--	54.00
Manure spreader	700.00	315.00	70.00	15	42.00	20.80	18.90	1.25	--	82.95
Elevator	300.00	135.00	30.00	15	18.00	9.00	8.10	.75	--	35.85
Fencing	1,854.00	927.00	--	20	92.70	37.20	55.62	4.00	--	189.52
Farm tools	--	500.00	--	--	--	60.00	30.00	--	--	90.00
Electricity	--	--	--	--	--	--	--	--	45.00	45.00
Telephone	--	--	--	--	--	--	--	--	40.00	40.00
Liability insurance	--	--	--	--	--	--	--	40.00	--	40.00
Fire insurance	--	--	--	--	--	--	--	90.00	--	90.00
Legal and miscellaneous	--	--	--	--	--	--	--	--	40.00	40.00
Total		4,337.00			557.70	254.50	260.22[a]	217.20	645.00	1,934.62[b]

[a]Total interest at 10% was $433.70.

[b]When 10% interest was charged, total annual cost increased to $2,108.10.

CHAPTER IV

LINEAR PROGRAMMING AND DETERMINATION OF PRODUCTION COEFFICIENTS FOR THE LINEAR PROGRAMMING ANALYSIS

I. LINEAR PROGRAMMING

Linear programming is an empirical tool credited as a product of World War II. The method was developed to help maximize the output of war products with the limited labor and resources available and then to help distribute the goods with the minimum amount of travel possible. Since World War II, linear programming has been further refined and is extensively used by researchers in agriculture and industry who are seeking optimum organizations of resources and enterprises for firms, desirable firm adjustments, maximum returns from limited resources, minimum costs from unlimited resources, and optimum patterns of resource use and product specialization (4, p. 1).

Three "quantitative components" and four "assumptions" must be applicable to a problem that is being solved, or linear programming may not provide a satisfactory solution. The quantitative components necessarily contained by a linear programming problem are: 1) an objective, 2) alternative methods or processes for arriving at the objective, and 3) restrictions (4, pp. 2-3). Necessary assumptions for linear programming problems are:

(1) Additivity and linearity--The activities must be additive in the sense that when two or more are used, their total product must be the sum of their individual products.

(2) Divisibility--It is assumed that factors can be used and commodities can be produced in quantities which are fractional units.

(3) Finiteness--It is assumed that there is a limit to the number of alternative activities and to the resource restrictions which need be considered.

(4) Single-value expectations--The assumption is employed that resource supplies, input-output coefficients, and prices are known with certainty (4, pp. 17-18).

The above described characteristics of linear programming were assumed applicable to this study. Therefore, numerous coefficients of costs, returns, and technical demands of production relevant to each crop and livestock enterprise used in this study were developed for use in linear programming analyses. A description of the development of such coefficients follows:

Since the objective of the linear programming technique in this study was to obtain maximum profits from the existing resources, any activity capable of contributing to the overall profit earned on each farm was included in the optimum solution. Due to the assumptions associated with linear programming, especially divisibility, the optimum solutions often contained activities in quantities too small to be practical for production. The inclusion of some production activities at impractical levels is a shortcoming of the linear programming technique. Slight adjustments would need to be made on the optimum system if applied in an actual farm operating system.

II. CROP ENTERPRISES

Enterprise production coefficients were developed for 14 crops; but with calculation of different coefficients for each enterprise on the various soil groups, a total of 47 crop enterprise budgets was developed for each of the three representative farms. Coefficients were assumed to be the same for the small and medium size farms because the same production practices were assumed and the same size tractors and equipment were used. Different practices and larger tractors and equipment were assumed for the large farms.

In determining costs or returns for the enterprises, no charges were made for the operator's labor or for land in the enterprise budgets. Charges for land were deducted only in the final analysis, when determining net returns to labor and management on the various farms, and then at the appropriate interest rates for investment capital on each particular farm being considered. Estimated capital requirements and net costs or net returns for crop enterprises on the small and medium size farms are shown in Table IX and corresponding data for the large farms are shown in Table X.

Operating capital is the estimated amount of funds needed to meet expenses during the year and is prorated on an annual basis. Investment capital is an estimate of the prorata share of machinery investment requirements for production of that particular crop. In the column labeled "net cost or net return" the negative figures indicate cost of production of an acre of the crop on an annual basis. The positive

Table IX. Estimated Annual Capital Requirements and Net Costs or Net Returns Per Acre for Crop Enterprises on the Small and Medium Size Farms

Crop Enterprise	Operating Capital	Investment Capital	Net Cost or Net Return[a]
Alfalfa--Soil I	$ 8.50	$16.57	$-57.46
Soil II	8.50	16.57	-53.62
Soil III	8.50	16.57	-56.18
Corn (no government program)			
Soil I	18.90	18.14	-62.77
Soil II	14.95	18.14	-51.12
Soil III	12.75	18.14	-42.97
Corn (government program)			
Soil I	9.90	18.14	-44.77
Soil II	7.45	18.14	-36.12
Soil III	6.75	18.14	-30.97
Corn silage--Soil I	19.84	18.71	-92.74
Soil II	19.84	18.71	-84.97
Soil III	19.84	18.71	-76.42
Cotton--Soil I	22.57	23.29	196.88
Soil II	21.47	23.29	172.83
Soil III	19.27	23.29	136.13
Lespedeza hay--Soil I	5.33	6.43	-28.02
Soil II	5.33	6.43	-27.06
Soil III	5.33	6.43	-25.46
Soil IV	5.33	6.43	-23.86
Midland Bermuda hay			
Soil I	18.13	7.57	-86.54
Soil II	18.13	7.57	-83.50
Soil III	18.13	7.57	-79.18
Soil IV	18.13	7.57	-74.86
Midland Bermuda pasture			
Soil I	11.96	4.14	-24.53
Soil II	11.96	4.14	-24.53
Soil III	11.96	4.14	-24.53
Soil IV	11.96	4.14	-24.53
Permanent pasture[b] (grazed)			
Soil I	7.57	4.14	-15.76
Soil II	6.86	4.14	-14.33
Soil III	6.21	4.14	-13.46
Soil IV	4.49	4.14	9.60

Table IX (continued)

Crop Enterprise	Operating Capital	Investment Capital	Net Cost or Net Return[a]
Permanent pasture[b] (grazed and hay)			
Soil I	$ 7.57	$ 6.14	$-28.28
Soil II	6.86	6.14	-26.39
Soil III	6.21	6.14	-24.25
Soil IV	5.49	6.14	-22.06
Soybeans--Soil I	10.69	20.00	49.18
Soil II	10.69	20.00	39.94
Soil III	10.69	20.00	30.64
Soybeans--wheat (double cropped)			
Soil I	19.83	29.86	37.67
Soil II	19.83	29.86	32.42
Soil III	19.83	29.86	28.17
Wheat--Soil I	11.12	14.43	13.49
Soil II	9.44	14.43	11.14
Soil III	7.77	14.43	9.74
Wheat--red clover hay (double cropped)--Soil I	12.50	8.00	-11.35
Soil II	12.50	8.00	-14.34
Soil III	12.50	8.00	-19.73

[a]Net costs and net returns, as shown here, do not include deductions for interest on operating capital. Negative values indicate a net cost of production and that the activity is handled as an intermediate product while positive values indicate a net return obtainable from sale of the product exclusive of charges for land, labor, overhead costs, and intermediate product.

[b]Permanent pasture consists of Orchardgrass-Ladino mixture or Fescue-Ladino mixture.

Table X. Estimated Annual Capital Requirements and Net Costs or Net Returns Per Acre for Crop Enterprises on the Large Farms

Crop Enterprises	Operating Capital	Investment Capital	Net Cost or Net Return[a]
Alfalfa--Soil I	$ 6.36	$53.71	$-36.99
Soil II	6.36	53.71	-36.43
Soil III	6.36	53.71	-36.83
Corn (no government program)			
Soil I	18.46	22.42	-47.46
Soil II	14.51	22.42	-38.81
Soil III	12.31	22.42	-33.66
Corn (government program)			
Soil I	9.46	22.42	-29.46
Soil II	7.01	22.42	-23.81
Soil III	6.31	22.42	-21.66
Corn silage--Soil I	19.37	14.43	-91.28
Soil II	19.37	14.43	-83.51
Soil III	19.37	14.43	-74.96
Cotton--Soil I	22.25	17.43	198.00
Soil II	21.15	17.43	175.44
Soil III	18.95	17.43	138.59
Lespedeza hay--Soil I	5.32	18.71	-18.93
Soil II	5.32	18.71	-18.77
Soil III	5.32	18.71	-18.53
Soil IV	5.32	18.71	-18.29
Midland Bermuda hay			
Soil I	18.37	48.43	-62.16
Soil II	18.37	48.43	-61.72
Soil III	18.37	48.43	-61.04
Soil IV	18.37	48.43	-60.40
Midland Bermuda pasture			
Soil I	11.99	17.43	-24.56
Soil II	11.99	17.43	-24.56
Soil III	11.99	17.43	-24.56
Soil IV	11.99	17.43	-24.56
Permanent pasture[b] (grazed)			
Soil I	7.56	4.14	-15.73
Soil II	6.91	4.14	-14.43
Soil III	6.26	4.14	-13.13
Soil IV	5.55	4.14	-11.70

Table X (continued)

Crop Enterprise	Operating Capital	Investment Capital	Net Cost or Net Return[b]
Permanent pasture[b] (grazed and hay)			
Soil I	$ 7.63	$19.57	$-22.74
Soil II	6.85	19.57	-21.10
Soil III	6.20	19.57	-19.68
Soil IV	5.48	19.57	-18.13
Soybeans--Soil I	10.12	22.57	63.54
Soil II	10.12	22.57	53.74
Soil III	10.12	22.57	41.49
Soybeans--wheat (double cropped)			
Soil I	19.69	49.71	60.66
Soil II	19.69	49.71	53.60
Soil III	19.69	49.71	47.60
Wheat--Soil I	11.13	28.00	27.89
Soil II	9.46	28.00	23.44
Soil III	7.78	28.00	20.29
Wheat--red clover hay (double cropped)--Soil I	12.38	23.14	13.50
Soil II	12.38	23.14	7.28
Soil III	12.38	23.14	.66

[a]Net costs and net returns, as shown here, do not include deductions for interest on operating or investment capital. Negative values indicate a net cost of production and that the activity is handled as an intermediate product while positive values indicate a net return obtainable from sale of the product exclusive of charges for land, labor, overhead costs, and intermediate products.

[b]Permanent pasture consists of Orchardgrass-Ladino mixture or Fescue-Ladino mixture.

figures in this column for cotton, soybeans and wheat indicate net returns per acre or the difference between gross income and production expenses in an average year.

Yield estimates for all crop enterprises by soil groups are shown in Table XI. These estimates were considered reasonable averages for the study area when good management practices were applied.

Estimates for labor requirements were compiled by applying labor requirement data from unpublished power unit and labor time requirement sources to the operations assumed in each of the crop enterprises (7). Estimated labor requirements by labor period for crop enterprises for the small and medium size farms appear in Table XII and for the large size farms in Table XIII.

Row Crops

Row crop budgets were developed using the format established for use in Regional Project S-67. Pre-harvest and harvest costs were considered separately in the budgets so interest charges could be made on operating capital only for the length of time the capital was used; about six months from planting to harvest, in most cases. No interest on harvest costs was charged to operating capital as it was assumed the products could be sold soon after harvest.

Cotton and corn grown in association with government programs required additional land set aside in order to qualify for supplementary payments. Cotton required a 20 percent set aside (.2 acre set aside per acre of cotton planted) and corn required a 25 percent set aside. In each case, set aside acres were assumed sowed in vegetative cover and

Table XI. Estimated Yield Levels by Soil Groups for Crop Enterprises

Crop Enterprise	Unit	Estimated Yield Per Acre for Soil Group: I	II	III	IV
Alfalfa	Tons	3.0	2.3	2.8	--
Corn	Bu.	90.0	75.0	60.0	--
Corn silage	Tons A.D.[a]	6.5	5.5	4.4	--
Cotton	Lbs. lint	750.0	675.0	550.0	--
Lespedeza hay	Tons	1.8	1.6	1.3	1.0
Midland Bermuda hay	Tons	5.5	4.95	4.12	3.3
Midland Bermuda pasture	CAD	200.0	172.0	160.0	140.0
Permanent pasture	CAD	180.0	160.0	140.0	110.0
Permanent pasture (pasture and hay)					
pasture	CAD	120.0	107.0	94.0	74.0
hay	Tons	1.0	0.9	0.75	0.6
Soybeans	Bu.	36.0	32.0	27.0	--
Soybeans--wheat (double cropped)					
soybeans	Bu.	24.0	24.0	24.0	--
wheat	Bu.	40.0	35.0	30.0	--
Wheat	Bu.	46.0	40.0	35.0	--
Wheat--red clover hay					
wheat	Bu.	20.0	17.5	15.0	--
hay[b]	Tons	1.85	1.5	1.65	--

[a] Assumes 7 percent allowance for waste and spoilage.

[b] Represents average annual yield for a two year period.

Table XII. Hours of Estimated Labor Requirements by Labor Period for Crop Enterprises on the Small and Medium Size Farms

Crop Enterprise	Labor Period[a]						
	I	II	III	IV	V	VI	Total
Alfalfa--Soil I, II, and III	.21	.28	2.84	1.59	1.74	--	6.66
Corn (no government program)							
Soil I, II, and III	--	2.23	2.07	--	--	--	4.30
Corn (government program)							
Soil I, II, and III	--	2.23	2.07	--	--	--	4.30
Corn silage--Soil I, II, and III	--	2.23	2.21	--	--	--	4.44
Cotton--Soil I, II, and III	--	1.80	2.64	2.12	--	--	6.56
Lespedeza hay--Soil I, II, III, and IV	.29	.46	.43	1.00	--	--	2.18
Midland Bermuda hay--Soil I, II, III, and IV	--	.40	1.32	1.96	--	--	3.68
Midland Bermuda pasture--Soil I, II, III, and IV	--	.11	.33	.68	--	--	1.12
Permanent pasture (grazed)							
Soil I, II, III, and IV	.28	--	.28	.41	.17	--	1.14
Permanent pasture (grazed and hay)							
Soil I, II, III, and IV	.28	--	1.28	.41	.17	--	2.14
Soybeans--Soil I, II, and III	--	.66	3.11	.67	--	--	4.44
Soybeans--wheat (double cropped)							
Soil I, II, III, and IV	--	.26	--	5.07	1.63	--	6.96
Wheat--Soil I, II, and III	--	.31	--	1.00	1.63	--	2.94
Wheat--red clover hay (double cropped)							
Soil I, II, and III	--	.31	.80	2.10	.98	--	4.19

[a]Dates associated with each labor period correspond to those shown in Table VI.

Table XIII. Hours of Estimated Labor Requirements by Labor Period for Crop Enterprises on the Large Farms

Crop Enterprise	Labor Period[a]						
	I	II	III	IV	V	VI	Total
Alfalfa--Soil I, II, and III	.16	.21	4.05	2.77	2.82	--	10.01
Corn (no government program) Soil I, II, and III	--	1.06	.99	--	.70	--	2.75
Corn (government program) Soil I, II, and III	--	1.06	.99	--	.70	--	2.75
Corn silage--Soil I, II, and III	--	1.06	.99	--	--	--	2.05
Cotton--Soil I, II, and III	--	.85	1.20	1.84	.11	--	4.00
Lespedeza hay--Soil I, II, III, and IV	.23	.26	.15	2.30	--	--	2.94
Midland Bermuda hay--Soil I, II, III, and IV	--	.25	2.84	5.39	--	--	8.48
Midland Bermuda pasture--Soil I, II, III, and IV	--	.06	.25	.39	--	--	.70
Permanent pasture (grazed) Soil I, II, III, and IV	.19	--	.21	.19	.09	--	.68
Permanent pasture (grazed and hay) Soil I, II, III, and IV	.19	--	2.61	.19	.09	--	3.08
Soybeans--Soil I, II, and III	--	.27	1.45	.28	.70	--	2.70
Soybeans--wheat (double cropped) Soil I, II, and III	--	.31	--	3.97	1.92	--	6.20
Wheat--Soil I, II, and III	--	.21	--	2.20	.86	--	3.27
Wheat--red clover hay (double cropped) Soil I, II, and III	--	--	1.70	5.00	.54	--	7.24

[a]Dates associated with each labor period correspond to those shown in Table VI.

grazed year round except during the period between April 1 and August 31. The Government Farm Program does not permit harvesting or grazing of set aside land during those summer months.

Prices used for the crop enterprises appear in Table XIV and are those recommended by the prices subcommittee of Regional Project S-67, with the exception of soybean prices. A soybean price of $2.50 per bushel was used which was the average price received by Tennessee farmers between 1966 and 1970 (15, p. 25).

Forage Crops

Estimates of the capital requirements and net costs of forage crops on both the small and medium and on the large farms, which appear in Tables IX and X, respectively, are annual averages. These Annual averages were determined by prorating total pre-harvest and harvest costs over the number of years which a crop could be harvested following a single establishment.

Distribution of grazing for forage crops throughout the year was handled by dividing the year into five forage periods as used by Anderson (2, p. 45). The forage periods used were as follows: I, November 16-March 15; II, March 16-May 31; III, June 1-July 31; IV, August 1-September 30; and V, October 1-November 15. The cow acre days of grazing, as shown in Table XV, represent the annual production of the various forages divided into the forage periods based upon the seasonal distribution of forage production. Transfer of forage from one forage period to the next was allowed with the assumption that the cow acre day

Table XIV. Prices Assumed for Buying and Selling of Farm Products

Product	Unit	Price
Corn (sell)	Bu.	$ 1.20
Corn (buy)	Bu.	1.35
Corn (government payment)	Bu.	.20
Cotton	Lb. lint	.24
Cotton (government payment)	Lb. lint	.15
Cottonseed	Lb.	.025
Soybeans	Bu.	2.50
Wheat (sell)	Bu.	1.30
Feeder calf--good grade (sell)	Cwt.	26.00
Cull cows (sell)	Cwt.	18.00
Cull bulls (sell)	Cwt.	22.00
Feeder steer--good grade (buy)	Cwt.	26.00
Feeder steer--high good or low choice (sell)	Cwt.	26.00
Feeder heifer--good grade (buy)	Cwt.	23.50
Feeder heifer--high good or low choice (sell)	Cwt.	24.50
Feeder pigs (buy or sell)	Lb.	.37
Cull sows (sell)	Lb.	.17
Slaughter hogs (sell)	Lb.	.21

Table XV. Estimated Distribution of Forage Production by Forage Periods

Forage Crop	Forage Periods (CAD)					
	I	II	III	IV	V	Total
Alfalfa hay[a]						
Soil I	--	--	--	--	12	12
Soil II	--	--	--	--	10	10
Soil III	--	--	--	--	11	11
Midland Bermuda pasture						
Soil I	0	30	90	70	10	200
Soil II	0	31	69	60	12	172
Soil III	0	24	72	56	8	160
Soil IV	0	21	63	49	7	140
Permanent pasture (grazed)						
Soil I	22.5	89.1	26.1	23.4	18.9	180
Soil II	20.0	79.2	23.2	20.8	16.8	160
Soil III	17.5	69.3	20.3	18.2	14.7	140
Soil IV	13.8	54.4	16.0	14.3	11.5	110
Permanent pasture (grazed and hay)[b]						
Soil I	29.8	--	34.4	30.8	24.9	120
Soil II	26.5	--	30.7	27.5	22.3	107
Soil III	23.3	--	30.0	24.2	19.6	97
Soil IV	18.4	--	21.2	19.0	15.4	74

[a]Aftermath grazing was permitted after removal of the last hay crop in the fall.

[b]Cattle would be removed from the pasture about March 15 and hay harvested in late May.

values were reduced to nine-tenths of their original yields. Grazing could only be transferred from periods II-III, III-IV, and IV-V.

Buying and selling of hay was permitted with all hay converted to alfalfa equivalents. Alfalfa equivalents could be sold for $31.35 per ton or bought for $33.00 per ton. Conversion factors used were .65 for Midland Bermuda hay, .75 for grass hay, .80 for lespedeza hay, and .85 for red clover hay.

III. LIVESTOCK ENTERPRISES

Coefficients from a series of budgets developed for Regional Project S-67 by Keller and Wade were used for livestock enterprises (8). Two beef cow-calf operations, 12 feeder cattle operations, and two swine operations were included in the research model. Dairy was not considered due to the relatively large labor requirements of dairying and the limited labor available in each of the three labor situations assumed.

Capital requirements and net returns for each of the livestock enterprises are shown in Table XVI. Items such as interest on operating and investment capital, and charges for farm-grown feeds were not deducted from the net returns shown in Table XVI, as these costs were handled elsewhere in the model. Estimates of grain and feed requirements, forage requirements by forage periods, and labor requirements by labor periods for all the livestock enterprises are shown in Tables XVII, XVIII, and XIX, respectively. Prices paid and received for livestock are shown in Table XIV.

Table XVI. Estimated Capital Requirements and Net Returns[a] for Livestock Enterprises

Livestock Unit[b]	Operating Capital	Investment Capital	Net Returns
Cow-calf I[c]	$513.20	$9,510.00	$2,496.25
Cow-calf II[c]	439.42	9.760.00	2,548.25
Feeder steer I	143.82	47.70	103.49
Feeder steer II	118.97	47.70	105.59
Feeder steer III	117.00	47.70	105.49
Feeder steer IV	200.01	47.70	101.09
Feeder steer V	209.78	47.70	98.69
Feeder steer VI[d]	326.78	47.70	202.16
Feeder heifer I	96.29	47.70	79.23
Feeder heifer II	82.50	47.70	79.32
Feeder heifer III	84.01	47.70	80.24
Feeder heifer IV	164.04	47.70	74.97
Feeder heifer V	176.11	47.70	74.97
Feeder heifer VI[d]	284.02	47.70	151.52
Sow-feeder pig[e]	75.60	137.25	388.22
Slaughter hog[f]	12.75	275.50	52.83

[a]Net returns do not include deductions for farm produced feeds or interest on operating and investment capital.

[b]One unit is one animal unless otherwise indicated.

[c]One unit is a 25 cow herd.

[d]One unit is two animals.

[e]One unit is two sows and four litters.

[f]One unit is three slaughter hogs.

Table XVII. Estimated Feed Requirements for Livestock Enterprises

Livestock Unit[a]	Feed Requirements Per Unit		
	Corn (bushels)	Hay (tons alfalfa equivalent)	Silage (tons-air dry)
Cow-calf I[b]	--	27.97	--
Cow-calf II[b]	--	--	23.8
Feeder steer I	10.0	0.34	2.1
Feeder steer II	20.8	0.3	1.35
Feeder steer III	49.0	0.4	--
Feeder steer IV	26.0	0.49	0.5
Feeder steer V	40.0	0.4	--
Feeder steer VI[c]	89.0	0.8	--
Feeder heifer I	9.6	0.29	16.46
Feeder heifer II	15.3	0.25	0.86
Feeder heifer III	41.9	0.33	--
Feeder heifer IV	9.8	0.5	0.6
Feeder heifer V	34.0	0.44	--
Feeder heifer VI	75.0	0.85	--
Sow-feeder pig[d]	82.0	--	--
Slaughter hog[e]	28.35	--	--

[a]One unit is one animal unless otherwise indicated.

[b]One unit is a 25 cow herd.

[c]One unit is two animals.

[d]One unit is two sows and four litters.

[e]One unit is three slaughter hogs.

Table XVIII. Estimated Forage for Livestock Enterprises by Forage Periods

Livestock Unit[a]	Forage Periods (CAD)					
	I	II	III	IV	V	Total
Cow-calf I[b]	--	1,718	1,689	1,689	844	5,940
Cow-calf II	--	1,718	1,689	1,689	844	5,940
Feeder steer I	--	--	--	--	--	--
Feeder steer II	--	--	--	--	--	--
Feeder steer III	--	--	--	--	--	--
Feeder steer IV	--	63	42	--	--	105
Feeder steer V	--	63	57	--	--	120
Feeder steer VI[c]	--	63	57	--	--	120
Feeder heifer I	--	--	--	--	--	--
Feeder heifer II	--	--	--	--	--	--
Feeder heifer III	--	--	--	--	--	--
Feeder heifer IV	--	63	49	--	--	112
Feeder heifer V	--	63	27	--	--	90
Feeder heifer VI[c]	--	63	27	--	--	90
Sow-feeder pig[d]	8.8	34.6	10.0	9.2	7.4	70
Slaughter hog[e]	--	--	--	--	--	--

[a]One unit is one animal unless otherwise indicated.

[b]One unit is a 25 cow herd.

[c]One unit is two animals.

[d]One unit is two sows and four litters.

[e]One unit is three slaughter hogs.

Table XIX. Seasonal Distribution of Estimated Labor Requirements for Livestock Enterprises

Livestock Unit[b]	Labor Period[a]						
	I	II	III	IV	V	VI	Total
Cow-calf I[c]	62.0	35.0	29.0	26.0	38.0	44.0	234.0
Cow-calf II	62.0	35.0	29.0	26.0	38.0	44.0	234.0
Feeder steer I	1.0	1.2	1.0	0.5	0.25	1.0	4.95
Feeder steer II	1.0	1.2	0.8	--	0.25	1.0	4.25
Feeder steer III	1.0	1.2	0.55	--	0.25	1.0	4.00
Feeder steer IV	1.0	0.8	0.6	1.0	0.60	1.0	5.00
Feeder steer V	1.0	0.8	0.6	0.6	0.75	1.0	4.75
Feeder steer VI[d]	2.0	2.0	1.15	0.6	1.0	2.0	8.75
Feeder heifer I	1.0	1.0	0.65	--	0.25	1.0	3.90
Feeder heifer II	1.0	1.0	0.15	--	0.25	1.0	3.40
Feeder heifer III	1.0	1.0	0.5	--	0.25	1.0	3.75
Feeder heifer IV	1.0	0.7	0.6	1.0	0.30	1.0	4.60
Feeder heifer V	1.0	0.85	0.6	0.7	0.25	1.0	4.10
Feeder heifer VI[d]	2.0	1.85	1.1	0.7	0.50	2.0	8.15
Sow-feeder pig[e]	9.3	4.65	4.65	9.3	--	9.3	37.20
Slaughter hog[f]	0.33	0.33	0.33	0.33	0.33	0.33	1.98

[a]Dates associated with each labor period correspond with those shown in Table VI.

[b]One unit is one animal unless otherwise indicated.

[c]One unit is a 25 cow herd.

[d]One unit is two sows and four litters.

[e]One unit is three slaughter hogs.

Beef Cow-Calf Enterprises

Two beef cow-calf systems were considered. The systems were identical except for the feed supplied during the winter months. In System I animals were wintered on hay while with System II animals were wintered on silage. In both cow-calf systems, calves were dropped in late winter and sold in October. No creep feeding was used. Heifer replacements were raised on the farm and the bull was assumed replaced every two years.

Four cull cows from the herd of 25 were sold each year and one cow was assumed to have died. Five heifers were then kept as replacements annually. Cost of the herd bull was handled as a depreciation item and variable expenses for the bull were included in the budgets.

A 92 percent calf crop was assumed, so 18 calves were sold each year. Prices for both the calves and cull cows are shown in Table XIV. Birth weight of calves was 70 pounds and average daily gain was 1.7 pounds per day for 240 days.

Beef Steer and Heifer Feeding Enterprises

Twelve beef finishing systems were considered in the study. Budgets of costs and returns for the beef feeding systems were developed on a per animal basis for ten of the systems, while the budgets for the feeder steer VI and feeder heifer VI systems were for two animals each. The basic assumptions for ten of the systems were those described by Anderson and Keller (2). Different feeds and different average daily rates of gain were assumed for each of the systems. All animals were

purchased on October 15, held on a maintenance ration for 15 days, and placed on a finishing program on November 1. All animals were graded good at the time of purchase and were sold grading high good or low choice. Nutrient requirements and amounts of feed necessary to fill the nutrient requirements for the specified rates of gain were based on standards specified in Nutrient Requirements of Beef Cattle (13).

Swine Enterprises

Two swine enterprises were budgeted. Swine I was a sow-feeder pig system and Swine II was a slaughter hog production system.

In the sow-feeder pig system, two litters of eight pigs each were weaned annually per sow. An average of 15.5 pigs were sold each year, with an average of one-half pig per sow per year kept for replacement purposes. Each sow was assumed kept through two years of production. Coefficients representing two sows and four litters were used for analysis in order to utilize farrowing facilities more fully. Three sows and six litters can pass through a farrowing to weaning facility, but this possibility was not considered due to the limited labor available in each of the farm situations. Sows were assumed to have been bred to farrow January 1, April 1, July 1, and November 1, in order to avoid major labor conflicts with crop enterprises. Costs of each boar were distributed among each ten sows.

Slaughter hog budgets were prepared on a per animal basis of in order to achieve more even distribution of labor demands, three hogs were included in each unit for purposes of analysis. These three hogs represented one hog on feed at all times with three batches fed out and

sold each year. Nutrient and feed requirements for both swine systems were based on specifications contained in Nutrient Requirements of Swine (14).

IV. OTHER ENTERPRISES AND ACTIVITIES

In one phase of the study options to buy, lease in, and lease out land were included. Thus the optimum quantity of land to combine with each of the special labor situations was determined. Leasing out of cotton allotments was also considered as an option.

Buying Land

The assumption was made that openland could be purchased for an average price of $335.60, the estimated price for an average acre of openland in the Brown Soil and Delta Areas of Tennessee as shown in Table V (page 18). When the $335.60 land cost was amortized over a 30 year period at 6 percent interest the annual payment was $24.38 per acre. An additional $2.00 per year for taxes was added for each additional acre of land bought.

When an acre of land was bought, all four soil groups were considered to be represented in the added acre in the same proportions as the average distribution of soil groups in the area of study. Therefore, a purchased acre was assumed to contain .48 acre of Soil I, .11 acre of Soil II, .19 acre of Soil III, and .22 acre of Soil IV. The land in each soil group then carried the same cropping restrictions, allotments, and bases as did the soils present in the original farm.

Leasing Land In or Out

For purposes of leasing land out, leasing rates of $25.00 per acre for Soil I, $15.00 per acre for Soil II, $12.00 per acre for Soil III, and $7.00 per acre for Soil IV were used. The leasing in of land was handled in the same fashion as buying land. An acre leased in included proportionate amounts of all four soil groups and was assumed leased in for $17.49 per acre, which is the weighted average of the leasing in rates for each of the soil groups.

Leasing Out Cotton Allotment

The supplementary government payment to cotton producers is $.15 per pound of lint for the farm's base yield, which was considered the average yield for this study. A price of $.07 per pound was used as the lessor's share for determining the lease rate and $.08 per pound for the lessee's share. Since cotton is not grown on Soil IV, the proportions of Soil Groups I, II, and II were considered to be 62, 14, and 24 percent, respectively for each acre of cotton allotment leased out. The weighted average of the above proportions and the yields given in Table XI (page 33) for cotton at $.07 per pound gave a leasing rate of $48.41 per acre of cotton allotment.

CHAPTER V

RESULTS AND DISCUSSION OF THE PROFIT MAXIMIZING SOLUTIONS

Profit maximizing organizations for the different size farms are presented in this chapter. Each farm size, with the various assumptions used in the analysis of that farm, is presented separately. All variations for each part-time farm are presented; i.e., original size farm with 6 and 7 percent capital costs, original size farm with 10 and 18 percent capital costs, farm having option of buying or leasing in land with 6 and 7 percent capital costs, and farm having option of buying or leasing land with 10 and 18 percent capital costs. Opportunities for the farms under the various situations to lease out land are also presented. Three labor supply situations, A, B, and C, are presented for each farm that was considered.

I. SMALL SIZE FARMS

Original Size, 6 and 7 Percent Capital Costs

The optimum solution for the small size farm, under all three labor situations, included primarily the sow-feeder pig enterprise with some grain raised and additional corn purchased. Cotton was the major row crop included in the optimal system and cotton acreage was equal to the cotton allotment in each labor situation. Alfalfa hay, produced for sale, was included in each of the three labor situations. Pasture acreages were included to meet the requirements of the swine enterprises. The

major income producing enterprise for all three labor situations was Swine I, the production and sale of feeder pigs. Numbers of feeder pigs to be sold would be 465, 412, and 887 for the labor situations A, B, and C, respectively. Enterprises included in the optimum solution are shown in Table XX.

Resources available, resources unused, and returns for the small farm under the three labor situations appear in Table XXI. A small quantity of Soil Group IV was unused in the solutions with labor supplies A and B. Unused labor resulted under all three labor situations in all labor periods except Labor Period I.

Returns to land, labor, and management were reduced by deductions for land and overhead costs to show the net returns accruing to labor and management. Net returns to labor and management were $4,146.60, $3,711.82, and $7,583.91 respectively, for labor supply situations A, B, and C. Since the number of hours of farm labor actually used was 753 for labor situation A, 699 for labor situation B, and 1,258 for labor situation C; this would represent returns to labor and management per hour of $5.51, $5.31, and $6.03 respectively for the three labor supplies.

Original Size, 10 and 18 Percent Capital Costs

Assuming higher rates of interest on investment and operating capital resulted in no change in the optimum enterprise, combination for the small farms with farm acreages fixed at 70. Profit maximizing enterprises for these farms are the same as for similar farms with 6 and 7 percent capital costs. Neither were there changes in the quantities of resources available nor in the resources used for the enterprises. The

Table XX. Profit Maximizing Solutions for the Small Farm (70 Acre), 6 and 7 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	B	C
Crops				
Alfalfa hay--Soil I	Ac.	5.0	5.0	4.7
Alfalfa hay--Soil II	Ac.	7.6	7.6	7.6
Sell hay (alfalfa equivalent)	Ton	48.4	48.4	35.5
Corn--Soil I (gov. program)	Ac.	6.5	6.5	6.5
Corn--Soil II (gov. program)	Ac.	1.4	1.4	1.4
Corn--Soil III (gov. program)	Ac.	1.6	1.6	1.6
Buy corn	Bu.	417.4	279.0	1,530.2
Cotton--Soil I	Ac.	9.9	9.9	9.9
Midland Bermuda hay--Soil II	Ac.	3.8	3.8	--
Permanent pasture--Soil I (grazed)	Ac.	--	--	0.3
Permanent pasture--Soil II (grazed)	Ac.	--	--	3.8
Permanent pasture--Soil III (grazed)	Ac.	--	--	0.5
Permanent pasture--Soil IV (grazed)	Ac.	9.2	8.1	11.2
Wheat--Soil III	Ac.	0.5	0.5	--
Transfer forage (period 2-3)	CAD	--	0.4	—
Transfer forage (period 3-4)	CAD	0.1	0.4	1.9
Set aside	Ac.	4.4	4.4	4.4
Livestock				
Swine I	Sow	29.4	26.0	56.5

Table XXI. Resources Available, Resources Unused, and Returns to Labor and Management for the Small Farm (70 Acre), 6 and 7 Percent Capital Costs, by Labor Supply

	Unit	A	B	C
Resources Available[a]				
Openland	Ac.	52.0	52.0	52.0
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 6%[b]	Dol.	2,705.0	2,468.0	4,554.0
Operating capital @ 7%	Dol.	1,642.0	1,509.0	2,633.0
Resources Unused				
Soil IV	Ac.	2.0	3.1	--
Total		2.0	3.1	--
Labor II	Hr.	61.3	43.2	115.0
Labor III	Hr.	38.4	198.5	91.2
Labor IV	Hr.	10.3	354.6	10.0
Labor V	Hr.	150.7	134.9	271.9
Labor VI	Hr.	16.2	15.9	9.0
Total		277.1	747.1	497.1
Returns				
Land, labor, and management	Dol.	6,727.0	6,293.0	10,165.0
Land charge (52 acres)	Dol.	1,047.0	1,047.0	1,047.0
Overhead charge	Dol.	1,534.0	1,534.0	1,534.0
Labor and management	Dol.	4,146.0	3,711.0	7,583.0

[a]No restrictions were placed on amount of capital available, thus amount shown is amount needed for the optimum system.

[b]Does not include investment in land.

only changes arising from using interest rates of 10 percent for investment capital and 18 percent for operating capital were in the returns section. Due to the higher capital costs, initial returns to land, labor, and management were lower, charges for land and overhead were higher, and returns to the operators' labor and management were therefore reduced. Per hour returns to labor and management were reduced to $4.01, $3.74, and $4.99, for labor situations A, B, and C respectively as a result of the higher interest rates.

Option of Acquiring More Land, 6 and 7 Percent Capital Costs

Given the small size farms with interest rates of 6 percent for investment capital and 7 percent for operating capital, the addition of an option to buy or lease in additional land resulted in considerable expansion in farm size in all three labor supply situations. Total farm size was expanded from 70 to 168, 212, and 216 acres for labor situations A, B, and C respectively. Quantities of land bought and the activities included in the optimum system are shown in Table XXII.

In labor supply situations A and C, corn and cotton were the primary row crops generating maximum net profits, while the sow-feeder pig enterprise and the feeding of a few heifers under System II were the livestock enterprises included in the solution. All corn used for feeding the livestock was produced on the farms with a small quantity of corn sold from farm situation A. With labor situation B, cotton, hay, and soybeans were the major cash crops and the sow-feeder pig enterprise was the only livestock enterprise. All corn for the swine would be bought.

Table XXII. Profit Maximizing Solutions for the Small Farm, with Option of Buying or Leasing in Land, 6 and 7 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Acquire Land				
Buy land	Ac.	98.5	141.6	145.5
Crops				
Alfalfa hay--Soil I	Ac.	--	19.2	--
Alfalfa hay--Soil III	Ac.	--	27.2	--
Buy hay (alfalfa equivalent)	Ton	1.1	--	7.0
Sell hay (alfalfa equivalent)	Ton	--	134.3	--
Corn--Soil I (gov. program)	Ac.	16.8	--	21.2
Corn--Soil II (gov. program)	Ac.	4.6	--	6.1
Corn--Soil III (gov. program)	Ac.	--	--	1.9
Buy corn	Bu.	--	1,006.1	--
Sell corn	Bu.	593.7	--	--
Corn silage--Soil I	Ac.	0.6	--	3.7
Cotton--Soil I	Ac.	28.6	36.8	37.5
Permanent pasture--Soil I (grazed)	Ac.	5.4	--	9.4
Permanent pasture--Soil IV (grazed)	Ac.	--	7.5	--
Soybeans--Soil I	Ac.	1.5	--	--
Soybeans--Soil III	Ac.	--	--	5.4
Soybeans-wheat--Soil I	Ac.	--	29.6	--
Soybeans-wheat--Soil II	Ac.	--	7.5	--
Soybeans-wheat--Soil III	Ac.	--	7.7	--
Transfer forage (period 2-3)	CAD	4.4	2.7	5.1
Set aside	Ac.	11.1	7.4	14.8
Livestock				
Swine I	Sow	29.2	24.5	50.0
Feeder heifer II	Hd.	4.7	--	28.0

In all optimizing solutions for these farms, land and labor in one or more soil groups and the labor periods were left unused. In some cases, some of the more productive soils were left unused, but no row crop land remained unused. To maximize profits, the operator could justify the buying of land to acquire use of the row crop land even though some acreage remained idle. A considerable acreage of Group III and IV soils were unused. Unused resources, capital requirements, and net returns to land, labor, and management appear in Table XXIII.

The effect of adding the option of acquiring more land can be seen by comparison of results shown in Tables XXI and XXIII. Net returns to labor and management increased by $1,624, $2,898, and $2,729 for the A, B,, and C labor supplies, respectively. When given the option of acquiring land, farms with labor situations A and C showed a higher return per hour to labor and management while the farm with labor situation B did not. Returns per hour to labor and management for the forms acquiring additional land were $7.75, $4.97, and $7.11 for labor situations A, B, and C respectively. Income potential was increased by acquiring land in all three cases even when per hour returns to labor and management did not increase in every case. The purchase of additional land also resulted in large increases in investment capital. Investment capital requirements increased from $2,705 to $36,403 for farm situation A, from $2,468 to $52,211 for farm situation B, and from $4,554 to $55,218 for farm situation C.

Option of Acquiring More Land, 10 and 18 Percent Capital Costs

Given the small size farms, 10 and 18 percent capital costs and

Table XXIII. Resources Available, Resources Unused, and Returns to Labor and Management for the Small Farm with the Option of Buying or Leasing in Land, 6 and 7 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Resources Available				
Openland	Ac.	150.5	193.6	197.5
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 6%	Dol.	36,403.0	52,211.0	55,218.0
Operating capital @ 7%	Dol.	2,382.0	3,076.0	5,519.0
Resources Unused				
Soil I	Ac.	9.4	--	10.1
Soil II	Ac.	10.7	13.7	14.0
Soil III	Ac.	28.8	1.9	29.9
Soil IV	Ac.	32.9	34.8	43.2
Total		81.8	50.4	97.2
Labor I	Hr.	--	--	6.5
Labor III	Hr.	--	59.3	--
Labor IV	Hr.	--	31.7	--
Labor V	Hr.	173.0	3.7	287.4
Labor VI	Hr.	12.5	22.9	11.1
Total		285.5	117.6	305.0
Returns				
Land, labor, and management	Dol.	8,351.0	9,191.0	12,894.0
Land charge (52 acres)	Dol.	1,047.0	1,047.0	1,047.0
Overhead charge	Dol.	1,534.0	1,534.0	1,534.0
Labor and management	Dol.	5,770.0	6,610.0	10,313.0

the option of acquiring more land, the optimum solutions included both the buying and leasing in of land. Less land was bought in each labor situation on the small farm when the higher interest rates were imposed than with the lower; and land leasing was included only at the higher interest rate.

Corn, cotton, and hay were the major crop enterprises with labor supply A. Cotton and most of the hay were sold while most of the corn was fed to the swine enterprises. With labor situation B, cotton, soybeans, wheat, and hay were included for sale, and all corn would be bought for the swine enterprise. The optimum solution for farm situation C included cotton and alfalfa hay for sale and the production of corn for the large sow-feeder pig enterprise and the feeder heifer enterprise. Some land was left idle and part of the labor supply was unused in two or more labor periods for all three labor supply situations. Levels of unused resources, along with the resources available and returns to land, labor, and management are shown in Table XXV.

As would be expected, returns to land, labor, and management were less for those farms borrowing capital at interest rates of 10 and 18 percent than for similar farms paying lower rates. Returns to labor and management were $3,406.00, $3,581.00, and $6,867.00 respectively, for labor supply situations A, B, and C.

Option of Leasing Out Land

For the small farm including an option to lease out land; some acreage was leased out in every case. Leasing rates were assumed to be $25.00, $15.00, $12.00, and $7.00, respectively for soils of Groups I, II, III, and IV.

Table XXIV. Profit Maximizing Solutions for the Small Farm, with Option of Buying or Leasing in Land, 10 and 18 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Acquire Land				
Buy land	Ac.	68.5	100.0	116.3
Lease in land	Ac.	2.1	8.7	11.4
Crops				
Alfalfa hay--Soil I	Ac.	5.9	15.9	8.2
Alfalfa hay--Soil II	Ac.	--	22.8	--
Sell hay (alfalfa equivalent)	Ton	17.6	111.5	17.1
Corn--Soil I (gov. program)	Ac.	15.5	--	20.9
Corn--Soil II (gov. program)	Ac.	3.7	--	5.5
Corn--Soil III (gov. program)	Ac.	3.9	--	5.7
Buy corn	Bu.	--	1,020.4	--
Sell corn	Bu.	673.1	--	95.7
Corn silage--Soil I	Ac.	--	--	4.0
Cotton--Soil I	Ac.	22.9	28.9	32.0
Permanent pasture--Soil I (grazed)	Ac.	5.6	--	9.5
Permanent pasture--Soil IV (grazed)	Ac.	--	7.7	--
Soybeans--Soil I	Ac.	--	26.6	--
Soybeans--Soil II	Ac.	--	6.1	--
Soybeans-wheat--Soil III	Ac.	--	6.3	--
Wheat--Soil I	Ac.	0.6	--	--
Wheat--Soil II	Ac.	--	11.4	--
Wheat--Soil III	Ac.	--	1.6	--
Transfer forage (period 2-3)	CAD	3.7	1.7	4.6
Transfer forage (period 4-5)	CAD	--	1.1	--
Set aside	Ac.	10.4	5.8	14.4
Livestock				
Swine I	Sow	30.0	24.8	50.6
Feeder heifer II	Hd.	--	--	30.4

Table XXV. Resources Available, Resources Used, and Returns to Labor and Management for the Small Farm with the Option of Buying or Leasing in Land, 10 and 18 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	B	C
Resources Available				
Openland	Ac.	122.6	160.7	179.7
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 10%	Dol.	26,129.0	37,637.0	45,522.0
Operating capital @ 18%	Dol.	1,954.0	2,552.0	5,652.0
Resources Unused				
Soil II	Ac.	8.7	--	12.7
Soil III	Ac.	18.7	--	27.3
Soil IV	Ac.	26.7	27.4	39.3
Total		54.1	27.4	79.3
Labor II	Hr.	10.0	--	0.5
Labor IV	Hr.	--	219.3	--
Labor V	Hr.	162.9	58.9	272.4
Labor VI	Hr.	13.8	21.3	6.4
Total		186.7	299.5	279.3
Returns				
Land, labor, and management	Dol.	6,824.0	6,998.0	10,285.0
Land charge (52 acres)	Dol.	1,745.0	1,745.0	1,745.0
Overhead charge	Dol.	1,672.0	1,672.0	1,672.0
Labor and management	Dol.	3,406.0	3,581.0	6,867.0

In each case, where the option of leasing out was permitted, no changes occurred in the optimum enterprise combination or the acreage of a particular crop produced. Acreage that would have otherwise remained unused was leased out and net returns to land, labor, and management; therefore, to labor and management, were increased by the amount of income acquired from leasing out land. This additional income in each farm situation amounted to the number of acres of unused soils multiplied by the appropriate leasing rate.

II. MEDIUM SIZE FARMS

Original Size, 6 and 7 Percent Capital Costs

Optimum farm organizations were developed for a 150 acre farm alternatively with the A, B, and C labor situations. Cropping systems included were similar for all three situations with only minor variations in acreages devoted to a particular crop. Cotton, wheat, corn, and hay were the principal crops. The only exception was the inclusion of soybeans in the optimum solution for labor situation B, and the production of less wheat. Almost all corn was used for livestock production while some hay was sold in each case. Additional corn was purchased for feeding livestock in labor situation C. The production of feeder pigs and the finishing of feeder steers using System II were included in all three solutions. Solutions for each labor situation are shown in Table XXVI.

Resources available, unused resources, and returns to land, labor, and management associated with the optimum solutions for each

Table XXVI. Profit Maximizing Solutions for the Medium Size Farm (150 Acre), 6 and 7 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Crops				
Alfalfa hay--Soil I	Ac.	6.9	10.8	--
Alfalfa hay--Soil III	Ac.	--	16.2	13.9
Sell hay (alfalfa equivalent)	Ton	16.0	102.4	63.2
Corn--Soil I (gov. program)	Ac.	11.3	7.1	5.9
Corn--Soil II (gov. program)	Ac.	3.2	3.2	3.2
Corn--Soil III (gov. program)	Ac.	3.4	3.4	3.4
Buy corn	Bu.	--	--	1,923.8
Sell corn	Bu.	48.2	--	--
Corn silage--Soil I	Ac.	3.3	0.7	10.1
Cotton--Soil I	Ac.	21.2	21.2	21.2
Midland Bermuda hay--Soil I	Ac.	--	--	10.8
Midland Bermuda hay--Soil II	Ac.	--	8.0	--
Permanent pasture--Soil II (grazed)	Ac.	5.6	--	--
Permanent pasture--Soil IV (grazed)	Ac.	--	7.6	14.4
Soybeans--Soil I	Ac.	--	7.9	--
Wheat--Soil I	Ac.	3.9	--	--
Wheat--Soil II	Ac.	2.4	--	8.0
Wheat--Soil III	Ac.	12.4	1.1	3.4
Transfer forage (period 2-3)	CAD	3.1	2.2	0.4
Set aside	Ac.	8.7	7.7	7.4
Livestock				
Swine I	Sow	26.4	24.7	26.1
Feeder steer II	Hd.	16.0	3.3	48.6

situation are shown in Table XXVII. Both unused land and labor occurred in all three solutions. Most of the unused land was in Soil Group IV while excess labor was greatest in Labor Period V (September-October).

The returns to labor and management in Table XXVII show smaller total returns to labor supply B than to supply A, while labor supply B had over 400 more hours of available labor than A. This difference in returns results from the seasonal distribution of labor assumed for the two labor supplies. Distribution of available labor is important in how well the labor supply can be utilized.

The returns to labor and management were $5,890.00, $5,695.00, and $9,533.00, respectively for the farms with labor supply situations A, B, and C. The small farms contained 70 acres and the medium farms 150 acres. The effects of adding an additional 80 acres to the original 70 acre units can be seen by comparing results shown in Tables XXI (page 51) and XXVII. The additional 80 acres added $1,743, $1,983, and $1,950 to the estimated labor and management returns for the A, B, and C labor situations respectively.

Original Size, 10 and 18 Percent Capital Costs

Using a charge of 10 percent interest on investment capital and 18 percent interest on operating capital rather than 6 and 7 percent, resulted in some change in the most profitable enterprise combination. The most significant changes occurred among the livestock enterprises. With the higher interest rates, the number of sows in the sow-feeder pig enterprises changed very little except in Labor Supply C, but beef feeding was not included in the optimum solutions. Apparently beef

Table XXVII. Resources Available, Resources Unused, and Returns to Labor and Management for the Medium Size Farm (150 Acre), 6 and 7 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Resources Available				
Openland	Ac.	111.0	111.0	111.0
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 6%	Dol.	3,866.0	3,322.0	6,927.0
Operating capital @ 7%	Dol.	3,861.0	2,438.0	8,784.0
Resources Unused				
Soil III	Ac.	4.9	--	--
Soil IV	Ac.	24.0	16.4	9.6
Total		28.9	16.4	9.6
Labor II	Hr.	--	--	23.1
Labor III	Hr.	--	88.0	--
Labor IV	Hr.	--	300.0	--
Labor V	Hr.	127.5	108.1	238.7
Labor VI	Hr.	14.0	18.8	8.9
Total		141.5	514.9	270.7
Returns				
Land, labor, and management	Dol.	9,669.0	9,474.0	13,313.0
Land charge (111 acres)	Dol.	2,245.0	2,245.0	2,245.0
Overhead charge	Dol.	1,534.0	1,534.0	1,534.0
Labor and management	Dol.	5,890.0	5,695.0	9,533.0

feeding enterprises become relatively unprofitable at the higher interest rates. Enterprises included in the optimum solutions are shown in Table XXVIII.

Without exception, returns to labor and management were lower in the situations with the higher interest charges. In addition, the capital necessary for investment and operating costs were lower for the farms with the higher interest rates. Higher capital costs led to more emphasis on enterprises with lower capital requirements. Resources available, unused resources, and returns for the medium size farms with 10 and 18 percent interest charges are shown in Table XXIX.

Option of Acquiring More Land, 6 and 7 Percent Capital Costs

When the option of acquiring more land was permitted on medium size farms at interest rates of 6 and 7 percent, respectively for investment and operating capital, additional land was purchased in all three labor supply situations, but none was leased in. Acreages acquired were 39, 82, and 86 for labor situations A, B, and C respectively. Optimum farming systems for farms with labor supply situations A and C included cotton, corn, feeder pigs, and feeding out some heifers using feeding System II. The optimum system for the farm situation with labor supply B included cotton, soybeans, wheat, and hay for sale and the purchase of corn to feed the sows. The enterprise systems which would return maximum net returns are shown in Table XXX for each of the three labor supplies.

Considerable quantities of land were left unused in all four soil groups for labor situations A and C, but no row crop land was left unused. Apparently the conditions specified favored the purchase of land to acquire

Table XXVIII. Profit Maximizing for the Medium Size Farm (150 Acre), 10 and 18 Percent Capital, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Crops				
Alfalfa hay--Soil I	Ac.	9.4	10.8	2.6
Alfalfa hay--Soil III	Ac.	--	16.2	--
Sell hay (alfalfa equivalent)	Ton	28.0	103.4	7.8
Corn--Soil I (gov. program)	Ac.	13.9	9.5	14.0
Corn--Soil II (gov. program)	Ac.	3.2	3.2	3.2
Corn--Soil III (gov. program)	Ac.	3.4	3.4	3.4
Buy corn	Bu.	--	--	644.5
Sell corn	Bu.	472.5	258.9	--
Corn silage--Soil I	Ac.	0.1	--	--
Cotton--Soil I	Ac.	21.2	21.2	21.2
Midland Bermuda hay--Soil II	Ac.	--	8.0	--
Permanent pasture--Soil I (grazed)	Ac.	1.4	--	8.2
Permanent pasture--Soil II (grazed)	Ac.	4.7	--	3.1
Permanent pasture--Soil IV (grazed)	Ac.	--	7.8	--
Soybeans--Soil I	Ac.	--	5.6	--
Wheat--Soil II	Ac.	--	1.1	--
Transfer forage (period 2-3)	CAD	3.2	2.5	1.6
Set aside	Ac.	9.4	8.3	9.4
Livestock				
Swine I	Sow	29.6	25.4	57.2
Feeder steer II	Hd.	0.7	--	--

Table XXIX. Resources Available, Resources Unused, and Returns to Labor and Management for the Medium Size Farm (150 Acres), 10 and 18 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Resources Available				
Openland	Ac.	111.0	111.0	111.0
Labor	Hr.	1,030.0	1,446.0	1,775.0
Investment capital @ 10%	Dol.	3,113.0	3,198.0	4,887.0
Operating capital @ 18%	Dol.	1,964.0	2,057.0	2,933.0
Resources Unused				
Soil II	Ac.	3.3	--	4.9
Soil II	Ac.	17.3	--	17.3
Soil IV	Ac.	24.0	16.2	24.0
Total		44.6	16.2	46.2
Labor II	Hr.	17.7	--	71.0
Labor III	Hr.	--	92.7	65.7
Labor IV	Hr.	--	298.3	--
Labor V	Hr.	157.4	108.9	289.6
Labor VI	Hr.	14.7	18.9	5.7
Total		189.8	518.9	432.0
Returns				
Land, labor, and management	Dol.	9,188.0	9,117.0	12,433.0
Land charge (111 acres)	Dol.	3,741.0	3,741.0	3,741.0
Overhead charge	Dol.	1,672.0	1,672.0	1,672.0
Labor and management	Dol.	3,774.0	3,703.0	7,019.0

Table XXX. Profit Maximizing Solutions for the Medium Size Farm, with Option of Buying or Leasing in Land, 6 and 7 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Acquire Land				
Buy land	Ac.	38.8	82.1	85.8
Crops				
Alfalfa hay--Soil I	Ac.	--	19.0	--
Alfalfa hay--Soil II	Ac.	--	27.7	--
Buy hay (alfalfa equivalent)	Ton	1.1	--	7.0
Sell hay (alfalfa equivalent)	Ton	--	134.6	--
Corn--Soil I (gov. program)	Ac.	17.1	--	21.4
Corn--Soil II (gov. program)	Ac.	4.4	--	6.0
Corn--Soil III (gov. program)	Ac.	--	--	1.8
Buy corn	Bu.	--	1,005.9	--
Sell corn	Bu.	604.3	--	--
Corn silage--Soil I	Ac.	0.6	--	3.7
Cotton--Soil I	Ac.	28.6	36.8	37.5
Permanent pasture--Soil I (grazed)	Ac.	5.5	--	9.4
Permanent pasture--Soil IV (grazed)	Ac.	--	7.5	--
Soybeans--Soil I	Ac.	1.4	--	--
Soybeans--Soil III	Ac.	--	--	5.5
Soybeans-wheat--Soil I	Ac.	--	29.9	--
Soybeans-wheat--Soil II	Ac.	--	7.3	--
Soybeans-wheat--Soil III	Ac.	--	7.6	--
Transfer forage (period 2-3)	CAD	4.4	2.7	5.1
Transfer forage (period 3-4)	CAD	--	--	--
Transfer forage (period 4-5)	CAD	--	2.0	3.2
Set aside	Ac.	11.1	7.4	14.8
Livestock				
Swine I	Sow	29.2	12.3	50.1
Feeder heifer II	Hd.	4.3	--	28.0

row crop acreages, leaving idle less productive acres. Unused land for labor situation B was primarily in Soil Groups II and IV. Unused labor was evident in several labor periods, but especially in Labor Period V for labor situations A and C and Labor Period III for labor situation B. Resources available, resources unused, and net returns for the three labor situations are shown in Table XXXI.

Investment capital requirements for these farms were high both as a result of buying additional land and feeding beef. Net returns to labor and management were $6,143.00, $6,983.00, and $10,688.00, respectively for labor situations A, B, and C.

Option of Acquiring More Land, 10 and 18 Percent Capital Costs

Given the medium size farm with a 10 percent interest charge for investment capital and 18 percent interest charge for operating capital, the inclusion of the option of acquiring more land resulted in much less land purchased than at 6 and 7 percent interest, but some land was leased in (Table XXXII). Cotton, corn, and hay were the main crop enterprises included for the situation with labor supplies A and C. Most of the corn produced would be fed to the swine and feeder cattle. Cotton, soybeans, wheat, and hay produced for sale were the basic enterprise combination with labor situation C. Corn would be purchased to meet the requirements of the sow-feeder pig operation.

Unused land occurred in the optimum systems for all three labor situations. Investment and operating capital requirements were fairly low for farm labor situation A, while investment capital requirements were higher for farms with labor supplies B and C which included the

Table XXXI. Resources Available, Resources Unused, and Returns to Labor and Management for the Medium Size Farm with the Option of Buying or Leasing in Land, 6 and 7 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Resources Available				
Openland	Ac.	149.8	193.1	196.8
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 6%	Dol.	16,355.0	32,229.0	35,199.0
Operating capital @ 7%	Dol.	2,373.0	3,077.0	5,526.0
Resources Unused				
Soil I	Ac.	9.2	--	10.0
Soil II	Ac.	10.7	13.7	14.0
Soil III	Ac.	29.0	1.9	30.2
Soil IV	Ac.	32.5	34.5	42.9
Total		81.4	50.1	97.1
Labor I	Hr.	--	--	6.4
Labor III	Hr.	--	59.1	--
Labor IV	Hr.	--	31.4	--
Labor V	Hr.	173.0	3.4	287.4
Labor VI	Hr.	12.5	22.9	11.0
Total		185.5	116.8	304.8
Returns				
Land, labor, and management	Dol.	9,923.0	10,762.0	14,467.0
Land charge (111 acres)	Dol.	2,245.0	2,245.0	2,245.0
Overhead charge	Dol.	1,534.0	1,534.0	1,534.0
Labor and management	Dol.	6,143.0	6,983.0	10,688.0

Table XXXII. Profit Maximizing Solutions for the Medium Size Farm, with Option of Buying or Leasing in Land, 10 and 18 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Acquire Land				
Buy land	Ac.	9.4	40.7	56.9
Lease in land	Ac.	2.3	8.2	11.6
Crops				
Alfalfa hay--Soil I	Ac.	5.7	15.7	8.1
Alfalfa hay--Soil III	Ac.	--	23.0	--
Sell hay (alfalfa equivalent)	Ton	17.0	111.5	16.8
Corn--Soil I (gov. program)	Ac.	15.8	--	21.2
Corn--Soil II (gov. program)	Ac.	3.6	--	5.4
Corn--Soil III (gov. program)	Ac.	3.8	--	5.6
Buy corn	Bu.	--	1,020.3	--
Sell corn	Bu.	692.0	--	111.2
Corn silage--Soil I	Ac.	--	--	4.0
Cotton--Soil I	Ac.	23.0	28.9	32.0
Permanent pasture--Soil I (grazed)	Ac.	5.6	--	9.5
Permanent pasture--Soil IV (grazed)	Ac.	--	7.7	--
Soybeans--Soil I	Ac.	--	26.7	--
Soybeans--Soil II	Ac.	--	6.0	--
Soybeans-wheat--Soil III	Ac.	--	6.3	--
Wheat--Soil I	Ac.	0.7	--	--
Wheat--Soil II	Ac.	--	11.4	--
Wheat--Soil III	Ac.	--	1.6	--
Transfer forage (period 2-3)	CAD	3.7	1.7	4.6
Transfer forage (period 4-5)	CAD	--	1.1	2.6
Set aside	Ac.	10.4	5.8	14.5
Livestock				
Swine I	Sow	29.9	24.9	50.6
Feeder heifer II	Hd.	--	--	30.3

purchase of 40.7 and 56.9 acres of land, respectively. As shown in Table XXXIII, net returns to labor and management were considerably lower with 10 and 18 percent interest charges than with 6 and 7 percent interest charges.

Option of Leasing Out Land

When the option to lease out land was added for the medium size farm situation, some land was leased out in every case. Leasing rates were assumed to be $25.00, $15.00, $12.00, and $7.00 respectively for soils of Groups I, II, III, and IV.

In every case where the option of leasing out was permitted, the optimum enterprise combination and level of production was the same as for situations where leasing out was not permitted. The inclusion of this option simply allowed for disposal of unused acreage. In each case the soils that would have otherwise remained unused were leased out and net returns to labor and management were increased by the amount of income acquired from leasing out land. The additional income in each farm situation amounted to the number of acres of unused soils multiplied by the appropriate leasing rate, indicated above.

III. LARGE SIZE FARMS

Original Size, 6 and 7 Percent Capital Costs

Selling of cotton, hay, and wheat were the major activities included in the optimum solution of the large size farms of 225 acres each with labor supply situations A and C. In labor situation C some additional corn would be bought to supplement that grown on the farms to supply the

Table XXXIII. Resources Available, Resources Unused, and Returns to Labor and Management for the Medium Size Farm with the Option of Buying or Leasing in Land, 10 and 18 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	B	C
Resources Available				
Openland	Ac.	122.7	159.9	179.5
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 10%	Dol.	6,314.0	17,728.0	25,606.0
Operating capital @ 18%	Dol.	1,958.0	2,550.0	5,645.0
Resources Unused				
Soil II	Ac.	8.8	--	12.8
Soil III	Ac.	19.1	--	27.6
Soil IV	Ac.	26.6	27.1	39.1
Total		54.5	27.1	79.5
Labor II	Hr.	9.4	--	0.3
Labor IV	Hr.	--	219.6	--
Labor V	Hr.	163.1	58.9	272.7
Labor VI	Hr.	13.8	21.3	6.4
Total		186.3	299.8	279.4
Returns				
Land, labor, and management	Dol.	9,195.0	9,371.0	12,656.0
Land charge (111 acres)	Dol.	3,741.0	3,741.0	3,741.0
Overhead charge	Dol.	1,672.0	1,672.0	1,672.0
Labor and management	Dol.	3,781.0	3,956.0	7,242.0

swine and beef systems. Corn silage was included in solutions for labor supplies A and C for use in the beef feeding systems. With labor situation B, the optimum system included selling cotton, hay, wheat, and soybeans. All corn required for the swine enterprise was produced on the farm. The levels of enterprises in the optimum solutions are shown in Table XXIV.

For all labor situations the amount of unutilized labor was relatively small. Investment and operating capital requirements were higher for the optimum solutions including beef than for the solutions not including beef. Returns to labor and management were $7,826.00, $8,662.00, and $11,613.00 respectively to the operators with labor supplies A, B, and C. The resources available, unused resources, and returns for the large size farms described above are shown in Table XXXV.

Original Size, 10 and 18 Percent Capital Costs

With 10 and 18 percent capital costs the optimum systems for the large farms with labor supplies A and C included corn produced for feeding swine and beef and cotton, wheat, and alfalfa hay produced primarily for sale. Cotton, hay, soybeans, wheat, corn, and feeder pig production were the main enterprises in the optimum solution with labor supply B. Enterprises in the optimum solutions for all three labor supply situations are shown in Table XXXVI.

Comparison of Tables XXXV and XXXVII shows net returns to labor and management were considerably smaller for farms with the higher interest rates. Increasing the interest charged from 6 and 7 percent to 10

Table XXXIV. Profit Maximizing Solutions for the Large Farm (225 Acre), 6 and 7 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Crops				
Alfalfa hay--Soil I	Ac.	16.1	6.3	6.3
Alfalfa hay--Soil III	Ac.	3.8	25.9	25.9
Sell hay (alfalfa equivalent)	Ton	39.9	165.4	54.7
Corn--Soil I (gov. program)	Ac.	12.9	11.7	4.2
Corn--Soil II (gov. program)	Ac.	4.7	--	4.7
Corn--Soil III (gov. program)	Ac.	3.2	--	5.2
Buy corn	Bu.	--	--	2,365.4
Corn silage--Soil I	Ac.	10.1	--	21.0
Cotton--Soil I	Ac.	31.8	31.8	31.8
Midland Bermuda hay--Soil I	Ac.	--	9.8	--
Midland Bermuda hay--Soil II	Ac.	--	12.1	--
Permanent pasture--Soil II (grazed)	Ac.	1.7	--	--
Permanent pasture--Soil III (grazed)	Ac.	1.1	--	--
Permanent pasture--Soil IV (grazed)	Ac.	--	7.8	8.1
Soybeans--Soil I	Ac.	--	11.6	--
Soybeans--Soil II	Ac.	--	5.9	--
Soybeans--Soil III	Ac.	2.5	--	--
Soybeans-wheat--Soil III	Ac.	--	6.5	--
Wheat--Soil I	Ac.	--	--	9.8
Wheat--Soil II	Ac.	10.4	--	12.1
Transfer forage (period 2-3)	CAD	5.4	3.5	3.3
Transfer forage (period 4-5)	CAD	--	--	2.5
Set aside	Ac.	11.7	6.4	9.9
Livestock				
Swine I	Sow	13.4	25.6	26.4
Feeder steer II	Hd.	--	--	31.7
Feeder heifer II	Hd.	76.0	--	109.1

Table XXXV. Resources Available, Resources Unused, and Returns to Labor and Management for the Large Size Farm (225 Acres), 6 and 7 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	B	C
Resources Available				
Openland	Ac.	167.0	167.0	167.0
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 6%	Dol.	7,138.0	6,119.0	12,071.0
Operating capital @ 7%	Dol.	8,123.0	2,744.0	15,454.0
Resources Unused				
Soil III	Ac.	21.0	--	--
Soil IV	Ac.	36.1	28.3	28.0
Total		57.1	28.3	28.0
Labor II	Hr.	--	29.9	5.0
Labor III	Hr.	--	18.9	--
Labor IV	Hr.	--	110.7	--
Labor V	Hr.	70.9	31.1	137.1
Labor VI	Hr.	14.7	17.6	8.7
Total		85.6	198.2	150.8
Returns				
Land, labor, and management	Dol.	13,128.0	13,964.0	16,915.0
Land charge (167 acres)	Dol.	3,366.0	3,366.0	3,366.0
Overhead charge	Dol.	1,934.0	1,934.0	1,934.0
Labor and management	Dol.	7,826.0	8,662.0	11,613.0

Table XXXVI. Profit Maximizing Solutions for the Large Farm (225 Acre), 10 and 18 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	B	C
Crops				
Alfalfa hay--Soil I	Ac.	16.1	6.3	1.4
Alfalfa hay--Soil III	Ac.	--	25.9	--
Sell hay (alfalfa equivalent)	Ton	37.7	165.4	1.1
Corn--Soil I (gov. program)	Ac.	16.5	7.8	19.7
Corn--Soil II (gov. program)	Ac.	4.7	4.7	4.7
Corn--Soil III (gov. program)	Ac.	5.2	--	5.2
Sell corn	Bu.	652.1	--	--
Corn silage--Soil I	Ac.	5.6	--	1.6
Cotton--Soil I	Ac.	31.8	31.8	31.8
Midland Bermuda hay--Soil I	Ac.	--	9.8	--
Midland Bermuda hay--Soil II	Ac.	--	12.1	--
Permanent pasture--Soil I (grazed)	Ac.	--	--	10.4
Permanent pasture--Soil II (grazed)	Ac.	4.2	--	--
Permanent pasture--Soil IV (grazed)	Ac.	--	7.8	--
Soybeans--Soil I	Ac.	--	16.5	--
Soybeans-wheat--Soil III	Ac.	--	6.5	--
Transfer forage (period 2-3)	CAD	5.6	--	4.1
Set aside	Ac.	13.0	9.5	13.8
Livestock				
Swine I	Sow	20.7	25.7	55.0
Feeder heifer II	Hd.	42.5	3.4	12.1

Table XXXVII. Resources Available, Resources Unused, and Returns to Labor and Management for the Large Size Farm (225 Acre), 10 and 18 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	B	C
Resources Available				
Openland	Ac.	167.0	167.0	167.0
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 10%	Dol.	5,556.0	6,114.0	5,710.0
Operating capital @ 18%	Dol.	5,460.0	2,730.0	4,156.0
Resources Unused				
Soil I	Ac.	--	--	4.3
Soil II	Ac.	7.9	--	12.1
Soil III	Ac.	25.9	--	25.9
Soil IV	Ac.	36.1	28.3	36.1
Total		69.9	28.3	78.4
Labor II	Hr.	19.1	29.3	88.6
Labor III	Hr.	5.6	19.6	101.5
Labor IV	Hr.	--	111.0	--
Labor V	Hr.	96.6	31.2	263.9
Labor VI	Hr.	14.4	17.6	4.2
Total		135.7	208.7	458.2
Returns				
Land, labor, and management	Dol.	12,101.0	13,418.0	15,431.0
Land charge (167 acres)	Dol.	5,611.0	5,611.0	5,611.0
Overhead charge	Dol.	2,108.0	2,108.0	2,108.0
Labor and management	Dol.	4,382.0	5,699.0	7,712.0

and 18 percent reduced net returns to labor and management by 44 percent in labor situation A, 34 percent in labor situation B, and 34 percent in labor situation C.

Option of Acquiring More Land, 6 and 7 Percent Capital Costs

When the option of acquiring more land was permitted on large size farms at interest rates of 6 and 7 percent, respectively for investment and operating capital, additional land was purchased in all three labor supply situations, but none was leased in. Under these conditions, 345, 445, and 631 additional acres were purchased with labor supply situations A, B, and C, respectively. In all cases the land purchases were much larger than the original 225 acre sizes of the farms. With labor supplies A and C cotton and corn would be produced, along with a small quantity of wheat, as major cash crops. Some of the corn produced would be utilized for heifer feeding. No livestock enterprises were included in the solution for farm B and no swine systems were included in the optimum solutions for farms A, B, or C. The activities and the levels at which they were included in the solutions are shown in Table XXXVIII.

In each of the above situations, large quantities of land were left idle, but soils most suitable for row cropping were completely utilized. The purchase of acres which remained idle was justified on the basis of the high returns to the acres which were row cropped. Sizable quantities of labor were unused in the labor periods extending from November through February since no swine and only small quantities of beef were included in the profit maximizing solutions.

Table XXXVIII. Profit Maximizing Solutions for the Large Size Farm, with Option of Buying or Leasing in Land, 6 and 7 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	Labor Supply B	Labor Supply C
Acquire Land				
Buy land	Ac.	345.8	445.8	631.2
Crops				
Buy hay (alfalfa equivalent)	Ton	1.4	--	6.3
Sell hay (alfalfa equivalent)	Ton	--	72.2	--
Corn--Soil I (gov. program)	Ac.	62.5	--	95.1
Corn--Soil II (gov. program)	Ac.	15.8	--	24.9
Sell corn	Bu.	6,722.3	--	10,036.3
Corn silage--Soil I	Ac.	0.7	--	3.4
Cotton--Soil I	Ac.	97.5	116.5	151.7
Lespedeza hay--Soil I	Ac.	--	29.8	--
Soybeans--Soil I	Ac.	--	94.0	--
Soybeans--Soil II	Ac.	--	23.7	--
Soybeans--Soil III	Ac.	--	22.6	--
Wheat--Soil I	Ac.	9.4	11.4	18.5
Wheat-red clover hay--Soil I	Ac.	--	19.4	--
Set aside	Ac.	39.1	23.3	60.3
Livestock				
Feeder heifer II	Hd.	5.4	--	25.4

The purchase of land required extremely high quantities of investment capital, but operating capital requirements were fairly small since few livestock were included. Returns to the operator's labor and management with resources available and unused resources for the three labor supply situations are shown in Table XXXIX. Returns per unit of labor were quite high and averaged $15.73, $12.80, and $16.20 per hour for the A, B, and C labor situations respectively.

Option of Acquiring More Land, 10 and 18 Percent Capital Costs

With the imposition of higher interest rates, 10 and 18 percent, no land was purchased; the leasing in of land was included in the optimum solutions and the sow-feeder enterprises reappeared in the farming systems.

Corn and cotton were included in the solutions for all three farm labor situations with sizable quantities of corn produced for sale in labor situations A and C. With labor situation B soybeans, wheat, and hay were produced for sale. The extent of land leasing and crop and livestock production activities included in the optimum solutions are shown in Table XL.

At the higher interest rates less land was left idle in all soil groups than at the lower rate and very little labor remained unused except during labor period V for farms A and C. Unused resources and returns to land, labor, and management are shown in Table XLI. Returns remaining to labor and management were $5,090, $7,859, and $9,168 respectively for the large size farms paying 10 and 18 percent interest rates with labor supply situations A, B, and C.

Table XXXIX. Resources Available, Resources Unused, and Returns to Labor and Management for the Large Size Farm with the Option of Buying or Leasing in Land, 6 and 7 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply A	B	C
Resources Available				
Openland	Ac.	512.8	612.8	798.2
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 6%	Dol.	120,035.0	156,766.0	218,958.0
Operating capital @ 7%	Dol.	3,438.0	4,755.0	6,816.0
Resources Unused				
Soil I	Ac.	41.3	--	60.7
Soil II	Ac.	36.3	43.3	56.3
Soil III	Ac.	98.1	94.5	152.3
Soil IV	Ac.	112.2	134.2	175.0
Total		287.9	272.0	444.3
Labor I	Hr.	136.6	119.1	244.6
Labor V	Hr.	100.1	--	173.0
Labor VI	Hr.	147.6	137.0	246.6
Total		384.3	256.1	664.2
Returns				
Land, labor, and management	Dol.	16,020.0	20,528.0	22,973.0
Land charge (167 acres)	Dol.	3,366.0	3,366.0	3,366.0
Overhead charge	Dol.	1,934.0	1,934.0	1,934.0
Labor and management	Dol.	10,719.0	15,226.0	17,672.0

Table XL. Profit Maximixing Solutions for the Large Size Farm, with Option of Buying or Leasing in Land, 10 and 18 Percent Capital Costs, by Labor Supply

Activity	Unit	Labor Supply A	B	C
Acquire Land				
Lease in land	Ac.	110.7	214.7	216.2
Crops				
Buy hay (alfalfa equivalent)	Ton	1.2	--	3.7
Sell hay (alfalfa equivalent)	Ton	--	73.2	--
Corn--Soil I (gov. program)	Ac.	32.2	11.9	32.2
Corn--Soil I	Ac.	11.7	--	44.4
Corn--Soil II	Ac.	10.3	--	14.5
Corn--Soil III	Ac.	10.9	--	15.1
Sell corn	Bu.	4,109.7	--	6,438.6
Corn silage--Soil I	Ac.	0.6	--	1.9
Cotton--Soil I	Ac.	31.8	31.8	31.8
Lespedeza hay--Soil II	Ac.	--	16.5	--
Permanent pasture--Soil I (grazed)	Ac.	5.4	--	10.3
Permanent pasture--Soil II (grazed)	Ac.	--	6.2	--
Soybeans--Soil I	Ac.	15.7	93.0	21.8
Soybeans--Soil II	Ac.	--	14.5	--
Soybeans--Soil III	Ac.	--	15.1	--
Wheat--Soil I	Ac.	--	4.6	--
Wheat--Soil II	Ac.	--	10.6	--
Wheat--Soil III	Ac.	--	34.8	--
Wheat-red clover--Soil I	Ac.	--	33.0	--
Transfer forage (period 2-3)	CAD	6.2	3.9	4.8
Transfer forage (period 4-5)	CAD	--	2.5	--
Set aside	Ac.	14.4	9.4	14.4
Livestock				
Swine I	Sow	29.2	26.0	54.5
Feeder heifer II	Hd.	4.9	--	14.6

Table XLI. Resources Available, Resources Unused, and Returns to Labor and Management for the Large Size Farm with the Option of Buying or Leasing in Land, 10 and 18 Percent Capital Costs, by Labor Supply

	Unit	Labor Supply		
		A	B	C
Resources Available				
Openland	Ac.	277.7	381.7	383.2
Labor	Hr.	1,030.0	1,446.0	1,755.0
Investment capital @ 10%	Dol.	4,643.0	7,871.0	7,937.0
Operating capital @ 18%	Dol.	3,236.0	4,001.0	5,831.0
Resources Unused				
Soil I	Ac.	21.8	--	27.4
Soil II	Ac.	19.9	--	27.2
Soil III	Ac.	42.5	17.0	58.3
Soil IV	Ac.	60.5	83.3	83.7
Total		144.7	100.3	196.6
Labor V	Hr.	113.2	--	198.2
Labor VI	Hr.	12.0	16.0	4.0
Total		125.2	16.0	202.2
Returns				
Land, labor, and management	Dol.	12,808.0	15,569.0	16,886.0
Land charge (167 acres)	Dol.	5,611.0	5,611.0	5,611.0
Overhead charge	Dol.	2,108.0	2,108.0	2,108.0
Labor and management	Dol.	5,089.0	7,849.0	9,167.0

Option of Leasing Out Land

The inclusion of the option to lease out land on the large farm resulted in some land leasing in each of the three labor situations. Leasing rates were assumed to be $25.00, $15.00, $12.00, and $7.00 respectively for soils of Groups I, II, III, and IV.

In every case where the option of leasing out was permitted, no changes occurred in the optimum enterprises or the quantities of the enterprises included in the profit maximizing solutions. In each labor situation the soils that would have otherwise remained unused were leased out and net returns to land, labor, and management; therefore to labor and management, were increased by the amount of income acquired from leasing out land. This additional income in each farm situation amounted to the number of acres of unused soils multiplied by the appropriate leasing rate indicated above.

CHAPTER VI

SUMMARY AND CONCLUSIONS

I. SUMMARY

Census information indicates the total number of farms in Tennessee has continuously decreased over the last couple of decades. During the same period the number of part-time farms, as defined by the census, and the number of farms whose operators worked off the farm 100 or more days per year fluctuated, but the numbers of these farms in 1969, were only slightly higher than in 1949. Therefore, the number of farmers working off the farm 100 or more days per year, defined as part-time farmers in this study, has remained about constant, while the total number of farms has sharply decreased.

The purpose of this study was to determine what level of returns might be expected by the part-time farmers who were in possession of various quantities of land and farm labor and also to determine the influence of different interest rates on net returns. In addition, variations in land-labor combinations and interest rates were made to determine the effect of such variations on the combination and size of various farm enterprises in the optimal farm system. Linear programming was used to determine profit maximizing combinations for each farm. The maximum profits obtainable from each of the farm situations considered in this study are shown in Table XLII. As indicated in Table XLII, net returns to labor and management for the part-time farms considered ranged from $2,610.00 to $17,672.00. The smallest net return was for a 70 acre

Table XLII. Summary of Net Returns to Labor and Management for Three Labor Supplies, Two Rates of Interest, and Three Farm Sizes, With and Without the Options of Acquiring Additional Land

Labor Supply	Interest Rate		Land	Net Returns		
	Investment (%)	Operating (%)	Buy of Lease in	Small Farm	Medium Farm	Large Farm
A	6	7	No	$ 4,146.00	$ 5,890.00	$ 7,826.00
A	6	7	Yes	5,770.00	6,143.00	10,719.00
A	10	18	No	3,021.00	3,774.00	4,382.00
A	10	18	Yes	3,406.00	3,781.00	5,089.00
B	6	7	No	3,711.00	5,695.00	8,662.00
B	6	7	Yes	6,610.00	6,983.00	15,226.00
B	10	18	No	2,610.00	3,703.00	5,699.00
B	10	18	Yes	3,581.00	3,956.00	7,849.00
C	6	7	No	7,583.00	9,533.00	11,613.00
C	6	7	Yes	10,313.00	10,688.00	17,672.00
C	10	18	No	6,275.00	7,019.00	7,712.00
C	10	18	Yes	6,867.00	7,242.00	9,167.00

farm using about 700 hours of operator labor per year and paying 10 and 18 percent interest charges for investment and operating capital respectively. The $17,672 net return was for an 856 acre farm utilizing approximately 1,100 hours of operator labor and paying interest charges of 6 percent for investment capital and 7 percent for operating capital.

As expected, imposition of a higher interest rate reduced estimated returns to labor and management in every case. Higher interest charges, in all cases but one, resulted in some change in the combination and quantity of enterprises included in the optimum solution. The higher rates of interest in many cases resulted in the exclusion of activities with high investment capital requirements such as beef feeding activities and the purchase of additional land. With higher interest charges, additional land tended to be acquired by leasing rather than purchase.

Comparisons of farms alike in every way except labor supply indicated that farms with the larger labor supplies did not necessarily return higher potential net returns to the farm operator. Comparison of farms with labor situations A, a smaller labor supply, and B, a larger labor supply, in some cases showed higher maximum net returns being earned on farms possessing the smaller labor supply. Apparently the seasonal distribution of labor is an important criterion in determining what enterprises can be included in an optimum solution, and the magnitude of the enterprises.

Acquisition of land in this study varied considerably both in quantity and method of acquisition. Land was purchased at the lower interest rates and leased at the higher interest rates. Much larger quantities of land were acquired in the large farm situation (225 acres).

The larger power units and machinery assumed for the large farms allowed for more profitable use of larger acreages than on the small and medium size farms with smaller equipment. Acreages purchased or leased in usually resulted in increased production of cotton, corn, and/or soybeans on the farms affected.

A trend was recognizable among the part-time farm situations studied. Farms of the original sizes, 70, 150, and 225 acres and paying the lower interest rates usually returned higher net returns with the inclusion of primarily cotton, corn, hay, swine, and some beef animals. Relatively small quantities of soil remained unused in the above situations. When higher interest rates were charged on the same farms, little changed in the above system, except the number of beef animals generally declined.

The acquisition of additional farm land had little effect upon livestock numbers in any of the farm situations except the farm which was originally 225 acres and which paid the lower of the two interest rates. In this particular situation, so much additional land was acquired that very little time was left available for livestock production. Large quantities of land often remained unused when large sums of additional land were acquired because all land was not suitable for row cropping in any one year. As a result, large quantities of land were bought to get land suitable for tilling while the land unsuited for tilling remained idle.

II. CONCLUSIONS

Based on conditions assumed for this study, part-time farmers could not only supplement their income considerably from farm sources, but in many cases could potentially earn more for labor utilized on the farm than in off-farm work. With similar labor supplies, but different farm sizes and capital costs, net returns to labor and management ranged from a low of $2,610 to a high of $17,672. Per hour net returns to labor and management used on the farms yielding the low and high net returns to labor and management were $3.74 and $13.48 respectively.

Large quantities of land could be worked by the part-time farmers in some of the farming situations studied. Farms sizes ranges from 70 acres to 798 with each being worked by one unassisted operator on a part-time basis. Some jobs would be performed on a custom hire basis.

The linear programming technique has some inherent limitations which may affect the results of any linear programming study. Enterprise budgets are necessary for use in a linear programming model. It is very difficult to include all resource requirements and to estimate exact costs and returns from enterprises for inclusion in budgets. Therefore, representative situations are used and estimates for the representative situations are made as accurately as possible. Inaccuracies in data or failure to include all relevant costs and/or production alternatives will be inherent in the results, but not obviously discernible. Yet, even with the shortcomings of linear programming, the technique can be useful for obtaining good approximations of the relationships studied.

The reader should be cautioned that the results for each situation apply only to the particular situation described and its associated assumptions. A major underlying assumption is that the operator is a profit maximizer. Obviously all farm operators and particularly part-time farm operators have a variety of goals, objectives and aspirations and the selection of a particular farming system will need to take account of the unique value system of the individual farmer.

The results of this study indicate that level of returns that can be expected and the system of enterprises that will maximize net profits on specified part-time farm situations in the Brown Soil and Delta Areas of Tennessee. It is obvious that most part-time farmers in the area are not realizing the level of returns indicated here and that resource returns to individual farmers and to the area as a whole could be enhanced by adjustments in resource use and enterprise combinations. For an efficiently operated farm the returns to labor in some cases may exceed the returns from the off-farm job alternative and the farmer should view the off-farm job in terms of a supplement to the farm income rather than vice-versa.

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He is married to the former Charlotte Ann Dennison of Newbern, Tennessee, and they have one daughter, Tara.