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To the Graduate Council:

I am submitting a thesis written by Vernon M. Bounds entitled "Farm Adjustment Opportunities in the Baxter-Mountview-Bewleyville Soil Association of the Eastern Highland Rim of Tennessee." I recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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FARM ADJUSTMENT OPPORTUNITIES IN THE BAXTER-MOUNTVIEW-BEWLEYVILLE SOIL ASSOCIATION OF THE EASTERN HIGHLAND RIM 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

Vernon M. Bounds

August 1963

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(33)

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CHAPTER I

THE NATURE OF THE STUDY

I. INTRODUCTION

Rapid changes in the technological and economic conditions faced by farmers in recent years have changed the nature of the problems regarding the management and operation of their farms. With the decline in the importance of subsistance farming, farmers' goals and objectives are becoming increasingly profit oriented. Economic factors are now playing a more predominant role in farm decision making. Farmers now use considerably more purchased inputs and more expensive and complex machinery to obtain a larger volume of production. This is a result of an effort to overcome the declining profit margin per unit on many farm products and has greatly increased the capital requirements of an efficient farm unit. The increasing competitiveness of farming, coupled with a wide range of technological choices faced by the farmer, has increased emphasis on the role and function of the management factor in organizing and operating a modern, efficient farm business.

The development of better means of communication between rural and urban communities has affected the desires and aspirations of farm families. Such things as better education, modern home conveniences, more leisure time, and recreation are now becoming increasingly important to rural families. Attainment of goals or desires such as these require,

either directly or indirectly, more income. These factors have resulted in more attention being given to economic considerations by farm families in making management decisions.

The major portion of this analysis is based on profit-maximization goals. The fact that other goals do exist does not make the assumption invalid, but limits the application of any findings to the extent that profits do remain a major goal. Profits are probably one of the most common aspirations of almost all farmers, and therefore studies using them as a goal provide a basis for guiding farmers in determining the kind of adjustments in their farm organization necessary to increase income levels.

Technological changes in agriculture have been quite pronounced in recent years. In their efforts to improve their material well-being and to become or continue to be competitive with other farmers, it is imperative that farmers incorporate many of these advances into the farming operation. The lag between the development of new ideas and practices that are economically feasible and justified constitutes the adjustment problem faced by farmers.

II. STATEMENT OF THE PROBLEM

The rapid rate of technological development and the increasing pressure of economic forces in agriculture make it necessary for farmers to adjust their farming operations in order to improve profit levels and achieve higher standards of living. The income level of many farmers is insufficient to provide their families with a level of living comparable

to non-farm families. The problem is not one of simple incorporation of new techniques, since not all technological advances apply equally to all farms. In many cases, organizational, rather than technological, changes may have a more significant impact on farm incomes.

By studying resource situations which are somewhat common on large groups of farms, a guide may be constructed which would have general, though not specific, application. This could be used by agricultural workers, policy makers, and even individual farmers. The guide would suggest the magnitude and direction of changes which seem necessary to achieve higher income levels. This study is designed to provide a basis for, and some insights into, the farming adjustment problem and the nature of factors which retard or limit the adjustment process in a particular area. This study deals with the Baxter-Mountview-Bewleyville Soil Association in the Eastern Highland Rim of Tennessee.

III. PURPOSES AND OBJECTIVES OF THE STUDY

The purposes and objectives of this study are:

1. To describe the existing patterns of farm organization and resource use in the Baxter-Mountview-Bewleyville Soil Association of the Eastern Highland Rim.

2. To determine the economic optimum farm organization of "representative" small, medium, and large size farms with land as a fixed resource.

3. To determine economic optimum farm organization and farm size with a fixed resident labor supply of one and two men.

4. To estimate the magnitude of the "adjustment gap" of farmers and to describe the nature of factors limiting farming adjustments in the area.

IV. PROCEDURE

This study was conducted in the following manner:

1. The present distribution of farms by size and the farm organization and resource use by size of farm was determined from a one-stop survey of a stratified random sample of farms in Putnam County, Tennessee.

2. Representative farms were selected to typify various sizes of farms and soil patterns in the area.

3. Enterprise budgets were developed indicating the technical and economic conditions faced by farmers in the area with respect to the major production alternatives.

4. Linear programming techniques were used to estimate the farm organizations necessary to maximize income under specified conditions for three sizes of representative farms and the two farms with fixed resident labor forces.

5. The overall adjustment problems and adjustment limitations were determined by comparing the optimum systems with the present structure of resource ownership and farm organization in the area.

V. PREVIOUS RESEARCH

This study is a part of a larger research project in the southern region titled "An Economic Appraisal of Farming Adjustment Opportunities

in the Southern Region to Meet Changing Conditions" and referred to as the Southern Regional Project S-42. The major objective of this study is:

> . . . to provide guides to farmers when choosing among alternative production opportunities, especially as those opportunities are affected by changes in prices and technology, in order that they may make the most profitable decisions; and to provide guides to farmers, those persons engaged directly in making and administering public programs, and to the public at large in order that choices of action at the public level may be made in a manner consistent with the public objectives . . . .[1]

This study uses the basic physical and price data developed for the S-42 project. The main project for the Eastern Highland Rim concerns itself with studying three major soil associations in the area to determine optimum farm organization for representative resouce situations under varying conditions of prices, costs, and resource supplies. The results of the optimum systems for individual farms will be aggregated for the area on the basis of the relative occurrence of the representative resource situations. Aggregations made at various price levels for particular products will serve as a basis for drawing inferences regarding the nature of the supply relation for particular farm products. This study deals with only one of the three major Eastern Highland Rim soil areas and with adjustment problems at the micro-level rather than the macro-level.

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[1] A guide to Procedures in Southern Research Project S-42, "An Economic Appraisal of Farming Adjustment Opportunities in the Southern Region to Meet Changing Conditions." (Knoxville, Tennessee: Agricultural Experiment Station, Unpublished, May, 1958).

The experiment station at Virginia Polytechnic Institute, in connection with S-42, conducted a research project: "Farm Adjustment Opportunities (Southside Virginia)." Some of the conclusions reached in this study of a flue-cured tobacco area were: Farmers do have opportunity to increase significantly their incomes above present levels. Tobacco allotments have a high value in the farmer's enterprise system and additional capital investment over existing levels has profitable use possibilities.[2]

Earl O. Heady suggests a use for farm adjustment studies that significantly broadens their scope. Dr. Heady explains that, while there have been significant advances made in the field of demand analysis and prediction, there is a serious void in the area of the nature of supply and particularly specific supply functions. The method that could be used to obtain such information is aggregation. The farm organization from farm adjustment studies may be aggregated under varying price levels to determine the nature of the supply relationship for the various agricultural products that would be produced in the area.[3] Thus, studies of farm adjustment have still further use as supply studies and there exists a great need for information in this field.

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[2]Harold W. Walker, Ralph G. Kline, and Carl J. Harold, Farm Adjustment Opportunities, Southside Virginia, (Virginia Agricultural Experiment Station, Technical Bulletin 150, May, 1961).

[3]Earl O. Heady and others, Agricultural Supply Functions (Ames, Iowa: Iowa State University Press, 1961), pp. 2-24.

VI. JUSTIFICATION AND USES OF THE STUDY

A prerequisite to the success of any research project is that the use for which it is designed is worthy of the cost and time it demands. In addition, to the use that can be derived by farmers, the results from this and similar studies should provide indications regarding both the need for adjustments on individual farms and the aggregative effects of adjustments over time on the needs for additional capital, product market facilities, production inputs and educational programs in the area as a whole.

CHAPTER II

AREA DESCRIPTION

I. INTRODUCTION

This chapter describes the general environment of the study area and the nature of the agriculture in the area at present. The description of existing patterns of farm organization and resource use will provide the benchmark necessary to identify the "adjustment gap," i.e., the magnitude of the changes necessary for farmers to achieve maximum income levels as estimated in the study.

II. THE STUDY AREA

The Eastern Highland Rim is composed of the following thirteen counties: Cannon, Clay, Coffee, Dekalb, Franklin, Grundy, Overton, Pickett, Putnam, Van Buren, Warren, and White. Figure 1 shows the location of the Eastern Highland Rim and the county surveyed, Putnam. The Rim lies between the Central Basin and the Cumberland Mountains. The topography of the area is generally rolling in nature. There are three major soil associations in the area: Baxter-Mountview-Bewleyville, Dickson-Mountview-Bewleyville, and Waynesville-Cumberland.

Farming systems are primarily a combination of crop and livestock enterprises. Tobacco is grown as a cash crop on the majority of farms. Livestock are generally limited to the number that can be supported by grains and forages produced on the farm. The area contains no major

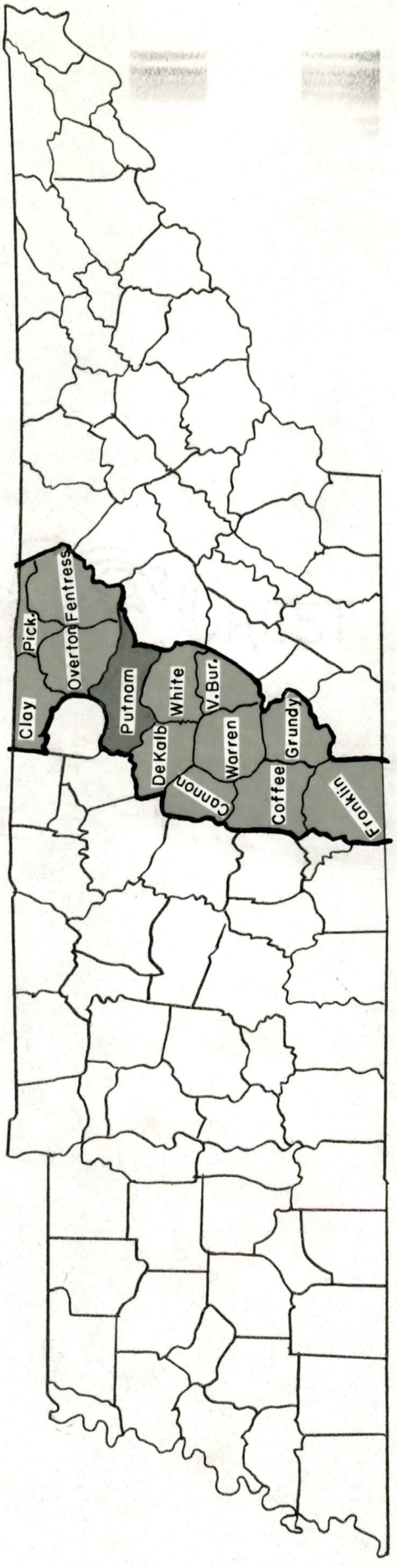


Figure 1. Map of Eastern Highland Rim.

metropolitan areas although there are many small towns scattered throughout the area. Intensive enterprises such as the production of Grade A milk, eggs, and broilers are not common in the area.

III. THE SAMPLE

Background data for the study were obtained from a stratified random sample of farms in Putnam County. This county was used as a sample area for two reasons. First, it was considered somewhat typical of the entire Rim Region with respect to topography, soil resources, farming systems, and general market environment. Secondly, it contained significant areas of each of the three major soil associations of the Eastern Highland Rim.

A randomized block sample of farms were selected for study in each of the three major soil areas. Each area was divided into square mile blocks. Sample blocks were selected at random.

The farm data were obtained during the summer of 1961 for the calendar year 1960. The following numbers of farms were slected from the three soil association areas:

Baxter-Mountview-Bewleyville - 60

Dickson-Mountview-Bewleyville - 35

Waynesville-Cumberland - 60

The total number of farms surveyed was 155. This study is concerned with the adjustment opportunities in the Baxter-Mountview-Bewleyville Soil Association area and all subsequent analysis will deal with this soil area only.

A farm unit was defined, following the definition used for the 1959 Census of Agriculture, as any unit over ten acres with gross sales of agricultural products equal to or exceeding $50.00 or any unit under ten acres with sales exceeding $250.00.[1]

IV. PRESENT FARM ORGANIZATION AND RESOURCE USE

Farm Size and Distribution

Since it was assumed that the adjustment problem would be different on various sizes of farms, the study farms were divided into four size groups based on acres of openland:

Group I - 0-29.9 acres

Group II - 30.0-69.9 acres

Group III - 70.0-139.9 acres

Group IV - 140.0 acres and over

Table I presents the distribution of farm by size and number of farms surveyed by size classifications.

Labor Availability and Use

From the farm survey, information was obtained regarding the amount of family labor available, and the amount of regular and seasonal hired labor used on the farms in 1960. Due to the fact that there were

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[1] United States Bureau of Census, United States Census of Agriculture: 1959. Tennessee, Vol. I (Washington: United States Government Printing Office, 1959).

TABLE I

NUMBER OF FARMS AND AVERAGE ACRES OF OPENLAND PER FARM BY SIZE GROUP

Size Group	Farm-Size Range (Openland Acres)[a]	Number of Farms Surveyed	Average Openland Acres per Farm
Group I	0- 29.9	16	17.7
Group II	30- 69.9	25	48.9
Group III	70-139.9	20	91.0
Group IV	140 plus	3	242.2
Total		64[b]	65.0

[a]Openland acres = (total acres owned + total acres rented in) - (total open acres rented out + total acres of woodland + total acres waste or other unuseable land).

[b]This figure does not correspond to farm numbers shown on the previous page because it includes the soil bank farms which were used for farm-size determination only.

many variations in age, sex, and physical ability among the family labor, labor estimates were based on the work capability of a fully able-bodied man.[2]

This information is presented in Table II and, in addition, the average age of the farm operator is included. Age is included because it may be an important factor in adjustments in farming systems.

Enterprises

The prevalence and relative size of various common enterprises in the area are presented by size groups in Tables III and IV.

The two major types of livestock in the area were beef and dairy. Swine were found on some farms, but usually on a relatively small scale. Most of the dairy farms produced milk for manufacturing purposes. Beef cattle were primarily cow-calf systems with some cattle fattened on grass. There were no dry lot feeding operations in the Baxter-Mountview-Bewleyville Soil Association area. Burley tobacco was a major cash crop and was grown on 54 per cent of the farms. The average tobacco acreage was .50 acres per reporting farm and .24 acres for all farms. Corn and

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[2]Labor availability was computed on the basis of 240 days of ten hours for each man between the ages of 19 and 34. Women were assumed to have one-half the value of available labor as men. Age differentials were compiled to allow for varying physical ability with various ages, and were as follows: 10-13, 50%; 14-18, 80%; 19-34, 100%; 35-39, 90%; 40-44, 80%; 45-49, 70%; 50-54, 60%; and 55 plus, 50%. Provision was made for part-time farmers allowing them 40% of their normal available labor. Handicapped farm workers were assumed to have 50% physical capabilities.

TABLE II

FAMILY LABOR AVAILABILITY, HIRED LABOR, AND AGE OF OPERATOR BY FARM SIZE

Farm-Size Group	Available Family Labor (MEWU)[a]	Hired Seasonal Labor (MEWU)	Hired Regular Labor (MEWU)	Average Age of Operator (Years)	Number of Farms Interviewed
I	131.6	2.4	--	59.5	16
II	196.1	1.8	--	53.5	22
III	233.9	16.5	0.7	47.1	19
IV	356.0	26.7	76.0	39.3	3
All Farms	198.9	9.0	4.0	52.4	60

[a]MEWU is equal to the amount of work that could be accomplished by one 19-34 year old male in a ten-hour day.

TABLE III

AVERAGE ACRES OF CROP ENTERPRISES OF SURVEY FARMS
BY SIZE GROUPS

Enterprises	Group I	Group II	Group III	Group IV	Total Area
Tobacco:					
Per cent farms reporting	31.25	56.00	60.00	33.33	54.00
Acres for reporting farms	0.43	0.40	0.62	0.96	0.50
Acres for all farms	0.12	0.21	0.37	0.32	0.24
Corn:					
Per cent farms reporting	25.00	64.00	100.00	100.00	67.10
Acres for reporting farms	7.30	10.87	15.10	13.30	11.90
Acres for all farms	1.60	5.80	15.10	13.30	8.00
Hay:					
Per cent farms reporting	25.00	48.00	55.00	100.00	50.00
Acres for reporting farms	5.31	11.67	28.73	67.00	24.60
Acres for all farms	1.20	8.50	15.81	67.00	12.30
Small Grains:					
Per cent farms reporting	--	8.00	10.00	66.67	10.00
Acres for reporting farms	--	7.50	10.00	18.45	6.60
Acres for all farms	--	0.60	1.00	12.30	1.10
Pasture:					
Per cent farms reporting	100.00	100.00	85.00	100.00	96.00
Acres for reporting farms	11.10	18.50	41.41	153.10	29.53
Acres for all farms	11.10	18.50	35.20	153.10	28.55

TABLE IV

LIVESTOCK ANIMAL UNITS OF VARIOUS LIVESTOCK CLASSES[a]
ON SURVEY FARMS BY FARM SIZE

Enterprise	Group I	Group II	Group III	Group IV	Total Area
Beef:					
Per cent farms reporting	18.8	31.8	63.2	100.0	41.7
Units per reporting farms	6.4	6.6	7.0	42.0	10.8
Units per all farms	1.2	2.1	4.4	42.0	4.5
Dairy:					
Per cent farms reporting	87.5	86.4	73.7	100.0	83.3
Units per reporting farms	3.7	4.2	8.6	14.6	5.8
Units per all farms	2.8	3.6	6.3	14.6	4.8
Swine:					
Per cent farms reporting	62.5	77.3	78.9	100.0	75.0
Units per reporting farms	1.4	1.3	2.7	2.8	1.9
Units per all farms	0.9	1.0	2.1	2.8	1.4
Other:					
Per cent farms reporting	100.0	100.0	94.7	100.0	83.2
Units per reporting farms	1.8	1.4	2.0	2.2	1.7
Units per all farms	1.8	1.4	1.9	2.2	1.7
Total Animal Units:					
Per cent farms reporting	100.0	100.0	94.7	100.0	98.3
Units per reporting farms	6.7	8.1	15.5	61.6	12.6
Units per all farms	6.7	8.1	14.3	61.6	12.4

[a]Animal units were computed on the basis of unpublished data from the University of Tennessee Department of Agricultural Economics, Knoxville, Tennessee.

small grains were not grown on significantly large acreages to be considered primary crops. Since the area had large acreages of hay and pasture, forage production would be classed as the major crop enterprise.

Capital, Debt, and Income

Capital investment was classified as real estate, machinery, livestock, and buildings. Real estate was the largest of the four items, comprising 75.3 per cent of the total investment, livestock accounted for 14.6 per cent, machinery 9.2 per cent, and buildings 10.9 per cent. Table V presents additional information regarding average capital investment by farm size along with debt, equity, and gross income. The real estate value was based on value estimates of the farmers, while the value of machinery, livestock, and buildings were synthesized. Machinery investments were based on one-half of 1957 new costs less salvage value (10 per cent). Livestock were valued on the basis of 1961 prices for livestock of various classes. Buildings were valued on the basis of their size, use, condition, and estimated replacement cost. Throughout the remainder of this thesis capital investment will not include the land value of the existing farm unit. The value of additional purchased land will be included where applicable.

Since loans are the normal means of obtaining capital beyond that which is readily available from the actual business capital, the equity of the farmer becomes an important factor in his ability to secure capital for adjustment or expansion. The average equity of all farms surveyed in the study area was 90.4 per cent.

TABLE V

AVERAGE CAPITAL INVESTMENT, DEBT, EQUITY, AND GROSS INCOME OF SURVEY FARMS BY FARM SIZE[a]

Item	Group II	Group III	Group IV
Capital Investment:			
Real Estate	$ 7,020.45	$14,147.37	$ 47,083.33
Buildings	2,513.67	2,851.81	9,415.94
Livestock	1,711.61	3,279.88	9,598.00
Machinery	1,418.80	1,936.41	6,113.60
Total	$12,664.53	$22,215.47	$ 72,210.87
Debt:			
Real Estate	$ 331.82	$ 2,325.26	$ 4,000.00
Livestock	56.82	116.32	
Machinery	60.91	245.26	1,433.33
Miscellaneous	45.45	105.26	
Total	$ 495.00	$ 2,792.10	$ 5,433.33
Equity (per cent)	92.90	85.20	91.30
Gross Income	$ 827.00	$ 1,801.00	$ 6,567.00

[a]Since Group I farms were not to be included in the later analysis, investment, debt, equity, and income calculations were not made for this group.

Of the total indebtness, 81.6 per cent was secured on real estate, 11.8 per cent on machinery, 3.6 per cent on livestock, and 3.0 per cent was either unsecured or secured on other assets.

The basis for almost all adjustment studies is to determine changes necessary to raise farm income. Information was collected from the survey farms relative to gross farm income. Since cost data were not obtained, it was not possible to arrive at any reasonable estimate of net farm income from the existing farming systems. Gross farm income was found to range from a low of $88.00 to a high of $11,050.00 with the average for all farms being $1,719.02.

CHAPTER III

DETERMINING THE REPRESENTATIVE FARM RESOURCE SITUATION

I. INTRODUCTION

The representative farms are synthetic in that they do not present any specific operation but rather an average situation. They were determined on the basis of two factors: farm size and soil resources.

Only three of the size groups were used in the analysis. The smallest of the original four classes, 0-29.9 openland acres, was not considered. The opportunities for adjustment on these farms were considered to be relatively limited. Since any major adjustments on these small farms would likely involve an increase in acreage, the optimum systems derived for the larger size groups would be applicable. In addition, operators of these small farms were on an average 59.5 years of age and 66.7 per cent were employed one-half of the time or more in off-farm work.

II. FARM SIZE

The acreage of the representative farms were based on the mean acreage of openland on the survey farms for each size group. Elimination of the smallest size group resulted in three representative farms, one for each of the remaining size groups referred to earlier. These farms and the size groups they represent are as follows:

Farm A - 30.0 to 69.9 open acres

Farm B - 70.0 to 139.9 open acres

Farm C - 140.0 open acres and over

Since only three survey farms were included in the largest size group (140 open acres and over), information was insufficient to provide reliable estimates of average farm size of farms in this size group. Comparisons between all three of the soil associations using Fisher's F test showed that at the 95 per cent level there were no significant differences between the average farm size for each of the other size groups. On this basis, the mean acreage of the largest size group was based on the mean acreage of all the farms in the 140 acres and over category surveyed in the three soil associations. Table I, page 12, presents the mean acreage used for the representative Farms A and B. The average farm size for Farm C, using all 16 farms surveyed in the three soil associations, was 253.9 acres of openland.

III. SOIL RESOURCES

One of the primary factors affecting the efficient operation of a farm is the use of the soil resources. Farm managers need to know the types of soil resources they have at their disposal and how best to use them.

The nature of the soil resources on the three representative farms was determined on the basis of a summary of actual soils occurring on a sub-sample of approximately 50 per cent of the survey farms. Detailed soil maps were obtained for these farms from the Soil Conservation Service.

The information, with respect to soils, was summarized by farm-size groups. These soils were distributed among 19 land–capability groups. Due to the complexity of handling so many different soils in the research and since many of the groups could be put to similar management uses, the soils were recombined into seven groups with the assistance of the Agronomy Department Staff of the University of Tennessee. A description of the seven soil groups and their use suitability is shown below. Only the major soil capability groups involved are listed in the description of the soil groups.

Soil I: (Capability group I-1) Alluvial soils, little or no slope, fertile, deep and well drained, suitable for extensive row cropping.

Soil II: (Capability groups IIe-1, IIe-2) 2 to 5 per cent slope, slight to moderate erosion, deep and well drained, varying fertility, row crops one year out of two.

Soil III: (Capability group IIe-3) 5 to 12 per cent slope, slight erosion, low in natural fertility, droughty, fragipan 22 to 30 inches, row crop one year out of two.

Soil IV: (Capability group IIIe-1) Slope 5 to 12 per cent, slight to moderate erosion, moderate natural fertility, responds well to fertilization, row crops one year out of three.

Soil V: (Capability groups IVe-2, IVe-3) Slope 5 to 20 per cent, slight to severe erosion, deep and well drained,

varying natural fertility, relatively acid, responds well to fertilization, row crops not recommended for more than one year out of six.

Soil VI: (Capability groups IIIe-4, IVe-4) Slope 5 to 20 per cent, moderate to severe erosion, low in natural fertility, clay subsoil, droughty, narrow range for tilling, primarily forage crops are grown.

Soil VII: (Capability groups VIe-1, VIe-2) Slope 5 to 30 per cent, erosion moderate to severe, low in natural fertility, acid, primarily natural pasture or forest.[1]

The various soil groups were first classified by farm-size groups. A chi square test showed no significant differences at the 95 per cent level between the soil resources of the various farm-size groups. Thus, the same soil pattern was assumed for all three representative farms. The percentage distribution and the actual acres in each soil group by farm size are presented in Table VI.

IV. LABOR RESOURCES

Farms A and B were assumed to have available a one-man resident labor supply, whereas Farm C was considered to be a two-man operation.

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[1]Soil Conservation Service, United States Department of Agriculture, "Tennessee Soil Survey - Putnam County" (Washington: Government Printing Office), manuscript in process, pp. 297-362.

TABLE VI

SOIL RESOURCES FOR THE REPRESENTATIVE FARMS

Soil Group	Per Cent Open Acres	Actual Acres in the Farms		
		Farm A	Farm B	Farm C
I	14.15	6.93	12.88	35.93
II	18.34	8.98	16.69	46.57
III	6.27	3.08	5.71	15.92
IV	25.94	12.68	23.61	65.86
V	16.04	7.81	14.60	40.73
VI	9.96	4.87	9.06	25.28
VII	9.30	4.55	8.45	23.61
Total	100.00	48.90	91.00	253.90

Hours worked per day and days worked per period, in addition to labor periods, were based on such factors as seasons, labor peaks, and probable enterprise requirements. Table VII shows the hours available on the one-and two-man farms by labor periods.

TABLE VII

LABOR USE AND AVAILABILITY BY PERIODS

Labor Period	Days in Period	Days Worked in Period	Hours Per Day	Hours Operator Labor Available	
				1-Man Farm	2-Man Farm
Dec. 1-Feb. 28	90	77	8	616	1232
March 1-April 15	46	39	9	351	702
April 15-May 31	46	39	10	390	780
June 1-Aug. 15	76	65	10	650	1300
Aug. 16-Sept. 30	46	39	10	390	780
Oct. 1-Nov. 30	61	52	9	468	936
Total	365	311		2865	5730

CHAPTER IV

DETERMINATION OF THE PROGRAM MODEL

The technique used to determine the optimum farm plans was linear programming. This technique selects the combination of enterprises which will maximize net revenue,[1] given the production alternatives considered, the resource restrictions of the representative farms, and the prices and costs assumed for this analysis. The following discussion deals with the development and determination of the programming model.

I. DEVELOPMENT OF ENTERPRISE BUDGETS

An enterprise budget was developed for each production alternative considered. These budgets showed the resource requirements and the cost and returns for a given unit of each alternative. The alternatives are referred to as activities.

Enterprise

Enterprises considered as alternatives were usually limited to the major systems found on the study farms. Grade A dairy was not included as an alternative as limited markets for fluid milk in the area would preclude any general adjustment toward production of this product.

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[1] Net revenue is defined as the returns above variable and fixed costs and represents the residual return to land, labor, and management.

The following is a list of the crop activities considered: burley tobacco, corn, soybeans, oats followed by lespedeza pasture, oats followed by lespedeza hay, alfalfa hay, red clover hay, lespedeza hay, lespedeza pasture, orchardgrass-ladino clover pasture, orchardgrass-ladino clover hay and pasture, common bermudagrass pasture, and unimproved pasture.

In the orchardgrass-ladino clover hay and pasture combination, it was assumed that the early growth was cut for hay while the remaining forage production was used for pasture. Since Soil VII included land generally too steep and erosive to cultivate, use of this soil group was limited to unimproved pasture.

There were four beef cattle alternatives included in the model. All the activities were cow-calf systems with varying methods of handling the calf crop. Beef I assumes a spring calf crop that is marketed as feeder calves after weaning at 500 pounds. Beef II is similar to Beef I except the steers and heifers are assumed to be marketed as finished animals, rather than feeders. The steers are to be sold at 1000 pounds, while the heifers are placed on the market at 810 pounds. After weaning at 500 pounds, both steers and heifers are placed on a limited grain winter ration and then full fed after reaching about 700 pounds. Beef III is essentially the same as Beef II except that the steers are pastured for about 60 days following the period on the limited grain winter ration instead of being fed out immediately. Beef IV is the same as Beef I except that it assumes a fall calf crop instead of spring calves.

There were two alternative swine enterprises, both assuming the use of pasture for the sows and pigs. Swine I involves the production of feeder pigs to be sold at 40 pounds. For Swine II, it is assumed that the pigs are finished to slaughter weight of 200 pounds.

The dairy enterprise alternative involves the production of milk for manufacturing purposes, that is for the production of such products as cheese, dry milk, and evaporated milk.

The sheep enterprise was a ewe-lamb system and provided for marketing of both lambs for slaughter and wool.

In Appendix B selected budgets for various enterprise alternatives are presented.

Forage Periods

In order to insure adequate forage for the livestock throughout the grazing season, forage production and needs were determined for four different time periods. The basis for selecting the forage periods was mainly the growth patterns of the major pasture crops that were considered as alternatives. There were four periods:

Period I: March 16 - May 31

Period II: June 1 - July 31

Period III: August 1 - September 30

Period IV: October 1 - November 15

Appendix C presents, by periods, the forage production and livestock enterprise requirements of several alternatives.

Machinery

A basic set of equipment was estimated for each of the representative farms on the basis of farm size and the amounts of the various soil classes and their probable use. For those machines that were not considered economical for any or all of the three farms, custom machine hiring was allowed. The exception to this was the manure spreader. In this case, the value of manure as fertilizer was assumed to be equivalent to the cost of the machinery used to handle manure.

The cost of operating each piece of machinery was based on the expected hours of use. The expected hours of use per year were estimated for each piece of equipment on each of the representative farms. Annual useage of each machine was estimated on the basis of probable acreages of various enterprises. As farm size increased, the machine usage increased also and, thus, the cost per unit of machine time decreased.

The costs were divided into two categories:

1. variable - included repairs, depreciation, fuel, and oil;
2. fixed - included insurance, taxes, storage, and interest.[2]

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[2]Costs per hour were determined by the following formulas:
Insurance = average cost x .00325 ÷ expected hours of use.
Taxes = average cost x .0038 ÷ expected hours of use.
Interest = average cost x .06 ÷ expected hours of use.
Storage = .07 x square of storage area ÷ expected hours of use.
Total Fixed Cost per Hour = insurance + taxes + storage interest.
Depreciation = annual depreciation amount ÷ expected hours of use, or total depreciable amount ÷ expected life in hours. The largest of the two costs was used.
Repairs = a given percentage of the new cost ÷ expected hours of use.
Total Variable Cost per Hour = depreciation + repairs + fuel and oil.

The cost of the machines was reflected directly in the revenue of the various enterprises that required their use. Enterprise machinery requirements were adapted from Tennessee Bulletin 316.[3] The expected hours of use for machinery and the cost of operation by farm size are shown in Tables VIII and IX, respectively.

Input - Output Data

Crop yields for each of the soils on the representative farms were based on estimates under "good"management as shown in the Putnam County Soil Survey. Estimated yield levels for each of the soil groups were based on weighted averages of yield levels shown for the particular soils in the respective soil groups. Estimated yields for the various crops are presented for each soil group in Table X. Additional details regarding input-output relationships for crop activities are shown in Table XI of a following section and in individual crop budgets in Appendix B.

Input-output data for each of the livestock alternatives were derived from various published research data and with the assistance of livestock production specialists of the University of Tennessee. Resource requirements for the restrictive resources for the major livestock alternatives are shown in Table XI of a following section. Individual livestock budgets are presented in Appendix B.

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[3]W. P. Ranney, Labor Requirements on Tennessee Farms. (Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, Bulletin No. 316, September, 1960).

TABLE VIII

ESTIMATED HOURS OF USE OF MACHINES BY FARM SIZE

Machine	Description	Estimated Hours of Use		
		Farm A	Farm B	Farm C
Tractor	3 plow			650
Tractor	2 plow		600	
Tractor	1 plow	250		700
Baler	p.t.o.	a	16	75
Corn Picker	1 row	a	a	85
Plow	3 bottom			140
Plow	2 bottom		67	
Plow	1 bottom	44		
Fertilizer Distributer	8 foot	25	45	100
Disc	8 foot	25	45	100
Cultipacker	10 foot	25	45	100
Harrow	3 section	25	45	100
Cultivator	2 row	18	36	72
Mower	7 foot	45	90	225
Sprayer	2 row	a	24	45
Rake	side delivery	30	60	150
Elevator	18 foot-grain	30	50	75
Wagon	8 x 14 foot	50	100	150
Corn Planter	2 row	a	18	45
Grain Drill	8 foot	a	a	75
Tobacco Setter	1 row	a	16	24

[a]Machine was assumed to be custom hired on this particular size of farm.

TABLE IX

ESTIMATED TOTAL OPERATING COST PER HOUR
OF MACHINERY BY FARM SIZE

Machine	Description	Estimated Total Cost Per Hour		
		Farm A	Farm B	Farm C
Tractor	3 plow	$	$	$1.39
Tractor	2 plow		1.04	
Tractor	1 plow	0.88		0.62
Baler	p.t.o.	a	5.93	2.94
Corn Picker	1 row	a	a	1.85
Plow	3 bottom			0.51
Plow	2 bottom		0.50	
Plow	1 bottom	0.42		
Fertilizer Distributer	8 foot	0.87	0.51	0.33
Disc	8 foot	1.50	0.86	0.42
Cultipacker	10 foot	0.81	0.47	0.23
Harrow	3 section	0.51	0.29	0.14
Cultivator	2 row	1.52	0.74	0.41
Mower	7 foot	1.04	0.59	0.37
Sprayer	2 row	a	1.61	0.88
Rake	side delivery	1.33	0.73	0.44
Elevator	18 foot-grain	1.24	0.76	0.52
Wagon	8 x 14 foot	0.55	0.29	0.20
Corn Planter	2 row	a	1.44	0.62
Grain Drill	8 foot	a	a	1.14
Tobacco Setter	1 row	a	1.55	1.04

[a]Machine was assumed to be custom hired on this particular size of farm.

TABLE X

ESTIMATED YIELDS OF SELECTED CROPS BY SOIL GROUPS

Soil Group	Corn (bu.)	Tobacco (lbs.)	Alfalfa (tons)	Oats (bu.)	Lespedeza (tons)	Pasture (cad)[a]
Soil Group I	90.2	2130.6	2.8	52.1	2.2	184.8
Soil Group II	68.4	1994.3	2.8	57.9	1.6	144.3
Soil Group III	59.3	1805.3	2.0	50.0	1.4	134.3
Soil Group IV	55.5	1574.0	2.9	51.5	1.2	128.6
Soil Group V	37.6	1234.3	2.2	39.8	0.8	104.2
Soil Group VI	44.5	1452.1	2.5	47.5	1.0	123.5
Soil Group VII	49.9	--	1.4	27.7	0.5	76.5

[a]cad = cow acre day or the forage production equivalent to 15 pounds of total digestible nutrients.

Prices

A partial list of the prices for farm inputs and crop and livestock products is shown in Appendix A. These prices are assumed to be expected average prices over the next 10-15 year period. Prices and costs are based on the assumption that present governmental control programs will continue in effect.

II. SPECIAL PROGRAM FEATURES

Row Crop Soil Use

The row crop land available was limited on the basis of a percentage of the years that row crops could be raised on a particular soil and maintain soil erosion within tolerable limits. Thus, on a soil group for which erosion hazards necessitated row cropping no more than one year out of three, only 33.3 per cent of the total acreage of that soil group was available for row crop production.

Hired Labor

To permit farmers to hire labor during peak periods for specific jobs, a hired labor transfer activity was established. Hired labor was restricted to specific crop operations, such as baling hay, stripping tobacco, or grain storage. No hired labor was allowed for livestock labor needs. Hired labor was allowed only in periods III through VI. Since seasonal labor was priced at $0.75 per hour, labor would be hired only if resident labor was exhausted for one of the above periods. Thus, labor used for a particular period could exceed that available from resident farm labor only if it was profitable to hire labor.

Forage

Delayed grazing is a relatively common practice on many farms as a method of more nearly balancing the pasture forage supply with forage needs for livestock. As indicated earlier, forage production was determined on the basis of growth periods. In the programming, delayed grazing was provided for by "forage transfer activities." Forage produced in Period I or Period II could be "transferred" into the following period at 90 per cent of its original feed value. Forage grown in Period III could be "transferred" into Period IV at 80 per cent of its original feed value.

Grain

Corn and oats may be alternated to some extent in livestock rations at an approximate one to two ratio. In the programming a transfer activity allowed for substitution of oats for corn in the ration at a ratio of two bushels of oats for one bushel of corn.

Operating Capital

The annual requirement of operating capital was estimated for each enterprise included as a production alternative. The cost of this capital was assumed to be 6 per cent per year. When operating capital was required for a period of less than 12 months, capital charge was computed only for the period the capital was actually used.

Purchased Land

Optimum farm organization was estimated first for three representative farms with fixed land. In subsequent analysis, size of farm

was considered to be variable. Farm A and B were reprogrammed, assuming a one-man resident labor supply, with the same production alternatives except for the inclusion of an activity which allowed the purchase of additional land. Farm C, with two-man resident labor supply, was also reprogrammed with the addition of the land purchase activity. The land value was assumed to be $200.00 per openland acre. The annual cost of the purchased land was determined on the basis of a charge of 6 per cent interest on the value of the purchased land. The same soil distribution as the original land was assumed to be purchased.

Burley Tobacco

Tobacco allotment levels for each size farm were restricted to the average allotment acreage of the study farms in the respective farm groups. Allotment levels were fixed at 0.21 acres, 0.37 acres, and 0.32 acres, respectively, for Farms A, B, and C.

Capital Investment

The investment needs for each alternative were estimated on an average value. For the purpose of this study, investment capital was assumed to be unlimited and was charged at an annual rate of 6 per cent.

Sign of the Coefficient

In the programming matrix shown in Table XI, the sign on the coefficient indicates whether the resource restriction was being used or supplied. A negative sign on the coefficient meant that restricted resource was being supplied as on intermediate products. For example, corn output with a negative coefficient indicates corn is supplied to

TABLE XI

SAMPLE OF THE PROGRAM MATRIX

Resource	Resource Level	Unit	Swine II (12 sows)	Beef III (25 cows)	Dairy (10 cows)
Soil Group I	12.9	acres			
Soil Group II	16.7	acres			
Row Crop II	8.3	acres			
Soil Group III	5.7	acres			
Row Crop III	2.9	acres			
Soil Group IV	23.6	acres	10.7		
Row Crop IV	7.9	acres			
Soil Group V	14.6	acres			
Soil Group VI	9.1	acres	5.3		
Soil Group VII	8.4	acres			
Labor Period I	616.0	hours	184.8	180.5	258.5
Labor Period II	351.0	hours	98.4	98.5	121.3
Labor Period III	390.0	hours	78.4	19.6	91.9
Labor Period IV	650.0	hours	154.7	39.3	152.8
Labor Period V	390.0	hours	98.3	26.5	91.7
Labor Period VI	468.0	hours	107.6	73.5	154.1
Hire Labor III		hours			
Hire Labor IV		hours			
Hire Labor V		hours			
Hire Labor VI		hours			
Corn		bushels	2224.3	469.4	228.3
Oats		bushels			59.0
Hay		tons		51.1	18.9
Forage Period I		c.a.d.		2664.0	893.0
Forage Period II		c.a.d.		1972.0	716.0
Forage Period III		c.a.d.		1708.0	716.0
Forage Period IV		c.a.d.		1288.0	541.0
Operating Capital	unlimited	$	776.9	77.8	28.3
Investment Capital	unlimited	$	2382.8	7288.0	2343.5
Revenue		$	3707.8	3336.7	1964.9

TABLE XI (CONTINUED)

Resources	Resource Level	Unit	Sheep (25 ewes)	Tobacco (one acre)	Corn (one acre)
Soil Group I	12.9	acres		1.0	
Soil Group II	16.7	acres			1.0
Row Crop II	8.3	acres			1.0
Soil Group III	5.7	acres			
Row Crop III	2.9	acres			
Soil Group IV	23.6	acres			
Row Crop IV	7.6	acres			
Soil Group V	14.6	acres			
Soil Group VI	9.1	acres			
Soil Group VII	8.4	acres			
Labor Period I	616.0	hours	115.0	10.0	
Labor Period II	351.0	hours	28.3	32.0	2.5
Labor Period III	390.0	hours	25.4	30.2	1.7
Labor Period IV	650.0	hours	15.8	46.4	0.6
Labor Period V	390.0	hours	9.4	88.0	
Labor Period VI	468.00	hours	22.1	154.8	2.1
Hire Labor III		hours		-16.0	
Hire Labor IV		hours		-20.0	
Hire Labor V		hours		-44.0	
Hire Labor VI		hours		-77.4	
Corn		bushels	37.3		-68.0
Oats		bushels	7.5		
Hay		tons	4.3		
Forage Period I		c.a.d.	464.0		
Forage Period II		c.a.d.	372.0		
Forage Period III		c.a.d.	372.0		
Forage Period IV		c.a.d.	281.0		
Operating Capital	unlimited	$	7.0	168.9	20.2
Investment Capital	unlimited	$	911.9	1,148.7	30.9
Revenue		$	521.5	1,146.7	-42.9

TABLE XI (CONTINUED)

Resource	Resource Level	Unit	Oats - Lespedeza Pasture (one acre)	Common Bermuda-grass Pasture (one acre)	Red Clover Hay (one acre)
Soil Group I	12.9	acres			
Soil Group II	16.7	acres			
Row Crop II	8.3	acres			
Soil Group III	5.7	acres	1.0		
Row Crop III	2.9	acres			
Soil Group IV	23.6	acres			1.0
Row Crop IV	7.9	acres			
Soil Group V	14.6	acres		1.0	
Soil Group VI	9.1	acres			
Soil Group VII	8.4	acres			
Labor Period I	616.0	hours	1.1		1.1
Labor Period II	351.0	hours	0.5	1.5	
Labor Period III	390.0	hours		0.1	
Labor Period IV	650.0	hours	3.5	0.7	5.3
Labor Period V	390.0	hours	3.0	0.7	3.5
Labor Period VI	468.0	hours			
Hire Labor III		hours			
Hire Labor IV		hours	-0.8		-1.4
Hire Labor V		hours			-0.8
Hire Labor VI		hours			
Corn		bushels			
Oats		bushels	-50.0		
Hay		tons		-0.1	-2.2
Forage Period I		c.a.d.		-43.0	
Forage Period II		c.a.d.	-19.0	-42.0	
Forage Period III		c.a.d.	-17.0	-33.0	
Forage Period IV		c.a.d.	-4.0	-10.0	
Operating Capital	unlimited	$	30.2	29.7	23.0
Investment Capital	unlimited	$	36.7	9.4	57.4
Revenue		$	-25.2	-30.5	-27.5

TABLE XI (CONTINUED)

Resource	Resource Level	Unit	Orchardgrass-ladino Clover Hay and Pasture (one acre)	Unimproved Pasture (one acre)	Operating Capital
Soil Group I	12.9	acres			
Soil Group II	16.7	acres			
Row Crop II	8.3	acres			
Soil Group III	5.7	acres			
Row Crop III	2.9	acres			
Soil Group IV	23.6	acres			
Row Crop IV	7.9	acres			
Soil Group V	14.6	acres			
Soil Group VI	9.1	acres	1.0		
Soil Group VII	8.4	acres		1.0	
Labor Period I	616.0	hours	1.1	2.0	
Labor Period II	351.0	hours			
Labor Period III	390.0	hours	2.8		
Labor Period IV	650.0	hours	0.7		
Labor Period V	390.0	hours	0.2		
Labor Period VI	468.0	hours			
Hire Labor III		hours	-1.0		
Hire Labor IV		hours			
Hire Labor V		hours			
Hire Labor VI		hours			
Corn		bushels			
Oats		bushels			
Hay		tons	-1.0	-0.1	
Forage Period I		c.a.d.		-27.0	
Forage Period II		c.a.d.	-32.0	-17.0	
Forage Period III		c.a.d.	-16.0	-8.0	
Forage Period IV		c.a.d.	-11.0	-6.0	
Operating Capital	unlimited	$	16.9	3.5	-100.0
Investment Capital	unlimited	$	28.1		
Revenue		$	-19.1	-3.5	-6.0

TABLE XI (CONTINUED)

Resource	Resource Level	Unit	Transfer Forage II - III	Buy Oats (one bushel)	Transfer Oats to Corn
Soil Group I	12.9	acres			
Soil Group II	16.7	acres			
Row Crop II	8.3	acres			
Soil Group III	5.7	acres			
Row Crop III	2.9	acres			
Soil Group IV	23.6	acres			
Row Crop IV	7.9	acres			
Soil Group V	14.6	acres			
Soil Group VI	9.1	acres			
Soil Group VII	8.4	acres			
Labor Period I	616.0	hours			
Labor Period II	351.0	hours			
Labor Period III	390.0	hours			
Labor Period IV	650.0	hours			
Labor Period V	390.0	hours			
Labor Period VI	468.0	hours			
Hire Labor III		hours			
Hire Labor IV		hours			
Hire Labor V		hours			
Hire Labor VI		hours			
Corn		bushels			1.0
Oats		bushels		1.0	-2.0
Hay		tons			
Forage Period I		c.a.d.			
Forage Period II		c.a.d.	-1.0		
Forage Period III		c.a.d.	0.0		
Forage Period IV		c.a.d.			
Operating Capital	unlimited	$		0.8	
Investment Capital	unlimited	$			
Revenue		$		-0.8	

TABLE XI (CONTINUED)

Resource	Resource Level	Unit	Hire Labor Period III (one hour)	Purchase Land (ten acres)
Soil Group I	12.9	acres		-1.4
Soil Group II	16.7	acres		-1.9
Row Crop II	8.3	acres		-0.9
Soil Group III	5.7	acres		-0.6
Row Crop III	2.9	acres		-0.3
Soil Group IV	23.6	acres		-2.6
Row Crop IV	7.9	acres		-0.9
Soil Group V	14.6	acres		-1.6
Soil Group VI	9.1	acres		-1.0
Soil Group VII	8.4	acres		-0.9
Labor Period I	616.0	hours		
Labor Period II	351.0	hours		
Labor Period III	390.0	hours	-1.0	
Labor Period IV	650.0	hours		
Labor Period V	390.0	hours		
Labor Period VI	468.0	hours		
Hire Labor III		hours	1.0	
Hire Labor IV		hours		
Hire Labor V		hours		
Hire Labor VI		hours		
Corn		bushels		
Oats		bushels		
Hay		tons		
Forage Period I		c.a.d.		
Forage Period II		c.a.d.		
Forage Period III		c.a.d.		
Forage Period IV		c.a.d.		
Operating Capital	unlimited	$	0.8	
Investment Capital	unlimited	$		2000.0
Revenue		$	-0.8	-120.0

the corn restriction from the enterprises, while the corn requirement for livestock enterprises will be shown as a positive coefficient.

Revenue

The objective of the program is to maximize the net revenue. Only activities from which products are marketed show a positive coefficient. Activities such as pasture and hay, which show a negative coefficient for revenue, are treated as an intermediate product. In this case, the numerical value of the revenue coefficient indicates the cost of production of a unit of the activity, rather than an actual revenue.

III. SAMPLE PROGRAM MATRIX

For illustrative purposes a portion of the program matrix is shown in Table XI. Included in this matrix are the various transfer activities explained above.

CHAPTER V

PROGRAMMING RESULTS

Optimum farm plans for each of the representative farms were determined by linear programming techniques and were processed by the IBM 1620 Digital Computer. As previously discussed, five optimum farm plans are presented. The optimum plan for each of the three representative farms with fixed land acreage are presented in the following section. In a later section of this chapter the optimum farm plans for the one- and two-man labor force with farm-size variable are presented.

I. OPTIMUM PLANS FOR REPRESENTATIVE FARMS

Each farm plan is discussed in detail separately. The results of the programming are presented in Tables XII, XIII, and XIV. The basic plans are shown without any adjustments. For example, livestock numbers are shown in fractional quantities even though as a matter of practical application an individual farmer would adjust the plan to whole numbers.

Farm A

This farm plan is based on 48.9 acres of openland with one man resident labor supply.

All available openland was utilized for the optimum plan for Farm A. All allowable row crop land was planted in corn with exception of the 0.21 acres of tobacco allotment. The pasture needs were met by a

TABLE XII

LIVESTOCK NUMBERS AND ACRES OF CROPS IN THE BASIC OPTIMUM FARM PLANS

Enterprise	Unit	Farm A	Farm B	Farm C
Land	Acres	48.90	91.00	253.90
Dairy	Cows	7.00	13.10	11.60
Beef	Cows	--	--	11.70
Swine	Sows	5.80	10.80	37.00
Tobacco	Acres	0.21	0.37	0.32
Corn	Acres	16.90	31.60	88.80
Oats[a]	Acres	--	--	31.30
Lespedeza Pasture[a]	Acres	--	--	18.80
Lespedeaz Hay[a]	Acres	--	--	12.50
Orchardgrass-ladino Clover Pasture	Acres	17.10	24.60	85.10
Orchardgrass-ladino Clover Hay and Pasture	Acres	8.60	18.70	24.80
Common Bermudagrass Pasture	Acres	1.50	7.20	--
Unimproved Pasture	Acres	4.60	8.50	23.60

[a]Oats were followed by either annual lespedeza pasture or hay.

TABLE XIII

NET AND GROSS INCOME, CAPITAL INVESTMENT, AND OPERATING CAPITAL OF THE BASIC OPTIMUM FARM PLANS

	Farm A	Farm B	Farm C
Net Income	$ 2,102.18	$ 4,003.40	$ 9,997.94
Gross Income	3,427.10	9,414.60	23,630.30
Operating Capital	1,148.37	2,127.52	5,956.41
Capital Investment			
Buildings	1,813.76	3,376.37	7,408.90
Livestock	1,179.20	2,217.27	6,363.48
Machinery	957.32	1,726.43	4,351.91
Total	$ 3,950.28	$ 7,320.07	$ 18,124.29

TABLE XIV

HOURS OF RESIDENT LABOR USE AND AVAILABILITY BY LABOR PERIODS FOR THE BASIC OPTIMUM FARM PLANS

Labor Period	One-Man			Two-Man	
	Hours Available	Farm A Hours Used	Farm B Hours Used	Hours Available	Farm C Hours Used
I	616.0	300.2	558.4	1232.0	1114.8
II	351.0	293.8	349.6	702.0	702.0
III	390.0	133.4	316.0	780.0	601.7
IV	650.0	224.3	409.5	1300.0	944.2
V	390.0	140.5	259.6	780.0	635.4
VI	468.0	227.4	422.8	936.0	931.4
Total	2865.0	1319.6	2315.9	5730.0	4929.5

combination of orchardgrass-ladino clover pasture, common bermudagrass, and unimproved pasture. The spring growth of some of the orchardgrass-ladino clover pasture was cut for hay and provided the hay needed for the livestock.

Dairy cattle producing milk for manufacturing purposes and Swine II constituted the livestock of the optimum farm plan. The programming solution included 7.0 milk cows and 5.8 sows. A total of 88 slaughter hogs weighing 200 pounds each and 52,500 pounds of milk would be sold. Forty-one bushels of oats were purchased for use in feeding the dairy animals. Since corn was not allowed to be purchased, the swine enterprise was limited by the maximum acreage available for corn production. The only other product marketed was the 419 pounds of burley tobacco produced on the 0.21 acres of tobacco allotment acreage allowed.

Since the labor available was not completely used in any of the six labor periods, no labor was hired.

The estimated net revenue or returns to land, labor, and management was $2,102.18. This plan would require a capital investment of $3,950.28, with 24.2 per cent invested in machinery, 45.9 per cent in buildings, and 29.9 per cent invested in livestock. In addition, this system would require $1,148.37 of annual operating capital.

Farm B

The optimum plan for Farm B assumed 91.0 acres of openland distributed among the soil groups in the manner shown in Table VI. Resident labor supply was limited to one full-time man.

Soil resources were fully used. Row crop lands were used to produce 0.37 acres of tobacco and 31.6 acres of corn. The hay production of 18.1 tons was cut from the early growth of 18.7 acres of orchardgrass-ladino clover pasture and hay enterprise. Orchardgrass-ladino clover, common bermudagrass, and unimproved pasture provided all the necessary pasture requirements for the livestock. There were 788.1 pounds of tobacco produced for marketing.

The optimum plan for Farm B included 13.1 dairy cows and 10.8 sows. The dairy cows would produce a total of 98,250 pounds of milk for manufacturing purposes. The sows would produce 162.9 slaughter hogs for market. As in the plan for Farm A, swine were limited by the available row crop land for corn production. The oat requirement for dairy animals necessitated the purchase of 77.5 bushels of oats.

The labor available from the resident supply was adequate for each of the six labor periods and, thus, no labor would need to be hired.

Estimated net revenue for the optimum plan for Farm B was $4,003.40. Estimated capital investment, exclusive of land, totaled $7,320.07. Of this investment, 23.6 per cent was invested in machinery, 30.3 per cent in livestock, and 46.1 per cent invested in buildings. A total of $2,127.52 of annual operating capital would be required.

It should be noted that the optimum plan for Farm B is very similar in organization to the plan for Farm A. The production of hogs, milk, corn, hay, and pasture forage are approximately in the same proportion to total acreage on both Farm A and Farm B.

Farm C

Resources available on Farm C include 253.9 acres of openland and a two-man resident labor force.

The entire tobacco allotment of 0.32 acres was included in the optimum plan along with 88.8 acres of corn on the remaining allowable row crop land. A total of 31.3 acres of oats were included in the plan for Farm C. The oats would be used for feeding dairy animals and as a partial substitute for corn in animal grain rations. The lespedeza following oats was used for hay and pasture. The remaining hay was produced by the orchardgrass-ladino clover hay and pasture activity. Pasture requirements were met by orchardgrass-ladino clover pasture, lespedeza, and unimproved pasture.

This plan included 11.6 head of dairy cows and 11.7 head of beef cows using Beef III alternative. The swine enterprise included 37.0 sows and 551.6 hogs sold for slaughter purposes.

All labor periods had surplus resident labor, except Period II. Since hired labor was allowed only for Periods III-VI, labor became restrictive to any activity requiring labor in Period II.

This plan would provide an estimated net revenue of $9,997.94. A total of $18,124.29 of investment capital, other than land, and $5,956.41 of operating capital would be required for the plan. Machinery accounted for 24.0 per cent of the capital investment, while livestock required 35.1 per cent, and the remaining 40.9 per cent would be invested in buildings.

II. VARIABLE LAND OPTIMUM FARM PLANS

These plans were based on one-and two-man resident labor supply and allowed the land to be variable. This was done to permit the technique to determine the optimum size, in terms of acreage, of one-and two-man farms. Tables XV, XVI, and XVII present the results of these two programs.

One-man Farm

The optimum program for the one-man farm with acreage variable included 137.8 acres of openland. This is in contrast to the 48.9 acres of land available on Farm A and the 91.0 acres available on Farm B, each with one-man labor supply.

Corn would be raised on 48.0 acres of the row crop land with the tobacco allotment of 0.37 acres planted on the remaining available row crop land. All of the 733 bushels of oats produced on the 12.6 acres would be substituted for corn in the animal grain rations. The lespedeza following oats was used for hay and pasture. Additional hay requirements would be supplied by hay harvested from the orchardgrass-ladino clover hay and pasture enterprise. The optimum plan included 38.0 acres of orchardgrass-ladino clover (used for hay and pasture) and 12.8 acres of unimproved pasture to be used for the beef animals. An additional 26.0 acres of orchardgrass-ladino clover pasture would be available for swine pasture.

Beef III and Swine II were the two livestock systems used on the farm. No dairy animals were included in the optimum plan. The beef unit

TABLE XV

LIVESTOCK NUMBERS AND ACRES OF CROPS IN THE OPTIMUM PLANS FOR THE ONE- AND TWO-MAN LABOR FARMS

Enterprise	Unit	One-Man Farm	Two-Man Farm
Land	Acres	137.8	313.1
Beef	Cows	13.4	28.9
Swine	Sows	19.5	43.6
Tobacco	Acres	0.37	0.32
Corn	Acres	48.0	89.5
Oats[a]	Acres	12.6	64.1
Lespedeza Pasture[a]	Acres	6.1	36.1
Lespedeza Hay[a]	Acres	6.5	28.0
Orchardgrass-ladino Clover Pasture	Acres	48.6	108.9
Orchardgrass-ladino Clover Hay and Pasture	Acres	15.4	21.2
Unimproved Pasture	Acres	12.8	29.1

[a]Oats were followed by either annual lespedeza pasture or hay.

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TABLE XVI

NET AND GROSS INCOME, CAPITAL INVESTMENT, AND OPERATING CAPITAL IN THE OPTIMUM PLANS FOR ONE- AND TWO-MAN LABOR FARMS

	One-Man Farm	Two-Man Farm
Net Income	$ 4,348.41	$10,272.95
Gross Income	12,090.30	26,631.80
Operating Capital	3,354.89	7,549.10
Capital Investment		
Buildings	3,746.65	7,824.79
Livestock	4,404.29	9,596.99
Machinery	2,799.31	5,387.65
Additional Land	9,358.00[a]	11,824.00
Total	$20,308.25	$34,633.43

[a]This is the capital required to purchase additional land assuming that Farm B is the base farm for this optimum plan.

TABLE XVII

HOURS OF RESIDENT LABOR AVAILABLE AND USED BY LABOR PERIODS IN THE OPTIMUM PLANS ON THE ONE- AND TWO-MAN LABOR FARMS

Labor Period	One-man Farm		Two-man Farm	
	Hours Available	Hours Used	Hours Available	Hours Used
I	616.0	482.3	1232.0	1092.0
II	351.0	351.0	702.0	702.0
III	390.0	276.0	780.0	542.8
IV	650.0	409.1	1300.0	1041.7
V	390.0	287.4	780.0	780.0
VI	468.0	372.5	936.0	865.8
Total	2865.0	2178.3	5730.0	5024.3

included 13.4 brood cows and would involve selling 3.8 heifers and 5.9 steers at slaughter weight.

Surplus labor from the resident supply existed in all periods except Period II. Thus, no labor was hired.

Estimated net revenue under this system was $4,348.41. The system would require $20,308.25 of capital investment and $3,354.89 of annual operating capital. Capital investment (exclusive of the amount invested in additional purchased land) would be divided between machinery requiring 25.6 per cent of the investment, buildings 34.2 per cent, and livestock 40.2 per cent.

Two-man Farm

The optimum size for the two-man farm was estimated to be 313.1 open acres. This was in contrast to 253.9 acres of fixed land base for Farm C which also had a two-man resident labor supply.

The plan included 0.32 acres of tobacco, 89.5 acres of corn, and 64.1 acres of oats followed by either annual lespedeza hay or pasture. This was the only plan which did not use the maximum row crop land available leaving a surplus of 2.5 acres of row crop land unused. Oats would be substituted for corn in the livestock rations. Pasture supply included orchardgrass-ladino clover pasture and unimproved pasture in addition to that acquired from lespedeza and the orchardgrass-ladino clover hay and pasture activity (21.2 acres).

Beef III and Swine II with 28.9 brood cows and 43.6 sows would be the livestock systems.

Except for Period II, all labor periods had a surplus of resident labor; therefore no labor would have to be hired.

The gross revenue totaled $26,631.80, while estimated net revenue would be $10,272.95. There would be 34.3 per cent of capital invested in buildings (exclusive of the investment in additional land), 42.1 per cent invested in livestock, and 23.6 per cent of investment in machinery. The total capital investment including the additional land investment would be $34,633.43.

CHAPTER VI

ADJUSTMENT OPPORTUNITIES AND NEEDS

This chapter will discuss the direction and the magnitude of the changes necessary to reach the level of income estimated for the optimum farm plans. The following section will deal with adjustments necessary assuming farm acreage is fixed at the levels used for the representative farms. Thus, in this case, adjustments will not involve expanding the land base of the farms. In the latter section of the chapter, the discussion will deal with adjustments assuming farm size can also be varied.

I. ADJUSTMENTS OF THE REPRESENTATIVE FARMS WITH FIXED LAND

Farm A

A comparison of the optimum plans for Farm A and the existing situation for the size group represented by Farm A is presented in Table XVIII.

The mean gross revenue for the survey farms of this size group was $827.00, which is $2,600.10 below that of the optimum farm plan for Farm A. To achieve this difference, certain organizational changes must be made.

Swine enterprises under the existing farm organization were primarily feeder pigs, whereas the optimum plan includes only slaughter hogs. The number of sows would be increased from 0.9 to 5.8.

TABLE XVIII

COMPARISONS OF OPTIMUM PLAN FOR FARM A WITH AVERAGE OF EXISTING SITUATION ON SIZE GROUP II

Item	Unit	Optimum Situation	Existing Situation
Land	acres	48.90	48.90
Enterprises:			
Beef	cows		1.40
Dairy	cows	7.00	3.20
Swine	sows	5.80	0.90
Tobacco	acres	0.21	0.21
Corn	acres	16.90	5.80
Oats	acres		0.60
Lespedeza Hay	acres		1.00
Alfalfa Hay	acres		0.60
Orchardgrass-ladino Clover Pasture	acres	17.10	a
Orchardgrass-ladino Clover Hay and Pasture	acres	8.60	
Grass Hay	acres		7.00
Common Bermudagrass Pasture	acres	1.50	
Unimproved Pasture	acres	4.60	
Capital Investment:			
Buildings	$	1,813.76	2,513.67
Livestock	$	1,179.20	1,711.61[b]
Machinery	$	957.32	1,418.80
Total Capital Investment	$	3,950.28	5,644.08
Gross Income	$	3,427.10	827.00

[a]The average total acreage of pasture on the existing farms was 18.5 acres. It was not possible to distinguish between the various types of pasture from the survey data for any of the size groups.

[b]Livestock investment on the existing farms includes all types of livestock, whereas only breeding stock was included in the optimum livestock investment figure.

The survey farms in the size group represented by Farm A reported an average of 3.2 dairy cows and 1.4 beef cows, while the optimum plan for Farm A included 7.0 dairy cows and no beef animals. Production rates of dairy cows assumed for the optimum plan would also be considerably higher than under the existing situation.

Corn acreage would be increased from 5.8 to 16.9 to meet the needs of the increased numbers of dairy animals and hogs. On the average, the existing farms had fewer animals but had approximately the same pasture acreage as the optimum farm plan. Total hay acreage would remain relatively the same, but all hay would be produced from orchardgrass-ladino clover pasture and hay in the optimum plan.

The existing farm organization has to undergo several changes to reach levels of income equal to the optimum. First, dairy cow and sow numbers must be increased and emphasis should be placed on producing milk for manufacturing purposes and slaughter hogs. Secondly, land use must be intensified to produce more corn to met the larger needs of livestock for grain. In this same respect, there are some land resources that are not being used that could be placed in production. Some additional investment capital would likely be necessary for adding hog facilities, purchasing of improved breeding stock, and the improvement of pasture and hay land. Annual operating capital would likely be considerably higher for the optimum system.

Farm B

Table XIX presents the basic relationships that exist between the existing situation on the average for the 70 to 140 acre size group and

TABLE XIX

COMPARISONS OF OPTIMUM PLAN FOR FARM B WITH AVERAGE OF EXISTING SITUATION ON SIZE GROUP III

Item	Unit	Optimum Situation	Existing Situation
Land	acres	91.00	91.00
Enterprises:			
Beef	cows		2.70
Dairy	cows	13.10	4.60
Swine	sows	10.80	2.60
Tobacco	acres	0.37	0.37
Corn	acres	31.60	15.10
Oats	acres		1.00
Lespedeza Hay	acres		1.20
Alfalfa Hay	acres		1.20
Orchardgrass-ladino Clover Pasture	acres	24.60	a
Orchardgrass-ladino Clover Hay and Pasture	acres	18.70	
Grass Hay	acres		13.50
Common Bermudagrass Pasture	acres	7.20	
Unimproved Pasture	acres	8.50	
Capital Investment:			
Buildings	$	3,376.37	2,851.81
Livestock	$	2,217.27	3,279.88[b]
Machinery	$	1,726.43	1,936.41
Total Capital Investment	$	7,320.07	8,068.10
Gross Income	$	9,414.60	1,801.00

[a]Total average pasture acreage for the existing situation was 35.2 acres. (Refer to Table XVIII, footnote a.)

[b]Refer to footnote b, Table XVIII.

the optimum farm plan for Farm B, the representative farm for this size group.

The gross revenue of the optimum plan exceeds that of the average for the group under the existing situation by $7,613.60. Most of the income would be a result of the increased sale of milk and slaughter hogs.

Ruminant type livestock numbers would be increased by 5.8 and all animals would be dairy rather than beef and dairy combination. Instead of raising feeder pigs, the optimum plans involved producing hogs for the slaughter market. Sow numbers would be increased from 2.6 to 10.8.

To provide for the increased grain requirements, corn acreage would be increased to approximately twice its present level, from 15.1 acres to 31.6 acres. Pasture acreage would be larger than that under the existing farm situation. Some of this increased acreage would be used, to some extent, for hay production. While the pasture under the present organization was primarily orchardgrass or fescue, some of the pasture included in the optimum program is common bermudagrass. The hay production would be supplied by the orchardgrass-ladino clover hay and pasture activity, thus replacing the alfalfa and lespedeza that was raised on the existing farms.

The actual investment capital required, exclusive of land, would be slightly less for the optimum plan for Farm B than under the average of existing situations. However, some additional investment capital would likely be needed in converting to the new plan for expanding livestock numbers, remodeling or adding building facilities suitable for the dairy and hogs, and for improvement of forage stands.

The necessary changes to reach optimum are similar to Farm A. Essentially adjustment requires a minor change in ruminant livestock numbers and types. The swine enterprise would not only be expanded, but production would be shifted from feeder pigs to slaughter hogs. Capital investment would require some reorganization and expansion to provide for livestock and crop changes. The intensifying of land use and shifting of some crop acreages completes the organizational adjustment needed to reach the optimum plan.

Farm C

The data presented in Table XX compares the organization under the existing situations and the optimum plan for Farm C. As was the case in previous groups discussed, a significant increase in gross revenue would be realized under the optimum farm plan.

The livestock systems of these two situations would be considerably different, with the exception that number of dairy cows which would remain about the same. Beef cow numbers would be reduced from 32.3 to 11.7 and the system of handling them would be different. The majority of beef cattle were marketed as feeder calves under the existing situation. However, the optimum plan assumes that heifers and steers would be sold as finished animals at 810 and 1000 pounds, respectively, for slaughter. The number of sows would be increased from 2.0 to 37.0 and the offspring marketed at slaughter weight rather than as feeders at weaning.

Existing crop land use was much less intensive than the optimum plan. The optimum plan includes 88.8 acres of corn and 31.3 acres of oats as compared to an average of 13.3 acres of corn and 12.3 acres of

TABLE XX

COMPARISONS OF OPTIMUM PLAN FOR FARM C WITH AVERAGE OF EXISTING SITUATION ON SIZE GROUP IV

Item	Unit	Optimum Situation	Existing Situation
Land	acres	253.9	253.9
Enterprises:			
Beef	cows	11.70	32.30
Dairy	cows	11.60	11.30
Swine	sows	37.00	2.00
Tobacco	acres	0.32	0.32
Corn	acres	88.80	13.30
Oats	acres	31.30[a]	12.30
Lespedeza Pasture	acres	18.80[a]	
Lespedeza Hay	acres	12.40[a]	5.00
Orchardgrass-ladino Clover Pasture	acres	85.10	b
Orchardgrass-ladino Clover Hay and Pasture	acres	24.80	
Grass Hay	acres		55.70
Unimproved Pasture	acres	23.60	
Capital Investment:			
Buildings	$	7,408.90	9,415.94
Livestock	$	6,363.48	9,598.00[c]
Machinery	$	4,351.91	6,113.60
Total Capital Investment	$	18,124.29	25,127.54
Gross Income	$	23,630.30	6,567.00

[a]Oats under the optimum plan were followed by either annual lespedeza hay or pasture.

[b]Total average pasture acreage on the existing farms was 153.10 acres. (Refer to footnote a, Table XVIII.

[c]Refer to footnote b, Table XVIII.

oats under existing systems. Oats would be double cropped with annual lespedeza to be used for either hay or pasture. Since forage consuming livestock would be reduced and the pasture and production rates would be increased, less acreage would be devoted to forage production in the optimum plan than under existing situations.

The present or existing capital investment must be reorganized to provide for the expansion of the swine enterprise.

In general, the entire livestock system needs to be revamped to place emphasis on slaughter hog production and the cropping system centered on grain production rather than forage.

II. ADJUSTMENT ON VARIABLE LAND FARMS

One-man Farm

This program is applicable to either Farm A or B. These two representative farms were discussed thus far to present what opportunities existed for them and the changes necessary to achieve an optimum income level assuming their land resources remain fixed. However, it was assumed at the outset that maximum net revenue was the goal of the farmer. Additional adjustment alternatives are available when the possibility of increasing the size of the farm acreage is considered. Comparisons of the optimum plan for the one-man resident labor situation with variable land and the optimum plans for representative Farms A and B are presented in Table XXI.

Since the necessary adjustments to reach the optimum levels from existing situations have been discussed, this section will concern itself

TABLE XXI

COMPARISONS OF OPTIMUM FARM PLANS FOR FARMS A AND B WITH OPTIMUM PLAN FOR THE FARM WITH ONE-MAN LABOR SUPPLY AND VARIABLE LAND SUPPLY

Item	Unit	Farm A	Farm B	One-Man Labor Supply
Land	acres	48.90	91.00	137.80
Enterprises:				
Beef	cows			13.40
Dairy	cows	7.00	13.10	
Swine	sows	5.80	10.80	19.50
Tobacco	acres	0.21	0.37	0.37
Corn	acres	16.90	31.60	48.00
Oats[a]	acres			12.60
Lespedeza Pasture[a]	acres			6.10
Lespedeza Hay[a]	acres			6.50
Orchardgrass-ladino Pasture	acres	17.10	24.60	48.60
Orchardgrass-ladino Pasture and Hay	acres	8.60	18.70	15.40
Common Bermudagrass Pasture	acres	1.50	7.20	
Unimproved Pasture	acres	4.60	8.50	12.80
Capital Investment:				
Land	$			9,358.00[b]
Buildings	$	1,813.76	3,376.37	3,746.65
Livestock	$	1,179.20	2,217.27	4,404.29
Machinery	$	957.32	1,726.43	2,799.31
Total Capital Investment	$	3,950.28	7,320.07	20,308.25
Operating Capital	$	1,148.37	2,127.52	3,354.89
Net Income	$	2,102.18	4,003.40	4,348.41

[a]Oats are followed by either annual lespedeza pasture or hay.

[b]This is the capital required to purchase additional land assuming that Farm B is the basis for the comparison.

with moving from the position of optimum with fixed land to the optimum plan with one-man resident labor supply assuming the farmer could acquire additional land at $200.00 per acre of openland. The emphasis will be placed on adjustment from Farm A to this plan. The reason for this is that Farms A and B are primarily the same except the latter is approximately twice the size of Farm A and in the optimum plans all enterprises and resources are in relatively the same proportion for both Farm A and B.

The optimum size for the one-man labor situation was 137.8 acres, thus requiring an additional 88.9 acres to be purchased by Farm A or 46.8 acres by Farm B. At the assumed land prices this would require an additional capital investment of $17,780.00 by Farm A or $9,358.00 by Farm B.

The emphasis in livestock would be changed from Dairy and Swine II to Beef III and Swine II. From Farm A to this situation would require the purchase of an additional 7.4 ruminants and 13.7 sows.

The cropping system would be changed in comparison to Farm A in that small grains would be grown rather than purchased. Corn acreage would increase from 16.9 acres on Farm A to 48.0 acres on the optimum plan for one-man labor supply with land variable. Some of the hay requirements would be furnished by annual lespedeza under the optimum plan. Orchardgrass-ladino clover pasture would be increased from 17.1 to 48.6, while hay and pasture orchardgrass-ladino clover would be increased from 8.6 acres to 15.4 acres. There would be no common bermudagrass under this optimum plan.

The net revenue for this optimum plan for one-man labor supply was $4,348.41 as compared to $2,102.18 for Farm A and $4,003.40 for Farm B optimum plans.

Capital investment for the variable land optimum plan was $6,999.97 more than Farm A and $3,630.18 more than the optimum plan for Farm B. These figures do not include the capital necessary to purchase the additional land used in the one-man labor optimum farm plan. Both livestock and machinery capital requirements increased significantly from both Farms A and B to this optimum plan. Building capital would have to be greatly increased to provide for the optimum plan's needs in comparison to the optimum plan for Farm A. In comparison to the optimum for Farm B, building capital would be adequate for the beef enterprise but additional buildings would be needed for the expansion of the swine activity. To achieve this optimum would require $24,779.97 as compared to Farm A or $10,893.65 as compared to Farm B. These figures include investment in buildings, livestock, machinery, and additional land.

In general, developing either Farm A or B to the optimum farm with one-man resident labor available would require several adjustments. To begin with, ruminant livestock emphasis would shift from dairy to beef and the swine enterprise would be expanded. Secondly, significant investment of capital would be necessary. Finally, some changes would be made in the cropping system, although all three farm plans have about the same relative intensity of crop farming.

Two-man Farm

As in the previous section, there will be no attempt to show the necessary adjustments from the existing situation to this optimum, but rather the adjustment will be discussed on the basis of moving from the optimum plan with fixed land resources for Farm C to this optimum plan. Table XXII presents a comparison of the two optimum farm plans.

The primary adjustment in moving from the Farm C plan to this plan would be to purchase 59.2 acres of additional openland at an investment of $11,824.00.

The dairy enterprise would be replaced by Beef III which would increase to 28.9 brood cows producing calves to be finished for slaughter. Sows would be increased by 6.6 and total slaughter hogs by 100.7 to 658.2.

Corn acreage increased less than one acre, but oats more than doubled in acreage. Since more annual lespedeza hay would be raised, acreage of orchardgrass-ladino clover hay and pasture combination decreased slightly. Orchardgrass-ladino clover pasture increased 23.6 acres and lespedeza pasture 17.3 acres.

Capital investment increased to $34,633.43, of which $11,824.00 would be for the additional land. Machinery would increase by $1,035.74, livestock by $3,233.51, and buildings by $415.89 for a total, including purchased land value, of $16,509.14.

The most significant change in this situation was the switch in livestock from dairy and beef to all beef. Secondly, increases in swine and the shifting of some of the crop acreages would be necessary.

TABLE XXII

COMPARISONS OF OPTIMUM FARM PLAN FOR FARM C AND OPTIMUM FARM PLAN FOR FARM WITH TWO-MAN LABOR SUPPLY AND VARIABLE LAND SUPPLY

Item	Unit	Farm C	Two-Man Labor Supply
Land	acres	253.90	313.10
Enterprises:			
Beef	cows	11.70	28.90
Dairy	cows	11.60	
Swine	sows	37.00	43.60
Tobacco	acres	0.32	0.32
Corn	acres	88.80	89.50
Oats[a]	acres	31.30	64.10
Lespedeza Pasture[a]	acres	18.80	36.10
Lespedeza Hay[a]	acres	12.40	28.00
Orchardgrass-ladino Pasture	acres	85.10	108.70
Orchardgrass-ladino Pasture and Hay	acres	24.80	21.20
Unimproved Pasture	acres	23.60	29.10
Capital Investment:			
Land	$		11,824.00
Buildings	$	7,408.90	7,824.79
Livestock	$	6,363.48	9,596.99
Machinery	$	4,351.91	5,387.65
Total Capital Investment	$	18,124.29	34,633.43
Operating Capital	$	5,956.41	7,549.10
Net Income	$	9,997.94	10,272.95

[a]Oats were followed by either annual lespedeza pasture or hay.

Increasing the capital investment would be necessary to provide for livestock expansion and rearranging both crop and livestock systems in addition to the capital required to purchase additional land. This would complete the major adjustment needed to move from Farm C's optimum plan to this two-man labor supply optimum farm plan.

CHAPTER VII

SUMMARY AND CONCLUSIONS

I. SUMMARY

This study has four basic objectives: (1) to describe the present farm organization; (2) to determine the optimum farm organization of "representative" small, medium, and large farms; (3) to determine optimum farm organization and farm size for fixed resident labor supply of one and two men; and (4) to estimate the magnitude of the "adjustment gap" of farmers and the nature of factors limiting farming adjustments in the Eastern Highland Rim area of Tennessee.

Putnam County was thought to be typical of the area and a sample was taken from the farms of that county. The information obtained from these farms and soil resource data obtained from the Soil Conservation Service were used to describe the existing farm situation and to select the "representative" farms for the three major soil associations of the Eastern Highland Rim. This study applies specifically to the Baxter-Mountview-Bewleyville Soil Association.

Enterprises considered as alternatives were generally limited to the major systems found on the survey farms. The resource requirements, costs and returns were budgeted for each of the activities. Linear programming was the technique used to determine the optimum farm organizations. There were five optimum programs developed representing the

small, medium, and large representative farms with a fixed land base and the one- and two-man resident labor farms with no restrictions on land base.

Each of the five solutions was analyzed and then discussed on the basis of adjustment from the existing situation to the basic three farm size optimums. Following that discussion, an analysis was made on the "adjustment gap" between the basic farm optimums and the one- and two-man resident labor optimum farm plans.

A brief discussion of some of the limitations to making the adjustments indicated will be presented in the following section.

II. CONCLUSIONS

It would be well to have a knowledge of some of the factors that may restrict overall adjustment opportunities before the actual conclusions are presented. There are also some limitations on the specific adjustment needs and these will be discussed as they are applicable.

The success or failure of any farm operation is highly dependent on the ability of the operator to "manage" his resources in an efficient, profitable manner. The levels of livestock production and crop yields used in this study assume "good" management. Therefore if this level of management is not achieved, the assumption becomes invalid and the applicability of the optimum farm plans may be questionable.

Age plays an important role in farm adjustment, in that a person's willingness to change, in general, decreases with age. For older

operators, planning spans become too short to justify many types of adjustments. In addition, ability to obtain long term capital may be limited as age increases. The average age of farm operators by farm-size groups was as follows: Group I - 59.5, Group II - 53.5, Group III - 47.1, and Group IV - 39.3. The average age of all farmers surveyed was 53.4.

Only two of the farmers included in the study group were college graduates while less than 30 per cent had a high school diploma. While education level is not always indicative of intelligence or the ability to learn, it may be an important asset in comprehending modern farming methods. The fact that so many farmers' educational level is relatively low means that some of them may have difficulty in understanding the technological changes necessary to reach optimum.

The three major livestock enterprises included in optimum plans for the five situations assumed were dairy, producing milk for manufacturing purposes; swine, marketing slaughter hogs; and beef, marketing slaughter steers and heifers. The possibility of these enterprises being feasible is highly dependent upon the availability of an adequate market. Markets seem adequate for additional milk. However, if a major proportion of the farmers adjust in the direction of the optimum plans, it is likely that marketing facilities in the area for slaughter hogs and cattle would be inadequate. Before any major adjustments are made to produce slaughter hogs and cattle, the market facilities in the area for these types of animals would need to be expanded and improved.

In all the optimum farm plans, intensifying the land use on the present farms was indicated. Since all grains, except oats, had to be raised on the farm, grain production became an important factor in the determination of the type and magnitude of livestock enterprises. The soil resources have the capacity to withstand more intensive use than under present cropping systems.

The crop and livestock systems included in all five of the optimum farm plans could be handled adequately by the resident labor force assumed for each particular situation. Peak labor loads for all of the optimum systems would occur in the spring season due to competition between crop planting and handling of the spring sow farrowing.

On the three basic farms, the existing levels of capital investment were not adequate to support the needs for the optimum farm plan. Additional investment in livestock breeding animals was required in all three cases, while machinery and building investment probable levels would be sufficient with minor changes. On the two situations in which purchasing of land was allowed, capital investment was considerably larger than on the basic optimum farm plans. Land capital required the majority of the additional capital, but machinery, buildings, and livestock investment level would also be somewhat higher.

The willingness of farmers to go into debt would have a definite effect on the adjustment to reach the two optimum plans with variable land. While most of the surveyed farmers expressed a willingness to go into debt, they indicated they would do so only if chances of gain were very certain. The high equity ratio, 90.4 per cent, is indicative of some reluctance of farmers to incur indebtedness.

While net farm income comparisons between the optimum programs and the existing farm situation are not possible, it is quite apparent increased income opportunities are good if one accepts the underlying assumptions and conditions used for the analysis. The net income of the optimum solutions was over twice that of the existing farm's gross income on farm Groups II and III, and nearly one-third larger than for Group IV. Increases from the basic optimum farm plans to the farm situations with variable land were much smaller with the exception of the optimum plan for Farm A.

There are many aspects of this study that could be given further attention, and some of these will be mentioned in the following discussion. Additional work is needed to determine the optimum farm organization and income possibilities for part-time farmers. If the price assumptions of this study were not to materialize, the application of the study results would be questionable. Thus, it would be well to plan the optimum farms using several different price levels. Since the majority of beef and hog production in the area at present involves marketing of unfinished animals, such as feeder pigs and cattle, it would be interesting and informative to program the five situations assuming only unfinished animals could be marketed.

On the basis of the study, excluding the limitations previously discussed, it was concluded that:

1. Capital needs are small assuming that the resource situation, farm size, and labor force remain the same as on existing farms.

2. Capital is needed, primarily, to purchase land and some other types of investment if farm size is to be increased.

3. Corn and oats production needs to be increased to meet the needs of increased livestock numbers.

4. Resident labor is sufficient for handling the needs of all the optimum systems developed.

5. There do exist significant opportunities to increase the income returns to land, labor, and management.

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APPENDIXES

APPENDIX A

PRODUCT AND INPUT PRICES

TABLE XXIII

SELECTED SAMPLE OF PROJECTED PRICES RECEIVED AND PAID BY FARMERS IN RIM AREA

Item	Unit	Price (Dollar)
Prices Received:		
Burley Tobacco	lb.	0.62
Slaughter Hogs (200 lbs.)	cwt.	14.50
Feeder Pigs (40 lbs.)	head	11.00
Sows, cull	cwt.	11.00
Lambs (90 lbs.)	cwt.	21.00
Ewes, cull	head	6.00
Rams, cull	head	8.80
Wool	lb.	0.51
Slaughter Steers (1000 lbs.)	cwt.	23.50
Slaughter Heifers (810 lbs.)	cwt.	23.50
Cows, beef culls	cwt.	15.00
Feeder Calves (500 lbs.)	cwt.	22.50
Dairy Heifers, bred	head	175.00
Cows, dairy culls	cwt.	13.45
Manufacturing Milk, 4% butterfat	cwt.	3.30
Veal Calves	head	7.50
Soybeans	bu.	2.00
Oats	bu.	0.70
Corn	bu.	1.10

TABLE XXIII (CONTINUED)

Item	Unit	Price (Dollar)
Prices Paid:		
Seed:		
Ladino Clover	lb.	0.65
Korean Lespedeza	lb.	0.20
Sericea Lespedeza	lb.	0.20
Orchardgrass	lb.	0.32
Oats, certified	bu.	1.40
Corn, hybrid	bu.	10.00
Soybeans	bu.	4.25
Feed:		
Wheat Bran	cwt.	3.50
Dairy Calf Starter	cwt.	2.50
Cottonseed Meal	cwt.	3.70
Oats	bu.	0.80
Salt	cwt.	1.60
Minerals	cwt.	2.00
Fertilizer:		
Nitrogen	lb.	0.12
Muriate of Potash	ton	52.00
3-12-12	ton	38.60
Lime (spread)	ton	5.00
Labor	hour	0.75

APPENDIX B

SELECTED SAMPLE OF CROP AND LIVESTOCK BUDGETS

TABLE XXIV

BEEF III - MARKETING GRAIN-FINISHED HEIFERS AND STEERS (25-COW UNIT)

Item	Unit	Price	Quantity	Value
Receipts:				
Heifers (7 @ 810 lbs.)[a]	cwt.	$23.50	55.00	$1,292.50
Steers (11 @ 1000 lbs.)[a]	cwt.	23.50	106.70	2,507.45
Cows, culls (4 @ 1000 lbs.)[a]	cwt.	15.00	38.80	582.00
Total Receipts				$4,381.95
Variable Costs:[d]				
Pasture	acres	10.84	55.00	$ 596.20
Hay, mixed	acres	14.43	38.30	552.67
Corn	acres	46.03	6.70	308.40[b]
Cottonseed Oil Meal	cwt.	3.70	50.72	187.66[b]
Loose Mineralized Salt	cwt.	2.00	9.00	18.00[b]
Veterinary and Medicine	head	1.85	30.00	55.50
Hauling and Selling	head	2.50	22.00	55.00[c]
Interest @ 6% for 12 months				87.68
Total Variable Costs				$1,861.11
Fixed Costs:				
Pasture	acres	0.83	55.00	$ 45.65
Hay, mixed	acres	2.20	38.30	84.26
Corn	acres	2.56	6.70	17.15
Bull Depreciation	head	54.00	1.00	54.00
Buildings and Equipment				675.06
Total Fixed Costs				$ 876.12
Total Costs				$2,737.23
Net Revenue				$1,644.72

[a]Quantity sold deducted 3 per cent for shrinkage.

[b]Interest charged for six months only, all other variable costs charged for 12 months.

[c]No interest charged.

[d]All crops are priced at cost of production.

TABLE XXV

DAIRY - MARKETING MILK FOR MANUFACTURING PURPOSES (10-COW UNIT)

Item	Unit	Price	Quantity	Value
Receipts:				
Milk (6500 lbs. @ 4 per cent)	cwt.	$ 3.30	750.00	$2,475.00
Cull Cows (2 @ 1000 lbs.)[a]	cwt.	13.45	19.40	260.93
Surplus Heifers, bred	head	175.00	0.50	87.50
Calves (3 days old)	head	7.50	5.50	41.25
Total Receipts				$2,864.68
Variable Costs:[c]				
Pasture	acres	10.84	25.80	$ 279.67[b]
Hay (legume)	acres	22.50	7.00	157.50[b]
Oats - Lespedeza Pasture	acres	41.89	1.01	42.31[b]
Corn	acres	46.03	2.60	119.68[b]
Cottonseed Oil Meal	cwt.	3.70	48.63	179.93
Salt	cwt.	1.60	2.21	3.54
Minerals	lbs.	0.02	62.50	1.25
Calf Starter	cwt.	2.50	5.00	12.50[b]
Replacement Milk	cwt.	8.75	2.95	25.80[b]
Hauling Milk	cwt.	0.35	741.75	259.61
Hauling and Selling Cull Cows	head	2.50	2.00	5.00
Breeding Fee	head	6.50	10.00	65.00
Veterinary and Medicine	head	2.00	17.00	34.00
Grinding and Mixing	cwt.	0.25	164.00	41.00
Interest @ 6 per cent for 12 months				38.25
Total Variable Costs				$1,265.04
Fixed Costs:				
Pasture	acre	0.83	25.80	$ 21.41
Hay (legume)	acre	4.36	7.00	30.52
Oats - Lespedeza Pasture	acre	2.97	1.01	3.00
Corn	acre	2.50	2.60	6.50
Buildings and Equipment				302.97
Total Fixed Costs				$ 364.40
Total Costs				$1,629.44
Net Revenue				$1,235.24

[a]Quantity sold allows for 3 per cent shrinkage.

[b]These costs were charged interest, while all other costs were not because of the rapid turnover of capital.

[c]All crops are priced at cost of production.

TABLE XXVI

SWINE - PRODUCING SLAUGHTER HOGS
(12-SOW UNIT)

Item	Unit	Price	Quantity	Value
Receipts:				
Hogs (181 @ 210 lbs.)[a]	cwt.	$14.50	372.50	$5,401.25
Sows (4.8 @ 450 lbs.)[a]	cwt.	11.00	21.17	232.87
Total Receipts				$5,634.12
Variable Costs:[d]				
Corn	acres	46.03	24.70	$1,136.94[b]
Pasture	acres	11.25	16.00	180.00[b]
Cottonseed Oil Meal	cwt.	3.70	65.25	241.43
Soybean Oil Meal	cwt.	3.95	65.25	257.74
Tankage	cwt.	5.25	44.10	231.53
Loose Mineralized Salt	cwt.	2.00	14.40	28.80
Vaccination, Iron, Erysipilas	head	0.90	192.00	172.80
Wormer	head	0.20	192.00	38.40
Other (electricity, etc.)				21.00
Hauling and Selling	head	1.25	186.00	232.50[c]
Interest @ 6% for 12 months				108.77
Total Variable Costs				$2,649.91
Fixed Costs:				
Corn	acre	2.50	24.70	$ 61.75
Pasture	acre	1.65	16.00	26.40
Building and Equipment				441.82
Total Fixed Costs				529.97
Total Costs				$3,179.88
Net Revenue				$2,454.24

[a]Quantity sold allows for 2% shrinkage.

[b]Interest charged on these items for 12 months, while all other items are charged for 6 months.

[c]No interest charged.

[d]All crops were priced at the cost of production.

TABLE XXVII

BURLEY TOBACCO ON SOIL I
(ONE ACRE)

Item	Unit	Price	Quantity	Value
Receipts:				
Burley Tobacco	lbs.	$ 0.62	2,130.00	$ 1,320.60
Variable Costs:				
Seed - rye grass	lbs.	0.13	72.00	$ 9.00
Seed - crimson clover	lbs.	0.25	12.00	3.00
Methyl Bromide	lbs.	0.85	9.00	7.65
Plastic Cover	yards	0.04	100.00	2.00
Tobacco Seed	oz.	2.00	0.50	1.00
Fermate and DDT	lbs.	0.13	15.00	1.95
Cheese Cloth	yards	0.05	100.00	5.00
Fertilizer - nitrogen	lbs.	0.12	50.00	6.00
Fertilizer (4-12-8)	cwt.	2.25	0.50	1.13
Fertilizer (5-10-15)	cwt.	2.20	12.00	26.40
Insurance (storm)	$100	5.00	5.00	25.00
Dust	lbs.	0.13	60.00	7.80
Storage	cwt.	0.47	21.30	10.01
Tobacco Sticks	100	1.00	20.00	20.00
Machinery				43.01
Interest for 12 months	$	0.06	161.00	9.66
Total Variable Costs				$ 178.61
Fixed Cost:				
Storage				$ 60.00
Machinery				11.65
Total Fixed Costs				$ 71.65
Marketing Expenses:				
Selling Fee	$	0.03	1,320.60	$ 39.62
Basket and Weighing Fee				5.00
Total Marketing Expenses				$ 44.62
Total Costs				$ 294.88
Net Revenue				$ 1,025.72

TABLE XXVIII

CORN FOR GRAIN ON SOIL I
(ONE ACRE)

Item	Unit	Price	Quantity	Value
Receipts:				
Corn	bu.	$1.10	90.00	$99.00
Variable Costs:				
Seed	lbs.	0.18	9.00	$ 1.62
Fertilizer (12-6-6)	cwt.	2.20	10.00	22.00
Lime	ton	5.00	0.25	1.25
80% Atrazine	lbs.	2.90	2.50	7.25
Machinery				7.91
Corn picker (custom hired)	acres	1.00	6.00	6.00
Interest for 6 months	$	0.03	40.00	1.20
Total Variable Costs				$47.23
Fixed Costs:				
Machinery				2.50
Total Fixed Costs				$ 2.50
Total Costs				$49.73
Net Revenue				$49.27

TABLE XXIX

OATS FOR GRAIN FOLLOWED BY ANNUAL LESPEDEZA PASTURE ON SOIL II
(ONE ACRE)

Item	Unit	Price	Quantity	Value
Receipts:				
Oat Grain	bu.	$ 0.70	52.00	$ 36.40
Straw	ton	15.00	0.80	12.00
Lespedeza Pasture	cad[a]		55.00	
Total Receipts				$ 48.40
Variable Costs:				
Seed - oats	bu.	1.40	2.00	$ 2.80
Seed - Korean lespedeza	lbs.	0.20	25.00	5.00
Fertilizer (15-20-10)	cwt.	3.75	2.00	7.50
Lime	ton	5.00	0.25	1.25
Machinery				9.64
Combine (custom hired)	acre	6.00	1.00	6.00
Grain Drill (custom hired)	acre	2.00	1.00	2.00
Interest for 12 months	$	0.06	28.16	1.69
Total Variable Costs				$ 35.88
Fixed Costs:				
Machinery				2.97
Total Fixed Costs				$ 2.97
Total Costs				$ 38.85
Net Revenue				$ 9.55

NOTE: Net revenue is the cash returns to land, labor and management and does not take into account the pasture production of the enterprise.

[a]cad refers to cow acre days.

TABLE XXX

ORCHARDGRASS-LADINO CLOVER USED FOR HAY AND PASTURE ON SOIL III
(ONE ACRE)

Item	Unit	Price	Quantity	Value
Receipts:				
Mixed Hay	ton	$ 20.00	1.60	$ 32.00
Pasture	cad		109.00	
Total Receipts				$ 32.00
Variable Costs:				
Seed - orchardgrass	lbs.	0.32	2.14	$ 0.68
Seed - ladino clover	lbs.	0.65	0.29	0.19
Fertilizer (3-12-12)	cwt.	1.93	1.14	2.20
Fertilizer (0-20-0)	cwt.	2.45	2.00	4.90
Lime	ton	5.00	0.25	1.25
Machinery				7.43
Interest for 12 months	$	0.06	16.65	1.00
Total Variable Costs				$ 17.65
Fixed Costs:				
Machinery				2.31
Total Fixed Costs				$ 2.31
Total Costs				$ 19.96
Net Revenue				$ 12.04

NOTE: Net revenue is the cash returns to land, labor and management and does not take into account the pasture production of the enterprise.

TABLE XXXI

ORCHARDGRASS-LADINO CLOVER PASTURE ON SOIL III
(ONE ACRE)

Item	Unit	Price	Quantity	Value
Receipts:				
Pasture	cad		134.00	
Variable Costs:				
Seed - orchardgrass	lbs.	$ 0.32	2.14	$ 0.68
Seed - ladino clover	lbs.	0.65	0.29	0.19
Fertilizer (3-12-12)	cwt.	1.93	1.14	2.20
Fertilizer (0-20-0)	cwt.	2.45	2.00	4.90
Lime	cwt.	5.00	0.25	1.25
Machinery				3.44
Interest for 12 months	$	0.06	12.66	0.76
Total Variable Costs				$13.42
Fixed Costs:				
Machinery				0.79
Total Fixed Costs				$ 0.79
Total Costs				$14.21
Cost Per Cow Acre Day				$ 0.11

APPENDIX C

SELECTED SAMPLE OF LIVESTOCK FORAGE REQUIREMENTS AND CROP FORAGE PRODUCTION BY FORAGE PERIODS

TABLE XXXII

LIVESTOCK FORAGE REQUIREMENTS AND CROP FORAGE PRODUCTION BY FORAGE PERIODS FOR SELECTED CROP AND LIVESTOCK ACTIVITIES

Enterprise	Forage Period I 3/15-5/31	II 6/1-7/31	III 8/1-9/30	IV 10/1-11/15	Annual Total
	(Cow Acre Days)				
Crop Production - one acre:					
Oats - lespedeza pasture (Soil II)		26	23	6	55
Orchardgrass-ladino clover hay and pasture		35	17	12	64
Orchardgrass-ladino clover pasture	55	35	17	12	119
Livestock Requirements - One Cow:					
Beef III	90	89	67	54	300
Dairy	89	72	72	54	287

NOTE: The crop production data does not always agree with that presented in the budgets because winter growth was assumed to substitute for hay on a hay-equivalent basis.

APPENDIX D

SELECTED SAMPLE OF CROP AND LIVESTOCK LABOR REQUIREMENTS BY LABOR PERIODS

TABLE XXXIII

HOURS OF LABOR REQUIRED BY LABOR PERIOD FOR SELECTED CROP AND LIVESTOCK ENTERPRISES

Labor Periods	Crops (one acre)					Livestock - One Unit		
	Corn	Tobacco	Oats - Lespedeza Pasture	Orchardgrass-Ladino Clover Hay & Pasture	Orchardgrass-Ladino Clover Pasture	Beef	Dairy	Swine
I - 12/1-2/28		10.0	1.1	1.1	1.1	7.9	25.9	13.9
II - 3/1-4/15	2.5	32.0	0.5			4.5	12.1	8.2
III - 4/16-5/31	1.8	30.2		3.4		0.8	9.2	6.5
IV - 6/1-8/15	0.6	46.4	4.2	0.7	1.4	1.8	15.3	10.8
V - 8/16-9/30		88.0	3.8	0.1	0.8	1.2	9.2	7.0
VI - 10/1-11/31	2.1	154.8				3.2	15.4	9.0
Total	7.0	361.4	9.6	5.3	3.3	19.4	87.1	55.4