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To the Graduate Council:

I am submitting herewith a thesis written by Gerald Vincent Eagan entitled "Minimum Land Requirements for Specified Levels of Farm Income in the Eastern Highland Rim Area of Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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MINIMUM LAND REQUIREMENTS FOR SPECIFIED LEVELS OF FARM INCOME IN 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

---

by

Gerald Vincent Eagan

August 1966

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CHAPTER I

INTRODUCTION

Drastic changes in the agricultural economy have taken place during the last two decades. Increased productivity of agricultural labor and declining profit margins for many farm products have contributed to a considerable disparity between farm and nonfarm incomes. The income disparity continues in spite of large net migration of farm family workers and farm operators into nonfarm employment and significant decreases in farm numbers.

The number of farm family workers in Tennessee decreased by 37.3 per cent from 1954 to 1959.[1] The adoption of improved technology, particularly mechanization, has enabled the remaining farm labor force to be used more productively upon farms of greater acreage. The number of farms in Tennessee decreased from 247,600 in 1940 to 154,000 in 1964, a cumulative change of 38 per cent, while the decrease in total acres in farms was 12 per cent. Concurrently, the average acreage per farm in Tennessee has increased from 75 in 1940 to 102 in 1959 and to 105 acres in 1964.[2]

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[1]United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. I (Washington: Government Printing Office, 1961), pp. 184-191.

[2]Tennessee Department of Agriculture, Excellence Attained, 45th Biennial Report: 1963-1964 (Nashville, 1965), p. 226.

The average size of farm in Tennessee increased approximately 24 per cent from 1950 to 1959. However, average size of all farms in the United States increased 40 per cent, from 215.6 to 302.4 acres, from 1950-59.[3] Tennessee farmers have failed to increase output as compared to United States farmers. The value of agricultural products sold per farm in Appalachian counties of Tennessee was less than 25 per cent of the national average in 1950 and slightly over 27 per cent of the national average in 1960.[4] For all farms in Tennessee the average value of farm products sold in 1959 was approximately 37 per cent of that for all farms in the United States.

I. THE PROBLEM

Tweeten estimated that 10 per cent of farm family workers in the United States received average wages on a par with "the factory worker standard of $4,665 in 1960."[5] The situation was more favorable when returns to capital were considered as income. However, considering net returns to farm family labor, management, and risk, Tweeten considered

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[3] Ibid., pp. 144-151.

[4] R. I. Coltrain and E. L. Baum, An Economic Survey of the Appalachian Region, with Special Reference to Agriculture, Economic Research Service, USDA (Washington: Government Printing Office, April 1965), pp. 3, 8, 9, and 42.

[5] Luther G. Tweeten, "The Income Structure of Farms by Economic Class," Journal of Farm Economics, Vol. 47, No. 2, May 1965, pp. 210-211.

Estimates of the minimum land and other resource requirements for specific income goals would provide more insight for consideration in agricultural decision-making problems. These estimates would aid farmers in evaluating their individual situations with regard to their adjustment needs and adjustment opportunities. Further, estimates of the bundle of resources required for specific levels of income would be helpful to professional workers in agriculture, to lending agencies and other institutions both public and private, and to those concerned with agricultural policy formulation.

II. OBJECTIVES OF THE STUDY

The objectives of this study were:

1. To estimate the minimum land and other resource requirements for farms which would return net operator labor-management incomes of $3,000, $4,500, and $6,000 and compare enterprise organizations at the various income levels for representative resource situations in the Eastern Highland Rim Area of Tennessee.

2. To determine the effects of variations in resident labor supply and farm type upon the minimum land requirement necessary to achieve the specified income levels. Estimates were made with one-man and two-man resident labor supplies at each income level and for each of four types of farms.

III. PROCEDURE

To achieve the study objectives the following procedures were used:

1. The distribution of farms by size, predominant types of farming, patterns of resource use, and farm-operator-income situation prevalent in the study area were established from analysis of census and survey data used in an earlier study.[7] Income goals for the study were selected as long-run levels of earnings approximating the expected earnings of unskilled, semi-skilled, and skilled workers at off-farm occupations.

2. A representative soils distribution for the study area was developed from analysis of soil survey data obtained for a subsample of farms in Putnam County.

3. Production alternatives for the study-area farms were selected in light of existing and expected markets for agricultural products.

4. Labor requirements, forage requirements, machine costs, and purchased input costs were obtained or adapted from information available from current research to establish the economic and technical conditions of production.

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[7]Unpublished survey data, Department of Agricultural Economics.

5. The linear programming technique was used to obtain estimated minimum land requirements necessary to realize net operator incomes of $3,000, $4,500, and $6,000 for various types of farms and under assumed conditions of one-man and two-man resident labor supply. Only land-based production alternatives were considered.

IV. PREVIOUS RESEARCH

Portions of the data used in this study were obtained from the research project entitled, "An Economic Appraisal of Farming Adjustment Opportunities in the Southern Region to Meet Changing Conditions," Southern Regional Project S-42, Revised. One objective of the above study is "to examine the impact of changes in the prices of selected factors of production on the minimum land requirements for specified levels of income under alternative allotment level-product price combinations."[8]

Compilation of the research findings of the fourteen cooperating agencies involved in the regional project will provide detailed analyses of individual and area farm adjustments in response to variations of acreage allotment programs, land prices, labor prices, equity positions, and farm types. These analyses will provide insight as to the direction and magnitude of needed resource adjustments in the southern region at

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[8]A Guide to Procedures in Southern Research Project S-42, Revised, "An Economic Appraisal of Farming Adjustment Opportunities in the Southern Region to Meet Changing Conditions" (unpublished, The University of Tennessee, Knoxville, 1963), pp. 3-4.

the micro- and macro-economic level if farm income levels are to be improved.

The attainment of farm-nonfarm income equality has long been a goal of farm people and agricultural policy makers. Johnson gave further impetus to research directed toward this goal by indicating that farm people have a labor capacity approaching that of nonfarm people of the same age and sex.[9] The question of what constitutes real equality of farm and nonfarm incomes is difficult to answer and many definitions have been offered in recent years. Brewster stated the problem as:

> . . .determination of the amounts and kinds of resources needed to enable farm operators to have levels of money earnings comparable to industrial workers, and then do the best that can be done in pointing up the respects in which significant differences in "real" values may be associated with farm and nonfarm work.[10]

Brewster estimated that capital investment required for operator earnings of $2,500 ranged from $14,000 upward of $89,000 in a study of six types of farms in major regions of the United States.[11] The Oklahoma cotton farm required approximately six times as much labor as

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[9]D. G. Johnson, "Comparability of Labor Capacities of Farm and Nonfarm Labor," The American Economic Review, Vol. 43, No. 3, pp. 311-12.

[10]John M. Brewster, "Analyzing Minimum Resource Requirements For Specified Income Levels," Farm Size and Output Research: A Study in Research Methods, Southern Cooperative Series Bulletin No. 56 (Knoxville: Agricultural Experiment Station, The University of Tennessee, 1958), p. 99.

[11]John M. Brewster, Farm Resources for Specified Income Levels, Agriculture Information Bulletin No. 180 (Washington: Government Printing Office, December 1957).

the capital-intensive Montana wheat farm. Farming operations returning $2,500, according to Brewster's estimate, were in Economic Class IV (1959 census classification) in the Piedmont of South Carolina with gross product values in the range of $5,000 to $9,999. Farms at this income level in other sections of the country were intermediate in capital investment requirements.

Lanham and Coutu reported that minimizing the total capital investment gave results almost identical to those obtained by minimizing land in a North Carolina study.[12]

Strickland, Plaxico, and Lagrone estimated that 80 per cent of the farms in the Low Rolling Plains Area of Oklahoma lacked minimum land resources to yield $3,000 net operator labor-management returns.[13] Their research indicated that adjustment of land resource of the study area into farms of the minimum size would reduce farm numbers in the area by approximately 50 per cent. Adjustments to minimum-sized farms capable of producing net incomes of $5,000 and $7,000 would entail reduction of farm numbers by 70 and 77 per cent, respectively.

Results of a study reported by Jones, Strickland, and Partenheimer indicated that for a beef-type farm, variation of land prices caused

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[12]W. J. Lanham and A. J. Coutu, Area Resource Adjustments for Specified Net Revenue Goals and Levels of Factor Prices on Farms in Economic Area 7, North Carolina, Agriculture Economics Series No. 109 (Raleigh: University of North Carolina, January 1964), p. 9.

[13]Percy L. Strickland, J. S. Plaxico, and W. F. Lagrone, Minimum Land Requirements and Adjustments for Specified Income Levels, Southwestern Oklahoma, Bulletin B608 (Stillwater: Oklahoma Agricultural Experiment Station, May 1963).

variations in the minimum land requirement.[14] Land price variations from $52.50 to $210 per acre caused the minimum land requirement at the $5,000 income level to vary from 153 to 193 acres. Beef cow numbers for these organizations ranged from 13 to 16 head. Increasing the land price raised the minimum land requirement but did not affect enterprise proportions in the programmed organizations.

Atkins indicated that many farmers in the Red Soil Area of the Eastern Highland Rim could improve their incomes by improving production practices.[15] Bounds in a more recent study found that resource-use adjustments and improved production practices would provide higher incomes for farm operators in the Baxter-Mountview-Bewleyville soil association of the Eastern Highland Rim.[16] These systems were larger than most existing farms with one-man and two-man labor supplies and would return estimated net incomes of $4,348 and $12,273 to land, labor, and management. Profit maximization under fixed one-man and two-man resident labor situations, assuming land resources variable, resulted in optimal systems of 137 and 313 acres.

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[14]Gary C. Jones, P. L. Strickland, and E. J. Partenheimer, Minimum Open Land Requirements for $5,000 Farm Income, Wiregrass Area, Lower Coastal Plains, Alabama, Agricultural Economics Series 6 (Auburn, Alabama: Agricultural Experiment Station of Auburn University, July 1965).

[15]S. W. Atkins, Increasing Incomes Through Farm Adjustments in the Red Soil Area, Eastern Highland Rim of Tennessee. Bulletin No. 245 (Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, December 1955).

[16]Vernon M. Bounds, "Farm Adjustment Opportunities in the Baxter-Mountview-Bewleyville Soil Association of the Eastern Highland Rim of Tennessee," (unpublished Master's thesis, The University of Tennessee, 1963), pp. 67-70.

From the preceding citations, attainment of farm operator net incomes equivalent to nonfarm wages requires highly variable minimum combinations of land, labor, and capital resources. Resource costs, the choice of production enterprises, product prices, institutional restraints, and specific income goals sought will affect the minimum resources required. The effects of variations in specified income goals, resident labor supply, and type of farm upon the minimum land requirement and enterprise organization of farms in the Eastern Highland Rim of Tennessee were the concern of this study.

CHAPTER II

DESCRIPTION OF THE STUDY AREA

This chapter provides a description of the study area and a discussion of relevant background data to be used later to indicate the kind of farm adjustments implied by the results of the study.

I. THE STUDY AREA

The Eastern Highland Rim of Tennessee is a relatively narrow geological region forming a distinct zone of transition between the Central Basin and Cumberland Plateau regions of Tennessee. The area of study falls within 12 counties which collectively will be referred to as the Eastern Highland Rim or region hereafter in this thesis. The study area, as shown in Figure 1, is smaller than the geographic area contained within the boundaries of the 12 counties: Cannon, Clay, Coffee, DeKalb, Franklin, Grundy, Overton, Pickett, Putnam, Van Buren, Warren, and White.

The study area was comprised of three major soil associations: the Baxter-Mountview-Bewleyville, Dickson-Mountview-Bewleyville, and Cumberland-Waynesboro associations. These associations comprise approximately 40 per cent of the 12-county region referred to above. The acreage of these associations and their relative importance are shown in Table I. Other soil associations found within the 12 counties

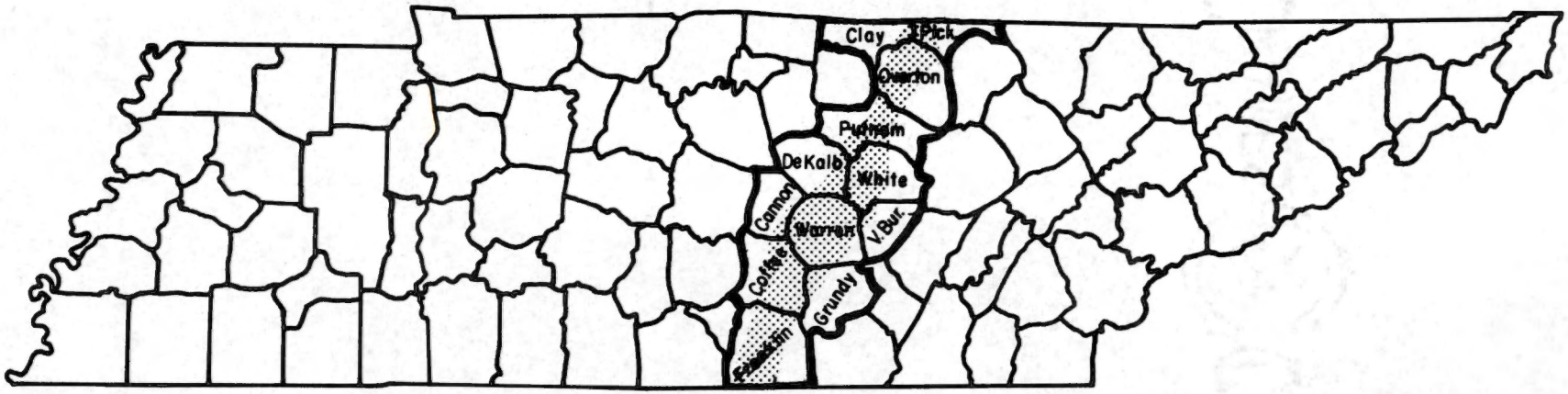

Figure 1. The 12 counties of the Eastern Highland Rim and the generalized location of the study area.

TABLE I

SOIL ASSOCIATIONS OF THE STUDY AREA, ACREAGE AND RELATIVE IMPORTANCE

Association	Acres	Per cent of study area	Per cent of Eastern Highland Rim
Baxter-Mountview-Bewleyville	208,945	19.6	7.7
Dickson-Mountview-Bewleyville	353,396	33.2	13.1
Cumberland-Waynesboro	503,355	47.2	18.7
Total Study Area	1,065,693	100.0	39.5

Source: Unpublished data, Department of Agronomy, The University of Tennessee, Knoxville, Tennessee.

are typical of the Central Basin, and the Cumberland Plateau, or are soils of intermediate character atypical of the study area soil associations.

Soils of the Baxter-Mountview-Bewleyville association were primarily formed from loess deposited over a cherty limestone residium. Well drained Mountview and Bewleyville soils predominate on the undulating hill tops and areas of mild slopes. The Baxter soils were formed from cherty residium and dominate the steeper slopes adjoining the Mountview and Bewleyville soils.

The Dickson-Mountview-Bewleyville association is characterized by a slightly to moderately undulating surface with many areas of nearly level depressions. The Dickson soils, like the Mountview and Bewleyville soils, were formed from loess but possess a characteristic brittle, mottled fragipan at varying depths. These soils are usually moderately well drained and often associated with small areas of Lawrence, Guthrie, and Melvin soils of poor to very poor internal drainage.

The Cumberland-Waynesboro association is characterized by soils of alluvial parentage formed on terraces of an older drainage system. They are generally productive, well drained, and less subject to erosion than the loess soils of the other two associations.

Information regarding the particular soil pattern in each of the three soil associations was obtained from a summary of soils found on a group of 25-30 randomly selected farms in each of the associations.

These farms were selected as a subsample from a group of 155 Putnam County farms surveyed in 1961.[1]

II. THE NATURE OF THE STUDY AREA

The Eastern Highland Rim of Tennessee is predominantly a rural region. There are no metropolitan centers of population in or adjacent to the region. Industrial job opportunities exist in many of the county seat towns of the region and part-time farming is common.

The region has benefited from recent construction of the Tennessee portions of the Interstate Highway System, giving improved access to Nashville, Knoxville, and Chattanooga.

Population Characteristics

Fifty-one per cent of the population of the region was classified rural-farm in 1950 whereas 29 per cent of the population was classified rural-farm by the 1960 Census of Population.[2] Coffee county, in 1960, was the only county in the region in which a majority of the population resided in urban places. All other counties were either predominantly or completely rural (Table II).

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[1]Vernon M. Bounds, "Farm Adjustment Opportunities in the Baxter-Mountview-Bewleyville Soil Association of the Eastern Highland Rim of Tennessee," (unpublished Master's thesis, The University of Tennessee, 1963), pp. 10-12.

[2]United States Bureau of the Census, United States Census of the Population: 1960, Population, Vol. 1, Part 44 (Washington: Government Printing Office, 1961), pp. 206-213, 255-263.

TABLE II

DISTRIBUTION OF THE FARM AND NONFARM POPULATION BY COUNTIES, EASTERN HIGHLAND RIM, 1950 AND 1960

County	Per cent in 1950		Per cent in 1960		Per cent change 1950-60	Net migration rate
	Rural nonfarm	Rural farm[b]	Rural nonfarm	Rural farm[c]		
Cannon	27.1	72.9	51.9	48.9	- 6.9	-14.5
Clay	29.3	70.7	43.3	56.7	-16.2	-24.7
Coffee	33.7	38.5	26.6	17.3	24.1	12.5
DeKalb	34.9	65.1	54.4	45.6	- 7.8	-16.2
Franklin	39.8	44.6	55.7	25.0	.4	-12.8
Grundy	67.0	33.0	88.9	11.1	- 8.3	-21.5
Overton	30.5	69.5	44.1	36.6	-16.5	-25.2
Pickett	18.9	81.1	37.5	62.5	-13.0	-23.4
Putnam	34.9	41.9	50.7	22.6	- 2.1	-13.6
Van Buren	36.2	63.8	66.4	33.6	- 7.9	-20.0
Warren	20.6	45.4	34.5	26.4	3.7	- 8.1
White	21.5	52.0	34.4	36.6	- 3.9	-14.1

[a]Includes persons living in unincorporated places of less than 2,500 inhabitants.

[b]Includes persons living on places of 3 acres or more.

[c]Includes all persons living on places of 10 or more acres or with sales in excess of $250.00.

Source: United States Bureau of the Census; United States Census of Population: 1960, Tennessee, Vol. 1, Part 44 (Washington: Government Printing Office, 1961), pp. 206-213, 255-263; United States Bureau of the Census; United States Census of Population: 1950, Tennessee, Vol. 1, Part 42 (Washington: Government Printing Office, 1951), pp. 134-139; Economic Research Service U. S. D. A., Net Migration of the Population, 1950-60, Vol. 1, Part 4 (Washington: Government Printing Office, 1965), pp. 653-679.

Between 1950 and 1960 migration rates of 11 counties were negative, indicating population losses. The migration rates of persons 20 to 29 years of age were approximately twice the rates for persons of all ages shown in Table II.[3] The percentage of population between the ages of 18-65 decreased for 10 counties from 1950 to 1960.[4]

For 11 counties the median for school years completed by persons 25 years and older was below the corresponding statistic for Tennessee in both 1950 and 1960. Nine counties in the region had lower percentages of the population age 14 to 17 in school than the 82 per cent of this age group in school in Tennessee in 1960.[5] Overton County and Pickett County had approximately 60 per cent of the 14 to 17 year age group in school in 1960.

Farm Numbers and Tenure

The change in the number of farms and farm operators corresponded with the changed distribution of population in the Eastern Highland Rim from 1950 to 1960. The gross decrease in the number of farmers from 1950 to 1959 was approximately 28 per cent, as shown in Table III. Part of this change was due, however, to a change in the census definition

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[3]Economic Research Service, United States Department of Agriculture, Net Migration of the Population, 1950-60, Vol. 1, Part 4 (Washington: Government Printing Office, 1965), pp. 653-679.

[4]Charles L. Cleland, Selected Population and Agricultural Characteristics for Tennessee Counties, Bulletin 359 (Knoxville: The University of Tennessee Agricultural Experiment Station, January 1963), pp. 37-39.

[5]Ibid.

TABLE III

FARM OPERATORS BY TENURE GROUPS, EASTERN HIGHLAND RIM, 1950 AND 1959

Tenure group	1950 Number	1950 Per cent of total	1959 Number	1959 Per cent of total	Per cent of change, 1950-1959
All farmers:					
Full owners	15,152	68.2	11,058	69.4	-27.0
Part owners	2,907	13.1	3,036	19.0	4.4
Managers	12	.1	21	.2	75.0
All tenants	4,134	18.6	1,823	11.4	-55.9
Total	22,205	100.0	15,938	100.0	-28.2[a]
Commercial farmers:					
Full owners	6,554	62.8	3,843	57.5	-41.3
Part owners	1,681	16.1	1,939	29.0	15.3
Managers	11	.1	21	.3	90.9
All tenants	2,189	21.0	871	13.0	-60.2
Total	10,435	100.0	6,674	100.0	-36.0

[a]Net change for all operators when adjusted for changed census definition of farm used in 1959 amounted to -21.8 per cent.

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 160-167, 168-175; United States Bureau of the Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 58-64, 72-75, 143-156.

of a farm used in 1959. The net change for the period was approximately 22 per cent. However, the number of tenant farmers in the region decreased almost 56 per cent during the period.

The change in tenure pattern for the region from 1950 to 1959 was even more pronounced among commercial farmers. Full ownership decreased in relative importance as a tenure form and a 41 per cent decrease occurred in the number of full-owner commercial farmers. There was a 15 per cent increase in the number of part-owners during the period. The acreage in the region controlled by part-owners in 1950 amounted to 16.4 per cent of all land in farms; in 1959, part-owners controlled 407,000 acres, or 25 per cent, of all farmland in the region.[6]

Farm Size

The average size of all farms in the region was 82.4 acres in 1950 and 102.3 acres in 1959, approximately the same as for Tennessee in both years, as shown in Table IV. The average commercial farm of the Eastern Highland Rim was somewhat larger in acreage in both 1950 and 1959 than for Tennessee but increased only 28 per cent in size between 1950 and 1959 as compared to an increase of 37 per cent for the state. The average commercial farm of the United States increased 47 per cent in size from 1950 to 1959.

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[6] United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. I, Part 31 (Washington: Government Printing Office, 1961), pp. 160-167; United States Bureau of the Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 72-75.

TABLE IV

FARM SIZE COMPARISONS, EASTERN HIGHLAND RIM, TENNESSEE, AND THE UNITED STATES, 1950 AND 1959

Farms	Average acreage 1950	Average acreage 1959	Per cent change 1950-1959
Eastern Highland Rim			
All farms	82.4	102.3	+24.2
Commercial farms	115.6	147.9	+27.9
Tennessee			
All farms	80.0	102.0	+27.5
Commercial farms	101.8	139.1	+36.6
United States			
All farms	215.3	302.8	+40.6
Commercial farms	275.6	404.5	+46.8

Source: United States Bureau of Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 3, 160-167, 168-175; United States Bureau of Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 3, 58-64, 143-156; United States Bureau of the Census, United States Census of Agriculture: 1959, Vol. II, General Report, Chapter XI (Washington: Government Printing Office, 1962), p. 1229; United States Bureau of the Census, United States Census of Agriculture: 1950, Vol. II, General Report, Chapter XII (Washington: Government Printing Office, 1952), p. 1137.

The number of farms of 219 acres or less in the Eastern Highland Rim declined from 1950-59 as is shown in Table V. The number of farms less than 50 acres in size decreased 38 per cent and the number with 50 to 99 acres declined 31 per cent and the number with 100 to 219 acres declined 17 per cent. In 1959 there remained more than 10,000 farms of less than 100 acres in the Eastern Highland Rim.

Income Characteristics

Median incomes per worker for the Eastern Highland Rim counties in 1960 were, without exception, below the corresponding median incomes for the United States, as shown in Table VI. Coffee County, site of an extensive space research facility, had the highest median income for all groups except farmers and farm managers. For farmers and farm managers the high median county income in 1960 was $1,449 in Franklin County. Median incomes of farmers and farm managers for nine of the counties in the region were below the $1,092 median income of farmers and farm managers in Tennessee in 1959.

As shown in Table VI the 1960 median income for farmers and farm managers in Tennessee was $1,092 as compared to $2,136 for farmers and farm managers in the United States. The mean of the median incomes for farm managers in the 12-county region was $939. In 1960 the median income of laborers, considered an unskilled group, was $2,940 for the United States or over three times the mean median income to farmers and farm managers in the region.

TABLE V

DISTRIBUTION OF FARMS BY SIZE, EASTERN HIGHLAND RIM, 1950 AND 1959

Size of farms	Number of farms 1950	1959	Per cent change, 1950-59
Less than 50 acres	9,872	6,161	-37.6
50 acres to 99 acres	6,238	4,297	-31.1
100 acres to 219 acres	4,815	3,981	-17.3
220 acres and over	1,297	1,531	+18.0
All farms	22,222	15,970	-28.1

Source: United States Bureau of Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 152-160; United States Bureau of Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 64-71.

TABLE VI

INCOMES PER WORKER BY OCCUPATIONAL GROUP, EASTERN HIGHLAND RIM, TENNESSEE AND UNITED STATES, 1960

Workers by census group	Median income range of 12 Eastern Highland Rim counties		Region mean[a]	Tennessee median	United States median
	High	Low			
Professional and managerial	$6,454	$2,592	$4,194	$5,715	$6,640
Farmers and farm managers	1,449	603	939	1,092	2,136
Craftsmen, foremen	4,738	1,917	2,822	3,992	5,240
Operatives and kindred workers	2,809	1,298	2,092	3,000	4,282
Farm laborers and foremen	783	440	608	665	1,107
Laborers except farm, mine	1,750	862	1,370	1,928	2,940

[a]Mean of the 12-county median incomes.

Source: United States Bureau of the Census, United States Census of the Population: 1960, Tennessee, PC(1)-44C (Washington: Government Printing Office, 1961), pp. 238-245, 255-262, 268-275, 168; United States Bureau of the Census, United States Census of the Population: 1950, Tennessee PC(1)-1C (Washington: Government Printing Office, 1952), pp. 289-291.

In 1959 a high proportion of all farms in the region were classified as part-time and part-retirement farms. Only 43 per cent of all the farms in the 12-county region were commercial farms. The distribution of commercial farms in the region in 1959 by Economic Class is presented in Table VII. In 1959 78 per cent of the commercial farms in the region had gross sales of less than $5,000 and 45 per cent had gross sales of less than $2,500 (Economic Class VI). Gross income for farmers in Economic Class VI was lower than the median wage of unskilled laborers in the United States in 1960.

Types of Farms

In 1959 livestock farms comprised 40.3 per cent of all commercial farms in the region[7] (Table VIII). Field crop, general, and dairy farms were 22.0, 15.9, and 15.6 per cent of Eastern Highland Rim farms respectively.

Most dairy farmers in the region were engaged in production of manufacturing milk. Reports of the Nashville and Chattanooga Milk Market Administrators indicated there were approximately 170 Grade A producers in the 12-county region during 1961.[8]

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[7]United States Bureau of the Census, United States Census of Agriculture: 1959, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 176-183.

[8]Milk Market Information. Monthly Report of Market Administrators, Chattanooga, Tennessee, September, 1961; Milk Market Information, Monthly Report of Market Administrators, Nashville, Tennessee, December 1961.

TABLE VII

DISTRIBUTION OF COMMERCIAL FARMS BY ECONOMIC CLASS, EASTERN HIGHLAND RIM AND TENNESSEE, 1959

Economic Class[a]	Eastern Highland Rim		Tennnessee	
	Number of farms	Per cent in class	Number of farms	Per cent in class
I	51	.7	649	.8
II	56	.8	1,760	2.1
III	339	4.9	5,713	6.9
IV	1,057	15.4	14,797	17.9
V	2,298	33.5	30,112	36.4
VI	3,062	44.7	29,608	35.9
Total	6,863	100.0	82,639	100.0
Other farms	9,014		75,056	

[a]Census classification divides commercial farms into six economic classes on the basis of the total value of all farm products sold: Class I, $40,000 and over; Class II, $20,000 to $39,999; Class III, $10,000 to $19,999; Class IV, $5,000 to $9,999; Class V, $2,500 to $4,999; Class VI, $50 to $2,499. In addition Class VI farm operators were under 65 years of age, did not work off the farm more than 100 days, and nonfarm income was less than the value of farm products sold.

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 176-184.

TABLE VIII

DISTRIBUTION OF COMMERCIAL FARMS BY TYPE, EASTERN HIGHLAND RIM, 1959

Type of farm	Number of farms	Per cent of all farms
Field crop	1,511	22.0
Vegetable	15	.2
Fruit and nut	35	.5
Poultry	154	2.2
Dairy	1,070	15.6
Livestock	2,764	40.3
General	1,090	15.9
Miscellaneous	224	3.3
Total	6,863	100.0

[a]To be classified as a particular type, a farm had to have sales of a particular product or group of products amounting to 50 per cent or more of all farm products sold during the year. A farm with cash income from three or more sources not meeting other type criterion was classed as a general farm. Miscellaneous farms included those with green house, nursery, forest product, horse, mule and other varied sales.

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 176-183.

Crop Production

Important shifts in the use of farmland occurred in the Eastern Highland Rim during the period 1950 to 1959. Total land in farms decreased 11 per cent to approximately 1,630,000 acres.[9] Cropland harvested declined 29 per cent, or approximately 147,000 acres.

Two high-value crops, cotton and tobacco, were grown in the region. Tobacco growing was more common to the entire region, and was an important source of income in a majority of the counties in both 1950 and 1959. The total acres of tobacco grown in the region declined approximately 5 per cent during the decade.

Cotton acreage for the region was mainly confined to the three southernmost counties. Acreage of cotton decreased more than 55 per cent from 1950 to 1959 (Table IX). Small grains, hay, and pasture crops decreased in acreage during the period but were a larger proportion of the 1959 crop acreage because row crop acreage declined more sharply, approximately 34 per cent from 1950 to 1959.

Despite the declines in crop acreages, the value of all crops sold was approximately 25 per cent greater in 1959 than in 1950. Field crop sales were 25 per cent of total farm sales from the region in 1959 as compared to 33 per cent in 1950 (Table X).

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[9]United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 160-167; United States Bureau of the Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 72-75.

TABLE IX

ACREAGES OF MAJOR CROPS, EASTERN HIGHLAND RIM, 1950 AND 1959

Type of crop	1950 Acres	1950 Per cent of total acres	1959 Acres	1959 Per cent of total acres	Per cent of change
Cotton	11,701	1.8	5,188	1.0	-55.6
Tobacco	4,452	.7	4,214	.8	- 5.3
Corn, for all uses	222,293	33.7	149,775	29.7	-32.6
Small grains, except for hay	42,463	6.4	36,238	7.2	-14.6
Soybeans	28,306	4.3	17,776	3.6	-37.2
Hay crops, except soybeans	163,423	24.7	130,588	25.9	-20.0
Pasture, other	188,020	28.4	160,331	31.8	-14.7
Total	660,658	100.0	504,110	100.0	-23.6

Source: United States Bureau of Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 220-243; United States Bureau of Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 97-117.

TABLE X

VALUE OF FARM PRODUCTS SOLD, EASTERN HIGHLAND RIM, 1950 AND 1959

Product sold	1950 $1,000 of sales	1950 Per cent of total sales	1959 $1,000 of sales	1959 Per cent of total sales	Per cent of change, 1950-59
Crops:					
Field crops	7,435	32.9	8,735	25.0	+ 17.5
Vegetables	59	.3	110	.3	+ 86.4
Fruit and nuts	115	.5	285	.8	+148.0
Horticultural	883	3.9	1,449	4.2	+ 64.0
Crop sales	8,492	37.6	10,579	30.3	+ 24.6
Livestock:					
Dairy products	2,477	10.9	5,014	14.4	+102.4
Poultry and products	1,534	6.8	2,139	6.1	+ 39.4
Other livestock	9,500	42.0	16,487	47.3	+ 73.5
Livestock sales	13,511	59.7	23,640	67.8	+ 75.0
Forest products	622	2.7	643	1.8	+ 3.4
Total sales	22,625	100.0	34,862	100.0	+ 54.0

Source: United States Bureau of Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 176-183; United States Bureau of Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 157-164.

Livestock Production

The increasing importance of livestock in the agricultural economy of the Eastern Highland Rim of Tennessee was indicated by sizable increases in livestock numbers, and value of livestock and livestock products sold. The number of livestock on farms in the region increased for all classes except dairy cows and workstock from 1950 to 1959. Number of all cows and heifers that have calved increased 35 per cent from 1950 to 1959 (Table XI). Swine numbers showed similar rates of increase for the period. The number of all hogs and pigs increased from 163,348 in 1950 to 222,782 in 1959, an increase of more than 36 per cent.

The value of livestock and livestock products sales from the region increased by 75 per cent from 1950 to 1959 while the value of crop sales increased 25 per cent from 1950 to 1959 as shown in Table X, page 29).

As has been shown, the Eastern Highland Rim has a high proportion of small livestock-crop farms which were providing operator incomes considerably lower than the median wage of semi-skilled factory workers in 1960. The remainder of this thesis will be concerned with the estimation of minimum land requirements and other resources necessary for farmers in the study area to achieve net labor incomes approximating wages in unskilled, semi-skilled, and skilled off-farm employment.

TABLE XI

NUMBERS OF MAJOR CLASSES OF LIVESTOCK ON FARMS, EASTERN HIGHLAND RIM, 1950 AND 1959

Class of livestock	Number of head		Per cent change, 1950-59
	1950	1959	
Cattle and calves	140,953	194,035	+37.7
Cows and heifers that have calved	72,965	98,705	+35.3
Milk cows	61,197	53,740	-12.2
All young stock, including steers	67,388	95,330	+41.5
Hogs and pigs	163,148	222,782	+36.6

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. 1, Part 31 (Washington: Government Printing Office, 1961), pp. 200-207; United States Bureau of the Census, United States Census of Agriculture: 1950, Tennessee, Vol. 1, Part 20 (Washington: Government Printing Office, 1952), pp. 82-96.

CHAPTER III

PROGRAMMING DATA AND THE MODEL

I. INTRODUCTION

The linear programming technique has been used for the solution of numerous types of agricultural minimization problems. Estimation of minimum resources required for specified income levels has been accomplished by minimizing one of a number of resources under the broad headings of land, labor, capital, or simultaneously through minimization of total costs. Results obtained in research previously cited indicate minimization of land attains solutions similar to resource estimations achieved by minimization of total capital. Land, difficult to obtain and forming a major part of total investment, appeared to be a realistic value for minimization in an area where family and hired labor are relatively plentiful.

II. RESOURCE ASSUMPTIONS

The soil distribution for this study was developed from a summary of survey data for a group of 25 to 30 farms in each of the three soil associations. Individual soil maps were obtained for each farm and the acreage of each soil type was determined on each farm. The soil pattern used in this study was based upon a summary of this soil information and subsequent grouping of the soils data into meaningful management categories.

Thus, for this study, a composite soil pattern was derived for the three soil associations based on a weighted aggregation of the open acreage of each soil-capability group within the three soil associations. The 20 individual soil-capability units of the study area were then combined into six groups of open cropland soils based upon production capabilities, required production practices, and agronomic limitations (Table XII).

A brief description of these six soil groups is presented below:

Soil Group I (capability unit I e-1) deep, well drained, fertile, alluvial soils with little or no slope; well suited for intensive row cropping, but accounts for only 7.3 per cent of the soils in the study area.

Soil Group II (capability units II e-1 and II e-2) deep, well drained soils with slight to moderate erosion and of variable fertility; respond well to fertilization and are suited for row crops about one year out of two without serious erosion hazard; comprise 24 per cent of the study area soils.

Soil Group III (capability units III e-1 and III e-2) moderately sloping (5 to 12 per cent), with slight to moderate erosion; usually of moderate depth and moderately well to well drained; slope limits use for intensive row cropping to no more than one year in three; some areas underlain by fragipans which limit successful growth of deep-rooted legumes; in general are quite responsive to fertilization.

TABLE XII

COMPOSITE SOILS DISTRIBUTION DERIVED FOR THE STUDY AREA

Soil Groups	Major capability units[a]	Per cent of total acreage
Soil I[b]	I e-1	7.3
Soil II[b]	II e-1, II e-2	24.0
Soil III[b]	III e-1, III e-2	23.5
Soil IV	IV e-1, IV e-2, IV e-3	10.6
Soil V	III w-2, IV w-1	3.2
Soil VI	VI e-1, VI e-2	7.5
Wasteland + woodland		23.9

[a]Descriptions of major capability units and soils for the study were adapted from Soil Conservation Service information.

[b]Maximum allowable row crop acreage was 100 per cent of Soil Group I, 50 per cent of Soil Group II, and 33 per cent of Soil Group III.

Soil Group IV (capability units IV e-1, IV e-2, and IV e-3) varies from sloping to steep, and requires careful management to prevent erosion; depths quite variable, usually moderate to deep; drainage usually very good, with minor exceptions for soils with heavy clay subsoils; no row-crop alternatives considered economically feasible.

Soil Group V (capability units III w-2, and IV w-1) poor to very poorly drained, does not provide dependable yields of row crops; poor internal drainage and aeration and/or surface water accumulations impose moderate to severe restrictions upon use; pasture yields from adapted varieties of forage crops range from low to medium under good management.

Soil Group VI (capability units VI e-1 and VI e-2) generally well drained to excessively drained and subject to summer drought; moderate to severe erosion either present or a hazard on these soils; natural fertility usually very low, and poor moisture-supplying capacity limits fertilizer response; best productive use is for pasture of low to medium yield under good management systems.

The suitability of the soil groups for crop use and the yields which were assumed for this study are presented in Table XIII. Soil Group I contained the most productive soils, but acreage was quite limited in the study area. The yield levels for the crops considered on the various soil groups are based on weighted averages of estimated yields for specific soils in the groups. These estimated yields were obtained from Soil Conservation Service data and consultation with production specialists.

TABLE XIII

ESTIMATED YIELDS FOR CROP ENTERPRISES CONSIDERED BY SOIL GROUP CAPABILITY

Crop	Unit	Soil Group I	II	III	IV	V	VI
Corn	bushels	85	68	58	a	47	a
Tobacco	pounds	2,078	a	a	a	a	a
Soybeans	bushels	35	30	28	a	a	a
Oats, grain	bushels	a	56	52	41	a	a
Lespedeza pasture	CAD	a	80	70	48	75	a
Lespedeza hay	tons	a	1.5	1.3	.9	1.4	a
Orchard grass-ladino pasture	CAD	a	144	132	109	a	a
Orchard grass-ladino hay and past	CAD	a	84	78	64	a	a
	tons	a	1.1	1.0	.8	a	a
Fescue-ladino pasture	CAD	a	a	a	a	122	70
Alfalfa hay	tons	a	2.9	2.85	2.6	a	a
Red clover hay	tons	a	2.4	1.9	a	a	a

[a]Production of this crop was not considered feasible on this soil group because of economic or physical relationships and was not considered as an alternative in this study.

Land requirements for the model were provided by a land-buying activity. Each additional acre of land bought provided proportionate amounts of the six productive soil groups shown by Table XII, page 34. No limit was placed on the amount of land which could be purchased.

Labor Resources

Two resident labor situations were used for this study, an owner-operator situation and an owner plus one full-time hired worker. In both instances up to 1400 hours of seasonal labor could be hired on an hourly basis to meet peak requirements. The one-man and two-man resident labor situations provided 2865 and 5730 hours, respectively, of labor per year, distributed seasonally as shown in Table XIV. Labor requirements for representative crops are shown in Appendix D. A maximum of 1,400 hours of seasonal labor was assumed to be available for both resident labor situations at $1.125 per hour in labor periods III through VI, but not in periods I and II. For the two-man labor situation, a full-time worker was assumed available at a cost of $2,400 per year.

Capital Resources

Operating and non-land investment capital were unrestricted and were assumed to be available at 6 per cent interest. This cost was charged only for the portion of the year such capital would actually be used. Investment capital for such items as machines, buildings, and equipment was also assumed to be unrestricted at 6 per cent interest. Land investment capital was charged at 5 per cent interest

TABLE XIV

ASSUMED LABOR AVAILABILITY BY PERIODS

Labor period	Resident labor supply, hours[a]	
	Owner-operator	Owner-operator and one hired worker
I. Dec. 1 - Feb. 28	616	1232
II. Mar. 1 - Apr. 14	351	702
III. Apr. 15 - May 31	390	780
IV. June 1 - Aug. 15	650	1300
V. Aug. 16 - Sept. 30	390	780
VI. Oct. 1 - Nov. 30	468	936
Total hours per year	2865	5730

[a]Seasonal labor supply for both situations was restricted to an annual maximum of 1400 hours available in periods III through VI.

and based on an estimated land value of $152 per acre.[1]

The livestock enterprise budgets included capital charges of 6 per cent on the value of feeds produced for the average time from harvest until returns were realized by livestock sales.

Machinery Resources

Machinery costs were included in the enterprise budgets on the basis of assumed performance rates and an hourly charge for necessary machines. Since this was a long-run model, costs of operation, repair, depreciation, and interest on average investment were included. Hourly costs were determined on the basis of estimated total annual cost of owning a particular implement, given the assumptions regarding initial cost, salvage value, years of life, and hours of use. Annual total cost divided by estimated annual hours use of the machine on a particular sized farm yielded the hourly charges used to estimate crop enterprise returns. These costs are shown in Table XV for small and medium-sized farms. If the likely use of a particular machine was too small to justify ownership it was assumed that custom work was available at specified rates.

A prorata share of the machine investment cost was associated with each hour of use for a particular machine. For example, the

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[1]The $152 value per acre of land was established after study of land transfer records in White county and interviews with professional farm-lending agency workers and Extension workers in White and Coffee counties.

TABLE XV

ESTIMATED COSTS PER HOUR OF MACHINE USE

Machine	Description	Farm size	
		Small	Medium
		(cost per hour)	
Tractor	25 DBHP		$1.24
	35 DBHP	$1.28	
	45 DBHP		1.74
Plow	2 bottom	.46	.42
Disk	8 foot	.51	.30
Section harrow	2 section	.23	.14
Planter-fertilizer	2 row	1.24	.87
Cultivator	2 row	1.04	.74
Fertilizer spreader (with grass seeder)	8 foot	.61	
	12 foot		.42
Sprayer	21 foot boom	1.25[a]	.65
Mower	6 foot	.76	
	7 foot		1.13
Side delivery rake			1.70
Baler		5.00[b]	4.00[b]
Combine		6.00[c]	6.00[c]
Corn picker		6.00[c]	6.00[c]

[a]Custom rate per acre.

[b]Small farm custom cost includes the hire of the side delivery rake in the per ton rate; rake was assumed to be owned on larger farms.

[c]Custom rate per acre.

average investment over the expected 12-year life of a 35-horsepower tractor on the small farm was $1,395 and annual use was estimated at 570 hours. The associated investment per hour was approximately $2.50. Thus if production of one acre of corn required five hours of tractor time the prorata tractor investment for one acre of corn would be $12.50. The investment costs for other machines and other enterprises were computed in a similar manner. Estimates of the required machinery investment per acre of crop enterprises were obtained by capitalizing the per acre machine investment costs at 6 per cent and are shown in Appendix C.

The farm truck, manure spreader, shop equipment and machinery housing costs were included in an unassigned overhead charge for the small and medium farms. The overhead costs are presented in Appendix E.

III. PRODUCTION ALTERNATIVES

The production alternatives considered for inclusion in this study were those enterprises commonly found in the study area; not included were Grade A milk production, horticultural, and broiler activities for which little or no land is required. Cotton was not included as an alternative enterprise since production of this crop was largely confined to three counties of the region and acreage has declined considerably in recent years.

Row Crops

Row crop production was limited to corn, tobacco, and soybeans. The model provided that Soil I could be used for row crops every year. Soils II and III were restricted to maximums of 50 and 33 per cent, respectively, of available acreages used for row crops in any one year.

It was assumed that no corn could be purchased. Corn produced could either be used as feed in livestock production or sold at an assumed price of $1.10 per bushel. Soybeans could be grown on Soil Groups I, II, and III and sold for $2.30 per bushel. The production of tobacco was restricted to Soil I. The acreage allotment for tobacco was .267 per cent of total acres of land.

Small Grains

Oats could be grown on Soil Groups II, III, and IV and were assumed to be followed by lespedeza for hay or pasture. Oats could be substituted for corn in the livestock rations at the ratio of two bushels of oats for each bushel of corn.

Forage Production

Pasture requirements for the livestock enterprises were met by combinations of orchard grass-ladino clover, fescue-ladino clover, and/or oats-lespedeza pasture enterprises.

Efficient utilization of the forages produced was aided by the division of use into five forage periods. These periods were mainly selected to fit the growth patterns of the forages produced. The

distribution of forage growth by period is presented in Table XVI. A "forage transfer" activity was included in the model to allow delayed grazing of pasture in the period following period of production. The value of forage when grazing was delayed from period II to III, and III to IV was assumed to be .9 that of forage utilized in the period it was produced. Forage transferred from period IV to period V was assumed to have .8 as much feed value. Forage could not be transferred to or from Period I as it was assumed to be a hay-feeding period and forage production during this period was converted to hay equivalents. Appendix B presents forage requirements for the cattle enterprises. Hay requirements were met by the production of alfalfa, red clover, lespedeza, and/or orchard grass-ladino clover. Production and use were in terms of hay equivalents. Alfalfa hay was selected as the standard equaling one. All other hays were assumed to have .9 the value of alfalfa both in terms of feed and market value. Hay selling was included as an alternative at a price of $30 per ton of alfalfa hay equivalent.

Swine Production

Two swine enterprise alternatives, designated Swine I and Swine II, were included. Both involved the maintenance of a 12-sow herd. For the Swine I alternative it was assumed that pigs were fed out and sold for slaughter at an average weight of 210 pounds each. The slaughter-hog price assumed for this study was $14.50 per hundredweight. Swine II was an alternative system involving production of feeder pigs

TABLE XVI

PERCENTAGE DISTRIBUTION OF FORAGE BY PERIODS[a]

Forage period	Orchard grass-ladino clover	Fescue-ladino clover	Lespedeza after oats	Lespedeza alone
I. Nov. 16 - Mar. 15	11	15	0	0
II. Mar. 16 - May 31	41	52	0	3
III. June 1 - July 31	26	10	47	47
IV. Aug. 1 - Sept. 30	13	11	42	42
V. Oct. 1 - Nov. 15	9	12	11	8

[a]The figures represent the percentage of Cow Acre Days in each period of the total days furnished by the particular enterprise.

to be sold at a weight of 40 pounds each for $10.50 per head.

For both swine enterprises it was assumed that two litters were farrowed per sow per year from which 16 pigs were weaned. The assumed sow death rate was 2 per cent and there was an assumed death loss of 3 per cent for pigs from weaning to slaughter weight. Approximately half the sows were replaced each year.

Beef Cattle

Four beef enterprises were considered in this study. Beef I, II, and III were variations of a basic 25-cow unit. Beef IV was a steer-feeding operation based on a 10-head unit.

The cow-calf operations were based on different methods of handling the calves produced. Calves born in February for Beef I were assumed to be pastured with their dams through the summer until sale about October 1. It was assumed that calves were sold at an average weight of 500 pounds for $22.50 per hundredweight. A 95 per cent calf crop was assumed with 18 head sold annually from the 25-cow unit. An average of 4.5 head of heifers were saved for replacement purposes annually. A 2 per cent death loss of replacement heifers from weaning age to calving was assumed.

The Beef II organization involved wintering of the 18 steers and heifers on a ration of hay, corn-cob meal, and cottonseed meal for approximately 150 days. The ration was assumed to result in gains of 1.4 pounds per day. Following the wintering period, heifers were

placed on a finishing ration consisting of the same ingredients as the wintering ration, but in larger quantities, for 50 days. Steers were assumed dry lot finished for 116 days. The expected rates of gain for the finishing periods were 2.0 and 2.5 pounds per day for the heifers and steers, respectively. Sale price was assumed to be $23.50 per hundredweight for heifers weighing 800 pounds and steers weighing 1,000 pounds.

The Beef III enterprise differed from Beef II only in the manner of handling steers following the wintering period. Following the wintering period, steers were pastured approximately 90 days prior to a 75-day finishing period which ended about September 15. The expected rates of gain for the two periods were 1.1 pounds per day and 2.0 pounds per day, respectively. The steers were expected to reach a weight of 1,000 pounds and sell for $23.50 per hundredweight.

Beef IV involved the purchase of feeder steers at an average weight of 450 pounds about October 1 for $24.00 per hundredweight. These calves were assumed to be wintered and finished in the same manner as were the steers in Beef III. The expected sale price and sale weight for steers produced by this operation were the same as in Beef III.

Dairy Enterprise

The Grade A dairy enterprise was not considered in this study. Production of manufacturing milk was considered as an enterprise alternative as this enterprise was the predominant dairy activity in the

region. Feed requirements for the enterprise and costs and returns were calculated for a 10-cow unit producing 7,500 pounds of milk per cow per year. The expected price of milk was $3.30 per hundredweight.

Replacement needs were assumed to be met by retaining approximately four heifers each year. The remaining six calves were sold at three days of age and two cull cows were assumed to be sold per year. Feed requirements, other than supplements, were met by grain and forage enterprises previously discussed. The forage and concentrate requirements of the livestock enterprises are presented in Appendix B and labor requirements are shown in Appendix D.

CHAPTER IV

RESULTS OF THE ANALYSES

I. INTRODUCTION

The optimal systems developed for the resource situations outlined earlier are presented in this chapter. The solutions sought were the minimum land and other resource requirements at each of the three specified income levels, with and without restrictions regarding farm type. Estimates of minimum land and other resources required to attain income levels of $3,000, $4,500, and $6,000 when farm type was unrestricted are presented in the second section of this chapter. Optimal systems for each of the income levels with particular farm type restrictions are presented in the third section of this chapter.

II. MINIMUM LAND REQUIREMENTS, UNRESTRICTED TYPE FARMS

The minimum land and other resources required for attainment of the income goals previously selected as approximating nonfarm incomes of unskilled, semi-skilled and skilled workers were estimated in the solutions to be discussed in this section. These solutions were unrestricted as to the enterprise alternatives which could be selected within the bounds of the model. Certain kinds of enterprises, with small or no land requirements or limited market potential, were excluded from the model. Broiler, truck gardening, and horticultural specialty

enterprises were not considered for this reason. The market limitations and the relatively small number of Grade A dairy farms in the study area were the reason for excluding this enterprise in the model.

No Type Restriction, One-man Labor Supply

The owner-operator farm solutions were based on the assumption that the farm operator had available 2,865 hours of labor per year for conducting combinations of the enterprise alternatives considered in this study. It was further assumed that seasonal labor could be hired during labor periods III through VI to allow for the harvesting of crops common to the study area. The amount of seasonal labor was restricted to no more than 1,400 hours, approximately 50 per cent of the man hours of one full-time worker.

$3,000 net income level. One hundred twenty acres of land, of which 91 acres were open land, were required to provide the $3,000 net return to operator labor and management as shown in Table XVII. The solution required an estimated $29,728 capital investment distributed in the following amounts: livestock, $2,888; buildings, $4,953; machinery, $3,640; and land, $18,247.

Total labor use was 2,569 hours of which 24 hours was seasonal labor hired during labor period V.

The major enterprise of this optimal system was the production of feeder pigs from 51 sows. Hay production of over 94 tons was from 32 acres of alfalfa, 4.8 acres of lespedeza, and 2.6 acres of orchard

TABLE XVII

ESTIMATED MINIMUM LAND AND OTHER RESOURCE REQUIREMENTS AND ENTERPRISE ORGANIZATIONS FOR SPECIFIED NET INCOME LEVELS ON OWNER-OPERATOR FARMS WITH NO TYPE OF FARM CONSTRAINT, EASTERN HIGHLAND RIM

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Resources				
Total land	Acres	120	410	No
Land investment	Dollars	18,247	62,416	
Livestock investment	Dollars	2,888	1,142	feasible
Building investment	Dollars	4,953	5,749	
Machinery investment	Dollars	3,640	7,322	solution
Total investment	Dollars	29,729	76,629	
Annual capital	Dollars	2,229	8,105	
Labor requirements				
Resident labor	Hours	2,545	2,650	
Seasonal labor	Hours	24	840	
Sources of gross income				
Swine	Dollars	9,270	9,050	
Beef	Dollars		4,772	
Tobacco	Dollars	417	1,425	
Hay	Dollars	2,827	8,019	
Soybeans	Dollars		1,536	
Gross income	Dollars	12,514	24,802	

TABLE XVII (continued)

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Open land	Acres	91.0	312.0	No
Crop land				
Corn	Acres	25.7	61.5	feasible
Soybeans	Acres		23.8	
Tobacco	Acres	.3	1.1	solution
Oats-lespedeza	Acres			
Pasture		14.2		
Hay		4.8		
Orchard grass-ladino				
Hay and pasture	Acres	2.6	39.1	
Fescue-ladino				
Pasture	Acres	11.1	43.8	
Red clover hay	Acres		137.7	
Alfalfa hay	Acres	32.0	4.3	
Building, lot space	Acres	.3	.7	
Livestock enterprises				
Beef IV	Steers		38	
Swine I	Sows		18	
Swine II	Sows	51	3	

grass-ladino hay and pasture. Grain crop production consisted of 25.7 acres of corn and 19 acres of oats. Pasture activities were: lespedeza, 14.2 acres and 11.1 acres of fescue-ladino clover in addition to the 2.6 acres of orchard grass-ladino clover used for both hay and pasture. All hay produced was sold. All grain grown was used for feeder pig production.

The income-producing activities were feeder pigs (Swine II), sale of hay, and .32 acre of tobacco. The sale of feeder pigs provided approximately 74 per cent of the total gross farm income of $12,514. Sale of hay was the second largest source of income providing 23 per cent of the gross income. Tobacco sales accounted for the remaining $417 of farm sales.

$4,500 net income level. A minimum of 410 acres of land, including 312 acres of open land, was required to meet the $4,500 income goal. The total investment required for this operation was estimated to be $76,629. Capital was distributed between livestock, $1,142; buildings, $5,749; machinery, $7,322; and land, $62,416 as shown in Table XVII, pages 50 and 51.

This system required 2,650 hours of operator labor or approximately 100 hours above the amount of operator labor needed to attain the $3,000 income goal. Seasonal labor hire totaled 840 hours during labor periods III, IV, V, and VI. Thus, total labor required for this system was approximately 900 hours greater than for the $3,000-income situation.

The enterprise organization for the owner-operator farm at the $4,500 income level was diversified. The major crops produced were: corn, 61.5 acres; soybeans, 23.8 acres; orchard grass-ladino hay and pasture, 39.1 acres; fescue-ladino pasture, 43.8 acres; and red clover hay, 137.7 acres. Tobacco acreage was 1.1 acres, the maximum allowable, and 4.3 acres of alfalfa were grown.

The livestock enterprises were Swine I, Swine II, and Beef IV. Combined swine production totaled 330 weaned pigs, from 21 sows, 40 head to be sold as feeder pigs (Swine II) and the balance to be fed to market weight. Beef IV, finishing steers, was included in the organization at the level of 38 head. The hay requirement for the beef enterprise was much less than the tonnage of hay produced, and hay sales were a larger source of income than beef sales.

The gross farm income necessary to obtain the $4,500 net operator income was $24,802. The gross income sources and the amounts from each were: swine, $9,050; beef, $4,772; tobacco, $1,425; hay, $8,019; and soybeans, $1,536.

$6,000 net income level. Given the assumptions of this study the achievement of a $6,000 net income for the owner-operator farm was not feasible. The limiting resource was labor supply. Labor was somewhat restrictive at the $4,500 income level, since 840 hours of the 1400 hours of available seasonal labor were required to satisfy that income goal.

No Type Restriction, Two-man Labor Supply

The resident labor supply was assumed to include that of the operator plus one full-time hired worker available at a cost of $2,400 per year. Resident labor supply for the farm was 5,730 hours and could be supplemented by as many as 1,400 hours of seasonal labor during labor periods III through VI.

$3,000 net income level. Satisfaction of the $3,000 net income goal with the two-man labor supply required a minimum of 200 acres of land as shown in Table XVIII. The distribution of total investment was $30,382 for land, $5,473 for livestock, $9,277 for buildings, and $5,748 for machinery, a total of $50,880.

Resident labor supply for this organization was adequate, with 1,216 hours of unused resident labor. No seasonal hired labor was used. Resident labor was in excess during all labor periods except period V.

The sole livestock enterprise in the farm organization, Swine II, was the source of $18,195 in gross income, or 86 per cent of the total sales.

Crop acreages grown were: corn, 47.2 acres; oats-lespedeza, 62.9 acres; fescue-ladino and orchard grass-ladino, 18.0 acres; and 22.6 acres of alfalfa. Tobacco acreage was the maximum allowable, .5 acre. The relatively large acreage of oats-lespedeza resulted in double cropping of more than one-third of the cropland. The use of the oats-lespedeza combinations for hay or pasture provided an important part of the grain and pasture required for the swine enterprise.

TABLE XVIII

ESTIMATED MINIMUM LAND AND OTHER RESOURCES REQUIRED AND ENTERPRISE ORGANIZATIONS FOR SPECIFIED NET INCOME LEVELS ON OWNER-HIRED WORKER FARMS WITH NO TYPE OF FARM CONSTRAINT, EASTERN HIGHLAND RIM

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Resources				
Total land	Acres	200	277	484
Land investment	Dollars	30,382	42,123	73,660
Livestock investment	Dollars	5,473	5,906	5,051
Building investment	Dollars	9,277	10,074	10,711
Machinery investment	Dollars	5,748	7,703	10,920
Total investment	Dollars	50,880	65,806	100,342
Annual capital	Dollars	3,953	4,567	9,379
Labor requirements				
Resident labor	Hours	4,514	5,247	4,810
Seasonal labor	Hours		68	613
Gross income sources				
Swine	Dollars	18,195	19,636	17,059
Beef	Dollars			4,662
Hay	Dollars	2,318	5,530	9,193
Tobacco	Dollars	694	962	1,681
Soybeans	Dollars			1,780
Gross farm income	Dollars	21,207	26,128	34,375

TABLE XVIII (continued)

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Open land	Acres	152.0	211.0	368.0
Crop land				
Corn	Acres	47.2	57.7	72.5
Soybeans	Acres			27.6
Tobacco	Acres	.5	.7	1.3
Oats-lespedeza				
Pasture	Acres	42.8	18.8	
Hay	Acres	20.1	12.0	
Orchard grass-ladino				
Pasture	Acres	3.1		
Hay and pasture	Acres		6.0	59.2
Fescue-ladino				
Pasture	Acres	14.9	29.5	51.6
Red clover hay	Acres		62.2	154.8
Alfalfa hay	Acres	22.6	23.2	
Building, lot space	Acres	.8	.9	1.0
Livestock enterprises				
Beef IV	Steers			37
Swine I	Sows			1
Swine II	Sows	100	108	91

$4,500 net income level. Increasing the net income goal 50 per cent from $3,000 to the $4,500 level required a 39 per cent increase in the minimum land needed, raising it to 277 acres. Capital investment required for this income level was $65,806. Livestock investment was $5,906; building investment, $10,074; and machinery investment, $7,703. Land required a $42,123 investment (Table XVIII, pages 55 and 56).

The resident labor supply was almost sufficient for labor requirements of the operation as only 68 hours of seasonal labor were hired. Small quantities of resident labor were unused during labor periods I, IV and VI.

The enterprise organization of this farm included the following crops: corn, 57.7 acres; tobacco, .7 acre; oat-lespedeza hay or pasture, 30.8 acres; orchard grass-ladino hay and pasture, 6.0 acres; fescue-ladino pasture, 29.5 acres; red clover hay, 62.2 acres; and alfalfa hay, 23.2 acres.

Production of feeder pigs was the only livestock enterprise included in the system and was the source of 75 per cent of the total gross income of $26,128. The sale of hay was the second largest source of income returning $5,530 and tobacco sales ranked third providing $962 of gross income.

$6,000 net income level. The $6,000 income goal required a minimum of 484 acres of total land or 368 acres of open land. Total capital investment was $100,342 of which $73,660 was invested in the required land. Investments of $5,051, $10,711, and $10,920 were

required for livestock, buildings, and machinery, respectively (Table XVIII, pages 55 and 56).

Resident labor use totaled 4810 hours, 437 hours less than for the $4,500 income system. Seasonal hired labor use was 613 hours reflecting a shift to more extensive field crop production to meet the $6,000 income goal.

The optimum solution included both Swine I and Swine II; 91 sows producing feeder pigs and one sow producing pigs to be fed to slaughter weight. The Beef IV enterprise involved production of 37 finished steers.

Crop enterprises were less diversified than in the solutions for the $3,000 and $4,500 income levels. The crops grown were: corn, 72.5 acres; soybeans, 27.6 acres; tobacco, 1.3 acres; orchard grass-ladino hay and pasture, 59.2 acres; fescue-ladino pasture, 51.6 acres; and red clover hay, 154.8 acres.

Gross income required to obtain $6,000 net operator income was $34,375, of which approximately 50 per cent was provided by swine sales. The sale of hay returned $9,193 and beef sales brought $4,662, providing about 27 and 14 per cent, respectively, of gross farm income.

Variation of Resident Labor Supply on Minimum Land Requirement

$3,000 net income level. When the specified income goal was $3,000 the addition of a full-time worker at a cost of $2,400 annually was in a sense identical to raising the net income goal 80 per cent,

while doubling available labor supply. The two-man farm required 200 acres, compared to 120 acres for the owner-operator farm returning a net income of $3,000, an increase of approximately 67 per cent in minimum land needs (Table XVII, pages 50 and 51 and Table XVIII, pages 55 and 56).

The total capital investment needs rose 71 per cent, from $29,728 for the one-man system to $50,880 for the two-man system. The investment requirements for livestock and buildings each rose nearly 90 per cent while machinery investment needs increased approximately 58 per cent.

Enterprises included in the optimal systems for the $3,000 income level were similar in kind for both the one-man and two-man labor situations. Corn acreage was approximately doubled, from 25.8 to 47.2 acres; oat-lespedeza acreage more than trebled, from 19.1 to 62.9; and orchard grass- or fescue-ladino combinations increased slightly from 13.7 to 18.0 acres. Less alfalfa was grown on the two-man farm, 22.6 acres as compared to 32.0 acres for the owner-operated farm.

At the $3,000 income level both the unrestricted one-man and two-man solutions were highly specialized hog systems producing feeder pigs. The availability of a two-man labor supply with associated cost resulted in doubling of the number of sows (Swine II) from 51 to 100 head. A gross income of $21,207 was indicated for the two-man situation of which 86 per cent came from the sale of hogs. The optimal system for the one-man labor supply provided gross sales of $12,514, 75 per cent

resulting from the sale of feeder pigs. Thus, a 69 per cent increase in gross income was required to meet the added labor expense.

$4,500 net income level. The minimum land requirement was 277 acres for the two-man labor supply as compared to 410 acres for the one-man labor supply at the $4,500 income level. This indicated a degree of substitutability between labor and land resources. Capital investment for the owner-hired worker situation was $65,806 and $76,629 for the owner-operator situation. Investment in livestock, buildings and machinery for the two-man labor supply was nearly $23,700, as compared to the $14,171 investment in these same items for the one-man system (Table XVII, pages 50 and 51, and Table XVIII, pages 55 and 56).

The two-man labor supply allowed specialization in feeder pig production which returned 75 per cent of the $26,128 gross income. The owner-operator solution was more diversified with hay and feeder pigs, each the source of approximately 33 per cent of the gross income, and beef steers providing 19 per cent. Other income sources for the one-man system were tobacco and soybeans.

$6,000 net income level. The attainment of $6,000 net labor and management income from an unrestricted type farm was infeasible within the restrictions of the one-man resident labor supply. The optimal two-man system at the $6,000 income level was presented in an earlier section.

III. OPTIMAL SYSTEMS FOR SPECIFIED FARM TYPES

The solutions discussed in this section were restricted to obtain optimal systems representative of specific types of farms. Farm type was defined as a situation in which 55 per cent, or more, of the gross income was provided by the specified enterprise or enterprises. The minimum land requirements for beef systems were sought considering Beef I, II, III, and IV as alternative beef activities at each income level and resident labor supply. For the swine farm type the two alternatives were production of feeder pigs and production of slaughter hogs. For the dairy type systems, only production of ungraded milk was considered.

Beef Type Restriction, One-man Labor Supply

As for the unrestricted farm types the one-man labor situation assumed availability of 2,865 hours of resident labor and the option of hiring no more than 1,400 hours of seasonal labor at a cost of $1.125 per hour. The beef type could include one or a combination of the three beef cow-calf systems (Beef I, II, and III) or the buying and finishing of steers (Beef IV).

$3,000 net income level. Two hundred thirteen acres of land was the estimated minimum requirement to obtain a $3,000 net income from the one-man beef system. Total investment capital required was $44,994 as shown in Table XIX. The total investment required was constituted as

TABLE XIX

ESTIMATED MINIMUM LAND AND OTHER RESOURCES REQUIRED AND ENTERPRISE ORGANIZATIONS FOR SPECIFIED NET INCOME LEVELS ON OWNER-OPERATOR BEEF FARMS, EASTERN HIGHLAND RIM

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Resources				
Total land	Acres	213	456	No
Land investment	Dollars	32,439	69,424	
Livestock investment	Dollars	1,764	445	feasible
Building investment	Dollars	6,358	7,219	
Machinery investment	Dollars	4,433	9,371	solution
Total investment	Dollars	44,994	86,459	
Annual capital	Dollars	10,001	15,894	
Labor requirements				
Resident labor	Hours	2,533	2,687	
Seasonal labor	Hours		480	
Sources of gross income				
Swine	Dollars	5,865	3,812	
Beef	Dollars	8,478	14,039	
Tobacco	Dollars	741	1,586	
Hay	Dollars	331	4,288	
Soybeans	Dollars		1,801	
Gross farm income	Dollars	15,415	25,526	

TABLE XIX (continued)

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Open land	Acres	162.0	347.0	No
Crop land				
				feasible
Corn	Acres	35.0	63.5	
Soybeans	Acres		27.6	solution
Tobacco	Acres	.6	1.2	
Oats-lespedeza				
Pasture	Acres	27.7		
Hay	Acres	6.0	6.1	
Orchard grass-ladino				
Pasture	Acres	41.0	59.8	
Hay and pasture	Acres	9.9	48.1	
Fescue-ladino				
Pasture	Acres	22.6	48.6	
Red clover hay	Acres		90.6	
Alfalfa hay	Acres	17.9		
Building, lot space	Acres	1.3	1.5	
Livestock enterprises				
Beef IV	Steers	67	110	
Swine I	Sows		8	
Swine II	Sows	32		

markedly from $2,229 to $10,001 as the Beef IV enterprise required an annual outlay of approximately $7,500 for purchase of feeder steers.

There was little difference in the total labor requirements for the unrestricted system and the beef system at the $3,000 income level. Both systems used approximately 2540 hours of operator labor. The solution for the unrestricted farm type included only 24 hours of seasonal labor while no hired labor was necessary for the beef system.

The beef type system included the Beef IV enterprise in addition to the enterprises found in the unrestricted type system. The one-man beef type system included 67 steers and 32 sows (Swine II) as compared to 51 sows (Swine II) which were the only livestock included in the unrestricted system at the $3,000 income level. Hay and tobacco sales were the source of 5 and 2 per cent of the gross income, which totaled $15,415. By comparison the unrestricted system grossed $12,514 of which 74 per cent was provided by Swine II.

$4,500 net income level. The one-man beef system at the $4,500 income level required a minimum of 456 acres of land and a capital investment of $86,459 (Table XIX, pages 62 and 63). Livestock investment was $445 for the eight-sow swine herd. Beef building and equipment needs were included in the building investment. The purchase price of the steers was charged as annual capital. Building and machinery investments for this system were $7,219 and $9,371 respectively. Land investment, $69,424, was approximately 80 per cent of the total investment required. The annual capital requirement of the system was $15,894.

The livestock enterprises were Beef IV and Swine I with 110 steers and 8 sows. The enterprises provided a total gross income of $25,526. Beef IV was the source of 55 per cent of the gross as specified by the model. The balance of gross income came from sales of swine for $3,812; tobacco, $1,586; hay, $4,288; and soybeans, $1,801.

Crop enterprises were corn, 63.5 acres; soybeans, 27.6 acres; tobacco, 1.2 acres; oat-lespedeza hay, 6.1 acres; orchard grass-ladino, 156.5 acres; and red clover, 90.6 acres.

The operator labor requirement was 2,687 hours and 480 hours of seasonal labor were hired for the operation.

Comparison of the one-man beef system with the unrestricted type owner-operator system revealed several similarities. The minimum land requirement for the beef system was 456 acres as compared to 410 acres for the unrestricted system. Total labor requirement was less for the beef type system.

Both the beef system and the unrestricted system returning $4,500 operator net incomes included production of beef and swine. The beef system was organized for the production of 110 fed steers and market hogs from 8 brood sows, whereas the unrestricted system included 38 steers, and 21 sows producing 40 feeder pigs and 290 slaughter hogs.

Gross incomes of the unrestricted and the beef system were comparable at $24,802 for the unrestricted system and $25,526 for the beef system. Beef provided 55 per cent of the gross income for the

beef system as specified. The balance of income was contributed by sales of hay, 17 per cent; swine, 15 per cent; soybeans, 7 per cent; and tobacco, 6 per cent. The gross income for the unrestricted system was provided by swine, 37 per cent; hay sales, 37 per cent; beef, 19 per cent; tobacco, 6 per cent; and soybeans, 6 per cent.

Beef Type Restriction, Two-man Labor Supply

$3,000 net income level. The two-man beef system at the $3,000-income level required a total of 352 acres, or 268 acres of open land. Required capital investment was $75,076 of which $53,538, or 71 per cent, was for land. Other investments were livestock, $3,155; buildings, $10,745; and machinery, $7,638 (Table XX) The livestock investment of $3,155 included the value of the 58 sows while the $16,749 of annual capital included the purchase of 112 steers.

Livestock enterprises were Beef IV (112 steers) and Swine II (58 sows). No cow-calf production (Beef I, II, or III) was included. The beef enterprise was, as specified, the source of 55 per cent of the gross income; the balance of income was from the swine and tobacco enterprises at 40 per cent and 5 per cent, respectively. Gross farm sales totaled $26,028.

Crop enterprises were 67.1 acres of corn, .9 acre of tobacco, 47.3 acres of oats-lespedeza pasture, 70.8 acres of orchard grass-ladino pasture and 15.8 acres of orchard grass-ladino hay and pasture, 37.3 acres of fescue-ladino pasture and 26.3 acres of alfalfa hay.

TABLE XX

ESTIMATED MINIMUM LAND AND OTHER RESOURCES REQUIRED AND ENTERPRISE ORGANIZATIONS FOR PSECIFIED NET INCOME LEVELS ON OWNER-HIRED WORKER BEEF FARMS, EASTERN HIGHLAND RIM

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Resources				
Total land	Acres	352	441	621
Land investment	Dollars	53,538	67,092	95,541
Livestock investment	Dollars	3,155	3,794	2,950
Building investment	Dollars	10,745	12,868	13,261
Machinery investment	Dollars	7,638	8,464	11,993
Total investment	Dollars	75,076	92,218	123,745
Annual capital	Dollars	16,749	20,129	24,311
Labor requirements				
Resident labor	Hours	4,105	4,919	4,915
Seasonal labor	Hours			329
Sources of gross income				
Swine	Dollars	10,490	12,614	9,809
Beef	Dollars	14,315	17,290	21,390
Tobacco	Dollars	1,223	1,532	2,159
Hay	Dollars			3,655
Soybeans	Dollars			1,878
Gross farm income	Dollars	26,028	31,436	38,891

TABLE XX (continued)

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Open land	Acres	268.0	335.0	473.0
Crop land				
Corn	Acres	67.1	85.9	92.8
Soybeans	Acres			29.2
Tobacco	Acres	.9	1.2	1.7
Oats-lespedeza				
Pasture	Acres	47.3	39.8	
Hay	Acres		3.6	24.6
Orchard grass-ladino				
Pasture	Acres	70.8	88.0	100.3
Hay and pasture	Acres	15.8	35.2	78.1
Fescue-ladino				
Pasture	Acres	37.3	46.7	66.0
Red clover hay	Acres		26.5	76.8
Alfalfa hay	Acres	26.3	5.1	
Building, lot space	Acres	2.5	3.0	3.5
Livestock enterprises				
Beef IV	Steers	112	136	168
Swine II	Sows	58	69	54

No seasonal labor was required for the operation and 4,105 hours of the resident labor supply were used.

The two-man beef system required approximately 75 per cent more land than the unrestricted type two-man system and approximately 50 per cent more capital investment. The beef operation required 400 hours less annual labor than the unrestricted system. Neither system required the hiring of seasonal labor.

The unrestricted type system included no beef production and almost 86 per cent of the gross income was from the Swine II enterprise. With the beef-type restriction 55 per cent of the gross income was provided from beef sales, 40 per cent from swine, and 5 per cent from tobacco.

$4,500 net income level. With an assumed two-man labor supply the minimum land required for a $4,500 net operator income from a beef system was 441 acres. The investment capital required was $92,218, with $67,092 (73 per cent) required for land as shown in Table XX, pages 68 and 69. Other investments were $12,868 in buildings, $8,464 for machinery, and $3,794 for livestock. The livestock investment included only the average value of the 69-sow swine herd as the steer purchase cost was charged to annual capital.

The livestock enterprises were 136 beef steers (Beef IV) and 69 sows producing feeder pigs (Swine II). The income sources were beef, 55 per cent; feeder pigs, 40 per cent; and tobacco, 5 per cent. Gross income for the organization totaled $31,436.

The row crops included were corn and tobacco at 85.9 and 1.2 acres, respectively. Pasture crops were orchard grass-ladino clover, 88.0 acres; fescue-ladino clover, 46.7 acres; oats-lespedeza, 39.8; and 35.2 acres of orchard grass-ladino for joint hay-pasture use. Hay sources included 35.2 acres of orchard grass-ladino clover for hay and pasture supplemented by 5.1 acres of alfalfa and 26.5 acres of red clover.

The optimal system required about 86 per cent of the available resident labor supply of 5,730 hours but no seasonal hired labor was necessary.

For the unrestricted type system with the same labor supply and income level 75 per cent of gross income resulted from the sale of hogs and 21 per cent from the sale of hay. The unrestricted system required $26,128 of gross income to provide a $4,500 net operator return.

$6,000 net income level. To achieve the $6,000-income level a minimum of 621 acres of land was required of which 473 acres were open land (Table XX, pages 68 and 69). Total capital requirement was estimated to be $123,745. Land investment was approximately 77 per cent of the total amounting to $95,541. Livestock investment was $2,950, and building and machinery investments were $13,261 and $11,993, respectively. The $24,311 annual capital requirement included the purchase of steers for the Beef IV enterprise.

The beef steer feeding activity (Beef IV) involving 168 head provided 55 per cent of the $38,891 gross farm income. Swine II was the

source of 25 per cent of the gross income. The remaining sources of gross income were tobacco, 6 per cent; hay, 9 per cent; and soybeans, 5 per cent.

Crop enterprises included the production of corn, 92.8 acres; tobacco, 1.7 acres; soybeans, 29.2 acres; and oats followed by lespedeza for hay, 24.6 acres. Orchard grass-ladino clover and fescue-ladino clover pasture acreage totaled 166.3. The system included 76.8 acres of red clover grown for hay.

Annual labor requirement for the operation was satisfied by use of 4,915 hours of resident labor and 329 hours of seasonal labor.

Comparison with the unrestricted $6,000-income system showed that 137 more acres of land and $27,450 more capital were required to realize an equal net income. The beef system required approximately 200 hours less labor per year than the unrestricted type system.

Income sources for the two systems were the same, however, they were proportioned quite differently. For the unrestricted system 50 per cent of the gross sales was from swine and 27 per cent was from beef. For the beef type system 55 per cent of gross income came from beef and 25 per cent from swine.

Other Beef Systems

Even though four beef systems were included as alternatives in the programming model only Beef IV, the steer feeding system, was included in any of the optimum farm organizations discussed in the previous sections. The other three beef systems included as alternatives

(Beef I, II, and III) were variations of a cow-calf system. As beef cow-calf systems were much more common in the study area the programming model was extended to include a beef farm type restriction requiring 55 per cent or more of the gross income to come from Beef I, II, and/or III. With Beef IV excluded as a production alternative, solutions were infeasible for the beef type system with either one-man and two-man labor supplies at the $3,000, $4,500, and $6,000 income levels.

Swine Type Restriction, One-man Labor Supply

The unrestricted farm type solutions discussed previously satisfied the requirements for the swine type system in several cases. A swine type operation was defined as one in which 55 per cent or more of the gross income came from swine sales (Swine I and/or Swine II).

$3,000 net income level. The solution for this system was obtained as the unrestricted one-man operation and was discussed in detail earlier. The sale of feeder pigs was the source of 74 per cent of the gross farm income in this organization. The minimum land requirement for the farm at the $3,000 net income level was 120 acres.

$4,500 net income level. An infeasibility was obtained when the $4,500 owner-operator swine farm was programmed. The infeasibility indicated that given the assumed labor supply and other restrictions simultaneous satisfaction of the specified gross income ratio and the net income constraint was impossible.

$6,000 net income level. There was no feasible solution for this income level and one-man resident labor situation in the unrestricted farm type situation. Therefore, no solution for the swine system at the $6,000 income level was possible.

Swine Type Restriction, Two-man Labor Supply

Solutions discussed earlier for the two-man labor supply with unrestricted farm type satisfy the definition of a swine system at the $3,000 and $4,500 net income levels. In the unrestricted type solution at the $3,000 income level, Swine II was the source of 86 per cent of the gross income. At the $4,500 income level 75 per cent of the gross income was provided by the Swine II enterprise. The unrestricted solution for the two-man labor situation at the $6,000 income level included the Swine II enterprise at a level sufficient to provide only 50 per cent of the gross income. Thus an optimal system in which the swine enterprise provided 55 per cent or more of the total gross income at the $6,000 net income level was determined.

$6,000 net income level. To obtain at least 55 per cent of gross income from swine production and a net labor income of $6,000 as estimated 505 acres of land were required. Open land for this system amounted to 384 acres. Capital investment was estimated to be $102,440. Division of the required capital was as follows: livestock, $4,661; buildings, $9,478; machinery, $11, 465; and land $76,836. The land investment was 75 per cent of the total (Table XXI).

TABLE XXI

ESTIMATED MINIMUM LAND AND OTHER RESOURCES REQUIRED AND ENTERPRISE ORGANIZATIONS FOR SPECIFIED NET INCOME LEVELS ON OWNER-HIRED WORKER SWINE FARMS, EASTERN HIGHLAND RIM

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Resources				
Total land	Acres	200	277	505
Land investment	Dollars	30,382	42,123	76,836
Livestock investment	Dollars	5,473	5,906	4,661
Building investment	Dollars	9,277	10,074	9,478
Machinery investment	Dollars	5,748	7,703	11,465
Total investment	Dollars	50,880	65,806	102,440
Annual capital	Dollars	3,953	4,567	8,150
Labor requirements				
Resident labor	Hours	4,514	5,246	5,366
Seasonal labor	Hours		68	676
Sources of gross income				
Swine	Dollars	18,195	19,636	19,589
Beef	Dollars			2,715
Tobacco	Dollars	694	962	1,754
Soybeans	Dollars			1,002
Hay	Dollars	2,318	5,530	10,555
Gross farm income	Dollars	21,207	26,128	35,616

TABLE XXI (continued)

Item	Unit	Level of net return to operator labor		
		$3,000	$4,500	$6,000
Open land	Acres	152.0	211.0	384.0
Crop land				
Corn	Acres	47.2	57.7	89.6
Soybeans	Acres			15.6
Tobacco	Acres	.5	.7	1.4
Oats-lespedeza				
Pasture	Acres	42.8	18.8	
Hay	Acres	20.1	12.0	
Orchard grass-ladino				
Pasture	Acres	3.1		
Hay and pasture	Acres		6.0	45.5
Fescue-ladino				
Pasture	Acres	14.9	29.5	33.9
Red clover hay	Acres		62.2	169.6
Alfalfa hay	Acres	22.6	23.2	8.0
Idle land	Acres			19.4
Building, lot space	Acres	.8	.9	1.0
Livestock enterprises				
Beef IV	Steers			21
Swine I	Sows			14
Swine II	Sows	100	108	91

Dairy Systems

As stated earlier the Grade A dairy enterprise was excluded from this study by reason of the small number of such producers and the limited market potential for Grade A milk in the Eastern Highland Rim.

The Grade C dairy enterprise was considered but did not enter in any of the unrestricted farm type solutions developed in this study. Using the farm type restriction 55 per cent or more of the gross income was required to come from dairy. Given the cost price and input-output relationships used for this study the Grade C dairy systems were infeasible at all three income levels considering either the one-man or two-man resident labor supplies.

CHAPTER V

SUMMARY AND IMPLICATIONS

I. SUMMARY

The objectives of this study were: (1) to estimate the minimum land requirements for farm systems which would provide net returns to operator labor and management of $3,000, $4,500, and $6,000; (2) to estimate the effects of variations in resident labor supply and farm type upon the minimum land requirements at each of the specified levels of income; and (3) to compare the enterprise organizations of the systems developed.

Background data were obtained from a previous survey of a sample of Putnam County farms and census data for the 12 Eastern Highland Rim counties. The soils characteristics obtained from a summary of the soils on a sample of Putnam County farms were used to develop a single soils distribution representative of the three soil associations comprising the study area. The land resource was assumed to be completely variable and a land purchase activity provided the means for estimating minimum land requirements given the income goals and the labor and farm type situations considered in this study. This study was concerned with the Cumberland-Waynesboro, Baxter-Mountview-Bewleyville, and Dickson-Mountview-Bewleyville soil associations of the Eastern Highland Rim of Tennessee.

The farm types considered in the study were unrestricted, dairy (manufacturing milk), beef, and swine. The type definition for the livestock systems was satisfied when the specified enterprise or group of enterprises provided 55 per cent, or more, of the gross income of the organization.

The enterprise alternatives included were generally limited to those commonly found on farms throughout the study area. Budgets were developed specifying the resource requirements, costs, and returns for these enterprises. The cost-price relationships used generally reflected expected long-run costs and price relationships. The linear programming technique was used to estimate the minimum land requirements and the optimal enterprise organizations.

There were 24 labor-farm type- income situations considered in the study. For these 24 situations 11 optimal solutions were obtained; the remainder were infeasible. Certain of the optimal systems developed for unrestricted farm-type situations also satisfied the definition of a swine system since more than 55 per cent of gross farm income was provided by swine sales. No feasible systems were obtained for the dairy and beef cow-calf type systems, nor was any feasible solution obtained for the unrestricted one-man resident labor situation at the $6,000 income level.

Wide variations in the minimum land requirements for farming systems in the study area were indicated as income goals, labor situation, and farm type were varied. The minimum land requirements ranged

from 120 acres for the one-man labor supply unrestricted type system returning $3,000 to 621 acres for the two-man beef type system returning $6,000 to operator labor and management. The estimated capital investments for these systems were $29,729 and $123,745, respectively.

With unrestricted farm type and one-man labor supply feasible solutions were obtained for the $3,000 and $4,500 income levels but not for the $6,000 income level. The minimum land requirements were 120 acres at the $3,000 income level and 410 acres at the $4,500 income level. An increase of 240 per cent in the minimum acreage was required to satisfy a 50 per cent increase in the income goal along with an estimated increase of 158 per cent in the capital investment. These increases were the results of shifts to land extensive enterprises as the fixed labor supply became more limiting.

The enterprise organizations for the unrestricted farm type systems varied from highly specialized swine systems to more diverse operations including Beef IV and higher proportions of field crops as the income goal increased and the labor supplies became more restrictive.

The beef type systems for both the one-man and two-man resident labor situations were feasible only when Beef IV was the included enterprise. No feasible solutions were obtained when Beef IV was excluded and Beef I, II, and III were the alternatives considered. The one-man beef systems required minimums of 213 and 465 acres to provide returns of $3,000 and $4,500. The two-man beef system required minimums of 352,

441, and 621 acres to provide net returns of $3,000, $4,500, and $6,000.

Swine enterprises were included in the organization of all optimal systems developed in this study. The importance of the swine enterprises varied from providing 15 per cent of the gross income for the one-man $4,500 beef type situation to providing 86 per cent of the gross income for the two-man, unrestricted type situation.

Corn, tobacco, and fescue-ladino clover pasture were the crop enterprises most consistently included in the optimal systems developed. Tobacco was produced in all systems to the full extent of the acreage allotment. Fescue-ladino pasture was included in the systems developed to the extent that soils V and VI were present in all but one of the systems. Corn production was generally included on about 25 per cent of the open land acreage for the smaller systems and decreased in relative importance to approximately 15 per cent of the open acreage of the larger systems as acreage of hay and soybeans increased. None of the optimal systems included the corn selling alternative but used all corn produced for livestock feed.

The production of alfalfa hay and of lespedeza for hay or pasture were usually included in the systems developed for the $3,000 income level. The relative importance of these two crops decreased, however, as the minimum farm size was increased to meet the $4,500 and $6,000 income goals. Labor supply and seasonal labor requirements became more critical for systems with the higher income goals. Red clover hay production was generally included in the $4,500 income systems and

increased in importance replacing most of or all of the alfalfa and lespedeza production for the $6,000 income systems.

II. IMPLICATIONS

The extent of resource adjustment needed if farmers in the study area are to attain net labor-management returns comparable to industrial wages for unskilled, semi-skilled, and skilled workers cannot be directly determined from the data available. However, the average value of farm assets on a random sample of Putnam County farms surveyed in 1961 was $22,345, while the estimated value of these same assets for the smallest optimal system developed in this study was $29,728. The average gross income of farmers surveyed in Putnam County was $2,357, an amount obviously too low to provide the minimum $3,000 net return to operator labor considered in this study. The gross income of $12,514 required to provide a $3,000 net return was more than 5 times the average gross income for the random sample of Putnam County farmers. The $3,000 income level approximated the median income of unskilled non farm workers in the United States in 1960.

To realize a $3,000 net return required gross returns exceeding those realized by more than 93.6 per cent of Eastern Highland Rim farmers in 1959. Estimated gross sales for systems developed in the study ranged from $12,514 to $26,028 to provide a $3,000 net return to operator labor. The owner-operator swine and owner-operator beef systems at the $3,000 income level provided gross incomes within the

range of Economic Class III ($10,000-$19,999 gross sales). Only 6.4 per cent of commercial farmers in the Eastern Highland Rim had sales of more than $10,000 during the year 1959.

All other optimal systems developed had estimated gross sales within the range of $20,000 to $39,999, or equivalent to Economic Class II. The two-man swine system returning a $3,000 net operator income and the two-man beef system returning a $6,000 net to operator labor had gross incomes estimated at $21,206 and $38,891, both in the range of Economic Class II. Only 1.5 per cent of Eastern Highland Rim farmers had gross farm sales equal to or exceeding $20,000 in 1959 (Economic Classes I and II).

The study has primary implication for the area comprised of the Baxter-Mountview-Bewleyville, Dickson-Mountview-Bewleyville, and the Cumberland-Waynesboro soil associations if the underlying assumptions are accepted. The study results are normative and indicative of what should be if the assumed conditions existed but are not predictive of adjustments that individual farmers might undertake under the same circumstances.

Adjustments in resource use in the study area will undoubtedly be affected by the level of efficiency achieved by the farm operators of the area. Bound's study of the Baxter-Mountview-Bewleyville soil association and census data revealed that many farmers fail to achieve the efficiency levels assumed for this analysis. Failure to achieve a comparable level of efficiency necessarily implies that minimum land

requirements would be larger for the specified income levels than systems developed in this study.

Certain enterprises with limited land requirements or for which limited markets are expected to prevail in the long run were excluded from this study. It must be recognized that some limited opportunity exists in the study area for individual farmers to adjust toward production of horticultural specialty crops, broilers, Grade A milk, and other specialty products.

Since net incomes for this study were computed on the basis of returns to labor and management only, a charge of 5 per cent interest for land investment and a 6 per cent interest charge for non-land investments were treated as costs of operation. Modification of the model to treat returns as income to both labor and capital investment, i.e., no interest charge for capital, would likely allow attainment of the specified income goals with lower minimum land requirements than resulted in this study. It also seems likely that elimination of charges for capital might have allowed the inclusion of dairy and beef cow-calf enterprises at a level which would have met the type restriction imposed in this study.

Since acreage requirements for most of the systems reported in this study are considerably larger than the average commercial farm size in the Eastern Highland Rim, adjustments toward the income goals of this study by farm operators would result in larger and considerably fewer farms in the study area.

SELECTED BIBLIOGRAPHY

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A guide to Procedures in Southern Research Project S-42, Revised. "An Economic Appraisal of Farming Adjustment Opportunities in the Southern Region to Meet Changing Conditions." Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, Unpublished, August 1964.

Amick, R. J., and J. R. Allison. Minimum Land Requirements for Specified Levels of Income for General Crop-Livestock Farms in the Piedmont of Georgia. Bulletin N. S. 146. Athens, Georgia: Georgia Agricultural Experiment Station, September 1965.

Atkins, S. W. Increasing Incomes Through Farm Adjustments in the Red Soil Area, Eastern Highland Rim of Tennessee. Bulletin No. 245, Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, December 1955.

Barnhill, H. E. Resource Requirements on Farms for Specified Operator Incomes. Agricultural Economic Report No. 5. Washington: Government Printing Office, November 1964.

Bounds, V. M. "Farm Adjustment Opportunities in the Baxter-Mountview-Bewleyville Soil Association of the Eastern Highland Rim of Tennessee." Unpublished Master's thesis, The University of Tennessee, Knoxville, 1963.

Brewster, John M. Farm Resources for Specified Income Levels. Agricultural Information Bulletin No. 180. Washington: Government Printing Office, December 1957.

_____. "Analyzing Minimum Resource Requirements for Specified Income Levels," Farm Size and Output Research: A Study in Research Methods. Southern Cooperative Series Bulletin No. 56. Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, 1958.

Coltrain, R. I., and E. L. Baum. An Economic Survey of the Appalachian Region, with Special Reference to Agriculture. Washington: Government Printing Office, April 1965.

Cleland, Charles L. Selected Population and Agricultural Characteristics for Tennessee Counties. Bulletin 359. Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, January 1963.

Economic Research Service, United States Department of Agriculture. Net Migration of the Population, 1950-60. Vol. 1, Part 4. Washington: Government Printing Office, 1965.

Johnson, G. G. "Comparability of Labor Capacities of Farm and Nonfarm Labor," The American Economic Review. Vol. 43, No. 3. Menasha, Wisconsin: The American Economic Association, June 1953.

Jones, G. C., P. L. Strickland, and E. J. Partenheimer. Minimum Open Land Requirements for a $5,000 Farm Income, Wiregrass Area, Lower Coastal Plains, Alabama. Agricultural Economics Series 6. Auburn, Alabama: Agricultural Experiment Station of Auburn University, July 1965.

Lanham, W. J., and A. J. Coutu. Area Resource Adjustments for Specified Net Revenue Goals and Levels of Factor Prices on Farms in Economic Area 7, North Carolina. Agricultural Economics Series No. 109. Raleigh, North Carolina: The University of North Carolina, January 1964.

Martin, Joe A., and B. H. Luebke. Types of Farming in Tennessee. Bulletin 311. Knoxville, Tennessee: The University of Tennessee Agricultural Experiment Station, March 1960.

Milk Market Information. Monthly Report of Market Administrator, Chattanooga, Tennessee, September 1961.

Milk Market Information. Monthly Report of Market Administrator, Nashville, Tennessee, December 1961.

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

Soil Conservation Service, United States Department of Agriculture. Soil Survey, Putnam County, Tennessee. Washington: Government Printing Office, November 1963.

Strickland, P. L., J. S. Plaxico, and W. F. Lagrone. Minimum Land Requirements and Adjustments for Specified Income Levels, Southwestern Oklahoma. Bulletin B-608. Stillwater, Oklahoma: Oklahoma Agricultural Experiment Station, May 1963.

Tennessee Department of Agriculture. Excellence Attained, 45th Biennial Report, 1963-1964. Nashville, Tennessee: Tennessee Department of Agriculture, 1964.

Tweeten, L. G. "The Income Structure of Farms of Economic Class," Journal of Farm Economics, Vol. 47, No. 2. Menasha, Wisconsin: The American Farm Economic Association, November 1965.

Tyner, F. H. "Minimum Land Requirements for Specified Levels of Income in the Delta Area of Mississippi." Unpublished Master's thesis, Mississippi State University, State College, 1962.

United States Bureau of the Census. Fifteenth and Seventeenth Censuses of the United States: 1950 and 1960. Population and Agriculture. Washington: Government Printing Office.

APPENDIXES

APPENDIX A

PRODUCT AND INPUT PRICES

TABLE XXII

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

Item	Unit	Price (Dollars)
Prices received:		
Burley tobacco	lb.	.62
Slaughter hogs (200 lbs.)	cwt.	14.50
Feeder pigs (40 lbs.)	head	10.50
Sows, cull	cwt.	11.00
Slaughter steers (1,000 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.	2.30
Oats	bu.	.70
Corn	bu.	1.10
Hay, equivalent	ton	30.00

TABLE XXII (continued)

Item		Unit	Price (Dollars)
Prices paid:			
Seed:	Alfalfa	lb.	.45
	Ladino clover	lb.	.65
	Korean lespedeza	lb.	.20
	Orchard grass	lb.	.32
	Oats, certified	bu.	1.40
	Corn, hybrid	bu.	10.08
	Soybeans	bu.	4.25
Feed:			
	Dairy calf starter	cwt.	5.00
	Cottonseed meal	cwt.	3.70
	Salt	cwt.	2.00
	Minerals	cwt.	2.00
Fertilizer:			
	Nitrogen	lb.	.12
	6-12-12	cwt.	2.60
	0-20-20	cwt.	2.45
	0-20-30	cwt.	2.95
	0-9-27	cwt.	2.25
	Lime (spread)	ton	5.00
Labor		hour	1.125
Feeder steers (450 lbs.)		cwt.	24.00

APPENDIX B

FORAGE AND CONCENTRATE REQUIREMENTS FOR LIVESTOCK

TABLE XXIII

ESTIMATED FORAGE REQUIREMENTS FOR LIVESTOCK ENTERPRISES

Livestock enterprise	Forage periods[a]				
	I	II	III	IV	V
	Tons	CAD	CAD	CAD	CAD
Dairy, grade C	15.98	936	741	741	559
Beef I	33.9	2,128	1,708	1,708	1,288
Beef II	52.2	2,128	1,708	1,708	1,288
Beef III	51.1	2,664	1,875	1,708	1,288
Beef IV	9.25	450	225	0	345

[a]Forage requirements are in terms of hay equivalents for period I and in terms of Cow Acre Days for periods II-V.

TABLE XXIV

ESTIMATED GRAIN AND SUPPLEMENT REQUIREMENTS FOR LIVESTOCK ENTERPRISES

Enterprise	Corn (Bushels)	Protein supplement (Cwt.)	Mineralized salt (Cwt.)
Beef I[a]			6.0
Beef II	579.5	59.5	9.0
Beef III	455.5	50.7	9.0
Beef IV	310.0	32.8	2.0
Dairy	221.6	50.0	3.0[b]
Swine I	2,224.3	221.4[c]	
Swine II	550.3	54.0[c]	

[a]No corn or protein supplement were assumed necessary for cow herd maintanence as grass-legume pasture and legume hay were available. Creep feeding of calves was not considered for beef enterprises.

[b]It was assumed that 63 pounds of mineral mixture would be used by the 10-cow unit in conjunction with this amount of plain salt.

[c]Swine supplements included salt and mineral requirements.

APPENDIX C

ESTIMATED MACHINERY USE AND INVESTMENT PER ACRE FOR SELECTED CROPS

TABLE XXV

ESTIMATED HOURS OF ANNUAL MACHINERY USE

Machine	Description	Farm size	
		Small	Medium
		(Hours)	
Tractor	25 DBHP		400
	35 DBHP	570	
	45 DBHP		500
Plow	2 bottom	90	100
Disk	8 foot	90	150
Section harrow	2 section	45	75
Planter fertilizer	2 row	35	50
Cultivator	2 row	45	65
Fertilizer spreader	8 foot	55	
	12 foot		80
Sprayer	6 row	a	55
Mower	6 foot	65	
	7 foot		50
Side delivery rake		a	35
Baler		a	a
Combine		a	a
Corn picker		a	a

[a]Assumed custom hired.

TABLE XXVI

ESTIMATED PRORATED MACHINERY INVESTMENT PER ACRE FOR SELECTED CROPS

Crop	Size of farm	
	Small	Medium
Corn	27.00	23.33
Soybeans	28.50	28.67
Tobacco	194.17	194.17
Alfalfa	27.33	54.83
Orchard grass-ladino hay and pasture	14.17	21.50
Orchard grass-ladino pasture	11.50	13.70
Oats-lespedeza pasture	20.67	24.33
Oats-lespedeza hay	31.33	41.00
Fescue-ladino pasture	10.00	7.17
Red clover hay	21.33	31.00

APPENDIX D

LABOR REQUIREMENTS

TABLE XXVII

ESTIMATED LABOR REQUIREMENTS FOR REPRESENTATIVE CROP ENTERPRISES BY LABOR PERIODS

Enterprise	Soil Group	Labor period					
		I	II	III	IV	V	VI
		(Hours)					
Crop enterprises:							
Corn I	I		1.8	1.8			2.0
Soybeans II	II		1.1	1.4	1.8	2.0	
Alfalfa hay	II		.8	3.8	5.2	2.6	
Orchard grass-ladino hay and pasture	III	.8		3.7	1.0	.1	
Oats-lespedeza pasture	II		.5		4.5	1.6	
Fescue-ladino pasture	V	.8		.6	1.0	.1	
Red clover hay	II	.3		3.8	3.7	.9	

TABLE XXVIII

ESTIMATED LABOR REQUIREMENTS FOR LIVESTOCK ENTERPRISES BY LABOR PERIODS

Livestock enterprises	Labor period					
	I	II	III	IV	V	VI
	(Hours)					
Swine I	133.8	82.2	62.7	103.7	67.4	86.1
Swine II	112.1	60.2	37.6	74.1	60.7	54.9
Beef I	140.0	88.0	17.0	25.0	18.0	60.0
Beef IV	18.0	10.0	2.0	3.0	5.0	8.0
Dairy I	258.5	121.3	91.9	152.8	91.7	154.1

APPENDIX E

ESTIMATED OVERHEAD COSTS

TABLE XXIX

ESTIMATED ANNUAL OVERHEAD COSTS FOR SMALL-SIZED FARMS

Item or equipment	Cost New	Cost Average	Salvage value	Years life	Annual depr.	Annual repairs	Interest at 6%	Taxes and insurance	Fuel and other	Total cost
Machine shed	$1,000.00	$500.00	$ 0.00	20	$ 50.00	$ 5.00	$ 30.00	$ 6.00		$ 91.00
Truck (1/2 T.)	2,000.00	900.00	200.00	10	180.00	80.00	54.00	45.00	$121.23[a]	480.23
Wagon and bed (5 T.)	340.00	153.00	34.00	15	20.40	12.24	9.18	.75		42.57
Manure spreader (100 bu.)	650.00	292.50	65.00	15	19.50	19.50	17.55	1.50		58.05
Shop equipment, tools		100.00				20.00	6.00			26.00
Liability insurance								25.00		25.00
Telephone[b]									40.00	40.00
Electricity[c]									24.00	24.00
Tax, miscellaneous legal services									25.00	25.00
Auto expense (farm share), 1,000 miles at 8¢/mile									80.00	80.00
Total	$269.90	$136.74	$116.73		$78.25				$290.23	$891.85

[a] 5,000 miles - 333 gal. gas at 31¢ = $103.23; $18.00 lubrication and oil.

[b] Farm share of monthly service charge assumed to be $2.50 per month; estimated annual toll charge was $10.00.

[c] Swine and dairy enterprise budgets included estimated electricity costs above the base charge of $2.00 per month.

TABLE XXX

ESTIMATED ANNUAL OVERHEAD COSTS FOR MEDIUM-SIZED FARMS

Item of equipment	Cost New	Cost Average	Salvage value	Years life	Annual depr.	Annual repairs	Interest at 6%	Taxes and insurance	Fuel and other	Total cost
Machine shed	$1,200.00	$ 600.00	$ 0.00	20	$ 60.00	$ 6.00	$ 36.00	$ 7.20		$ 109.20
Truck (1 T.)	2,400.00	1,080.00	240.00	10	216.00	96.00	64.80	50.00	$130.00[a]	556.80
Wagon and bed (5 T.)	340.00	153.00	34.00	15	20.40	12.24	9.18	.75		42.57
Manure and spreader (100 bu.)	650.00	292.50	65.00	15	19.50	19.50	17.55	1.50		58.05
Elevator (24')	300.00	135.00	30.00	15	18.00	9.00	8.10	.68		35.78
Shop equipment, tools		100.00				20.00	6.00			26.00
Liability insurance								25.00		25.00
Telephone[b]									40.00	40.00
Electricity[c]									24.00	24.00
Tax and miscellaneous legal services									25.00	25.00
Auto expense (farm share), 1,400 miles at 8¢/mile									112.00	112.00
Total	$2,360.50		$333.90		$162.74	$141.63	$85.13		$331.00	$1,054.40

[a] 4,500 miles - 380 gal. gas at 31¢ = $117.80; $12.20 for oil and grease.

[b] Farm share of monthly service charge assumed to be $2.50 per month; estimated annual toll charge was $10.00.

[c] Swine and dairy enterprise budgets included estimated electricity costs above the base charge of $2.00 per month.