

Minimum Land Requirements For Specified Levels of Farm Income In the Eastern Highland Rim

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SUMMARY

The objectives of this study were: a) 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; b) to estimate the effects of variations in resident labor supply and farm type upon the minimum land requirements at each of the specified income levels; and c) to compare the enterprise organizations developed.

Background data were secured from census and survey data from an earlier study, while soil characteristics of a subsample of farms in Putnam County were summarized to obtain a soils distribution representative of the study area.

Farm types considered were manufacturing milk, beef, swine, and unrestricted. Enterprise alternatives considered were those commonly found in the study area and were based upon assumed resource requirements, costs, and returns taken from budgets which reflect expected long run cost-price relationships.

To obtain a \$3,000 net farm income with no farm type restrictions, the estimated minimum land requirements were 120 acres for a one-man labor supply and 200 acres for a two-man labor supply. Estimated total investments in land, livestock, buildings, and machinery required for these farming systems were \$29,729 and \$50,880, respectively. To achieve a \$4,500 net income level, minimum land requirements were 410 acres for the one-man labor situation, and 277 acres for the two-man labor situation. Increasing the net income goal to \$6,000 increased the minimum land requirement for the two-man labor situation to 484 acres. No feasible system could be developed for the one-man labor situation at this income level.

With no farm type restrictions, the optimal systems involved primarily hog and hay production. As the income goal was increased, steer feeding became a more important income source. When a beef farm type was specified, the land requirement was greater than for the unrestricted farm type situation and the beef system was a steer-feeding operation. No feasible systems were obtained for the dairy and beef cow-calf types at any of the specified income levels. Returns from these alternatives were too low to cover all costs and provide the level of returns specified.

The general nature of the resource adjustments needed for farmers to realize returns to their labor and management equal to those selected for this study can be indicated by comparison with earlier studies and with census data. A farm survey was con-

ducted in 1961 in Putnam County, considered to be representative of the Eastern Highland Rim Area. The average value of assets on the 151 farms studied was \$22,345 as compared to the estimated \$29,729 in assets required for the smallest minimum farm size indicated in this study. The average gross income of the farmers surveyed in Putnam County in 1961 was \$2,357. Estimated gross sales for systems returning \$3,000 net incomes varied from \$12,514 to \$26,028. However, only 10.5% of commercial farmers in the Eastern Highland Rim had estimated sales of more than \$10,000 in 1964. Approximately 3.3% of Eastern Highland Rim farmers had sales greater than \$20,000 in 1964. The optimal systems which would return \$4,500 net return to operator had gross incomes ranging from \$24,802 to \$31,436, while the systems which would return a net return of \$6,000 to operator labor and management would generate gross incomes ranging from \$34,375 to \$38,891.

Since land requirements and sales volumes of the systems developed in this study are considerably greater than the averages for commercial farmers in the Eastern Highland Rim, adjustments toward the income goals considered in the study would result in larger and considerably fewer farms in the study area.

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Minimum Land Requirements For Specified Levels of Farm Income In the Eastern Highland Rim Of Tennessee

by

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INTRODUCTION

Changes in technology, institutional setting, and economic forces through time require adjustments in resource use for most efficient farm operation. 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, significant decreases in farm numbers, and increases in the average size of farms.

The number of farm family workers in Tennessee decreased 47% between 1954 and 1964. The average size of farm in Tennessee increased by 28% between 1950 and 1959 and grew 12% between 1959 and 1964. In the same periods, the average size of farm in the United States increased 40.6% and 16.2%, respectively.¹ The average value of farm products sold per farm for all farms in Tennessee in 1959 was \$3,009 or approximately 37% of the average value of products sold per farm for the United States. In 1964, the average value of farm sales for Tennessee was 21% of the average value of sales per farm for the United States. Thus, the income disparity between Tennessee and U.S. farms has widened in recent years.

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¹The change in census definition of a farm would account for part of the change between 1950 and 1959. In 1950 a farm was defined to include units of 3 acres or more if sales and home use values were \$150 or more and units of less than 3 acres if sales were \$150 or more. In 1959, a farm was defined to include units of 10 acres or more if sales were \$50 or more and units of less than 10 acres if sales were \$250 or more. No essential change in farm definition was made between 1959 and 1964.

THE PROBLEM

Tweeten estimated that only 10% of farm family workers in the United States received average wages on a par with "the factory worker standard of \$4,665 in 1960."² The situation was more favorable if returns to farmer-owned capital were considered as income. However, considering net returns to farm family labor, management, and risk, Tweeten concluded that only those farms falling within Economic Classes I and II generated net labor-management returns equal to factory workers' incomes.³

Achievement of farm incomes commensurate with nonfarm incomes involves complex considerations of resource allocation and use. The extent of reallocation and adjustment in resource use on farms in Tennessee was indicated by the fact that approximately 72% of all commercial farms in Tennessee were in Economic Classes V and VI in 1959; this means gross sales were less than \$5,000. Almost 68% of the commercial farms in Tennessee were included in these same two classes in 1964.

The Eastern Highland Rim of Tennessee is an area with an even less satisfactory farm income situation. The proportion of Eastern Highland Rim farms classified as commercial was 43% in 1959 and 53% in 1964. About 78% of these commercial farms had sales of less than \$5,000 in 1959. In 1964, the comparable percentage was 75%. The proportion of commercial farms with sales of less than \$2,500 was 45% in 1959 and 47% in 1964. A substantial proportion of the operators of commercial farms in the Eastern Highland Rim Area have unsatisfactory income levels when compared to the wages of unskilled laborers in the United States.

Some farmers may be able to raise their net incomes through adjustment of resources other than land. However, considerable evidence exists that many farms in Tennessee and in the study area are so small as to preclude the attainment of adequate net earnings even with good management and use of most profitable enterprise organizations. For these operators, the addition of land — through purchase or rental — offers a main avenue of adjustment if they are to obtain a satisfactory income solely from farming. The effects of variations in specified farm income goals, resident labor supply, and type of farm upon the minimum land requirement and

²Luther G. Tweeten, "The Income Structure of Farms by Economic Class," *Journal of Farm Economics*, Vol. 47, No. 2, May 1965. Sales of agricultural products from Class I farms were \$40,000 or more; sales from Class II farms were between \$20,000 and \$39,999.

³*Ibid.*

enterprise organization of farms in the Eastern Highland Rim of Tennessee were the concerns of this study.

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 to 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 from farming. Estimates were made with one-man and two-man resident labor supplies at each income level and for each of four types of farms.

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 obtained in an earlier study.⁴ Income goals from the study were selected as 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 considered were selected on the basis of current production 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. 5) Linear programming 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 under assumed conditions of one-man and two-man labor supply. Only land based production alternatives were considered. Poultry and livestock feeding enterprises utilizing purchased feeds were excluded.

⁴Vernon 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.

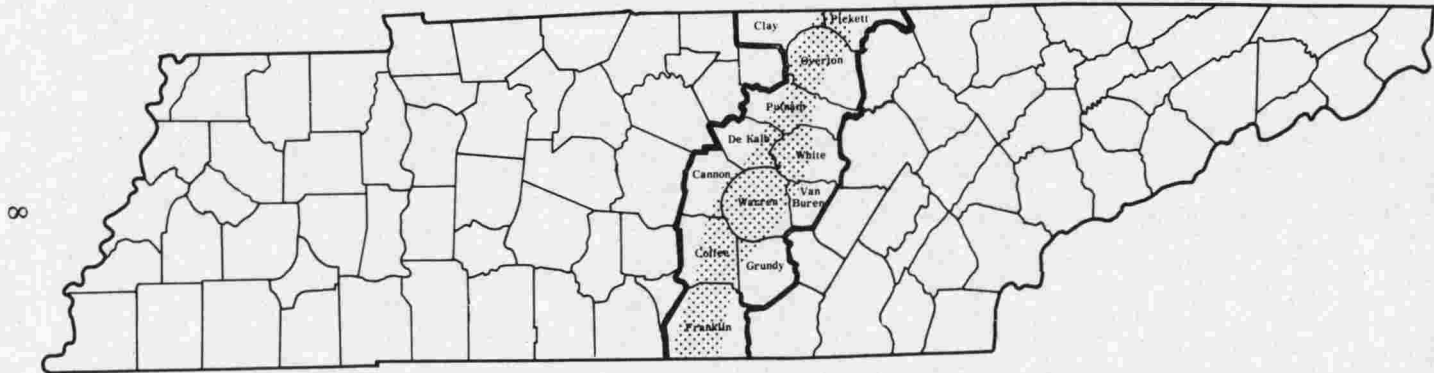


Figure 1. The 12 counties of the Eastern Highland Rim and the generalized location of the study area.

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. 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 the Cumberland-Waynesboro associations. These associations make up approximately 40% of the 12-county region referred to above. The acreage of these associations and their relative importance are shown in Table 1. Other soil associations found within the 12 counties are typical of the Central Basin, and the Cumberland Plateau, or are soils of intermediate character not typical of the soil associations in the study area.

Table 1. Soil Associations of the study area, acreage and relative importance, Eastern Highland Rim, Tennessee

Soil Association	Acres	Percent of study area	Percent 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.

THE NATURE OF THE STUDY AREA

The Eastern Highland Rim of Tennessee is predominantly a rural region. In 1960 Coffee County was the only county in the region with a majority of the population residing in urban places. All other counties were classed as either predominantly or completely rural. Eleven of the counties had negative net migration rates between 1950 and 1960. Median school years completed by the population was lower for 11 of the 12 counties than for Tennessee in 1960.

Farm Numbers and Tenure

The number of farms in the Eastern Highland Rim declined approximately 22% between 1950 and 1959 and 14% between 1959 and 1964. The number of commercial farms increased from 6,674 in 1959 to 7,328 in 1964. The increase in commercial farms was largely in Economic Classes V and VI, defined as those with gross incomes of less than \$5,000. The relative proportions of land controlled by full owners and part owners has remained quite stable for the 1959 to 1964 period. Acreage of land in farms in the region decreased about 60,000 acres from 1959 to 1964. Acreage operated by tenants decreased approximately 46,600 during this 5-year period.

Farm Size Changes

Farm size characteristics of farms in the Eastern Highland Rim, Tennessee, and the United States are given in Table 2. In

Table 2. Farm size changes, Eastern Highland Rim, Tennessee, and the United States, 1950 and 1964

Farms	Average acreage per farm		Percent change 1950-1964
	1950	1964	
Eastern Highland Rim			
All farms	82.4	113.6	+37.8
Commercial	115.6	149.3	+29.1
Tennessee			
All farms	80.0	114.4	+43.0
Commercial	102.2	147.6	+44.4
United States			
All farms	215.3	352.0	+63.4
Commercial	275.6	445.8	+61.8

1964, the average size of all farms was 114 acres in the Eastern Highland Rim, 114 acres in Tennessee, and 352 acres in the United States. Commercial farms averaged slightly less than 150 acres for both the Eastern Highland Rim and Tennessee in 1964. From 1950 to 1964, average farm size increased 38% in the Eastern Highland Rim, 43% in Tennessee, and 63% for the United States. In 1964 gross sales were \$10,000 or more on only 3% of the commercial farms of the area and were less than \$5,000 on 75% of the commercial farms (Table 3).

Table 3. Distribution of commercial farms by economic class, Eastern Highland Rim and Tennessee, 1964

Economic class ^a	Eastern Highland Rim		Tennessee	
	Number of farms	Percent in class	Number of farms	Percent in class
I	65	.9	1,287	1.7
II	176	2.4	2,835	3.7
III	531	7.2	6,552	8.6
IV	1,063	14.5	13,804	18.1
V	2,607	28.2	23,365	30.6
VI	3,426	46.8	28,509	37.3
Total commercial farms	7,328	100.0	76,352	100.0
Other farms	6,400		57,094	

^aCommercial farms included all farms with sales of \$2,500 or more and farms with sales of \$50 to \$2,499 if the operator was under 65 years of age and he did not work off the farm 100 or more days during the year. The commercial farms were divided into economic classes on the basis of total value of all farm products sold as follows: Class I, \$40,000 or more; 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; and Class VI, \$50 to 2,499.

Types of Farms

Despite the general increase in relative farm size in the region during the period 1959 to 1964, there still remained 8,573 farms of less than 100 acres in the region in 1964. This amounted to 62% of all farms, a slight decrease from the 66% of all the farms in the region which were in this size range in 1959. Approximately 11% of the farms were 220 acres or over in size in 1964.

The distribution of farms in the region by type is shown in Table 4. Of all the farm types, livestock farms had the greatest percentage decrease between 1959 and 1964, dropping from 40% of all farms to 31%. The increases in relative importance of other types of commercial farms were shared relatively equally by field crop, dairy, and miscellaneous types of farms.

Volume and Value of Agricultural Production

Important shifts in the use of farmland have occurred in the Eastern Highland Rim during the past two decades. The total acreage of land in farms in the region declined by approximately 11% from 1950 to 1959 and decreased 3.7% from 1959 to 1964.

**Table 4. Distribution of commercial farms by type, 1959 and 1964,
Eastern Highland Rim, Tennessee**

Type of farm ^a	Number of farms		Percent of all farms	
	1959	1964	1959	1964
Field crop	1,511	1,942	22.0	26.5
Vegetable	15	8	.2	.1
Fruit and nut	35	31	.5	.4
Poultry	154	202	2.2	2.8
Dairy	1,070	1,321	15.6	18.0
Livestock	2,764	2,272	40.3	31.1
General	1,090	1,043	15.9	14.2
Miscellaneous	224	509	3.3	6.9
Total	6,863	7,328	100.0	100.0

^aTo be classified as a particular type, a farm had to have sales of a particular product or group of products amounting to 50% 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 greenhouse, nursery, forest product, horse, mule and other varied sales.

Source: United States Bureau of the Census, **United States Census of Agriculture: 1959**, Vol. I, Part 31 (Washington: Government Printing Office, 1961), pp. 176-183; United States Bureau of the Census, **United States Census of Agriculture: 1964, Preliminary Report**, Series AC 64-P1 (Washington: Government Printing Office, 1966).

Cotton declined from 11,701 acres in 1950 to 3,997 acres in 1964, a decline of over 67%. Tobacco acreage on the other hand has remained quite stable from 1950 through 1964. In 1964, the combined acreage of cotton and tobacco accounted for less than 1% of the total cropland acreage.

Corn and small grains have both decreased in relative importance in the region with a combined acreage decline of more than 59% for the period 1950 to 1964. Soybean acreage for the region decreased about 37% from 1950 to 1959, but has increased considerably since 1959. In 1964, soybean acreage accounted for 3.4% of crop acreage in the 12 counties.

The number of cattle and calves other than dairy cows in the Eastern Highland Rim increased rather steadily between 1950 and 1964. The numbers of dairy cattle decreased by 12% between 1950 and 1959 and declined by 22% between 1959 and 1964. The numbers of hogs and pigs on farms in the region have fluctuated

quite widely during the years from 1950 to 1964. Between 1959 and 1964 hog numbers decreased 43%.

The relative contribution of crops and livestock to farm income has fluctuated considerably between 1950 and 1964. The proportion of income from crop sales varied from 30% to 40% and the proportion of sales from livestock from 60% to 70%.

RESOURCE ASSUMPTIONS

Soil Resources

The soil distribution for this study was developed from a summary of 1961 survey data for a group of 25 to 30 randomly selected 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 into meaningful management categories.

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 limi-

Table 5. Composite soils distribution derived for the study area, Eastern Highland Rim, Tennessee

Soil groups	Major capability units ^a	Percent of total acreage
I ^b	I e-1	7.3
II ^b	II e-1, II e-2	24.0
III ^b	III e-1, III e-2	23.5
IV	IV e-1, IV e-2 IV e-3	10.6
V	III w-2, IV w-1	3.2
VI	VI e-1, VI e-2	7.5
Wasteland and woodland		23.9

^aMajor capability units of soils for the study are described in Soil Survey Report, Putnam County, Tennessee, 1963.

^bMaximum allowable row crop acreage was 100% of Soil Group I, 50% of Soil Group II, and 33% of Soil Group III.

tations. The major capability units included in each of the six soil groups used for planning and the proportion of acreage in each group is shown in Table 5.

A brief description of these six soil groups follows:

Soil Group I includes deep, well-drained, fertile, alluvial soils with little or no slope. These are well suited for intensive row cropping. This group accounts for 7.3% of the soils in the study area.

Soil Group II includes deep, well-drained soils of variable fertility with slight to moderate erosion; they respond well to fertilization and are suited for row crops about 1 year out of 2 without serious erosion hazard; they comprise 24% of the soils of the study area.

Soil Group III includes moderately sloping soils (5% to 12%), with slight to moderate erosion, usually moderately deep and moderately well to well drained. The degree of the slope limits the use of these soils for intensive row cropping to no more than 1 year in 3. Some areas are underlain by fragipans which limit successful growth of deep-rooted legumes. In general, these soils are quite responsive to fertilization.

Soil Group IV includes soils which vary from sloping to steep, and requires careful management to prevent erosion. Soil depths are quite variable, usually ranging from moderate to deep. Drainage is usually very good, with minor exceptions for soils with heavy clay subsoils. They were considered unsuitable for row crop production.

Soil Group V includes soils which were poorly to very poorly drained, and do not provide dependable yields of row crops. Poor internal drainage and aeration and/or surface water accumulations impose moderate to severe restrictions upon their use. Pasture yields from adapted varieties of forage crops would range from low to medium under good management.

Soil Group VI includes generally well drained to excessively drained soils subject to summer drought. Moderate to severe erosion is either present or a hazard on these soils. Natural fertility is usually very low, and poor moisture-supplying capacity limits fertilizer response. The best productive use is generally for pasture and yield will be low to medium even 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 6. Soil Group I contained the most productive soils, but acreage was quite limited in the study area. The yield levels for the crops con-

Table 6. Estimated yields for crop enterprises by soil group capability, Eastern Highland Rim, Tennessee

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 ^b	^a	80	70	48	75	^a
Lespedeza hay	tons	^a	1.5	1.3	.9	1.4	^a
Orchardgrass-ladino pasture	CAD	^a	144	132	109	^a	^a
Orchardgrass-ladino	CAD	^a	84	78	64	^a	^a
hay and pasture	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

^aProduction 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.

^bCAD refers to a cow acre day of grazing and is equivalent to 25 pounds of hay equivalent.

sidered 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.

Land requirements for the model were provided by a land-buying alternative. Each additional acre of land bought provided proportionate amounts of the six productive soil groups shown by Table 5. 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 1,400 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 2,865 and 5,730 hours, respectively, of labor per year, distributed seasonally as shown in Table 7. Labor requirements for representative crops are shown in Appendix Table 6. 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 the period April 15 - November 30,

Table 7. 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	1,232
II. Mar. 1 - Apr. 14	351	702
III. Apr. 15 - May 31	390	780
IV. June 1 - Aug. 15	650	1,300
V. Aug. 16 - Sept. 30	390	780
VI. Oct. 1 - Nov. 30	468	936
Total hours per year	2,865	5,730

^aSeasonal labor supply for both situations was restricted to an annual maximum of 1,400 hours available in periods III through VI.

but not in the period December 1 - April 14. 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% 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% interest. Land investment capital was charged at 5% interest and based on an estimated land value of \$152 per acre.⁵

The livestock enterprise budgets included capital charges of 6% 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

⁵The \$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 8. Estimated costs per hour of machine use, Eastern Highland Rim study, Tennessee

Machine	Description	Farm size	
		Small	Medium
		Cost per hour	
Tractor	25 DBHP ^a		\$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 ^b	.65
Mower	6 foot	.76	
	7 foot		1.13
Side delivery rake			1.70
Baler		5.00 ^c	4.00 ^c
Combine		6.00 ^b	6.00 ^b
Corn picker		6.00 ^b	6.00 ^b

^aDrawbar horsepower.

^bCustom rate per acre.

^cSmall 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.

annual hours use of the machine on a particular sized farm yielded the hourly charges used to estimate crop enterprise returns. Estimated annual hours of use are shown in Appendix Table 4. These costs are shown in Table 8 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 specific rates.

A prorata share of the machine investment cost was associated with each hour of use for a particular machine. For example, the 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 1 acre of corn required 5 hours of tractor time, the prorata tractor investment for 1 acre of corn would be \$12.50. The investment costs for other machines and other enterprises were computed in a similar manner. Esti-

mates of the required machinery investment per acre of crop enterprises were obtained by capitalizing the per acre machine investment costs at 6% and are shown in Appendix Table 5.

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 Tables 8 and 9.

PRODUCTION ALTERNATIVES

The production alternatives considered for inclusion in this study were those enterprises commonly found in the study area and considered to be general adjustment possibilities for a large number of the farmers in the area; not included were Grade A milk production, horticultural, and broiler activities since only a small proportion of farmers are now engaged in these enterprises and market limitations would preclude general adjustments in these types of production. Cotton was not included as an alternative enterprise since production of this crop was rather limited and acreage has declined considerably in recent years.

Prices paid and received which were assumed for this study are presented in Appendix Table 1.

Row Crops

Row crop production was limited to corn, tobacco, and soybeans. The model provided that Soil Group I could be used for row crops every year. Soil Groups II and III were restricted to maximums of 50% and 33%, respectively, of available acreages used for row crops in any 1 year.

It was assumed that no corn could be purchased. Corn produced could be used either 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% 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 2 bushels of oats for each bushel of corn.

Forage Production

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

Efficient utilization of the forages produced was assured by the division of use into five forage periods. These periods were selected to fit the growth patterns of the forages produced. The distribution of forage growth by period for each of the forage crops considered is presented in Table 9. A "forage transfer"

Table 9. Percentage distribution of forage production by periods, Eastern Highland Rim, Tennessee^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

^aThe figures represent that percentage of the total Cow Acre Days furnished by the particular forage crop in each period.

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 (March 16 - May 31) to III (June 1 - July 31), and III to IV (August 1 - September 30) was assumed to be .9 that of forage utilized in the period it was produced. Forage transferred from period IV to period V (October 1 - November 15) 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 Tables 2 and 3 present forage and grain requirements for the cattle enterprises. Hay requirements were met by the production of alfalfa, red clover, lespedeza, and/or orchardgrass-ladino clover. Production and use were in terms of hay equivalents. Alfalfa was selected as the hay standard. 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

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 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% and there was an assumed death loss of 3% 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. For Beef I, calves were assumed to be born in February and were 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% 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% death loss of replacement heifers from weaning age to calving was assumed.

Beef II was based on the same 25 brood-cow herd as in Beef I, but steers and heifers would be retained for finishing. The 18 steers and heifers would be wintered on a ration of hay, corn-cob meal, and cottonseed meal for approximately 150 days at a daily gain of 1.4 pounds. Following the wintering period, heifers would be 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 rate of gain was 1.1 pounds per day for the pasture period and 2.5 pounds per day for the finishing period,

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 (Manufacturing Milk)

The Grade A dairy enterprise was not considered in this study. Production of manufacturing milk was considered as an enterprise alternative since this 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 3 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 Tables 2 and 3 and labor requirements are shown in Appendix Table 7.

RESULTS OF THE ANALYSIS

The objective of the analysis was to estimate minimum land requirements (farm size) necessary to provide a specific net farm income level for different farm types and sizes of labor supply. Income levels considered were \$3,000, \$4,500, and \$6,000 while farm types included were unrestricted beef, swine, and dairy. Separate estimates were made for each situation with one-man and two-man labor supply. Minimum land requirements for each situation were estimated using linear programming techniques and could be considered an optimal system given the assumptions and data used.

MINIMUM FARM SIZE — UNRESTRICTED FARM TYPE

In these situations, no restrictions were placed on the enterprises which could be included in the optimal system other than those specified earlier. Certain enterprises such as broilers, horticultural specialties, and Grade A dairy were excluded from con-

sideration either because they require little or no land and/or limited market potential precluded them as general adjustment alternatives in the area.

Unrestricted Farm Type, One-Man Labor Supply

The farm operator was assumed to have available 2,865 hours of labor per year distributed seasonally as shown in Table 7. Up to a total of 1,400 hours of seasonal labor could be hired during labor periods III through VI (April 15 through November 30.) No seasonal labor could be hired in labor periods I and II.

\$3,000 net income level. One-hundred twenty acres of land, of which 91 acres were openland, were required to provide the \$3,000 net return to operator labor and management (Table 10). The total capital investment for this optimum system was \$29,728 distributed as follows: 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 totaled 94 harvested tons and was harvested from 32 acres of alfalfa, 4.8 acres of lespedeza, and 2.6 acres of orchardgrass-ladino hay and pasture. Grain production consisted of 25.7 acres of corn and 19 acres of oats. Pasture activities were: 14.2 acres of lespedeza, 11.1 acres of fescue-ladino clover, and 2.6 acres of orchardgrass-ladino clover used for both hay and pasture. All hay produced was to be sold. All grain would be used for feeder pig production.

The income-producing activities were feeder pigs (Swine II), sale of hay, and .32 acres of tobacco. The sale of feeder pigs provided approximately 74% of the total gross farm income of \$12,514. Sale of hay was the second largest source of income providing 23% 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 openland, was required to meet the \$4,500 income goal. The total investment required for this system was estimated to be \$76,629. Capital was distributed between livestock, \$1,142; buildings, \$5,749; machinery, \$7,322; and land, \$62,416 (Table 10).

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 as follows: corn, 61.5 acres; soybeans, 23.8 acres; orchardgrass-ladino hay and pasture, 39.1 acres; fescue-ladino pasture 43.8 acres; red clover hay, 137.7 acres; tobacco, 1.1 acres; and 4.3 acres of alfalfa.

Table 10. Estimated minimum land and other resource requirements and enterprise organizations for specified net income levels on one-man farms with no type of farm constraint, Eastern Highland Rim, Tennessee

Item	Unit	Level of net return to operator labor		
		\$3,000	\$4,500	\$6,000
Resources				
Total land	Acres	120	410	No
Land investment	\$	18,247	62,416	
Livestock investment	\$	2,888	1,142	
Building investment	\$	4,953	5,749	feasible
Machinery investment	\$	3,640	7,322	
Total investment	\$	29,728	76,629	
Annual capital	\$	2,229	8,105	solution
Labor requirements				
Resident labor	Hours	2,545	2,650	
Seasonal labor	Hours	24	840	
Gross income sources				
Swine	\$	9,270	9,050	
Beef	\$		4,772	
Tobacco	\$	417	1,425	
Hay	\$	2,827	8,019	
Soybeans	\$		1,536	
Gross farm income	\$	12,514	24,802	
Open land	Acres	91.0	312.0	
Cropland				
Corn	Acres	25.7	61.5	
Soybeans	Acres		23.8	
Tobacco	Acres	.3	1.1	
Oats-lespedeza				
Pasture	Acres	14.2		
Hay	Acres	4.8		
Orchardgrass-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	

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 was generated as follows: swine, \$9,050; beef, \$4,772; tobacco, \$1,425; hay, \$8,019; and soybeans, \$1,536.

\$6,000 net income level. Given the assumptions and data used in this analysis, the achievement of a \$6,000 net income for the owner-operator farm was not possible. The limits of 1,400 hours of hired labor and the one-man resident labor supply were the restricting resources.

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 11. The distribution of total investment was \$30,382 for land, \$5,473 for livestock, \$9,277 for buildings, and \$5,748 for machinery. Total investment was \$50,880.

Resident labor supply was adequate to handle the labor requirements of this system. In fact, 1,216 hours of the available 5,730 hours of resident labor would be unused. No seasonal hired labor was necessary. Resident labor was in excess during all labor periods except Period V.

Swine II was the only livestock enterprise included and provided \$18,195 in gross income, or 86% of the total sales. Hay and tobacco sales accounted for the remainder of gross income.

Crop acreages grown were: corn, 47.2 acres; oats-lespedeza, 62.9 acres; fescue-ladino and orchardgrass-ladino, 18.0 acres; alfalfa, 22.6 acres; and tobacco, .5 acres. Lespedeza grown in combination with oats would be used partially for hay and partially for pasture.

Table 11. Estimated minimum land and other resources required and enterprise organizations for specified net income levels on two-man farms with no type of farm constraint, Eastern Highland Rim, Tennessee

Item	Unit	Level of net return to operator labor		
		\$3,000	\$4,500	\$6,000
Resources				
Total land	Acres	200	277	484
Land investment	\$	30,382	42,123	73,660
Livestock investment	\$	5,473	5,906	5,051
Building investment	\$	9,277	10,074	10,711
Machinery investment	\$	5,748	7,703	10,920
Total investment	\$	50,880	65,806	100,342
Annual capital	\$	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	\$	18,195	19,636	17,059
Beef	\$			4,662
Hay	\$	2,318	5,530	9,193
Tobacco	\$	694	962	1,681
Soybeans	\$			1,780
Gross farm income	\$	21,207	26,128	34,375
Openland	Acres	152.0	211.0	368.0
Cropland				
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	
Orchardgrass-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% from \$3,000 to the \$4,500 level required a 39% increase in farm acreage from 200 to 277 acres. Capital investment required for this income level was \$65,806. Livestock investment was \$5,906; building investment, \$10,074; machinery investment, \$7,703; and land investment, \$42,123 (Table 11).

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 acres; oats-lespedeza hay or pasture, 30.8 acres; orchardgrass-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% 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 openland. 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 11).

Resident labor use totaled 4,810 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 solution 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; orchardgrass-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% was provided by swine sales. The sale of hay returned \$9,193 and beef sales brought \$4,662, providing about 27% and 14%, respectively, of gross farm income.

Effects of Variation in 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%, 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% in minimum land needs (Tables 10 and 11).

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

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; oats-lespedeza acreage more than trebled, from 19.1 to 62.9; and orchardgrass- 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% came from the sale of hogs. The optimal system for the one-man labor supply provided gross sales of \$12,514, 75% resulting from the sale of feeder pigs. Thus, a 69% 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 two-man labor situation was \$65,806 as compared with \$76,629 for the one-man labor 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 (Tables 10 and 11).

The two-man labor supply allowed specialization in feeder pig production which returned 75% of the \$26,128 gross income. The one-man solution was more diversified with hay and feeder pigs, each the source of approximately 33% of the gross income, and beef steers providing 19%. 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 Table 11.

OPTIMAL SYSTEMS FOR SPECIFIED FARM TYPES

The solutions discussed in this section are for specific types of farms. Farm type was defined as a situation in which 55%, 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 system, only production of ungraded milk was considered.

Beef Type Restriction, One-Man Labor Supply

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 12. The total investment required was distributed as follows: land, 72%; buildings, 14%; machinery, 10%; and livestock, 4%.

Beef IV was the sole beef alternative included in this system. The activity provided the specified 55% of the total gross income with the finishing of 67 steers. The purchase price of the beef steers was charged to operating capital; therefore, the livestock investment of \$1,764 for the system reflects the average investment in breeding animals for Swine II, but not the average value of the steers.

Crop enterprise organization included 35.0 acres of corn, .6 acres of tobacco, 33.7 acres of oats-lespedeza combination, and 63.6 acres of orchardgrass-ladino and fescue-ladino pasture. There were 17.9 acres of alfalfa and 9.9 acres of orchardgrass-ladino clover grown for joint hay-pasture use. Hay equivalent totaling 66.4

Table 12. Estimated minimum land and other resources required and enterprise organizations for specified net income levels on one-man beef farms, Eastern Highland Rim, Tennessee

Item	Unit	Level of net return to operator labor		
		\$3,000	\$4,500	\$6,000
Resources				
Total land	Acres	213	456	No
Land investment	\$	32,439	69,424	
Livestock investment	\$	1,764	445	
Building investment	\$	6,358	7,219	feasible
Machinery investment	\$	4,433	9,371	
Total investment	\$	44,994	86,459	
Annual capital	\$	10,001	15,894	solution
Labor requirements				
Resident labor	Hours	2,533	2,687	
Seasonal labor	Hours		480	
Gross income sources				
Swine	\$	5,865	3,812	
Beef	\$	8,478	14,039	
Tobacco	\$	741	1,586	
Soybeans	\$		1,801	
Hay	\$	331	4,288	
Gross farm income	\$	15,415	25,526	
Openland	Acres	162.0	347.0	
Cropland				
Corn	Acres	35.0	63.5	
Soybeans	Acres		27.6	
Tobacco	Acres	.6	1.2	
Oats-lespedeza				
Pasture	Acres	27.7		
Hay	Acres	6.0	6.1	
Orchardgrass-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		

tons was produced and used mainly by the 67-head Beef IV enterprise. Only 11 tons of hay equivalent were sold.

Operator labor required for the system was 2,533 hours. No seasonal labor was hired. All available operator labor for Period II was used and only 10 hours of operator labor were unused during Period V.

Comparison of the \$3,000 beef system with the \$3,000 unrestricted owner-operator system (Table 10) revealed several key differences. There was a 93-acre increase in the minimum land requirement, from 120 to 213 acres for the beef system. Total investment increased 51% and the annual capital requirement increased 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. 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 with 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 2% and 5% of the gross income, which totaled \$15,415. By comparison, the unrestricted system grossed \$12,514 of which 74% 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 12). 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% 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 enterprise provided a total gross income of \$25,526. Beef IV was the source of 55% of the gross as specified by the model. The balance of gross income came from sales of swine, \$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; oats-lespedeza hay, 6.1 acres; orchardgrass-ladino, 107.9 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 with 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% of the gross income for the beef system as specified. The balance of income was contributed by sales of hay, 17%; swine, 15%; soybeans, 7%; and tobacco, 6%. The gross income for the unrestricted system was provided by swine, 37%; hay sales, 37% beef, 19%; tobacco, 6%; and soybeans, 6%.

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 openland. Required capital investment was \$75,076 of which \$53,538, or 71%, was for land. Other investments were livestock, \$3,155; buildings, \$10,745; and machinery, \$7,638 (Table 13). 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 as a minimum, the source of 55% of the gross income; 40% of the income was from the swine, and 5% from tobacco. Gross farm sales totaled \$26,028.

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

No hired seasonal labor was required for the operation and 1,625 hours of the resident labor supply was unused.

The two-man beef system required approximately 75% more land than the unrestricted type two-man system and approxi-

Table 13. Estimated minimum land and other resources required and enterprise organizations for specified net income levels on two-man beef farms, Eastern Highland rim, Tennessee

Item	Unit	Level of net return to operator labor		
		\$3,000	\$4,500	\$6,000
Resources				
Total land	Acres	352	441	621
Land investment	\$	53,538	67,092	95,541
Livestock investment	\$	3,155	3,794	2,950
Building investment	\$	10,745	12,868	13,261
Machinery investment	\$	7,638	8,464	11,993
Total investment	\$	75,076	92,218	123,745
Annual capital	\$	16,749	20,129	24,311
Labor requirements				
Resident labor	Hours	4,105	4,919	4,915
Seasonal labor	Hours			329
Gross income sources				
Swine	\$	10,490	12,614	9,809
Beef	\$	14,315	17,290	21,390
Tobacco	\$	1,223	1,532	2,159
Soybeans	\$			1,878
Hay	\$			3,655
Gross farm income	\$	26,028	31,436	38,891
Openland	Acres	268.0	335.0	473.0
Cropland				
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
Orchardgrass-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

mately 50% 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% of the gross income was from the Swine II enterprise. With the beef-type restriction, 55% of the gross income was provided from beef sales, 40% from swine, and 5% 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%) required for land (Table 13). 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 included in 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% ; feeder pigs, 40% ; and tobacco, 5%. 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 orchardgrass-ladino clover, 88.0 acres; fescue-ladino clover, 46.7 acres; oats-lespedeza, 39.8; and 35.2 acres of orchardgrass-ladino for joint hay-pasture use. Additional hay would be produced on 5.1 acres of alfalfa and 26.5 acres of red clover.

The optimal system required about 86% 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% of the gross income resulted from the sale of hogs and 21% from the sale of hay. The unrestricted system required \$26,128 of gross income to provide a \$4,500 net operator return. Minimum land required was 277 acres for the unrestricted type and 441 acres for the beef type.

\$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 openland (Table 13). Total capital requirement of \$123,745 included \$95,541 for land, \$2,950 for livestock, \$13,261 for buildings, and \$11,993 for machinery. 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% of the \$38,891 gross farm income. Swine II was the source of 25% of the gross income. The remaining sources of gross income were tobacco, 6% ; hay, 9% ; and soybeans, 5%.

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

Annual labor requirement for the system 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% of the gross sales was from swine and 27% was from beef. For the beef type system, 55% of the gross income came from beef and 25% 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% 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 or 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% 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% 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 re-

strictions, simultaneous satisfaction of the minimum 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% of the gross income. At the \$4,500 income level, 75% 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% of the gross income. Thus, an optimal system in which the swine enterprise provided 55% 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% of gross income from swine production and a net labor income of \$6,000, an estimated 505 acres of land were required. Openland 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% of the total (Table 14).

The swine system involved production of both feeder pigs and market hogs. A total of 105 sows were included with pigs from 14 of these to be kept for feeding to market weight (Swine I). Income from the two swine enterprises amounted to 55% of the gross farm income. A 21 steer Beef IV activity was also included in the organization.

Gross income sources for the system other than swine were: Beef IV, 8.6%; hay, 29%; tobacco, 5%; soybeans, 3%.

Crops produced were as follows: corn, 89.6 acres; soybeans, 15.6 acres; orchardgrass-ladino (for hay and pasture), 45.5 acres; red clover, 169.6 acres; alfalfa, 8.0 acres; and fescue-ladino clover pasture, 33.9 acres. This system included 19.4 acres of idle land on Soil VI.

Labor required for the system was 5,366 hours of resident labor, and 676 hours of seasonal labor. The supply of resident labor was exhausted during periods II through V.

Table 14. Estimated minimum land and other resources required and enterprise organizations for specified net income levels on two-man swine farms, Eastern Highland Rim, Tennessee

Item	Unit	Level of net return to operator labor		
		\$3,000	\$4,500	\$6,000
Resources				
Total land	Acres	200	277	505
Land investment	\$	30,382	42,123	76,836
Livestock investment	\$	5,473	5,906	4,661
Building investment	\$	9,277	10,074	9,478
Machinery investment	\$	5,748	7,703	11,465
Total investment	\$	50,880	65,806	102,440
Annual capital	\$	3,953	4,567	8,150
Labor requirements				
Resident labor	Hours	4,514	5,246	5,366
Seasonal labor	Hours		68	676
Gross income sources				
Swine	\$	18,195	19,636	19,589
Beef	\$			2,715
Tobacco	\$	694	962	1,754
Soybeans	\$			1,002
Hay	\$	2,318	5,530	10,555
Gross farm income	\$	21,207	26,128	35,616
Openland	Acres	152.0	211.0	384.0
Cropland				
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	
Orchardgrass-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

Comparisons of the two-man swine system with the unrestricted system at the \$6,000 income level showed that the swine system required 20.8 acres more land and \$7,000 more total investment. The total labor requirement for the swine system was 5,366 hours compared to 4,810 hours required for the unrestricted system. Seasonal labor usage increased only 53 hours for the swine system.

Dairy Systems

As stated earlier, the Grade A dairy enterprise was excluded from this study since the limited market potential for Grade A milk in the Eastern Highland Rim precludes this enterprise as a general adjustment possibility.

The Grade C dairy enterprise was included as an alternative but did not enter in any of the unrestricted farm type solutions developed in this study. Using the farm type restriction 55% 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.

IMPLICATIONS

Adjustments in farm resource use are needed if farmers in the Eastern Highland Rim Area are to attain returns for their labor comparable to industrial wages of even unskilled workers. The average value of farm assets on a random sample of 153 Putnam County farms surveyed in 1962 was \$22,345, while the estimated value of assets required for the smallest optimum system developed in this study was \$29,729. The average gross income of the Putnam County farmers surveyed was \$2,357 — an amount obviously too small to provide the minimum \$3,000 net return to operator labor specified for this study. The gross income of \$12,514 required to provide a \$3,000 net return (approximately the median wage to unskilled non-farm workers in the United States in 1960) was more than five times the average gross income for the random sample of Putnam County farmers.

Realization of a \$3,000 net return required a gross farm income larger than that received by more than 89% of Eastern Highland Rim farmers in 1964. Gross sales of the systems developed ranged from \$12,514 to \$26,028 to provide an estimated \$3,000 net return to operator labor, depending on assumed labor supply and farm type being considered. For a one-man system a gross income in the range of Economic Class III (\$10,000 to \$19,999 gross sales) would be required to produce a \$3,000 net income.

The two-man swine system returning \$3,000 to operator labor and management and the two-man system returning a \$6,000 net operator income had gross incomes estimated at \$21,206 and \$38,891, respectively, both in the range of Economic Class II.

Only 3.3% of Eastern Highland Rim farmers had gross sales equal to or exceeding \$20,000 in 1964 (Economic Classes I and II).

This study has primary implication for the area comprised of the Baxter-Mountview-Bewleyville, Dickson-Mountview-Bewleyville, and the Cumberland-Waynesboro soil associations. The results depend on the underlying assumptions and data used in the analysis. The study results are normative and indicative of what should be if the assumed conditions existed. The results are not predictive, however, 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 few farmers achieve the efficiency levels assumed for this analysis. Failure to achieve a comparable level of efficiency necessarily implies that minimum land requirements for such systems at the specified income levels would be larger than requirements for the 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% interest for land investment and a 6% interest charge for nonland 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.

APPENDIX

Appendix Table 1. Selected sample of projected prices received and paid by farmers in Eastern Highland Rim, Tennessee

Item	Unit	Price (\$)
Prices received:		
Burley tobacco	lb.	.62
Slaughter hogs (200 lb.)	cwt.	14.50
Feeder pigs (40 lb.)	head	10.50
Sows, cull	cwt.	11.00
Slaughter steers (1,000 lb.)	cwt.	23.50
Slaughter heifers (810 lb.)	cwt.	23.50
Cows, beef culls	cwt.	15.00
Feeder calves (500 lb.)	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
Prices paid:		
Seed: Alfalfa	lb.	.45
Ladino clover	lb.	.65
Korean lespedeza	lb.	.20
Orchardgrass	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	1.13
Feeder steers (450 lb.)	cwt.	24.00

Appendix Table 2. Estimated forage requirements per unit of livestock enterprises, Eastern Highland Rim, Tennessee

Livestock enterprise ^a	Forage periods ^b				
	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

^aA unit of livestock enterprise was 10 milk cows for Dairy; 25 brood cows for Beef I, II, and III; and 10 steers for Beef IV.

^bForage requirements are in terms of hay equivalents for period I and in terms of Cow Acre Days for periods II-V.

Appendix Table 3. Estimated grain and supplement requirements per unit of livestock enterprises, Eastern Highland Rim, Tennessee

Enterprise ^a	Corn	Protein supplement	Mineralized salt
	Bushels	Cwt.	Cwt.
Beef I ^b			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 ^c
Swine I	2,224.3	221.4 ^d	
Swine II	550.3	54.0 ^d	

^aA unit of livestock enterprise was 10 milk cows for Dairy; 25 brood cows for Beef I, II, and III; 10 steers for Beef IV; and 12 sows for Swine I and II.

^bNo corn or protein supplement was assumed necessary for cow herd maintenance as grass-legume pasture and legume hay were available. Creep feeding of calves was not considered for beef enterprises.

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

^dSwine supplements included salt and mineral requirements.

Appendix Table 4. Estimated hours of annual machinery use, Eastern Highland Rim, Tennessee

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

^aAssumed custom hired.

Appendix Table 5. Estimated prorated machinery investment per acre for selected crops, Eastern Highland Rim, Tennessee

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
Orchardgrass-ladino hay and pasture	14.17	21.50
Orchardgrass-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 Table 6. Estimated labor requirements for representative crop enterprises by labor periods, Eastern Highland Rim, Tennessee

Enterprise	Soil group	Labor period					
		I	II	III	IV	V	VI
Crop enterprises:		Hours per acre					
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	
Orchardgrass-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	

Appendix Table 7. Estimated labor requirements per unit of livestock enterprises by labor periods, Eastern Highland Rim, Tennessee

Livestock enterprise ^a	Labor period					
	I	II	III	IV	V	VI
	Hours per unit					
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	285.5	121.3	91.9	152.8	91.7	154.1

^aA unit of livestock enterprise was 10 milk cows for Dairy, 25 brood cows for Beef I, 10 steers for Beef IV, and 12 sows for Swine I and II.

Appendix Table 8. Estimated annual overhead costs for small-sized farms, Eastern Highland Rim, Tennessee

Item	New cost	Annual ^a depr.	Annual repairs	Interest at 6%	Other	Total cost
Machine shed	\$1,000.00	\$ 50.00	\$ 5.00	\$ 30.00	\$ 6.00	\$ 91.00
Truck (½ T.)	2,000.00	180.00	80.00	54.00	166.23	\$480.23
Wagon and bed (5 T.)	340.00	20.40	12.24	9.18	.75	42.57
Manure spreader (100 bu.)	650.00	19.50	19.50	17.55	1.50	58.05
Shop equipment, tools			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 services					25.00	25.00
Auto expense (farm share), 1,000 miles at 8¢/mile					80.00	80.00
Total	\$3,990.00	\$269.90	\$136.74	\$116.73	\$368.48	\$891.85

^aDepreciation of machine shed over 20-year period, truck 10 years, and wagon and manure spreader over 15-year period.

^bFarm share of monthly service charge assumed to be \$2.50 per month; estimated annual toll charge was \$10.00.

^cSwine and dairy enterprise budgets included estimated electricity costs above the base charge of \$2.00 per month.

Appendix Table 9. Estimated annual overhead costs for medium-sized farms, Eastern Highland Rim, Tennessee

Item	New cost	Annual ^a depr.	Annual repairs	Interest at 6%	Other	Total cost
Machine shed	\$1,200.00	\$ 60.00	\$ 6.00	\$ 36.00	\$ 7.20	\$109.20
Truck (1 T.)	2,400.00	216.00	96.00	64.80	180.00	556.80
Wagon and bed (5 T.)	340.00	20.40	12.24	9.18	.75	42.57
Manure spreader (100 bu.)	650.00	19.50	19.50	17.55	1.50	58.05
Elevator (24 ft.)	300.00	18.00	9.00	8.10	.68	35.78
Shop equipment, tools			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 services					25.00	25.00
Auto expense (farm share), 1,400 miles at 8¢/mile					112.00	112.00
Total	\$4,890.00	\$333.90	\$162.74	\$141.63	\$416.13	\$1,054.00

^aDepreciation of truck over 10 years; machine shed, 20 years; and wagon, manure spreader, and elevator, 15 years.

^bFarm share of monthly service charge assumed to be \$2.50 per month; estimated annual toll charge was \$10.00.

^cSwine and dairy enterprise budgets included estimated electricity costs above the base charge of \$2.00 per month.

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