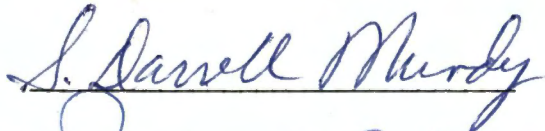


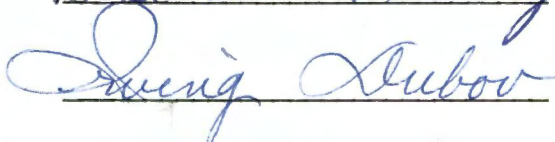
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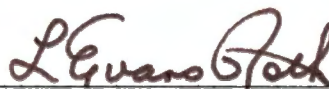
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AN ECONOMIC ANALYSIS OF SWINE PRODUCTION
IN THE TENNESSEE VALLEY WATERSHED
OF TENNESSEE

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Robert Malcolm Ray

March 1977

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ABSTRACT

The primary objectives of the study were to determine the effect of specific variables on the net returns to swine producers, to determine the competitiveness of swine with other major farm enterprises in the use of farm resources and to determine crop and livestock combinations which will maximize returns to the fixed resources for specified resource situations. The analysis was conducted under various resource and pricing situations for representative-type farms in three study areas of the Tennessee Valley Watershed Area of Tennessee.

The representative farm included 160 acres of openland in Area I, 135 acres of openland in Area II, and 125 acres of openland in Area III. The base labor supply included 3,000 hours of annual labor. The land-labor ratios were varied by alternatively increasing farm size by 100 and 200 percent and labor to 6,000 and 7,392 hours of available labor. The size of the livestock enterprises were restricted to not more than 120 Grade "A" dairy cows; 200 brood sows; 3,000 purchased feeder pigs; 500 beef steers; 200 beef cows; and 100 ewes.

Standard budgetary techniques were utilized in developing costs and returns, input requirements and estimated output for the major crops and livestock considered in the analysis. Linear programming techniques were used to determine the optimal farm organization which would maximize returns to land, labor, capital, and management for each situation.

Optimal farm organizations were developed for each of the resource situations considered when swine was an excluded alternative and when

swine was an alternative, and swine prices were varied from \$30 to \$60 per hundredweight. Variations were also made in grain prices, number of pigs produced per sow, feed conversion ratio for finishing hogs, and in livestock enterprises considered.

In general, when swine were priced at \$35 per hundredweight and above, the optimal farm organization included either a farrow-to-finish swine production system or the feeding out of purchased feeder pigs to slaughter weights. The number of brood sows varied from 55 to 194 as the land-labor ratios were varied by area. The number of purchased feeder pigs varied from 32 to 2,834. A large volume of grains would be purchased in most situations analyzed.

When the price of corn was varied from \$1.50 to \$4.00 per bushel, the number of hogs produced per sow from 10 to 20 per year, and the feed conversion was varied from 3.2 to 4.8 pounds of feed per pound of gain, the enterprise organization remained relatively stable; however, large changes occurred in the potential net returns to land, labor, capital, and management.

When comparisons were made of livestock alternatives, highest potential net returns were realized when the farm organization was restricted to swine. Where grain purchases were not permitted, the returns from swine production were severely reduced.

Based on the assumptions and results of the study, farrow-to-finish swine production and feeding out purchased feeder pigs appear to be relatively profitable farm enterprises under a variety of technical conditions and resource situations when the price of slaughter hogs are \$35 per hundredweight and above.

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CHAPTER I

INTRODUCTION

Tennessee agriculture is characterized by much diversity as to soil types, topography, climatic conditions and types of crops and livestock which can be successfully produced in the State. Though this diversity allows great latitude for farm operators to make choices of what to produce, more decision-making ability is required on their part if the available resources are to be used in an efficient manner.

During recent years Tennessee has become a major supplier of feeder pigs for finishing operations in other states to the east, north, and west of the State. Tennessee is a deficit area with respect to supplies of slaughter hogs; therefore, large numbers of live hogs are shipped in for slaughter each year. The number of feeder pigs moving through organized feeder pig sales increased 635 percent from 1964 through 1974, from 82,754 head in 1964 to 608,684 in 1974. A recent study by Fox [13] reported that 501,000 or 82 percent of the feeder pigs sold through the organized feeder pig sales in 1974 were later shipped to points outside of Tennessee. Forty-six percent that year went to Indiana and Iowa, while feeders in Illinois, Ohio, Kentucky, North Carolina, Kansas, and Nebraska purchased another 6 percent of the feeder pigs. In 1974, 2.95 million head of swine were slaughtered in Tennessee, while only about one million head were produced in the State for slaughter. Under these conditions, the question arises—Can Tennessee farmers economically produce more swine for slaughter purposes?

A. DISCUSSION OF THE PROBLEM

Low realized net farm income is a major problem in Tennessee. In 1974, Tennessee farmers realized an average net income per farm of \$1,118, which was a decrease of 66 percent from the income level of 1973 [38]. This decrease was attributed largely to decreased cotton and wheat production and lower livestock prices. This occurred during a period when prices of inputs such as fuel and fertilizer rose sharply.

Realized net farm income in Tennessee has been consistently lower than for other southeastern states of similar resource capabilities and nationally was lower in 1974 than all states except West Virginia. This strongly suggests that adjustments in resource use are absolutely necessary if farm incomes are to be increased in the future. A comparison of average net farm income of Tennessee and adjacent southeastern states is shown in Figure 1.¹ Not only are absolute levels of farm income lower in Tennessee, but the rate of increase over time has not kept pace with that for surrounding states.

Lower income is either a symptom that available resources—land, labor, capital, and management—are not being combined in the most efficient way, or else that not enough resources are available to individual farmers to produce a higher level of income per farm. Although much diversity exists in the resource mix, many Tennessee farms have available resources which are similar in respect to those on farms

¹The states adjacent to Tennessee include Alabama, Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia.

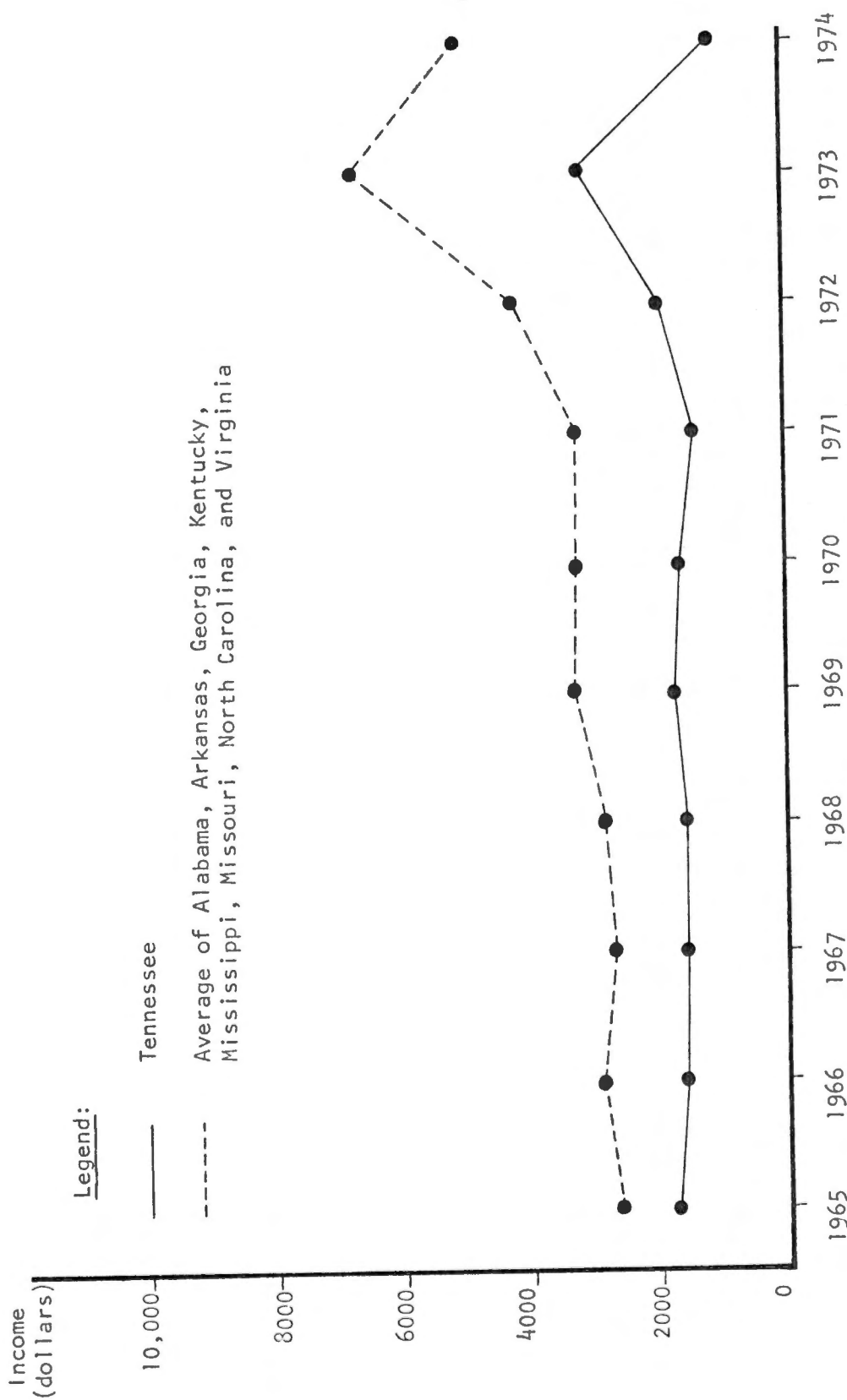


Figure 1. Comparison of average realized net income per farm for Tennessee and adjoining states for the years 1965-1974.

in adjacent states; therefore it can be assumed that adjustments can be made in resource use on these farms which will result in higher levels of realized net income.

Several studies completed in recent years indicated that enterprise adjustments on many farms would tend to increase farm income. Mitchell [23] found that in the Southeast, those states in which the largest shifts to enterprises which give a high return to labor occurred also experienced faster rates of increases in income. Research by Bounds, Cowan, and Eagan, [6, 9, 12] working independently suggested that a shift from feeder calves to some type of beef feeding system could improve incomes of some farms. Anderson [2] concluded that a shift in the type of rations fed to steers would reduce the cost of finishing steers for slaughter purposes. In the development and execution of plans on individual farms in Tennessee, the author [28] found that finishing swine to slaughter weights generated higher returns to land, labor, capital, and management than was possible with feeder pig production. Records of selected farms on Rapid Adjustment Program² [28] show that farm income increased from 200 to 500 percent when grain production was intensified, supplemental grain was purchased, and a swine finishing system was developed to produce slaughter hogs.

²The Rapid Adjustment Program is a cooperative project between the University of Tennessee and the Tennessee Valley Authority where intensive farm planning and management is emphasized on a limited number of carefully selected farms. These farms are selected to provide data and experience on adjustments needed to improve resource efficiency for specified segments of agriculture.

Williams [40] concluded that feeder pig production and finishing out purchased feeder pigs would be profitable in the Delta and Brown Soil area of Tennessee, while beef enterprises could provide additional income. However, when beef enterprises were included in the optimal enterprise mix, they were at a relatively low level.

Colyer and Irvin [8] reported in 1967 that the Corn Belt had the resources to meet the potential total national demand for pork for the next decade. This would indicate a comparative advantage for that area because of the availability of lower cost grain (a major cost of swine finishing) than is true for Tennessee. At the same time Tennessee has an advantage in the availability of feeder pigs at a relatively lower cost. Since this study was completed large shifts have occurred in the location of swine production. Rhodes and Grimes [30] in a 1974 survey found that large volume units were not as concentrated in the Corn Belt as was total hog production. Large volume operations in the Southeast led in swine marketings, though not in the number of operations. The survey indicated that 30.1 percent of the slaughter hogs were marketed in the Southeast region and that 42.4 percent of the feeder pigs were purchased in the region. These findings suggested that changes in technology, shifts in demand, changes in resource situations and other interrelationships in the economy are affecting the traditional pattern of swine production.

Trede and James [36] analyzed a typical farm situation in Iowa and found that swine generated more income than cattle feeding and that corn was the most profitable crop of those considered in the analysis. They

concluded that numerous swine producing systems could be profitable, but that management was the most important factor in determining the profitability of a given system. Similar findings by Colyer and Irwin [8] show that mixed crop-livestock farms with emphasis on livestock provided higher levels of income. They stated "that this was particularly true for farms with limited funds, where land is not readily available for expansion, and where labor is relatively abundant."

Sappington [32] estimated that on the average Tennessee farmers who purchased feeder pigs and finished them to slaughter weights would have made satisfactory returns from 1964 through 1972. The estimated returns to land and management averaged about \$5.00 per head, but were highly variable during different phases of the hog cycle.

Rundel [31] evaluated the potential for feeding out swine in the Upper Cumberland Area of Tennessee. Using 1969 average prices and assuming the use of a complete ration, he estimated that a return of \$4.89 per hog could be obtained by finishing feeder pigs to slaughter weights. With on-farm processing and buying corn by the trailer load from the Corn Belt, a return of \$9.45 per hog would be possible.

Bullock and Beal [7] compared the costs of producing hogs in North Carolina with different size and types of pork production systems. They found that with all types of operations, production costs declined as the size of the operation increased; however, most of the economies were realized by units of 200-400 sows. Farrow to finish units had a cost advantage over specialized feeder pig producing units and also over topping out operations at all size groups considered.

Researchers [43] at the University of Missouri estimated the returns to labor and management for typical swine farmers for the years 1969 through 1975 to determine the size of swine herd needed to obtain a return of \$15,000 per year. They concluded that it would have taken a 90 brood sow unit to obtain this income level where slaughter hogs were being produced. Returns were highly variable from year to year, but were positive in each of the years considered. For the producer of feeder pigs, the size of the sow unit would have to be increased to 122 head in order to generate a \$15,000 return to labor and management. With 122 sows returns again were highly variable but also positive in each year.

These and other studies made in Tennessee as well as other areas of the country indicate that swine production can be a profitable enterprise on many types of farms with varied resource situations. Since several of the above mentioned studies were completed, major shifts have occurred in the availability and costs of productive inputs as well as in the prices of the output for most enterprises. A need exists to investigate the economic relationships between different enterprises and different resource situations as well as levels of production possible. Also, given the hypothesis that swine production can generate higher returns to the resources on many farms, a need exists to evaluate alternative systems to determine which production systems are most feasible in order to guide farm operators in making adjustment decisions.

B. OBJECTIVES OF THE STUDY

The general objective of the study was to determine the competitive positions of alternative swine production systems in optimum use of farm resources and to determine the enterprise combinations which will maximize potential returns to land, operator labor, capital, and management under various resource conditions for representative farm situations in three areas in the Tennessee Valley Watershed of Tennessee.

Specific objectives were:

- (1) To evaluate data recorded by swine farmers cooperating in the Resource Management Program³ [41] to isolate factors which contribute to profitable swine production.
- (2) To develop optimal farm plans for three representative sized farms, with variations in swine prices and level of available land and labor in the three areas.
- (3) To determine the effect of variation in selected management and efficiency factors in swine production on the optimal farm plan and income potential for selected representative farm situations.
- (4) To compare alternative swine production systems with alternative livestock enterprises which are feasible in Tennessee with respect to their effects on optimal farm organization and potential net returns to land, operator labor, capital, and management.

³The Resource Management Program involves a group of farmers cooperating with the University of Tennessee and the Tennessee Valley Authority where the effectiveness of resource use adjustments in achieving agriculture progress is being evaluated.

C. PROCEDURE

The following procedures were used to accomplish the preceding objectives:

(1) Selected input-output data and net income estimates for swine production were taken from the annual farm records provided by 146 swine farmers cooperating in the Tennessee Resource Management Program for the years 1965 through 1971. The data were analyzed using ordinary least squares regression analysis to determine the relationship between the specified input-output variables and the net returns to land, labor, capital, and management. Some of the variables which were found to have a significant relationship as well as other variables hypothesized to affect efficiency were used in developing the model to evaluate the effects of efficiency factors on the potential net returns to swine production (Chapter VI).

(2) Data derived from records on Resource Management farms located in the three study areas were used to estimate total acreage, distribution of acreage by land class, and labor availability for the basic representative farms used in the analysis for the three areas. These land and labor estimates were then increased by first 100, and then by 200 percent to determine the effect of increased size on the optimal farm organization and net returns to land, labor, capital, and management.

Standard budgetary techniques were used to develop costs and returns for alternative swine, beef, and dairy production systems, as well as for cash crops, feed grains, and forage crops which can be produced in

Tennessee. Revised crop and livestock budgets developed by Ray and Walch [29] were used in the analysis. A linear programming algorithm was used to determine optimum resource allocation, enterprise combinations, and potential net returns to land, labor, capital, and management for the resource situations considered.

Optimal farm plans were developed for various land and labor situations where swine prices were varied from \$30 to \$60 per hundred-weight for slaughter hogs, and the prices of feeder pigs varied from \$20.70 to \$41.40 per head. Purchased grain prices were set at different levels in each of the three study areas to account for differences in transportation costs of grain from surplus areas.

(3) Optimal farm plans were developed to show the effect on net returns to land, labor, capital, and management when the values of selected factors were varied in the production system. Corn prices were varied from \$1.50 to \$4.00 per bushel, the number of hogs produced per sow was varied from 4 to 20 hogs per year, and the gain per pound of feed was varied from 3.2 to 4.8 pounds. The restrictions used in this model were the average acres of various classes of land and hours of labor for bimonthly periods.

(4) Using the same restrictions which were assumed in Objective 3, the major livestock enterprises which are produced in Tennessee were evaluated to determine their effects on net returns to land, labor, capital, and management. Optimal farming systems were derived where all livestock enterprises and alternative production systems for swine and beef production were considered. The model was then modified

by the systematic deletion of selected enterprises and system to determine their effect on net returns.

(5) Optimum farm organizations were estimated using linear programming techniques and maximizing net returns to land, labor, capital, and management.

(6) Residual returns to land, operator labor, and management were estimated for each programming situation by deducting a charge for all nonland capital and \$3.00 per hour for each hour of hired labor. Interest on operating capital was charged at an annual rate of 9 percent while interest on nonland investment capital was charged at a 7.5 percent rate.

CHAPTER II

AREAS FOR STUDY

The quality of land resources, topography, and climatic conditions vary widely throughout Tennessee [20]. In the western portion of the state large areas of highly productive loess soils are found at elevations of only 250 feet above sea level, while in the extreme eastern part elevations rise to more than 2,000 feet and the supply of productive soils is very limited. In much of this area slopes are so great that only sod crops should be grown in order to constrain erosion to acceptable limits.

The length of growing season in the State varies from 180 to 220 days, and the average rainfall ranges from 44 to 56 inches. The wide differences in the climatic environment as well as different soil capabilities, crop production alternatives, markets, and availability of labor requires that separate analyses be made in different sections of the State to determine the effect of specific variables on most efficient use of farm resources.

The three areas selected for analysis in the study are delineated in Figure 2.

A. AREA I

Area I includes the counties adjacent to the Tennessee River in the midwest portion of the State. The counties included are Benton, Carroll, Decatur, Lawrence, Lewis, Perry, and Stewart Counties. Soils

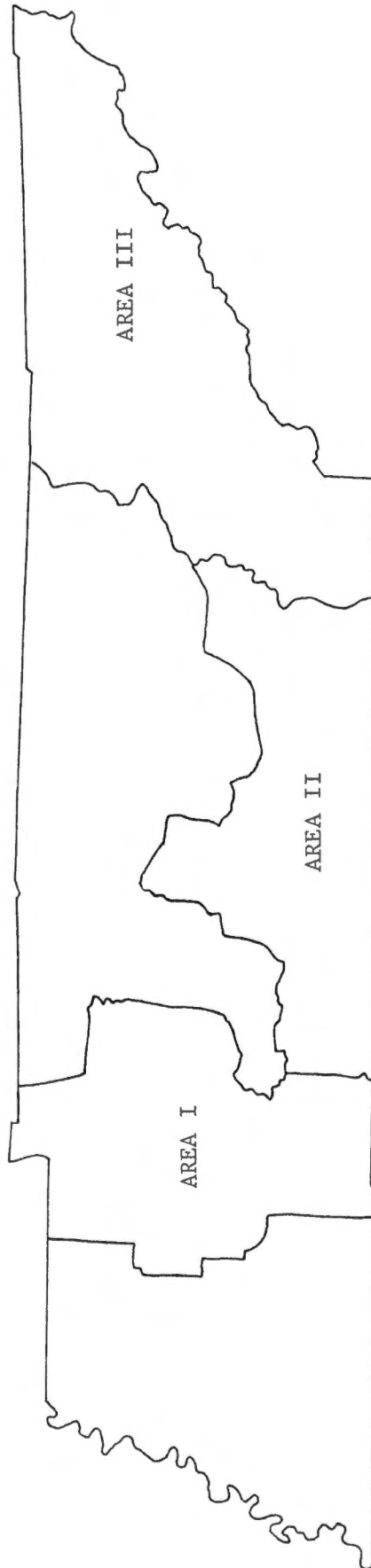


Figure 2. Location of three study areas.

in the area include the Providence-Dulac-Ruston Soil Association to the west of the river and the Dickson-Mountview-Bodine series on the east bank of the river [20]. Both soil series contain large amounts of low quality soils with a limited quantity of highly productive areas along the streams.

The major crops produced in the area include cotton, corn, small grain, soybeans, hay, and pasture. Swine and beef are the major livestock enterprises in the area. Although this is a deficit grain area, grain prices are somewhat lower than in Area II and Area III because of the closer proximity to surplus grain producing areas in Tennessee and other states.

B. AREA II

Area II includes the Southern Highland Rim in the South Central part of the State, plus the Sequatchie Valley. The counties of Bedford, Bledsoe, Coffee, Franklin, Giles, Grundy, Hamilton, Lincoln, Marion, Marshall, Moore, Rhea, Rutherford, and Sequatchie are included in this area. Major soil types found in the area include the Hartsell-Muskigum, Sango-Bodine, and Baxter-Dellrose-Mimosa Soil Associations.

Much diversity exists in the quality of the soils and the proportion of land suitable for row crop production. Several major crops are produced in the area. A rapid decline in cotton acreage has occurred in the area in recent years. Beef, dairy, and swine are the major livestock enterprises. Historically, sheep production was a major enterprise, but presently contributes very little to the agricultural income of the area.

C. AREA III

Area III includes the East Tennessee counties of Anderson, Blount, Bradley, Campbell, Carter, Claiborne, Cocke, Grainger, Greene, Hawkins, Jefferson, Johnson, Knox, Loudon, McMinn, Meigs, Monroe, Polk, Roane, Sevier, Sullivan, Unicoi, Union, and Washington. Principal soil types are those of the Fullerton-Dewey-Dunmore, and Dandridge-Needmore Soil Associations. Much of the upland soils are rocky and shallow; however, very productive soils are found on terraces and in the bottomlands along the streams.

The area is characterized by small farms, limited cropland, a high degree of industrialization, and many part-time farm operators. Most major crops with the exception of cotton are produced in the area. Burley tobacco is an important source of farm income. Beef cattle and dairy (both Grade "A" and manufacturing milk) are produced throughout the area. Feeder pig production is the predominant swine enterprise. Markets for livestock and livestock products are readily available; however, markets for crops, except tobacco, are not well established primarily because of low volume of crops produced for sale.

CHAPTER III

FRAMEWORK FOR ANALYSIS

A. INTRODUCTION

Data used in the analysis included farm records on 146 Resource Management farms which derived a major portion of their income from swine operations and from "economic-engineering" data compiled from individual swine farm records, research data from the University of Tennessee Experiment Station, research from other state experiment stations and personal communication with swine specialists in the Animal Science Department at the University of Tennessee [27, 29, 41].

Records on Resource Management farms provided data on selected input-output variables used in swine production and also net income estimates for swine farmers for the years 1965 through 1971. Acreages of various land classes and labor availability on Resource Management farms were used to define the representative farm situation in each study area. Regression analysis was used to determine the effect of specified variables on net return to land, labor, capital, and management for the 146 farms over a six-year period [11].

Economic-engineering data were used in developing enterprise budgets for the representative farms. The linear programming technique was used to determine a set of product outputs for each study area which would yield maximum returns to land, labor, capital, and management [15]. Appropriate resource constraints were established for each representative

farm situation. The price of swine was varied from \$30-60 per hundred-weight to determine the stability of the optimum farm plan to wide fluctuations in swine prices [14].

The basic data were then modified to evaluate the effects of changes in the level of grain prices, number of hogs produced per brood sow, and the rate of gain in finishing slaughter hogs. Also the data were modified so that comparisons could be made between different feeding systems for farrow-to-finish operations, for feeder pig production, and for feeding out purchased feeder pigs as these systems relate to other livestock enterprises.

B. RESOURCE ASSUMPTIONS

Land Availability

A 1972 study conducted by the staff in Agricultural Economics Extension, Research, and Teaching projects a decrease of 42 percent in the number of farms in Tennessee from 1969 to 1985. During the same period farm size was projected to increase from 123 to 200 acres [40]. In 1974 the average size farm in Tennessee was 124 acres. For the 146 Resource Management farms analyzed, the average size farm for the 1965-71 period was 243 acres for all three study areas. Cropland and pasture averaged 141 acres. The average size of the Resource Management farms and distribution of land by use for the 1965-71 period is shown in Table I for each of the three study areas. For the analysis for Objective 2, the representative farms were assumed to have these base acreages. Representative farm situations were also analyzed which were 200 and 300 percent of the base acreage established for each study area.

TABLE I
 LAND USE CLASSIFICATION USED TO OBTAIN OPTIMUM
 FARM ORGANIZATIONS FOR BASE SIZE FARMS
 IN THREE AREAS OF TENNESSEE

Land Class	Area I		Area II		Area III	
	Acres	Percent	Acres	Percent	Acres	Percent
Continuous crops	55	19	49	20	25	13
3 year rotation	26	9	22	9	28	15
6 year rotation	<u>15</u>	<u>5</u>	<u>7</u>	<u>3</u>	<u>17</u>	<u>9</u>
Total	96	33	78	32	70	37
Pasture	64	41	57	23	59	37
Woods	121	41	98	40	51	27
Other	<u>12</u>	<u>4</u>	<u>12</u>	<u>5</u>	<u>10</u>	<u>5</u>
Total	293	100	245	100	190	100
No. of farms	78		52		16	

Source: Based on land classification on 146 Resource Management Swine Farms, 1965-1971.

Most representative farm studies have classified the available land based on a soil capability classification derived by the Soil Conservation Service where different yield levels are assumed, based on the characteristics of a given soil. A major problem with this method has been over estimation of the product supply when the land classes are aggregated. This occurs because soil variations are not only heterogenous between areas and farms, but within farms as well. It is not uncommon to find areas of highly productive soils on a farm which cannot be used in their highest potential because of field layout, flooding problems, or some other physical condition. In other situations SCS capability classifications have been so restrictive relative to the potential use of a given soil that farm operators have been unwilling to consider the classification.

An alternative classification method to the Soil Conservation Service Capability unit was developed for planning on Rapid Adjustment farms and has been adapted for use on all Resource Management farms. This method includes an on-site inspection of each field on a given farm. The inspection consists of making a determination of soil type, past cropping history, and any problems associated with production. From this evaluation the field is then classified as to its most intensive use. Such a classification may include some or all of the following categories: Continuous row cropland, two years of row crops each four years, one year of row crops each three years, one year of row crops each six years, a combination of hay and pasture, and permanent pasture only. Forest land is evaluated to determine if there is a potential for

expanding farm size by land clearing. This is done by determining soil quality, slope, physical problems, estimated costs of clearing, and potential use of such soils.

Experience of Rapid Adjustment farms since 1963 indicates that more variation in crop yields occur from different management practices and exogenous variables such as weather, insects, and disease than occur from differences in soil characteristics within a given land class. For this reason a minimum number of different yield expectations was assumed in the model.

Labor Availability

Three levels of labor availability were assumed in the study for determining optimum farm organizations with alternative farm size situations where swine prices were varied over a wide range. In the first situation an owner operator having 3,000 hours of labor available was used. The labor was then increased to 6,000 hours assuming a father-son or other partnership arrangement. A third situation assumed an owner-operator using two full-time hired men. The operator would provide 3,000 hours while the hired men would work 44 hours per week for 50 weeks making a total labor supply of 7,392 hours. The total available labor was divided into six two-month periods with more labor available during the summer months than for winter months. Data on labor availability by period and size of the labor force are presented in Table II.

Data from records on 325 Resource Management swine farms indicate that the average available labor for the period 1969 through 1973

TABLE II
LABOR AVAILABILITY BY PERIOD AND SIZE OF LABOR FORCE

Labor Period	Hours		
	1-Man ^a	2-Man ^b	3-Man ^c
January-February	475	950	1,171
March-April	500	1,000	1,230
May-June	525	1,050	1,295
July-August	525	1,050	1,295
September-October	500	1,000	1,230
November-December	475	950	1,171
Total for year	3,000	6,000	7,392

^a Assumes an owner operator.

^b Assumes a partnership arrangement.

^c Assumes an owner operator with two full-time hired men.

was 1.6 man equivalents or 4,895 hours.¹ The amount of labor increased 16 percent from 1969 through 1973. In evaluating management factors and livestock production systems in Chapters VI and VII a labor supply of 4,895 hours of labor was assumed as representative of the labor available on typical swine farms in Tennessee.

The labor coefficients associated with the production of a given enterprise assumed that 20 percent of the total labor allocated to that enterprise would be used for management, supervision of family or hired labor, and other jobs not directly involved in the production of the enterprise. No seasonal labor was included in the model because the availability of such labor is highly variable in the study area.

C. DERIVATION OF THE PRODUCTION COEFFICIENTS

Numerous sources were used in obtaining basic data necessary to develop a set of input-output budgets. Some sources of data include results of experiments at the University of Tennessee Experiment Station, research data from other state experiment stations, personal communications with research and extension personnel in various departments in the Institute of Agriculture, farm records kept by Tennessee farmers and personal contact with cooperating farmers throughout the state. Estimated costs of inputs were obtained mainly from agri-business firms which supply inputs to farm operators, while output prices were projected

¹A man equivalent is the total months of labor put into the farm business by hired labor, family labor, and the operator, divided by 12.

from published data by public and private forecasters² and from consultations with personnel in the Department of Agricultural Economics at the University of Tennessee. Production coefficients were obtained for crop and livestock enterprises which are most common in the study areas. Specialty crops and livestock were excluded from consideration in the analysis.

Crop Budgets

The major crop enterprises included in the models were cash crops such as tobacco, cotton, and soybeans; grain corn and small grains which could either be sold as a cash crop or used as a feed grain; hay crops including alfalfa, bermuda grass, and grass and clover mixtures which also could be sold or fed; corn and small grain silage for feed; and permanent and temporary pasture for livestock feed. Burley tobacco was excluded from consideration in Area I and cotton was included as an alternative in Areas I and II only. Budgets were developed and incorporated into the models for double cropping and rotations were specified to more fully utilize the soil resources. Double-cropping systems included small grain and soybeans, small grain and milo, and small grain silage and corn silage. Rotational systems included grain corn and alfalfa, silage corn and alfalfa, small grain, corn, and grass clover hay mixtures and corn silage and hay rotations.

²The sources of these data included Doan Agricultural Services, Kiplinger Agricultural Letter, Iowa State University, U.S. Department of Agriculture, and others.

A constraint of 1,100 pounds of burley tobacco was used in the models for Area II and Area III and wheat and soybean double-cropping was constrained to not more than 33 percent of the cropland.

The major components included in the crop budgets were estimates of yield per acre for various land classifications, price of the product, types and amounts of technical inputs such as seed, fertilizer, chemicals, and machine requirements required to produce a unit of output. The data on estimated yields, variable and fixed expenses and gross and net returns per unit for the crop enterprises considered in the study are shown in Table III. Estimated labor requirements by two-month periods and capital requirements were taken from Farm Planning Manual.³

Livestock Budgets

Livestock budgets developed and used in the analysis included four Grade "A" dairy production systems using different rations and forages; eight farrow to finish swine systems using alternative grain rations; two feeder pig systems; twelve purchased feeder pig systems where rations and time of production were varied; two cow-calf systems where the size of unit and forage program was varied, five steer budgets where type of feeding system, length of the production period and calf weights were varied; and one sheep production system.

³Robert M. Ray and Herbert N. Walch, Farm Planning Manual, Tennessee Agricultural Extension Service Extension Circular 622C (revised) December 1975.

TABLE III

YIELD, PRODUCT PRICE, EXPENSES PER ACRE AND NET RETURN
TO LAND, LABOR, CAPITAL, AND MANAGEMENT
PER ACRE FOR CROP ENTERPRISES

Crop	Unit	Yield ^a	Product Price (Dollars)	Expenses ^b per Acre (Dollars)	Net Return per Acre (Dollars)
Burley tobacco	lb.	2,200	1.00	583.44	1,616.56
Cotton	lb.	625	.45	160.02	133.73
Soybeans	bu.	30	5.00	60.97	89.03
Grain corn	bu.	80	2.50	81.28	118.72
Milo	bu.	70	2.15	72.74	78.06
Wheat	bu.	40	2.75	77.19	60.31
Barley	bu.	45	2.00	77.39	40.11
Wheat-soybeans	bu.	40	2.75	--	--
	bu.	26	5.00	107.70	132.30
Wheat-milo	bu.	40	2.75	--	--
	bu.	50	2.15	129.98	87.52
Wheat silage	ton	7.5	15.00	87.93	24.57
Corn silage	ton	15	15.00	135.60	89.40
Alfalfa	ton	3.5	55.00	140.55	51.95
Red clover-timothy	ton	2.5	45.00	76.92	35.58
Bermuda grass	ton	5	42.00	157.03	52.97
Permanent pasture	acre	1	--	29.42	--
Summer pasture	acre	1	--	54.05	--
Winter pasture	acre	1	--	61.34	--

^aThe basic yields represent a production level approximately 25 percent above the average yield for Tennessee. These yields were modified in the model depending on the soil classifications.

^bExpenses include variable expenses such as seed, fertilizer, lime, pesticides, fuel, oil and repairs for machinery, and custom machine hire. Fixed expenses include depreciation on tractors, machinery, and buildings for specialized crops such as tobacco.

Source: Ray, Robert M., and Walch, Herbert N., Farm Planning Manual, Tennessee Agricultural Extension Service, EC622, (Revised) December, 1975.

Constraints placed on the livestock enterprises were 120 dairy cows, 200 brood sows, 1,000 purchased feeder pigs per production period, 500 beef steers, 200 brood sows, and 100 ewes.

Components included in the livestock budgets were total production per livestock unit; product price per unit; the technical production coefficients such as feed, minerals, veterinary and medicine, machine costs; and trucking or hauling which are associated with livestock production; and the input cost, labor, land, building and equipment required to produce a defined unit of enterprise.

Budgets were developed for the following size livestock units: 30 and 100 beef cows, 10, 24, and 120 brood sows, 60 Grade "A" dairy cows, 50 beef steers, and 50 purchased feeder pigs. Fixed costs were computed on the basis of these size units.

Six alternative swine production systems are shown in Table IV. All swine and other livestock budgets used in the analysis were derived from data outlined in Farm Planning Manual.⁴

The model was designed so that corn, small grain, and hay crops could either be sold or used as livestock feed. These crops could also be purchased for livestock feed, but at the market price plus transportation and handling charges. Corn and small grain silage were restricted to on-farm production and both temporary and permanent pasture were restricted to on-farm production and could be produced on all land classifications. The variable cost of production was the basis for charging pasture to the livestock enterprise.

⁴Ray and Walch [29].

TABLE IV

ESTIMATED RETURNS, VARIABLE AND FIXED EXPENSES, AND CAPITAL
CHARGE FOR ALTERNATIVE SWINE PRODUCTION SYSTEMS

	Swine Systems ^a					
	Feeder Pigs	Farrow to Finish	Purchase Pigs (Corn)	Purchase Pigs (Corn and Wheat)	Purchase Pigs (Corn and Milo)	Purchase Pigs (Corn and Barley)
Gross returns (less death loss)	\$401.75	\$1,196.27	\$72.94	\$72.94	\$72.94	\$72.94
<u>Variable expenses</u>						
Corn ^b	110.24	478.66	27.56	14.05	14.05	14.05
Wheat	--	--	--	13.98	--	--
Milo	--	--	--	--	14.35	--
Barley	--	--	--	--	--	14.99
Supplement ^c	57.00	201.74	11.93	11.93	11.93	11.93
Creep feed ^d	80.00	80.00	--	--	--	--
Pasture ^e	5.00	5.00	--	--	--	--
Marketing	12.26	--	--	--	--	--
Vet. and medicine	10.00	18.00	1.25	1.25	1.25	1.25
Electricity	5.00	5.00	--	--	--	--
Machinery expense	28.66	39.22	2.51	2.51	2.51	2.51
Feeder pig	--	--	22.00	22.00	22.00	22.00
<u>Fixed expenses</u>						
Boar	3.75	3.12	--	--	--	--
Depreciation on bldg. and equip.	10.00	30.58	1.26	1.26	1.26	1.26
Repairs on bldg. and equip.	2.00	9.67	.39	.39	.39	.39
Tractor	.21	--	--	--	--	--
Repairs and depreciation on fences	1.44	1.44	--	--	--	--

TABLE IV (Continued)

	Swine Systems ^a				
	Feeder Pigs	Farrow to Finish	Purchase Pigs (Corn)	Purchase Pigs (Corn and Wheat)	Purchase Pigs (Corn and Milo)
Total variable and fixed expenses	310.56	872.43	66.90	67.37	67.74
Net returns to land, labor, capital, and management	91.19	323.84	6.04	5.57	5.20
					4.56

^aFeeder Pigs: Feeder pig production included one brood sow producing two litters of eight pigs per litter, and selling 15.5 pigs at a weight of 45 pounds. Fixed costs were computed on the basis of a 20 sow unit.

Farrow to Finish: Farrow to finish included one brood sow producing two litters of eight pigs per litter and selling 15.5 head at a weight of 230 pounds. Fixed costs were computed on the basis of a 24 sow unit. Assumes a death loss of 1 1/2 percent.

Purchase Pigs: Purchase a unit of 50 head of 45 pound feeder pigs and feed to 230 pounds using a corn and supplement ration. Fixed costs were computed on the basis of a 300 head feeding floor. Assumes a 3 percent death loss.

Purchase Pigs: Same as system 3 except pigs are fed 50 percent corn and wheat providing the remainder of the grain ration.

Purchase Pigs: Same as system 3 except pigs are fed 50 percent corn and milo providing the remainder of the grain ration.

Purchase Pigs: Same as system 3 except pigs are fed 50 percent corn and barley providing the remainder of the grain ration.

TABLE IV (Continued)

^b Corn requirements for system 1 was 42.4 bushels per sow, replacement and boar. Corn was charged at \$2.65 per bushel. It was assumed that wheat, milo, and barley substituted for corn at the rates of 1.15, .85, and .76, respectively. For system 2, the corn requirement was 40.7 bushels of corn for sow, replacement and boar and 9.25 bushels for each hog produced. For system 3, each purchased feeder pig required 10.6 bushels of corn equivalent when fed to market weight.

^c The sow replacement and boar required 570 pounds of supplement at \$8.06 per cwt. while each pig fed out required 148 pounds of supplement.

^d In systems 1 and 2 each pig required 50 lbs. of creep feed at \$10.00 per cwt.

^d Two-tenths of one acre of pasture were required for dry sows in feeder pig and farrow to finish operations.

Adjustments in Net Returns to Land, Labor,
Capital, and Management

The net returns to land, labor, capital, and management in the optimum farm situations in all models were adjusted to remove the effects of nonland capital costs and hired labor so that returns to land, operator labor, and management could be compared.

Interest on investment capital was charged at an annual rate of 7.5 percent while interest on operating capital was charged at an annual rate of 9 percent for the length of time needed to complete the production cycle of a specified enterprise. Labor was charged at a rate of \$3.00 for the resource situations where two and three man labor situations were analyzed. A higher wage rate than the prevailing wage rate for Tennessee was used because higher levels of technology than is presently applied on the average by Tennessee farmers was assumed in the analysis.

CHAPTER IV

ANALYSIS OF RECORD DATA ON RESOURCE MANAGEMENT SWINE FARMS

A. INTRODUCTION

Records collected from farmers participating in the Tennessee Resource Management Program are analyzed on an annual basis and then divided into six categories determined by their major source of income. One category includes farmers receiving more than 50 percent of their gross income from the sale of swine. The total number of records analyzed varies from 325 to 350 per year and of this total, 146 records were for swine farms during the years 1965 through 1971. New farmers enter the program each year while others complete the program; therefore, some farmers were not enrolled in the program for every year considered. It was hypothesized that certain characteristics unique to the farm, the farmer, the area and the the time period would affect the level of net income achieved by these farm operators. The objective of this analysis was to determine if several selected variables had an influence on the returns to swine producers for a specified time period.

B. PROCEDURE

Though the farmers enrolled in the Resource Management Program are not selected at random, it was assumed that they are a good proxy for typical farm operators in the Tennessee Valley of Tennessee. A

combination of cross section and time series data was used in making the analysis with 425 observations available for the 146 swine farms considered. Ordinary least squares regression analysis was used to analyze the relationship between selected independent variables and net returns earned by farm operators where swine sales was the major source of cash receipts from farming.

Family farm income in dollars was the dependent variable used to measure net returns. This is defined as gross farm income minus total farm expenses and is the amount of farm income the farm family earns on its land, labor, capital, and management.¹ Seventeen independent variables hypothesized to be related to net returns were selected for analysis.

The independent variables included in the regression equation were defined as follows:

X_1 = Acres of openland per farm.

X_2 = Percentage of openland planted to row crops.

X_3 = Amount of purchased protein supplement in dollars.

X_4 = Number of beef cows per farm.

X_5 = Number of brood sows per farm.

X_6 = Investment in machinery per farm in dollars.

X_7 = Number of pigs weaned per brood sow.

¹Gross farm income measures total farm income including both cash and noncash receipts while total farm expenses include both variable and fixed expenses attributed to the farm business.

Region of State

$X_8 = 1$ if farm was in Area II; $= 0$ otherwise.

$X_9 = 1$ if farm was in Area III; $= 0$ otherwise.

Year

$X_{10} = 1$ if 1966; $= 0$ otherwise.

$X_{11} = 1$ if 1967; $= 0$ otherwise.

$X_{12} = 1$ if 1968; $= 0$ otherwise.

$X_{13} = 1$ if 1969; $= 0$ otherwise.

$X_{14} = 1$ if 1970; $= 0$ otherwise.

$X_{15} = 1$ if 1971; $= 0$ otherwise.

Omitted²

$X_{16} = 1$ if farm was in Area I; $= 0$ otherwise.

$X_{17} = 1$ if 1965; $= 0$ otherwise.

Research shows that where row crop production can be increased, farm income normally increases [28]; therefore it was hypothesized that a positive relationship would exist between acres of openland and the percentage of that land devoted to row crops. The farms included in the analysis averaged 163 acres of openland and 37 acres of row crops. Since a sufficient level of protein is necessary in a feeding program to have efficient gain, a positive relationship was hypothesized between the amount of purchased protein and family income. Beef and swine

²These two dummy variables were deleted in solving for the regression coefficients to prevent perfect dependency, respectively, among regional and yearly independent variables and the intercept term.

production can be compatible enterprises on a given farm since forages such as pasture and corn stover can best be utilized by beef animals; therefore, a positive relationship could be expected with increases in beef numbers by utilizing these resources. An increase in the number of brood sows would be expected to have a positive effect on net income since better facilities and more concentrated management would be expected with larger size swine units, as well as more units of output from additional brood sows. Machinery investment could have a positive or negative effect on income. If additional machinery investment improves labor efficiency substantially, a positive effect would be expected; however, if labor becomes underemployed to the extent that additional machinery investment does not increase output, the opposite effect would be expected. Since income can be increased with little additional cost with increased hogs produced per sow unit, the number of pigs would be expected to have a positive effect on net farm income.

A hypothesis was made that a difference exists in net returns to land, labor, capital, and management from the production of swine in the three study areas, mainly because of costs associated with the transportation of grain and different amounts and qualities of the land resources available. Zero-one dummy variables were used to help to account for these differences between areas. Also, zero-one dummy variables were used to account for differences in family farm income due to differences in the years of observation.

C. DISCUSSION OF THE ANALYSIS

In the regression analysis, eight of the seventeen independent variables were found to be highly related to net farm income. The means, standard deviations, estimated regression coefficients, and standard errors for the regression equation are given in Table V. The effect of open acres (X_1) and percentage of this land (X_2) used to produce row crops was positive and significant at the 0.01 level. The effect of variations in the amount of purchased protein (X_3) was positive, but not statistically different from zero at the .05 level. The number of brood cows kept on swine farms (X_4) also had a positive coefficient but was statistically insignificant at the .05 level. An average of 21 brood cows were kept on these farms.

The number of brood sows averaged 24 head on the farms analyzed and the regression coefficients for number of brood sows (X_5) was positive and significant at the 0.01 level. This was expected because farmers with a larger number of sows usually have better facilities and devote more time and management to the swine enterprise. Investment in farm machinery (X_6) had a negative coefficient, but was not significantly different from zero. The effect of the number of pigs weaned per sow (X_7), an indicator of more efficient production, was positive and highly significant. Farmers who wean more pigs per sow are probably better managers who also market more pounds of pork.

Zero-one dummy variables were used to separate the effects of weather, prices, and other factors by time period. The effect of

TABLE V

MEANS, STANDARD DEVIATIONS, ESTIMATED REGRESSION COEFFICIENTS
AND STANDARD ERRORS FOR THE REGRESSION EQUATION OF
NET INCOME ON SELECTED INPUT VARIABLES

Variable	Mean	Standard Deviation	Regression Coefficients	Standard Errors
$R^2 = .3423$				
Intercept			-149.31	
Y	3780.74	5830.9	--	--
X ₁	162.94	88.79	11.98**	3.37
X ₂	37.37	25.78	37.47**	9.80
X ₃	181.88	371.19	0.37	0.81
X ₄	21.05	79.89	18.50	14.52
X ₅	24.88	20.61	64.91**	13.50
X ₆	429.12	714.45	-0.63	0.44
X ₇	6.59	2.30	262.40**	105.55
X ₈	0.33	0.47	301.92	535.23
X ₉	0.09	0.29	247.90	863.72
X ₁₀	0.14	0.35	-1214.90	903.19
X ₁₁	0.15	0.36	-4883.80**	888.82
X ₁₂	0.19	0.39	-4682.20**	855.35
X ₁₃	0.14	0.35	-643.57	909.13
X ₁₄	0.14	0.35	-6106.30**	921.71
X ₁₅	0.11	0.31	-3012.30**	995.02

** Coefficients significantly different from zero at the 0.01 Level.

variations in the years 1967-68 (X_{11}) and (X_{12}) and 1970-71 (X_{14}) and (X_{15}) were both negative and significant at the 0.01 level. These findings are consistent with those of Sappington [32] and his conclusion that high variability exists in the level of returns to swine production. The variables for 1966 (X_{10}) and 1969 (X_{11}) were also negative but not significantly different from zero at the .05 level. As shown in Figure 3, the price of swine began moving lower in the years of 1966 and 1969 and reached the low point during each of the following two year periods (1967-68 and 1970-71), respectively.

It has been hypothesized that farmers in the western part of Tennessee have an advantage in producing swine over other sections of the State. From the data analyzed Area II (X_8) and Area III (X_9) were not found to be significantly different from Area I.

On the basis of this limited analysis, selected variables were evaluated in developing optimal farm organizations and the effect of the variables on potential returns to land, labor, capital, and management. Variables considered included the level of slaughter hog prices, the number of hogs produced per brood sow, the amount of openland available, and the area of the State. These variables were supplemented by variables such as labor supply, price for grain, and feed conversion for swine.

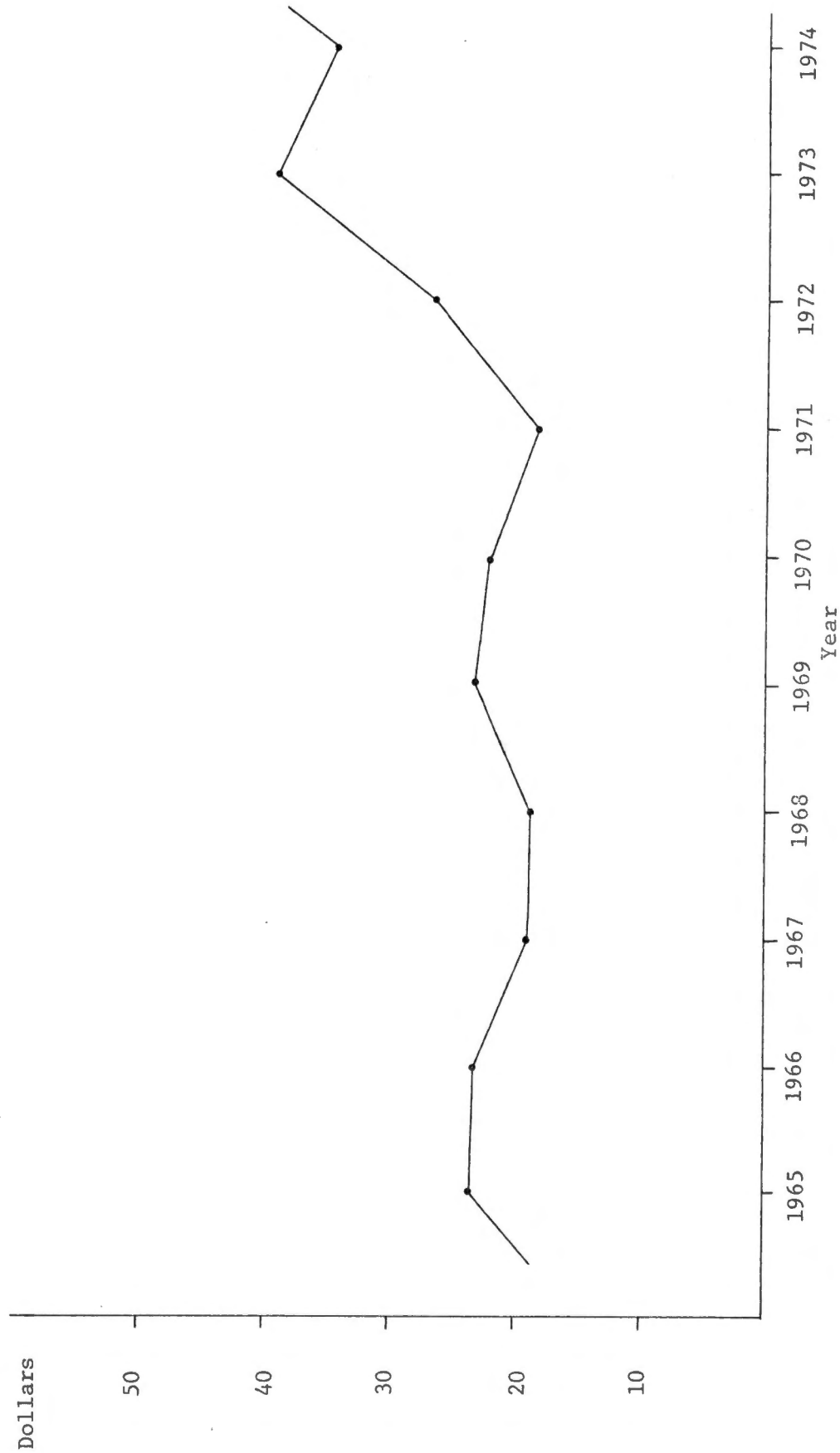


Figure 3. Average swine price per hundredweight received by Tennessee farmers, 1965-1974.

Source: Tennessee Agricultural Statistics, Bulletin T-8 and T-9, Tennessee Crop Reporting Service, August 1971; 1976.

CHAPTER V

RESULTS AND DISCUSSION OF ALTERNATIVE FARM ORGANIZATIONS WHERE SWINE PRICES WERE VARIED FROM \$30-60 PER HUNDREDWEIGHT

A. INTRODUCTION

In this chapter comparisons are made of optimum farming systems for three geographical areas of Tennessee, for three farm sizes in terms of acres, and three levels of the labor supply with no swine feeding in the system and where swine production was allowed and the output price for swine was varied from \$30-60 per hundredweight. Particular attention was given to comparing net returns to land, operator labor, and management under alternative situations, to changes in the amount and organization of the farm resources, and the value of the marginal product for the most restrictive resources. Output prices for crops and other livestock were held constant with the exception of feeder pigs. The price of a 45 pound feeder pig was assumed to sell for 69 percent of the price per hundredweight for market hogs, and was adjusted upward as the price of market hogs was increased. All input prices were held constant for each planning situation except feeder pigs which were adjusted upward as slaughter hog prices increased.

B. AREA I

Base Size Farm Using Operator Labor

In this situation, the land size was assumed to be 160 acres of openland (Table I, page 18) with 96 acres suitable for continuous or rotational cropping and 64 acres suitable only for permanent pasture. The labor supply was assumed to be 3,000 hours provided by the operator and divided into six two-month periods. Cotton production was restricted to 20 acres and wheat and soybeans in a double cropping system was restricted to 32 acres or one-third of the cropland. The number of purchased feeder pigs to be fed to slaughter weights was restricted to no more than 1,000 head in each of the four-month production periods while brood sows were restricted to 200 head. A base purchase price of \$2.65 per bushel for corn, \$2.90 per bushel for wheat, and \$2.30 per bushel for milo was used in the analysis for Area I.

The optimum farm organizations are shown in Table VI. Without swine feeding, 39 Grade "A" dairy cows and 36 steers "backgrounded" to a weight of 700 pounds were included in the livestock program. The cropping program included the production of hay, silage, and pasture for the livestock operation. Part of the hay requirements were met by purchasing alfalfa and red clover-timothy hay. Also, a limited amount of grain corn, wheat, soybeans, and cotton would be produced for sale.¹ A net return to land, operator labor,

¹In the planning procedure, all grain for the dairy was assumed to be purchased. Where grain for sale is in the optimal plans, this grain may be used for livestock on the farm.

TABLE VI

OPTIMUM FARM ORGANIZATION FOR BASE SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices			
		Swine Price per CWT (Dollars)			
	0	30	35	50	60
<u>Crop enterprises, acres</u>					
Grain corn	8.5	26.7	30.2	52.9	52.9
Cotton	10.3	--	--	--	--
Wheat-soybeans	14.0	14.3	15.9	--	--
Corn silage	22.3	13.9	--	--	--
Red clover-timothy	8.0	12.9	--	--	--
Permanent pasture	77.4	75.7	12.5	--	--
Summer pasture	19.5	12.2	--	--	--
Wheat-milo	--	--	8.9	2.1	--
<u>Livestock enterprises</u>					
Grade A dairy, cows	39	24	--	--	--
Steers, head	36	53	--	--	--
Slaughter hogs I ^a , head	--	--	--	--	--
Slaughter hogs II ^a , head	--	--	57	839	843
Slaughter hogs III ^a , head	--	--	--	766	768
Farrow to finish, sows	--	23	73	--	--
<u>Buy and sell activities</u>					
Sell corn, bu.	680	--	--	--	--
Sell wheat, bu.	557	--	--	--	--
Sell soybeans, bu.	362	372	413	--	--
Buy corn, bu.	--	5	4,640	8,472	8,401

TABLE VI (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	1,280	4,485	4,485	11,342	11,578
Sell milo, bu.	--	--	86	86	56	--
Buy red clover, ton	15	--	--	--	--	--
Buy alfalfa, ton	39	24	--	--	--	--
Sell swine, cwt.	--	--	--	--	--	--
Net return to land, labor, capital and management	\$27,239	\$27,515	\$45,676	\$54,016	\$90,081	\$128,022
Net return to land, operator labor, and management	\$21,937	\$22,737	\$41,495	\$49,830	\$84,464	\$122,039

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

and management of \$21,937 was generated by this plan.²

When the production of swine was considered in the plan and a price of \$30.00 per cwt. was specified for slaughter hogs, the number of dairy cows decreased from 39 to 24 head, the number of steers increased from 36 to 54 head, and the production of 23 brood sows in a farrow to finish operation was included in the livestock plan. The cropping program included the production of silage, red clover-timothy hay and pasture for the dairy. Alfalfa hay would be purchased. The corn and wheat produced would be used for swine feed and the soybeans produced would be sold. With an increase in swine prices to \$35.00 per cwt., all the dairy cows and steers were eliminated from the plan and the number of brood sows increased to 73 head. In addition to the grain produced on the farm, 9,125 bushels of corn and wheat would be purchased for the swine operation.

No changes occurred in the farm organization when swine prices were increased to \$40.00 per cwt.; however, when the price was increased to \$50.00 per cwt., the production of slaughter hogs using purchased feeder pigs replaced the farrow to finish operation.

Significant changes occurred in the amount of land used as prices and optimal farming systems change. When no swine were fed all the

²The optimal farm organizations were estimated using an objective function to maximize net returns to land, labor, capital, and management. Interest on nonland investment capital and operating capital were subtracted from these net returns as well as the cost of hired labor in the optimum plans. Interest on nonland investment capital was charged at 7 1/2 percent annually and interest on operating capital was charged at 9 percent for the time used. Hired labor was charged at \$3.00 per hour. A residual net return to land, operator labor, and management was obtained.

available land was used. At swine prices of \$35.00 and \$40.00 per cwt., 92.5 acres of the 160 total openland acres available are not used, while at swine prices of \$50.00 and \$60.00 per cwt., the unused land was 105 acres. At these price levels only the continuous cropland was utilized.

Farm income increased from \$21,937 without swine feeding to a level of \$122,039 when swine prices increased to \$60.00 per cwt.

The effects of changing swine prices on the marginal value products for both land and labor are shown in Table VII.³ The marginal value product for continuous cropland increased from \$54.94 per acre without swine feeding to \$81.26 with swine prices at \$30.00 per cwt. As swine prices increased the labor restrictions became more important, and at \$60.00 swine prices land was not restrictive. The value of an additional hour of labor in specific time periods varied from less than \$1.00 to more than \$84.00 in the various optimal plans. With swine prices at \$60.00 per cwt. the MVP for labor was very high in four labor periods.

Base Size Farm Using a Two-Man Labor Supply

The alternate farm plans are outlined in Table VIII using a two-man labor supply. When the labor supply was increased to 6,000 hours divided

³The marginal value product (MVP) of a limiting resource is the value of the product of the last unit of resource used in production. Even though the interpretation of the MVP is somewhat similar in linear programming and in production function analysis, the derivation is different. The value of the MVP of a resource which is computed from a production function is independent of the use of other resources involved, and it can be computed at any level of use. In linear programming the MVP's are computed only for resources that are restricting, and the value of the MVP is a result of a complementary effect among the resources [9, p. 46].

TABLE VII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine		With Swine Feeding for Selected Swine Prices				
	Feeding		Swine Price Per CWT (Dollars)				
	0		30	35	40	50	60
Land, per acre					--(Dollars)--		
Continuous cropland	54.94		81.26	39.96	24.54	5.78	--
Total cropland and pasture	22.38		13.32	--	--	--	--
Labor, per hour							
January-February	--		--	--	--	31.17	68.19
March-April	12.25		11.05	30.37	37.48	31.82	19.00
May-June	9.00		--	18.29	30.60	57.70	84.02
July-August	.70		8.98	--	--	--	--
September-October	18.83		18.27	29.90	24.10	53.96	84.02
November-December	--		3.24	7.87	12.23	3.74	--

TABLE VIII

OPTIMUM FARM ORGANIZATION FOR BASE SIZE FARM USING TWO MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	--	21.1	30.4	30.4	55.0	55.0
Corn silage	55.0	18.5	--	--	--	--
Wheat silage	4.9	--	--	--	--	--
Red clover-timothy	--	21.8	--	19.8	--	--
Alfalfa	--	--	--	5.17	--	--
Cotton	--	--	--	10.0	10.2	--
Permanent pasture	77.0	67.1	26.3	26.3	12.2	12.2
Summer pasture	27.5	16.2	--	14.9	--	--
Wheat-soybeans	--	15.5	24.6	25.6	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	87	32	--	--	--	--
Farrow to finish, sows	--	97	154	155	72	72
Slaughter hogs Ia, head	--	--	20	21	867	867
Slaughter hogs IIa, head	--	--	100	100	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	--	883	883
<u>Buy and sell activities</u>						
Buy corn, bu.	--	7,208	12,471	12,471	16,767	16,767
Buy wheat, bu.	--	7,116	12,002	12,002	17,849	17,849
Buy milo, bu.	--	--	--	--	1,473	1,473
Buy red clover, ton	46	--	--	--	--	--

TABLE VIII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy alfalfa, ton	102	32	--	--	--	--
Sell alfalfa, ton	--	--	--	15	--	--
Sell soybeans, bu.	--	402	639	639	--	--
Sell red clover, ton	--	20.7	--	--	--	--
Net return to land, labor, capital, and management	\$45,500	\$48,359	\$75,712	\$106,938	\$173,938	\$244,151
Net return to land, operator labor, and management	\$26,457	\$30,341	\$58,205	\$ 88,467	\$152,736	\$222,316

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

into six two-month periods, the optimum farm organization without swine feeding included 87 Grade "A" dairy cows, the production of silage and pasture for the dairy, and the purchase of alfalfa and red clover-timothy hay required in the dairy operation. No crops were produced for sale. This production system provided a net return of \$26,457 to the land, operator labor, and management.

When swine was permitted and prices were specified to be \$30.00 per cwt., the number of dairy cows decreased to 32 head and 97 brood sows were added to the livestock operation. The cropping program included the production of silage and forage for the dairy and 36 acres of wheat and corn for use in the swine operation. With the price of slaughter hogs at \$35.00 and \$40.00, respectively, the dairy was eliminated from the farm organization and 154 brood sows supplemented by 120 purchased feeder pigs became the livestock operation. The continuous cropland was used to produce wheat and corn for the swine and 24.6 acres of double cropped soybeans which were sold. With slaughter hog prices at \$50.00 and \$60.00 per cwt., the number of sows would be reduced to 72 head and the number of feeder pigs purchased and fed to market weights would increase to 2,750 head. Fifty-five acres of corn would be produced and fed and 36,089 bushels of corn, wheat, and milo would be purchased for swine feed. Of the total land available 105 acres would remain idle with this production system. Income would increase to a level of \$222,316 with hogs at \$60.00 per cwt.

The marginal value products for the restricting resources on the base size farm are shown in Table IX for a two-man labor supply for

TABLE IX

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price Per CWT (Dollars)				
	0	30	35	40	50	60
<u>Land, per acre</u>				--Dollars--		
Continuous cropland	83.57	79.15	66.25	29.31	70.82	47.77
Total cropland and pasture	85.37	14.82	--	--	--	--
<u>Labor, per hour</u>						
January-February	--	--	--	--	57.70	84.02
March-April	--	10.85	20.83	35.59	--	--
May-June	--	--	17.36	29.66	51.35	60.98
July-August	--	6.65	--	--	--	--
September-October	27.24	19.01	9.29	21.09	53.96	80.28
November-December	--	5.04	38.94	18.06	3.74	3.74
<u>Miscellaneous values</u>						
Slaughter Hogs II ^a , units	--	--	--	--	3.80	13.83

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

each price level for market hogs. When no swine feeding was allowed, the estimated MVP's indicate the farm operator could afford to pay more than \$80.00 per acre, in order to rent continuous cropland and more than \$27.00 per hour for labor in September and October in order to increase the size of the dairy operation. When swine feeding was considered in the plans, land had less value relative to labor since the operator had the alternative of purchasing grain for either beef or swine feeding and allocating the limited labor supply to these enterprises. The MVP's for additional labor were \$60.00 to \$80.00 per hour in three of the labor periods when slaughter hog prices were \$60.00 per cwt.

Base Size Farm Using a Three-Man Labor Supply

In this situation, the labor supply consisted of the operator and two hired men making a total of 7,392 hours of labor available. Land acreage was held constant. When no swine feeding was allowed a 100-cow dairy herd was the main livestock enterprise (Table X) and all the land was used to produce silage and pasture. This necessitated the purchase of both alfalfa and red clover-timothy hay for the dairy herd. When swine feeding was considered at \$30.00 per cwt., a 134-sow farrow to finish unit was included in the optimal plan and the dairy was reduced from 100 to 33 cows. Thirty-six acres of wheat and corn were produced and 21,063 bushels of grain would be purchased for swine feed. In addition 124 acres would be used for forage production for the dairy. When swine prices were specified at \$35.00 and \$40.00 per cwt., the number of sows increased to 192 head; at \$35.00 per cwt., 159

TABLE X

OPTIMUM FARM ORGANIZATION FOR BASE SIZE FARM USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Corn silage	55.0	19.0	--	--	--	--
Wheat silage	55.0	--	--	--	--	--
Grain corn	--	20.8	31.2	31.6	55.0	55.0
Red clover-timothy	--	24.8	--	--	--	--
Wheat-soybeans	--	15.2	23.8	23.4	--	--
Permanent pasture	79.7	64.0	32.6	32.6	19.1	19.1
Summer pasture	20.6	16.6	--	--	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	100	33	--	--	--	--
Steers, head	--	6	--	--	--	--
Farrow to finish, sows	--	134	192	192	112	112
Slaughter hogs Ia, head	--	--	33	33	827	827
Slaughter hogs IIa, head	--	21	126	143	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	--	858	858
<u>Buying and selling activities</u>						
Buy corn, bu.	--	10,921	16,005	16,062	20,181	20,181
Buy wheat, bu.	--	10,142	15,168	15,270	20,370	20,370
Buy red clover, ton	55	--	--	--	--	--

TABLE X (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy alfalfa, ton	119	33	--	--	--	--
Sell red clover, ton	--	41	--	--	--	--
Sell soybeans, bu.	--	395	619	608	--	--
Net return to land, labor, capital, and management	\$51,277	\$57,941	\$93,473	\$130,690	\$212,506	\$296,594
Net return to land, operator labor, and management	\$26,097	\$33,643	\$69,791	\$106,946	\$185,636	\$269,104

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

feeder pigs would be purchased and fed to a weight of 230 pounds; and at \$40.00 per cwt., 176 pigs would be purchased. No dairy would be included in the optimal plan with the assumed resources when swine prices were \$35.00 per cwt. and above. With swine prices of \$50.00 and above per cwt., the number of brood sows was reduced from 194 to 112 head and the number of purchased pigs was increased from 159 to 2,685 head. All continuous cropland would be used in the production of grain corn while the other cropland would be left idle. The optimum farm organizations for given price levels for slaughter hogs is summarized in Table X. Farm income increased from \$26,097 when no swine were fed to \$269,104 when a price level for hogs was set at \$60.00 per cwt.

The marginal value products for the restricting resources are shown in Table XI for alternative swine prices. The MVP for continuous cropland was very high when no swine was fed because a large amount of labor was assumed relative to the amount of land. Unused labor was available in all labor periods and could be used to increase the size of the dairy if additional land were available for silage production. When swine production was permitted the utilization of labor became more efficient and all the available labor was used in most labor periods. With high swine prices additional units of labor had a MVP of more than \$80.00 per hour in some periods. Land and labor are the important restrictions; however, the number of purchased pigs allowed was restrictive for swine produced during the summer period.

TABLE XI

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine		With Swine Feeding for Selected Prices				
	Feeding		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60	
<u>Land, per acre</u>				--Dollars--			
Continuous cropland	489.89	72.69	84.91	58.85	70.82	47.77	
Total cropland	--	10.85	--	--	--	--	
Total cropland and pasture	148.99	12.56	--	--	--	--	
<u>Labor, per hour</u>							
January-February	--	--	4.77	8.39	57.70	84.02	
March-April	--	9.58	15.10	25.52	--	--	
May-June	--	--	17.36	29.66	51.35	60.97	
July-August	--	3.90	--	--	--	--	
September-October	--	17.50	.59	--	53.96	80.29	
November-December	--	10.68	35.37	40.83	3.74	3.74	
<u>Miscellaneous values</u>							
Slaughter hogs II ^a , unit	--	--	--	--	3.81	13.83	

^aUnit of 50 head bought as feeder pigs and fed to 230 pounds.

Medium Size Farm Using Operator Labor

For this model the farm size was increased from 96 acres of cropland to 192 acres while the total cropland and pasture acreage was increased from 64 to 128 acres. All openland including cropland would be available for pasture if this was determined to be the best use. The labor supply was assumed to be one full-time operator or 3,000 hours of annual labor. All other restrictions remained the same as in the previous models.

The optimum farm organizations for the medium size farm one-man labor supply are shown in Table XII. The optimal farm plan where swine feeding was not allowed included the production of 18.8 acres of cotton in addition to corn, wheat, and soybeans for sale. A 22-cow dairy herd would be maintained and 170 steers would be kept to utilize roughages and to use excess winter labor. With this farm organization an estimated income of \$27,341 would be obtained.

When the price for slaughter hogs was \$30.00 per cwt., the dairy operation was eliminated from the plan and replaced with a 33-sow farrow to finish system and the purchase of 75 feeder pigs to be fed to slaughter weights. All the grain requirements would be grown on the farm and surplus corn and wheat would be sold. The number of steers would increase from 170 to 197 to utilize pasture and forage available on the farm. With a \$35.00 per cwt. swine prices, the number of sows increased to 61 and the number of steers decreased to 30. At \$40.00 per cwt. for swine, all the steers were eliminated. With swine prices of \$50.00 and \$60.00 per cwt., the farm resources would be

TABLE XII
OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	65.0	79.2	60.2	56.6	52.9	52.9	
Cotton	18.8	--	--	--	--	--	
Wheat-soybeans	13.9	30.8	32.0	25.6	--	--	
Corn silage	12.4	--	--	--	--	--	
Red clover-timothy	34.8	36.1	4.8	--	--	--	
Wheat-milo	--	--	17.8	27.8	50.8	--	
Permanent pasture	128.0	137.5	40.5	11.0	--	--	
Summer pasture	10.8	--	--	--	--	--	
Winter pasture	36.3	36.4	--	--	--	--	
<u>Livestock enterprises</u>							
Grade A dairy, cows	22	--	--	--	--	--	
Steers, head	170	197	30	--	--	--	
Slaughter hogs Ia, head	--	--	--	--	792	792	
Slaughter hogs IIa, head	--	--	50	69	771	842	
Slaughter hogs IIIa, head	--	75	--	--	707	768	
Farrow to finish, sows	--	33	61	65	--	--	
<u>Buy and sell activities</u>							
Sell corn, bu.	5,072	725	--	--	--	--	
Sell wheat, bu.	553	--	--	--	--	--	
Sell soybeans, bu.	360	799	832	665	--	--	
Sell red clover, ton	26	--	--	--	--	--	
Buy alfalfa, ton	22	30	--	--	--	--	

TABLE XII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	--	2,875	3,047	5,502	11,659
Buy corn, bu.	--	--	1,050	1,797	7,802	8,501
Buy milo, bu.	--	--	--	--	1,874	--
Sell milo, bu.	--	--	580	962	--	--
Net return to land, labor, capital, and management	\$34,740	\$36,337	\$62,210	\$89,902	\$154,375	\$223,242
Net return to land, operator labor, and management	\$27,341	\$28,529	\$38,472	\$51,067	\$82,969	\$120,158

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

used more efficiently by purchasing 2,402 feeder pigs. A large quantity of grain would be purchased for swine feed. At this price level no sows would be kept. At the \$50.00 and \$60.00 swine prices, 52.9 acres of land was used to produce grain corn and the remaining 266.1 acres would be idle. The level of income to land, operator labor, and management increased from \$28,529 when swine was \$30.00 per cwt. to \$120,158 with the maximum swine price considered.

The MVP's for the restricting resources which are associated with the optimum farm plans considered in the above section are shown in Table XIII. With swine prices at \$30.00 and \$35.00 per cwt., the MVP for additional acres of continuous cropland would be high enough so that cropland could be rented, if available, at more than the expected rental rate, and improve the income situation. With swine prices above this level the rental rate would likely be greater than the MVP. The value of additional units of labor continued to increase with increasing swine prices and reach a level of \$19.00 to \$84.00 per hour in 4 of the 6 time periods when swine prices were specified at \$60.00 per cwt. Labor was not restricting in July-August and November-December periods.

Medium Size Farm Using a Two-Man Labor Supply

When the annual labor supply increased from 3,000 to 6,000 hours, the amount of other resources were held constant and swine production not permitted, the number of dairy cows increased from 22 to 78 head and the number of steers decreased from 170 to 71 head. Silage and

TABLE XIII
MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices				
		Swine Price per CWT (Dollars)				
		0	30	35	40	50
Land, per acre				--Dollars--		
Continuous cropland	78.49	83.39	50.51	24.53	--	--
Total cropland	1.57	--	--	--	--	--
Total cropland and pasture	8.23	6.68	--	--	--	--
Labor, per hour						
January-February	--	.59	--	--	28.16	68.19
March-April	7.75	6.37	29.22	37.49	35.44	19.00
May-June	--	--	18.30	30.60	57.70	84.02
July-August	8.26	9.26	--	--	--	--
September-October	16.87	18.27	19.16	24.10	50.78	84.02
November-December	10.33	9.87	6.53	12.23	7.54	--
Other restrictions						
Wheat-soybeans, acre	--	--	10.94	--	--	--

pasture would be produced for the dairy but most of the hay required would be purchased. Cotton, corn, soybeans, and wheat would be produced for sale where no swine feeding was allowed in the plan. This optimum plan as well as those considering swine production are presented in Table XIV. With swine permitted and at prices of \$30.00 per cwt., the number of dairy cows was decreased from 78 to 49 head while steers increased to 106 head. A farrow to finish swine operation of 46 brood sows was included in the optimal plan at this price level. With an increase of five cents per pound for slaughter hogs to \$35.00 per cwt., the dairy and steers would be eliminated from the optimum farm plan and the number of sows would increase to 147 head. Grain corn, wheat, and milo would be produced for swine feed on 110 acres and in addition, more than 19,000 bushels of grain would need to be purchased.

As swine prices were increased above \$40.00 per cwt., the size of the sow unit decreased and a combination of farrow to finish and purchased feeder pigs were included in the optimum farm organization. Net returns to land, operator labor, and management varied from \$34,740 when no swine were permitted to a level of \$223,242 with swine prices at \$60.00 per cwt. At the \$60.00 swine price, 3,850 head of slaughter hogs would be produced.

As shown in Table XV the MVP for an acre of continuous cropland remained above \$50.00 per acre until swine prices increased above \$35.00 per cwt., then decreased. At \$60.00 swine price acres of continuous cropland was not restrictive. The MVP's for additional hours of labor were high in some labor periods for all price levels

TABLE XIV

OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	17.5	53.5	60.6	60.5	72.6	70.0	
Cotton	20.0	--	--	--	--	--	
Wheat-soybeans	27.9	28.6	32.0	31.8	--	--	
Corn silage	44.6	27.9	--	--	--	--	
Red clover-timothy	16.4	25.8	--	--	--	--	
Wheat-milo	--	--	17.3	17.7	37.4	--	
Permanent pasture	154.6	151.4	25.9	30.0	11.1	12.1	
Summer pasture	38.9	24.4	--	--	--	--	
Winter pasture	--	8.5	--	--	--	--	
<u>Livestock enterprises</u>							
Grade A dairy, cows	78	49	--	--	--	--	
Steers, head	71	106	1	--	--	--	
Slaughter hogs I ^a , head	--	--	--	--	930	876	
Slaughter hogs II ^a , head	--	--	114	114	1,000	1,000	
Slaughter hogs III ^a , head	--	--	--	--	879	874	
Farrow to finish, sows	--	46	147	147	65	71	
<u>Buy and sell activities</u>							
Sell corn, bu.	1,388	--	--	--	--	--	
Sell wheat, bu.	1,116	--	--	--	--	--	
Sell soybeans, bu.	725	744	832	--	--	--	

TABLE XIV (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy corn, bu.	--	10	9,255	9,280	15,094	15,493
Buy wheat, bu.	--	2,560	9,764	9,770	14,021	18,120
Buy milo, bu.	--	--	--	--	2,342	1,027
Buy red clover, ton	29	--	--	--	--	--
Buy alfalfa, ton	78	49	--	--	--	--
Net return to land, labor, capital, and management	\$54,476	\$55,030	\$79,701	\$108,032	\$175,601	\$244,862
Net return to land, operator labor, and management	\$34,740	\$36,337	\$62,210	\$ 89,902	\$154,375	\$223,242

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

TABLE XV

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre						
Continuous cropland	71.23	81.27	50.51	24.54	15.19	--
Total cropland and pasture	12.71	13.32	--	--	--	--
Labor, per hour						
January-February	--	--	--	--	33.40	63.17
March-April	9.91	11.05	29.22	37.48	29.15	25.03
May-June	--	--	18.29	30.60	46.49	56.80
July-August	11.34	8.98	--	--	--	--
September-October	20.60	18.27	19.16	24.10	53.96	80.29
November-December	--	3.24	6.42	12.23	3.74	3.74
Other restrictions						
Cotton, acre	7.78	--	--	--	--	--
Wheat-soybeans, acre	--	--	10.94	--	--	--
Slaughter hogs II ^a , unit	--	--	--	--	6.72	16.33

^aUnit of 50 head bought as feeder pigs and fed to 230 pounds.

considered, but were very high for price levels of \$50.00 and \$60.00 per cwt. for swine. Cotton and wheat-soybean acreage restriction had a positive, but relatively small value in two situations. The restriction on slaughter hogs II was exhausted at two price levels. Even for these restrictive situations, additional units of these enterprises would contribute little to the overall farm plan, with an additional acre of cotton adding \$7.78 per acre, wheat-soybeans adding \$10.94 net return per acre and 50 slaughter hogs adding an additional return of \$16.00 to the overall farm income.

Medium Size Farm Using a Three-Man Labor Supply

The optimum farm organization, without swine feeding, became a specialized dairy operation when an additional second hired man was available. A 102-cow Grade "A" dairy unit using home grown silage and pasture and purchasing alfalfa hay was the most profitable system (Table XVI). Net return to land, operator labor, and management was \$37,965. When swine prices of \$30.00 per cwt. were assumed, the dairy operation was reduced to 59 cows and a 70-sow herd was added producing pigs to be fed to market weights. Pasture for the brood sows were included in the pasture utilization. Also 80 steers would be kept to utilize the surplus forage and pasture. No cotton was included in this plan; however, 32 acres of wheat-soybeans and 44 acres of grain corn would be produced. The soybeans would be sold as a cash crop while the wheat and corn would be fed to the livestock. With an increase in swine price to \$35.00 per cwt., the dairy and steers were no longer

TABLE XVI

OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
Crop enterprises, acres							
Cotton	19.6	--	--	--	--	--	--
Wheat-soybeans	23.0	31.9	32.0	32.0	--	--	--
Corn silage	58.2	33.7	--	--	--	--	--
Red clover-timothy	25.7	25.4	--	--	30.2	--	--
Grain corn	9.2	44.3	64.3	64.3	75.0	72.5	72.5
Permanent pasture	133.4	154.4	31.3	31.3	18.1	18.9	18.9
Summer pasture	50.9	29.5	--	--	--	--	--
Wheat-milo	--	--	13.7	13.7	34.9	--	--
Livestock enterprises							
Grade A dairy, cows	102	59	--	--	--	--	--
Steers, head	25	80	--	--	--	--	--
Slaughter hogs I ^a , head	--	--	--	--	889	838	838
Slaughter hogs II ^a , head	--	--	155	155	1,000	1,000	1,000
Slaughter hogs III ^a , head	--	--	12	12	852	847	847
Farrow to finish, sows	--	70	184	184	106	111	111
Buy and sell activities							
Sell wheat, bu.	921	--	--	--	--	--	--
Sell soybeans, bu.	598	830	832	832	--	--	--
Buy corn, bu.	--	3,940	12,663	12,663	18,309	18,682	18,682

TABLE XVI (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	--	13,165	13,165	16,857	20,689
Buy milo, bu.	--	--	--	--	2,739	1,510
Buy alfalfa, ton	102	59	--	--	--	--
Sell corn, bu.	735	--	--	--	--	--
Net return to land, labor, capital, and management	\$63,988	\$64,691	\$96,667	\$132,337	\$214,314	\$297,790
Net return to land, operator labor, and management	\$37,965	\$40,040	\$73,084	\$108,698	\$186,732	\$270,163

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

included in the optimal plan. The size of the farrow to finish operation would be increased to 184 sows and 167 purchased feeder pigs would be added to the swine enterprise. An increase in swine prices of \$5.00 per cwt. to \$40.00 caused no changes in the optimum farm plan. The cropping program would include 31.3 acres of pasture for the brood sows and 110 acres used to produce wheat, milo, corn, and soybeans. The 832 bushels of soybeans would be sold as a cash crop. In addition 25,828 bushels of feed grain would be purchased.

Further increases in swine prices caused a reduction in the number of brood sows and an increase in purchased feeder pigs. Farm income varied from \$37,965 where no swine were produced to \$270,163 when \$60.00 swine prices were assumed.

The value of the MVP's for the restricting resources are shown in Table XVII. When no swine feeding was permitted, the MVP for continuous cropland was \$53.74 while total cropland and pasture was \$23.12 per acre. If an assumed rental rate of \$48.00 per acre (\$600 per acre of land at 8 percent interest) is considered a reasonable rental rate for continuous cropland, then a farm operator could improve his net returns by renting additional continuous cropland. This situation would hold true with swine priced at \$30.00 per cwt. At \$35.00 per cwt. the rental rate of continuous cropland would be greater than the returns for an additional acre, thus no renting should occur.

High MVP's for labor are characteristic at all price levels for some of the labor periods considered. Since the land and labor

TABLE XVII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Land, per acre</u>						
Continuous cropland	53.74	81.27	46.60	22.25	15.19	--
Total cropland and pasture	23.12	13.32	--	--	--	--
<u>Labor, per hour</u>						
January-February	--	--	--	--	33.40	63.17
March-April	12.37	11.05	35.81	41.86	29.15	25.03
May-June	9.38	--	17.36	29.66	46.69	56.80
July-August	--	8.98	--	--	--	--
September-October	18.96	18.27	4.02	13.49	53.96	80.29
November-December	--	3.24	16.00	19.40	3.74	3.74
<u>Miscellaneous values</u>						
Wheat-soybeans, ac.	--	--	41.34	21.14	--	--
Slaughter hogs I ^a , unit	--	--	--	--	6.72	16.33

^aUnit of 50 head bought as feeder pigs and fed to 230 pounds.

constraints are the same for all situations, the high swine price changed the relative profitability of different enterprises which have different land-labor requirements. The results are a shift in the relative scarcities of land and labor.

When swine prices reached a level of \$60.00 per cwt., very high marginal value products for labor per hour was noted in all labor periods except July and August. In this situation 50 percent of the cropland would be left idle and the labor supply concentrated on swine production. Additional grain needed for the swine would be purchased.

Large Size Farm Using Operator Labor

In this situation, it was assumed that 288 acres of cropland and 192 acres of pasture were available for a total of 480 of openland. Labor was restricted to one man or 3,000 hours annually. The effect of changes in enterprise options and swine price on the optimum farm organization are presented in Table XVIII. When swine was not permitted and at \$30.00 per cwt. swine price approximately 300 steers were in the optimal plan to utilize labor during the winter months when labor requirements for crops would be low. When no swine feeding was permitted, the cropping program included the production of 12.9 acres of cotton, 129.0 acres of grain corn, 20.2 acres of wheat-soybeans and 56.2 acres of red clover-timothy hay to be sold as cash crops. Also 192.0 acres of permanent pasture and 64.1 acres of winter small grain pasture were produced for the livestock needs. When swine prices reached \$35.00 per cwt., the steers were replaced by 55 brood sows and 121 purchased feeder pigs; thus the optimum farm plan

TABLE XVIII

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	129.0	141.0	86.8	86.8	52.9	52.9	
Cotton	12.9	--	--	--	--	--	
Wheat-soybeans	20.2	24.2	32.0	32.0	--	--	
Corn silage	2.9	--	--	--	--	--	
Red clover-timothy	56.2	54.8	--	--	--	--	
Permanent pasture	192.0	200.0	9.3	9.3	--	--	
Summer pasture	2.6	--	--	--	--	--	
Winter pasture	64.1	60.6	--	--	--	--	
Wheat-milo	--	--	46.2	46.2	50.8	--	
<u>Livestock enterprises</u>							
Grade A dairy, cows	5	--	--	--	--	--	
Steers, head	300	306	--	--	--	--	
Slaughter hogs Ia, head	--	--	--	--	--	--	
Slaughter hogs IIa, head	--	--	102	102	771	842	
Slaughter hogs IIIa, head	--	--	19	19	707	768	
Farrow to finish, sows	--	9	55	55	--	--	
<u>Buy and sell activities</u>							
Sell corn, bu.	10,090	10,194	--	--	--	--	
Sell wheat, bu.	806	227	--	--	--	--	
Sell soybeans, bu.	524	630	832	832	--	--	
Sell red clover, tons	50	45	--	--	--	--	

TABLE XVIII (Continued)

Without Swine Feeding	With Swine Feeding for Selected Prices				
	Swine Price per CWT (Dollars)				
0	30	35	40	50	60
Buy corn, bu.	--	--	--	7,802	8,501
Buy wheat, bu.	--	642	642	5,502	11,578
Buy milo, bu.	--	--	--	1,874	--
Buy alfalfa, ton	5	--	--	--	--
Sell milo, bu.	--	2,190	2,190	--	--
Net return to land, labor, capital and management	\$38,908	\$39,051	\$45,354	\$56,518	\$90,363
					\$128,023
Net return to land, operator labor, and management	\$32,913	\$33,390	\$40,913	\$52,051	\$84,664
					\$122,035

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

became a specialized swine producing unit. The cropping program changed to one of producing 175 acres of grain to be used for swine feed. With an increase in swine prices to \$50.00 per cwt., labor relative to land became very restrictive. The farrow to finish program was replaced by a system of feeding out purchased feeder pigs and the production of 103 acres of corn, wheat, and milo for swine feed.

When no swine feeding was considered in the optimum plan, all of the 480 acres of available land was used either for crops or as pasture for the livestock program. Of the 3,000 hours of available labor, all but 118 hours was utilized. As swine prices increased to \$35.00 per cwt., there was a shift from steers to brood sows and at the same time a significant change in land use. Of the total 480 acres available, 305 acres were left idle. These idle acres included rotational cropland and pasture. Also the idle labor increased from 118 to 208 hours. Increasing swine price from \$30.00 to \$35.00 per cwt. increased net returns by 24 percent.

When swine price was increased to \$60.00 per cwt., the optimum farm organization included only 53 acres used for production (corn); the remaining acreage (397 acres of openland) would be idle. With this situation only 20 hours of labor remained idle.

Net returns to land, operator labor, and management varied from \$32,913 without swine to \$122,035 with swine prices at \$60.00 per cwt.

As shown in Table XIX the MVP for an acre of continuous cropland varied from \$78.49 to \$14.22 as swine prices were varied from \$0-40 per cwt. Above this level the optimum plan included idle land of all

TABLE XIX
MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
Land, per acre				--Dollars--			
Continuous cropland	78.49	79.34	38.56	14.22	--	--	--
Total cropland	1.57	--	--	--	--	--	--
Total cropland and pasture	8.23	6.15	--	--	--	--	--
Labor, per hour							
January-February	--	--	--	--	28.16	68.19	
March-April	7.75	8.81	33.53	39.57	35.45	19.01	
May-June	--	--	19.52	31.82	57.69	84.03	
July-August	8.26	9.43	--	--	--	--	
September-October	16.87	18.01	5.96	15.43	50.78	84.03	
November-December	10.33	9.77	16.17	19.56	7.54	--	
Miscellaneous values							
Wheat-soybeans, acre	--	--	41.25	21.05	--	--	

types. The MVP's for labor indicate that additional labor in most periods would be profitable, even at prices much higher than the prevailing wage rates in Tennessee. With swine priced at \$35.00 per cwt., labor was exhausted in each labor period except January-February and May-June and had MVP's per hour which varied from \$8.81 to \$18.01. With swine prices at \$60.00 per cwt., labor was exhausted in four periods (except September-October and November-December) and the MVP's varied from \$19.01 to \$84.03 per hour.

Large Size Farm Using a Two-Man Labor Supply

When a second man is added to the labor supply more livestock production was included in the optimum farm organization. The optimum farm organizations for this farm situation are given in Table XX. Where no swine feeding was allowed, a 61-cow Grade "A" dairy operation and 204 beef steers would make up the livestock program. Silage corn would replace a part of the grain corn production and 20 acres of cotton and 32 acres of soybeans-wheat would be produced. In addition, all the hay and pasture requirements for the dairy and steers would be provided on the farm. When swine prices were increased to \$30.00 per cwt., the dairy was eliminated from the farm plan and replaced by 91 brood sows and 39 purchased feeder pigs. Also the number of steers increased to 277 head to be "backgrounded" to 700 pounds. Compared to the no swine feeding situation, the cropping program included the addition of 54 acres of grain corn, the elimination of cotton and an increase in red clover-timothy hay to 63.9 acres. At

TABLE XX

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Crop enterprises, acres						
Grain corn	78.0	132.1	98.2	98.2	73.7	69.9
Cotton	20.0	--	--	--	--	--
Wheat-soybeans	32.0	32.0	32.0	32.0	--	--
Corn silage	35.0	--	--	--	--	--
Red clover-timothy	39.2	63.9	--	--	--	--
Permanent pasture	214.4	192.0	22.9	22.9	10.7	12.0
Summer pasture	30.6	--	--	--	--	--
Winter pasture	30.7	57.7	--	--	--	--
Wheat-milo	--	--	34.8	34.8	52.5	--
Livestock enterprises						
Grade A dairy, cows	61	--	--	--	--	--
Steers, head	204	277	--	--	--	--
Slaughter hogs Ia, head	--	39	1	--	952	876
Slaughter hogs IIa, head	--	--	190	190	1,000	1,000
Slaughter hogs IIIa, head	--	--	56	56	882	846
Farrow to finish, sows	--	91	134	134	63	71
Buy and sell activities						
Sell red clover, ton	--	77	--	--	--	--
Sell corn, bu.	6,125	--	--	--	--	--
Sell wheat, bu.	1,275	--	--	--	--	--
Sell soybeans, bu.	829	832	832	832	--	--

TABLE XX (Continued)

Without Swine Feeding	With Swine Feeding for Selected Prices				
	Swine Price per CWT (Dollars)				
0	30	35	40	50	60
Buy corn, bu.	--	5,827	5,827	14,931	15,347
Buy wheat, bu.	--	4,693	8,087	12,359	18,781
Buy milo, bu.	--	--	--	2,875	--
Buy red clover, ton	1	--	--	--	--
Buy alfalfa, ton	61	--	--	--	--
Sell milo, bu.	--	207	207	--	--
Net return to land, labor, capital, and management	\$60,424	\$82,267	\$109,258	\$175,848	\$243,540
Net return to land, operator labor, and management	\$40,435	\$64,834	\$ 91,795	\$154,509	\$222,013

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

\$40.00 per cwt. for slaughter hogs, the optimum farm organization was a swine operation and included 165 acres of grain to be utilized by the hogs.

With swine prices at \$50.00 and \$60.00 per cwt., the number of brood sows was reduced and the number of feeder pigs purchased and fed to a slaughter weight increased. In both price situations the number of slaughter hogs produced from purchased pigs was at the maximum allowed level of 1,000 head for the May-August period. At the \$60.00 price level 3,822 head of hogs would be finished to slaughter weight. The net return to land, operator labor, and management increased from \$40,435 when no swine were fed to \$220,013 when hogs were sold for \$60.00 per cwt.

The marginal value products for the restricting resources associated with the large farm size using a two-man labor supply are shown in Table XXI. The MVP for an additional acre of continuous cropland varies from \$71.34 to \$22.23 as the price of swine increases from \$0-40 per cwt. At the \$50.00 and \$60.00 swine price levels land would be idle and additional land would have no value to the operation. The MVP's for labor were relatively high for most labor periods and became larger as swine prices were increased.

Large Size Farm Using a Three-Man Labor Supply

When a second hired man was assumed to be available, combined with 480 acres of openland, the size of the Grade "A" dairy increased from 61 to 87 cows where no swine feeding was considered. The number of steers produced decreased from 204 to 155 head (Table XXII). In

TABLE XXI
MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE SIZE FARM USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Land, per acre</u>				--Dollars--		
Continuous cropland	71.34	81.44	46.58	22.23	--	--
Total cropland	--	8.43	--	--	--	--
Total cropland and pasture	12.65	3.51	--	--	--	--
<u>Labor, per hour</u>						
January-February	--	--	--	--	24.56	46.34
March-April	9.90	6.62	34.59	40.63	39.76	45.23
May-June	--	--	18.30	30.59	42.71	53.44
July-August	11.35	7.58	--	--	--	--
September-October	20.56	13.21	8.21	17.68	43.89	--
November-December	.04	16.41	12.10	15.49	15.82	84.02
<u>Other restrictions</u>						
Cotton restriction, ac.	7.71	--	--	--	--	--
Wheat-soybean restriction, ac.--	--	--	33.32	13.12	--	--
Slaughter hogs IIA, unit	--	--	--	--	8.99	18.35

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

TABLE XXII

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices					
		Swine Price Per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	59.0	126.7	102.2	102.2	75.8	72.5	
Cotton	20.0	--	--	--	--	--	
Wheat-soybeans	32.0	28.4	32.0	32.0	--	--	
Corn silage	49.6	9.9	--	--	--	--	
Wheat-milo	3.9	--	30.7	30.7	44.8	--	
Red clover-timothy	39.4	63.8	--	--	--	--	
Permanent pasture	212.4	193.3	29.1	29.1	17.8	18.9	
Summer pasture	43.5	8.7	--	--	--	--	
Winter pasture	19.8	49.2	--	--	--	--	
<u>Livestock enterprises</u>							
Grade A dairy, cows	87	17	--	--	--	--	
Steers, head	155	243	--	--	--	--	
Slaughter hogs Ia, head	--	--	232	232	903	838	
Slaughter hogs IIa, head	--	--	69	69	1,000	1,000	
Slaughter hogs IIIa, head	--	--	--	--	854	807	
Farrow to finish, sows	--	108	171	171	105	111	
<u>Buy and sell activities</u>							
Buy corn, bu.	--	--	9,197	9,197	18,203	18,469	
Buy wheat, bu.	--	7,520	11,474	11,474	15,773	21,660	
Buy milo, bu.	--	--	--	--	3,087	--	

TABLE XXII (Continued)

Without Swine Feeding	With Swine Feeding for Selected Prices				
	Swine Price per CWT (Dollars)				
0	30	35	40	50	60
Buy alfalfa, ton	87	17	--	--	--
Sell corn, bu.	4,667	--	--	--	--
Sell wheat, bu.	1,438	--	--	--	--
Sell milo, bu.	197	--	--	--	--
Sell soybeans, bu.	832	832	832	--	--
Sell red clover, ton	--	--	--	--	--
Net return to land, labor, capital, and management	\$70,126	\$71,114	\$99,240	\$133,562	\$214,475
					\$295,846
Net return to land, operator labor, and management	\$43,553	\$46,671	\$75,657	\$109,943	\$187,134
					\$268,352

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

addition to providing silage and pasture for the livestock, the cropping program included 59.0 acres of grain corn, 20 acres of cotton, and 32 acres of wheat and soybeans for sale as a cash crop. A net revenue of \$46,653 could be obtained with this enterprise combination if the assumed yields and prices were obtained.

When swine prices were increased to \$35.00 per cwt., the available resources would be utilized more efficiently with a specialized swine operation. The optimum system would include 171 brood sows and 301 pigs which would be purchased and fed to slaughter weights. When slaughter hog price was assumed to be \$50.00 per cwt., the number of sows would be reduced to 105 head and the number of purchased feeder pigs would be increased to 2,757 head. With the maximum swine price considered (\$60.00), the livestock remained the same; however, the amount of grain produced decreased to 72.5 acres and a corresponding increase in purchased grain occurred. As swine prices increased from \$30-60 per cwt., the net revenue increased from \$46,671 to \$268,352.

The value marginal products for the restricting resources are shown in Table XXIII. Continuous cropland was a relatively scarce resource with low swine prices, but was not completely utilized at the \$50.00 and \$60.00 swine prices. The value of additional labor was high in some periods at all levels of price of swine. At the \$60.00 swine price the MVP was above \$45.00 per hour in four of the six time periods. The MVP for the cotton and wheat-soybean acreage restriction were greater than zero in some plans. At the \$50.00 and \$60.00 swine price, slaughter hog production was constrained by the 1,000 head restriction in the production period II.

TABLE XXIII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE SIZE FARM USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA I

	Without Swine Feeding	With Swine Feeding for Selected Prices					
		Swine Price per CWT (Dollars)					
	0	30	35	40	50	60	
Land, per acre			--Dollars--				
Continuous cropland	50.36	84.06	46.60	22.25	--	--	
Total cropland and pasture	18.48	10.17	--	--	--	--	
Labor, per hour							
January-February	--	--	--	--	24.56	46.34	
March-April	19.26	8.48	35.81	41.86	39.76	45.23	
May-June	--	--	17.36	29.66	42.71	53.44	
July-August	6.36	8.14	--	--	--	--	
September-October	16.13	17.42	16.00	13.49	43.88	--	
November-December	--	8.50	--	19.40	15.82	84.02	
Miscellaneous values							
Cotton restriction, ac.	15.26	--	--	--	--	--	
Wheat-soybean restriction, ac.	27.45	--	41.34	21.14	--	--	
Slaughter hog IIA, unit	--	--	--	--	8.99	18.35	

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

C. AREA II

Base Size Farm Using Operator Labor

The base farm situation in this area includes 78 acres of cropland and 57 acres of pastureland or a total of 135 acres of openland—16 percent less acres of openland than for Area I. The labor supply for each farm size in Area II remains the same with 3,000, 6,000, and 7,392 hours of annual labor assumed to be available. An acreage restriction of 20 and 32 acres were again placed on cotton and soybeans-wheat, respectively. Burley tobacco acreage was restricted to not more than one-half acre. Purchased grain prices for Area II were increased 8 percent above those prices in Area I to account for higher grain transportation costs from surplus grain areas. Corn prices were increased from \$2.65 to \$2.86 per bushel, wheat prices from \$2.90 to \$3.13 per bushel, and milo prices from \$2.30 to \$2.48 per bushel.

The effect of change in swine prices on the optimum farm organization is shown in Table XXIV. For this situation of an owner-operator with the assumed acreage and no swine feeding permitted, the optimum plan included 40 Grade "A" dairy cows and 13 steers "backgrounded" to 700 pounds. The cropping program included the production of cotton, wheat, and soybeans. Corn silage, pasture, and hay would be produced for livestock enterprises and 41 tons of alfalfa hay would be purchased for the dairy. A net return of \$21,266 would be generated by this farming system. At \$30.00 swine price a few sows were included but the optimum farm organization was similar to that without swine feeding. When swine prices for slaughter hogs were increased to \$35.00 per cwt.,

TABLE XXIV

OPTIMUM FARM ORGANIZATION FOR BASE SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Prices per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Cotton	9.7	7.3	--	--	--	--
Wheat and soybeans	11.1	11.9	19.2	14.8	--	--
Corn silage	23.3	21.3	--	--	--	--
Red clover-timothy hay	8.6	10.4	3.3	--	--	--
Permanent pasture	57.0	57.0	32.6	12.6	--	--
Summer pasture	20.4	18.6	--	--	--	--
Grain corn	4.9	8.5	29.8	27.4	49.0	49.0
Wheat-milo	--	--	--	6.7	--	--
<u>Livestock enterprises</u>						
Grade A dairy, head	41	37	--	--	--	--
Steer, backgrounded, head	13	16	20	--	--	--
Slaughter hogs Ia, head	--	--	--	--	792	792
Slaughter hogs IIa, head	--	--	43	56	845	845
Slaughter hogs IIIa, head	--	--	--	--	773	770
Farrow to finish, sows	--	6	72	74	--	--
<u>Buy and sell activities</u>						
Sell wheat, bu.	444	212	--	--	--	--
Sell soybeans, bu.	288	308	499	386	--	--
Buy alfalfa, ton	41	37	--	--	--	--

TABLE XXIV (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Prices per CWT (Dollars)				
	0	30	35	40	50	60
Buy corn, bu.	--	--	4,443	4,950	8,850	8,836
Buy wheat, bu.	--	--	4,969	5,086	--	--
Buy milo, bu.	--	--	301	11	16,782	16,772
Sell corn, bu.	395	137	--	--	--	--
Net return to land, labor, capital, and management	\$26,517	\$26,549	\$37,439	\$51,657	\$85,517	\$123,473
Net return to land, operator labor, and management	\$21,266	\$21,694	\$33,068	\$47,256	\$77,597	\$114,988

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

the dairy was replaced by a 72-sow farrow to finish swine operation. All the continuous cropland was utilized to produce grain for the swine operation and an additional 9,529 bushels of grain would be purchased. The optimum farm organization changed only slightly when swine price was increased to \$40.00. At \$50.00 per cwt. for swine, the farrow to finish program was eliminated and replaced by 2,407 pigs purchased and finished to slaughter weight. At the \$60.00 swine price, the optimum farm organization remained the same, but the net revenue to land, labor, capital, and management increased to \$114,988.

The marginal value products for the restricting resources are shown in Table XXV and indicate that it would be feasible to rent additional continuous cropland for grain production if available for \$47.00 per acre or less and hire additional labor in certain time periods, if available. MVP's per hour of labor were more than \$80.00 per hour in three of the labor periods when the price of swine was \$60.00 per cwt.

Base Size Farm Using a Two-Man Labor Supply

With the addition of a second man to the operation, the number of Grade "A" dairy cows increased from 41 to 85 head. When no swine feeding was allowed, this was the only livestock enterprise in the optimal plan. The cropping program would include the production of corn silage, small grain silage, and pasture for the dairy. Both the alfalfa and red clover-timothy hay requirements would be purchased. The optimum farm plans for the base farm and two full-time employees are shown in Table XXVI.

TABLE XXV

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
		0	30	35	40	50
Land, per acre				--Dollars--		
Continuous cropland	49.35	50.39	80.86	47.08	89.75	96.81
Total crops	17.35	17.44	--	--	--	--
Total cropland and pasture	24.20	24.27	--	--	--	--
Labor, per hour						
January-February	--	--	--	--	54.16	80.49
March-April	13.02	12.06	23.20	36.18	--	--
May-June	2.50	2.44	13.84	26.12	54.16	80.49
July-August	--	--	--	--	--	--
September-October	23.31	24.26	16.78	21.19	49.26	--
November-December	--	--	13.09	14.62	4.90	80.49

TABLE XXVI

OPTIMUM FARM ORGANIZATION FOR BASE SIZE FARM USING TWO MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Crop enterprises, acres						
Corn silage	49.0	26.8	--	--	--	--
Small grain silage	33.7	--	--	--	--	--
Permanent pasture	67.4	62.5	26.4	26.4	12.2	12.2
Summer pasture	18.6	23.4	--	--	--	--
Grain corn	--	11.9	33.2	26.9	49.0	49.0
Wheat-soybeans	--	10.2	15.8	22.1	--	--
Livestock enterprises						
Grade A dairy, cows	85	45	--	--	--	--
Slaughter hogs Ia, head	--	--	--	30	864	864
Slaughter hogs IIa, head	--	--	103	107	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	--	886	842
Farrow to finish, sows	--	73	156	156	72	72
Buy and sell activities						
Buy red clover, ton	45	25	--	--	--	--
Buy alfalfa	109	47	--	--	--	--
Buy corn, bu.	--	5,788	12,205	12,871	17,281	17,046
Buy wheat, bu.	--	5,455	11,823	11,549	23,083	24,621
Buy milo, bu.	--	--	715	954	1,652	--
Sell soybeans, bu.	--	266	410	574	--	--

TABLE XXVI (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Net return to land, labor, capital, and management	\$42,838	\$44,321	\$70,763	\$100,823	\$165,758	\$234,108
Net return to land, operator labor, and management	\$23,742	\$26,244	\$53,157	\$ 83,048	\$144,041	\$211,861

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August and Slaughter hogs III are produced from September through December.

At a swine price of \$30.00 per cwt., the dairy would be reduced to 45 cows and 73 brood sows would be added. Twenty acres of wheat and corn would be produced for feed and 10 acres of soybeans would be produced for sale. In addition 11,243 bushels of wheat and corn would be purchased for swine feed. With swine prices at \$35.00 and \$40.00 per cwt., the optimum farm organization would be a specialized swine producing system and would include 156 brood sows and over 100 purchased feeder pigs. All the continuous cropland would be used to produce grain for swine feed. At hog prices of \$50.00 and \$60.00 per cwt., the number of brood sows would be reduced to 72 head and the purchase of over 2,700 feeder pigs would give the highest returns for the limited resources which were available. Forty-nine acres of corn and 12.2 acres of pasture would be produced. The major portion of the grain required would be purchased. The net return to land, operator labor, and management varied from \$23,742 without swine feeding to \$211,866 as swine prices varied from \$30-60 per cwt.

The marginal value products for the limiting resources are shown in Table XXVII. Labor was not restrictive in at least three of the time periods for price situations analyzed. Labor was most restrictive in the September-October period for low swine prices and in the November-February period at high swine prices. The MVP for additional units of continuous cropland was relatively high in all situations analyzed.

Base Size Farm Using a Three-Man Labor Supply

In this situation it was assumed that an owner operator and two full-time hired men would provide 7,293 hours of available labor. Where

TABLE XXVII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre				--Dollars--		
Continuous cropland	99.57	49.43	96.63	74.78	90.50	103.74
Total cropland and pasture	85.42	56.80	--	--	--	--
Labor, per hour						
January-February	--	--	--	4.01	54.16	80.49
March-April	--	12.96	17.60	26.54	--	--
May-June	--	--	--	--	--	--
July-August	--	--	--	--	--	--
September-October	26.43	21.27	3.90	--	49.26	--
November-December	--	--	31.58	41.44	4.90	80.49
Other restrictions						
Slaughter hogs II ^a , unit	--	--	--	--	1.22	11.24

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

no swine feeding was permitted, the optimum farm organization (Table XXVIII) included a 89-cow Grade "A" dairy unit as the only livestock enterprise. The cropping program included the production of 48.9 acres of corn silage, 48.2 acres of small grain silage and the necessary permanent and summer pasture for the dairy cows. The hay requirement for the dairy were supplied by purchasing 165 tons of alfalfa and red clover-timothy hay.

As swine prices increased to \$30.00 per cwt., the size of the dairy decreased to 31 cows and 139 brood sows in a farrow to finish operation became the major livestock enterprise. With market hogs selling for \$35.00 per cwt., the number of sows increased to 192 head and in addition 173 head of feeder pigs would be purchased. Grade "A" dairy was no longer included in the optimal plan. The grain requirement for the swine would be met by producing 49.7 acres of grain and purchasing 31,651 bushels of corn and wheat. This organization remained stable when swine prices were increased five cents per pound to \$40.00 per cwt.

With an increase in swine prices to \$50.00 per cwt., a major shift occurred in the farm organization. The number of brood sows decreased from 192 to 113 head and 2,685 feeder pigs would be purchased and fed to 230 pounds. All the continuous cropland would be used to produce grain corn. Additional grain would be purchased. No change in the plan occurred as the price of swine was increased from \$50.00 to \$60.00 per cwt. The estimated farm income varied from \$20,732 with no swine feeding to \$259,137 at the \$60.00 swine price.

TABLE XXVIII

OPTIMUM FARM ORGANIZATION FOR BASE SIZE FARM USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Corn silage	48.9	17.7	--	--	--	--
Wheat silage	48.2	--	--	--	--	--
Red clover-timothy	--	12.8	--	--	--	--
Grain corn	--	18.0	31.8	31.4	49.0	49.0
Wheat-soybeans	--	13.2	17.9	17.6	--	--
Permanent pasture	68.7	57.0	32.7	32.7	19.2	19.2
Summer pasture	17.2	15.6	--	--	--	--
Burley tobacco	.2	--	--	--	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	89	31	--	--	--	--
Slaughter hogs Ia, head	--	--	28	28	824	824
Slaughter hogs IIa, head	--	83	145	157	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	--	861	802
Farrow to finish, sows	--	139	192	192	113	113
<u>Buying and selling activities</u>						
Buy corn, bu.	--	12,021	16,137	16,177	20,695	20,381
Buy wheat, bu.	--	10,839	15,514	15,584	20,261	21,686
Buy milo, bu.	--	--	--	--	2,214	--

TABLE XXVIII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy alfalfa, ton	117	29	--	--	--	--
Buy red clover, ton	48	--	--	--	--	--
Sell red clover, ton	--	15	--	--	--	--
Sell soybeans, bu.	--	344	--	458	--	--
Net return to land, labor, capital, and management	\$44,634	\$53,204	\$87,738	\$125,106	\$204,972	\$286,871
Net return to land, operator labor, and management	\$20,732	\$28,803	\$68,740	\$101,196	\$177,659	\$259,137

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

Both continuous cropland and total cropland and pasture were very restrictive where no swine feeding was considered and the marginal value products for these resources were quite high (Table XXIX). A MVP of \$495.20 per acre was estimated for continuous cropland and \$149.79 per acre for total land. With a large labor to land ratio, the size of the dairy was restricted because the production of silage was constrained by the available land. In this situation, surplus labor was available in all labor periods.

When swine was permitted, the labor force was used more efficiently because grain, a major input for swine, could be purchased rather than being constrained to on farm grain production. The MVP for continuous cropland was considerably lower with the inclusion of swine; however, for all situations considered the value exceeded the expected rental rates for cropland in the area. With swine prices specified at \$30.00 and \$35.00 per cwt., all available labor was utilized in five production periods and the MVP's per hour of labor ranged from \$.67 to \$36.04. At swine prices of \$40.00 to \$60.00 per cwt., all labor was used in four production periods with the MVP for labor ranging from \$3.74 to \$84.02 per hour in these periods.

Medium Size Farm Using Operator Labor

The medium size farm for Area II included 270 acres with 156 classified as cropland and 114 acres as pastureland. All other resources and restrictions remained the same as in the previous situation. Thus, this situation included a higher land to labor ratio than the base size

TABLE XXIX

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price Per CWT (Dollars)					
	0	30	35	40	50	60	
Land, per acre			--Dollars--				
Continuous cropland	495.20	74.79	86.53	58.85	70.82	86.31	
1-6 year rotation	20.94	--	--	--	--	--	
Total cropland	--	9.63	--	--	--	--	
Total cropland and pasture	149.79	16.84	--	--	--	--	
Labor, per hour							
January-February	--	--	5.25	8.40	57.70	84.02	
March-April	--	7.72	14.54	25.56	--	--	
May-June	--	2.69	16.71	29.66	51.35	60.98	
July-August	--	.67	.64	--	--	--	
September-October	--	11.05	--	--	53.95	--	
November-December	--	19.50	36.04	40.84	3.74	84.02	
Other restrictions							
Slaughter hogs II ^a , unit	--	--	--	--	3.81	13.83	

^aUnit of 50 head bought as feeder pigs and fed to 230 pounds.

farm. The optimal farm plans for this resource situation are shown in Table XXX.

As compared to the base size farm the emphasis was shifted from livestock to crop production. Forty-five acres of grain corn and 19 acres of wheat and soybeans were produced for sale. Corn silage and red clover-timothy hay were produced to support a 28-cow Grade "A" dairy operation and 117 steers. No slaughter hogs were allowed in the basic plan. Also, no hogs were in the optimal plan when a swine price of \$30.00 per cwt. was used.

When swine price was increased to \$35.00 per cwt., the dairy was replaced by 58 brood sows and the number of steers was reduced to 65 head. The production of grain corn was increased to 60.2 acres and 32.0 acres of wheat and soybeans would be produced. The soybeans would be sold as a cash crop while all other grain produced would be fed to the swine. With a five cents per pound increase in the price of market hogs to \$40.00, the number of sows increased to 67 head and 98 acres of grain would be produced.

When swine prices were increased to \$50.00 and \$60.00 per cwt., the farrow to finish program changed to a system of finishing out purchased feeder pigs. Only 52.9 acres of grain would be produced and the remaining grain needs would be met by the purchase of 20,079 bushels of corn and wheat. The net income varied from \$27,261 with no swine feeding to a maximum of \$115,599 at the \$60.00 swine price.

The value of land to the farm operation changed considerably as the price of swine was varied. With swine at \$30.00 per cwt., all

TABLE XXX

OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprise, acre</u>						
Grain corn	57.2	57.8	60.2	50.9	52.9	52.9
Wheat-soybeans	24.1	24.1	32.0	23.4	--	--
Corn silage	16.1	16.1	--	--	--	--
Red clover-timothy	21.9	21.9	9.6	--	--	--
Permanent pasture	122.2	122.2	67.7	11.3	--	--
Summer pasture	14.1	14.1	--	--	--	--
Winter pasture	13.8	13.8	4.3	--	--	--
Wheat-milo	--	--	5.8	23.7	45.1	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	28	28	--	--	--	--
Steers, head	117	117	65	--	--	--
Slaughter hogs Ia, head	--	--	--	--	792	792
Slaughter hogs IIa, head	--	--	47	66	779	842
Slaughter hogs IIIa, head	--	--	--	--	714	768
Farrow to finish, sows	--	--	58	67	--	--
<u>Buy and sell activities</u>						
Sell corn, bu.	4,573	4,573	--	--	--	--
Sell wheat, bu.	965	965	--	--	--	--
Sell soybeans, bu.	627	627	832	610	--	--

TABLE XXX (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy alfalfa, ton	28	28	--	--	--	--
Buy corn, bu.	--	--	747	2,417	7,880	8,501
Buy wheat, bu.	--	--	3,095	3,448	6,181	11,578
Buy milo, bu.	--	--	--	--	1,662	--
Sell milo, bu.	--	--	--	770	--	--
Net return to land, labor, capital, and management	\$32,746	\$32,746	\$41,202	\$53,902	\$86,955	\$123,574
Net return to land, operator labor, and management	\$27,661	\$27,661	\$37,289	\$49,597	\$79,481	\$115,479

Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

cropland was utilized; however, 45 acres of potential pastureland was left idle. With an increase in swine prices to \$40.00 per cwt., 161 acres of cropland and pasture was idle and at \$60.00 per cwt. the idle land increased to 217 acres.

The MVP's shown in Table XXXI indicate that the value of continuous cropland is greater than the expected rental rate until swine prices increase to \$40.00 per cwt. Above this price, the value drops below the likely rental rate and with swine at \$60.00 per cwt., additional acres of continuous cropland would have no value to the operation. At a swine price of \$35.00 per cwt. and above, additional acres of total cropland and pasture has no value to the operation with the specified labor supply. Additional labor would have a value of \$9.78 to \$19.03 per hour in three periods where no swine were fed, but a value of \$29.62 to \$80.33 in four of the labor periods when swine were priced at \$60.00 per cwt. Labor would not be restrictive in the July-August and November-December periods.

Medium Size Farm Using a Two-Man Labor Supply

With the addition of a second man to the operation, livestock relative to the production of crops became more important. Where no swine feeding was allowed in the operation, the most profitable organization (Table XXXII) included an 82-cow Grade "A" dairy operation with 27 beef steers to utilize surplus forage. All the pasture and silage requirements and a part of the hay requirements for the livestock would be produced on the farm. Both alfalfa and red clover-timothy hay

TABLE XXXI

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
	0	30	35	40	50	60	
Land, per acre			--Dollars--				
Continuous cropland	81.97	81.97	68.19	45.79	29.55	--	
Total cropland and pasture	14.95	14.95	--	--	--	--	
Labor, per hour							
January-February	--	--	--	--	28.65	55.64	
March-April	12.03	12.03	33.44	36.82	30.41	29.62	
May-June	--	--	14.67	26.98	53.99	80.33	
July-August	9.78	9.78	--	--	--	--	
September-October	19.03	19.03	6.53	21.43	50.10	80.33	
November-December	--	--	12.27	12.90	3.89	--	

TABLE XXXII

OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	9.9	17.1	56.0	54.7	71.8	71.7	
Cotton	19.4	14.6	--	--	--	--	
Wheat-soybeans	22.2	23.8	32.0	29.7	--	10.8	
Corn silage	46.6	42.7	--	--	--	--	
Red clover-timothy	17.2	20.7	1.7	--	--	--	
Permanent pasture	114.0	114.0	35.9	25.3	11.4	11.4	
Summer pasture	40.8	37.3	--	--	--	--	
Wheat-milo	--	--	10.0	13.5	26.2	--	
<u>Livestock enterprises</u>							
Grade A dairy, cows	82	75	--	--	--	--	
Steers, head	27	32	11	--	--	--	
Slaughter hogs I ^a , head	--	--	--	--	914	913	
Slaughter hogs II ^a , head	--	--	105	112	1,000	1,000	
Slaughter hogs III ^a , head	--	--	--	--	878	873	
Farrow to finish, sows	--	12	147	147	67	67	
<u>Buy and sell activities</u>							
Sell corn, bu.	790	274	--	--	--	--	
Sell wheat, bu.	888	--	--	--	--	--	
Sell soybeans, bu.	577	618	832	771	--	280	

TABLE XXXII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
Buy red clover, ton	11	--	--	--	--	--	--
Buy alfalfa, ton	82	75	--	--	--	--	--
Buy corn, bu.	--	--	9,630	9,900	15,212	15,197	
Buy wheat, bu.	--	--	10,231	10,186	15,246	18,361	
Buy milo	--	--	--	--	1,949	--	--
Net return to land, labor, capital, and management	\$53,035	\$53,099	\$74,705	\$103,313	\$168,366	\$236,017	
Net return to land, operator labor, and management	\$33,499	\$33,499	\$57,090	\$ 85,773	\$146,999	\$214,124	

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

would be purchased. Ten acres of grain corn, 19.4 acres of cotton, and 22 acres of double cropped wheat and soybeans were produced for sale.⁴

With an increase in swine prices to \$30.00 per cwt., only minor changes occurred in the optimum plan; however, with \$35.00 per cwt. for swine a major change occurred. The dairy operation was eliminated from the plan and replaced with 147 brood sows in a farrow to finish system. In addition, 105 feeder pigs would be purchased and fed to slaughter weights. Ninety-eight acres of grain would be produced and fed to the swine, while 832 bushels of soybeans would be sold as a cash crop. With a five cents per pound increase in the price of market hogs to \$40.00 per cwt. only minor changes occurred in the optimum farm organization.

With an increase in swine prices to \$50.00 per cwt., the number of sows decreased to 67 head while the number of purchased feeder pigs increased to 2,792 head. All the available continuous cropland was used to produce grain and an additional 32,407 bushels of grain would be purchased. Only minor changes in the optimum organization resulted as swine prices were increased to the maximum level being considered—\$60.00 per hundredweight.

Net revenue to land, operator labor, and management increased from \$33,499 when no swine were considered in the plan to a high of \$214,124 when swine was included and priced at \$60.00 per cwt. The optimum

⁴The linear programming procedure assumed that all grain for the dairy would be purchased. Where a dairy operation and grain for sale were in the optimal plans, this grain would be available as feed for the dairy operation.

farm organizations and net revenues with each specified level of swine prices is given in Table XXXII.

The marginal value products for the limiting resources are shown in Table XXXIII. With a medium size farm and a two-man labor supply the MVP's per hour of labor are much higher than the wage rate in Tennessee for some labor periods in all the optimum plans. With no swine production the values range from \$2.50 to \$23.31 per hour in the March-April, May-June, and September-October labor periods. These values become higher as the price of swine increases. With swine prices at \$60.00 per cwt., the range of values are \$1.18 to \$79.15 per hour. The labor supply was exhausted for all except July-August labor periods.

All the available land was utilized when no swine production was included in the model. An additional unit of continuous cropland was worth \$49.34, while total land had a MVP of \$24.20. If available, a farm operator would consider renting more continuous cropland.

With the introduction of swine into the optimal plans, the MVP's for all land classes remained about the same when swine were priced at \$30.00 per cwt.; however, with \$35.00 per cwt. for swine only continuous cropland was restrictive. When the price of swine was \$60.00 per cwt., additional land had no value.

Medium Size Farm Using a Three-Man Labor Supply

With a three-man labor supply, the assumption was made that the owner-operator would provide 3,000 hours of annual labor while two

TABLE XXXIII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING A TWO-MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price Per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre						
Continuous cropland	\$49.34	\$50.39	\$70.76	\$47.35	\$34.88	--
Total cropland	17.35	17.44	--	--	--	--
Total cropland and pasture	24.20	24.27	--	--	--	--
Labor, per hour						
January-February	--	--	--	--	29.91	35.31
March-April	13.01	12.06	31.29	36.06	28.89	54.02
May-June	2.50	2.44	13.65	25.96	47.65	53.09
July-August	--	--	--	--	--	--
September-October	23.31	24.26	9.07	21.14	50.11	1.18
November-December	--	--	12.89	14.97	3.89	79.15
Other restrictions						
Wheat-soybeans, acre	--	--	25.51	--	--	--
Slaughter hogs II ^a , unit	--	--	--	--	3.81	16.34

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

hired workers would provide 2,146 hours of labor each. The farm organization (Table XXXIV) remained essentially the same as for a two-man labor supply; however, dairy increased substantially from 82 to 104 dairy cows and steer production decreased. Where no swine were permitted, the cropping program included the production of silage and pasture for the livestock plus 20 acres of cotton and 18 acres of double cropped soybeans and wheat for sale as a cash crop. The hay requirements for the dairy enterprise would be purchased.

No major changes occurred in the optimum farm plan when swine were valued at \$30.00 per cwt.; however, at \$35.00 per cwt., the production of swine became more profitable than dairy production. At this price the livestock system included 187 brood sows and 138 purchased feeder pigs. Fifty-six acres of continuous cropland would be used to produce grain for the swine. Thirty-two acres of double cropped wheat would be used to produce grain for the swine. Thirty-two acres of double cropped soybeans would be sold as a cash crop. Sow pasture required 32.1 acres of the pastureland. Approximately 10 acres of wheat and milo would also be produced as feed grains. With an increase in swine prices to \$40.00 per cwt. essentially no changes occurred in the plan.

With an increase in swine prices to \$50.00 per cwt., the cropping program included the production of 74.2 acres of grain corn, 23.8 acres of wheat and milo and 18.3 acres of sow pasture. The number of brood sows decreased from 187 to 108 head, but purchased feeder pigs increased from 138 to 2,723 head. Slight changes occurred in the

TABLE XXXIV

OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING THREE MEN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	.6	21.1	56.2	56.2	74.2	72.3
Cotton	20.0	--	--	--	--	--
Wheat-soybeans	17.7	19.2	32.0	31.9	--	15.9
Corn silage	59.6	57.6	--	--	--	--
Red clover--timothy	5.8	7.5	--	--	--	--
Permanent pasture	114.0	114.0	32.1	31.7	18.3	18.0
Summer pasture	52.2	50.5	--	--	--	--
Wheat-milo	--	--	9.8	9.9	23.8	--
<u>Livestock enterprises</u>						
Grade A Dairy, cows	104	101	--	--	--	--
Steers, head	3	5	--	--	--	--
Farrow to finish, sows	--	5	187	187	108	106
Slaughter hogs Ia, head	--	--	--	--	872	892
Slaughter hogs IIa, head	--	151	138	138	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	--	851	847
<u>Buy and sell activities</u>						
Sell corn, bu.	44	--	--	--	--	--
Sell wheat, bu.	707	307	--	--	--	--
Sell soybeans, bu.	460	500	832	830	--	413

TABLE XXXIV (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy red clover, ton	42	37	--	--	--	--
Buy alfalfa, ton	104	101	--	--	--	--
Buy corn, bu.	--	--	13,404	13,414	18,428	18,247
Buy wheat, bu.	--	--	13,544	13,542	18,083	21,045
Buy milo	--	--	--	--	2,346	--
Net return to land, labor, capital, and management	\$61,880	\$62,019	\$90,184	\$126,137	\$205,568	\$237,014
Net return to land, operator labor, and management	\$35,353	\$36,329	\$66,365	\$102,302	\$178,131	\$259,044

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

optimum plan when a price of \$60.00 per cwt. was specified. The corn acreage decreased from 74.2 to 72.3 acres, the wheat and milo was replaced by 15.9 acres of wheat and soybeans and the number of brood sows decreased from 108 to 106 head while 16 purchased feeder pigs were added to the operation.

When no swine were permitted all cropland and pasture was utilized. In the optimum plan with a \$35.00 per cwt. price for swine, the continuous cropland was utilized but 57.9 acres of other cropland and 81.9 acres of pasture was left idle. With a \$60.00 per cwt. price for swine, 7 acres of continuous cropland, 57.8 acres of other cropland, and 96.0 of pastureland remained idle. The net returns to the fixed resources increased from a low of \$35,353 to a high of \$259,044 when the price of market hogs was varied from \$0-60 per cwt. The effect of variations in swine price on resource use and net returns is shown in Table XXXIV.

The marginal value products for the most restrictive resources are shown in Table XXXV. As with a two-man labor supply, labor is the most restrictive resource at high swine prices. Where no swine were considered in the farm organization, MVP's of \$42.77, \$23.58, and \$24.49 were noted for continuous cropland, total cropland, and total cropland and pasture. If additional land could be rented at these prices, the labor supply would be utilized more efficiently since only two labor periods were restrictive. MVP's of \$12.54 and \$25.90 were obtained for the March-April and September-October labor periods. With a price of \$35.00 per cwt. for swine, the MVP for

TABLE XXXV

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre						
Continuous cropland	42.77	49.95	70.76	47.35	34.88	--
Total cropland	23.58	19.39	--	--	--	--
Total cropland and pasture	24.49	24.37	--	--	--	--
Labor, per hour						
January-February	--	--	--	--	29.91	35.31
March-April	12.54	13.27	31.29	36.05	28.89	54.02
May-June	--	1.66	13.66	25.96	47.65	53.09
July-August	--	--	--	--	--	--
September-October	25.90	23.62	9.07	21.14	50.10	1.18
November-December	--	--	12.90	14.97	3.89	79.15
Other restrictions						
Cotton, ac.	5.76	--	--	--	--	--
Wheat-soybeans, ac.	--	--	25.51	--	--	--
Slaughter hogs II ^a , unit	--	--	--	--	3.80	16.34

^aUnit of 50 head bought as feeder pigs and fed to 230 pounds.

continuous cropland increased to \$70.76 while labor was restrictive in all periods except January-February and July-August. The MVP's for labor in restrictive periods ranged from \$9.07 to \$31.29 per hour. Also at this swine price level, an additional acre of wheat-soybeans would increase net revenue by \$25.51.

With \$60.00 per cwt. for swine, additional land had no value to the operation, while the MVP's for labor were greater than zero in all periods except July-August and ranged from \$1.18 to \$79.15 per hour. Another unit of 50 purchased feeder pigs would contribute \$16.34 or \$0.33 per head to the overall net revenue.

Large Size Farm Using Operator Labor

A large size farm included 405 acres of which 147 acres were classified as continuous cropland, 87 acres were classified rotational land and 171 acres were restricted to permanent pasture. With an owner-operator supplying 3,000 hours of annual labor and with no swine feeding considered, the optimum farm organization (Table XXXVI) would consist mainly of a cropping program where 107.1 acres of grain corn and 31.7 acres of wheat and soybeans would be produced as cash crops. Also 227 beef steers would be kept to utilize the forage crops produced as well as to use surplus winter labor.

With a price of \$30.00 per cwt. for swine, it would not be profitable to produce swine and the optimum plan was the same as when swine was not permitted. When swine prices was increased to \$35.00 per cwt., a major change in the optimum farm organization occurred.

TABLE XXXVI

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICES FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	107.1	107.1	74.4	74.4	52.9	52.9
Wheat-soybeans	31.7	31.7	32.0	32.0	--	--
Silage corn	8.2	8.2	--	--	--	--
Red clover-timothy	35.9	35.9	--	--	--	--
Permanent pasture	179.6	179.6	10.0	10.0	--	--
Summer pasture	7.2	7.2	--	--	--	--
Winter pasture	35.3	35.3	--	--	--	--
Wheat-milo	--	--	40.6	40.6	50.7	50.7
<u>Livestock enterprises</u>						
Grade A dairy, cows	14	14	--	--	--	--
Steers	227	227	--	--	--	--
Slaughter hogs Ia, head	--	--	--	--	792	792
Slaughter hogs IIa, head	--	--	77	77	771	771
Slaughter hogs IIIa, head	--	--	--	--	707	707
Farrow to finish, sows	--	--	60	60	--	--
<u>Buy and sell activities</u>						
Sell corn, bu.	8,443	8,443	--	--	--	--
Sell wheat, bu.	1,267	1,267	--	--	--	--
Sell soybeans, bu.	823	823	832	832	--	--

TABLE XXXVI (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Sell red clover, ton	9	9	--	--	--	--
Buy corn, bu.	--	--	--	--	7,802	7,802
Buy alfalfa, ton	14	14	--	--	--	--
Buy wheat, bu.	--	--	1,810	1,810	5,502	5,502
Buy milo, bu.	--	--	1,691	1,687	1,873	1,873
Net return to land, labor, capital, and management	\$38,746	\$38,746	\$44,528	\$56,129	\$87,122	\$122,988
Net return to land, operator labor, and management	\$32,989	\$32,989	\$40,528	\$51,775	\$79,637	\$114,981

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

The most profitable plan would include the production of 60 brood sows and the purchase of 77 feeder pigs. No dairy or steers were included in the plan. The cropping program would include the production of 147 acres of corn, 40.6 acres of wheat and milo for swine feed and 32 acres of soybeans double cropped with wheat. The wheat would be fed while the soybeans would be sold as a cash crop. No changes occurred in the farm organization when swine prices were increased to \$40.00 per cwt.

As swine prices were increased to \$50.00 and above per cwt., all brood sows were eliminated and the operation became a specialized swine unit feeding out purchased feeder pigs. The amount of cropland used to produce grain was reduced to 103 acres and the amount of purchased grain increased to 15,177 bushels of corn, wheat, and milo. With a very limited labor to land ratio, increased swine prices with input costs at a fixed level caused labor to become more profitable in the swine operation relative to producing feed on the farm; thus all except 52.9 acres of corn land was idle.

The optimum farm plans with varying swine prices are shown in Table XXXVI. Net returns to land, operator labor, and management varied from \$32,989 to \$114,981.

The marginal value products for the restricting resources are shown in Table XXXVII. When no swine were considered in the optimum farm organization, continuous cropland had a MVP of \$87.20 per acre, well above the expected rental rate of \$48.00 per acre; however, for total cropland and pasture the MVP was only \$12.39 per acre.

TABLE XXXVII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Land, per acre</u>						
Continuous cropland	87.20	87.20	60.16	34.44	--	--
Total cropland and pasture	12.39	12.39	--	--	--	--
<u>Labor, per hour</u>						
January-February	--	--	--	--	13.21	13.21
March-April	10.61	10.61	32.32	40.26	48.92	48.92
May-June	--	--	15.81	28.11	53.99	53.90
July-August	7.43	7.43	--	--	--	--
September-October	16.76	16.76	4.41	10.05	33.90	33.90
November-December	6.99	6.99	16.32	21.66	23.34	23.34
<u>Other restrictions</u>						
Wheat-soybeans	--	--	39.15	26.77	--	--

In this situation, labor also had MVP's per hour in some periods which were well above the expected wage rate in Tennessee. The values ranged from \$6.99 to \$16.76 per hour for four labor periods. In January-February and May-June periods, labor was not a restricting resource.

With a swine price of \$35.00 per cwt. for swine the MVP for continuous cropland decreased to \$60.16 per acre while total cropland and pasture acreage was not restricting. The MVP's per hour of labor ranged from \$4.41 to \$32.32 in four labor periods. At a swine price of \$50.00 and \$60.00 per cwt., labor was restrictive in all periods except July and August.

Large Size Farm Using a Two-Man Labor Supply

When an additional 3,000 hours of labor are added to the 405-acre land base, a 70-cow Grade "A" dairy operation supplemented with 124 steers became the most profitable livestock alternative when no swine were permitted (Table XXXVIII). The cropping program included the production of 40 acres of silage, 32.6 acres of hay and 225.4 acres of pasture for the livestock. In addition, 66.4 acres of grain corn and 32.0 acres of wheat and soybeans would be produced as a cash crop. Sixty-nine tons of alfalfa hay would be purchased for the dairy cows. Net revenue to land, operator labor, and management with this farm plan was \$39,599.

As with a one-man operation no changes occurred in the optimum farm organization when a price of \$30.00 per cwt. was used for market hogs. When the swine price was increased to \$35.00 per cwt., the

TABLE XXXVIII

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	66.4	66.4	94.6	85.7	75.9	71.7
Wheat-soybeans	32.0	32.0	32.0	32.0	8.7	10.8
Corn silage	40.0	40.0	--	--	--	--
Red clover-timothy	32.6	32.6	9.3	--	--	--
Permanent pasture	179.2	179.2	69.9	23.5	10.0	11.4
Summer pasture	35.0	35.0	--	--	--	--
Winter pasture	11.2	11.2	18.9	--	--	--
Wheat-milo	8.6	8.6	20.4	29.3	62.3	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	70	70	--	--	--	--
Steers, head	124	124	82	--	--	--
Slaughter hogs Ia, head	--	--	--	--	996	913
Slaughter hogs IIa, head	--	--	163	164	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	37	833	873
Farrow to finish, sows	--	--	128	139	59	67
<u>Buy and sell activities</u>						
Sell corn, bu.	5,275	5,275	--	--	--	--
Sell wheat, bu.	1,623	1,623	--	--	--	--
Sell soybeans, bu.	832	832	832	832	226	281

TABLE XXXVIII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy alfalfa, ton	70	70	--	--	--	--
Sell milo, bu.	428	428	--	203	--	--
Buy wheat	--	--	8,164	8,637	11,479	18,362
Buy corn	--	--	5,160	6,692	14,587	15,197
Buy milo	--	--	--	--	2,393	--
Net return to land, labor, capital, and management	\$59,314	\$59,314	\$78,062	\$105,443	\$169,368	\$236,017
Net return to land, operator labor, and management	\$39,599	\$39,579	\$60,284	\$ 86,872	\$147,829	\$214,126

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

Grade "A" dairy was eliminated and the optimum plan included 128 sows and 163 feeder pigs. The number of steers decreased from 124 to 82 head. With an increase in the swine price to \$40.00 per cwt., the number of sows increased to 139 while the number of purchased feeder pigs increased to 201. At this price level for swine the steers were eliminated from the optimal farm plan. The cropping program included 85.7 acres of grain corn, 32.0 acres of wheat-soybeans and 29.3 acres of wheat-milo. The pasture acres decreased to 23.5 acres to be used for sow pasture.

With \$50.00 per cwt. for swine, the number of sows was reduced to 59, but purchased feeder pigs increased to 2,829. Corn acreage decreased from 85.7 to 75.9, wheat-soybeans decreased from 32 to 8.7 acres, wheat-milo increased from 29.3 to 62.3 acres while swine pasture decreased from 23.5 to 10 acres.

With swine price at \$60.00 per cwt., a small increase occurred in the number of sows from 50 to 67 head, and the number of purchased feeder pigs decreased to 2,786 head. Corn acreage decreased to 71.7 acres, wheat-soybeans increased slightly to 10.8 acres and sow pasture increased to 11.4 acres. All wheat and milo acreage was eliminated from the plan. With higher swine prices, a higher proportion of the grain was purchased. With \$60.00 per cwt. for swine a total of 33,559 bushels of wheat and corn would need to be purchased for the swine enterprise. Net returns to land, operator labor, and management varied from \$39,599 to \$214,126 as swine prices varied from \$30.00 to \$60.00 per cwt. The optimum farm plans on a large farm with a two-man labor supply are shown in Table XXXVIII.

The marginal value products for the restricting resources associated with these plans are shown in Table XXXIX. Where no swine were produced, the MVP for continuous cropland was \$67.35 per acre for continuous cropland and \$19.01 per acre for total cropland and pasture. An additional acre of wheat-soybean quota would have increased returns by \$16.19. Labor was restrictive in the March-April, July-August, and September-October labor periods and had an MVP ranging from \$6.59 to \$18.55 per hour. These values remained constant when swine were priced at \$30.00 per cwt., but when increased to \$35.00 per cwt., the MVP for continuous cropland increased slightly to \$68.19 per acre, while total cropland and pasture was not a restrictive resource. The MVP's per hour of labor varied from \$6.53 to \$33.44 during four restrictive labor periods. The wheat-soybean acreage was restrictive and had an MVP of \$31.31 per acre. Similar values were noted with swine at \$40.00 per cwt.

With a price of \$50.00 per cwt. for swine, the land resource was not restrictive, but labor was restricted in five labor periods. The MVP's per hour of labor varied in these five periods from \$10.05 to \$52.73. At \$50.00 per cwt. hog price an additional unit of 50 purchased feeder pigs in the second production period had a positive MVP of \$8.90, less than 50 cents per pig. With an increase to \$60.00 per cwt. the restricting resources remained the same but MVP's were higher.

TABLE XXXIX

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE SIZE FARM USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
--Dollars						
Land, per acre						
Continuous cropland	67.35	67.35	68.19	42.54	--	--
Total cropland and pasture	19.01	19.01	--	--	--	--
Labor, per hour						
January-February	--	--	--	--	10.05	25.30
March-April	18.55	18.50	33.44	41.26	52.73	54.02
May-June	--	--	14.67	26.98	39.15	53.09
July-August	6.29	6.29	--	--	--	--
September-October	15.94	15.94	6.53	12.39	27.48	1.17
November-December	--	--	12.27	17.50	31.03	79.15
Other restrictions						
Wheat-soybeans, ac.	19.16	19.16	31.31	18.49	--	--
Slaughterer hogs II ^a , unit	--	--	--	--	8.90	16.34

^aUnits of 50 purchased feeder pigs fed to 230 pounds.

Large Size Farm Using a Three-Man Labor Supply

With the addition of a second hired man to the fixed land base, the size of the dairy increased from 70 to 96 cows while the number of steers decreased from 124 to 76 head. The acreage of grain corn decreased from 66.4 to 47.6 acres while corn silage production was increased for the larger dairy herd.

The optimal farm plan, where no swine were considered, included 96 cows and 76 beef steers (Table XL). Forage would be provided by 54.7 acres of corn silage, 32.5 acres of red clover-timothy hay, and 225.5 acres of pasture. The optimal plan also included 47.6 acres of grain corn, 32 acres of wheat and soybeans and 12.8 acres of wheat and milo as cash crops. A net return of \$50,955 could be obtained with this optimal plan. With a swine price specified at \$30.00 per cwt., no changes occurred in the plan.

With swine prices at \$35.00 per cwt., the Grade "A" dairy was eliminated from the optimal farm plan and replaced by 174 brood sows and 192 purchased feeder pigs. The number of steers was reduced to 50 head. Silage corn would no longer be produced, with this acreage being converted to grain corn production. With fewer forage consuming livestock a large reduction (77.6 to 52.1 acres) occurred in pasture production and hay production (32.5 to 5.0 acres). With a swine price of \$40.00 per cwt., the remaining 50 steers were eliminated while the number of brood sows increased to 176. Purchased feeder pigs increased to 256 head. Only slight changes occurred in the cropping program.

TABLE XL

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	47.6	47.6	91.0	89.9	78.6	75.3
Wheat-soybeans	32.0	32.0	32.0	32.0	11.1	15.9
Corn silage	54.7	54.7	--	--	--	--
Wheat-milo	12.8	12.8	30.0	25.2	57.3	--
Red clover-timothy	32.5	32.5	5.0	--	--	--
Permanent pasture	177.6	177.6	52.1	29.8	16.9	18.0
Summer pasture	47.9	47.9	--	--	--	--
Winter pasture	--	--	15.3	--	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	96	96	--	--	--	--
Steers, head	76	76	50	--	--	--
Slaughter hogs Ia, head	--	--	--	--	959	892
Slaughter hogs IIa, head	--	--	192	206	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	50	856	847
Farrow to finish, sows	--	--	171	176	99	106
<u>Buy and sell activities</u>						
Sell corn, bu.	3,806	3,806	--	--	--	--
Buy milo	--	--	--	--	2,473	--
Sell wheat, bu.	1,790	1,790	--	--	--	--

TABLE XL (Continued)

Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
	Swine Price per CWT (Dollars)				
0	30	35	40	50	60
Sell soybeans	832	832	832	288	413
Sell milo	638	--	--	--	--
Buy alfalfa	96	--	--	--	--
Buy corn	--	9,487	10,331	17,766	18,247
Buy wheat	--	11,412	12,027	14,653	21,045
Net return to land, labor, capital, and management	\$68,789	\$93,562	\$128,226	\$206,489	\$287,014
Net return to land, operator labor, and management	\$50,955	\$69,563	\$104,437	\$178,794	\$259,016

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

With an increase in the swine price to \$50.00 per cwt., the brood sows were reduced to 99 and the purchased feeder pigs increased to 2,815. The corn acreage was reduced from 89.9 to 78.6, wheat-soybeans from 32 to 11.1 and pasture from 29.8 to 16.9, while wheat-milo acres increased from 25.2 to 57.3. In addition, 34,892 bushels of wheat, milo, and corn would be purchased. With \$60.00 per cwt. for swine, the number of brood sows increased to 106, while the number of purchased feeder pigs was reduced to 2,739. Wheat and milo were no longer produced, and slight changes occurred in the acreage of wheat-soybeans, grain corn, and pasture. The major part of the grain would be purchased at this swine price level. Net returns to land, operator labor, and management varied from \$50,955 to \$259,016 when swine prices varied from \$30.00 to \$60.00 per cwt. The optimum farm organizations for various swine prices are shown in Table XL.

The marginal value products (Table XLI) for continuous cropland was above the expected rental rate when swine prices are \$35.00 per cwt. and less. With swine prices at \$40.00 per cwt. and above, it would probably not be profitable for a farmer to rent continuous cropland even if it were available. Where no swine were considered the MVP's for labor were positive in the March-April, July-August, and September-October periods. The values in the restrictive periods ranged from \$6.29 to \$18.56 per hour. The wheat-soybean restriction also had a positive value of \$19.16 per acre in this situation. With swine priced at \$30.00 per cwt., no changes occurred in the MVP's. With swine at \$35.00 per cwt., total crops and pasture was no longer

TABLE XLI

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE SIZE FARM USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA II

	Without Swine Feeding		With Swine Feeding for Selected Swine Prices				
	0	30	Swine Price per CWT (Dollars)				
			35	40	50	60	
Land, per Acre							
Continuous cropland	67.35	67.35	68.19	42.57	--	--	--
Total cropland and pasture	19.01	19.01	--	--	--	--	--
Labor, per hour							
January-February	--	--	--	--	10.05	35.31	
March-April	18.56	18.56	33.44	42.58	52.73	54.02	
May-June	--	--	14.67	25.96	39.15	53.09	
July-August	6.29	6.29	--	--	--	--	--
September-October	15.94	15.94	6.53	7.84	27.48	1.18	
November-December	--	--	12.27	21.74	31.03	79.15	
Other restrictions							
Wheat-soybeans, ac.	19.16	19.16	31.31	27.19	--	--	
Slaughter hogs II ^a , unit	--	--	--	--	8.90	16.34	

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

restrictive; however, the value of additional labor increased in four production periods. The MVP's per hour of labor in restrictive periods varied from \$6.53 to \$33.44. At \$40.00 swine price, the MVP's for labor in restrictive periods ranged from \$7.84 to \$42.58 per hour. The wheat-soybean restriction had a MVP of \$27.19 per acre.

For a \$50.00 swine price, additional land had no value to the operation, but labor became more important. Labor was restrictive in five time periods and MVP's ranged from \$10.05 to \$52.73 per hour. An MVP of \$8.90 per unit of 50 slaughter hogs in the summer production period was obtained. At a swine price of \$60.00 per cwt., the same resources were restrictive, but higher values were estimated for labor in restrictive periods in all but the September-October production period.

D. AREA III

Base Size Farm Using Operator Labor

Area III, which includes 24 East Tennessee counties is characterized by small farms. Total openland for the base farm⁵ in this area was 129 acres with 25 acres classified as continuous cropland, 28 acres suitable for row crops one year in three, and 17 acres suitable for row crops only one year in six. Fifty-nine acres were classified as pastureland only. The major crops considered in the model included burley tobacco, grain

⁵The base size farm was assumed to have the same acreage and land distribution as 16 swine farms in the area which participated in the Resource Management Program, 1965-1971.

corn, wheat, milo, barley, corn and small grain silages, and hay crops. All livestock enterprises which were considered in the two previous areas were also considered in the model for Area III. The three assumed labor situations were the same as for other areas—3,000, 6,000, and 7,392 hours of annual labor available.

Since this is a deficit grain area, grain prices were increased 16 percent above the prices used in the plans for Area I. Corn prices were increased from 2.65 to 3.07 bushel, wheat prices were increased from \$2.90 to \$3.36 per bushel, and milo prices were increased from \$2.30 to \$2.67 per bushel.

With these conditions, an owner-operator using 129 acres of openland and no swine production would maximize farm income with a 42-cow Grade "A" dairy and feeding 32 steers to a weight of 700 pounds (Table XLII). The cropping program would include the production of 23.9 acres of silage corn, 9.6 acres of red clover-timothy hay and 94.6 acres of pasture for livestock feed. In addition, 42 tons of alfalfa hay would be purchased for the dairy. An estimated net return to land, operator labor, and management of \$19,451 would be generated with this farm organization.

When swine prices were increased to \$30.00 per cwt., essentially no change occurred in the optimum farm organization.

When a level of \$35.00 per cwt. was specified, the dairy and steers were eliminated and replaced by farrow to finish operation and 51 purchased pigs to be fed out during the summer months. All 25 acres of continuous cropland was used to produce grain for the swine enterprise.

TABLE XLII

OPTIMUM FARM ORGANIZATION FOR BASE FARM SIZE USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	1.0	1.0	16.8	13.5	25.0	25.0
Corn silage	23.9	23.9	--	--	--	--
Red clover-timothy	9.6	9.6	--	--	--	--
Permanent pasture	69.9	69.9	13.2	13.2	--	--
Summer pasture	21.0	21.0	--	--	--	--
Winter pasture	3.7	3.7	--	--	--	--
Wheat-soybeans	--	--	8.2	11.5	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	42	42	--	--	--	--
Steers, head	32	32	--	--	792	792
Slaughter hogs Ia, head	--	2	--	15	860	860
Slaughter hogs IIa, head	--	--	51	52	803	803
Slaughter hogs IIIa, head	--	--	--	--	--	--
Farrow to finish, sows	--	--	78	78	--	--
<u>Buy and sell activities</u>						
Sell corn, bu.	72	48	--	--	--	--
Buy red clover, ton	9	9	--	--	--	--
Buy alfalfa, ton	42	42	--	--	--	--

TABLE XLII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy corn, bu.	--	--	6,088	6,426	11,005	11,005
Buy wheat, bu.	--	--	6,141	6,078	11,200	11,200
Sell soybeans	--	--	214	300	--	--
Buy milo	--	--	--	--	811	811
Net returns to land, labor, capital, and management	\$24,631	\$24,634	\$35,425	\$50,442	\$83,128	\$121,897
Net return to land, operator labor, and management	\$19,451	\$19,451	\$31,040	\$45,972	\$75,433	\$113,638

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

Only minor changes occurred in the plan with a price increase to \$40.00 per cwt. for swine. A few more pigs and some additional grain were purchased. When the price of market hogs reached \$50.00 per cwt., all brood sows were eliminated and the optimum farm organization became a specialized feeding operation using purchased feeder pigs. Twenty-five acres of grain corn was produced, and 23,016 bushels of corn, milo, and wheat would be purchased to feed 2,455 head of purchased feeder pigs to a weight of 230 pounds per head.

With an increase in the price of market hogs from \$50.00 to \$60.00 per cwt., the net return to land, operator labor, and management increased from \$75,433 to \$113,638. The optimum farm organization, both without swine feeding and where swine were fed, and the price was varied from \$30-60 per cwt. is shown in Table XLII.

The marginal value products of the restricting resources are shown in Table XLIII. Where no swine production was considered in the optimum farm plans the marginal value product for an acre of continuous cropland was \$110.73 and for an acre of total cropland and pasture was \$5.98. Based on expected rental rates of \$40.00 to \$60.00 per acre for continuous cropland, a farm operator would be justified in renting additional such land, if available, to increase net returns. The MVP's for labor in the July to December months were higher than the farm wage rate in Tennessee and varied from \$6.17 to \$22.15 per hour. During the first six months, labor was not a restrictive resource. Similar MVP's were noted when swine was considered at a price of \$30.00 per cwt.

TABLE XLIII
MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE SIZE FARM USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre				--Dollars--		
Continuous cropland	110.73	103.84	96.62	74.94	89.45	60.32
Total cropland and pasture	5.98	8.19	--	--	--	--
Labor, per hour						
January-February	--	--	--	3.92	53.99	80.32
March-April	--	2.84	17.57	26.45	--	--
May-June	--	--	13.66	25.96	53.99	80.32
July-August	13.49	12.78	--	--	--	--
September-October	22.15	21.58	4.07	--	50.11	76.44
November-December	6.17	4.34	31.61	41.79	3.89	3.89

With swine price at \$35.00 per cwt., total cropland and pasture were no longer restrictive; however, continuous cropland continued to have a high MVP. The MVP's for labor were high in all labor periods except the January-February and July-August periods. These values ranged from \$4.07 to \$31.61 per hour. As swine price increased to \$40.00 per cwt., the MVP for land decreased while the MVP's for labor continued to increase. With swine prices at \$50.00 and \$60.00, respectively, the MVP's for continuous cropland was \$89.45 and \$60.32 while the MVP's for labor ranged from \$3.89 to \$53.99 and \$3.89 to \$80.32 per hour in the restrictive periods. Two labor periods were not restrictive at these price levels.

Base Size Farm Using a Two-Man Labor Supply

With land held constant and no swine permitted and an additional 3,000 hours of labor added to the resource base, the number of dairy cows increased from 42 to 60 and steer backgrounding was eliminated from the optimal farm plan (Table XLIV). Fifty-one acres of silage and 93.4 acres of pasture would be produced on the farm while the hay requirements of 61 tons for the dairy would be purchased.

With an increase in swine prices to \$30.00 per cwt., the size of the dairy was reduced to 47 cows and a 76-sow farrow to finish swine operation was added to the optimal organization. When swine prices were increased to \$35.00 per cwt., the dairy was eliminated, the number of sows was increased to 157 head and 167 purchased feeder pigs were included. The cropping program included the production of 25 acres of

TABLE XLIV

OPTIMUM FARM ORGANIZATION FOR BASE FARM SIZE USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Corn silage	26.6	25.4	--	--	--	--
Wheat silage	25.0	5.8	--	--	--	--
Alfalfa	8.7	2.4	--	--	--	--
Permanent pasture	63.6	63.6	27.8	26.7	12.5	12.5
Summer pasture	29.8	23.8	--	--	--	--
Burley tobacco	.14	--	--	--	--	--
Grain corn	--	--	25.0	25.0	25.0	25.0
Red clover-timothy	--	14.1	--	--	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	60	47	--	--	--	--
Slaughter hogs Ia, head	--	--	10	11	849	849
Slaughter hogs IIa, head	--	--	157	162	1,000	1,000
Slaughter hogs IIIa, head	--	--	--	--	901	901
Farrow to finish, sows	--	76	157	157	73	73
<u>Buy and sell activities</u>						
Buy corn, bu.	--	6,970	14,180	14,077	19,396	19,396
Buy red clover, ton	32	--	--	--	--	--
Buy alfalfa, ton	29	40	--	--	--	--

TABLE XLIV (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	6,061	12,628	12,796	17,249	17,249
Sell red clover, ton	--	10	--	--	--	--
Net return to land, labor, capital, and management	\$31,806	\$42,398	\$68,257	\$98,952	\$163,346	\$234,250
Net return to land, operator labor, and management	\$15,678	\$23,865	\$50,453	\$81,111	\$142,051	\$212,322

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

grain corn and 27.8 acres of pasture for the sows. An additional 26,808 bushels of grain for swine feed would be purchased.

With swine prices at \$40.00 per cwt., no change occurred in the farm organization; however, with \$50.00 per cwt. for market hogs, the number of brood sows decreased from 157 to 73 and a purchased feeder pig enterprise was expanded to 2,750. This plan remained stable when the swine price was increased to \$60.00. Net revenues varied from \$15,678 when no swine were fed to a high of \$212,332 when a swine price of \$60.00 per cwt. was used. The variations in farm organization and net returns where the price of swine varied from \$30-60 per cwt. are shown in Table XLIV.

As shown in Table XLV, the marginal value products for a unit of land are very high when no swine are fed. The MVP for continuous cropland declined with increases in swine prices but exceeded usual cropland rental rates at all swine prices considered. These MVP's varied from \$567.00, when no swine were fed to \$67.24 when the price of market hogs was \$60.00 per cwt. Total cropland and pasture had an MVP of \$134.07 with no swine feeding and a value of \$35.58 with swine price at \$30.00 per cwt. This land class was not restrictive at higher swine prices. When no swine were fed, a surplus labor supply existed in each of the six labor periods. With swine included in the model at a sales price of \$30.00 per cwt., labor became more restrictive and exhausted in three labor periods. Additional labor in these periods would have had a value ranging from \$7.89 to \$15.90 per hour. As the price of swine was varied from \$35.00 to \$60.00 per cwt., labor was

TABLE XLV

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE FARM SIZE USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
<u>Land, per acre</u>				--Dollars--		
Continuous cropland	567.00	141.15	119.28	126.17	90.28	67.24
One-six year rotation	19.74	--	--	--	--	--
Total cropland and pasture	134.07	35.58	--	--	--	--
<u>Labor, per hour</u>						
January-February	--	--	7.40	25.96	53.99	80.32
March-April	--	7.89	7.51	--	--	--
May-June	--	--	8.89	25.25	51.73	61.36
July-August	--	--	4.38	.71	.71	.71
September-October	--	15.90	--	--	50.11	76.44
November-December	--	11.04	37.63	46.19	3.89	3.89
<u>Miscellaneous values</u>						
Slaughter hogs IIA, unit	--	--	--	--	.93	10.95

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

restrictive in five labor periods and the MVP's per hour of labor in the restrictive periods ranged from \$0.71 to \$80.32. With swine at \$60.00 per cwt., an additional unit of 50 purchased feeder pigs would have increased net returns by \$10.95 or 22 cents per slaughter hog.

Base Size Farm Using a Three-Man Labor Supply

With a total labor supply of 7,392 hours and no increase in available land, a dairy operation of 60 cows, the same as with a two-man labor supply, was included in the optimum plan when no swine were fed (Table XLVI). The cropping program included the production of 51.5 acres of silage, 8.7 acres of alfalfa hay, and 93.4 acres of pasture for the dairy. An additional 29 tons of alfalfa hay and 32 tons of red clover-timothy hay for the dairy would be purchased. An estimated net revenue of \$11,503 was generated in this plan.

An increase in the price of market hogs to \$30.00 per cwt. caused a decrease in the number of dairy cows from 60 to 45 head and the addition of 117 brood sows in a farrow to finish operation. As swine prices were increased to \$35.00 per cwt., the dairy was eliminated and the number of brood sows was increased to 194. Also, 195 purchased feeder pigs would be fed to slaughter weights.

When a price of \$50.00 per cwt. for swine was specified, the number of brood sows decreased to 114 head and purchased feeder pigs increased to 2,685 head. With a specialized swine operation, the cropping program included 25.0 acres of grain corn production and 19.4 acres of pasture to provide for the needs of brood sows. Also, 45,540 bushels of grain would be purchased for swine feed.

TABLE XLVI

OPTIMUM FARM ORGANIZATION FOR BASE FARM SIZE USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding		With Swine Feeding for Selected Swine Prices			
			Swine Price per CWT (Dollars)			
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Corn silage	26.6	25.0	--	--	--	--
Wheat silage	24.9	--	--	--	--	--
Permanent pasture	63.6	68.1	32.9	33.0	19.4	19.4
Summer pasture	29.8	22.6	--	--	--	--
Burley tobacco	.14	--	--	--	--	--
Alfalfa	8.7	--	4.3	--	--	--
Red clover-timothy	--	6.7	--	--	--	--
Grain corn	--	--	25.0	25.0	25.0	25.0
<u>Livestock enterprises</u>						
Grade A dairy, cows	60	45	--	--	--	--
Slaughter hogs I ^a , head	--	--	11	11	809	809
Slaughter hogs II ^a , head	--	--	184	202	1,000	1,000
Slaughter hogs III ^a , head	--	--	--	--	876	876
Farrow to finish, sows	--	117	194	194	114	114
<u>Buy and sell activities</u>						
Buy corn, bu.	--	10,785	17,856	17,954	23,116	23,116
Buy red clover, ton	32	7	--	--	--	--
Buy alfalfa, ton	29	45	--	--	--	--

TABLE XLVI (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	9,378	14,568	15,686	19,492	19,492
Buy milo, bu.	--	--	--	--	2,932	2,932
Sell alfalfa, ton	--	--	15	--	--	--
Net return to land, labor, capital, and management	\$31,806	\$50,217	\$83,402	\$121,257	\$200,511	\$285,651
Net return to land, operator labor, and management	\$11,503	\$25,717	\$59,452	\$ 97,172	\$172,888	\$257,410

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

Estimated net returns to land, operator labor, and management reached a level of \$257,410 at the \$60.00 swine price. The optimum plans and net returns for each price situation is shown in Table XLVI.

The marginal value products for the restricting resources associated with the optimum farm plans are shown in Table XLVII. Land was very restrictive at low swine prices while labor became the major restriction at the price of market hogs was increased.

The MVP for continuous cropland ranged from a high of \$567.00 per acre when no swine were fed to a low of \$69.24 per acre when the market price for swine was \$60.00 per cwt. These values are considerably higher than the expected rental rate for this class of land. Total cropland and pasture had an MVP of \$134.07 per acre when no swine were produced. Labor was not a restricting factor in any time period. With swine permitted in the farm plan, labor was utilized more fully. With \$30.00 per cwt. for swine, the labor was restrictive in three labor periods with MVP values ranging from \$0.31 to \$18.09. Further increases in swine price increased the MVP for labor in five labor periods. With \$60.00 per cwt. for swine, the MVP's per hour of labor ranged from \$0.71 to \$80.22 in restrictive periods. Only in the March-April period was labor not restrictive. An MVP of 10.95 was obtained for a 50-pig unit of feeder pigs in the summer feeding period.

Medium Size Farm Using Operator Labor

A medium size farm in Area III was twice the size of the base farm and included 50 acres of continuous cropland, 90 acres of rotational

TABLE XLVII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR BASE FARM SIZE USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre				--Dollars--		
Continuous cropland	567.00	106.99	129.80	126.17	90.28	67.24
1-6 year rotation	19.74	--	--	--	--	--
Total cropland and pasture	134.07	48.08	--	--	--	--
Labor, per hour						
January-February	--	--	10.85	25.95	53.99	80.32
March-April	--	16.07	3.36	--	--	--
May-June	--	--	4.00	24.24	51.73	61.36
July-August	--	--	11.44	.71	.71	.71
September-October	--	.31	--	--	50.11	76.44
November-December	--	18.09	36.98	46.19	3.89	3.89
Miscellaneous values						
Slaughter hogs IIa, unit	--	--	--	--	.93	10.95

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

cropland, and 118 acres of land suitable only for permanent pasture. When swine feeding was not permitted, the optimum plan included 36.2 acres of grain corn, approximately 15 acres of silage corn, 6.5 acres of alfalfa hay, 24.6 acres of red clover-timothy hay and more than 175 acres of permanent pasture (Table XLVIII). The livestock program would include 26 Grade "A" dairy cows and 161 steers "backgrounded" to 700 pounds.⁶

When swine were permitted and a price of \$30.00 per cwt. was specified, only slight changes occurred in the optimal plans. Forty purchased feeder pigs would now be fed to slaughter weights and net returns would increase slightly. With a swine price of \$35.00 per cwt., the dairy was eliminated from the optimum plan, the number of steers was reduced from 161 to 21, a herd of 71 brood sows in a farrow to finish operation would be maintained and 43 purchased feeder pigs would be fed to slaughter weights. The cropping program would include 30.4 acres of grain corn, 3.4 acres of red clover-timothy hay, 19.6 acres of wheat-soybeans and 33.6 acres of sow pasture. An additional 9,501 bushels of wheat and corn would be purchased for swine feed, while 50.6 bushels of soybeans would be sold as a cash crop.

With an increase in the swine price to \$40.00 per cwt., the number of sows increased to 74 and purchased feeder pigs increased to 56 head. The steers and red clover-timothy were eliminated and

⁶Because of the high fixed costs associated with a Grade "A" dairy, in many cases a 26-cow unit would be too small to be a practicable unit.

TABLE XLVIII

OPTIMUM FARM ORGANIZATION FOR MEDIUM SIZE FARM USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price Per CWT (Dollars)				
	0	30	35	40	50	60
<u>Crop enterprises, acres</u>						
Grain corn	36.2	36.2	30.4	27.9	50.0	50.0
Corn silage	14.9	14.9	--	--	--	--
Alfalfa	6.5	6.5	--	--	--	--
Red clover-timothy	24.6	24.6	3.4	--	--	--
Permanent pasture	128.4	128.4	33.6	12.6	--	--
Summer pasture	13.1	13.1	--	--	--	--
Winter pasture	33.9	33.9	--	--	--	--
Wheat-soybeans	--	--	19.6	15.0	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	26	26	--	--	--	--
Steers, head	161	161	21	--	--	--
Slaughter hogs Ia, head	--	40	--	--	792	792
Slaughter hogs IIa, head	--	--	43	56	844	844
Slaughter hogs IIIa, head	--	--	--	--	772	772
Farrow to finish, sows	--	--	71	74	--	--
<u>Buy and sell activities</u>						
Sell corn, bu.	2,772	2,344	--	--	--	--
Buy alfalfa, ton	3	3	--	--	--	--
Buy wheat, bu.	--	--	5,135	5,052	11,556	11,556

TABLE XLVIII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price Per CWT (Dollars)				
	0	30	35	40	50	60
Buy corn, bu.	--	--	4,366	4,898	8,760	8,760
Buy milo, bu.	--	--	--	--	62	62
Sell soybeans, bu.	--	--	506	390	--	--
Net return to land, labor, capital, and management	\$28,100	\$28,157	\$37,515	\$51,704	\$85,364	\$123,402
Net return to land, operator labor, and management	\$23,590	\$23,590	\$33,107	\$47,459	\$77,778	\$115,362

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

corn, wheat-soybeans, and pasture acreage were reduced. With \$50.00 per cwt. swine prices, all sows were eliminated in the optimum plan and the livestock program shifted to purchasing feeder pigs and feeding to a slaughter weight. In this system, 2,408 pigs would be fed. Fifty acres of corn would be produced and the remaining grain requirement of 20,378 bushels of wheat, corn, and milo would be purchased. No change in the optimum plan occurred with the maximum swine price considered (\$60.00 per cwt). The estimated net return to land, operator labor, and management varied from \$33,590 without swine to \$115,362 when swine were permitted with a market value of \$60.00 per cwt. (Table XLVIII).

With the land-labor ratio used in this situation, labor was very restrictive relative to all land classes except continuous cropland. The marginal value products for continuous cropland varied from \$110.76 to \$64.32 per acre and for all swine prices, well above an expected rental rate of \$48.00 per acre (Table XLIX). Total cropland and pasture had a MVP of \$5.99 and \$8.19 per acre, respectively, where no swine were fed and when swine were priced at \$30.00 per cwt. The MVP's for this land class were zero at higher swine prices.

Without swine feeding, the MVP's for labor varied from \$6.17 to \$22.15 per hour for the last six months of the year. With swine at \$30.00 per cwt., these values range from \$2.84 to \$21.57 for four labor periods. In January-February and May-June periods labor was not a restrictive resource. As the price of swine increased to \$35.00, the MVP for labor varied from \$4.07 to \$31.61 for the restricting periods.

TABLE XLIX
MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING OPERATOR LABOR WITH
AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Land, per acre				--Dollars--		
Continuous cropland	110.76	103.84	96.62	74.94	90.02	64.32
Total cropland and pasture	5.99	8.19	--	--	--	--
Labor, per hour						
January-February	--	--	--	3.92	53.99	52.03
March-April	--	2.84	17.57	26.45	--	--
May-June	--	--	13.66	25.96	52.46	52.03
July-August	13.49	12.78	--	--	--	--
September-October	22.15	21.57	4.07	--	50.11	46.89
November-December	6.17	4.34	31.61	41.79	3.88	5.14

At \$50.00 per cwt. for swine, the MVP's varied from \$3.88 to \$53.99 per hour for the restrictive periods and at \$60.00 varied from \$51.40 to \$52.03 for the same periods.

Medium Size Farm Using a Two-Man Labor Supply

When an additional 3,000 hours of labor were added to the land resource base of 258 acres of openland, a 84-cow Grade "A" dairy operation supplemented with 63 beef steers became the optimum farm organization for the situation excluding swine as an alternative (Table L). Corn silage, red clover-timothy hay and pasture would be produced for the livestock enterprises. An additional 102 tons of hay would be purchased for feeding the livestock. An estimated net return of \$30,263 would be generated with this farm organization.

Only a slight change in the optimal farm organization occurred when swine prices were \$30.00 per cwt.; however, at \$35.00 per cwt. for swine, both the dairy and beef steers were eliminated from the plan and replaced by 156 brood sows in a farrow to finish operation. The cropping system included the production of 33.5 acres of corn, 16.5 acres of wheat-soybeans and 26.4 acres of pasture for the brood sows. When the swine price was increased to \$40.00 per cwt., the number of brood sows increased to 155 and 103 purchased feeder pigs were included in the optimum plan. The corn acreage was reduced from 33.5 to 26.9 acres, while wheat-soybeans were increased from 16.5 to 23.0 acres.

When the price of swine was raised to \$50.00 and \$60.00 per cwt., a sharp increase in the number of purchased feeder pigs was noted and

TABLE L

OPTIMUM FARM ORGANIZATION FOR MEDIUM FARM SIZE USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	2.1	2.1	33.5	26.9	50.0	50.0	
Corn silage	27.9	27.9	--	--	--	--	
Red clover-timothy	19.2	19.2	--	--	--	--	
Permanent pasture	139.7	139.7	26.4	26.4	12.2	12.2	
Summer pasture	41.9	41.9	--	--	--	--	
Winter pasture	7.2	7.2	--	--	--	--	
Wheat-soybeans	--	--	16.5	23.0	--	--	
<u>Livestock enterprises</u>							
Grade A dairy, cows	84	84	--	--	--	--	
Steers, head	63	63	--	--	--	--	
Slaughter hogs Ia, head	--	5	--	31	864	864	
Slaughter hogs IIa, head	--	--	103	104	1,000	1,000	
Slaughter hogs IIIa, head	--	--	--	--	886	886	
Farrow to finish, sows	--	--	156	155	72	72	
<u>Buy and sell activities</u>							
Sell corn, bu.	143	95	--	--	--	--	
Buy red clover, ton	18	18	--	--	--	--	
Buy alfalfa, ton	84	84	--	--	--	--	

TABLE L (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy corn, bu.	--	--	12,177	12,852	17,195	17,195
Sell soybeans, bu.	--	--	429	599	--	--
Buy wheat, bu.	--	--	12,282	12,156	17,758	17,758
Buy milo, bu.	--	--	--	--	1,622	1,622
Net return to land, labor, capital, and management	\$49,261	\$49,268	\$70,849	\$100,884	\$165,597	\$235,926
Net return to land, operator labor, and management	\$30,263	\$30,263	\$53,078	\$ 82,947	\$144,131	\$213,837

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

the number of brood sows decreased from 155 to 72 head. All 50 acres of the continuous cropland was used to produce grain corn and in addition more than 36,000 bushels of grain were purchased. The optimal plans for a medium size farm with a two-man labor supply are shown in Table L. The addition of a second man increased the size of the enterprises, thus the net revenue; however, the organization of the enterprises remained essentially the same as for an owner-operator situation.

The marginal value products for the most restricting resources are given in Table LI. The MVP's for continuous cropland are higher than the expected rental rate for such land in each of the optimum plans with varying swine price. The values range from \$112.27 to \$60.72 per acre. The value of the marginal product for total cropland was relatively low when no swine were fed and when swine were priced at \$30.00 per cwt.

The MVP's for labor were higher than the wage rate for certain periods at all swine price levels. When no swine were permitted, these values were \$11.69, \$20.45, and \$10.20 for the July-August, September-October, and November-December labor periods, respectively. When swine were priced at \$30.00 per cwt., the MVP for January-February labor was \$2.87 per hour. With a swine price from \$35.00 to \$60.00 per cwt., labor was restrictive in four production periods and MVP's ranged from \$3.88 to \$80.32.

Medium Size Farm Using a Three-Man Labor Supply

With the addition of a second hired man to the labor supply (Table LII), a specialized dairy operation consisting of 104 Grade "A"

TABLE LI
MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM SIZE FARM USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
Land, per acre							
Continuous cropland	111.91	112.27	80.91	45.79	89.45	60.72	
Total cropland and pasture	5.02	5.18	--	--	--	--	
Labor, per hour							
January-February	--	2.37	--	--	53.99	80.32	
March-April	--	--	23.15	36.82	--	--	
May-June	--	--	13.65	26.97	53.99	80.32	
July-August	11.69	11.54	--	--	--	--	
September-October	20.45	20.57	16.91	21.43	50.10	76.44	
November-December	10.20	7.86	13.19	12.90	3.89	3.88	

TABLE LII

OPTIMUM FARM ORGANIZATION FOR MEDIUM FARM SIZE USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Corn enterprises, acres</u>							
Corn silage	53.4	50.0	--	--	--	--	--
Alfalfa	16.8	--	--	--	--	--	--
Wheat silage	19.8	13.8	--	--	--	--	--
Red clover-timothy	17.9	22.9	--	--	--	--	--
Permanent pasture	118.0	137.6	32.7	32.7	19.2	19.2	19.2
Summer pasture	51.9	47.4	--	--	--	--	--
Grain corn	--	--	33.2	31.4	50.0	50.0	50.0
Wheat-soybeans	--	--	16.8	18.6	--	--	--
<u>Livestock enterprises</u>							
Grade A dairy, cows	104	95	--	--	--	--	--
Steers, head	7	33	--	--	--	--	--
Slaughter hogs I ^a , head	--	--	18	29	824	824	824
Slaughter hogs II ^a , head	--	--	127	155	1,000	1,000	1,000
Slaughter hogs III ^a , head	--	--	--	--	861	861	861
Farrow to finish, sows	--	22	192	192	113	113	113
<u>Buy and sell activities</u>							
Buy red clover, ton	14	6	--	--	--	--	--
Buy alfalfa, ton	45	95	--	--	--	--	--
Buy corn, bu.	--	2,067	16,492	16,158	20,609	20,609	20,609

TABLE LII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	1,798	14,808	15,532	20,279	20,279
Buy milo, bu.	--	--	--	--	2,184	2,184
Sell soybeans, bu.	--	--	437	483	--	--
Net return to land, labor, capital, and management	\$57,367	\$57,833	\$86,141	\$123,430	\$202,766	\$287,330
Net return to land, operator labor, and management	\$31,853	\$32,010	\$62,157	\$ 99,302	\$175,164	\$259,111

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

dairy cows was the most profitable farm organization when swine were excluded as an alternative. All the cropland would be utilized to supply the forage needs of the dairy and an additional 69 tons of hay would need to be purchased for the livestock. The estimated net returns to land, operator labor, and management were \$31,852 with the assumed labor and land, and no swine feeding permitted.

At a swine price of \$30.00 per cwt., the number of dairy cows was reduced to 95 head and 22 brood sows were added in the optimal farm organization. Also included were 33 steers to be "backgrounded" to 700 pounds. Silage, pasture, and a part of the hay requirements would be produced for the livestock with 100 tons of alfalfa and red clover and timothy purchased for the dairy herd and steers. At \$35.00 swine prices, the dairy and steers were eliminated and replaced by 192 brood sows in a farrow to finish operation and 145 head of feeder pigs would be purchased and fed to a weight of 230 pounds. The cropping program included 33.2 acres of grain corn, 16.8 acres of wheat-soybeans, and 32.7 acres of sow pasture. The expanded number of swine would require the purchase of 31,300 bushels of corn and wheat.

With \$40.00 per cwt. for swine, the number of sows remained the same, the number of purchased feeder pigs increased to 184 and the cropping systems changed only slightly. With swine prices at \$50.00 and \$60.00 per cwt., respectively, the number of sows was reduced from 192 to 113 while purchased feeder pigs increased from 184 to 2,685. The 50 acres of continuous cropland was utilized for corn production and 19.2 acres of sow pasture was used. The remaining grain for the swine

would be purchased. The net returns to land, operator labor, and management ranged from \$131,853 with \$30.00 per cwt. for swine to \$259,111 when market hogs had a sales price of \$60.00 per cwt. Optimum farm plans where no swine were considered and for various levels of swine prices are shown in Table LII.

The marginal value products for the restricting resources are shown in Table LIII. With no swine feeding permitted, the MVP for continuous cropland was more than \$200 per acre. Returns to additional acres of continuous cropland was above \$65.00 per acre for all levels of swine price. When no swine feeding was permitted labor was restrictive in only two of the labor periods, while labor was restrictive in four of the labor periods when swine prices were \$60.00 per cwt. The range of MVP's for labor in restrictive periods varied from \$1.44 per hour to \$80.33. With swine priced at \$30.00 per cwt., labor was restrictive in the May-June, July-August, and September-October labor periods, while with \$35.00 per cwt., labor was restrictive in all periods except January and February. At swine prices of \$40.00, \$50.00, and \$60.00, labor was restrictive in four production periods in each case.

Large Size Farm Using Operator Labor

The land resource base for the large farm was increased to three times the base size farm. It included 75 acres of continuous cropland, 135 acres of rotational land and 177 acres of permanent pasture. With the one-man labor supply on 387 acres of openland, labor was quite

TABLE LIII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR MEDIUM FARM SIZE USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
	0	30	35	40	50	60	
Land, per acre			--Dollars--				
Continuous cropland	218.23	180.44	99.92	74.94	90.02	66.97	
Total cropland	3.50	--	--	--	--	--	
Total cropland and pasture	28.52	19.48	--	--	--	--	
Labor, per hour							
January-February	--	--	--	3.92	53.99	80.33	
March-April	--	--	16.39	26.45	--	--	
May-June	6.15	1.44	12.29	25.96	52.46	62.09	
July-August	--	7.96	1.50	--	--	--	
September-October	24.91	25.70	2.54	--	50.11	76.44	
November-December	--	--	34.15	41.80	3.88	3.88	
Other restrictions							
Slaughter hogs II ^a , unit	--	--	--	--	.92	10.94	

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

limited relative to land and only a very small dairy herd was included in the optimal plan when swine was an excluded alternative. The major enterprises for the plan in the situation were cash grain and 294 beef steers utilizing the available forage and pasture (Table LIV). The net income to land, operator labor, and management for this plan was \$25,869.

When swine prices were increased to \$30.00 per cwt., the plan remained essentially unchanged except for the addition of 64 purchased pigs to be finished to slaughter weight and some reduction in cash grain sales. With swine prices at \$35.00 per cwt., the dairy cows were eliminated and the number of steers decreased from 294 to 47 head. These livestock were replaced by 64 brood sows in a farrow to finish swine operation. All 75.0 acres of the continuous cropland was used to produce grain corn and wheat for the swine and soybeans for sale, while the amount of permanent pasture was reduced from 177.0 to 58.3 acres. More than 6,500 bushels of grain would be purchased.

With \$40.00 per cwt. for swine the remaining 47 steers were dropped from the plan and the sows were increased to 70 head. Grain purchases would also be increased to 7,823 bushels. With \$50.00 per cwt. for swine, the swine operation shifted from a farrow to finish system to a feeding operation with purchased feeder pigs. The optimal plan changed only slightly when swine price was increased to \$60.00 and included 53 acres of grain corn, purchase of 20,079 bushels of wheat and corn, and 2,402 purchased pigs fed to slaughter weight. The net return to land, operator labor, and management was \$115,445 at the \$60.00

TABLE LIV

OPTIMUM FARM ORGANIZATION FOR LARGE FARM SIZE USING OPERATOR LABOR WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
		0	30	35	40	50
<u>Crop enterprises, acres</u>						
Grain corn	70.1	70.1	45.5	39.8	52.9	52.9
Corn silage	6.0	6.0	--	--	--	--
Alfalfa	5.9	5.9	--	--	--	--
Red clover-timothy	50.6	50.6	7.6	--	--	--
Permanent pasture	177.0	177.0	58.3	11.9	--	--
Summer pasture	5.3	5.3	--	--	--	--
Winter pasture	71.9	72.0	--	--	--	--
Wheat-soybeans	--	--	29.5	19.4	--	--
Wheat-milo	--	--	--	15.8	22.1	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	11	11	--	--	--	--
Steers, head	294	294	47	--	--	--
Slaughter hogs I ^a , head	--	64	32	--	792	792
Slaughter hogs II ^a , head	--	--	--	61	811	842
Slaughter hogs III ^a , head	--	--	--	--	742	768
Farrow to finish, sows	--	--	64	70	--	--
<u>Buy and sell activities</u>						
Sell corn, bu.	5,353	4,671	--	--	--	--
Sell red clover, ton	39	39	--	--	--	--
Buy corn, bu.	--	--	2,430	3,606	8,197	8,501

TABLE LIV (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	--	4,099	4,217	8,942	11,578
Buy milo, bu.	--	--	--	--	803	--
Sell soybeans	--	--	768	505	--	--
Net return to land, labor, capital, and management	\$31,402	\$31,493	\$39,538	\$52,848	\$86,275	\$123,574
Net return to land, operator labor, and management	\$25,869	\$25,869	\$35,392	\$48,510	\$78,693	\$115,445

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

swine price. The optimum plans for the large farm and one-man labor supply are shown in Table LIV.

The marginal value products of the restricting resources for the optimal farm organizations are shown in Table LV. When no swine production was permitted, the MVP's for continuous and total cropland was \$112.37 and \$5.64 per acre, respectively. Labor was restrictive during the last six months of the year and the MVP varied from \$9.54 per hour in the July-August period to \$18.52 per hour in the November-December period.

With the swine price increased to \$35.00 per cwt., the MVP for continuous cropland remained above the expected rental rate while total cropland had a zero marginal value product. With the increased swine production, labor became more restrictive and the MVP's for labor varied from \$13.19 to \$23.15 per hour in four labor periods. With \$50.00 per cwt. for swine, continuous cropland had an MVP of \$29.55 per acre, while labor was restrictive in five periods, and MVP values ranged from \$3.89 to \$53.99 per hour. At \$60.00 swine prices the MVP for an acre of continuous cropland became zero, and surplus labor occurred in July, August, November, and December. For the remaining four labor periods the MVP's for labor ranged from \$29.62 to \$80.32 per hour.

Large Size Farm Using a Two-Man Labor Supply

With the addition of a second man to the labor supply, the optimum farm plan when no swine are fed, included a 68-cow Grade "A" dairy and

TABLE LV

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE FARM SIZE USING OPERATOR LABOR
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
--Dollars--						
Land, per acre						
Continuous cropland	112.37	112.37	80.91	45.79	29.55	--
Total cropland	5.64	6.01	--	--	--	--
Labor, per hour						
January-February	--	2.37	--	--	28.65	55.63
March-April	--	--	23.15	36.82	30.41	29.62
May-June	--	--	13.65	26.97	53.99	80.32
July-August	9.54	9.42	--	--	--	--
September-October	15.83	15.84	16.91	21.43	50.11	80.32
November-December	18.52	16.27	13.19	12.90	3.89	--

193 beef steers (Table LVI). Thirty-seven acres of grain corn would be produced and the corn would be sold. The remaining 81 acres of cropland and 269 acres of pasture would be utilized in the production of forage for the livestock. Fifty-three tons of alfalfa hay would also be purchased for the dairy cows. A net return to land, operator labor, and management of \$33,335 could be obtained with this farm organization.

With swine prices of \$30.00 per cwt., the dairy and steer numbers remained the same, but was supplemented with 59 purchased feeder pigs. The cropping program remained unchanged; however, the amount of corn sold was reduced by 626 bushels to provide grain for the slaughter hogs. With a swine price of \$35.00 per cwt., the dairy operation was replaced by 151 brood sows in a farrow to finish operation supplemented with 96 purchased feeder pigs. The number of steers were reduced from 193 to 17. All 75 acres of continuous cropland was used to produce grain corn, and double cropped wheat and soybeans. Pasture acreage decreased from 269.2 to 42.5 acres. Grain purchased included 10,688 bushels of corn and 11,308 bushels of wheat. With \$40.00 per cwt. for swine, the steers were eliminated from the optimal plan and slight changes occurred in swine numbers as well as in the acreages of the crops produced.

At \$50.00 and \$60.00 per cwt. for swine, the number of brood sows was reduced from 152 to 70 head and the number of purchased feeder pigs to be fed to slaughter weight increased to 2,757. The grain corn acreage increased to 70.2 acres and permanent pasture was reduced to

TABLE LVI

OPTIMUM FARM ORGANIZATION FOR LARGE SIZE FARM USING A TWO MAN LABOR SUPPLY WITH AND WITHOUT
SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices					
		Swine Price per CWT (Dollars)					
		0	30	35	40	50	60
<u>Crop enterprises, acres</u>							
Grain corn	36.7	36.5	45.7	43.7	70.2	70.2	70.2
Corn silage	38.9	38.9	--	--	--	--	--
Alfalfa	4.4	4.4	--	--	--	--	--
Red clover - timothy	37.5	37.5	2.7	--	--	--	--
Permanent pasture	195.2	195.2	42.5	25.9	11.9	11.9	11.9
Summer pasture	34.1	34.1	--	--	--	--	--
Winter pasture	39.9	39.9	--	--	--	--	--
Wheat-soybeans	--	--	29.3	25.6	--	--	--
Wheat-milo	--	--	--	5.7	4.8	4.8	4.8
<u>Livestock enterprises</u>							
Grade A dairy, cows	68	68	--	--	--	--	--
Steers, head	193	193	17	--	--	--	--
Slaughter hogs I ^a , head	--	59	--	--	883	883	883
Slaughter hogs II ^a , head	--	--	96	107	1,000	1,000	1,000
Slaughter hogs III ^a , head	--	--	--	--	874	874	874
Farrow to finish, sows	--	--	151	152	70	70	70
<u>Buy and sell activities</u>							
Sell corn, bu.	2,812	2,186	--	--	--	--	--
Buy alfalfa, ton	53	53	--	--	--	--	--
Buy corn, bu.	--	--	10,668	11,089	15,442	15,442	15,442

TABLE LVI (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Buy wheat, bu.	--	--	11,308	11,238	17,596	17,596
Buy red clover, ton	--	--	3	--	--	--
Buy milo, bu.	--	--	--	--	1,195	1,195
Sell soybeans, bu.	--	--	761	666	--	--
Net return to land, labor, capital, and management	\$52,755	\$52,839	\$73,008	\$102,225	\$167,564	\$237,297
Net return to land, operator labor, and management	\$33,335	\$33,335	\$55,148	\$ 84,445	\$146,037	\$215,209

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

11.9 acres. To meet the feed requirements for the swine operation, a total of 34,233 bushels of corn, wheat, and milo would be purchased. The enterprise combinations and net returns are shown in Table LVI. Net returns varied from \$33,335 with a \$30.00 per cwt. to \$215,209 when swine could be sold for \$60.00 per cwt.

The marginal value products for the restricting resources are shown in Table LVII. When no swine were fed, continuous cropland and labor in the July-December labor periods were very restrictive. An additional acre of continuous cropland had an MVP of \$111.91 while total cropland and pasture had an MVP of only \$5.02 per acre. Labor in the last six months had MVP's ranging from \$10.20 to \$20.45 per hour. With a price of \$30.00 per cwt. for swine, the land-labor use changed only slightly, thus the MVP's remained almost constant. An increase to \$35.00 per cwt. for swine caused a drop in the MVP of continuous cropland to \$80.91 per acre while the value for total cropland and pasture became zero. In this situation 267 acres of total land was left idle. Labor was restrictive in each labor period except the January-February and July-August periods. The MVP of labor in the restrictive periods varied from \$13.19 to \$23.15 per hour.

As swine prices increased from \$40.00 to \$60.00 per cwt., the MVP for continuous cropland decreased from \$47.35 to \$8.10 per acre. The amount of total land left idle increased from 286 to 300 acres. Labor was not restrictive for the July-August period for swine prices of \$35.00 per cwt. and above. During this period 16 to 30 hours of surplus labor occurred in the optimal farm organization.

TABLE LVII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE FARM SIZE USING A TWO MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Dollars						
Land, per acre						
Continuous cropland	111.91	112.27	80.91	47.35	34.87	8.10
Total cropland and pasture	5.02	5.18	--	--	--	--
Labor, per hour						
January-February	--	2.37	--	--	29.91	54.62
March-April	--	--	23.15	36.06	28.89	30.85
May-June	--	--	13.66	25.96	47.65	56.95
July-August	11.69	11.54	--	--	--	--
September-October	20.45	20.58	16.91	21.14	50.10	76.44
November-December	10.20	7.86	13.19	14.96	3.88	3.88
Miscellaneous values						
Slaughter hogs IIA, unit	--	--	--	--	3.81	14.02

^aUnits of 50 head bought as feeder pigs and fed to 230 pounds.

Large Size Farm Using a Three-Man Labor Supply

Changes occurring in the optimal farm organizations when a third man was added to the fixed resource base are shown in Table LVIII. When no swine were fed, the size of the dairy increased from 68 to 95 cows while the number of steers decreased from 193 to 148 when compared to the two-man labor situation. Approximately, 21 acres of grain corn were produced for sale. In addition 54.3 acres of corn silage, 36.6 acres of red clover-timothy hay, 200.1 acres of permanent pasture, and 75.3 acres of temporary pasture would be produced to provide the forage needed for the dairy cows and steers. An additional 99 tons of hay would need to be purchased. All the land resources would be utilized with this plan; however, 130 hours of surplus labor would be available from January through June. This farming system would generate an estimated \$36,588 to land, operator labor, and management.

With a swine price of \$30.00 per cwt. for market hogs, essentially no changes occurred in the plan. Forty-three purchased feeder pigs were to be fed to slaughter weights and the amount of corn for sale was reduced. With \$35.00 per cwt. for hogs, the dairy operation was eliminated and the number of steers was reduced to 6 head. A farrow to finish swine herd of 189 head became the major livestock enterprise supplemented by 130 purchased feeder pigs. Grain corn production increased to 45.8 acres and 29.2 acres of wheat-soybeans would be produced. Permanent pasture acreage was reduced from 200.1 to 38.2 acres. A large amount (29,072 bushels) of wheat and corn would be purchased to support the swine operation. Only minor changes occurred in the plan as the price of swine was increased to \$40.00 per cwt.

TABLE LVIII

OPTIMUM FARM ORGANIZATION FOR LARGE FARM SIZE USING A THREE MAN LABOR SUPPLY WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
		0	30	35	40	50
<u>Crop enterprises, acres</u>						
Grain corn	20.7	20.7	45.8	45.1	75.0	75.0
Corn silage	54.3	54.2	--	--	--	--
Red clover-timothy	36.6	36.6	1.0	--	--	--
Permanent pasture	200.1	200.1	38.2	32.3	18.9	18.9
Summer pasture	47.5	47.5	--	--	--	--
Winter pasture	27.8	28.0	--	--	--	--
Wheat-soybeans	--	--	29.2	27.9	--	--
<u>Livestock enterprises</u>						
Grade A dairy, cows	95	95	--	--	--	--
Steers, head	148	148	6	--	--	--
Slaughter hogs I ^a , head	--	43	--	--	841	841
Slaughter hogs II ^a , head	--	--	130	133	1,000	1,000
Slaughter hogs III ^a , head	--	--	--	--	847	847
Farrow to finish, sows	--	--	189	190	111	111
<u>Buy and sell activities</u>						
Sell corn, bu.	1,560	1,102	--	--	--	--
Buy red clover, ton	4	4	--	--	--	--
Buy alfalfa, ton	95	95	--	--	--	--

TABLE LVIII (Continued)

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Sell soybeans, bu.	--	--	758	725	--	--
Buy corn, bu.	--	--	14,454	14,603	18,657	18,657
Buy wheat, bu.	--	--	14,618	14,594	20,432	20,432
Buy milo, bu.	--	--	--	--	1,593	1,593
Net return to land, labor, capital, and management	\$62,566	\$62,628	\$88,485	\$125,048	\$204,879	\$288,856
Net return to land, operator labor, and management	\$36,588	\$36,588	\$64,442	\$101,055	\$177,248	\$260,692

^a Slaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

With \$50.00 and \$60.00 per cwt. for swine, the number of sows was reduced to 111 head and the purchased feeder pigs increased to 2,688 head. The 75 acres of continuous cropland would be used for grain corn production and 18.9 acres of land would be used for sow pasture. A total of 40,682 bushels of corn, milo, and wheat would be purchased. Net returns to land, operator labor, and management increased from \$36,588 with swine prices at \$30.00 per cwt. to \$260,692 when these prices were increased to \$60.00 per cwt.

Marginal value products for the restricting resources in the optimum plans shown in Table LVIII are presented in Table LIX. When swine prices were specified at zero and \$30.00 per cwt., continuous cropland had a marginal value product exceeding \$100 per acre while the MVP's for total land were \$5.99 and \$8.19 per acre. As the swine price ranged from \$35.00 to \$60.00 per cwt., the value for continuous cropland decreased from \$80.91 to \$8.11 per acre. Total cropland and pasture had no value in increasing returns to the operation with this range of swine prices, since 267 to 300 acres of such land was not used in the optimum farm organization.

Labor was very restrictive in some labor periods. Without swine production, MVP's for labor varied from \$6.17 to \$13.49 and \$22.15 per hour for the July-December labor periods. With \$30.00 per cwt. for swine, only minor changes occurred in these values; however, labor was also exhausted in the March-April period.

With swine prices ranging from \$35.00 to \$60.00 per cwt., labor was restrictive in at least four production periods. The MVP's

TABLE LIX

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR LARGE FARM SIZE USING A THREE MAN LABOR SUPPLY
WITH AND WITHOUT SWINE FEEDING AND VARYING SWINE PRICE FROM \$30-60 PER CWT--AREA III

	Without Swine Feeding	With Swine Feeding for Selected Swine Prices				
		Swine Price per CWT (Dollars)				
	0	30	35	40	50	60
Dollars						
Land, per acre						
Continuous cropland	110.73	103.84	80.91	47.35	34.85	8.11
Total cropland and pasture	5.99	8.19	--	--	--	--
Labor, per hour						
January-February	--	--	--	--	29.91	54.62
March-April	--	2.84	23.15	36.06	28.89	30.85
May-June	--	--	13.70	25.96	47.65	56.95
July-August	13.49	12.78	--	--	--	--
September-October	22.15	21.57	16.91	21.14	50.10	76.44
November-December	6.17	4.33	13.19	14.97	3.89	3.89
Miscellaneous values						
Slaughter hogs II ^a , unit	--	--	--	--	3.81	14.02

^a Units of 50 head bought as feeder pigs and fed to 230 pounds.

varied from \$3.89 to \$76.44 during these labor periods. Labor was not a restricting resource in the July-August labor period with swine prices of \$35.00 per cwt. and above. Also the 1,000 head restriction on purchased feeder pigs during the May-August production period was effective when swine prices were \$50.00 and \$60.00 per cwt. The MVP's for additional hog units were small (\$3.81 and \$14.02 per 50 hogs) and an additional unit would contribute little to net revenue.

CHAPTER VI

RESULTS OF THE ANALYSIS ON SELECTED EFFICIENCY FACTORS AND THEIR EFFECT ON ON POTENTIAL FARM INCOME

A. INTRODUCTION

In this chapter comparisons of the effect of variation in efficiency factors of production on the optimum farm organization and net returns are made for a "representative" farm. Three factors considered were costs of grain, number of pounds of pork produced per sow, and amount of feed required to produce a pound of pork.

In the basic model a "representative" farm and resource situation were developed for each of the three study areas to account for the varying amounts of land available in each land class, the alternative enterprises, and differences in grain costs in each of the three regions. As shown in the preceding chapter the crop and livestock mix in the optimal farm organizations were similar across the areas. On this basis, the "representative" farm for the analysis of efficiency factors was modified so that the acreage in each land classification was based on the average for the three study areas.

The "representative" farm included 149.0 acres of openland distributed as follows: 45 acres of continuous cropland, 26.3 acres of 1-3 year rotational land, and 16 acres of 1-6 year rotation land, and 61.7 acres of permanent pasture. Tobacco and cotton were excluded

as enterprise alternatives. Double cropped wheat and soybean acreage were restricted to 32 acres.

The average available labor reported on 225 Resource Management swine farms from 1969 to 1973 was 1.6 man equivalents or 4,898 hours. This was used as the labor restriction for the "representative" farm in this model. In the models analyzed in Chapter V three levels of labor (3,000, 6,000, and 7,293 hours) were assumed.

Since the variables being analyzed in the model are directly related to swine production, no dairy was considered in the model. Livestock alternatives considered were two beef (cow-calf) operations, four steer systems, and a feeder pig operation.

B. THE EFFECTS OF VARYING THE PRICE OF CORN
ON NET REVENUE FROM SWINE PRODUCTION
AND OPTIMUM FARM ORGANIZATIONS

Since feed costs account for 60 to 90 percent of the total costs of finishing swine to market weight and corn or other grain amounts to 60 to 70 percent of the total cost of the ration, profitability of swine production is heavily influenced by grain prices. An individual farm operator cannot control the market price of grain; however, he can take actions which may reduce his costs. These actions include the acquiring of grain storage facilities, and the purchase of annual grain needs during grain harvesting periods when seasonal lows normally occur. Grain cost may also be affected by buying in volume at reduced costs.

A comparison of net revenue from a farrow to finish swine operation and the purchase of pigs at a weight of 45 pounds and fed to a slaughter weight of 230 pounds was made with the price of corn varying from \$1.50 to \$4.00 per bushel. These comparisons are shown in Table LX. Swine budgets developed by Ray and Walch [29] were modified to account for differences in grain prices.

Swine prices were held constant at \$35.00 per cwt. for slaughter hogs and \$24.15 for purchased feeder pigs. A reduction in the price of corn of \$.50 per bushel increased the net revenue for the farrow to finish system by \$92 per brood sow while the same reduction in corn price increased the return on a purchased feeder pig by \$5.50 per head.

Optimal farm plans were obtained by use of linear programming to determine the effect on returns to land, labor, capital, and management when corn was charged to the swine at \$1.50, \$2.00, \$2.50, \$3.00, \$3.50, and \$4.00 per bushel. The returns to land, labor, capital, and management were then modified to remove the costs of hired labor and annual capital charges. In evaluating the optimum farm organization with a resource base of 149 acres of openland combined with a 1.6 man labor supply, it was found that significant changes occurred in the type and size of the swine enterprises and other livestock as well as with land use, when corn prices were varied from \$1.50 to \$4.00 per bushel. When corn was priced at \$1.50 per bushel, the optimum farm organization (Table LXI) included 122 brood sows in a farrow to finish operation and 196 purchased feeder

TABLE LX

EFFECTS OF VARYING CORN PRICES ON GROSS AND NET REVENUE
PER UNIT FOR TWO SYSTEMS OF SWINE PRODUCTION

Corn Price	Farrow to Finish ^a		Purchased Feeder Pigs ^b	
	Gross Revenue	Net Revenue ^c	Gross Revenue	Net Revenue ^d
	----- Dollars -----			
1.50	1,309	642	79.78	22.47
2.00	1,309	550	79.78	17.17
2.50	1,309	458	79.78	11.87
3.00	1,309	366	79.78	6.57
3.50	1,309	274	79.78	1.27
4.00	1,309	182	79.78	-4.03

^aAssumes a sow producing two litters of eight pigs each with 15.5 head of market hogs sold at \$35.00 per hundredweight. A feed conversion of 3.8 pounds per pound of gain was used.

^bAssumes a purchased feeder pig bought for \$24.15 and sold at 230 pounds for \$35.00 per hundredweight. The feed conversion was increased to 4.0 pounds of feed per pound of gain.

^cNet revenue equals gross revenue minus variable and fixed costs per sow.

^dNet revenue equals gross revenue minus variable and fixed cost per purchased feeder pig and fed to a slaughter weight of 230 pounds. Net revenue is the return to land, labor, capital, and management.

TABLE LXI

OPTIMUM FARM ORGANIZATION FOR A REPRESENTATIVE FARM
WITH VARYING PRICES OF CORN

	Corn Price per Bushel (Dollars)					
	1.50	2.00	2.50	3.00	3.50	4.00
Crop enterprises, acre						
Wheat-soybeans						
Corn	32.0	17.9	25.2	10.0	--	--
Permanent pasture	--	23.3	28.6	43.7	53.8	53.8
Red clover-timothy	20.7	21.3	34.6	39.9	61.7	61.7
Winter pasture	--	--	17.6	17.6	17.6	17.6
Wheat-milo	--	--	--	16.0	16.0	16.0
	13.0	3.8	--	--	--	--
Livestock enterprises						
Farrow-to-finish, sows	122	125	123	117	112	112
Slaughter hogs Ia, head	76	38	33	--	--	--
Slaughter hogs IIa, head	88	96	11	76	25	--
Slaughter hogs IIIa, head	32	21	7	--	61	--
Steers, head	--	--	14	48	71	71
Buy and sell activities						
Buy corn, bu.	22,303	22,135	20,145	18,909	17,677	16,776
Sell soybeans, bu.	832	465	655	261	--	--
Sell red clover, ton	--	--	38	32	23	23
Net return to land, labor, capital, and management	\$82,186	\$70,113	\$58,774	\$48,743	\$39,664	\$31,042
Net return to land, operator labor, and management	\$69,220	\$57,265	\$45,929	\$53,914	\$26,900	\$18,537

^aSlaughter hogs I are produced from January through April and Slaughter hogs III are produced from September through December.

pigs which would be fed to slaughter weight. The majority of the grain needs (22,303 bushels) would be purchased to feed the swine. The cropping program included the production of wheat, milo, and soybeans. When the corn price was increased to \$2.00 per bushel, the number of sows increased to 125 and the number of purchased feeder pigs decreased from 196 to 155. The wheat-soybean acreage decreased to 17.9, wheat-milo to 3.8, and 23.3 acres of corn were produced. At prices of \$2.50 per bushel for corn, the feasible plan included 123 brood sows, 51 purchased feeder pigs, and 14 steers. The number of steers varied from 14 at \$2.50 per bushel for corn to 71 when the corn price was increased to \$4.00 per bushel. The amount of grain purchased decreased from 20,145 bushels to 16,776 over this same price variation. Net returns to land, operator labor, and management varied from \$69,220 with \$1.50 per bushel corn to \$18,537 when it cost \$4.00 per bushel to purchase corn. With corn prices at \$3.50 and above the optimum plan included the production of grain corn on all continuous cropland and on 8.8 acres of rotational land in combination with 17.6 acres of red clover-timothy hay.

The marginal value products for the restricting resources are shown in Table LXII. Continuous cropland was exhausted in each optimal plan and had MVP's ranging from \$34.10 to \$137.55 per acre. With corn priced at \$2.50 and above the MVP was above the expected rental rate of \$48.00 per acre for the land class. Other land classes had MVP's ranging from \$9.32 to \$34.54 when corn was \$2.50 to \$4.00 per bushel. Total cropland had MVP's greater than zero when corn was \$3.00 and

TABLE LXII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR A REPRESENTATIVE
FARM WITH VARYING PRICES OF CORN

	Corn Price per Bushel (Dollars)					
	1.50	2.00	2.50	3.00	3.50	4.00
<u>Land, per acre</u>				--Dollars--		
Continuous cropland	34.10	42.15	58.35	78.94	84.06	137.55
1-3 year rotation	--	--	9.32	10.76	13.13	34.54
Total cropland	--	--	--	27.29	30.08	26.97
Total cropland and pasture	--	--	--	--	23.46	35.93
<u>Labor, per hour</u>						
January-February	37.65	23.68	3.87	--	--	--
March-April	--	6.76	20.53	23.52	31.47	19.87
May-June	19.58	19.03	15.85	--	--	--
July-August	18.07	10.29	5.12	12.65	4.32	--
September-October	23.50	22.83	19.03	6.13	--	--
November-December	--	.72	3.35	9.63	--	--

above and total cropland and pasture had MVP's greater than zero when corn prices were \$3.50 and \$4.00 per bushel.

The labor supply was exhausted in four labor periods with corn priced at \$1.50 per bushel with MVP's ranging from \$18.07 to \$37.64 per hour. With corn priced at \$2.00 and \$2.50 per bushel, labor was exhausted in all labor periods. The MVP's per hour of labor in restrictive periods ranged from \$0.72 to \$23.68. As corn price was increased to \$3.50 per bushel labor became less restrictive.

C. THE EFFECT VARYING THE NUMBER OF HOGS PRODUCED
PER BROOD SOW FARROWED ON NET REVENUE
AND OPTIMUM FARM ORGANIZATION

The average number of pigs per litter for Tennessee producers was 7.6 head in 1974 and 7.2 head in 1964.¹ These figures indicate that little progress has been made in the management of breeding and farrowing in swine operations during the past ten years. During the same period the technology and genetic ability of brood sows was available for producing a litter size of 10 to 12 pigs per farrowing. Since a minimal additional expense is required to farrow, wean, and produce larger litters, improved management could substantially increase returns to swine producers.

In this section, comparisons are made of the effects of varying the number of market hogs produced per brood sow farrowed on the return

¹Tennessee Agricultural Statistics, Bulletin T-8 and T-11, Tennessee Crop Reporting Service, Nashville, 1971 and 1974.

to the brood sow and also on the optimum farm organization where different rates of production were achieved from the swine operation.

As shown in Table LXIII an increase in the number of hogs produced per brood sow increases gross revenue by the added production multiplied by price; whereas, additional costs are only those directly associated with the production of the additional animals. By modifying the swine budgets in Farm Planning Manual² to account for different amounts of pork produced, it was noted that each additional animal produced increased net return to land, labor, capital, and management by \$32.48 per sow.

Alternative farm organizations which maximize potential net income to the fixed resources when the number of swine produced per sow was varied from 10 to 20 per year are shown in Table LXIV. With an average of ten hogs per year, only 19 brood sows in a farrow to finish operation were in the optimal plan. Purchased feeder pigs to be fed to slaughter weight amounted to 2,235 head and 75 beef steers would be backgrounded to 700 pounds. All continuous cropland was used to produce grain and 42.3 acres of winter pasture would be produced to provide feed for the steers. As the number of hogs produced per year increased, the number of brood sows in the optimum farm organization increased substantially to a maximum of 126 when 18 and 20 hogs per sow were produced. The number of purchased feeder pigs declined from 2,235 to 8 head over the same production range. The number of steers

²Ray and Walch [29].

TABLE LXIII

EFFECTS OF RATE OF PRODUCTION PER SOW (TWO LITTERS
PER YEAR) ON GROSS REVENUE, TOTAL COST,
AND NET REVENUE PER BROOD SOW^a

Pigs Produced Per Litter	Gross Revenue Per Sow ^b	Total Cost Per Sow ^c	Net Revenue Per Sow ^d
4.0	723.33	544.68	178.65
4.5	796.60	585.47	211.13
5.0	869.87	626.26	243.61
5.5	943.14	667.05	276.09
6.0	1,016.41	707.83	308.58
6.5	1,089.68	748.83	340.85
7.0	1,162.95	789.42	373.53
7.5	1,236.22	830.31	405.91
8.0	1,309.49	870.99	438.50
8.5	1,382.86	911.78	471.08
9.0	1,456.03	952.57	503.46
9.5	1,529.40	993.36	536.04
10.0	1,602.57	1,034.15	568.42

^aSelling price assumed to be \$35.00 per cwt. and 1½% death loss. Feed requirement per hog is 1.25 cwt. of supplement at \$8.06 per cwt. and 9.14 bushels of corn at \$2.65 per bushel.

^bGross revenue derived by modifying basic swine budgets to account for different amounts of pork produced per sow.

^cTotal cost modified to account for different amounts of pork produced.

^dNet revenue equals gross revenue minus variable and fixed costs.

TABLE LXIV

OPTIMUM FARM ORGANIZATION FOR A REPRESENTATIVE FARM WITH VARYING
NUMBERS OF HOGS PRODUCED PER BROOD SOW FALLOWED

	Number of Hogs Produced Per Brood Sow Farrowed					
	10	12	14	16	18	20
Crop enterprises, acres						
Grain corn	45.0	40.7	37.9	28.5	32.3	32.3
Wheat-soybeans	--	4.3	15.9	25.2	19.9	19.9
Permanent pasture	3.2	17.3	45.9	17.1	21.3	21.3
Winter pasture	42.3	42.3	16.0	--	--	--
Red clover-timothy	--	--	17.6	34.6	17.6	17.6
Livestock enterprises						
Farrow to finish, sows	19	102	116	123	126	126
Slaughter hogs, Ia head	1000	172	37	33	--	--
Slaughter hogs, IIa head	1000	311	71	--	8	8
Slaughter hogs, IIIa head	235	71	--	7	--	--
Steers, head	75	75	54	14	--	--
Buy and sell activities						
Buy corn, bu.	21,342	17,251	16,567	20,144	21,920	24,117
Sell soybeans, bu.	--	110	413	655	518	518
Buy red clover, ton	9	9	--	--	--	--
Sell red clover, ton	--	--	30	38	44	44
Net return to land, labor capital, and management	\$41,649.	\$46,694	\$53,625	\$58,775	\$69,421	\$77,465
Net return to land operator, labor, and management	\$28,370	\$33,697	\$41,308	\$45,778	\$56,592	\$64,460

^aSlaughter hogs I are produced from January through April and Slaughter hogs III are produced from September through December.

decreased from 75 to 14 head as the number of hogs produced per sow increased from 10 to 16 head. With higher swine production rates no steers were produced.

The cropping program included the production of grain corn, wheat-soybeans and red clover-timothy hay. The amount of purchased grain varied from 16,563 to 24,117 bushels in the optimal plans when the production rate per sow was varied from 10 to 20 hogs per sow per year. The net return to land, operator labor, and management varied from \$28,370 to \$64,460.

The marginal value products (Table LXV) for continuous cropland were greater than zero and above the expected rental rates when the number of swine produced per sow varied from 10 to 16 head. Total cropland had an MVP of \$59.94 with 10 hogs produced and \$32.32 when 12 hogs were produced per sow. Above this level the MVP's were zero for this land class. Between 14 and 20 hogs produced, the MVP's for one in three year rotation land varied from \$11.50 to \$0.19 per acre.

Some labor periods were restrictive for each level of swine production. Available labor was exhausted in all periods when 16 hogs were produced per sow. The MVP's for the restricting labor periods varied from \$3.81 to \$30.79 per hour.

D. EFFECTS OF VARYING FEED CONVERSION ON NET REVENUE AND OPTIMUM FARM ORGANIZATION

Data on the amount of feed per pound of gain for producing swine is very limited in Tennessee and such data are difficult to

TABLE LXV

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR A REPRESENTATIVE FARM WITH
VARYING NUMBERS OF HOGS PRODUCED PER BROOD SOW FARROWED

	Number of Hogs Produced per Brood Sow Farrowed					
	10	12	14	16	18	20
Land, per acre				--Dollars--		
Continuous cropland	59.56	64.89	70.63	58.35	35.81	25.73
1-3 year rotation	--	--	11.50	9.32	3.55	.19
Total cropland	59.94	32.32	--	--	--	--
Total cropland and pasture	--	--	.69	--	--	--
Labor, per hour						
January-February	18.04	14.42	7.36	3.81	--	--
March-April	--	7.88	16.33	20.52	27.75	30.79
May-June	--	5.47	11.58	15.86	20.98	20.98
July-August	20.98	15.52	9.40	5.12	--	--
September-October	--	6.56	15.96	19.03	26.37	30.72
November-December	--	--	--	3.35	7.11	10.39

--Dollars--

obtain since most producers feed both home grown as well as purchased feed. Recommendations by research and extension personnel in the Animal Science Department suggests that swine producers can produce a pound of pork with 3.8 or less pounds of feed [27]. Factors which affect the feed requirement include the quality of feed and the form in which it is fed, the genetic characteristics of the swine herd and the general health of the swine herd. The feeding facilities and the system of feeding also affect the amount of total feed used in the swine operation. All these factors are influenced by the management skills of the producer and all, with the exception of changing the genetic characteristics, can be changed in a relatively short period of time. Since the major portion of total costs of producing swine are the feed costs, the cost of production is determined to a considerable extent by feed conversion ratios. Costs and returns with varying feed conversions are shown in Table LXVI.

Optimum farm plans were developed for a "representative" farm using a 1.6 man labor supply to show the effect on farm organization and net returns to land, operator labor, and management with variations in feed conversion rates. A selling price of \$35.00 per cwt. for slaughter hogs and \$24.15 per head for feeder pigs was assumed. Corn could be produced or purchased. A purchase price of \$2.65 per bushel was assumed. The amount of feed to produce a pound of pork was varied from 3.2 to 4.8 pounds. The optimal farm plans are shown in Table LXVII. Net revenue decreased from \$57,826 with a feed conversion of 1-3.2 to \$27,246 for a feed conversion of 1-4.8.

TABLE LXVI
EFFECTS OF FEED EFFICIENCY ON NET RETURN TO LAND,
LABOR, CAPITAL, AND MANAGEMENT FOR A MARKET HOG^a

Pounds of Food Per Pound Per Gain	Total Revenue	Variable Cost	Variable and Fixed Cost	Net Return ^b
	----- Dollars -----			
3.2	79.78	57.45	59.10	20.68
3.4	79.78	59.32	60.97	18.81
3.6	79.78	61.18	62.83	16.95
3.8	79.78	63.04	64.69	15.09
4.0	79.78	65.25	66.90	12.88
4.2	79.78	66.77	68.42	11.36
4.4	79.78	68.64	70.29	9.49
4.5	79.78	70.50	72.15	7.63
4.7	79.78	72.36	74.01	5.77

^a Assumes a 230 pound market hog with a selling price of \$35.00 per cwt.

^b Net return to land, labor, capital, and management.

TABLE LXVII

OPTIMUM FARM ORGANIZATION FOR REPRESENTATIVE FARM
WITH VARYING FEED CONVERSION RATIOS

	Amount of Feed per Pound of Gain (Pounds)				
	3.2	3.6	3.8	4.0	4.4
Crop enterprises, acres					
Grain corn	23.9	25.3	28.5	28.5	32.1
Wheat-soybeans	21.0	28.4	25.2	25.2	21.8
Alfalfa	--	--	--	--	--
Red clover-timothy	--	17.6	17.6	17.6	25.1
Permanent pasture	21.1	20.6	34.6	34.6	38.1
Winter pasture	--	--	--	--	6.9
					6.7
Livestock enterprises					
Steers, head	--	--	14	14	54
Farrow-to-finish, sows	124	121	123	123	120
Slaughter hogs I ^a , head	52	79	33	33	115
Slaughter hogs II ^a , head	104	30	11	11	35
Slaughter hogs III ^a , head	29	31	7	7	--
					--
Buy and sell activities					
Buy corn, bu.	19,159	19,865	20,144	21,120	22,224
Sell alfalfa, ton	--	--	--	--	--
Sell soybeans, bu.	547	739	655	655	566
Sell red clover, ton	--	44	38	38	54
					27
Net return to land, labor, capital, and management	\$70,429	\$62,485	\$58,775	\$55,085	\$47,753
					\$40,558
Net return to land, operator labor, and management	\$57,826	\$49,695	\$45,931	\$42,163	\$34,651
					\$27,246

^aSlaughter hogs I are produced from January through April and Slaughter hogs III are produced from October through December.

With a 3.2 conversion rate the optimum plan included a 124-sow farrow to finish operation and the finishing of 185 purchased feeder pigs. In addition to the grain produced (44.9 acres), 19,159 bushels of corn would be purchased. With an assumed conversion rate of 3.8 pounds of feed per pound of gain, 14 steers would be added, the brood sows would decrease to 123 head, and the number of purchased pigs would decrease to 51 head. With a conversion rate of 4.0 to 4.8 pounds of feed, the steers increased to 54 head while the brood sows decreased to 115 head. Only 35 purchased feeder pigs were included in the optimal plan when the gain per pound of feed was 4.4 pounds and above.

With the assumed land and labor restrictions, continuous cropland and labor were the major restrictions to a higher production level. The marginal value products for the restricting resources are shown in Table LXVIII. The marginal value products for labor were above zero in all labor periods in each of the optimal plans with the exception of November-December labor with 3.2 and 3.6 feed efficiency and May and June labor with a 4.8 feed efficiency. With the exception of January-February labor and a feed efficiency of 4.4 and 4.8, the MVP's period per hour of labor were above the wage rate for all periods when the available labor was exhausted.

The optimal farm plans developed in this chapter show that at low corn prices and/or high feed conversion rates, increased swine production yields much higher net returns. At low corn prices, less resources are devoted to the cropping program, and a large part of

TABLE LXVIII

MARGINAL VALUE PRODUCTS FOR RESTRICTING RESOURCES FOR REPRESENTATIVE
FARM WITH FEED CONVERSION RATIOS

	Amount of Feed per Pound of Gain (Pounds)				
	3.2	3.6	3.8	4.0	4.4
<u>Land, per acre</u>				---Dollars---	
Continuous cropland	57.28	53.21	58.35	66.34	81.71
2-4 year rotation	--	1.50	9.32	18.07	31.64
Total cropland	--	--	--	--	--
Total cropland and pasture	--	--	--	--	--
					82.81
					32.01
					13.35
					.89
<u>Labor, per hour</u>					
January-February	11.87	5.14	3.88	3.32	2.38
March-April	22.27	22.78	20.53	17.25	10.98
May-June	14.67	17.12	15.86	13.61	4.12
July-August	15.75	7.00	5.12	4.08	7.95
September-October	17.61	20.53	19.03	16.33	15.74
November-December	--	--	3.35	8.33	11.90
					1.16
					4.90
					--
					6.83
					10.43
					19.88

the grain would be purchased. As corn prices rise and feed conversion rates decrease, the crop-livestock mix changes. The number of hogs produced decreases and crop production increases.

CHAPTER VII

A COMPARISON OF SWINE PRODUCTION SYSTEMS IN RELATION TO ALTERNATIVE LIVESTOCK ENTERPRISES AND THEIR EFFECT ON OPTIMAL FARM ORGANIZATIONS

A. INTRODUCTION

In this chapter an evaluation was made of feasible enterprise combinations on a "representative" farm and comparisons were made to determine the effect of different livestock enterprise constraints on the net returns to the available fixed resources. A "representative" farm was defined as having 149 acres of openland and 4,898 hours of labor available for the production of crops and livestock. The land and labor constraints used in developing the models for this chapter are identical to those outlined in Chapter VI. Input-output data for the crop and livestock budgets were the same as used in previous models.

Alternative livestock situations which are common on Tennessee farms were included in the models. Twelve situations and six livestock enterprise restrictions were considered. The six livestock enterprises considered were: Grade "A" dairy, manufacturing milk, brood sows to produce feeder pigs, brood sows in a farrow to finish system, brood cows to produce beef feeder calves, and purchased feeder steers. The six enterprise restrictions were evaluated under two grain acquisition assumptions: (1) Grain for livestock feeding was limited to that produced on the farm; and (2) additional grains could be purchased

at market prices as an input in livestock production. A purchase price of \$2.65 per bushel for corn, \$2.90 per bushel for wheat, \$2.15 per bushel for barley, and \$2.30 per bushel for milo was used in the analysis. In the first situation only the grains produced on the farm would be available for sale or as feed for the livestock.

B. OPTIMUM FARM ORGANIZATIONS WITH THE BUYING
AND SELLING OF FEED GRAINS PERMITTED

Optimum Farm Organization with All Major
Livestock Enterprises Considered

In this situation, Grade "A" dairy, manufacturing milk production, feeder pigs for sale, farrow to finish swine, beef cows producing feeder calves, and purchased beef steers were considered in the model. As shown in Table LXIX, Plan 1, the optimum cropping program included the production of 23.8 acres of grain corn, 21.3 acres of wheat, 21.3 acres of soybeans, and 21.5 acres of permanent pasture. The optimum farm plan would consist of a specialized farrow to finish swine operation with 126 brood sows and the purchase of 104 feeder pigs to be fed to slaughter weight. The purchase of 20,045 bushels of corn and wheat would be required. An estimated net return to land, operator labor, and management of \$50,055 would be realized.

Of a total supply of 149 acres of available land, 66.6 acres or 45 percent was used. All 45 acres of the continuous cropland was used for grain production. The labor supply was the critical resource. All available labor was used in four labor periods and only 20 hours of labor was unused in the remaining two periods. The marginal value

TABLE LXIX

THE EFFECT OF VARIOUS ENTERPRISE RESTRICTIONS ON THE OPTIMUM FARMING SYSTEMS
AND NET RETURNS FOR A REPRESENTATIVE FARM, PURCHASED GRAIN PERMITTED

	Enterprise Alternatives Permitted					
	Grade "A" Dairy, Mfg. Milk, Grade "A" Swine, and Dairy	Only	Feeder Pigs and Beef	Farrow to Finish Swine and Beef	Purchase Pigs and Beef	Farrow to Finish Swine, Feeder Pigs, Purchase Pigs, and Beef
<u>Corn enterprises, acres</u>						
Grain corn	23.8	--	40.0	28.6	45.0	30.0
Wheat-soybeans	21.3	2.6	4.6	16.0	--	15.0
Permanent pasture	21.5	72.4	32.8	21.5	--	21.4
Corn silage	--	42.2	--	--	--	--
Summer pasture	--	31.8	--	--	--	--
Burley tobacco	--	--	.3	--	--	--
Alfalfa	--	--	23.1	--	--	--
Red clover-timothy	--	--	--	20.0	--	--
Winter pasture	--	--	--	--	--	2.4
<u>Livestock enterprises</u>						
Farrow to finish. sows	126	--	--	127	--	126
Slaughter hogs I ^a , head	24	--	--	--	1,292	--
Slaughter hogs II ^a , head	80	--	--	--	1,401	96
Slaughter hogs III ^a , head	--	--	--	--	1,306	--
Grade A dairy, cows	--	71	--	--	--	--
Feeder pigs, sows	--	--	193	--	--	--
Steers, head	--	--	--	--	--	4

TABLE LXIX (Continued)

	Enterprise Alternatives Permitted					
	Grade "A" Dairy, Mfg. Milk Swine, and Beef	Grade "A" Dairy Only	Feeder Pigs and Beef	Farrow to Finish Swine and Beef	Purchase Pigs and Beef	Farrow to Finish Swine, Feeder Pigs, Purchase Pigs, and Beef
Buy and sell activities						
Buy corn, bu.	10,281	--	4,977	9,363	17,592	9,711
Buy wheat, bu.	9,764	--	186	9,734	18,289	9,944
Buy milo, bu.	--	--	--	--	1,273	--
Buy red clover, ton	--	38	--	--	--	--
Buy alfalfa, ton	--	75	--	--	--	--
Sell soybeans, bu.	553	68	121	431	--	390
Sell wheat, bu.	--	104	--	--	--	--
Sell alfalfa, ton	--	--	81	--	--	--
Sell red clover, ton	--	--	--	50	--	--
Net return to land, labor, capital and management	\$62,627	\$38,488	\$31,799	\$62,308	\$47,558	\$62,531
Net return to land, operator labor, and management	\$50,055	\$24,687	\$20,517	\$49,699	\$31,151	\$49,916

^aSlaughter hogs I are produced from January through April, Slaughter hogs II are produced from May through August, and Slaughter hogs III are produced from September through December.

products for the restricting resources (Table LXX) showed that the value for additional acres of continuous cropland was well above an expected rental rate (\$48.00 per acre) and value per hour of labor varies from \$12.60 to \$22.41 in the four restrictive periods.

Optimum Farm Organization with Grade "A" Dairy
as the Only Livestock Enterprise

When livestock alternatives were restricted to Grade "A" dairy only, the cropping program shifted from grain production to the production of forage for the dairy. The optimum plan (Table LXIX, Plan 2) included 71 cows and their replacements. An additional 113 tons of red clover and alfalfa hay would be purchased to satisfy the feed requirements.

All available land was used as well as 96 percent of the available labor. Although the resources were more fully utilized, the net revenue to land, operator labor, and management decreased by 51 percent to a level of \$24,687. The marginal value products for the restricting resource (Table LXX) show that the value of an additional acre of continuous cropland has a value of \$32.86 per acre. Total cropland and pasture has a value of \$69.98 per acre. The MVP's per hour of labor are \$17.35 and \$15.19, respectively for the March-April and September-October labor periods.

Optimum Farm Organization When the Livestock Alternatives
Were Restricted to Feeder Pigs and Feeder Calves

With the assumed resources and input-output coefficients, a 193-sow operation producing feeder pigs to be sold at a weight of 45 pounds was the only livestock in the optimum farm plan (Table LXIX, Plan 3).

TABLE LXX

THE EFFECT OF VARIOUS ENTERPRISE RESTRICTIONS ON THE MARGINAL VALUE PRODUCTS FOR
RESTRICTING RESOURCES FOR A REPRESENTATIVE FARM, PURCHASED GRAIN PERMITTED

	Enterprise Alternatives Permitted					
	Grade "A" Dairy, Mfg. Milk, Swine, and Beef	Grade "A" Dairy Only	Feeder Pigs and Beef	Farrow to Finish Swine and Beef	Purchase Pigs and Beef	Farrow to Finish Swine, Feeder Pigs, Purchase Pigs, and Beef
Land, per acre				--Dollars--		
Continuous cropland	68.10	32.86	121.88	41.52	113.24	54.91
Total cropland	--	--	21.64	--	--	--
Total cropland and pasture	--	69.98	--	--	--	--
Labor, per hour						
January-February	--	--	13.21	--	17.36	--
March-April	20.83	17.35	4.48	40.73	--	32.08
May-June	17.76	--	--	10.68	17.36	17.36
July-August	--	--	14.07	2.46	--	--
September-October	12.60	15.19	--	--	13.62	--
November-December	22.41	--	--	19.27	3.74	23.76

The cropping program included the production of 40 acres of corn for grain, 4.6 acres of wheat and soybeans, 23.1 acres of alfalfa, .3 acre of burley tobacco, and 32.8 acres of sow pasture. The tobacco, soybeans and hay would be sold as a cash crop and the grain would be used for feed. In addition, 5,163 bushels of grain would be purchased. Sixty-five percent (100.8 acres) of the available land was used and 98 percent of the labor supply was utilized.

The marginal value products (Table LXX) show that continuous cropland was very restrictive with a value of \$121.88 for an added acre, while labor in January-February, March-April, and July-August labor periods were restrictive with MVP's of \$13.21, \$4.48, and \$14.07, respectively, per hour.

With the production of feeder pigs as the major enterprise, an estimated net return to land, operator labor, and management of \$20,517 was realized.

Optimum Farm Organization When Livestock Alternatives
Were Restricted to a Farrow to Finish Swine System
and Feeder Calves

When a farrow to finish swine operation and a cow-calf beef unit were considered as the only livestock enterprises in the model (Table LXIX, Plan 4, pages 196-97), the resulting optimum organization was very similar to the farm organization when all livestock enterprises were allowed. The optimum farm organization included 127 brood sows as the only livestock enterprise. All continuous cropland and 20 acres of rotational cropland were used for grain production. In addition

20 acres of rotational cropland was used to produce red clover-timothy hay for sale. An additional 19,097 bushels of corn and wheat would be purchased.

The net returns to land, operator labor, and management was \$49,699, only slightly less than when all livestock enterprises were considered. Of the 149 acres of land available, 87.4 acres of land was used. Labor in four time periods was exhausted.

The MVP for an additional unit of continuous cropland was \$41.52 (Table LXX, page 199), somewhat lower than the expected rental rate for this land class. The MVP's per hour of labor ranged from \$2.46 to \$40.73 for the four restrictive labor periods. Labor was not restrictive in the January-February and September-October periods.

Optimum Farm Organization When Livestock Alternatives
Were Restricted to Purchased Feeder Pigs and
Feeder Calves

In this situation, the optimum farm plan (Table LXIX, Plan 5, pages 197-98) included the feeding of 3,999 purchased feeder pigs to a market weight or 230 pounds. All 45 acres of the continuous cropland was used to produce grain. All other cropland was left idle. An additional 37,154 bushels of grain would be purchased. All but 98 hours of the 4,898 hours of available labor was used.

The estimated net returns to land, operator labor, and management was \$31,151. The MVP for continuous cropland was \$113.24 per acre (Table LXX, page 199), while the MVP's for labor varied from \$3.74 to \$17.36 in four labor periods in which labor was restricted in the

optimum plan. Labor in March-April and July-August labor periods was not a restricting resource.

Optimum Farm Organization When Livestock Enterprises
Were Restricted to a Farrow to Finish Swine System,
Feeder Pig Production, Purchased Feeder Pigs,
Feeder Calves, and Purchased Beef Steers

When all major livestock enterprises, excluding dairy, were considered in the model, the optimum farm organization (Table LXIX, Plan 6, pages 196-97) included the production of swine with a 126-sow herd in a farrow to finish system. Ninety-six purchased feeder pigs and four feeder steers were included in the plan. The cropping program included the production of 30 acres of grain corn and 15 acres of wheat for feed, and 15 acres of soybeans for sale. Sow pasture used 21.4 acres and 2.4 acres of winter pasture was used for the steers. With this level of swine production 19,655 bushels of wheat and corn would be purchased.

The MVP for continuous cropland was \$54.91 per acre (Table LXX, page 199). High MVP's for labor were noted in the March-April, May-June, and November-December labor periods. These values ranged from \$17.36 to \$32.08 per hour.

C. OPTIMUM FARM ORGANIZATION FOR REPRESENTATIVE
FARM USING ONLY HOME GROWN GRAIN

Optimum Farm Organization with All Major
Livestock Enterprises Considered

When the model specification eliminated purchase grain as an input for the farm operation, a significant change occurred in the optimum

organization of the fixed resources as well as a large reduction in potential income (Table LXXI, Plan 1). The number of brood sows was reduced from 126 to 6 and the major livestock enterprise changed to a 67-cow grade "A" dairy. The cropping program in this plan included less grain production and increased forage production for the dairy. When grain buying was allowed, only 45 percent of the available land was used; without grain buying all available land was utilized. No major change occurred in labor usage; 97 percent of the available labor was used. The potential net returns to land, operator labor, and management decreased from \$50,055 to \$25,508, a decrease of 49 percent by eliminating purchased feed grains.

The marginal value products for the restricting resources (Table LXXII) show that both continuous cropland and total openland are very restricting. These values were \$154.47 and \$84.91 per acre respectively. All available labor was utilized in the March-April, May-June, and September-October labor periods with MVP's ranging from \$2.90 to \$14.96 per hour.

Optimum Farm Organization When the Livestock
Enterprises Were Restricted to the Production
of Feeder Pigs and Feeder Calves

In this situation (Table LXXI, Plan 2), the size of the sow herd decreased from 193 to 84 sows as compared to the optimum plan where purchased grains was allowed. Also 27 beef cows could be kept to produce feeder calves for sale. All the continuous cropland was used to produce grain corn and tobacco and 42.3 acres of bermuda

TABLE LXXI

THE EFFECT OF VARIOUS ENTERPRISE RESTRICTIONS ON THE OPTIMUM FARMING SYSTEMS
AND NET RETURNS FOR A REPRESENTATIVE FARM, PURCHASED GRAIN NOT PERMITTED

	Enterprise Alternatives Permitted				
	Grade "A" Dairy, Mfg. Milk, Swine, and Beef	Feeder Pigs and Beef	Farrow to Finish Swine and Beef	Purchase Pigs and Beef	Farrow to Finish Swine, Feeder Pigs, Purchase Pigs, and Beef
<u>Crop enterprises, acres</u>					
Grain corn	17.2	44.7	44.7	40.3	44.7
Corn silage	27.6	--	--	4.4	--
Wheat silage	25.6	--	--	4.4	--
Permanent pasture	71.5	61.7	61.7	61.7	61.7
Summer pasture	32.5	--	--	5.0	--
Burley tobacco	.1	.3	.3	.3	.3
Bermuda grass	--	42.3	42.3	34.4	--
Alfalfa	--	--	--	2.9	--
Winter pasture	--	--	--	--	42.3
<u>Livestock enterprises</u>					
Grade A dairy, cows	67	--	--	10	--
Farrow to finish, sows	6	--	19	--	--
Beef, cow-calf, cows	--	27	33	29	--
Feeder pigs, sows	--	84	--	--	81
Slaughter hogs I ^a , head	--	--	--	304	--
Steers, head	--	--	--	--	123

TABLE LXXI (Continued)

	Enterprise Alternatives Permitted				
	Grade "A" Dairy, Mfg. Milk, Swine, and Beef	Feeder Pigs and Beef	Farrow to Finish Swine and Beef	Purchase Pigs and Beef	Farrow to Finish Swine, Feeder Pigs, Purchase Pigs, and Beef
Buy and sell activities					
Buy red clover hay, ton	36	32	39	39	28
Buy alfalfa hay, ton	68	--	--	--	--
Sell wheat, bu.	--	--	--	--	--
Sell soybeans, bu.	--	--	--	--	--
Sell bermuda grass, ton	--	212	212	172	--
Net return to land, labor, capital and management	\$39,398	\$20,356	\$18,350	\$17,410	\$22,319
Net return to land, operator labor, and management	\$25,508	\$10,389	\$9,291	\$7,291	\$13,061

^aSlaughter hogs I are produced from January through April.

TABLE LXXII

THE EFFECT OF VARIOUS ENTERPRISE RESTRICTIONS ON THE MARGINAL VALUE PRODUCTS FOR
RESTRICTING RESOURCES FOR A REPRESENTATIVE FARM, PURCHASED GRAIN NOT PERMITTED

	Enterprise Alternatives Permitted				
	Grade "A" Dairy, Mfg. Milk, Swine, and Beef	Feeder Pigs and Beef	Farrow to Finish Swine and Beef	Purchase Pigs and Beef	Farrow to Finish Swine, Feeder Pigs, Purchase Pigs, and Beef
Land, per acre					
Continuous cropland	150.47	306.63	261.69	155.86	276.66
Total cropland	--	28.65	28.65	28.65	31.48
Total cropland and pasture	84.91	24.31	24.31	24.31	44.86
Labor, per hour					
January-February	--	--	--	--	--
March-April	2.90	--	--	--	--
May-June	6.24	--	--	--	--
July-August	--	--	--	--	--
September-October	14.96	--	--	--	--
November-December	--	--	--	--	--

grass hay was produced for sale as a cash crop. All the available land was utilized; however, only 42 percent of the available labor was used when livestock was restricted to the production of feeder pigs and calves. None of the six labor periods fully utilized the available labor in that period. With no purchased grain, the potential farm income decreased by 49 percent to \$10,389 as compared to the organization where purchased grain was permitted.

Continuous cropland, total cropland, and total cropland and pasture were restrictive in the optimum plan and had MVP's of \$306.63, \$28.65, and \$24.31 per acre, respectively. Excess labor was available in all labor periods.

Optimum Farm Organization When Livestock
Enterprises Were Restricted to a Farrow to
Finish Swine Operation and Feeder Calves

The optimum farm organization (Table LXXI, Plan 3, pages 204-5) included 19 sows in a farrow to finish swine system and 33 beef cows to produce feeder calves. Continuous cropland was used to produce 44.7 acres of corn and .3 of an acre of burley tobacco. The remaining acreage of openland was used to produce 42.3 acres of bermuda grass hay and 61.7 acres of permanent pasture for the sows and beef cows. The estimated net returns for this farm organization was \$9,292.

The marginal value products for the restricting resources (Table LXXI, Plan 3, pages 204-5) show positive values of \$261.69, \$28.65, and \$24.31 per acre for continuous, total, and total crops and pastureland. Excess labor was available in all labor periods and only 36 percent of the available labor was utilized.

Optimum Farm Organization When Livestock Enterprises Were Restricted to Purchased Feeder Pigs and Feeder Calves

Since feeding swine to slaughter weight requires large amounts of grain, this farm organization was the most severely affected by the grain purchase restriction. Even when the total continuous cropland acreage was used to produce grain only 304 purchased feeder pigs could be produced (Table LXXI, Plan 4, pages 204-5). In addition, 29 beef cows and 10 dairy cows were in the optimal solution.

All the land was used, but only 39 percent of the available labor would be utilized. The estimated net returns to land, operator labor, and management was reduced to \$7,653 as compared to \$25,508 when all major livestock enterprises were included.

The MVP for continuous cropland was restrictive with a value of \$155.86 (Table LXXII, page 206). Total cropland and total cropland and pasture had MVP's of \$28.65 and \$24.31 per acre, respectively. Excess labor was available in all labor periods.

Optimum Farm Organization When Livestock Enterprises Were Restricted to Farrow to Finish Swine, Feeder Pig and Feeder Calf Production, and Purchased Feeder Pigs and Steers

When purchasing of feed grain was not permitted, the brood sows in a farrow to finish system producing market hogs was eliminated in the optimal plan (Table LXXI, Plan 5, pages 204-5) and replaced by a herd of 81 sows producing feeder pigs. Also 123 steers to be fed to 700 pounds were included in the livestock program. All continuous cropland was used for grain corn and burley tobacco production.

Remaining land was used for small grain pasture and permanent pasture for the swine and steers. Only 2,649 hours of the 4,898 hours of labor available were utilized in the optimum plan.

An estimated net return to land, operator labor, and management of \$13,061 was obtained with this farm organization. The marginal value products (Table LXXII, Plan 5, page 206) for continuous cropland, total cropland, and total cropland and pasture were greater than zero and ranged from \$276.66 to \$31.48 per acre. Surplus labor was available in all labor periods.

Comparing various livestock enterprises with and without the use of purchased grain indicate that major changes occur in farm organization, crops produced and income levels depending on the types of livestock restrictions considered. The elimination of purchased grain substantially reduced the income possibilities with swine production systems. Also excess labor relative to the land base occurred in all plans where swine systems were the major livestock enterprise when only home produced grains were available.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

A. SUMMARY

The primary objective of the study was to evaluate factors associated with alternative swine production systems, to determine the competitiveness of swine in the use of farm resources and to determine crop and livestock combinations which will maximize potential returns to the fixed resources for specified resource situations. This analysis was conducted under various resource and pricing situations for representative-type farms in the Tennessee Valley Watershed Area of Tennessee.

The Study Areas

Three study areas were included in the analysis:

(1) Area I was a seven-county area adjacent to the Tennessee River in the midwest portion of the State and included parts of the Plateau Slope and the Western Highland Rim. Farm acreage was larger in this area than for other study areas and farm operators would likely have an advantage in swine production as compared to the other two areas because of nearness to the major grain producing areas.

(2) Area II included the Southern Highland Rim and the Sequatchie Valley in the South Central part of the State. This is a fourteen-county area, diverse in soil types, quality of soils, and proportion of land suitable for producing crops. Purchased grain prices were

assumed to be 8 percent higher than Area I due to greater distance from surplus grain areas.

(3) Area III included twenty-four counties located in East Tennessee. Farm size was smaller, cropland more limited, and nonfarm employment higher than for the two previous study areas. Livestock markets are well established in the area; however, markets for crops, except burley tobacco, are limited because of a low volume of production of most saleable crops. Grain prices were assumed to be 16 percent higher in this area than to Area I because of the greater distance from grain surplus areas [5].

The Resource Situations on Representative Farms

A representative farm situation was specified for each study area. The representative farm in Area I contained 160 acres of openland with 96 acres of cropland and 64 acres suitable only for permanent pasture. Double cropped wheat and soybeans were restricted to not more than 32 acres. The size of the livestock enterprises was restricted to 120 Grade "A" dairy cows; 200 brood sows; 1,000 purchased feeder pigs in each four-month production period; 500 beef steers; 200 beef cows; and 100 ewes. The available resources on the representative farm were varied to include 320 and 480 acres of openland and 6,000 and 7,392 hours of annual labor. All other restrictions remained constant as the land-labor ratios were varied in the analysis.

In Area II the fixed resources on the representative farm contained 135 acres of openland and had available 3,000 hours of

operator labor. The restriction on livestock numbers remained the same as for Area I. An eleven-hundred pound burley tobacco quota was incorporated into the model considered in this area. Resources on the representative farm were varied to include 270 and 405 acres of openland and 6,000 and 7,392 hours of annual labor.

The representative farm in Area III contained 129 acres of openland and had available 3,000 hours of operator labor. No changes were made in the livestock restrictions; however, no cotton was permitted.

The restrictions used for the various land classifications on each representative farm was based on data obtained from records on 146 Swine Resource Management farms for the years 1965 through 1971. The amount of available labor was assumed to be a full-time operator available a maximum of 60 hours per week for 50 weeks. Twenty percent of the available labor was assumed to be used for supervision, marketing, and other activities not directly related to the production of a given enterprise.

Production coefficients used in the analysis were obtained from results of experiments at the University of Tennessee Experiment Station, research data from other state experiment stations, personal communication with research and extension personnel, data recorded by Tennessee farm operators, and personal communication with cooperating farmers in the State. Costs of inputs were obtained from agribusiness firms which supply inputs to farmers while basic price data on output were estimated by personnel in the Department of Agricultural Economics in the University of Tennessee Institute of Agriculture.

Standard budgetary techniques were utilized in developing costs and returns, input requirements and estimated output for major crop and livestock enterprises produced in the three study areas. The crop enterprises included grain corn and small grains for feed or sale, soybeans for sale, corn and small grain silage, hay for feed or sale, and permanent and temporary pasture. Livestock enterprises alternative included four Grade "A" dairy systems, dairy producing manufacturing milk, two cow-calf beef systems, six swine production systems, and a sheep system.

Linear programming techniques were used to determine the effects on resource use and net returns to land, labor, capital, and management, with varying swine prices, resource efficiency levels, and livestock enterprise alternatives.

Statistical analysis was made of data from records obtained on 146 Resource Management swine farms over a six-year period (1965-1971) to determine the relationship between selected variables and net returns to land, labor, capital, and management on this group of farms. Variables considered included acres of openland, percent of openland devoted to row crops, amount of purchased protein swine feed, number of beef cows per farm, number of brood sows per farm, the number of pigs weaned per brood sow, area of the state, and year of production. Variables found to be significantly related to net returns were further studied in the linear programming analysis of representative farms.

Optimum farm organizations were developed using linear programming over a wide range of slaughter hog prices (\$30-60 per hundredweight)

using three levels of available labor, and three land sizes in each area. Feeder pig prices were varied proportionally with slaughter hog prices.

Further variations were made in both technical and economic factors which importantly affect profitability of swine production. The factors evaluated in this model included variation in corn prices, variation in the number of pounds of pork produced per sow, variations in the amount of feed required to produce a pound of pork, and variation in alternative livestock enterprises considered. The effect of eliminating the alternative to purchase grain was also evaluated. For this analysis the representative farm was redefined to describe a production situation which might be typical for all three study areas. The representative farm for this analysis included 149 acres of land and 4,898 hours of labor.

Statistical Analysis of Record Data on Resource Management Swine Farms

Net returns to land, labor, capital, and management were regressed on 17 independent variables hypothesized to be associated with swine production on 146 Resource Management swine farms enrolled in the program for the years 1967 through 1971.

Net returns were positively and significantly related to the number of open acres, the percentage of open acres in row crops, the number of brood sows on the farm, and the number of pigs weaned per brood sow. Results also indicated that net returns were significantly lower in 1967-68 and 1970-71 than for the base year, 1965. Positive, but insignificant relationships, were found between net returns and

purchased protein and the number of beef cows produced. Investment in machinery had a negative effect, but was not significantly different from zero at the .05 significance level. No significant difference was found between net returns for the three study areas.

Optimal Farm Organizations with Variation in Swine Prices

Optimal farm organizations which would maximize net returns to land, labor, capital, and management were developed for each study area for nine land-labor situations, representing three land sizes and three levels of available labor. Swine prices were varied from \$30 to \$60 per cwt. for each land-labor situation. Optimal farm organizations were also developed where swine production was not permitted. Interest on investment in machinery, equipment, buildings, and operating capital was subtracted from the estimated net returns to land, labor, capital, management and a return to land, operator labor, and management was obtained for each resource situation analyzed. The cost of hired labor was also subtracted from the estimated returns to land, labor, capital, and management.

When slaughter hogs were priced at \$35.00 per hundredweight and above, the major livestock enterprise in optimum farm organizations was either a farrow to finish swine production system or the feeding out of purchased feeder pigs to a slaughter weight of 230 pounds. When the price of slaughter hogs was \$35.00 per cwt. and only operator labor (3,000 hours) was considered, the number of brood sows (Table LXXIII) varied from 55 to 78 among the variations in farm size and study

NUMBER OF SOWS AND SLAUGHTER HOGS IN THE OPTIMUM FARM PLANS
WHEN SWINE PRICED AT \$35 AND \$50 PER HUNDREDWEIGHT,
BY AREA, FARM SIZE, AND LABOR SUPPLY

Farm Size ^a	Land-Labor Ratios ^b	Sows		Slaughter hogs	
		Farrow to Finish		Purchased Feeder Pigs	
		Swine Price (Dollars)			
		35	50	35	50
Area I					
Base (160 ac.)	1-18.7	73	--	57	1,611
	1-37.5	154	72	120	2,750
	1-46.2	192	112	159	2,685
Medium (320 ac.)	1-9.4	61	--	50	2,270
	1-18.7	147	65	114	2,809
	1-23.1	184	106	167	2,741
Large (480 ac.)	1-6.3	55	--	121	1,478
	1-12.5	134	63	247	2,834
	1-15.4	171	105	301	2,756
Area II					
Base (135 ac.)	1-22.2	72	--	63	2,410
	1-44.4	156	72	103	2,750
	1-54.7	192	113	173	2,685
Medium (270 ac.)	1-11.1	58	--	47	2,285
	1-22.2	147	67	147	2,792
	1-27.4	187	108	138	2,723
Large (405 ac.)	1-23.3	60	--	77	2,270
	1-46.5	128	59	163	2,829
	1-57.3	171	99	192	2,815
Area III					
Base (129 ac.)	1-23.3	78	--	51	2,455
	1-46.5	157	73	167	2,750
	1-57.3	194	114	195	2,685
Medium (258 ac.)	1-11.6	71	--	43	2,408
	1-23.3	156	73	103	2,750
	1-28.7	192	114	145	2,685
Large (387 ac.)	1-7.8	64	--	32	2,371
	1-15.5	151	72	96	2,757
	1-19.1	189	113	130	2,688

^aFarm size is the assumed open acres used in the analysis for each study area.

^bThe land to labor ratio is the number of hours of labor in relation to one acre of openland. Derived from 3,000, 6,000, and 7,392 hour labor supply.

areas. The number of purchased feeder pigs varied from 32 to 247 with the same labor supply for all land size and area situations. When an additional 3,000 hours was added to the labor supply, the farm organization remained essentially the same; however, the level of swine production increased to an average for all farm sizes of 144 sows in Area I, 144 sows in Area II, and 155 sows in Area III. The number of purchased feeder pigs in the optimal plan with a two-man labor supply averaged 160, 138, and 122 for the three respective areas. When the available labor was increased to 7,392 hours annually, the production level of brood sows and purchased feeder pigs increased to an average of 182, 183, 192, and 209, 160, 157 in Areas I, II, and III, respectively.

The cropping program in the optimal farm plans when market hogs were priced at \$35.00 per cwt. included the production of grain corn, wheat, milo, soybeans, and swine pasture. The grain would be used for feed and the soybeans sold as a cash crop. Where steers were in the optimal plans, winter pasture and red clover-timothy hay were also produced. In addition to the home grown grain, a substantial amount of purchased grain was necessary for the swine operation.

When swine prices were increased to \$50.00 per cwt. (Table LXXIII), a reduction in the number of brood sows occurred with each land-labor combination and a large number of purchased feeder pigs to be fed to slaughter weights were in the optimal farm plans for all land-labor combinations in each of the study areas. When only operator labor was available, no brood sows were in the optimal plans and the number

of purchased feeder pigs varied from 1,611 in Area I to 2,410 and 2,408 in Areas II and III, respectively. When an additional 3,000 hours of labor was available, the number of brood sows averaged 67 in Area I, 66 in Area II, and 73 in Area III. The number of purchased feeder pigs averaged 2,798, 2,790, and 2,752 for Area I, Area II, and Area III, respectively, with a two-man labor supply. With 7,392 hours of available labor, the combination of farrow to finish swine and feeding out purchased feeder pigs remained the major livestock enterprises; however, the level of sows increased in all optimal farm organizations. The number of brood sows increased to an average of 108, 107, and 114 for Areas I, II, and III, respectively.

As swine prices were varied from \$30.00 to \$60.00 per cwt., swine production became the more dominant livestock enterprise and potential net returns to land, operator labor, and management increased as a result of increased production and higher output prices. In addition, with higher land-labor ratios, the net returns were higher. Estimated net returns to land, operator labor, and management varied from \$22,737 to \$270,163 in Area I, \$26,549 to \$259,016 in Area II, and \$25,869 to \$260,292 in Area III in the optimal farm plans.

With \$35.00 per cwt. for swine and operator labor only (Table LXXIV), the estimated net returns varied from \$41,495 in Area I to \$31,040 in Area III. When swine prices were increased to \$50.00 per cwt., the returns increased to \$84,464 and \$75,433 for Area I and Area III. When the labor supply was increased within an area, the estimated net

TABLE LXXIV

NET RETURNS TO LAND, OPERATOR LABOR, AND MANAGEMENT IN THE
OPTIMUM FARM PLANS WITH SWINE PRICED AT \$35 AND \$50
PER CWT, BY AREA, FARM SIZE, AND LABOR SUPPLY

Farm Size	Land-Labor Ratios	Net Returns to Land, Operator Labor, and Management	
		Swine Prices (Dollars)	
		35	50
Area I			
Base (160 ac.)	1-18.7	\$41,495	\$ 84,464
	1-37.5	58,205	152,736
	1-46.2	69,791	185,636
Medium (320 ac.)	1-9.4	38,472	82,969
	1-18.7	62,210	154,375
	1-23.1	73,048	186,732
Large (480 ac.)	1-6.3	40,913	84,664
	1-12.5	64,834	154,509
	1-15.4	76,657	187,134
Area II			
Base (135 ac.)	1-22.2	33,068	77,574
	1-44.4	53,157	144,041
	1-57.7	68,740	177,659
Medium (270 ac.)	1-11.1	37,289	79,481
	1-22.2	57,090	146,999
	1-27.4	66,365	178,131
Large (405 ac.)	1-23.3	40,155	79,637
	1-46.5	60,284	147,829
	1-57.3	69,563	178,794
Area III			
Base (129 ac.)	1-23.3	31,040	75,433
	1-46.5	50,453	142,051
	1-57.3	59,452	172,888
Medium (258 ac.)	1-11.6	33,107	77,778
	1-23.3	53,078	144,131
	1-28.7	62,157	175,164
Large (387 ac.)	1-7.8	35,392	78,693
	1-15.5	55,148	146,037
	1-19.1	64,442	177,248

return to land, operator labor, and management increased in Area I from \$41,495 with operator labor to \$69,791 when 7,392 hours of labor was available. When farm size was increased to 320 acres, net returns increased from \$38,472 with operator labor to \$73,048 with the addition of 7,392 hours of labor. For the large farm (480 acres), net returns varied from \$40,913 with operator labor to \$76,647 when the labor supply was increased to 7,293 hours.

With swine priced at \$50.00 per cwt. in Area I, the net returns increased from \$84,464 to \$185,636 for the base farm when labor was increased from 3,000 to 7,392 hours, from \$82,969 to \$186,732 for the 320 acre farm size with an increase in labor from 3,000 to 7,293 hours, and from \$84,664 to \$187,134 on the large farm with an increase from 3,000 to 7,293 hours of available labor.

As shown in Table LXXIV, similar increases occurred in the net return to land, operator labor, and management as the labor supply was increased for a specified farm size. Also the level on income increased as a result of the increase in available acreage.

The marginal value products were determined for the most restrictive resources for all the optimal farm situations. As swine prices were varied from \$30.00 to \$60.00 per cwt. with different land-labor ratios, wide variations occurred in those resources which restricted the optimum plan as well as the level of the MVP. For all land-labor situations analyzed continuous cropland was the most restrictive land class for most swine price levels. The values for MVP for continuous cropland for the base size farm and operator labor are shown in

Figure 4. When swine were priced at \$35.00 per cwt., the MVP for continuous cropland was \$39.96 per acre and at \$50.00 per cwt. was \$5.78 per acre for Area I. With the addition of 3,000 hours of labor the MVP for continuous cropland increased to \$66.25 and \$70.82 per acre, and with 7,392 hours of labor available to \$84.91 per acre and \$70.82 per acre for the two levels of swine price. As farm size increased, the MVP for continuous cropland decreased with increases in labor supply. Continuous cropland was not a restricting resource for the large farm in Area I when swine was priced at \$50.00 per cwt.

Much higher MVP's were noted for continuous cropland in Area II and Area III. With operator labor and the base farm size (Figure 4), the MVP at both \$35.00 and \$50.00 swine prices exceeded \$80.00 per acre in these situations. As the labor supply and land size were increased, the marginal value products remained above a rental rate of \$48.00 per acre for continuous cropland; however, with \$50.00 per cwt. for swine, the MVP's were lower than this rental rate and with high land-labor ratios, land was not a restricting resource.

The MVP's for labor varied widely with alternative land-labor ratios and varying swine prices. The March-April and September-October labor periods had high MVP's for most situations considered. The MVP's for the March-April labor period (Figure 5) with \$35.00 per cwt. for swine and using operator labor, were above \$18.00 per hour in all areas; however, with \$50.00 per cwt. for swine only in Area I was labor restrictive in the March-April period. The MVP's for labor in the September-October labor period (Figure 6) was positive with both \$35.00

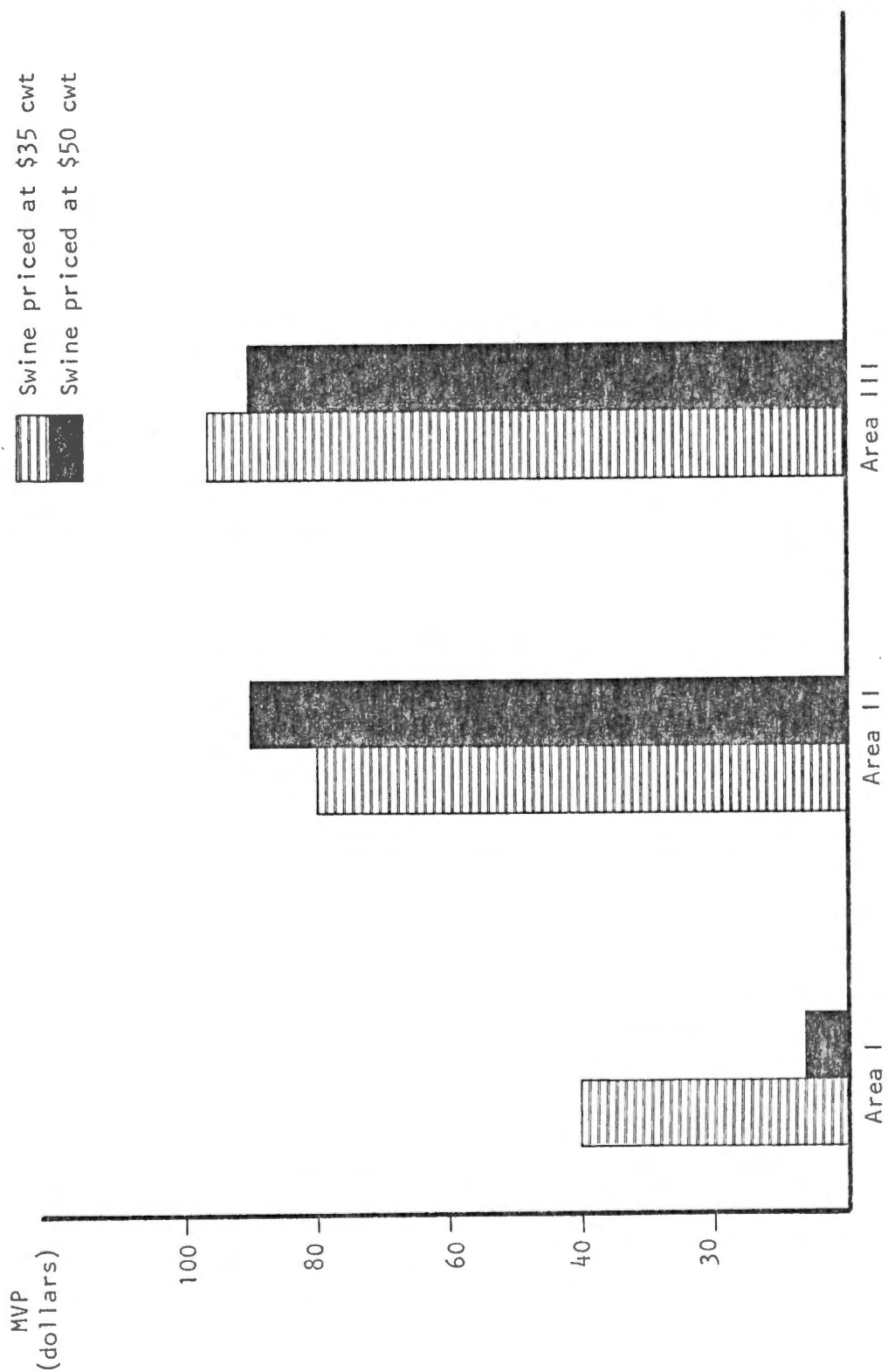


Figure 4. Marginal value products for continuous cropland for base size farm and operator labor, by areas.

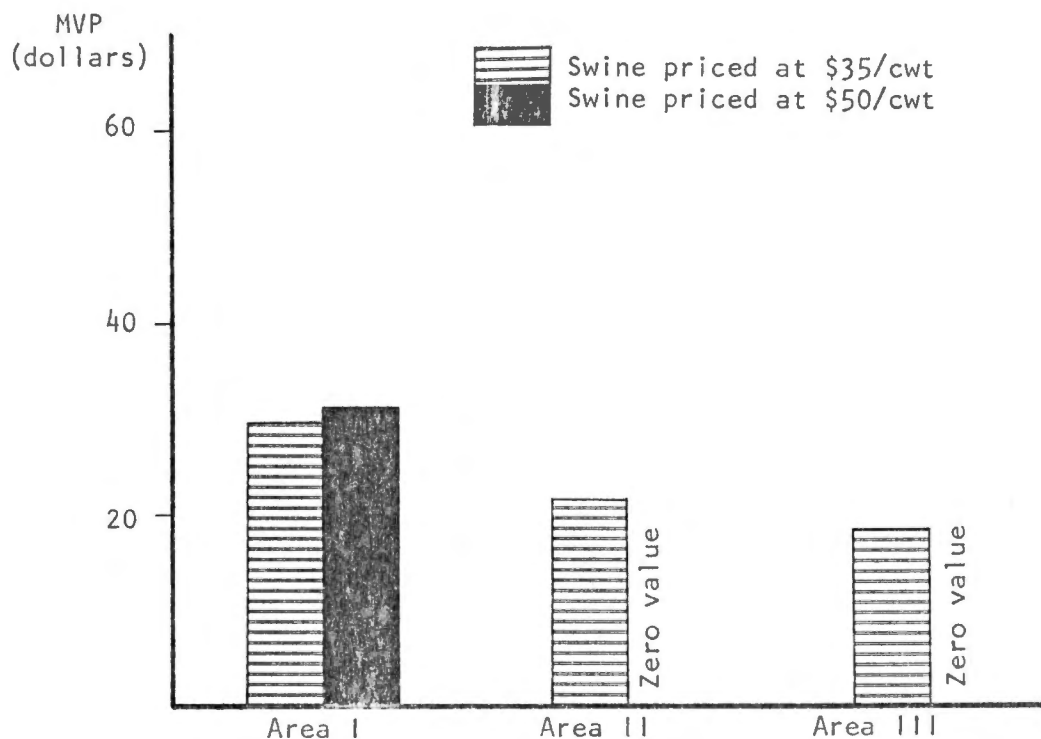


Figure 5. Marginal value products for March-April labor for base size farm and operator labor, by area.

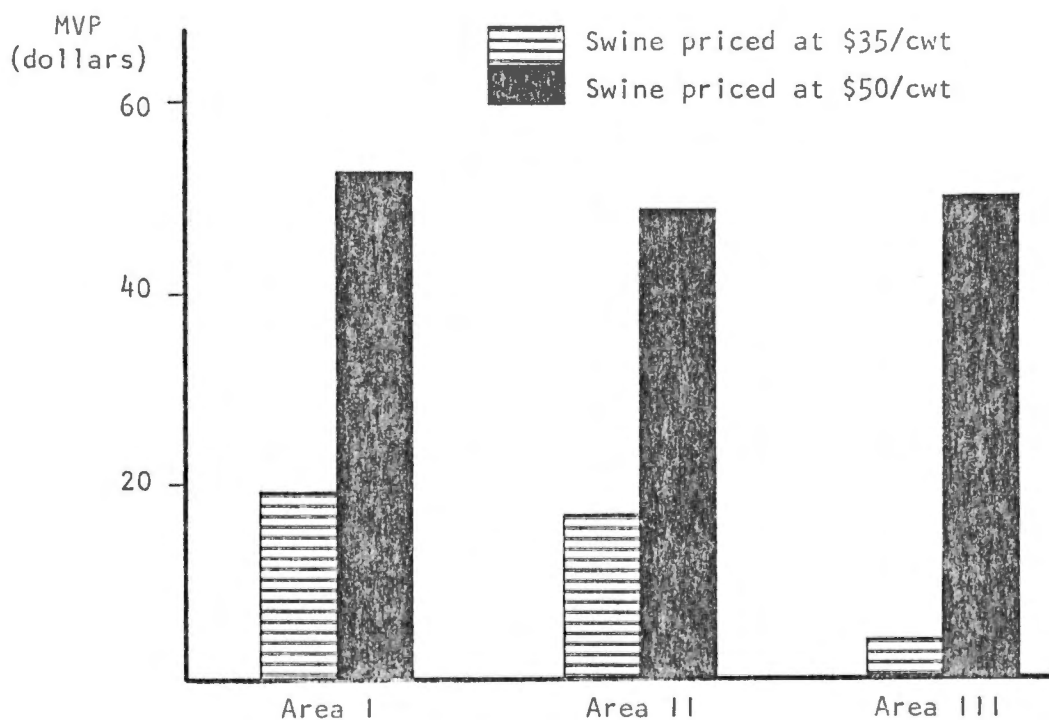


Figure 6. Marginal value products for September-October labor for base size farm and operator labor, by area.

and \$50.00 per cwt. prices for swine for all areas and exceeded the wage rate for the base farm using operator labor. As the labor supply increased on a given size farm, the MVP's decreased, but remained above above \$3.00 per hour for some labor periods.

Optimal Farm Organizations with Variation in Production Efficiency

Optimal farm organizations were obtained to determine the effect on net returns to land, operator labor, and management when selected efficiency factors were varied. Factors varied were the costs of grain, the number of pounds of pork produced per brood sow farrowed, and the amount of feed to produce a pound of pork. Land was restricted to 149 acres of openland while the available labor was restricted to 4,898 hours.

Swine prices were held constant at \$35.00 per cwt. and feeder pig prices were \$24.15 per head. Corn prices were varied from \$1.50 per bushel to \$4.00 per bushel.

When corn was priced at \$1.50 per bushel, the optimum farm organization included a 122-brood sow farrow to finish swine operation. The majority of the grain (22,303 bushels) would be purchased, while the cropping program included the production of wheat, milo, and soybeans. As corn prices were increased by fifty-cent intervals to a maximum of \$4.00 per bushel, corn production increased while the production of wheat-soybean acreage decreased. Red clover and timothy hay was produced on non-rowcrop acreage when corn was priced at \$2.50 per bushel and above. The number of brood sows

in the optimal plans (Figure 7) varied from 125 to 112, while purchased feeder steers varied from 14 to 71 when corn was priced at \$2.50 and \$4.00, respectively. Purchased feeder pigs to be fed to slaughter weight varied from 190 with \$1.50 corn to 86 when corn was priced at \$3.50 per bushel and were not in the optimal plan when corn was \$4.00 per bushel.

Net returns to land, operator labor, and management varied over a wide range as purchased corn price was increased (Figure 8). The estimated returns were \$69,200 with corn priced at \$1.50 per bushel and \$18,537 when corn was priced at \$4.00 per bushel.

The number of hogs produced per brood sow farrowed per year was varied from 10 to 20. With an average of five hogs per farrowing, the optimal plan (Figure 9) included 19 brood sows in a farrow to finish system, 2,235 purchased pigs fed to slaughter weight, and 75 backgrounded steers. All continuous cropland was used for grain corn production and 42.3 acres of winter pasture was used for the steer program. With an increase in the number of hogs produced per sow to six per litter the number of sows in the optimal plan increased from 19 to 102, while purchased feeder pigs decreased from 2,235 to 554. With 10 pigs produced per farrowing, the optimal plan included 126 sows and only 8 purchased feeder pigs. Steers were not included in the optimal plan when the number of hogs produced per sow per farrowing was 9 and 10.

Estimated net returns to land, operator labor, and management (Figure 10) increased 127 percent as the number of hogs produced per brood sow was increased from 10 to 20 per year.

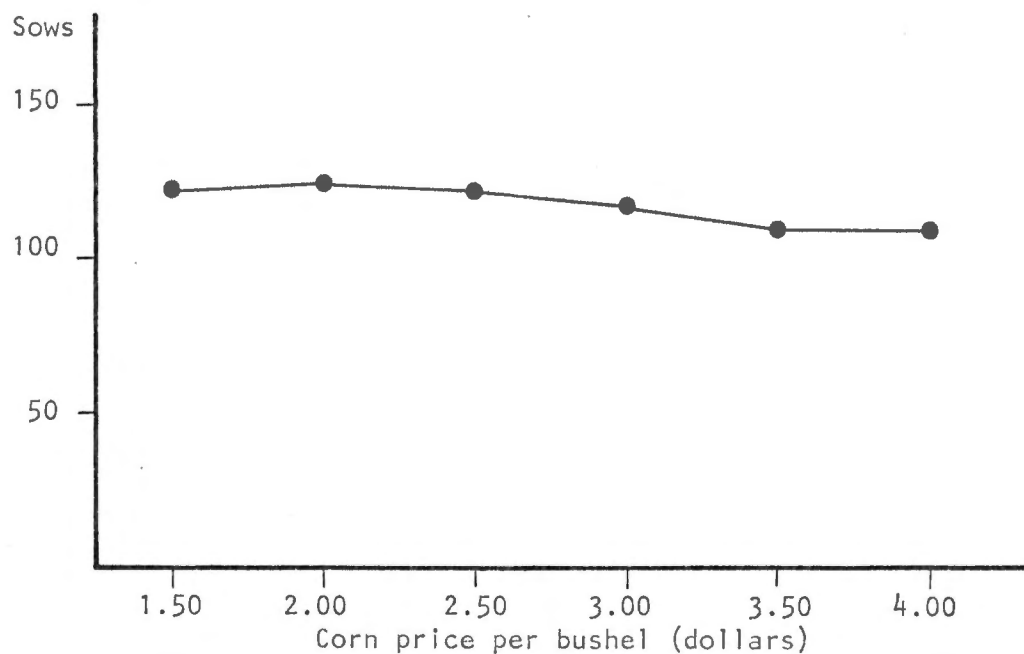


Figure 7 Number of brood sows in optimal plans with varying corn prices per bushel.

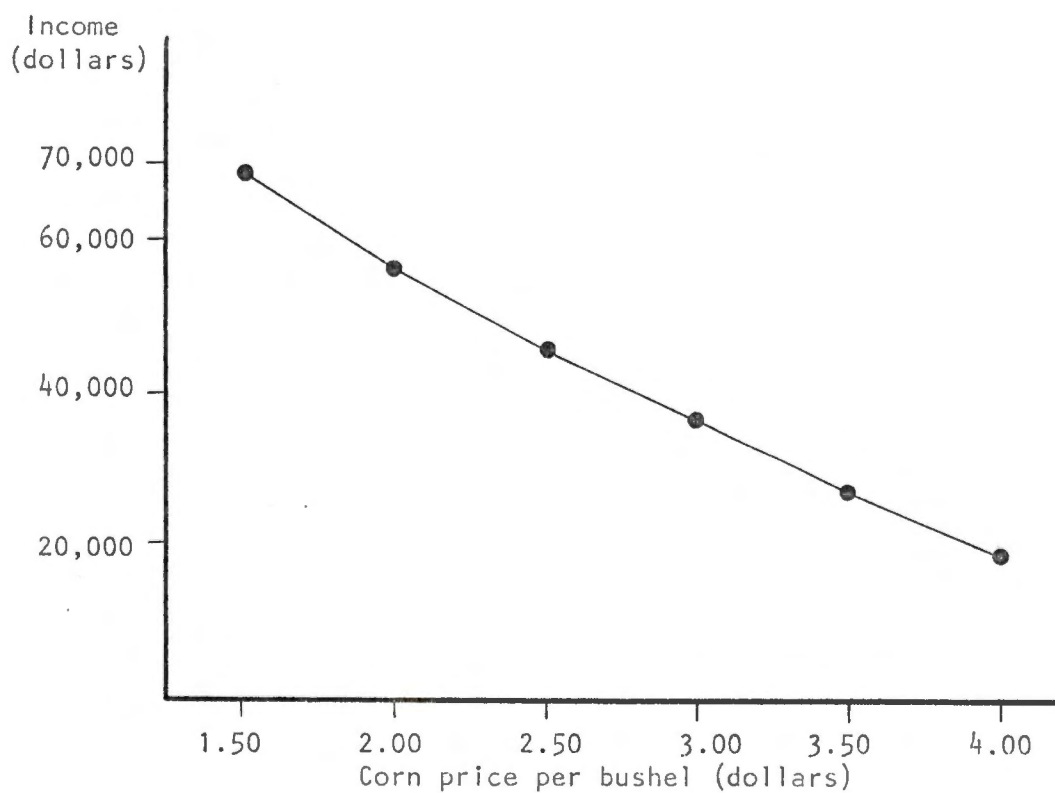


Figure 8. Relationship of net returns and varying corn prices per bushel.

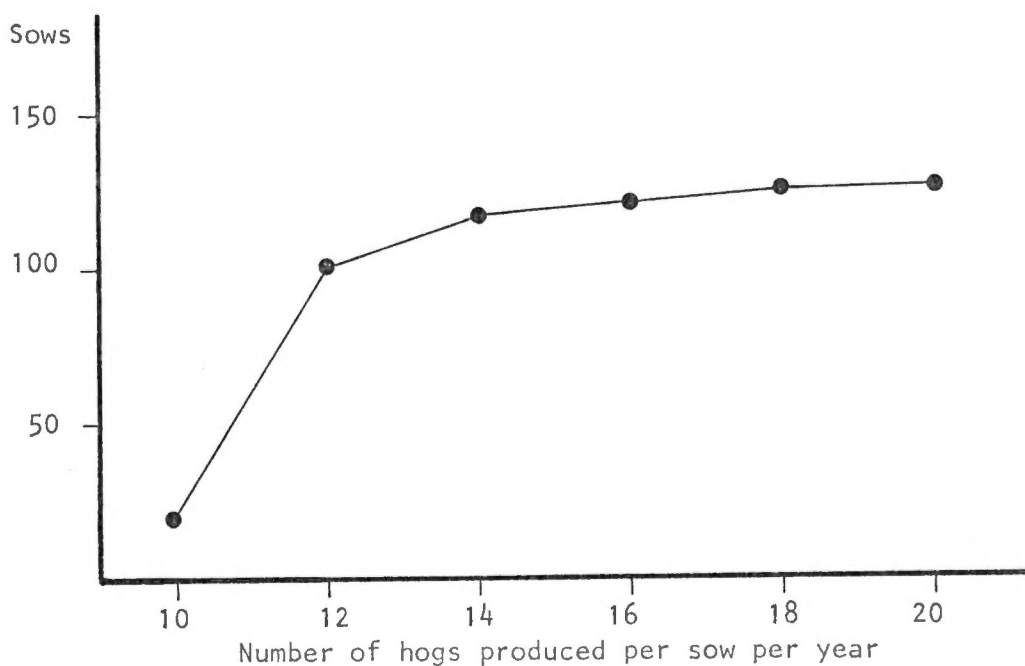


Figure 9. Number of brood sows in the optimal plans with varying numbers of hogs produced per sow.

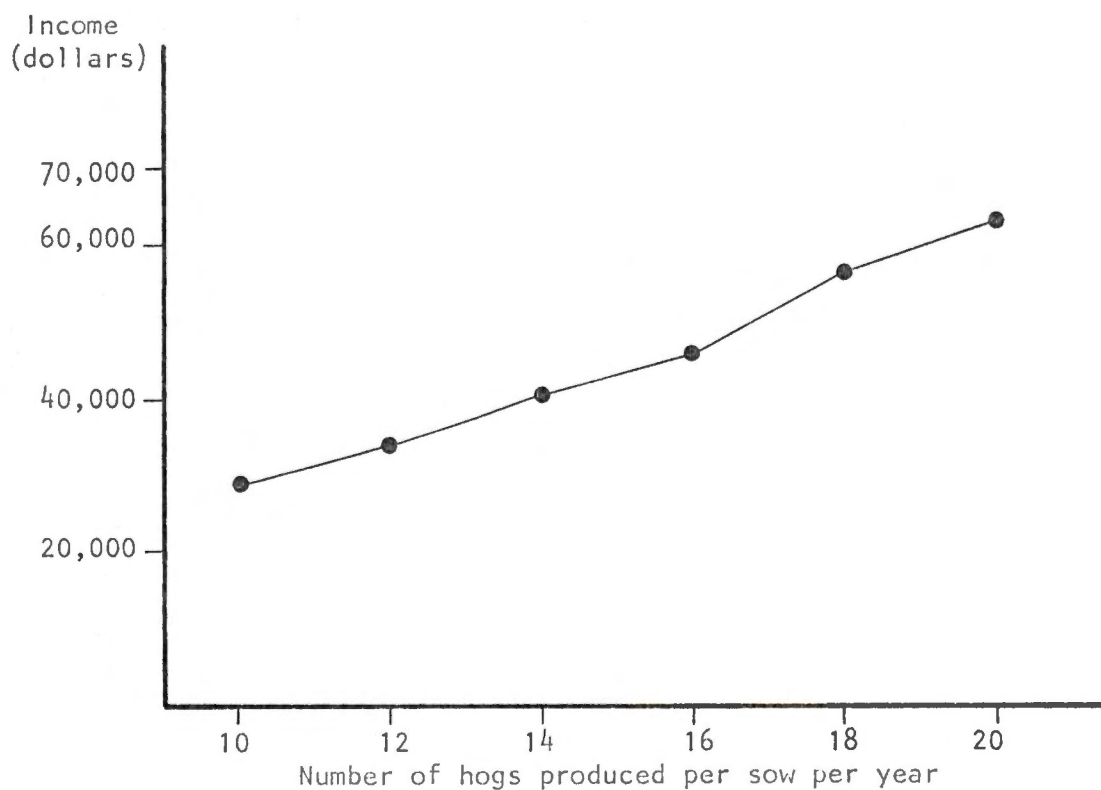


Figure 10. Relationship of net returns and varying the number of hogs produced per sow per year.

Optimum farm plans were also developed for the representative farm when the amount of feed to produce a pound of pork was varied from 3.2 to 4.8 pounds. A selling price of \$35.00 per cwt. was assumed for slaughter hogs, \$24.15 for purchased feeder pigs and \$2.65 per bushel for corn.

With a 3.2 conversion rate, the optimal plan included 124 brood sows (Figure 11) in a farrow to finish operation and 185 purchased feeder pigs to be fed to slaughter weight. Approximately 45 acres of grain would be produced and 19,159 bushels of corn would be purchased. A net return of \$57,826 could be obtained with this farm organization (Figure 12). As the amount of feed required to produce a pound of pork increased, the number of brood sows remained about the same. The number of purchased feeder pigs decreased from 185 to 150 as feed conversion varied from 3.2 to 4.8. Beef steers were in the optimal plan when the feed conversion ratio was 3.8 to 4.8 and varied from 14 to 54 head, respectively. The grain production increased to 76.4 from 49.9 acres with a 3.2 conversion rate for acres with a 4.8 feed conversion and 22,775 bushels of purchased grain was required to feed the swine. Potential net returns to land, operator labor, and management decreased to \$27,246 (Figure 12) with a 4.8 conversion compared to \$57,826 where a 3.2 conversion rate was assumed.

The Effect of Variation in Livestock Enterprise Alternatives
on Optimal Farm Organization and Net Returns to
Land, Operator Labor, and Management

Comparisons were made to determine the effect of various livestock enterprise constraints on the potential net returns to land,

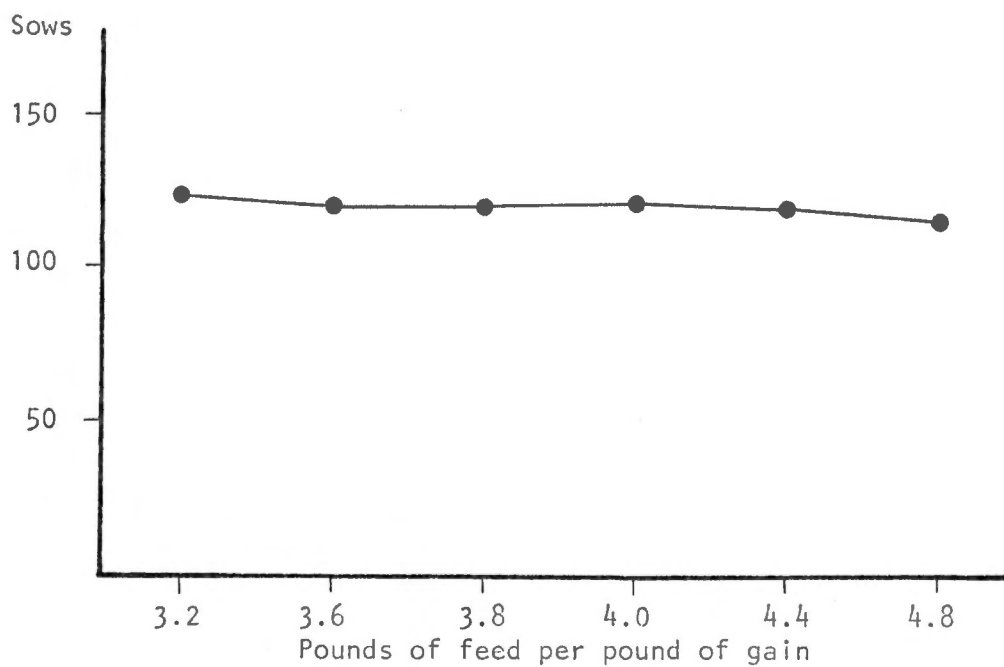


Figure 11. Number of brood sows in the optimal plans with varying the pounds of gain per pound of feed.

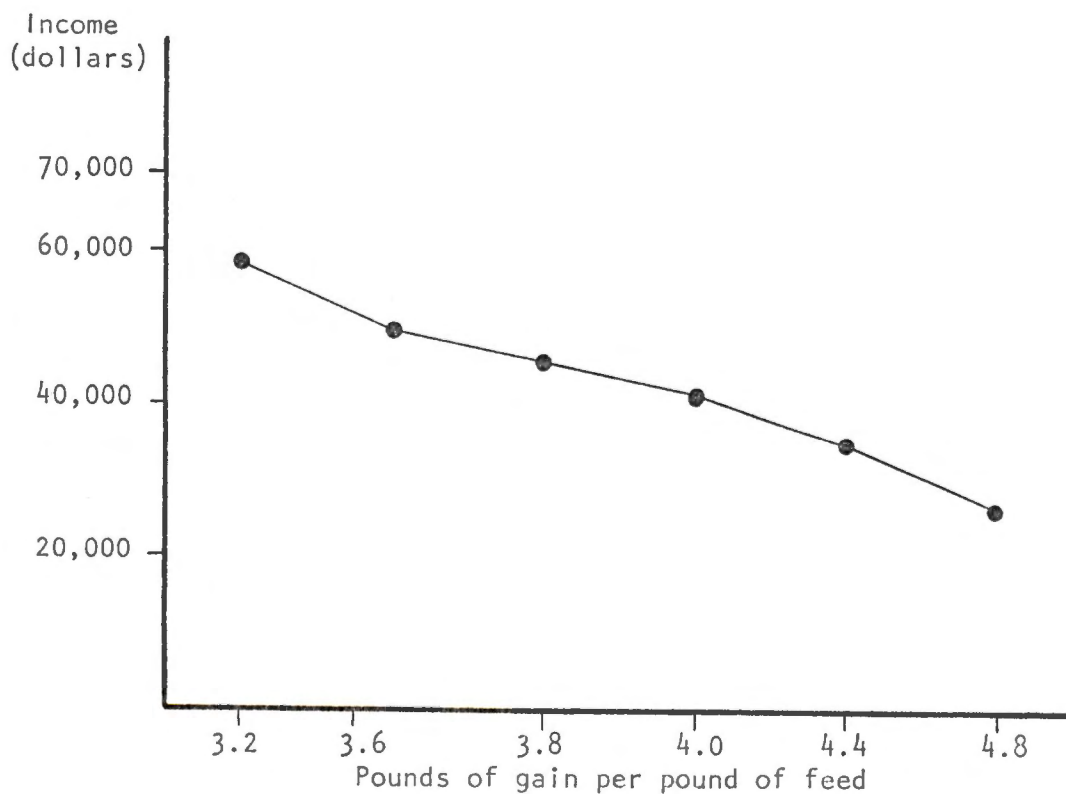


Figure 12. Relationship of net returns and varying the pounds of feed per pound of gain.

operator labor, and management in the optimal farm organizations.

A representative farm again was defined as having 149 acres of openland and 4,898 hours of available labor. Input-output data used in the cropping budgets were taken from Table III, Chapter III, page 25, while data used in the swine budgets were taken from Table IV, Chapter III, pages 27-29. Other livestock data were obtained from Farm Planning Manual, E.C. 622.

Two assumptions relative to grain supply were analyzed: (1) grain purchase permitted and (2) grain restricted to farm produced supply. Purchased grain was priced at \$2.65 per bushel for corn, \$2.90 per bushel for wheat, \$2.15 per bushel for barley, and \$2.30 per bushel for milo. Selling prices were assumed to be 6 percent less than the purchase price.

When all livestock enterprises considered in this study were permitted and grain purchase was allowed, the optimal farm organization included a specialized farrow to finish swine system consisting of 126 brood sows and 104 purchased feeder pigs to be fed to market weight. The cropping program included 23.8 acres of grain corn, 21.3 acres of wheat, 21.3 acres of soybeans, and 21.5 acres of permanent pasture. Purchased grain to meet the feed requirements included 20,045 bushels of corn and wheat. A net return of \$50,055 (Figure 13, Plan 1) would be possible with this farm organization. When only home grown grains were permitted, only six brood sows were included in the optimal farm organization. A 67-cow Grade "A" dairy operation was the major livestock enterprise. Grain corn production was reduced to 17.2 acres

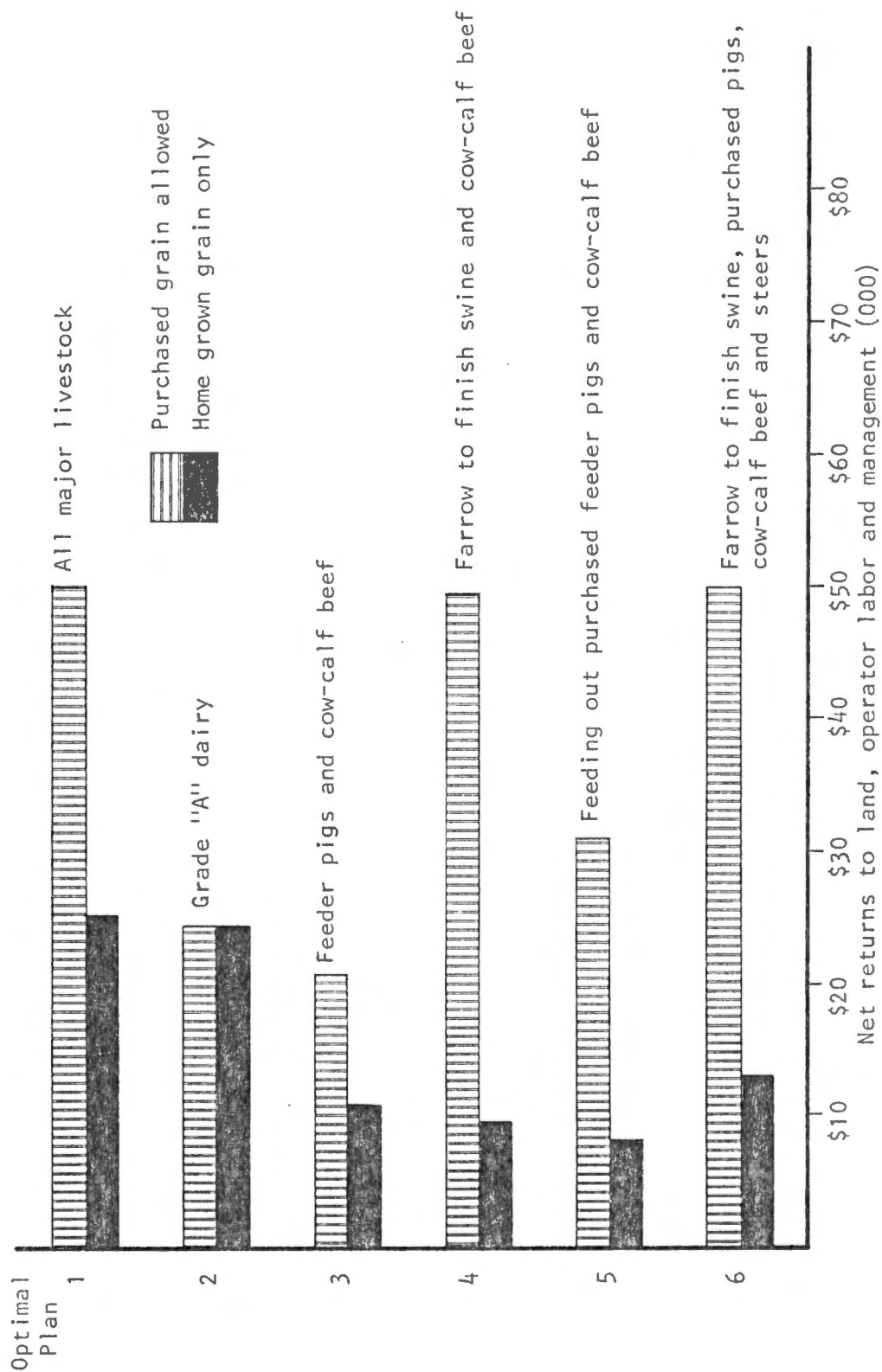


Figure 13. Net returns for alternative livestock systems, with and without purchased grain.

and most land was utilized for silage and pasture for the dairy herd. Estimated net returns to land, operator labor, capital, and management was reduced to \$25,508 (Figure 13, Plan 1).

When the only livestock permitted was Grade "A" dairy and purchased grain was allowed, the optimal plan included a 71-cow dairy operation. Corn silage and pasture would be produced on the farm and 113 tons of hay were purchased. An estimated net revenue of \$24,687 (Figure 13, Plan 2) would be obtained. No changes occurred in the optimal farm organization when grain buying was not permitted.¹

When the farm organization was restricted to the production of feeder pigs and feeder calves and purchased grain was permitted, the only livestock in the optimal plan was 193 sows. The cropping program included 40 acres of grain corn, 4.6 acres of wheat-soybeans, 23.1 acres of alfalfa, .3 acres of burley tobacco and 32.8 acres of pasture. When grain buying was not permitted, the number of sows decreased to 84 and a 27-cow beef cow-calf herd was in the optimal plan. All continuous cropland (45 acres) was used for corn and tobacco, and 42.3 acres of bermuda grass hay was produced for sale. The potential returns to the fixed resources decreased by 49 percent when only home grown grains were considered. This was a decrease from \$20,517 to \$10,389 (Figure 13, Plan 3).

When a farrow to finish swine system and feeder calves were the only livestock permitted and purchase grain was allowed, the only

¹The model was designed so that all grain for the dairy would be purchased. If home grown grains were available, these could be used as feed if practical.

livestock in the optimal plan was 127 sows. Forty-five acres of continuous cropland was used for grain production, 20 acres of rotational land was also used to produce grain, and 20 acres of red clover-timothy hay was produced for sale. The swine required 19,097 bushels of purchased corn and wheat. When the model was restricted to only home grown grains, the number of brood sows in the optimal plan was reduced to 19. The optimal plan also included 33 brood cows in a feeder calf system. The 45 acres of continuous cropland was used to produce grain corn and burley tobacco. Bermuda grass hay and permanent pasture utilized the remaining land. A potential net return of \$49,699 was obtained with purchased grain and \$9,292 when grain buying was not permitted (Figure 13, Plan 4, page 231).

When the livestock enterprises were restricted to purchasing feeder pigs and feeder calves, and allowing purchased grain, the optimum farm organization included the feeding out of 3,999 slaughter hogs to a market weight of 230 pounds. All continuous cropland was used to produce grain and 37,154 bushels of grain would be purchased. The estimated net returns to land, operator labor, capital, and management was \$31,151 (Figure 13, Plan 5, page 231). Where only home grown grains were permitted in the model, the number of purchased feeder pigs in the optimum plan was reduced from 3,999 to 304. In addition 29 beef cows were in the optimal farm plans. The potential net returns were reduced by 76 percent or from \$31,151 to \$7,353 (Figure 13, Plan 5, page 231) as a result of restricting grain to that amount produced with the available land.

When farrow to finish swine, feeder pig production, purchased feeder pigs, feeder calves, and purchased beef steers were considered as livestock enterprises in the optimal plan included 126 brood sows in a farrow to finish system, 96 purchased feeder pigs and 4 beef steers. Thirty acres of grain corn and 15 acres of wheat were produced for feed. Also 19,655 bushels of grain would be purchased. When grain purchasing was not permitted, the optimal plan included 81 brood sows producing feeder pigs to be sold at 45 pounds and 123 feeder steers. The estimated net returns were \$49,916 with purchased grain and \$13,061 when only home grown grain was considered in the model (Figure 13, Plan 6, page 231).

B. CONCLUSIONS

Based upon the assumptions and results of this study, farrow to finishing swine production and purchasing feeder pigs and feeding to a slaughter weight of 230 pounds are profitable livestock enterprises in relation to other livestock alternatives considered when the price of swine are \$35.00 per cwt. and above for the resource conditions in the three study areas. When slaughter hogs were priced at \$30.00 and less, Grade "A" dairy production became a more profitable livestock enterprise than the production of swine. Purchased feeder steers were also included in the optimal plans in a "backgrounding" program as a supplemental enterprise to swine under numerous land-labor combinations analyzed and would improve the overall income level.

When swine are priced at \$35.00 and \$40.00 per cwt., a farrow to finish production system was the major swine system in the optimal

plan, but at swine prices of \$50.00 and \$60.00 per cwt., a specialized swine feeding system using purchased feeder pigs would generate higher net returns to land, operator labor, and management.

In order to obtain the optimum farm organization for the representative farm situations analyzed, a large volume of grain would be purchased. For farm operators unable or unwilling to invest in adequate facilities and to purchase grain to feed swine to slaughter weights, the production of feeder pigs would be a more profitable enterprise. However the potential net returns to land, operator labor, and management would be considerably lower than when purchased grain was considered.

The results of the analysis indicate that swine production appears to be a relatively profitable enterprise alternative in the three study areas; however, Area I has an advantage over the areas to the east because of a larger acreage of continuous cropland and lower purchased grain prices.

In most resource situations analyzed, the continuous cropland was completely utilized in the production of feed grain and soybeans. High marginal value products for this land class (much higher than the expected rental rate in Tennessee) suggests the farm operators could improve income by renting continuous cropland, if available.

Consistently high marginal value products per hour of labor in March-April and September-October labor periods for most resource situations indicate that seasonal hired labor should be used during these periods if available and wages competitive with nonfarm employment could be paid by farm operators.

Analysis of factors related to production efficiency shows that producing more pork per sow farrowed and more pork per pound of feed could substantially improve net returns on swine farms. Also by acquiring grain storage facilities so that timeliness of grain purchases and volume buying of grain, which tend to reduce grain costs, could improve the level of income for farmers feeding swine provided that storage costs are more than offset by grain purchase costs.

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