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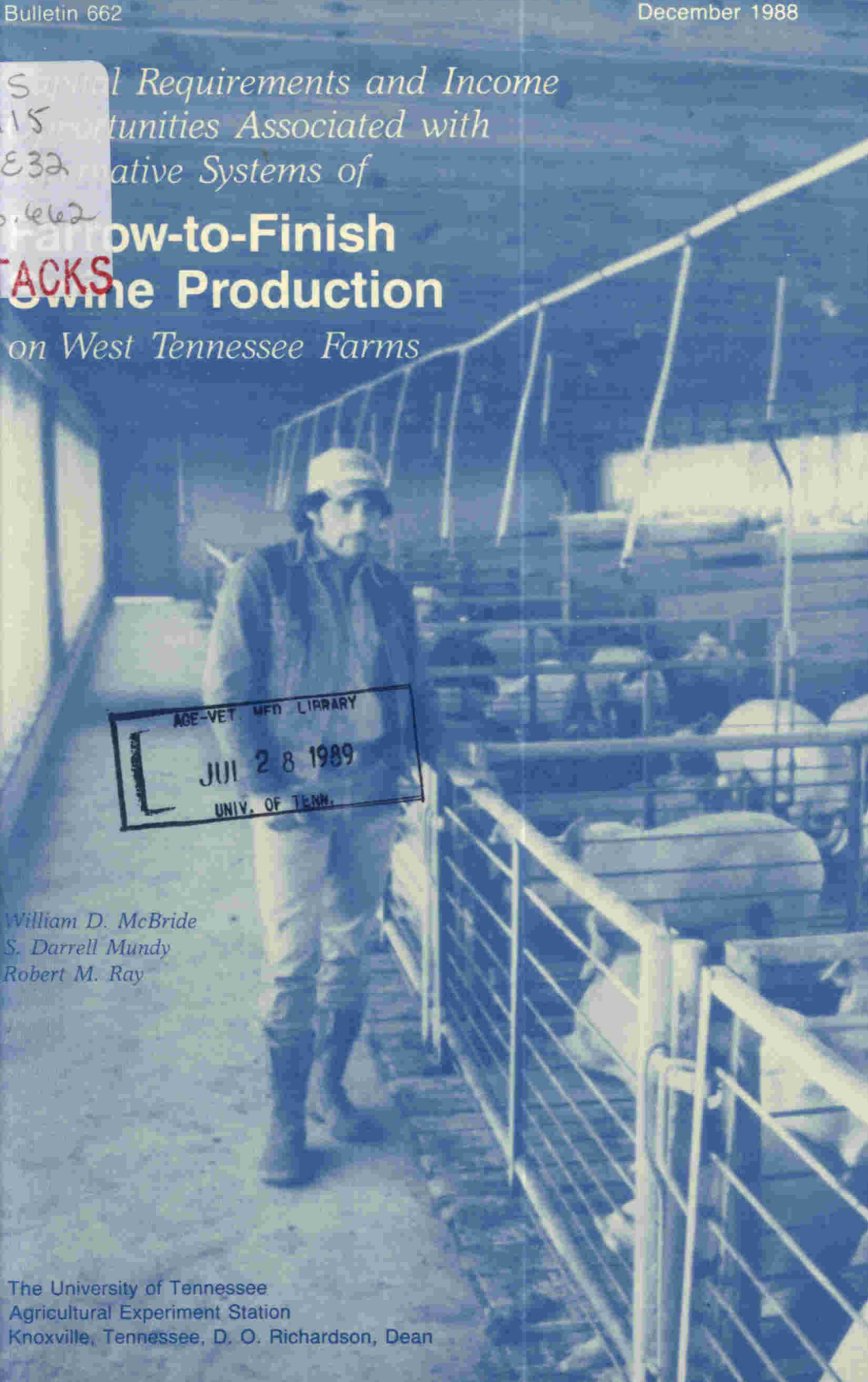

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Introduction

Both the Tennessee and U.S. swine industries have undergone significant changes in hog production methods over the past several years. In the 1950s, small farms, all producing hogs in much the same way, characterized the swine industry. Capital-intensive, labor-saving technologies introduced in the 1960s drastically changed the way hogs were produced. Fewer and larger operations characterize the swine industry today. Because of cost advantages and increased labor efficiency provided by modern production systems, the trend toward fewer and larger operations will likely continue into the future.

From 1974 to 1982, the percentage of all hog producers in Tennessee selling 500 or more hogs and pigs annually rose from 2.6 percent to 5.6 percent (U.S. Department of Commerce). During this period, the percentage of total swine sales from producers selling 500 or more head annually increased from 28.5 percent to 51.4 percent. While these changes show a clear trend toward larger production units in Tennessee, the concentration of production among larger producers in Tennessee is well below that of the U.S. swine industry as a whole. In 1982, 16.4 percent of the hogs and pigs sold in the U.S. came from operations selling 500 or more head annually. These operations accounted for nearly 70 percent of total swine sales in the U.S.

Possible reasons for the structural differences between the Tennessee and U.S. swine-producing industries are: 1) Tennessee swine farmers may lack information on resource requirements and production technologies that have made large-scale hog production economically efficient; and/or 2) Tennessee swine farmers may face resource and market situations that limit the implementation of modern hog production technologies on many farms relative to other producing areas.

The Economic Problem and Research Justification

Consistently low levels of realized net farm income have characterized Tennessee farmers for many years. Average net income per farm in 1982 was $4,274 for Tennessee compared to $9,188 for the U.S. (U.S. Department of Agriculture 1982). Compared to surrounding states, net farm income in Tennessee was lower than Georgia ($9,647), Alabama ($8,857), Mississippi ($5,970), Arkansas ($9,691), Kentucky ($8,765), and North Carolina ($11,027). Low levels of farm income indicate that Tennessee farmers either lack the resources to generate a higher level of net income; are not combining resources in the most efficient ways, or both. In any case, adjustments in resource use are necessary for incomes to be increased in the future.

Changes in U.S. agricultural policy in recent years are of increasing concern to Tennessee farmers. Economic prospects for many Tennessee farm products, including tobacco, corn, and soybeans, have been reduced

both by growing pressure to reduce government support programs and increased foreign competition. With expectations of reduced net returns from current enterprises, many farmers are seeking alternative enterprises for supplementing income.

Ongoing research at the Ames Plantation Experiment Station in West Tennessee (Lidvall et al. 1980) has shown several systems of hog production to be profitable in most years.[1] Results from studies in other states[2] have also shown that with above-average levels of management, alternative systems of swine production are profitable. While findings from these studies are based on a budgetary analysis of the hog enterprise, more research is needed to examine how alternative systems may fit into the overall farm organization. Information is needed by current and potential hog producers, as well as those advising farmers regarding the minimum levels of required resources to achieve a specified income.

The Research Problem

Recent technological advancement in hog production has substantially increased the investment required in facilities and materials. Higher initial investment and annual operating capital requirements involve decisions for long-term resource commitments to swine production. Information including resource requirements, incomes attainable, and farm organizations associated with alternative systems of swine production will enable decision makers to evaluate more effectively whether swine production offers a reasonable means of achieving the goals of the farm business.

The geographical area of analysis included selected West Tennessee counties. Physical and economic resource characteristics specific to West Tennessee have made this area prominent in the production of slaughter hogs. Many farmers in West Tennessee depend on swine production for a major portion of their annual income.

The focus of this study was the farrow-to-finish swine enterprise and the capital requirements and income opportunities associated with hog production on West Tennessee farms. Resource assumptions, price and yield estimates, and enterprise alternatives considered were developed to characterize typical West Tennessee farms. Consequently, farm plans generated in the analysis likely have limited relevance outside of those counties comprising the study area. However, results of the budgetary and investment analyses, with appropriate price and yield modifications, may be useful to current and potential producers statewide.

[1]The systems project is an ongoing study begun in 1975 to compare pasture, partial confinement and total confinement systems of farrow-to-finish swine production (Lidvall et al. 1980).

[2]See Bullock and Beals 1975; Crews et al. 1979; Kliebenstein and Sleper 1980; Saunders et al. 1979; and Schupp 1973.

Objectives

The general objectives of this study were to determine the required resources and the optimal farm organization to achieve selected net income levels in specified West Tennessee swine farming situations. Specific objectives included:

1. developing resource situations characteristic of West Tennessee farrow-to-finish swine farms,
2. developing enterprise budgets and investment requirements associated with selected farrow-to-finish swine production systems and other enterprises currently found on West Tennessee swine farms,
3. estimating the minimum investment and operating capital requirements and the associated enterprise organizations on representative West Tennessee swine farms to return specified net farm income levels, and
4. analyzing the effects of variations in hog prices, purchased-corn prices, labor supplies, feeder pig prices, and capital costs on the minimum capital requirements that achieve the specified net income goals.

Data Sources and Procedural Overview

A mail survey of farrow-to-finish swine producers in a 10-county area of West Tennessee was conducted in October of 1984. Farrow-to-finish swine producers in the counties of Obion, Weakley, Gibson, Crockett, Tipton, Fayette, Henry, Carroll, Henderson, and McNairy (Figure 1) were asked to participate. These counties were chosen because of the relative economic importance the production of slaughter hogs was to farmers in these counties as compared to other counties in West Tennessee (U.S. Department of Commerce 1982).

Each producer received an initial mailing that included the questionnaire and a cover letter explaining the purpose and goals of the survey. Nonrespondents were reminded by a postcard one week after the initial mailing, followed by a second mailing of the original questionnaire and a modified cover letter two weeks later. More than 60 percent of the farmers completed and returned the questionnaire. Information obtained included detailed reports concerning the types and sizes of swine production systems, descriptions of the general swine herd, resource availabilities and use, and overall farm characteristics and organization (McBride and Mundy 1987).

The resource assumptions for typical farms were derived from the survey data on 124 farrow-to-finish swine farms in West Tennessee. Statistical procedures, including univariate analysis, means, and frequencies, were used to analyze the data. A univariate analysis of the various types of available land acreages divided the farms into four separate groups by

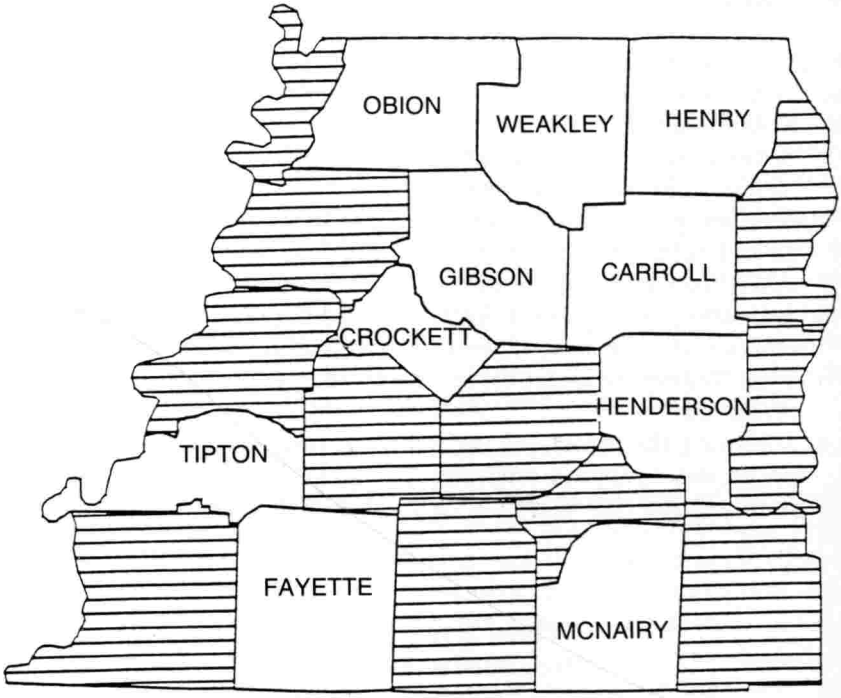

Figure 1. The Ten West Tennessee Counties in the Survey of Farrow-to-Finish Swine Farms, 1984.

land type (i.e., row crop, forage, pasture, and woodland). Mean acreage of each grouping provided the land base assumptions used in the study. Univariate procedures were also used to divide the farms into four groups based upon the acreage of productive land (owned plus rented cropland). Means and frequencies of the specific types of labor, machinery, and general overhead items available within each of these groups were used to determine the other resource assumptions for the typical farms. Typical farm situations were developed for small, medium, large, and extra-large farms. These four base situations were used throughout the study.

Enterprise budgets for the selected swine systems were developed using data from the swine systems project on the Ames Plantation in West Tennessee (Lidvall et al. 1980) as well as sources in other states. In cases where current costs for a specific item were not available, estimates were obtained by inflating dated costs by an appropriate price index. Input use rates and costs used in the budgets for the other enterprises were derived from the *Tennessee Farm Planning Manual* (Walch et al. 1984). Price and yield data used in the enterprise budgets were determined from historical Tennessee statistics (Tennessee Department of Agriculture 1984).

Linear programming techniques were used to obtain the estimated minimum capital requirements to realize the specified net farm income levels for each farm situation. The programming models were designed to minimize total capital requirements subject to a minimum net income constraint. Owned land was not included as part of the total capital requirement. Acreage rented and purchased corn for swine feed were treated as part of the total capital requirement and charged a fixed rate per unit of each required. Both owned and rented cropland were limited to the quantities indicated by the survey data for each farm situation. The amount of corn available for purchase was not limited in the analysis. Postoptimal procedures were utilized to examine the effects on the required resources and on farm organizations of changes in selected factors. Hog prices, purchased-corn prices, labor supplies, feeder pig prices and capital costs were individually varied. These factors were selected because of the influence they have in determining the income potential of swine production and the type and size of system required.

Four farm size situations were analyzed, each at two income levels. The net income levels included $15,000 and $30,000 on the small, medium, and large farms and $30,000 and $50,000 on the extra-large farm. Net income was defined as the residual return to owned land, operator labor, risk, and management. The base situations used five-year, weighted-average prices (1980-84), cost estimates based on 1984 levels and yields consistent with the levels of input use and an above-average level of management. Enterprise alternatives included four systems of farrow-to-finish swine production. In addition, alternatives allowing the sale of pigs as feeders and the purchase of feeders for finishing were available. Also included in the model were 10 other enterprises commonly found on West Tennessee swine farms. Row crop alternatives included corn, soybeans, cotton, wheat, double cropped wheat and soybeans, and grain sorghum. Alfalfa and red clover hay were the forage alternatives. The only other livestock alternative was the production of feeder calves in a beef cow-calf enterprise.

Resource Assumptions

Land Resources

Wide variation in the acreage of both owned and rented land existed on the survey farms (Table 1). For the smallest size group, acres of owned row cropland averaged 47.4, as compared to 571.3 acres for the extra-large farm group. Acreage of rented row cropland averaged 53.3 and 853.3 acres for the smallest and largest size groups, respectively. Farrow-to-finish swine production was found on a wide range of farm sizes.

In the programming analysis, owned land was considered a fixed resource; hence, costs were determined without including a charge for owned land. Net returns included a residual return to owned land. Available acreages of owned and rented land were limited to the mean quanti-

Table 1. Available Owned and Rented Land by Land Classification for the Four Farm Sizes

Land classification	Farm size			
	Small	Medium	Large	Extra-large
	number of acres			
Owned				
Row cropland	47.4	103.3	201.3	571.3
Forage land	9.5	23.9	53.9	199.9
Permanent pasture	9.9	23.7	46.5	117.7
Woodland	13.6	32.2	72.6	294.1
Total available owned land	80.4	183.1	374.3	1,183.0
Rented				
Row cropland	53.3	164.3	396.9	853.3
Forage land	10.7	22.8	45.0	146.7
Pasture	15.0	44.3	101.7	306.7
Total available rented land	79.0	231.4	543.6	1,306.7

ties indicated by the survey at each farm-size situation. Land could be rented in any amount up to the assumed limit. Rates charged on rented land were $60.00 per acre per year for row crop and forage land and $45.00 per acre per year for pastureland (Tennessee Department of Agriculture 1984).

Labor Resources

Substantial differences exist among alternative systems of swine production in the amount of required labor. Thus, the amount of available labor and cost of labor are important determinants of the most profitable system for a particular farm situation. Survey results indicated that the amount of available labor restricted opportunities to expand the swine operation on many of the farms.

Labor restrictions were developed using the survey information on labor availability for the farms in each size category. The small and medium farms were assumed to have a one-person (owner-operator) labor supply with the ability to hire seasonal labor of one-half laborer units on the small farm and one laborer on the medium farm. The labor supply on the large and extra-large farms was assumed to be an owner-operator plus one and two full-time hired hands, respectively. Constraints on the hiring of seasonal labor were set at one and one-half laborers on the large farm and two laborers on the extra-large farm.

Each full-time worker was assumed to provide 2,520 hours per year. This assumption was based upon 50 weeks at 50 hours per week with one-week vacation in July and three days in November and December

for the holidays. Seasonal workers could provide up to 2,520 hours per worker with the hours spread evenly over the year. Operator labor was reduced 10 percent for supervision on farms that employed hired labor. Full-time and seasonal labor availabilities by period and size of the labor force of the four farm sizes are shown in Table 2. Full-time hired labor was charged as an overhead item at the rate of $12,000 per laborer per year. Seasonal labor could be acquired on an hourly basis at the rate of $4.00 per hour up to the assumed limit for each farm situation.

Because of the importance that available on-farm labor has in selecting a swine production system, an alternative labor situation was considered in the postoptimal analysis. Most of the smaller farms in the state are sole proprietorships and, in many cases, the owner-operator is the only source of farm labor. Also, because of the specialized managerial skills required in many modern swine production operations, sources of skilled labor can be limited. For these reasons, an alternative labor situation was analyzed in which the labor force was restricted to only the amount of available full-time labor. In cases where this labor force was insufficient for generating the selected income goals, the available amount of labor was increased by 40 hours per month until the income level was reached. These additions to the labor force were not charged as a direct cost in the linear programming solution and were considered to be provided by

Table 2. Labor Availability by Period and Size of the Labor Force, Four Farm Sizes

Labor period	Farm size			
	Small	Medium	Large	Extra-large
	hours of labor			
Full-time labor				
January-February	433.5	433.5	823.7	1,213.8
March-April	433.5	433.5	823.7	1,213.8
May-June	433.5	433.5	823.7	1,213.8
July-August	383.0	383.0	727.7	1,072.4
September-October	433.5	433.5	823.7	1,213.8
November-December	403.0	403.0	765.7	1,128.4
Total hours available	2,520.0	2,520.0	4,788.2	7,056.0
Seasonal Labor				
January-February	210.0	420.0	630.0	840.0
March-April	210.0	420.0	630.0	840.0
May-June	210.0	420.0	630.0	840.0
July-August	210.0	420.0	630.0	840.0
September-October	210.0	420.0	630.0	840.0
November-December	210.0	420.0	630.0	840.0
Total hours available	1,260.0	2,520.0	3,780.0	5,040.0

family members. Family members were an important source of labor in at least part of the year on the swine farms in the survey. Over 50 percent of the survey respondents reported other family members available year-round while nearly 22 percent reported other family members available seasonally.

Capital Resources

Both operating and nonland investment capital requirements of the enterprises were included in the study. Total amounts of both were not limited individually. However, total required capital, the sum of operating and nonland investment capital, was chosen as the most limiting resource. Thus, total required capital was minimized in the programming analysis to achieve the selected income goals. Swine farmers in the survey reported that available capital for investment in production facilities and equipment was the resource most limiting expansion of the swine operation.

Operating and investment capital were charged in the enterprise budgets on the basis of estimated requirements per unit of production. In the base situations, investment capital was charged at an annual rate of 12.5 percent. Operating capital was charged at an annual rate of 14 percent (Amols and Kaiser 1984). Operating capital was assumed to be utilized for six months in the cropping enterprises and for three months in the swine enterprises. Charges for the use of operating capital were made only for the proportion of the year such capital would be required for a particular use.

Because of the substantial amount of capital required in many modern swine production systems, the cost of capital is important in determining which type and size of operation best fits into a particular farm situation. The postoptimal analysis included variations in capital costs of three percentage point intervals in both investment and operating capital. This analysis included investment capital charges at 9, 12, 15, and 18 percent and corresponding operating capital charges of 10.5, 13.5, 16.5, and 19.5 percent. The actual cost of capital can vary significantly depending upon sources of funds available to the farmer.

Machinery and Overhead Resources

Each farm size was assumed to have a given machinery complement available for use. Machine use was restricted to a specified total number of hours of annual use based upon Tennessee estimates of annual use rates (Walch et al. 1984). The machinery complements were constructed from the survey means of available machinery for each farm-size category. The complements of machinery and annual use restrictions for each farm size are shown in Table 3. A per acre charge for machinery items was assessed each enterprise at the rate in which machinery was utilized in the enterprise. Sources of machinery costs were published budgetary data on

Table 3. Machinery Complements and Restricted Maximum Annual Hours of Use, Four Farm Sizes

Machine	Size	Farm size			
		Small	Medium	Large	Extra-large
		hours of use			
Tractor #1	80 hp	600	600	600	600
Tractor #2	100 hp		600	600	600
Tractor #3	150 hp			600	600
Tractor #4	175 hp				600
Plow #1	4-14''	100	100	200	100
Plow #2	6-16''				100
Chisel plow #1	5 shank	80	80		
Chisel plow #2	9 shank			80	160
Disk #1	12'	70	70	140	70
Disk #2	21'				140
Cultimulcher #1	12'		70		
Cultimulcher #2	20'			70	70
Harrow #1	10'	70	70		70
Harrow #2	14'			70	70
Planter #1	4-row	70	70		70
Planter #2	6-row			70	70
Grain drill #1	11' x 7''	40	40		
Grain drill #2	21' x 7''			40	40
Sprayer	w/boom	40	40	80	120
Cultivator #1	4-row	60	60		60
Cultivator #2	6-row			60	60
Combine #1	13'		175		
Combine #2	15'	a		175	175
Corn header #1	4-row		100		
Corn header #2	6-row	a		100	100
Cotton picker	2-row	a	200	200	400
Pickup baler	PTO	a	a	210	210
Hay rake	side delivery	120	120	120	120
Haybine	7'	180	180	180	180
Grain auger	6'', 42'	80	80	120	160
Hay conveyor	24'	70	70	70	70
Rotary mower	5'	60	60	60	60

[a]Farm was assumed to use custom harvesting.

machinery use in various enterprises in Tennessee for 1984 (Walch et al. 1984).

The small farm was assumed to use custom harvesting of all grain and forage crops. The medium farm used custom harvesting only in the forage production alternatives. Custom rates were based upon those commonly charged West Tennessee farmers (Hunter and Keller 1982).

Certain joint-use resources were designated as overhead items; their costs were not charged to specific enterprises but to the farm as a whole. These items were determined from the joint-use resources of the survey

farms comprising each of the size categories. Joint-use resources included such items as machine sheds, grain bins, trucks, trailers, and full-time hired labor. Such overhead items were assumed to exist on the farms regardless of the enterprises chosen.

Annual overhead costs were developed based upon the average investment requirement of the particular item. The annual overhead costs were $3,490, $3,940, $18,457, and $31,228 for the small, medium, large, and extra-large farms, respectively. The breakdown of total overhead costs by item for each farm size is presented in Appendix Table 1.

Production Alternatives

Swine production alternatives included four systems of farrow-to-finish swine production. Systems were separated by type and level of required investment capital. Alternative systems were determined from an analysis of the cross-sectional data obtained from the mail survey. Farrow-to-feeder pig and feeder pig-to-finish operations were also considered as possible production alternatives for each farm. These systems were determined by splitting the farrow-to-finish systems into split-phase operations. Analysis of the survey data showed that 26.6 percent of the farrow-to-finish swine farms were also engaged in farrow-to-feeder pig operations and 17.7 percent in feeder pig-to-finish operations.

Enterprises other than swine were also considered as production alternatives and included those commonly found on swine farms in the survey. Corn, soybeans, and wheat, the three major crops of this area of Tennessee, were found on the majority of swine farms. Corn production on each farm could either be utilized as hog feed or sold directly. Purchased corn was an additional source of hog feed. The amount of corn available for purchase was not restricted in this analysis. Other enterprises included were cotton, grain sorghum, double-cropped wheat and soybeans, alfalfa, and clover hay. Besides the swine operation, the only commonly found livestock enterprise was beef cow-calf, reported on 35.5 percent of the farms.

Swine Systems

In addition to general information about the swine herd, survey respondents were asked to categorize their system based upon a description of swine facilities used in each phase of production. These categories provided the framework for developing four representative swine systems. Frequencies of specific equipment used in each production phase were utilized in constructing the representative swine systems. The four systems were:

1. A 25-sow pasture system in which sows are farrowed twice a year.
2. A 50-sow, low-investment confinement system in which sows are farrowed four times a year.
3. A 100-sow, high-investment confinement system in which sows are

farrowed six times a year.

4. A 200-sow, high-investment, high-intensity confinement system in which sows are farrowed 12 times a year.

These represented the types and associated sizes of systems commonly found on the survey farms.

The presence of economies as well as diseconomies of size dictated the establishment of assumed limits to variation in budgeted size of a particular system. A doubling of the budgeted size was deemed as a reasonable upper limit in the programming analysis. No statistical relationship was found to exist between the size of the productive land base of the farm and the type and size of swine system. For this reason, all systems were treated as potential production alternatives at each farm size.

A fixed set of performance standards was assumed across all systems. This assumption was consistent with other studies (Lidvall et al. 1980) that have shown small and inconsequential differences among systems in the majority of performance factors. The standards represented those attainable with above-average levels of management. Selected performance standards and annual results for each system are presented in Appendix Table 2.

Basic feed requirements for the hog enterprises were corn and fortified supplements of 40-percent protein. Annual feed requirements per sow varied only slightly among systems. Methods of feeding were directly related to the type of system. The more capital intensive a system was, the more capital intensive the feeding system assumed for that system. Feed was assumed to be ground and mixed on the farm except for creep feed, which was purchased. This assumption was supported by the survey data with nearly 85 percent of the farms having grinder-mixer capability.

In general, much variation exists among systems of swine production in amounts and qualities of required labor. One important consequence of high-investment technology in swine production has been greatly reduced labor needs through the use of slatted floors and mechanical devices for environment control and materials handling. In addition, high-intensity production schedules have smoothed out labor requirements to a more even flow throughout the year. In contrast, lower intensity systems such as pasture systems—require greater amounts of total labor per animal with peak labor demand periods occurring at farrowing. Monthly labor requirements for the farrow-to-finish as well as the split-phase swine systems are presented in Appendix Table 3.

Investments in production facilities represent a major portion of the total investment requirement, especially in modern, high-investment confinement systems. Detailed descriptions of facilities investments for the systems are presented in Appendix Tables 4-7. Costs are based upon 1984 estimates of the purchase price of specific items. In cases where the 1984 price of a specific item was unavailable, estimates were obtained from previous cost studies (Bache and Foster 1976a, 1976b, 1977a, 1977b) by

inflating with an appropriate price index. For the split-phase systems, cost estimates were obtained by dividing the farrow-to-finish enterprises into the phases of production and adding the required supporting facilities. These are also reported in Appendix Tables 4-7.

Annual ownership costs generally include such items as property taxes, insurance, repairs, interest on invested capital and depreciation. For depreciation purposes facilities were divided into two groups—items of a 15-year and an 8-year life. The annual ownership costs for the farrow-to-finish swine systems are shown in Table 4.

The estimated returns and expenses for an average year in the life of the farrow-to-finish swine systems are shown in Tables 5-8. The costs represent those characteristic of 1984. In the linear programming model, annual ownership costs for the swine systems were charged in proportion to the number of sows in each solution. Two types of net returns are shown in the budget summaries. Net returns to land, labor, risk, and management indicate the values that each system contributed to meeting the income goals. Returns to each source of the land and labor resources were not specified in the budget summaries. However, in the programming models rented land and part-time hired labor were charged a fixed amount per unit required. Full-time hired labor was charged as an ownership cost on each farm size. Therefore, net returns in the programming models included a residual return to the resources of owned land and operator labor, as well as risk and management.

Comparison of the alternative systems showed income over direct costs increasing as the level of investment and intensity increased. On a per sow basis, returns over direct costs were nearly identical for the pasture and low-investment confinement systems at $523.78 and $523.89, respectively. Returns over direct costs for the two high-investment confinement systems were higher at $542.48 and $571.76 per sow for the 100-sow and 200-sow systems, respectively. Much of the higher returns over direct costs can be attributed to lower per unit costs incurred by the larger systems due to annual input purchasing economies of large-volume systems.

In comparing net returns to land, labor, risk and management, the pasture and low-investment confinement systems provided much higher levels at $213.03 and $253.96 per sow, respectively, than either the 100-sow or 200-sow high-investment confinement systems at $172.47 and $190.52 per sow, respectively. The higher costs associated with maintaining the larger capital stock of the high-investment confinement systems was the main reason that returns to land, labor, risk, and management were much lower than those for the low-investment and pasture systems.

Net returns were more favorable in the higher investment confinement systems and less favorable in the labor-intensive pasture system once labor was charged as an expense. The 100-sow and 200-sow, high-investment confinement systems yielded net returns to land, risk and management at $72.07 and $110.52 per sow, respectively, compared to only $44.63 per

Table 4. Investment and Annual Ownership Costs for Four Farrow-to-Finish Swine Systems

Item	Investment		Annual ownership costs				
	New	Average	Depreciation	Interest	Maintenance	Insurance and taxes	Total
	dollars						
Part A. 25-sow pasture system							
1. Buildings and equipment							
a. 15-year depreciable facilities[a-i]	5,300.00	2,650.00	353.33	331.25	53.00	39.75	777.33
b. 8-year depreciable facilities	20,751.00	10,375.50	2,593.88	1,296.94	363.14	155.63	4,357.71
2. Breeding stock[b]							
a. Sows/gilts	4,751.89	4,751.89	—	332.63	—	71.28	403.91
b. Boars	879,00	879.00	942.00[c]	61.53	—	13.19	1,016.72
3. Operating inventory[d]	24,258.12	24,258.12	—	849.03	—	363.87	1,212.90
4. Total	55,940.01	42,914.51	3,889.21	2,871.38	416.14	643.72	7,768.57
5. Total per sow	2,237.60	1,716.58	155.57	114.86	16.65	25.75	310.74
Part B. 50-sow low-investment confinement system							
1. Buildings and equipment							
a. 15-year depreciable facilities[a-ii]	28,010.00	14,005.00	1,867.33	1,750.63	280.10	210.08	4,108.14
b. 8-year depreciable facilities	20,976.25	10,488.13	2,622.03	1,311.02	367.08	157.32	4,457.45
2. Breeding stock[b]							
a. Sows/gilts	9,503.78	9,503.78	—	665.26	—	142.56	807.82
b. Boars	1,465.00	1,465.00	1,570.00[c]	102.55	—	21.98	1,694.53
3. Operating inventory[d]	48,569.27	48,569.27	—	1,699.92	—	728.54	2,428.46
4. Total	108,524.30	84,031.18	6,059.36	5,529.38	647.18	1,260.48	13,496.40
5. Total per sow	2,170.49	1,680.62	121.19	110.59	12.94	25.21	269.93
Part C. 100-sow high-investment confinement system							
1. Buildings and equipment							
a. 15-year depreciable facilities[a-iii]	62,088.90	31,044.45	4,139.26	3,880.56	620.89	465.67	9,106.38
b. 8-year depreciable facilities	90,425.10	45,212.55	11,303.14	5,651.57	1,582.44	678.19	19,215.34

Table 4 (continued)

Item	Investment		Annual ownership costs				
	New	Average	Depreciation	Interest	Maintenance	Insurance and taxes	Total
	dollars						
2. Breeding stock[b]							
a. Sows/gilts	19,007.55	19,007.55	—	1,330.53	—	285.11	1,615.64
b. Boars	1,963.50	1,963.50	2,023.00[c]	137.45	—	29.45	2,189.90
3. Operating inventory[d]	96,395.86	96,395.86	—	3,373.86	—	1,445.94	4,819.80
4. Total	269,880.91	193,623.91	17,465.40	14,373.97	2,203.33	2,904.36	36,947.06
5. Total per sow	2,698.81	1,936.24	174.65	143.74	22.03	29.04	369.47
Part D. 200-sow high-investment, high-intensity confinement system							
1. Buildings and equipment							
a. 15-year depreciable facilities[a-iii]	166,131.00	83,065.50	11,075.40	10,383.19	1,661.31	1,245.98	24,365.88
b. 8-year depreciable facilities	171,144.00	85,572.00	21,393.00	10,696.50	2,995.02	1,283.58	36,368.10
2. Breeding stock[b]							
a. Sows/gilts	38,015.10	38,015.10	—	2,661.06	—	570.23	3,231.29
b. Boars	2,680.00	2,680.00	2,640.00[c]	187.60	—	40.20	2,867.80
3. Operating inventory[d]	188,275.52	188,275.52	—	6,589.64	—	2,824.13	9,413.77
4. Total	560,245.62	397,608.12	35,108.40	30,330.39	4,656.33	5,964.12	76,246.84
5. Total per sow	2,831.23	1,988.04	175.54	151.65	23.28	29.82	381.23

[a-i]Includes field fencing.
[a-ii]Includes concrete feeding slab, farrowing building slab and gutter, and finishing building and slab.
[a-iii]Includes concrete feeding slabs and 60 percent of the building investments. With the buildings used here, the manure pits and building shell make up approximately 60 percent of the total investments and have a longer life than the other equipment used.
[b]For the breeding stock, investments were based on boar values at the average of buying and selling prices while females were valued at their market price.
[c]Boar depreciation = (purchase price - selling price)/one year useful life.
[d]Operating inventory includes total feed, veterinary and medicine, and other direct expenses incurred by each system.

Table 5. Estimated Annual Costs and Returns Budget for the Farrow-to-Finish, 25-Sow Pasture System

Item	One sow			25 sows		
	Quantity	Unit	Amount (dollars)	Quantity	Unit	Amount (dollars)
A. Income						
1. Market hogs (220 lb @ $46.01/cwt)			1,445.45	357	head	36,136.25
2. Culled sows (425 lb @ $39.34/cwt)			60.19	9	head	1,504.76
3. Nonbreeders (300 lb @ $44.00/cwt)			26.14	5	head	660.00
4. Boars (425 lb @ $32.00/cwt)			16.32	3	head	408.00
5. Gross income			1,548.10			38,709.01
B. Direct costs						
1. Feed						
a. Corn equivalent ($2.93/bu)	193.02	bu	565.55	4,825.5	bu	14,138.72
b. Pasture ($48.24/acre)	0.60	acres	28.94	15	acres	723.60
c. Purchased feed ($0.12/lb)	2,351.6	lb	282.19	58,790.0	lb	7,054.80
d. Total feed			876.68			21,917.12
2. Veterinary and medicine			37.54			938.50
3. Boar purchase (@ $450.00)			54.00	3	head	1,350.00
4. Marketing			22.10			552.50
5. Power and fuel			8.00			200.00
6. Miscellaneous (bedding, supplies)			26.00			650.00
7. Total direct costs			1,024.32			25,608.12
8. Income over direct costs (A.5 - B.7)			523.78			13,100.89
C. Annual ownership costs						
1. Investment overhead						
a. 15-year depreciable facilities	212.00[a]		31.09	5,300.00[b]		777.33
b. 8-year depreciable facilities	830.04[a]		171.31	20,751.00[b]		4,357.71
c. Breeding stock			56.83			1,420.63
d. Operating inventory			48.52			1,212.90
e. Total investment overhead			310.75			7,768.57
2. Labor ($4.00 hr)	42.1	hr	168.40	1,050	hr	4,200.00
3. Total ownership costs			479.15			11,968.57
D. Summary						
1. Net return to land, labor, risk and management (B.8 - C.1)			213.03			5,332.32
2. Net return to land, risk and management (B.8 - C.3)			44.63			1,132.32

[a]Total investment per sow.
[b]Total investment per 25-sow unit.

Table 6. Estimated Annual Costs and Returns Budget for the Farrow-to-Finish, 50-Sow Low-Investment Confinement System

Item	One sow Quantity	Unit	Amount (dollars)	50 sows Quantity	Unit	Amount (dollars)
A. Income						
1. Market hogs (220 lb @ $46.01/cwt)			1,443.43	713	head	72,171.29
2. Culled sows (425 lb @ $39.34/cwt)			56.85	17	head	2,842.32
3. Nonbreeders (300 lb @ $44.00/cwt)			26.40	10	head	1,320.00
4. Boars (425 lb @ $32.00/cwt)			13.60	5	head	680.00
5. Gross income			1,540.28			77,013.61
B. Direct costs						
1. Feed						
a. Corn equivalent ($2.93/bu)	193.02	bu	565.55	9,651.0	bu	28,277.43
b. Purchased feed ($ 0.12/lb)	2,612.89	lb	313.55	130,644.5	lb	15,677.34
c. Total feed			879.10			43,954.77
2. Veterinary and medicine			37.54			1,877.00
3. Boar purchase (@ $450.00)			45.00	5	head	2,250.00
4. Marketing			21.75			1,087.50
5. Power and fuel			10.00			500.00
6. Miscellaneous (bedding, supplies)			23.00			1,150.00
7. Total direct costs			1,016.39			50,819.27
8. Income over direct costs (A.5 - B.7)			523.89			26,194.34
C. Annual ownership costs						
1. Investment overhead						
a. 15-year depreciable facilities	560.20[a]		82.16	28,010.00[b]		4,108.14
b. 8-year depreciable facilities	419.53[a]		89.15	20,976.25[b]		4,457.45
c. Breeding stock			50.05			2,502.35
d. Operating inventory			48.57			2,428.46
e. Total investment overhead			269.93			13,496.40
2. Labor ($4.00/hr)	32	hr	128.00	1,600	hr	6,400.00
3. Total ownership costs			397.93			19,896.40
D. Summary						
1. Net return to land, labor, risk and management (B.8 - C.1)			253.96			12,697.94
2. Net return to land, risk and management (B.8 - C.3)			125.96			6,297.94

[a]Total investment per sow.
[b]Total investment per 50-sow unit.

Table 7. Estimated Annual Costs and Returns Budget for the Farrow-to-Finish, 100-Sow High-Investment Confinement System

Item	One sow Quantity	Unit	Amount (dollars)	100 sows Quantity	Unit	Amount (dollars)
A. Income						
1. Market hogs (220 lb @ $46.01/cwt)			1,443.43	1,426	head	144,342.57
2. Culled sows (425 lb @ $39.34/cwt)			56.84	34	head	5,684.63
3. Nonbreeders (300 lb @ $44.00/cwt)			26.40	20	head	2,640.00
4. Boars (425 lb @ $32.00/cwt)			9.52	7	head	952.00
5. Gross income			1,536.19			153,619.20
B. Direct costs						
1. Feed						
a. Corn equivalent ($2.93/bu)	193.02	bu	565.55	19,302	bu	56,544.86
b. Purchased feed ($ 0.11/lb)	2,612.89	lb	287.42	261,289	lb	28,742.00
c. Total feed			852.97			85,296.86
2. Veterinary and medicine			37.54			3,754.00
3. Boar purchase (@ $425.00)			29.75	7	head	2,975.00
4. Marketing			21.25			2,125.00
5. Heating fuel			25.00			2,500.00
6. Electricity			5.00			500.00
7. Truck and tractor use			7.20			720.00
8. Miscellaneous (bedding, supplies)			15.00			1,500.00
9. Total direct costs			993.71			99,370.86
10. Income over direct costs (A.5 - B.9)			542.48			54,248.34
C. Annual ownership costs						
1. Investment overhead						
a. 15-year depreciable facilities	620.89[a]		91.60	62,088.90[b]		9,106.38
b. 8-year depreciable facilities	904.25[a]		192.15	90,425.10[b]		19,215.34
c. Breeding stock			38.06			3,805.54
d. Operating inventory			48.20			4,819.80
e. Total investment overhead			370.01			36,947.06
2. Labor ($4.00/hr)	25.1	hr	100.40	2,506	hr	10,024.00
3. Total ownership costs			470.41			46,971.06
D. Summary						
1. Net return to land, labor, risk and management (B.10 - C.1)			172.47			17,301.28
2. Net return to land, risk and management (B.10 - C.3)			72.07			7,277.28

[a]Total investment per sow.
[b]Total investment per 100-sow unit.

Table 8. Estimated Annual Costs and Returns Budget for the Farrow-to-Finish, 200-Sow High-Investment Confinement System

Item	One sow Quantity	Unit	Amount (dollars)	200 sows Quantity	Unit	Amount (dollars)
A. Income						
1. Market hogs (220 lb @ $46.01/cwt)			1,443.43	2,853	head	288,786.37
2. Culled sows (425 lb @ $39.34/cwt)			56.01	67	head	11,202.07
3. Nonbreeders (300 lb @ $44.00/cwt)			26.40	40	head	5,280.00
4. Boars (425 lb @ $32.00/cwt)			6.80	10	head	1,360.00
5. Gross income			1,533.14			306,628.44
B. Direct costs						
1. Feed						
a. Corn equivalent ($2.93/bu)	193.02	bu	565.55	38,604	bu	113,109.72
b. Purchased feed ($ 0.10/lb)	2,612.89	lb	261.29	522,578	lb	52,257.80
c. Total feed			826.84			165,367.52
2. Veterinary and medicine			37.54			7,508.00
3. Boar purchase (@ $400.00)			20.00	10	head	4,000.00
4. Marketing			21.00			4,200.00
5. Heating fuel			25.00			5,000.00
6. Electricity			12.00			2,400.00
7. Truck and tractor use			7.00			1,400.00
8. Miscellaneous (bedding, supplies)			12.00			2,400.00
9. Total direct costs			961.38			192,275.52
10. Income over direct costs (A.5 - B.9)			571.76			114,352.92
C. Annual ownership costs						
1. Investment overhead						
a. 15-year depreciable facilities	830.66[a]		121.83	166,131.00[b]		24,365.88
b. 8-year depreciable facilities	855.72[a]		181.84	171,144.00[b]		36,368.10
c. Breeding stock			30.50			6,099.09
d. Operating inventory			47.07			9,413.77
e. Total investment overhead			381.24			76,246.84
2. Labor ($4.00/hr)	20	hr	80.00	4,002	hr	16,008.00
3. Total ownership costs			461.24			92,254.84
D. Summary						
1. Net return to land, labor, risk and management (B.10 - C.1)			190.52			38,106.08
2. Net return to land, risk and management (B.10 - C.3)			110.52			22,098.08

[a]Total investment per sow.
[b]Total investment per 200-sow unit.

sow for the pasture system. Overall, the low-investment confinement system provided the highest returns to the required resources with net returns to land, risk and management of $125.96 per sow.

Enterprises Other Than Swine

Ten other enterprises were considered in the linear programming models as production alternatives for the selected farm situations. The enterprises were in direct competition with the swine systems for many of the resources required in meeting income goals. The majority of cropping systems found on the swine farms in the survey plus a beef cow-calf livestock enterprise were included as production alternatives. An enterprise such as beef cow-calf is typically found on swine farms because the beef enterprise tends to utilize resources not often required in swine production. Corn production was the most commonly found enterprise on the surveyed swine farms. Nearly 80 percent of the farmers produced corn in 1984, which is typical because corn is the major swine feed.

A common recommendation is that crops requiring intensive cultivation, such as corn and cotton, be rotated to promote sound cultural practices, including soil conservation. Therefore, certain agronomic restrictions were imposed upon the corn and cotton enterprises. Corn and cotton production on owned row cropland was limited to 50 percent of the available land on each farm. This model restriction represented the amount that each could be grown in any one year.

Labor requirements vary among enterprises in the amount required and in the time of year required. This variability influences the compatibility of various enterprises with different systems of swine production. Swine systems, with peak labor demand periods, usually fit well with enterprises that have low labor requirements during those same periods. Monthly labor requirements for selected nonswine enterprises appear in Appendix Table 8. These were based upon Tennessee estimates (Walch et al. 1984) as well as estimates used in other studies (Burney 1976; Ray 1977).

Capital requirements of the cropping enterprises included the machinery and direct expenses used in the production alternatives. Operating capital was taken to be the estimated amount of funds needed to meet expenses during the year and was prorated on an annual basis. Investment capital was estimated as a pro rata share of machinery investment requirements of that particular crop. Costs of crop storage facilities were not charged to either livestock or crop enterprises but were included as overhead items in each farm-size situation. Capital requirements for the beef cow-calf livestock enterprise were developed similarly to those for the swine alternatives. A summary of annual capital requirements for each enterprise is presented in Table 9.

The budgets developed for the alternative enterprises served as bases for indicating the potential contribution of each enterprise in meeting the

Table 9. Estimated Annual Capital Requirements and Net Returns for Selected Alternative Enterprises on Swine Farms

Enterprise	Operating capital	Investment capital	Net returns[a]
Part A. Crop enterprises	----------dollars per acre----------		
1. Corn	98.82	60.89	74.69
2. Soybeans	89.14	57.04	41.14
3. Wheat	61.95	41.72	38.33
4. Cotton	147.77	116.15	66.08
5. Wheat - soybeans	141.74	91.45	69.37
6. Grain sorghum	76.31	56.03	38.46
7. Alfalfa hay	118.17	154.79	-40.87
8. Clover - Timothy hay	58.02	90.80	-33.87
9. Permanent pasture	28.69	24.52	-53.21[b]
Part B. Livestock enterprise	----------dollars per head----------		
1. Beef cow-calf	213.38	80.98	-19.28

[a]Includes returns to land, labor, risk, and management.
[b]Permanent pasture generated zero gross returns and was used solely as an intermediate input for the swine pasture system and the beef cow-calf operation. Therefore, the figure presented here represents the per acre cost of permanent pasture to each of these enterprises.

income goals as well as the per unit costs incurred by each enterprise. The budgets were derived using expenses characteristic of 1984 cost levels and price and yield estimates representing those observed during 1980-84. A summary of the net returns for each enterprise is included in Table 9. The net returns to land, labor, risk, and management are those per unit values that each enterprise contributed to meeting the income goals in the programming model.

Results

Linear programming procedures were used to estimate the minimum capital requirements, exclusive of land investment, to return selected net farm incomes on four farm sizes. The selected income goals were $15,000 and $30,000 on the small, medium, and large farms, and $30,000 and $50,000 on the extra-large farm. Four systems of farrow-to-finish swine production, along with four associated systems of farrow-to-feeder pig and feeder pig-to-finish operations and 10 other enterprises, competed for the resources of each farm size. In cases where two separate systems of a swine enterprise were included in the optimal solution, each system was examined individually regarding the required resources for the farm. In such cases the model was run two additional times, each time considering only one of the systems that appeared in the original solution. Reported results include the system that provided an optimal solution with the least amount of required capital. Because two different systems of swine production are not typically found on the same farm, the results using a single swine

system were judged to be more representative of actual farm situations. The postoptimal analysis examined the effects of variations in hog prices, purchased-corn prices, labor supplies, costs of capital, and feeder pig prices.

Minimum Capital Requirements for the Base Situations

The minimum capital requirements reported for the base situations were determined under economic conditions assumed to be static in nature. That is, no consideration was given to the realities of farming such as price and yield variability, among other things, and the accompanying risks. Conditions assumed in the base situations were based on averages. Each farm was assumed to be operating during the mean year of useful life for investments. All farms faced costs representative of 1984 and prices representative of an average year during the early to mid 1980s.

Under these and other conditions assumed in the base situations, three enterprises were included in the solutions for all farm sizes. The enterprises were corn, double-cropped wheat and soybeans, and farrow-to-finish swine production. Detailed results of the base situations are shown in Table 10.

The Lower Income Goals. The plan for the small farm included 66 sows in the farrow-to-finish, low-investment confinement system. In addition to hogs, the optimum system included corn and double-cropped wheat and soybeans. Corn production was in the solution at its maximum amount including 50 percent of owned row cropland and the entire available rental acreage. The total amount of required capital (not including investment capital for owned land) for the $15,000 income goal was $93,593 with more than two-thirds being operating capital. Much of the operating capital requirements was for 275 hours of hired labor and 6,550 bushels of purchased corn.

Minimum capital requirements for the $15,000 net income level were lower on the medium farm than on the small farm. The cost reduction was caused primarily by lower operating capital requirements arising from more available land for corn production. Land for corn production was not limiting as on the small farm; enough corn was produced to meet the feed requirement of the swine system. The optimal farm plan included 45 sows in the farrow-to-finish, low-investment confinement system along with corn, wheat, and double-cropped wheat and soybeans. Only a small amount of seasonal labor was required above that provided by the owner-operator.

Even though the large farm had much larger amounts of available resources than the two previously discussed farm sizes, capital requirements were higher to achieve the $15,000 income target. The higher requirement, $129,064, arose mainly from the higher investment capital

Table 10. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Selected Income Levels under Base Situations for Four Farm Sizes, West Tennessee

Item	Unit	Net income in dollars[a]							
		Small farm		Medium farm		Large farm		Extra-large farm	
		15,000	30,000	15,000	30,000	15,000	30,000	30,000	50,000
Resources used:									
Total capital -	dollars	93,593		69,178		129,064	338,037	207,545	456,547
Operating	dollars	67,895		42,001		71,685	217,542	116,172	280,144
Investment	dollars	25,698		27,177		57,379	120,495	91,373	176,403
Total owned land-	acre	57		110		213	210	503	473
Cropland	acre	47		103		202	202	487	461
Land for hog system	acre	10		7		11	8	16	12
Rented cropland	acre	53		57		82	48		17
Total labor -	hr	2,438		2,252		3,354	5,261	5,051	7,515
Full-time	hr	2,163		2,158		3,331	4,648	4,944	6,681
Part-time (seasonal)	hr	275		94		23	613	107	834
Enterprises used:									
Corn	acre	77		109		183	149	286	303
Soybeans	acre					17			
Wheat	acre			6		50	16	68	55
Wheat-soybeans	acre	24		46		33	85	66	79
Cotton	acre						17	23	27
Grain sorghum	acre							46	15
Farrow-to-finish-									
Low-investment confinement	sow	66		45		89		100	
High-investment, high-intensity confinement	sow						222		302
Feeder pig-to-finish -									
Low-investment confinement	hog							389	

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Other activities used:							
Corn -							
Bought	bu	6,550		866	30,939		34,096
Sold	bu					24	
Feeder pig purchased	pig					397	
Custom harvest -							
Corn	hr	25					
Wheat	hr	8					
Soybeans	hr	8					

[a]Net income = net returns to owned land and operator labor used, risk and management.

costs associated with maintaining a much larger farm overhead. The optimal farm plan was a diversified organization including 80 sows in the farrow-to-finish, low-investment confinement system, corn, soybeans, wheat, and double-cropped wheat and soybeans. Neither the labor supply nor available land for corn production were limiting factors on the large farm.

To achieve the $30,000 net income goal on the extra-large farm, $207,545 was required. Nearly one man-equivalent in the full-time labor supply went unused in the solution. Significant capital savings would have resulted had not a second hired laborer been available and charged to the farm business. Part of the savings, though, would have been offset by much higher seasonal labor requirements. Seasonal labor was required only in small amounts during the fall and spring. The optimal farm plan was a highly diversified organization including two swine enterprises and five cropping systems. Farrow-to-finish swine production in the low-investment confinement system was in the solution at 100 sows, the maximum size allowed. An additional 389 market hogs were purchased and fed out in the feeder pig-to-finish, low-investment confinement system. Only a small percentage of the available cropland was used and rented land was not required. Systems of corn, wheat, double-cropped wheat and soybeans, cotton, and grain sorghum were also included in the solution. Corn production was sufficient to meet feed requirements of the swine systems with a small amount remaining for sale.

The Higher Income Goals. Solutions for achieving the $30,000 net income target in the base situations for the small and medium farms were infeasible. An insufficient available labor supply was the main reason a solution could not be obtained for either farm.

Achieving $30,000 in net income on the large farm required $338,037 in total capital (not including owned land). The optimum farm plan included 222 sows in the farrow-to-finish, high-investment, high-intensity confinement system. Increased labor requirements prompted the shift to this more labor-efficient system from the low-investment system used at the lower income level. Nearly all available full-time labor was exhausted and an additional 613 hours of seasonal labor were required. The large amount of seasonal labor plus 30,939 bushels of purchased corn made operating capital requirements extremely high in this plan relative to the lower income plan. A smaller total row crop acreage was used here as compared to the optimal plan at the lower income goal. The reduction was through less rented acreage. Shifts in amounts of enterprises also occurred. Single-crop soybean production was eliminated while corn and wheat acreages were reduced. More acres were devoted to the higher returning enterprises, like double-cropped wheat and soybeans and cotton. Overall, the plan was characterized by a high degree of specialization in farrow-to-finish swine production.

To return $50,000 in net income on the extra-large farm, $456,547 of capital exclusive of owned land was required. As with the large farm plan, the full-time labor supply was nearly exhausted, and an additional 834 hours of seasonal labor were required. Farrow-to-finish in the high-investment, high-intensity confinement system was in the solution at 302 sows. More farm-grown corn was available for swine feed in this plan than for the extra-large farm plan at the lower income goal; however, 34,096 bushels were purchased. The purchased-corn requirement, coupled with the required seasonal labor, again made required operating capital extremely high. Row crop acreage was nearly identical to that used at the lower income goal. Besides corn production, other cropping systems in the base solution included wheat, double-cropped wheat and soybeans, cotton, and grain sorghum.

Minimum Capital Requirements Under Price and Resource Variations

Hog Price Variations. Two alternative hog price situations were analyzed at both income levels on each farm size. The base price was $46.01/cwt for market hogs; a higher price of $53.00/cwt and a lower price of $40.00/cwt were examined. The high and low hog prices approximate the extreme prices observed during the 1979-83 period (Tennessee Department of Agriculture 1984). The price of all other hogs (i.e., feeder pigs, nonbreeders, culled sows, and boars) sold within a system were correspondingly varied by an equal proportion. At the low price of $40.00/cwt, feasible solutions were unattainable at either income level on any farm size. Hog prices were then varied upward by one dollar intervals from $40.00/cwt to the price where a feasible solution existed on each farm size to achieve each income goal. Results of the hog price variations for the four farm sizes appear in Tables 11 and 12.

The hog price variations had a dramatic effect on the optimal solutions for each farm size. When hog prices were high, many of the situations had total capital requirements less than half of those required at the base hog prices. Large amounts of resources went unused in many low and high-income farm plans. As hog prices were varied downward, solutions for all farm sizes included a system of swine production. Capital requirements at the low hog prices were much higher than those at the base hog prices. Labor supplies were completely utilized with large part-time labor and purchased-corn requirements accounting for much of the increased total capital requirements when hog prices were low.

Purchased-corn Price Variations. Three alternative prices of purchased corn were considered at both income levels on each farm size. From a base price of $3.12 per bushel, variations were made upward to $3.25, $3.35, and $3.50 per bushel. Consequently, the hog-corn price ratios used in this study range from nearly 15 in the base situation to a low of 13 at the $3.50 per bushel corn price. In the period from 1980 to 1983 aver-

Table 11. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Two Income levels under Hog Price Variations, Small and Medium Farm Sizes, West Tennessee

Item	Unit	Small farm				Medium farm			
		Hog price ($/cwt)				Hog price ($/cwt)			
		45[a]	53	48[a]	53	45[a]	53	47[a]	53
		Net income in dollars[b]							
		15,000	15,000	30,000	30,000	15,000	15,000	30,000	30,000
Resources used:									
Total capital -	dollars	166,491	43,598	203,167	91,743	82,619	39,010	231,632	79,698
Operating	dollars	114,273	28,051	141,626	66,511	52,033	22,381	155,673	49,986
Investment	dollars	52,218	15,547	61,541	25,231	30,586	16,629	75,959	29,712
Total owned land-	acre	52	52	53	57	111	56	110	60
Cropland	acre	47	47	47	47	103	52	103	52
Land for hog system	acre	5	5	6	10	8	4	7	8
Rented cropland	acre	53	51	47	53	72	22	72	98
Total labor -	hr	2,646	1,252	3,175	2,424	2,325	1,177	3,812	2,417
Full-time	hr	2,431	1,252	2,520	2,147	2,084	1,177	2,520	2,140
Part-time (seasonal)	hr	215		655	277	241		1,292	277
Enterprises used:									
Corn	acre	77	75	70	77	123	73	123	149
Soybeans	acre								
Wheat	acre					13		13	
Wheat-soybeans	acre	24	24	24	24	38		38	
Cotton	acre								
Grain sorghum	acre								
Farrow-to-finish-									
Low-investment confinement	sow		31		67	56	30		62
High-investment, high-intensity confinement	sow	116		141				159	

Other activities used:							
Corn -							
Bought	bu	16,266		21,670	6,718	911	20,736
Sold	bu						
Custom harvest -							
Corn	hr	25	25	24	25		
Wheat	hr	8	8	8	8		
Soybeans	hr	8	8	8	8		

[a]Minimum market hog price for which a solution was attained that yielded the specified net income level.
[b]Net income = net returns to owned land and operator labor used, risk and management.

Table 12. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Selected Income Levels under Hog Price Variations, Large and Extra-Large Farm Sizes, West Tennessee

Item	Unit	Large farm				Extra-large farm			
		Hog price ($/cwt)				Hog price ($/cwt)			
		44[a]	53	45[a]	53	44[a]	53	46[a]	53
		Net income in dollars[b]							
		15,000	15,000	30,000	30,000	30,000	30,000	50,000	50,000
Resources used:									
Total capital -	dollars	326,271	78,294	272,104	115,708	455,542	127,275	462,890	175,344
Operating	dollars	209,359	37,919	167,682	63,019	280,333	61,097	284,788	90,509
Investment	dollars	116,912	40,375	104,422	52,689	175,209	66,178	178,102	84,835
Total owned land-	acre	210	108	209	112	499	226	474	532
Cropland	acre	202	101	202	101	487	214	461	518
Land for hog system	acre	8	7	7	11	12	12	12	14
Rented cropland	acre	32	26	82	97			17	
Total labor -	hr	5,015	2,033	4,404	3,179	7,486	3,427	7,609	4,000
Full-time	hr	4,552	2,033	4,219	3,138	6,691	3,427	6,726	3,976
Part-time (seasonal)	hr	463		185	41	795		883	24
Enterprises used:									
Corn	acre	133	127	183	198	286	214	303	286
Soybeans	acre			17					99
Wheat	acre			50		68		55	133
Wheat-soybeans	acre	78		33		66		79	
Cotton	acre	22				23		27	
Grain sorghum	acre					46		15	
Farrow-to-finish-									
Low-investment confinement	sow		53		82		89		100
High-investment, high-intensity confinement	sow	211		180		300		307	
Other activities used:									
Corn -									
Bought	bu	30,208		20,160		35,138		34,956	
Sold	bu								3,550

[a]Minimum market hog price for which a solution was attained that yielded the specified net income level.
[b]Net income = net returns to owned land and operator labor used, risk and management.

age annual hog-corn price ratios in Tennessee ranged from 13 to nearly 21 (Tennessee Department of Agriculture 1984). Therefore, the price ratios used in the analysis represent the lower end of the range actually faced by Tennessee producers in the early 1980s.

Reported results include only the situations affected by the upward variation in the price of purchased corn. That is, in base situations (Table 10) where purchased corn was not required or infeasible solutions were found, raising purchased-corn prices would not affect the optimal solution. The extreme case of this occurred with the medium farm size as shown in Table 10. In the base situation purchased corn was not required at the $15,000 income level and the solution for $30,000 in net income was infeasible. For these reasons the medium farm situation was eliminated in this analysis. Results of farm situations in which this analysis was relevant are reported in Table 13.

The small farm incurred a sharp increase in total required capital as the purchased-corn price rose, especially when the price was $3.35 per bushel because of a switch to the higher investment production system. The large farm experienced little change in the optimal plan at the lower income goal when the purchased-corn price was increased. The small amount of required purchased corn caused total capital requirements to increase only slightly. At the higher income goals, capital requirements increased markedly on both the large and extra-large farm sizes. The higher requirements were due primarily to many more sows needed in the high investment production system.

Labor Supply Variations. Two alternative labor supply situations were examined at both income levels at each farm size. The first situation limited each farm to only the assumed amount of available operator and full-time hired labor in the base situation. Because this amount of labor was insufficient for generating the higher income goals on each farm, a second situation was considered. The labor supply was increased by increments of 40 hours per month until an optimal solution existed at the higher income goal for each farm. These increases were not charged as a cost in the solution but were assumed to be supplied as 'free' labor from available family members. Results in Tables 14 and 15 include both the above-mentioned situations. The minimum amount of family labor to achieve the higher income goal in the month(s) with the highest labor requirement is reported along with the corresponding solution at the lower income goal when this amount of family labor is available.

Reducing the available labor supply to only the owner-operator caused greatly increased capital requirements on the small and medium farm sizes. With limited labor, both farm plans included the relatively labor efficient high-investment system. Solutions yielding $30,000 in net income on the small and medium farms could only be achieved when 160 hours per month were available from family members. Much of the extra labor was necessary because of the large number of sows required in the high-

Table 13. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Selected Income Levels under Purchased-Corn Price Variations, Three Farm Situations, West Tennessee

Item	Unit	Small farm			Large farm					Extra-large farm	
		Corn price ($/bu.)			Corn price ($/bu.)					Corn price ($/bu.)	
		3.25	3.35	3.50	3.25	3.35	3.50	3.25	3.35	3.25	3.35
		Net income in dollars[a]									
		15,000	15,000	15,000	15,000	15,000	15,000	30,000	30,000	50,000	50,000
Resources used:											
Total capital -	dollars	106,376	168,577		129,791	129,938	130,249	468,523		562,476	
Operating	dollars	78,438	116,787		71,800	71,921	72,177	315,581		359,716	
Investment	dollars	27,938	51,790		57,991	58,017	58,072	152,942		202,760	
Total owned land-	acre	58	52		187	187	187	214		466	
Cropland	acre	47	47		176	176	176	202		451	
Land for hog system	acre	11	5		11	11	11	12		15	
Rented cropland	acre	53	53		99	99	99	48		17	
Total labor -	hr	2,722	2,622		3,446	3,449	3,455	7,135		8,985	
Full-time	hr	2,261	2,421		3,394	3,396	3,401	4,788		7,056	
Part-time (seasonal)	hr	461	201		52	53	54	2,347		1,929	
Enterprises used:											
Corn	acre	77	77		200	200	200	149		303	
Soybeans	acre										
Wheat	acre				42	42	42	16		49	
Wheat-soybeans	acre	24	24		33	33	33	85		84	
Cotton	acre									32	
Grain sorghum	acre										

INFEASIBLE

Farrow-to-finish-								
Low-investment confinement	sow	74		84	84	84		
High-investment, high-intensity confinement	sow		115				307	371
Other activities used:								
Corn -								
Bought	bu	8,152	16,049	139	158	197	47,367	47,446
Sold	bu							
Custom harvest -								
Corn	hr	25	25					
Wheat	hr	8	8					
Soybeans	hr	8	8					

[a]Net income = net returns to owned land and operator labor used, risk and management.

Table 14. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Two Income Levels under Labor Supply Variations, Small and Medium Farm Sizes, West Tennessee

Item	Unit	Small farm				Medium farm			
		Operator labor only		Operator labor plus 160 hr/mo.[a]		Operator labor only		Operator labor plus 160 hr/mo.[a]	
		Net income in dollars[b]							
		15,000	30,000	15,000	30,000	15,000	30,000	15,000	30,000
Resources used:									
Total capital -	dollars	126,644		85,793	262,020	94,062		67,085	229,076
Operating	dollars	85,752		61,462	183,882	55,720		40,463	153,595
Investment	dollars	40,892		24,331	78,138	38,342		26,622	75,481
Total owned land-	acre	51		56	55	106		109	110
Cropland	acre	47		47	47	103		103	103
Land for hog system	acre	4		9	8	3		6	7
Rented cropland	acre	42		53	38	55		54	52
Total labor -	hr	2,024		2,248	3,974	1,711		1,875	3,658
Full-time	hr	2,024		2,096	2,520	1,711		1,809	2,520
Family members	hr			152	1,454			66	1,138
Enterprises used:									
Corn	acre	66		77	62	107		105	104
Soybeans	acre								
Wheat	acre					5		4	3
Wheat-soybeans	acre	24		24	24	47		47	48
Cotton	acre								
Grain sorghum	acre								
Farrow-to-finish-									
Low-investment confinement	sow			61				44	
High-investment, high-intensity confinement	sow	88			186	61			159

INFEASIBLE

Other activities used:						
Corn -						
Bought	bu	11,676	5,572	30,892	3,332	
Sold	bu					
Custom harvest -						
Corn	hr	22	25	21		
Wheat	hr	8	8	8		
Soybeans	hr	8	8	8		

[a]Minimum amount of monthly available family labor to achieve the higher income level in the month(s) with the highest labor requirement and the associated solution at the lower income level.

[b]Net income = net returns to owned land and operator and family labor used, risk and management.

Table 15. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Selected Income Levels under Labor Supply Variations, Large and Extra-Large Farm Sizes, West Tennessee

Item	Unit	Large farm				Extra-large farm			
		Full-time labor only		Full-time labor plus 80 hr/mo.[a]		Full-time labor only		Full-time labor plus 200 hr/mo.[a]	
		Net income in dollars[b]							
		15,000	30,000	15,000	30,000	30,000	50,000	30,000	50,000
Resources used:									
Total capital -	dollars	129,456		128,198	326,658	244,004		202,715	424,963
Investment	dollars	72,431		70,522	211,086	125,426		111,976	256,687
Operating	dollars	57,025		57,676	115,572	118,577		90,739	168,276
Total owned land-	acre	213		189	210	467		502	457
Cropland	acre	202		178	202	461		487	445
Land for hog system	acre	11		11	8	6		15	12
Rented cropland	acre	69		98	5	17			14
Total labor -	hr	3,295		3,402	4,919	4,401		4,966	6,991
Full-time	hr	3,295		3,363	4,569	4,401		4,888	6,430
Family members	hr			39	350			78	561
Enterprises used:									
Corn	acre	170		199	106	303		286	299
Soybeans	acre	11		1	18				
Wheat	acre	37		42		55		68	36
Wheat-soybeans	acre	53		33	58	79		66	98
Cotton	acre				26	27		23	26
Grain sorghum	acre					15		46	
Farrow-to-finish-									
Low-investment confinement	sow	79		82				100	
High-investment, high-intensity confinement	sow				214	151			282

INFEASIBLE

Feeder pig-to-finish -					
Low-investment confinement	hog				322
Other activities used:					
Corn -					
Bought	bu	1,605	32,774	4,819	
Sold	bu				626
Feeder pigs purchased	pig				329

[a]Minimum amount of monthly available family labor to achieve the higher income level in the month(s) with the highest labor requirement and the associated solution at the lower income level.

[b]Net income = net returns to owned land and operator and family labor used, risk and management.

investment production system. Solutions at the low income goal required lower total capital requirements than the base situations primarily because of the availability of 'free' labor. With the large amount of unused full-time labor in the base plan of the large farm, restricting to only the full-time labor supply had a slight effect on the total capital required at the low income goal. However, this amount of labor was insufficient for generating the high income goal on the large farm. Family members were required to be available at the rate of 80 hours per month during months of high labor demand to achieve $30,000 in net income. The family labor requirement was much lower here than at any other farm size. Availability of this 'free' labor produced lower capital requirements than in the base situation. The solution at the low income goal when family labor was available required much the same level of total capital as in the base plan. While much of the full-time labor went unused in the base plan of the extra-large farm at the low income goal, restricting the labor supply to only the full-time labor force increased required capital sharply. Also, 200 hours per month of family labor were required during peak labor demand months to achieve the high income goal with much of this labor unused in most months. These factors point out the importance of available labor during the busy seasons on a farm relying heavily on crop production. When this amount of family labor was available, the solution at the low income goal highly resembled that of the base situation.

Variations in the Cost of Capital. Four levels of interest rates for investment and operating capital were examined at both income levels for each farm size. The interest rate charged investment capital was varied upward from 9 percent, in intervals of three percentage points, to 18 percent. Correspondingly, operating capital charges were 12.5 percent and varied upward at intervals of three percentage points to 19.5 percent. In this way, the same 1.5 percentage point differential was maintained between the prices of investment and operating capital as in the base situation. Investment capital was charged at 12.5 percent in the base situation while operating capital was charged at 14 percent. Hence, the variations considered in this analysis were two intervals above and two below the base situation. Methods of charging the interest expenses were identical to those used in the base situation. Results of this analysis appear in Tables 16 and 17.

Variations in interest rates paid by farmers for operating and investment capital highly influenced total capital requirements. Total capital requirements increased markedly at all farm sizes as the cost of capital rose. The largest increases occurred when the solution required the high-investment production system. Shifts to this more labor efficient system became necessary as the number of sows increased along with required labor. Higher purchased-corn requirements with larger production sizes also added significantly to the higher capital requirements. Results also indicated that the larger the farm size the more capital costs could rise

Table 16. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Two Income Levels under Variations in the Cost of Capital, Small and Medium Farm Sizes, West Tennessee

Item	Unit	Small farm					Medium farm					
		Interest rates (investment/operating)					Interest rates (investment/operating)					
		9%/ 10.5%	12%/ 13.5%	15%/ 16.5%	18%/ 19.5%	All levels	9%/ 10.5%	12%/ 13.5%	15%/ 16.5%	18%/ 19.5%	9%/ 10.5%	All other levels
		Net income in dollars[a]										
		15,000	15,000	15,000	15,000	30,000	15,000	15,000	15,000	15,000	30,000	30,000
Resources used:												
Total capital -	dollars	71,717	89,386	173,346			55,163	66,351	86,558	141,722	188,289	
Operating	dollars	51,898	64,766	116,340			33,858	40,327	53,594	96,515	128,459	
Investment	dollars	19,819	24,620	56,946			21,305	26,054	32,964	45,207	59,830	
Total owned land-	acre	55	56	52			108	109	111	116	109	
Cropland	acre	47	47	47			103	103	103	103	103	
Land for hog system	acre	8	9	5			5	6	8	13	6	
Rented cropland	acre	53	53	53			34	52	72	45	72	
Total labor -	hr	1,959	2,344	2,689			1,567	1,863	2,371	3,505	3,257	
Full-time	hr	1,930	2,130	2,448			1,567	1,797	2,104	2,419	2,520	
Part-time (seasonal)	hr	29	214	241				66	267	1,086	737	
Enterprises used:												
Corn	acre	77	77	77			85	104	123	97	123	
Soybeans	acre											
Wheat	acre							4	13		13	
Wheat-soybeans	acre	24	24	24			52	48	38	52	38	
Grain sorghum	acre											
Farrow-to-finish-												
Low-investment confinement	sow	52	63				35	43	57	92		

INFEASIBLE

Table 16. (continued)

Item	Unit	Small farm Interest rates (investment/operating) 9%/10.5%	12%/13.5%	15%/16.5%	18%/19.5%	All levels	Medium farm Interest rates (investment/operating) 9%/10.5%	12%/13.5%	15%/16.5%	18%/19.5%	9%/10.5%	All other levels
		Net income in dollars[a]										
		15,000	15,000	15,000	15,000	30,000	15,000	15,000	15,000	15,000	30,000	30,000
High-investment, high-intensity confinement	sow			118							134	
Other activities used:												
Corn -												
Bought	bu	3,808	6,023	16,650					1,169	9,945	15,916	
Sold	bu											
Custom harvest -												
Corn	hr	25	25	25								
Wheat	hr	8	8	8								
Soybeans	hr	8	8	8								

[a]Net income = net returns to owned land and operator labor used, risk and management.

Table 17. Estimated Minimum Capital and Other Resource Requirements and Enterprise Organizations at Selected Income Levels Under Variations in the Cost of Capital, Large and Extra-Large Farm Sizes, West Tennessee

		Large farm							Extra-large farm						
		Interest rates (investment/operating)							Interest rates (investment/operating)						
		9%/ 10.5%	12%/ 13.5%	15%/ 16.5%	18%/ 19.5%	9%/ 10.5%	12%/ 13.5%	All other levels	9%/ 10.5%	12%/ 13.5%	15%/ 16.5%	18%/ 19.5%	9%/ 10.5%	12%/ 13.5%	All other levels
		Net income in dollars[a]													
Item	**Unit**	**15,000**	**15,000**	**15,000**	**15,000**	**30,000**	**30,000**	**30,000**	**30,000**	**30,000**	**30,000**	**30,000**	**50,000**	**50,000**	**50,000**
Resources used:															
Total capital -	dollars	105,572	124,444	157,842		233,099	317,810		162,041	193,876	332,295		310,881	428,641	
Operating	dollars	57,235	68,476	92,115		146,817	203,451		85,715	105,367	183,472		182,392	261,214	
Investment	dollars	48,337	55,968	65,727		86,282	114,359		76,326	88,509	148,823		128,489	167,427	
Total owned land-	acre	210	212	215		208	210		479	502	470		470	473	
Cropland	acre	202	202	202		202	202		465	487	461		461	461	
Land for hog system	acre	8	10	13		6	8		14	15	9		9	12	
Rented cropland	acre	43	82	82		82	48				17		17	17	
Total labor -	hr	2,673	3,258	3,970	I	3,952	4,967	I	4,392	4,837	5,566	I	5,544	7,133	I
Full-time	hr	2,673	3,244	3,773	N	3,889	4,533	N	4,389	4,768	5,453	N	5,437	6,489	N
Part-time (seasonal)	hr		14	197	F	63	434	F	3	69	113	F	107	644	F
					E			E				E			E
Enterprises used:					A			A				A			A
Corn	acre	144	183	183	S	183	149	S	286	286	303	S	303	303	S
Soybeans	acre		17	17	I	17		I	46			I			I
Wheat	acre	11	50	50	B	50	16	B	133	68	55	B	55	55	B
Wheat-soybeans	acre	89	33	33	L	33	68	L		66	79	L	79	79	L
Cotton	acre				E		17	E		23	27	E	27	27	E
Grain sorghum	acre									46	15		15	15	

Table 17. (continued)

Item	Unit	Large farm							Extra-large farm						
		Interest rates (investment/operating)							Interest rates (investment/operating)						
		9%/ 10.5%	12%/ 13.5%	15%/ 16.5%	18%/ 19.5%	9%/ 10.5%	12%/ 13.5%	All other levels	9%/ 10.5%	12%/ 13.5%	15%/ 16.5%	18%/ 19.5%	9%/ 10.5%	12%/ 13.5%	All other levels
		Net income in dollars[a]													
		15,000	15,000	15,000	15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	50,000	50,000	50,000
Farrow-to-finish-															
Low-investment confinement	sow	60	77	99					100	100					
High-investment, high-intensity confinement	sow					158	208				208		207	284	
Feeder pig-to-finish -															
Low-investment confinement	hog									201					
Other activities used:															
Corn -															
Bought	bu		287	4,472		15,924	28,333				15,955		15,757	30,582	
Sold	bu								3,550	1,726					
Feeder pigs purchased	pig									206					

[a]Net income = net returns to owned land and operator labor used, risk and management.

and still achieve the income goals. Comparing farm sizes at the $30,000 income level showed that the larger farms were more capable of achieving the income level at higher capital costs.

Variations in Feeder Pig Prices. Variations in the price of feeder pigs were examined at both income goals for each farm size. Because feeder pig production was absent in the base situations, feeder pig prices were varied upward, holding all other hog prices constant, to the price where a system of producing feeder pigs was included in the solution. This price was found by rounding the base feeder pig price of $79.13/cwt to the nearest dollar and increasing by one-dollar increments. Results of this analysis are reported in Table 18. The feeder pig price quoted at the top of each column is the minimum price at which a feeder pig production system was included in the solution. Typically market hog and feeder pig prices move together with lagged adjustments occurring in the price of feeder pigs in response to changes in the market hog price. In the period from 1980 to 1983 this price relationship, expressed as the ratio of average annual market hog to feeder pig prices, ranged from .49 to .70 in Tennessee (Tennessee Department of Agriculture 1984).

In this analysis feeder pig production did not compare well with farrow-to-finish production. Feeder pig prices had to be at least $92.00/cwt before a feeder pig system would be included in any of the optimal solutions. These prices were well above the base price. In only one year during the period of 1980-1984 was the average annual feeder pig price at Tennessee organized feeder pig sales this high. Many of the farm plans at the higher feeder pig prices included both feeder pig and farrow-to-finish production. Feeder pig production also occurred in the farm plans at lower pig prices on the larger farms than on the smaller farms. Greater proportions of available labor on the larger farms, as compared to the smaller sizes, allowed the labor-intensive feeder pig enterprise.

Conclusions

This analysis suggests the following conclusions:

1. In the linear programming analysis, enterprise combinations that included farrow-to-finish swine production provided a minimum net income with the least amount of required capital, excluding owned land investment, at all farm sizes. The low-investment confinement system was best suited for the farm situation where labor was not a highly limited resource. In the cases where a large volume of production was necessary to achieve the income goal, production in the labor-efficient, high-investment, high-intensity confinement system was included in the optimal solutions.
2. Corn production complemented farrow-to-finish swine production on all farm sizes whenever on-farm production was possible. This enterprise provided the major source of swine feed with purchased corn used when corn acreage was insufficient. Double-cropped

Table 18. Minimum Capital and Other Resource Requirements and Enterprise Organizations at Selected Income Levels under Feeder-Pig Price Variations, Four Farm Sizes, West Tennessee

Item	Unit	Feeder pig price ($/cwt)[a]							
		Small farm		Medium farm		Large farm		Extra-large farm	
		95	103	95	99	93	95	92	95
		Net income in dollars[b]							
		15,000	30,000	15,000	30,000	15,000	30,000	30,000	50,000
Resources used:									
Total capital -	dollars	92,141	149,467	67,673	190,322	128,711	323,478	189,897	419,839
Operating	dollars	62,655	92,724	37,783	115,215	69,841	199,721	98,644	234,612
Investment	dollars	29,486	56,743	29,890	75,107	58,870	123,757	91,253	185,227
Total owned land-	acre	59	55	113	112	214	212	541	468
Cropland	acre	47	47	103	103	202	202	524	451
Land for hog system	acre	12	8	10	9	12	10	17	17
Rented cropland	acre	53	27	23	30	82	32		17
Total labor -	hr	2,772	3,385	2,231	4,378	3,483	5,814	5,221	8,862
Full-time	hr	2,281	2,520	2,072	2,520	3,439	4,788	5,114	7,056
Part-time (seasonal)	hr	491	865	159	1,858	44	1,026	107	1,806
Enterprises used:									
Corn	acre	77	51	74	81	183	133	286	303
Soybeans	acre					17		105	
Wheat	acre					50		133	49
Wheat-soybeans	acre	24	24	52	46	33	101		84
Cotton	acre				5				32
Grain sorghum	acre								
Farrow-to-finish-									
Low-investment confinement	sow	36		8		69		100	
High-investment, high-intensity confinement	sow						130		91
Farrow-to-feeder pig -									
Low-investment confinement	sow	57		69		21		29	
High-investment, high-intensity confinement	sow		205		252		158		367

Other activities used:								
Corn -								
Bought	bu	4,364	8,949	9,531	117	24,568		16,694
Sold	bu						1,701	
Custom harvest -								
Corn	hr	25	16					
Wheat	hr	8	8					
Soybeans	hr	8	8					

[a]Minimum feeder pig price in which feeder pigs entered the solution to achieve the specified net income level.
[b]Net income = net returns to owned land and operator labor used, risk and management.

wheat and soybeans was included as a high returns alternative. This enterprise was relatively less competitive with corn for labor.

3. Farmers confronted with situations similar to the small and medium farms will find it very difficult to achieve a $30,000 minimum net income level. If land payments or income reservations require this level of earnings, farmers would likely look to enterprises not considered here or to off-farm employment. Farmers facing situations not unlike those of the large or extra-large farms may consider the high-income goals as targets. In farm plans with low-income goals, many resources went unused, while for those with high-income goals, the large amounts of available resources were used more effectively.
4. Both the large and extra-large farms failed to utilize much of the available row crop acreage. Farmers in these situations might decide whether to concentrate more heavily in swine or crop production. The results suggest farrow-to-finish swine production.
5. The price farmers receive for hogs is an important factor in determining total capital requirements. Therefore, hog farmers need to be aware of and able to use marketing strategies that reduce "downward" price variability and avoid the risk of selling the majority of annual production in a depressed market.
6. Upward variation of the purchased-corn price sharply increased capital requirements in situations where corn production was limited and a large amount of purchased corn was required. Therefore, farmers in corn-deficit areas need to carefully examine alternative sources of operating funds and corn suppliers. Based on these results, on-farm corn production may be viewed as a much less capital-intensive swine feed source even when rented acres are used.
7. In farm situations where the labor supply is highly restricting, farrow-to-finish in the labor-efficient, high-investment confinement system was shown to be an enterprise providing high returns to the limited labor supply. Results indicated that when labor was in short supply, much higher capital requirements were incurred as production in the capital-intensive, labor-efficient system was necessary. This result is typical of the capital-labor substitution characteristic of swine production. However, in cases where labor was in short supply, income potential was limited to the lower income targets.
8. If family members are available as a source of farm labor, capital requirements can be substantially reduced. In the analysis, family labor, required mainly during peak demand periods of crop production, allowed more full-time labor to be devoted to swine production. Thus, required capital in the swine system was reduced. This situation was characteristic of the large and extra-large farms, which

required large amounts of labor during seasonal demand periods of the crop enterprises.

9. The analysis in which the cost of capital was varied indicated that capital requirements were highly sensitive to the price farmers pay for operating and investment capital. Results suggest that farmers carefully evaluate alternative sources of borrowed funds and the interest rates charged by each source.
10. Feeder pig production did not compare well with farrow-to-finish production. Results of the feeder pig price variations indicated that only at very high pig prices were feeder pigs in the optimal solutions. Farrow-to-feeder pig enterprises are relatively labor intensive and, in this analysis, did not yield the returns to the required resources achieved in the farrow-to-finish operations.
11. Results in nearly all analyzed situations indicated that a higher degree of diversification was more relevant the larger the farm size. Results showed smaller farms to be highly concentrated in corn and swine production. Larger farm plans often included several acres of soybeans and wheat, in addition to the corn and swine enterprises.
12. All optimum solutions included a system of swine production. Furthermore, swine production provided the major source of income in all situations. These factors suggest that swine production may be considered as a potential farm enterprise when minimizing capital requirements subject to achieving the goal of a minimum net income level. Capital requirements are highly variable and depend heavily on the individual farm situation. When quality management is available and the operator is willing to make a long-term commitment to swine production, achieving an acceptable level of earnings is possible.

Implications

The potential use of this study lies not so much in the specific results obtained but more in the general guide it provides to farmer advisors and farmers for planning and operating a successful swine operation. When analyzing the income potential for swine operations, farmers may be able to compare specific situations to ones considered here and estimate approximately what resources will be required and what incomes can be expected. Also, the study should prove helpful to producers in recognizing factors that may limit the profit potential of the farm and suggest ways of alleviating these problems.

A final implication of this study is for future research. Results indicate that capital requirements and income opportunities are highly sensitive to varying price and resource conditions. Therefore, the variability associated with hog and corn prices and yields as well as other sources of variation comprises a substantial element of risk on a swine farm. Fur-

ther research attempting to quantify and explain these risk elements would significantly add to the understanding of the physical and economic environment confronted by swine producers.

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Appendix

Table A 1. New Cost, Useful Life and Annual Overhead Costs for Joint-Use Buildings, Trucks, Equipment, Labor and Office Expenses, Four Farm Sizes

Item	Cost		Salvage value	Years life	Annual depreciation	Annual repairs	Interest	Taxes and insurance	Total annual cost
	New	Average							
	dollars				dollars				
Part A. Small farm									
1. Machine shed	2,250.00	1,125.00	—	15	150.00	22.50	157.50	16.88	204.88
2. Grain bins	3,300.00	1,650.00	—	15	220.00	75.00	231.00	24.75	550.75
3. Hay barns	1,500.00	750.00	—	15	100.00	15.00	105.00	11.25	231.25
4. Truck (one ton)	9,500.00	4,750.00	950.00	10	855.00	500.00	665.00	71.25	2,091.25
5. Livestock trailer (10 foot)	500.00	250.00	50.00	15	30.00	10.00	35.00	3.75	78.75
6. Wagons	400.00	200.00	40.00	15	24.00	8.00	28.00	3.00	63.00
7. Bookkeeping, legal fees, miscellaneous	—	75.00	—	—	—	—	—	—	75.00
8. Farm tools	—	750.00	—	—	—	90.00	105.00	—	195.00
9. Total									3,489.88
Part B. Medium farm									
1. Machine shed	2,850.00	1,425.00	—	15	190.00	24.00	199.50	21.38	434.88
2. Grain bins	4,000.00	2,000.00	—	15	266.67	90.91	280.00	30.00	667.58
3. Hay barns	1,750.00	875.00	—	15	116.67	17.50	122.50	13.13	269.80
4. Truck (one ton)	9,500.00	4,750.00	950.00	10	855.00	500.00	665.00	71.25	2,091.25
5. Livestock trailer (10 foot)	500.00	250.00	50.00	15	30.00	10.00	35.00	3.75	78.75
6. Wagons	400.00	200.00	40.00	15	24.00	8.00	28.00	3.00	63.00
7. Bookkeeping, legal fees, miscellaneous	—	75.00	—	—	—	—	—	—	75.00
8. Farm tools	—	1,000.00	—	—	—	120.00	140.00	—	260.00
9. Total									3,940.26

	dollars				dollars				
Part C. Large farm									
1. Machine shed	3,850.00	1,925.00	—	15	256.67	32.42	269.50	28.88	587.47
2. Grain bins	7,500.00	3,750.00	—	15	500.00	170.46	525.00	56.25	1,251.71
3. Hay barns	2,100.00	1,050.00	—	15	140.00	21.00	147.00	15.75	323.75
4. Truck (two ton)	16,170.00	8,085.00	1,617.00	10	1,455.30	900.00	1,131.90	121.28	3,608.48
5. Livestock trailer (16 foot)	840.00	420.00	84.00	15	50.40	16.80	58.80	6.30	132.30
6. Wagons	750.00	375.00	75.00	15	45.00	15.00	52.50	5.63	118.13
7. Bookkeeping, legal fees, miscellaneous	—	110.00	—	—	—	—	—	—	110.00
8. Farm tools	—	1,250.00	—	—	—	150.00	175.00	—	325.00
9. Full-time hired labor	—	12,000.00	—	—	—	—	—	—	12,000.00
10. Total									18,456.84
Part D. Extra-large farm									
1. Machine shed	5,000.00	2,500.00	—	15	333.33	42.10	350.00	37.50	762.93
2. Grain bins	10,000.00	5,000.00	—	15	666.67	225.00	700.00	75.00	1,666.67
3. Hay barns	2,500.00	1,250.00	—	15	166.67	25.00	175.00	18.75	385.42
4. Truck (two ton)	16,170.00	8,085.00	1,617.00	10	1,455.30	900.00	1,131.90	121.28	3,608.48
5. Livestock trailer (16 foot)	840.00	420.00	84.00	15	50.40	16.80	58.80	6.30	132.30
6. Wagons	1,000.00	500.00	100.00	15	60.00	20.00	70.00	7.50	157.50
7. Bookkeeping, legal fees, miscellaneous	—	125.00	—	—	—	—	—	—	125.00
8. Farm tools	—	1,500.00	—	—	—	180.00	210.00	—	390.00
9. Full-time hired labor	—	24,000.00	—	—	—	—	—	—	24,000.00
10. Total									31,228.30

Table A 2. Selected Performance Standards and Annual Results for the Farrow-to-Finish Swine Systems

Item	Standard	Annual results			
		25-sow pasture	50-sow low-investment confinement	100-sow high-investment confinement	200-sow high-investment confinement
Conception rate	Gilts - 85% Sows - 90%	50 litters	100 litters	200 litters	400 litters
Live pigs farrowed/ litter	10	500 pigs farrowed	1,000 pigs farrowed	2,000 pigs farrowed	4,000 pigs farrowed
Pigs weaned/litter	7.6	380 pigs weaned	760 pigs weaned	1,520 pigs weaned	3,040 pigs weaned
Mortatlity rate	4%				
Feeder pigs	2%	373 feeder pigs	745 feeder pigs	1,490 feeder pigs	2,980 feeder pigs
Market hogs	2%	366 market hogs	730 market hogs	1,460 market hogs	2,920 market hogs
Gilts kept for replacement	⅓ of sow herd replaced annually	9 gilts	17 gilts	34 gilts	67 gilts
Market hogs sold annually	—	357 hogs	713 hogs	1,426 hogs	2,853 hogs
Boars needed	—	3 boars	5 boars	7 boars	10 boars
Rate of gain[a]	220-lb market hog @ 6 mos.	844.8 cwt total gain	1,681.1 cwt total gain	3,420.0 cwt total gain	6,702 cwt total gain
Feed conversion (including sow herd)	400 lb feed/ cwt gain	169 tons total feed	366 tons total feed	684 tons total feed	1,340 tons total feed

[a]Gross weight produced = total poundage sold - purchase weight of boars. Purchase weight of boars = 2.2 cwt.

Table A 3. Monthly Labor Requirements for Three Swine Enterprises Under Four Swine Production Systems

System	Hours per animal per year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total hours
Part A. Farrow-to-finish (hours per sow)														
25-sow pasture	42.1	63	63	105	126	95	74	63	63	105	129	95	74	1,052
50-sow low-investment confinement	32.0	144	96	192	144	64	160	96	96	192	160	90	160	1,600
100-sow high-investment confinement	25.1	213	198	233	198	213	198	213	198	233	198	213	198	2,506
200-sow high-investment confinement	20.0	333	334	333	334	333	334	333	334	333	334	333	334	4,002
Part B. Farrow-to-feeder pig (hours per sow)														
25-sow pasture	30.0	45	45	75	83	67	60	45	45	75	83	67	60	750
50-sow low-investment confinement	22.4	100	68	134	100	45	112	68	68	134	112	68	112	1,121
100-sow high-investment confinement	19.5	166	154	181	154	166	154	166	154	166	154	166	154	1,950
200-sow high-investment confinement	14.9	248	249	248	249	248	249	248	249	248	249	248	249	2,982
Part C. Feeder pig-to-finish (hours per hog)														
380 hogs; pasture	1.3	40	40	42	45	45	33	40	40	42	45	45	33	490
760 hogs; low-investment confinement	1.1	67	67	73	67	67	73	67	67	73	67	67	73	828
1,520 hogs; high-investment confinement	0.9	113	113	112	113	113	113	113	113	113	113	113	113	1,356
3,040 hogs; high-investment confinement	0.7	176	176	175	175	175	176	176	175	175	176	176	176	2,107

Source: Synthesized from Bache and Foster 1976a, 1976b, 1977a, and 1977b.

Table A 4. Facilities Investments for the Farrow-to-Finish, 25-Sow Pasture System (25 Females Farrowing Twice a Year)

Item	Size and description	Units needed	Cost per unit	Total investment
			----------dollars----------	
Part A. Breeding herd facilities - portable buildings for 30 females (22 sows, 8 gilts)				
Sow shelters	10′ × 14′ portable	3	532.00	1,596.00
Feeding fence	Wooden panels	75 ft.	3.00	225.00
Waterers	80-gal. with heater	1	120.00	120.00
Fencing	Temporary	50 rods	4.75	237.50
Total				2,178.50
Part B. Farrowing-nursery facilities - individual houses with outside pens for 25 sows and litters				
Individual houses	6′ × 7′ portable	25	220.00	5,500.00
Feed pans	Individual	25	5.50	137.50
Wooden panels	10′	50	30.00	1,500.00
Heat lamps	250 watt bulb	25	3.00	75.00
Creep feeders	All-weather	3	100.00	300.00
Total				7,512.50
Part C. Growing-finishing facilities - portable houses on three pasture lots for 200 hogs				
Pull-together houses	20′ × 30′ portable	3	2,200.00	6,600.00
Feeders	60-bu, round	3	200.00	600.00
Waterers	80-gal. with heater	3	120.00	360.00
Field fencing[a]	Permanent	400 rods	13.25	5,300.00
Total				12,860.00
Part D. Supporting equipment				
Feed handling, manure handling and miscellaneous equipment[b]				3,500.00
Part E. Facilities investment summary				
Total facilities investment				
Farrow-to-finish operation				26,051.00
Investment per sow				1,042.00
Farrow-to-feeder pig operation (Parts A, B and D[c])				13,191.00
Investment per sow				527.64
Feeder pig-to-finish operation (Parts C and D[c])				16,360.00
Investment per hog marketed				43.86

[a]Permanent fencing was provided for three fields to permit a three-year rotation.

[b]Equipment needed varied from farm to farm but typically included: water hydrants, feed (auger) wagon or pickup truck, high-pressure pump, front-end loader, dry manure spreader, loading chute, and hog holders.

[c]One hundred percent of the supporting equipment was charged to each of the split-phase operations. An assumption was that the equipment was required for both operations if they were separate.

Table A 5. Facilities Investments for the Farrow-to-Finish, 50-Sow Low-Investment Confinement System (25 Females Farrowing in January and July, 25 in April and October)

Item	Size and description	Units needed	Cost per unit	Total investment
			----------dollars----------	
Part A. Breeding herd facilities - portable buildings in permanent dirt lots for 60 females (45 sows, 15 gilts)				
Sow shelters	10' × 14' portable	5	532.00	2,660.00
Feeding fence	Wooden panels	100 ft.	3.00	300.00
Waterers	2 hole, winter proof	2	133.00	266.00
Concrete feeding slab	7' × 100'	700 sq. ft.	1.50	1,050.00
Fencing	Woven wire	120 rods	13.25	1,590.00
Total				5,866.00
Part B. Farrowing-nursery facilities - 25 litter capacity, central farrowing house with flush gutter				
Building	32' × 72' pole	2,304 sq. ft.	86.65	15,320.00
Concrete slab	32' × 72'	2,304 sq. ft.	1.50	3,456.00
Concrete flush gutter	2 (2' × 80')	320 sq. ft.	1.50	480.00
Farrowing pens	Wooden panels	500 ft.	3.00	1,500.00
Feed pans	Individual	25	5.50	137.50
Heating devices	Space heater and lamps	—	—	410.00
Creep feeders	Individual	13	12.75	165.75
Total				21,469.25
Part C. Growing-finishing facilities - 200-hog capacity, open-fronted building with exposed concrete slab				
Building	20' × 72' pole	1,440 sq. ft.	3.85	5,544.00
Exposed concrete slab	20' × 72'	1,440 sq. ft.	1.50	2,160.00
Waterers	4 hole, winter proof	2	218.25	437.00
Feeders	20 hole, 75 bu	2	477.50	955.00
Partitions and gates	Wooden panels	235 ft.	3.00	705.00
Total				9,801.00
Part D. Supporting equipment - feed and manure handling				
Grinder-mixer	75 bu, portable	1	6,500.00	6,500.00
Bulk supplement storage	7 ton tank	1	850.00	850.00
Miscellaneous[a]		—	—	4,500.00
Total				11,850.00
Part E. Facilities investment summary				
Total facilities investment				
Farrow-to-finish operation				48,986.25
Investment per sow				979.25
Farrow-to-feeder pig operation (Parts A, B and D[b])				39,185.25
Investment per sow				783.71
Feeder pig-to-finishing operation (Parts C and D[b])				21,651.00
Investment per hog marketed				29.06

[a]A hog enterprise of the type described here was likely to be found on a multienterprise farm and thus shared equipment with other enterprises. Therefore, this system was charged 60 percent of the investment in a front-end loader, high-pressure pump, and dry manure spreader and 100 percent of a loading chute, hog holders, and scales.

[b]One hundred percent of the supporting equipment was charged to each of the split-phase operations. An assumption was that this equipment was required for both operations if they were separate.

Table A 6. Facilities Investments for the Farrow-to-Finish, 100-Sow High-Investment Confinement System (32 Females Farrowing Every Other Month)

Item	Size and description	Units needed	Cost per unit	Total investment
			----------dollars----------	
Part A. Breeding herd facilities - portable buildings in permanent dirt lots for 120 females (90 sows, 30 gilts)				
Sow shelters	20′ × 30′ portable	3	2,200.00	6,600.00
Feeding fence	Wooden panels	150 ft.	3.00	450.00
Waterers	4 hole, winter proof	2	218.25	436.50
Concrete feeding slab	7′ × 150′	1,050 sq. ft.	1.50	1,575.00
Fencing	Woven wire	200 rods	13.25	2,650.00
Total				11,711.50
Part B. Farrowing facilities - 32-sow capacity, partially slatted floor unit over underfloor manure storage				
Building (including plumbing, wiring, ventilation fans, heating, slatted floor, 4′-deep underfloor manure tank)	23′ × 90′	2,070 sq. ft.	20.75	42,952.50
Farrowing crates (including, invididual sow feeders, waterers and creep feeders)		32	315.25	10,088.00
Bulk feed holding bin	2 ton, hopper bottom	1	650.00	650.00
Total				53,690.50
Part C. Nursery facilities - 270 weaned-pig capacity, open-fronted building with manure flush system				
Building (including plumbing, wiring, ventilation fans, heating, partially slatted concrete floor over sloped flush gutter, wire mesh curtain)	24′ × 44′	1,056 sq. ft.	11.50	12,144.00
Bulk feed holding bin	3 ton, hopper bottom	1	750.00	750.00
Feeders and feed distribution equipment	5 bu, round	8	91.50	732.00
Waterers	Nipple	8	14.00	112.00
Pen partitions	Wood	175 ft.	3.00	525.00
Flush system	Equipment	1	250.00	250.00
Total				14,513.00

Table A 6 (continued)

Item	Size and description	Units needed	Cost per unit	Total investment
			----------dollars----------	
Part D. Growing-finishing facilities - 550-hog capacity open-fronted building with manure flush system				
Building (including plumbing, wiring, ventilation fans, partially slatted concrete floor over sloped flush gutter, wire mesh curtain)	32' x 130'	4,160 sq. ft.	11.00	45,760.00
Bulk feed holding bin	6 ton, hopper bottom	1	835.00	835.00
Feeders and feed distribution equipment	10 bu, round	12	103.00	1,236.00
Waterers	Nipple	12	14.00	168.00
Pen partitions	Wood	500 ft.	3.00	1,500.00
Flush system	Equipment	1	500.00	500.00
Cooling sprinklers	Spray fogger nozzle	12	6.25	75.00
Total				50,074.00
Part E. Supporting equipment				
Grinder-mixer	85 bu, portable	1	7,000.00	7,000.00
Bulk supplement storage	12-ton tank	1	1,000.00	1,000.00
Sprayer-washer	High pressure, 500 PSI	1	1,025.00	1,025.00
Liquid manure spreader	750 gal.	1	3,000.00	3,000.00
Manure handling equipment	Lagoon and piping	—	8,500.00	8,500.00
Miscellaneous[a]		—	—	2,000.00
Total				22,525.00
Part F. Facilities investment summary				
Total facilities investment				
Farrow-to-finish operation				152,514.00
Investment per sow				1,525.14
Farrow-to-feeder pig operation (Parts A, B, C, and E[b])				102,440.00
Investment per sow				1,024.40
Feeder pig-to-finish operation (Parts D and E[b])				72,599.00
Investment per hog marketed				48.72

[a]Items included were charged at 100 percent of investment - loading chute, hog holders and scales; charged at 50 percent of investment - front-end loader.

[b]One hundred percent of the supporting equipment was charged to each of the split-phase operations. An assumption was that this equipment was required for both operations if they were separate.

Table A 7. Facilities Investments for the Farrow-to-Finish, 200-Sow High-Investment High-Intensity Confinement System (32 Females Farrowing Each Month)

Item	Size and description	Units needed	Cost per unit	Total investment
			----------dollars----------	
Part A. Breeding facilities - portable buildings in permanent dirt lots for 40 females (30 sows, 10 gilts)				
Sow shelters	10′ × 14′	4	532.00	2,128.00
Feeding fence	Wooden	100 ft.	3.00	300.00
Waterers	2 holes, winter proof	2	122.75	245.50
Concrete feeding slab	7′ × 100′	750 sq. ft.	1.50	1,125.00
Fencing	Woven wire	100 rods	13.25	1,325.00
Total				5,123.50
Part B. Gestating facilities - 200-sow capacity, partially slatted open-fronted building with underfloor manure storage				
Building (including plumbing, wiring, ventilation fans, 10′ -wide slatted section with 6′ underfloor manure tank, wire mesh curtain)	30′ × 120′	3,600 sq. ft.	12.50	45,000.00
Bulk feed holding bin	3 ton, hopper bottom	1	750.00	750.00
Feeding system	Auguer distribution with automatic floor drop	12	54.50	654.00
Waterers	Nipple	12	14.00	168.00
Pen partitions	Wood	400 ft.	3.00	1,200.00
Cooling sprinklers	Sprary fogger nozzle	12	6.25	75.00
Total				47,847.00
Part C. Farrowing facilities - 64-sow capacity with two rooms of 32 sows each, slatted floor unit with underfloor manure storage				
Building (including) plumbing, wiring, ventilation fans, heating, slatted floor over 4′ underfloor manure tank)	23′ × 200′	4,600 sq. ft.	20.75	95,450.00
Farrowing crates (including individual waterers, sow and creep feeders)		64	315.25	20,176.00
Bulk feed holding bin	3 ton, hopper bottom	1	750.00	750.00
Total				116,376.00
Part D. Nursery facilities - 550 weaned-pig capacity, controlled environment building				
Building (including plumbing, wiring, ventilation fans, heating, fully slatted floor over 4′ manure tank)	32′ × 60′	1,920 sq. ft.	13.75	26,400.00
Bulk feed holding bins	3 ton, hopper bottom	2	750.00	1,500.00
Feeders and feed distribution equipment	5 bu, round	12	91.50	1,098.00

Table A 7 (continued)

Item	Size and description	Units needed	Cost per unit	Total investment
			----------dollars----------	
Waterers	Nipple	12	14.00	168.00
Pen partitions	Steel pipe	300 ft.	2.00	600.00
Total				29,766.00
Part E. Growing-finishing facilities - 1,100-hog capacity in two 550-capacity open-fronted, partially slatted buildings				
Buildings (including plumbing, wiring, ventilation fans, 15' - wide slatted section over 5' underfloor manure tank, wire mesh curtain)	2 (32' x 130')	8,320 sq. ft.	13.00	108,160.00
Bulk feed holding bins	6 ton, hopper bottom	2	835.00	1,670.00
Feeders and feed distribution equipment	10 bu, round	24	103.00	2,472.00
Waterers	Nipple	24	14.00	336.00
Pen partitions	Steel pipe	600 ft.	2.00	1,200.00
Cooling sprinklers	Spray fogger nozzle	24	6.25	150.00
Total				113,988.00
Part F. Supporting equipment				
Self-contained feed center	20-ton storage and automatic electric mill	1	9,550.00	9,550.00
Feed delivery system	Pneumatic	1	4,100.00	4,100.00
Sprayer-washer	High pressure, 500 PSI	1	1,025.00	1,025.00
Dead pig incinerator		1	1,300.00	1,300.00
Stand-by generator	25 kilowatt	1	2,750.00	2,750.00
Liquid manure spreader	1,500 gal. with plow down attachment	1	5,200.00	5,200.00
Miscellaneous[a]		—	—	250.00
Total				24,175.00
Part G. Facilities investment summary				
Total facilities investment				
Farrow-to-finish operation				337,275.50
Investment per sow				1,686.50
Farrow-to-feeder pig operation (Parts A, B, C, and F[b])				212,287.50
Investment per sow				1,061.44
Feeder pig-to-finish operation (Parts E and F[b])				127,163.00
Investment per hog marketed				42.67

[a]Items included were such things as loading chute, hog holders, and scales.

[b]One hundred percent of the supporting equipment was charged to the split-phase operations except the feeding system shown. An assumption was that if only one of the two split-phase operations was used, feed was handled by a portable grinder-mixer and bulk tank supplement storage.

Table A 8. Monthly Labor Requirements for Selected Alternative Enterprises on Swine Farms

Enterprise	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total hours/ unit
Part A. Crop enterprises	hours per acre												
1. Corn	—	—	.11	1.07	.33	.29	.29	—	—	.44	.23	—	2.76
2. Soybeans	—	—	.09	.35	.70	.46	.45	.19	—	.29	.29	—	2.82
3. Wheat	—	.25	—	—	—	.76	—	—	.52	.52	—	—	2.05
4. Cotton	—	—	.39	.62	.62	.84	.91	—	—	.10	—	—	3.48
5. Wheat - soybeans	—	.19	—	—	—	1.30	.25	.25	—	1.16	.68	—	3.83
6. Grain sorghum	—	—	.10	.94	.51	.44	—	—	.78	.41	—	—	3.18
7. Alfalfa hay	—	.20	—	.25	2.38	2.63	2.48	.16	2.40	—	—	—	10.50
8. Clover - Timothy hay	—	—	.01	.15	.15	1.69	1.66	1.67	1.67	—	—	—	7.00
9. Permanent pasture	—	.33	—	—	—	.52	—	.41	.02	—	—	—	1.26
Part B. Livestock enterprises	hours per head												
1. Beef cow-calf	1.00	1.00	1.13	.71	.57	.47	.47	.47	.57	.71	.90	1.00	9.00

Source: Synthesized from Burney 1976, Ray 1977, and Walch et al. 1984.

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