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I am submitting herewith a thesis written by Clayton M. Williams entitled "An Analysis of the Loan Repayment Capacity of Farrow-to-Finish Pork Production in Tennessee." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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# AN ANALYSIS OF THE LOAN REPAYMENT CAPACITY OF FARROW-TO-FINISH PORK PRODUCTION IN TENNESSEE

A Thesis

Presented for the

Master of Science

Degree

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Clayton M. Williams

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## ABSTRACT

The general objectives of the study were: (1) to determine the rates of return to equity for a representative farrow-to-finish swine farm when 100 percent equity financed, and (2) to examine the effects different combinations of income streams, interest rates, and owner equity contributions have on the debt servicing capacity of the representative swine farm.

A representative farrow-to-finish swine operation was synthesized after analyzing and comparing data from swine research units at Ames Plantation in west Tennessee along with similar research findings in the southeast.

The representative farm as described for this study had a total of 70 acres. Fifty-three acres of openland were available for pasture cultivation with the remaining 17 acres for buildings, roads and waste disposal systems. The basic farm situation remained the same throughout the study. Labor resource was scheduled to supply the equivalent of 4,576 hours annually. These hours were provided by family members of the operator along with one hired worker. On-farm capital investment contributions were generated both internally and externally. Management was assumed to have the necessary skill and dedication to efficiently operate the representative farm.

As a consequence of determining the loan repayment capacity of the farm, sub-analyses involving herd stablilization, cost and revenue estimates, hog price cycle, and interest rates were developed.

The number of animals sold annually, operating expenses, and total on-farm capital investment were held constant throughout the study.

Even though total on-farm investment was the same, for all situations, the proportions of equity contributions to borrowed capital were varied. The levels of equity contributions were 20, 30, 40, and 50 percent of long term capital assets while the corresponding levels of borrowed capital were 80, 70, 60, and 50 percent, respectively.

Three hog price sequences were used instead of a constant level pricing method. This approach was taken to better represent the fluctuation in income usually experienced by swine farmers.

Three levels of interest rates were analyzed to ascertain the impact of interest rate risk on the loan repayment capacity. The types of loans and interest rates analyzed were short and intermediate loans at 9, 12, and 15 percent while the long term loans were 8, 11, and 14 percent, respectively.

Forty-five cash flows involving different combinations of equity contributions, interest rates, and income streams based on the hog farm cycle were analyzed.

From the results of this study, it would appear that current swine producers in Tennessee with relatively debt-free farms are likely to continue their operation in the short-run. Generally, farms which are fully equity financed tend to yield lower rate of returns to equity than farms in leverage situations. The beginning farmers in leverage situation are not expected to show a positive after tax

net cash income for accumulation before the fifth year of operation and may extend until the tenth year depending on the income stream and level of interest rates.

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# CHAPTER I

## INTRODUCTION

Debt repayment capacity is a very important concept in agricultural business today. Investors in swine production, as in other livestock enterprises usually base their investment decisions on the feasibility of the project. When a single project is considered, the analysis must lead to an accept or reject decision based on some established investment criteria. Such criteria entail among other factors the ability of the project to provide a rate of return greater than or at least equal to the investor's opportunity cost. An analysis of the debt repayment capacity, of a swine farm, requires the developing of projections for livestock sales, capital investment, operating expenses, and cash flow schedules over some specified planning horizon.

The factors affecting debt repayment capacity of farrow-to-finish swine operation are interrelated. For simplification, this study was centered on the repayment capacity of a representative swine farm when varying combinations of three influential variables were examined. The three variables examined were owner's equity, interest rates, and hog prices based on the hog price cycle.

# I. PROBLEM

Modern swine producers are confronted with a tendency toward increased input cost and a wide variability in the prices of market hogs. Wide variation in hog prices places swine producers in a particularly risky position in periods of high inflation. Swine producers most likely to be adversely affected by high interest rates are those who have become highly leveraged to acquire resources. Thompson and Hanson (23, pp. 727-732) in their study on farm debt burdens contended that, "the combination of wide fluctuations in income coupled with heavy debt-servicing commitments can render the farm insolvent, imperiling continued survival." Further, P. J. Barry (3, p. 8) concluded that, "the burden of high volatile rates of inflation and interst is heaviest on those farmers who acquired considerable indebtedness to establish and expand their operations." The inability of farmers to fully service their debts because of cash shortfall has been plaguing the Tennessee swine industry. Potential and current operators of swine farms in Tennessee need to be able to determine debt servicing capacity and the "best" starting point on the hog price cycle before committing themselves to substantial investments in swine production. This study is intended to provide insight to swine operators and lending institutions regarding the financial operation of farrow-to-finish swine production systems in Tennessee.

## Shift in Production Emphasis

A shift of emphasis in swine production from total pasture systems to more intensive operations has been observed by Ray et al. (19, p. 2). This shift allowed more animals to be produced per farm and required more investment per animal.

Several factors have contributed to the increase in average number of hogs per farm since the 1950's. The rapid adoption of improved technology had both direct and indirect effects on the swine industry. Direct effects of technology on the swine industry have been evident by the substitution of capital for labor, larger but fewer farms, more specialized operations, increased use of buildings and equipment, use of superior breeding stock and crossbreeding programs, new drugs to prevent and control diseases, and better handling and restraining facilities. Indirectly, the increase in the average numbers of animals per farm in the 1954-1978 period has been aided by input supply support systems such as improved transportation systems to facilitate more efficient marketing, use of computers for accurate and speedy data analysis, better flow of information to aid decision making, and favorable prices in relation to input costs.

## Average Number of Animals per Swine Farm in Tennessee

Considering 1920 as the base year, two distinct phases in the swine industry can be identified.(25, p. 39). In Phase 1 (1920-1954) the average number of hogs and pigs per farm remained relatively constant; average number of hogs per farm were about 9 in 1920 and

fluctuated to 7, 7, 7, 6, 7, 9, and 9 respectively, through 1925-1954 consensus. The 1950 and 1954 censuses showed no increase or percent change in the average number of hogs per farm over the 1950 average. In 1940, the average numger of hogs and pigs per farm was 6, the lowest recorded for the entire period.

Phase 2 (1959-1978) was characterized by a rapid increase in the average number of hogs and pigs with an average of about 16 in 1959, to 17, 33, 33, and 47 respectively, through 1964-1978 consensus. The percent increase from 1920 to 1959 was about 80 percent and between 1920 and 1978 over 400 percent. An inventory of all hogs and pigs showing years, number of farms reporting, total number of hogs, average number of hogs per farm, and percentage change over the 1920 average for censuses 1920-1978, and estimates for 1979-1981 are shown in Table 1. A plot of the average number of hogs and pigs per farm in Tennessee for period 1920-1978 is shown in Figure 1.

## II. THE HYPOTHESIS

It was hypothesized that as swine producers establish or modernize their operations through borrowed capital, the probability of cash flow and debt repayment problems tend to increase. Alternatively, if swine producers do not expand or increase output to lower average cost, the producers may be forced out of business in the long run by competition. Swine producers, therefore, must determine their debt servicing ability before embarking on capital investment through debt financing.

Table 1. Inventory of Hogs and Pigs in Tennessee: Censuses of 1920-1978[a], and Estimates for 1979-1981[b]

| Year of Census | Farms Reporting Number | Number Head | Average Per Farm Head | Percent Change In Average Number Per Farm-1920 Base Year Percent |
|---|---|---|---|---|
| 1920 | 204,565 | 1,832,307 | 9 | |
| 1925 | 140,607 | 1,009,062 | 7 | -22.00 |
| 1930 | 143,906 | 1,002,319 | 7 | -22.00 |
| 1935 | 163,142 | 1,002,283 | 7 | -22.00 |
| 1940 | 174,112 | 1,061,875 | 6 | -33.00 |
| 1945 | 139,819 | 992,134 | 7 | -22.00 |
| 1950 | 150,690 | 1,365,757 | 9 | 0.00 |
| 1954 | 119,974 | 1,056,651 | 9 | 0.00 |
| 1959 | 99,400 | 1,609,569 | 16 | 78.00 |
| 1964 | 55,403 | 957,856 | 17 | 89.00 |
| 1969 | 33,398 | 1,099,948 | 33 | 207.00 |
| 1974 | 21,191 | 701,629 | 33 | 207.00 |
| 1978 | 23,115 | 1,077,379 | 47 | 422.00 |
| 1979 | NA | 1,400,000 | NA | NA |
| 1980 | NA | 1,140,000 | NA | NA |
| 1981 | NA | 900,000 | NA | NA |

[a]U.S. Bureau of the Census, Census of Agriculture, Volume 1, Part 31, Tennessee State and County Data, Washington, D.C.,: Government Printing Office, 1959, p. 9; 1969, p. 5; and 1978, p. 14.

[b]Tennessee Department of Agriculture, Tennessee Agricultural Statistics, Annual Bulletin T-19, 1982, p. 39.

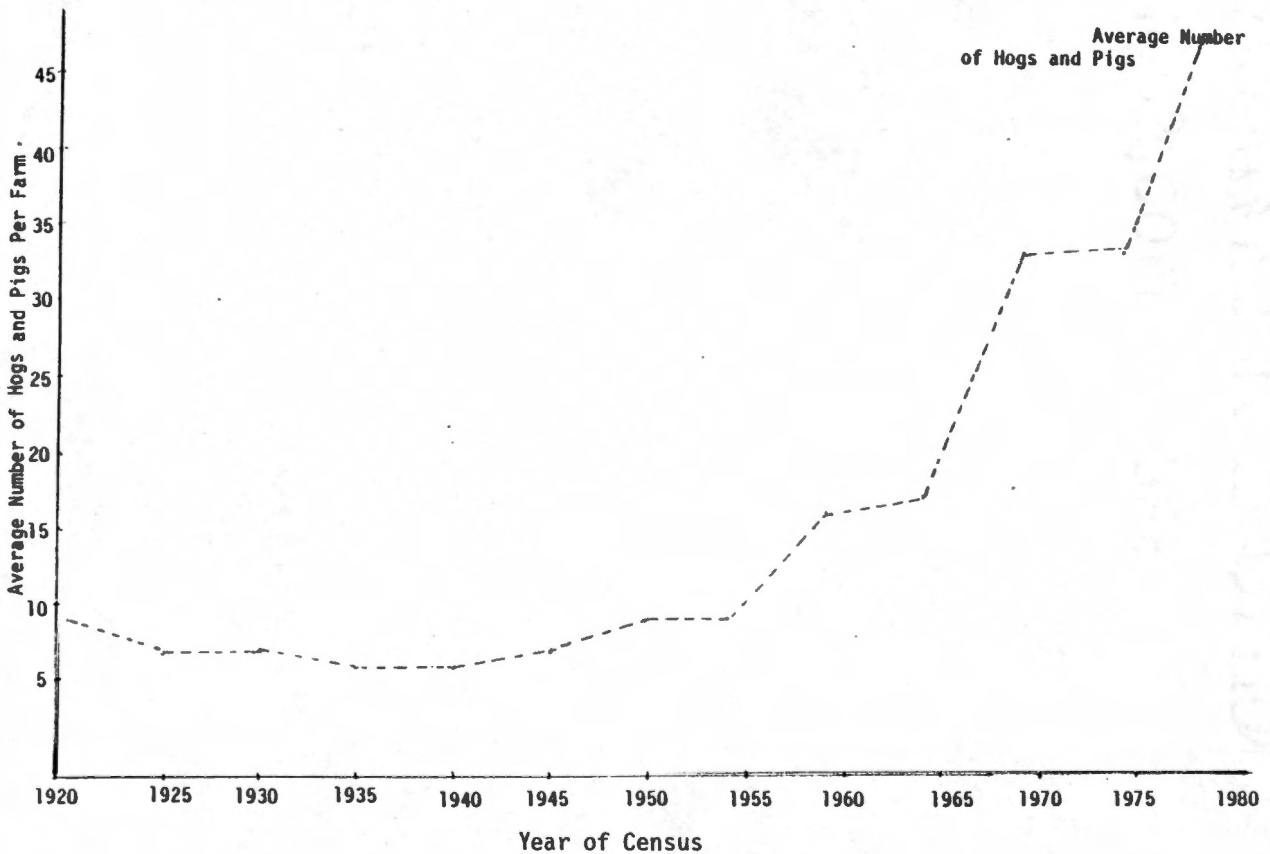


Figure 1. Average number of hogs and pigs per farm in Tennessee, 1920-1978.

Source: U.S. Bureau of Census, Census of Agriculture, Vol. I, Part 31, Tennessee State and County Data. Washington, D.C.: Government Printing Office, 1979.

# III. OBJECTIVE

The general objective of this study was to develop a representative swine production system with cost and revenue estimates and to determine the debt servicing capacity, for a specified period, with various combination of interest rates and hog price sequences.

## Specific Objectives

1. To determine the rate of return to equity for three different income streams when the representative farm is one hundred percent equity financed.
2. To examine what effects various combinations of hog prices, interest rates, and levels of owner equity would have on debt repayment capacity of the representative swine farm over a ten-year period.

## Assumptions and Procedures

The following assumptions and procedures were used to achieve the two objectives stated for this study.

A representative swine farm operation with sows farrowing twice annually was synthesized based on resource assumptions and technical coefficients detailed in Chapter II. Livestock production coefficients were derived mainly from a six-year summary of animal performance data from Ames Plantation Swine Research Unit in West Tennessee (19, pp. 2-6), and the Farm Planning Manual (20, pp. 115-120). Other data inputs were from consultations with livestock specialists, and reviews of research of similar nature from other experiment stations

in the Southeast. The representative farm was assumed to have 53 acres available for ladino-orchard grass pasture with an additional 17 acres for buildings, roads, and waste disposal system. The basic farm situation remained the same throughout the study.

Three streams of annual cash receipts were projected according to a three-year repeating hog price cycle. The duration of the hog price cycle was determined through a plot and inspection of annual hog prices data taken from Livestock and Meat Statistics Reports (28, p. 122). Hog prices were adjusted for inflation through indexing techniques. This approach was used to hold all prices received for market hogs and input costs constant at the 1980 price level. The last hog price cycle (1980-1982) was then examined to estimate annual average price per hundredweight at the low point, intermediate level, and peak of the cycle. From each of these points, a stream of annual cash receipts was projected for a ten-year period. Projected livestock sales from each stream was the number of animals sold per year in each sale category multiplied by the estimated prices based on the hog price cycle.

Standard budgetary techniques were used in estimating on-farm capital investment requirements and costs for the representative farm. Capital investment costs were based on 1980 price estimates. Swine budgets developed by Ray and Walch (20, pp. 115-120) were used in the analysis. The total cost for capital investment items included estimates on such groupings as buildings and equipment, pasture establishment, lagoon and piping, farm roads, and breeding stock. All capital

investment items (required for the duration of the study) were purchased and installed by mid of the first year.

Standard budgetary techniques were also used in estimating the operating expenses. Two estimates of cash operating expenses were developed. The first estimate was to determine the amount of operating cash expenses for the start-up year. The second estimate was to determine the annual operating cash expenses during normal years of operation. Operating cash expenses were held constant from the second year through the tenth year. Operating costs were also based on 1980 price levels.

Forty-five cash flow projections were developed. The general cash flow model used in estimating the net cash equity after taxes and debt services is shown below:

$$C_t = [(S_t - U_t - A_t)(1 - T)] - F_t - L_t$$

where:

$C_t$ = net cash flow after taxes, family living expenses, and loan payments for year t

$S_t$ = total operational cash inflows or sources of funds for year t which included livestock sales, equity contributions, borrowed funds, earned interest and the salvage value at the end of the tenth year

$U_t$ = total operational cash flow or use of funds for year t which included operating expenses, equity distribution, and borrowed funds distribution

$A_t$ = total income tax allowances for year t which included depreciation allowances, interest payments and net operating loss

$T$ = tax rate for year t

$F_t$ = family living expenses

$L_t$ = total payment on loan for year t, including advance repayments on loan principle when income was available

The cash flow results along with the net present value criterion were used to evaluate the rate of return of equity associated with each income stream based on the hog price sequences. With the three alternative income streams being considered, the basic situation was unchanged regarding farm size, on-farm capital investment, and operating expenses.

The varying combinations of interest rates, owner equity, and income streams were evaluated to determine the profitability of the swine operation. The three levels of short and intermediate loan rates used to account for interest variability were 9, 12, and 15 percent. Interest rates on long-term loans were 8, 11, and 14 percent. The saving rates or opportunity costs for capital before taxes were two percent lower than the interest rates for short and intermediate loans. The levels of owner capital equity contributions examined were 100, 50, 40, 30, and 20 percent. Income streams were designated "A," "B," and "C" representing the projected income stream associated with operators starting at the low point, intermediate level, and peak of the hog price cycle, respectively. Net present value and internal rate of return criteria were used to evaluate the loan repayment capacity for thirty-six alternative farm situations analyzed.

# CHAPTER II

## THEORETICAL FRAMEWORK

The concept of dynamic planning is pertinent to any investment project which has multiple production periods. There has been a tendency towards increased capital outlay for specialized buildings and equipment used in commercial hog operations. It requires long-term planning for an operator to fully realize the expected benefits of his investments. With this setting, a dynamic approach was taken in the analysis. Several economic theories and principles were considered as an integrated whole as the production periods were connected through time. More specifically, theories of profit maximization, financial management, the net present value criterion, and the principle of increasing risk, along with other pertinent economic theories and principles underline this study.

### I. PROFIT MAXIMIZATION

Simply defined, profit is the difference between revenue and cost. In a dynamic sense, as is envisaged in a ten-year project, profit takes a somewhat different interpretation. Doll and Orazen (8) argued that, "profit in this sense is not a once-over lump sum at a point in time but rather a stream of receipts into the future."

Given that the swine industry is competitive, the condition for profit maximization (MC = MR = P) would still exist in static analysis.

Although profit maximization is commonly identified as the chief goal of the operator, there are other goals specified by operators. In this study, the long-term goal of farm firm survival and a relatively high liquidity preference were preferred over short-term profit maximization.

## II. FINANCIAL MANAGEMENT

The theory of financial management explains the role of the operator in maximizing utility from the business where utility is a function of return and risk. Rational operators have a tendency toward selecting projects with higher expected returns and a relatively lower level of risk. Financial risk tends to increase as leverage is increased. Lee et al. (14, p. 37) referring to financial management stated that "increased leverage tends to magnify potential gains as well as potential losses; and as leverage increases, the spread between the two increases." Other factors being equal, profitable firms that use more leverage will show more rapid rate of growth in owner equity. For projects which are feasible this implies that so long as rate of return to owner equity is greater than the opportunity cost, then leverage should be increased. The tendency toward increased rate of return to equity as leverage is increased could be viewed as a compensation for risk. Conversely, the rate of loss of owner equity tends to be magnified for projects which are infeasible. Conceptionally, an optimal leverage situation would exist when the return from the use of non-equity capital is equal to the owner's opportunity cost.

# III. CHOICE OF DECISION CRITERIA

Net present value along with the internal rate of return criteria were selected to determine the "best" investment alternative. Other popular capital investment criteria are: (a) payback rule,[1] and (b) profitability index.[2] The payback rule is commonly used to provide a quick indication of the liquidity status of an investment. Strict adherence to the payback rule could lead to a "wrong" investment decision. The payback rule is considered "weak" because it does not account for the time value of cash flows, and there are differences among economists regarding the basis for establishing a meaningful payback period. For most projects, the profitability index and net present value rule would give the same accept or reject signals. However, in cases of mutually exclusive projects, the net present value is preferred because its results are expressed in absolute dollars. In contrast, profitability index reflects only relative benefits being derived from the projects being considered. Net present value and internal rate of return criteria were selected because in most instances they would provide correct and consistent accept or reject investment decisions.

Myers and Brealey (15, p. 63) identified some advantages in the use of net present value rule as compared to the payback and profitability index rules.

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[1] Payback is defined as $P = \frac{C_o}{I}$, where P = payback period in years, $C_o$ initial investment outlay, and $I$ = annual net cash return. The project with the shortest payback time is considered the best project based on the payback rule.

[2] Profitability index = $\frac{PV}{C_o}$, where PV = present value, and $C_o$ = initial investment outlay. The project is considered feasible if the profitability index is greater than one.

> First, the NPV rule recognizes the dollar today can be invested to start earning interest immediately. Any investment rule which does not recognize the time value of money cannot be sensible. Second, net present value depends solely on the forecasted cash flows from the project and the opportunity cost of capital. Any investment rule which is affected by manager's tastes, the company's choice of accounting method, the profitability of the company's existing business, or the profitability of other independent projects will lead to inferior decisions. Third, because present values are all measured in today's dollars, you can add them up.

The additivity property of net present value helps simplify the decision process and makes it easy for a consensus as to which of the independent projects is the "best."

The notion of net present value requires the introduction of the concept of discounting of revenues so that alternatives projects with different income streams could be placed on a time equivalent basis. The project with the highest net present value would be the project which is preferred. According to Schall and Haley (21, pp. 228-229),

> Either the present value method or internal rate of return method can be used to analyze present and future project cash flow. Both present value and IRR are appropriate for such an analysis whether it is assumed that future investments carry a rate of return equal to the cost of capital, equal to each investment's IRR, or equal to any other rate.

A reinvestment rate of 2 percent lower than the interest rate for short and intermediate loans were used in the analysis. The general formula used in this study for the calculation of the net present value is shown below.

$$NPV = -C_o + \frac{C_N}{(1+i)^N}$$

where:

$C_o$ = initial ivestment of equity capital

$C_N$ = accumulated net cash equity attributed to the investment that can be withdrawn at the end of the Nth year (the tenth year in this study) which included the salvage value

N = length of planning horizon

i = interest rate

## IV. PRINCIPLE OF INCREASING RISK

Lee et al. (14, p. 32) defined the principle of increasing risk as, "the tendency for risk to become greater at an increasing rate as the relative amount of nonequity capital used in the business expands." The long-term financial position of a business may look favorable while the business may still be having financial short-fall in the early stages of development. It is assumed that the operator would borrow money to continue the business but only when it is rational to do so; that is, when the expected return from the use of borrowed funds is higher than the cost of borrowing the money.

As this study was formulated the theories of profit maximization and financial management, along with the principle of increasing risk, and other relevant investment decision rules were consistently applied.

# CHAPTER III

# FRAMEWORK FOR ANALYSIS

## I. RESOURCE ASSUMPTIONS

### Land Ownership and Requirement

The arrangement under which land was controlled in this study formed a very important consideration. Even though several land control methods were not analyzed, it was recognized that the method used in acquiring and controlling land could have substantial long-run consequences on the feasibility of the representative farm unit being studied.

Ownership. The method used in controlling land required that the operator owned the farmland prior to the establishment of the swine farm. The hog operation was charged $45.00 per acre per year for the use of land (22, p. 88). The decision to use this method in controlling land resources was based mainly on three considerations: (1) since the operator would be relying heavily on borrowed capital, his land title along with other assets would provide an excellent source of collateral for funds requested from lending institutions; (2) landownership would assure operator's control over a key asset of the enterprise and avoid forced closure of the hog operation due to lease termination or disputes; (3) a fixed charge for land use would simplify the accounting process.

Requirement. Land resource was of size sufficient to accommodate the number of sows carried on the representative swine farm. Seventy acres of farmland were assumed to be adequate for the type of farrow-to-finish operation used in this study. From the 70 acre farmland, 53 acres of openland were cultivated with ladino-orchard grass to carry a maximum of 210 sows.[a] The stocking rate assumed for the ladino-orchard grass pasture was four sow units per acre, per year, with rotational grazing. The remaining 17 acre farm was set aside for farm buildings, roads, and waste disposal system.

## Labor Availability

A total of 4,576 man hours was assumed to be available per year on the representative farm. The contributors to the labor pool were the owner operator, a full-time hired worker, and the operator's son who worked mainly during the period of higher labor demand to complement the labor force. March through October was designated as the peak labor period because in addition to the normal activities of caring for and feeding animals, certain time specific activities such as pasture renovation, and purchasing and storing of corn had to be accomplished. The labor schedule was divided into two-month periods.

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[a]A boar or gilt was also considered a sow unit. The maximum number of sows, gilts, and boars to be carried on pasture lots at any given time were 150, 38, and 22, respectively. Market hogs and piglets were in confinement buildings.

The number of man hours available per two-month periods is shown in Table 2.

## Capital

It was assumed that on-farm capital investment would be available from internal and external sources at specified interest rates. Internal capital was represented as the total amount of funds which the owner contributed toward the operation of the swine farm. External capital was the total amount of funds which the owner obtained from lending institutions to operate the swine farm. The cost on internal capital was the owner-operator's opportunity cost which was assumed to be 2 percent lower than the interest rates charged for short and intermediate term loans. Interest rates specified for this study were varied depending on the type of loan used. The three types of loans were as follows:

1. Short-term loans: These types of loans could be repaid within one year and were used as operating or working capital.
2. Intermediate loans: These types of loans could be repaid within seven years and were used to purchase livestock.
3. Long-term loans: These loans could be repaid within 10 years and were used for on-farm capital investment items--farm buildings and equipment, machinery and equipment, pasture establishment, and waste disposal system.

Table 2. Maximum Number of Man-Hours Available by Two-Month Periods for the Representative Swine Farm

| Source of Labor | Labor Period | | | | | | |
|---|---|---|---|---|---|---|---|
| | Jan-Feb | March-April | May-June | July-August | Sept-Oct | Nov-Dec | Total |
| Owner-operator | 384 | 384 | 384 | 384 | 384 | 384 | 2,304 |
| Hired Labor | 320 | 320 | 320 | 320 | 320 | 160 | 1,760 |
| Son | --- | 114 | 114 | 114 | 114 | 56 | 512 |
| | 704 | 818 | 818 | 818 | 818 | 600 | 4,576[a] |

[a]Under the assumption that two full-time workers would be needed to operate the farm, a total of 4,576 man hours were required on a seven-day week schedule, at 44 hours per man, per week for 52 weeks.

Loan repayments were made directly from funds generated from the swine operation. As surplus funds became available advance payments were made on outstanding loans, short term and intermediate and then long term, to reduce interest costs. Once the loans were repaid then intertest was earned on excess funds and was accumulated after taxes.

Management

It was assumed that the owner-operator and other members of the labor force have the necessary skills, knowledge, and dedication needed to successfully manage a swine operation of the size specified for this study.

## II. MANAGEMENT STRATEGY AND THE FIRM'S LIFE CYCLE

It was recognized that goals and objectives of operators might differ greatly. It was also recognized that an owner-operator might change objectives over time depending on both social and economic factors such as the state of health of family members, change in goals of family members, interest of spouse, and persistent low hog prices. In spite of the likelihood of goal changes an owner-operator should enter the swine production business with some definite strategies.

The farrow-to-finish operation proposed in this study was set up under the scenario of a ten-year operation, with option for continuation or sale, at the end of the period. Barry et al. (5, pp. 24, 425) proposed four basic stages in the farm firm life cycle. The four

stages are: establishment, expansion, consolidation, and transfer or sale. Each stage of the cycle characterized a transition in owner-operator capital accumulation and management efficiency level. A conceptual relationship of the farm size and management efficiency over the life cycle of the representative farm is shown in Figure 2. An understanding of the different stages of the farm firm life cycle should help operators make decisions regarding their involvement in swine production depending on age and other social and economic factors. In Appendix A the features relating to the different phases of the farm firm life cycle are identified.

Annual Family Living Expenses

Farm family living expenses were fixed for each production period. The amount of funds estimated for living expenses was based on a percentage of the median income of Tennessee for a household of four. The equivalence between farm and nonfarm family labor income was estimated by Dale Hathaway (24, pp. 166-168) who reported that the return for labor would be about equal if the median income of farm families before taxes were 86 percent of nonfarm families. In Tennessee, the median income for a family of four (1980) was estimated at $16,572. Based on this information, a net amount of $11,736 was allocated annually for family living after deductions for social security and taxes.

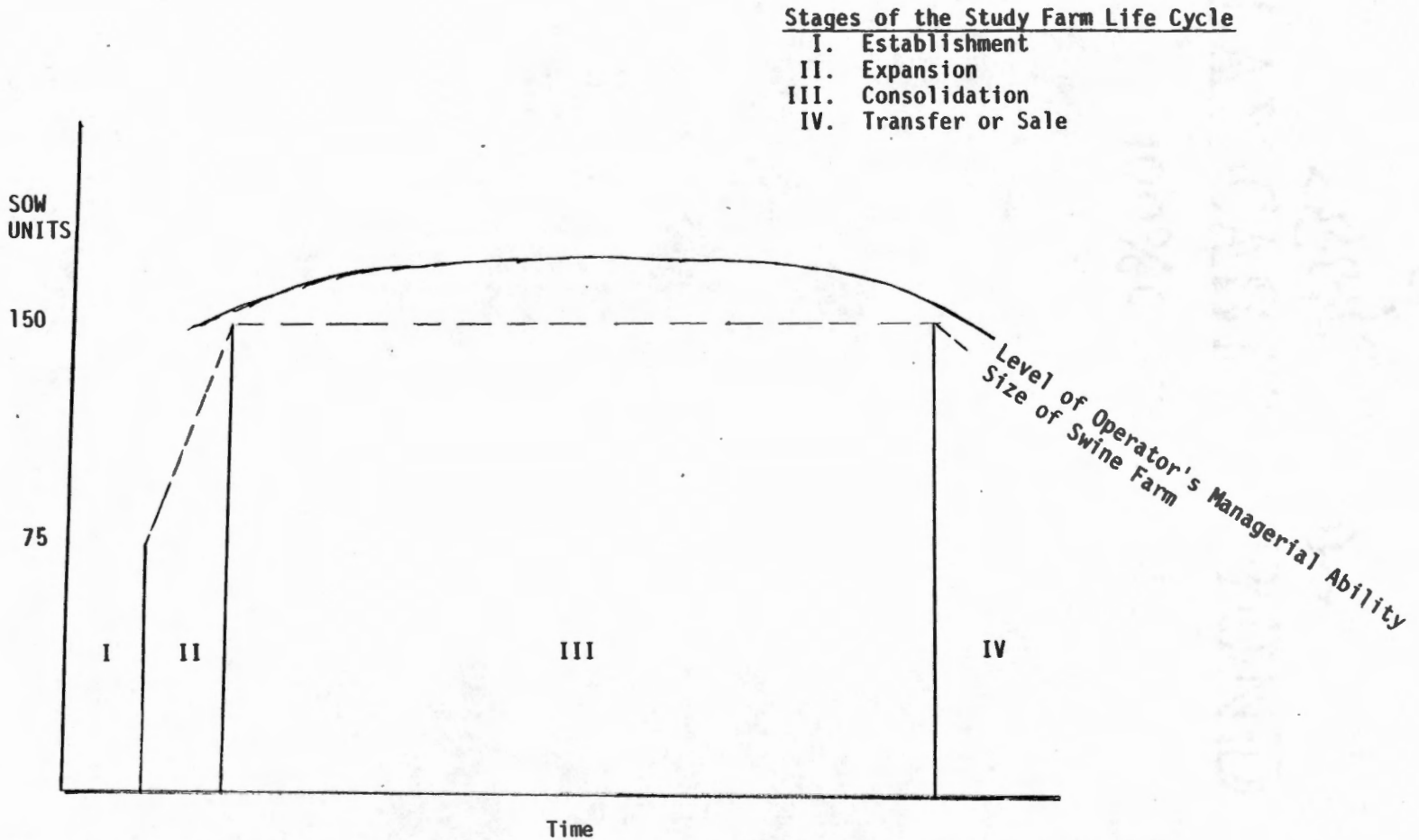


Figure 2. A Conceptual Relation of Farm Size and Managerial Level for the Life Cycle of the Study Unit.

Source: Adapted from J. P. Barry, J. A. Hopkin, and C. B. Baker, Financial Management in Agriculture, Third Edition. Danville: The Interstate Printers and Publichers, Inc., 1983. Pp. 24, 425.

# III. VARIABLES

## Equity Contributions and Percent of Funds Borrowed

One of the three variables used in the analysis was owner equity contribution to the percent of borrowed funds for long-term, intermediate term, and short-term loans. The capital structure involved several combinations of equity and nonequity financing. For this study, capital structure was defined as the relative utilization of owner equity versus nonequity financing to establish and operate the representative farrow-to-finish swine farm. In the case of long-term loans, five different combinations of initial owner equity to borrowed capital were evaluated. While the percent of long-term loans and initial equity contributions were varied accordingly, the amount of owner equity contributions towards intermediate and short-term financial requirement was zero. The combinations of owner equity to borrowed capital for long term assets used in the analysis are shown in Table 3.

## Interest Rates

The second variable in the study was interest rates. Secondary data (26, p. 450) were used to estimate the difference in the rates to be charged for long-term, intermediate, and short-term loans. Rates charged by the Federal Land Banks were considered as proxy for long-term loans. Production Credit Associations rates were considered as proxy for both short and intermediate loans. The average annual interest rates charged by these financial institutions, for the period 1972-1981, are shown in Table 4. The interest rates from these lending

Table 3. Ranges and Combinations of Owner Equity to Borrowed Capital used in the Analysis of the Representative Swine Farm

| Types of Loans | Owner Equity Contributions | Borrowed Capital |
|---|---|---|
| | Percent | |
| Long-term | 100 | 0 |
| | 50 | 50 |
| | 40 | 60 |
| | 30 | 70 |
| | 20 | 80 |
| Intermediate-term | 0 | 100 |
| Short-term | 0 | 100 |

Table 4. Average Annual Interest Rates Charged by Federal Land Banks and Production Credit Associations, 1972-1981

| Year | Federal Land Bank Average Rate on New Loans[1] | Production Credit Associations Average Cost of Loans[2] |
|---|---|---|
| 1972 | 7.42 | 7.02 |
| 1973 | 7.48 | 8.09 |
| 1974 | 8.14 | 9.43 |
| 1975 | 8.64 | 8.91 |
| 1976 | 8.66 | 8.24 |
| 1977 | 8.39 | 7.88 |
| 1978 | 8.35 | 8.83 |
| 1979 | 9.20 | 10.71 |
| 1980 | 10.39 | 12.86 |
| 1981 | 11.27 | 14.87 |

[1]Contract rates on loans through federal land bank associations. In computing the average rate each farm credit district was given equal weight.

[2]Rate represents interest (has patronage refunds) service fees, cost of record searches, end filing and releasing mortgages, etc., paid by borrowers at a percentage of average loans outstanding during the year.

Source: Adopted from United States Department of Agricultural Statistics 1982, Washington: United States Government Printing Office, 1982, p. 450.

institutions were presented mainly to estimate the difference in rates between the three types of loans. The rates in Table 4 were not the rates used in the study. However, the rates in Table 4 were used in estimating the differential in rates between long-term, intermediate, and short-term loans.

The means and standard deviations of the average annual interest rates charged by federal land banks and production credit associations for the period 1972-1981 are shown in Table 5.

The difference in the average annual interest rates between the proxy lending institutions for period 1972-1981 was estimated to be .88 percent. The short and intermediate loans used, in the study, were assumed at 1 percent higher than long-term loan rates in all cases. The 1 percent difference in interest rates was based on the standard deviation and difference in average annual interest rate associated with the two proxy lending institutions. A 3 percent "spread" between interest rate alternative levels was used to examine the impact of interest variability or financial risk on the loan repayment capacity of the representative farm.

The three levels and combinations of interest rates used in the study are shown in Table 6.

Theoretically, there seems to be a contradiction regarding the relative interest rates, in that short and intermediate loans carried the same rates and were higher than interest rates charged for long-term loans. This apparent contradiction arose because of the notion about the time value of money, i.e., a dollar today is worth more than a dollar tomorrow. However, the disparity in interest rates could be explained by the difference in service costs, size of loans, and nature

Table 5. Means and Standard Deviations of Interest Rates for Federal Land Banks and Production Credit Associations, 1972-1981

| Institutions | Mean of Annual Interest Rates | Standard Deviation | Difference in Average Interest Rate | Assumed Spread of Rates[a] |
|---|---|---|---|---|
| | (Percent) | | | |
| Federal Land Bank | 8.80 | 1.21 | .88 | 1 |
| Production Credit Associations | 9.68 | 2.46 | | |

[a]The assumed difference in interest rates between short and intermediate loans, and long-term loans.

Source: Computed from Table 4, United States Department of Agriculture, Agricultural Statistics 1982, Washington: United States Government Printing Office, 1982, p. 450.

Table 6. Combination and Level of Interest Rates and Types of Loans Used in Analyzing the Impact of Interest Variability on the Loan Repayment Capacity of the Representative Swine Farm

| Interest Rate Level | Types of Loan | | |
|---|---|---|---|
| | Short-Term | Intermediate | Long-Term |
| | | Percent | |
| 1 | 9 | 9 | 8 |
| 2 | 12 | 12 | 11 |
| 3 | 15 | 15 | 14 |

of pledged security. There is a tendency for long-term loans to cost less per dollar to process and service because they usually require less monitoring and routine paper work than in the case of short-term and intermediate loans. The assumption was made that short and intermediate loans would carry the same rates of interest. Production credit associations normally charge the same rate of interest for short and intermediate loans.

## Hog Price Cycle

From a plot and inspection of annual average price for market hogs taken from Livestock and Meat Statistics Reports, the average duration of the hog price cycle was estimated to be about three years. The prices taken from Livestock and Mean Statistics Reports were adjusted for inflation through indexing techniques. After making adjustments in market hog prices received by farmers, three levels of prices were taken from the 1980-1982 hog price cycle to represent prices at the beginning, intermediate, and peak levels of a typical hog price cycle. The adjusted prices at the beginning, intermediate level, and peak of the hog price cycle were estimated at $38.00, $42.32, and $52.70 per hundredweight, respectively. Estimates of annual average prices for market hogs after adjustment for inflation, for period 1980-1982, are shown in Table 7. A plot of undeflated annual average annual hog prices received by farmers from 1963-1982 is shown in Figure 3.

The planning horizon for this study was 10 years. It was envisaged that within the 10-year planning period all phases of the three-year hog price cycle would be observed at least thrice. The adjusted

Table 7. Estimates of the Annual Average Prices for Market Hogs After Adjustment for Inflation, 1980-1982

| Year | Annual Average Prices for Market Hogs | Index of Prices Received by Farmers | Index of Prices Received by Farmers | Annual Average Price for Market Hogs (Adjusted for Inflation) | Point on the Representing Hog Price Cycle |
|---|---|---|---|---|---|
| | Dollars/Cwt. | 1977 = 100 | 1980 = 100 | Dollars/Cwt. | |
| 1980 | 38.00[a] | 134[b] | 100.00 | 38.00 | A |
| 1981 | 43.90[a] | 139[b] | 103.73 | 42.32 | B |
| 1982 | 52.30[a] | 133[b] | 99.25 | 52.70 | C |

[a]U.S. Department of Agriculture, Economic Research Service, Livestock and Meat Statistics, Washington, D.C.: Government Printing Office, October 1983, p. 122.

[b]U.S. Department of Agriculture, Economic Research Service, Agricultural Outlook, Washington, D.C.: Government Printing Office, December 1983, p. 32.

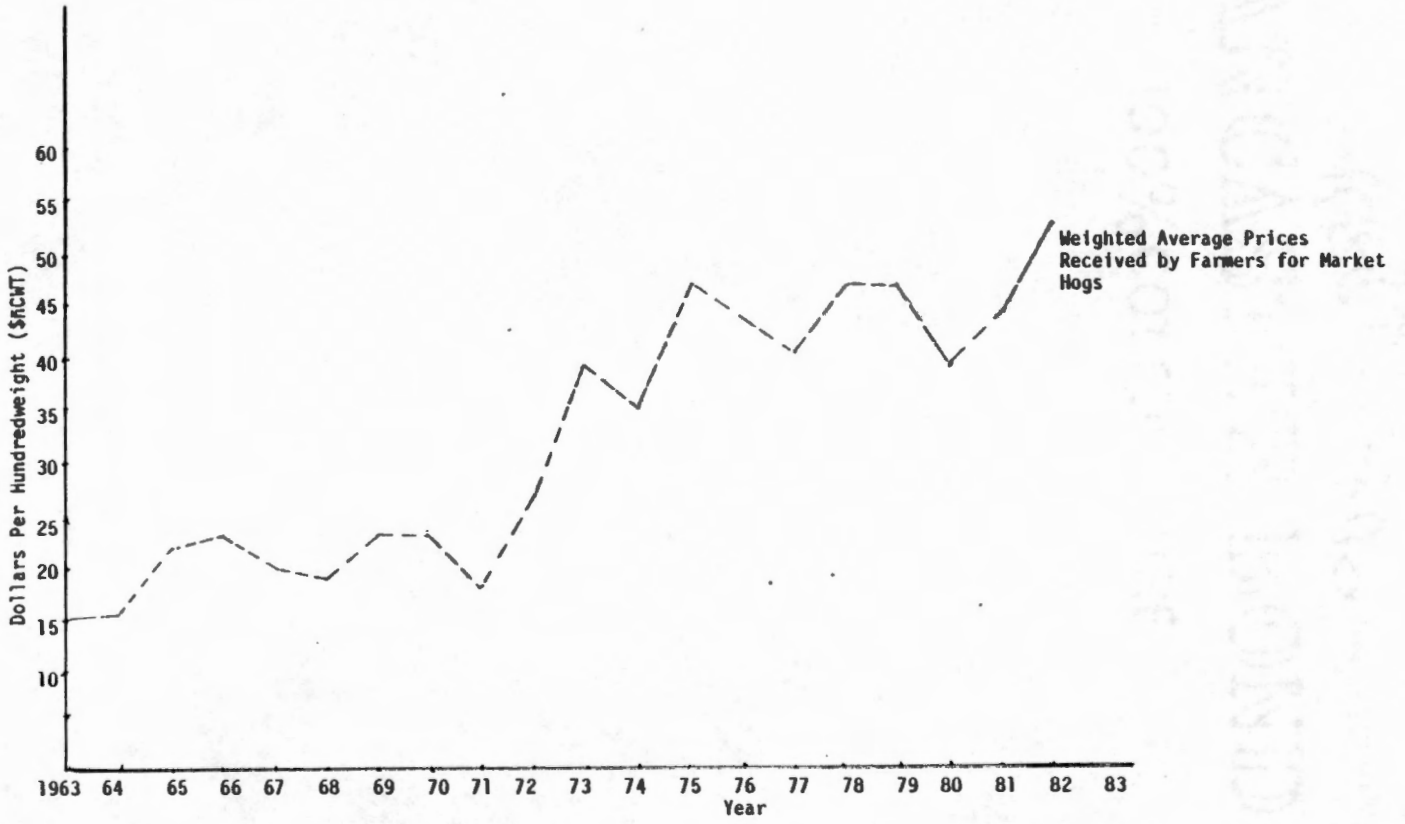


Figure 3. Weighted Average Price Received by Farmers for Market Hogs From 1963-1982.

Source: U.S. Department of Agriculture, Livestock and Meat Statistics Bulletin, Economic Research Service. Washington, D.C.: U.S. Government Printing Office, October 1983.

prices at the different levels of the hog price cycle were used in estimating the projected livestock income streams.

## IV. INFLATION AND INPUT PRICES

The problem of pricing inputs is an important but difficult one. It is not unusual to find farmers paying different prices for the same input items from the same source even within the time span of a week. Therefore, to make projections in price movements for each farm input in the budget is indeed a real and perhaps unsurmountable problem. It was anticipated that there would be differentials in price movements for any single input and among inputs. In project analysis, to circumvent this problem of differential in inflation rates on input prices,

> the customary analytical approach is to work in constant prices rather than current prices and to assume that inflation will affect the prices of all costs and benefits equally, except for specified cost and benefits that are varied in comparison with others so that the relative prices of the specified cost and benefits change. Using the constant prices allows the analyst to avoid making risky estimates of future inflation rates and to simplify the analytical procedures. [Gittinger (11, p. 479)]

The assumption is that inflation would have the same impact on most inputs, so that input prices retain their same general relationship.

## V. SWINE PRODUCTION ENTERPRISE

The swine production enterprise considered in this study represented a combination of pasture and confinement farrow-to-finish systems. During late 1975 a study was initiated at Ames Planataion in

West Tennessee to compare three farrow-to-finish systems typically practiced by swine producers. These systems were referenced by Ray et al. (19, pp. 2-6) as systems I, II, and III, respectively. The descriptions and discussion which follow provided the basis for selecting and designing the type of system used in this study. Below is a brief description of the three systems from which the representative swine production system was designed.

SYSTEM I: A pasture system where all animals were kept on pasture lots through all phases of production until marketed.

SYSTEM II: An intermediate system in which sows were placed in central housing unit (confined) with their piglets at the time of farrowing through weaning. After weaning, the sows were returned to pasture lots for breeding and gestation. About two weeks later the weaned pigs were placed in pasture lots and fattened until marketed.

SYSTEM III: A total confinement system where breeding, farrowing, weaning, and finishing were in buildings.

The technical coefficients and financial summary of these three systems were evaluated in the process of organizing the representative study unit. The technical coefficients from a six-year summary of standard animal performance data from Ames Plantation Swine Research Unit in West Tennessee (Ray, et al.) were used as an indirect way of setting performance standard for the representative farm. Some of the data compiled and analyzed over the six-year period included information on conception rate, mortality rate, sow/boar ratio, number of litters, number of hogs marketed per litter, and other relevant information.

While technical coefficients were useful in making determination on the performance of the animals, additional financial information and managerial constraints were considered for the representative farm. In considering the financial information, a comparative financial analysis of the three systems presented by Ray et al. was examined. The evaluation showed that System II had the highest average net return per sow at $280.00 annually, while Systems I and III were lower by about 6 and 15 percent, respectively. System II also showed an advantage over Systems I and III in that it had the lowest fixed investment per sow at about $110.00 while Systems I and III were higher by 27 and 117 percent, respectively. Although System II had an advantage over System III in terms of its lower level investment and higher return per sow, there were some limitations regarding the number of animals which System II could carry within a given period of time. An expansion of either Systems I or II to accommodate 150 farrowing sows would mean acquiring more land and labor inputs. Apart from the problems of finding suitable land and labor, there is also the likelihood of animal restraint and control problems in both Systems I and II if expanded in respective forms. Further, the expanded version of Systems I or II was expected to impose coordinating problems which would adversely affect the level of efficiency assumed for this study. System III has an operational advantage over Systems I and II because of its finishing facilities which allows it to accommodate more animals on a smaller area at any given time. After considering the

options regarding the three systems, a substitution of the finishing facilities of System III into System II was considered the type of farm organization which could result in more definite benefits than any of the systems taken individually. Some of the benefits which could be realized by combining parts of System II and System III are: (1) the elimination of pasture lot finishing as was practiced in System II; (2) more land would be released for sow breeding and gestation; (3) increased hog finishing capacity; (4) reduced animal control problems; and (5) help simplify management activities. All these factors are expected to result in a better organized and a more efficient farrow-to-finish operation. The above factors, both technical and financial, were considered in organizing the representative farm used as the study unit.

## VI. SIZE OF SWINE HERD

The number of animals which the representative farm could carry was another important consideration. This decision was based on the idea of having a size of farm to correspond with the resources and level of management efficiency assumed for this study. After considering several factors along with the resource assumptions and technical coefficients, a herd of 150 sows was selected for analysis. Some of the main considerations in selecting the 150 sow herd were:

1. Swine production was considered the primary enterprise thus a relatively large number of animals had to be sold to generate a level of income high enough to pay for the

specialized buildings and equipment over the proposed ten years of operation.

2. To generate a level of income to provide the owner-operator and his family a level of income comparable to the median income for a family of four in Tennessee.
3. To utilize a labor resource with basically two full-time workers.
4. Most commercial buildings and equipment specifications are designed for relatively large operators of 120 sows or more.
5. It was observed by swine specialists that most of the commercial farrow-to-finish producers tend to operate with about 150 sows.

The above considerations along with owner-operator financial and resources constraints affected the general size of the study unit.

## VII. MANAGEMENT OF THE FARROW-TO-FINISH OPERATION

In a typical farrow-to-finish operation animals are bred, farrowed, weaned, finished, and marketed from the same farm as a single operating enterprise. The basic decisions and movements of animals within a farrow-to-finish production model are shown in Figure 4. The timing of production activities through all phases of the operation is crucial for the success of the enterprise. A monthly schedule of breeding through marketing activities for the 150 sow unit,

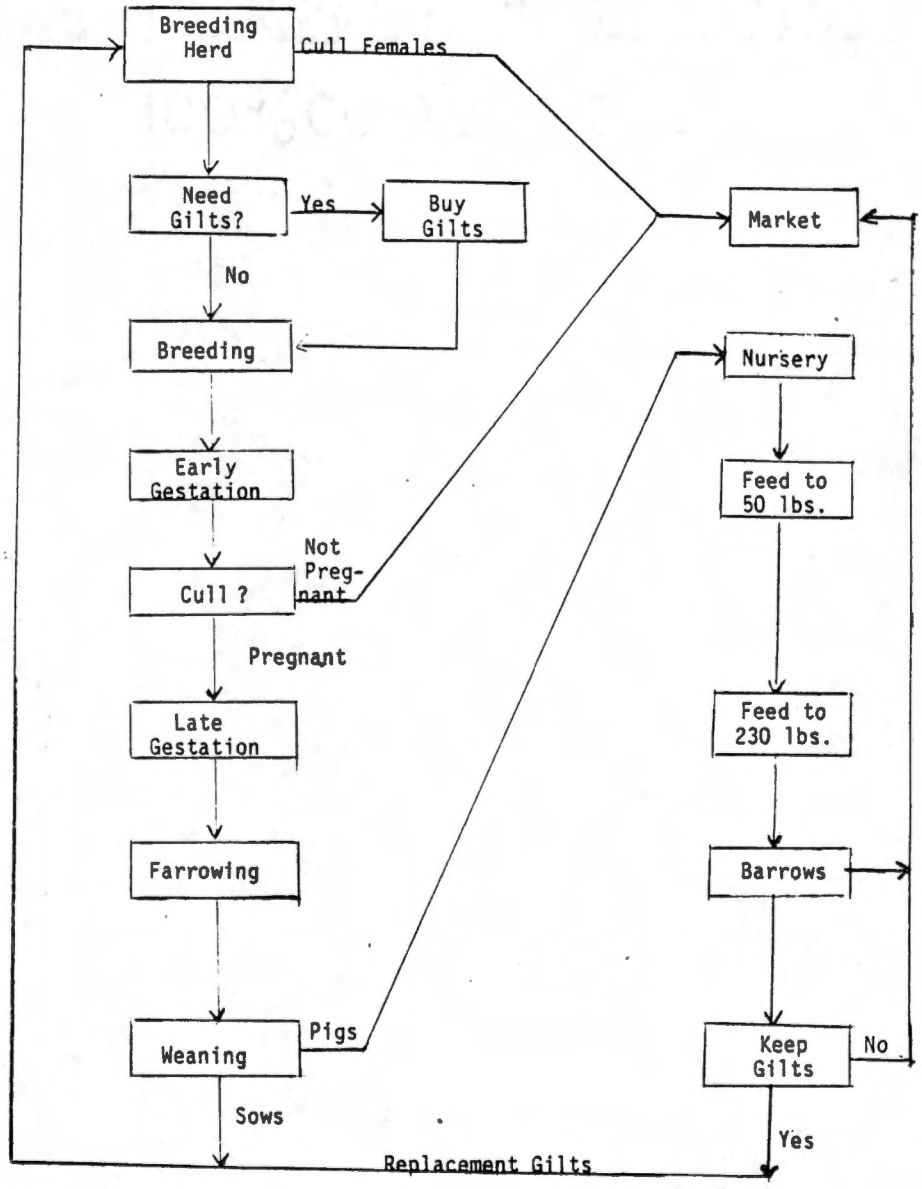


Figure 4. Basic Decisions and Movements of Animals within a Farrow-to-Finish Swine Production Model.

Source: Adapted from Ronald L. Plain and Joseph E. Williams, Adaptive Planning under Price Uncertainty in Pork Production, Southern Journal of Agriculture Economics, December 1981.

2-litter system, with four sow groups is shown in Appendix B. It was recognized that operators have the option to arrange and coordinate farm activities to fit specific farrowing and marketing dates. However, as a guide, the calendar of activities considered for each sow group within the farrow-to-finish system are shown in Appendix C. Apart from the internal efficiency and constant flow of animals which such planning affords the operator, it also provides a way for the operator to utilize some targeted markets which would assure higher prices for marketed animals.

## VIII. ANIMAL PERFORMANCE STANDARD

The coefficients pertaining to the representative farm were assumed to be attainable under commercial environment with superior management and good equipment. The coefficients for the representative farm along with those obtained from Ames Plantation Swine Research Unit in West Tennessee (19) have been summarized and presented in Table 8.

### Feed and Feeding

Feed and feeding formed a very important aspect of swine production and account for approximately 80 percent of the total variable cost. Changes could be expected in the feed requirements at different stages of production. Generally, the younger and growing animals require a higher percentage of protein than do older animals. The grouping of animals and the annual feed requirement, by pounds, for each group is summarized in Table 9.

Table 8. Animal Performance Data from Ames Plantation Swine Research Unit and the Corresponding Coefficients for the Representative Swine Farm

| Item | Unit | Pasture I[a] | Semiconfinement II[a] | Confinement III[a] | Representative Herd IV |
|---|---|---|---|---|---|
| Sow herds maintained | no. | 1 | 2 | 3 | 4 |
| Total no. sows in breeding herd | herd | 29.3 | 63.7 | 107.2 | 188 |
| Conception rate | % | 83 | 80 | 78 | 80 |
| No. live pigs farrowed/litter | head | 10.1 | 10.1 | 9.8 | 10 |
| No. pigs weaned/litter | head | 7.6 | 7.7 | 7.7 | 7.7 |
| Mortality from weaning to market | % | 5.6[b] | 9.5[b] | 9.0[b] | 1.5 |
| Gilts kept for replacement | head | 14 | 30 | 64 | 60 |
| No. hogs marketed/litter | head | 7.2 | 7.0 | 7.0 | 7.6 |
| No. litters/sow/year | litter | 1.64 | 1.69 | 1.78 | 2.00 |
| Culling rate boars | % | 33 | 33 | 39 | 50 |
| Boar to sows ratio | ratio | 1:15 | 1:21 | 1:15 | 1:10 |

[a]These coefficients are from a seven-year summary (1976-1982) unpublished data from: Ames Plantation Research Unit, West Tennessee.

[b]The relatively high deaths from weaning to market were explained by high predator losses. A 1.5 mortality rate was considered normal in similar research findings.

Source: Ray, R. M., R. E. Lidvall, et al. "A Comparison of Three Farrow-to-Finish Pork Production Systems," Tennessee Farm and Home Science, No. 116, Agricultural Experiment Station, The University of Tennessee, Knoxville, December 1980, pp. 2-6.

Table 9. Estimated Annual Feed Requirement for the 150 Sow Unit, 2-Litter Farrow-to-Finish Operation

| Class of Animal[a] | Animals | Amount Feed/ Animal | Percent Crude Protein[b] | Annual Feed Requirement |
|---|---|---|---|---|
| | (No.) | (lb.) | (%) | (lb.) |
| Pigs up to 45 lbs. | 2,310 | 50 | 18 | 115,500 |
| Pigs 45 lbs.-100 lbs. at 3.40 lbs. feed per 1 lb. gain | 2,310 | 187 | 16 | 431,970 |
| Pigs 100 lbs.-230 lbs. at 3.50 lbs. feed per 1 lb. gain | 2,310 | 455 | 14 | 1,051,050 |
| Gilts 4.5 lbs. for 30 days between selection and breeding | 38 | 135 | 14 | 5,130 |
| Gestating sows 222 days at 4.5 lbs./day | 150 | 999 | 14 | 149,850 |
| Lactation 84 days 11 lbs./ day | 150 | 924 | 14 | 138,600 |
| Boar: 60 days active breeding at 6 lbs./day=360 lbs. 10 day at 6 lbs./day before breeding season=60 lbs. 295 idle days at 4 lbs./day=1,180 lbs. | 22 | 1,600 | 14 | 35,200 |
| Total | | | | 1,927,300 |

[a]The grouping of animals was based on required crude protein levels, manner of feeding, ease of handling, and other herd management activities.

[b]The percent of crude protein requirement was adapted from: Ray, R. M., and H. M. Walch, Farm Planning Manual, Publication E.C. 622, Agricultural Extension Service, The University of Tennessee, Knoxville, Tennessee, April 1981, p. 119.

Estimated amounts and types of feedstuff required annually for 150 sow-units are shown in Table 10. Combinations of the feed ingredients may vary, but crude protein and other nutrient levels must be maintained for each group of animals.

Gestating sows and the boars were assumed to be fed the same ration. Nursing sows were assumed to be fed a rate of one pound of feed for each nursing piglet plus an additional three to five pounds for each sow.

Pond and Maner (17, pp. 208-209) recommended the substitution and alteration of feedstuff in swine ration as a way of obtaining a "least-cost" ration provided the animals would get the proper amounts of the needed nutrients, depending on their stage of growth and level of production.

## IX. STABILIZATION OF THE REPRESENTATIVE SWINE FARM

A planned schedule for selecting, breeding, culling, farrowing, weaning, finishing, and marketing of animals for the 150 sow unit was adopted and is shown in Appendixes B and C.

Selection of the initial breeding stock was made about one to two months before breeding. The breeding stock consisted mainly of breeding age gilts and ready to service boars. The period between selection and breeding was for quarantine and environmental adjustment before mating. Breeding and gestation were in pasture lots. The assumed boar to sow ratio was 1:10. However, an additional three boars that had passed the fertility test and possessed the traits desired by

Table 10. Estimated Amounts and Types of Feedstuff Required Annually for the 150 Sow-Unit, 2-Litter, Farrow-to-Finish Operation

| Percent Protein | Corn | Soybean Meal | Total Amount of Feed | Premix Added |
|---|---|---|---|---|
| (%) | (lbs.) | (lbs.) | (lbs.) | (cwt.) |
| 18 | 83,414 | 32,086 | 115,500 | 4,813 |
| 16 | 336,937 | 95,033 | 431,970 | 14,255 |
| 14 | 1,034,317 | 206,913 | 1,241,230 | 31,037 |
| 15 | 111,628 | 26,972 | 111,628 | 4,046 |
| | 1,566,296 | 361,004 | 1,927,300 | 54,151 |
| 150 sow unit = | 27,970 bu. | 3,610.04 cwt. | | 541.51 cwt. |
| Per sow unit = | 186.46 bu. | 24.06 cwt. | | 3.61 cwt. |

Source: Computed from Table 9 based on standard crude protein requirement for the number and classes of animals on the representative farm.

Source: Ray, R. M., and H. M. Walch, Farm Planning Manual, Publication E.C. 622, Agricultural Extension Service, The University of Tennessee, Knoxville, April 1981, p. 119.

the operator were retained. This arrangement provided some insurance on "boar power" in the event of injuries or death of boars in active breeding. With the culling rate for boars at 50 percent, 11 boars were culled and replaced annually to ensure a total of 22 boars. Forty percent of the sows were culled annually based on age, injuries, and temperament. An additional 20 percent of the sows was culled primarily because of failure to conceive within the breeding season. Replacement gilts were placed in the breeding herd to substitute for deaths and culled sows, so that breeding sows and gilts would be maintained at a total of 188 animals. Piglets were weaned around six to eight weeks. This schedule made allowances for the weaners to remain in their respective pens for an additional ten to fourteen days without interfering with the preparation and flow of other groups of animals through the system. From the weaning areas, the animals were grouped according to size and weight before being transferred to the finishing houses. They were kept in the finishing houses until marketed at about six to seven months or at an average weight of about 230 pounds. Prior to marketing, replacement gilts were selected and removed from the finishing houses for use in breeding herd.

For the herd to be kept stabilized the production coefficients were unchanged, and so were the estimates on the number of animals sold for years two through ten. Sale of animals during the start-up year did not begin until July.

Thirty-six non-breeding gilts, 4 dry sows, and 8 culled boars were sold in year one. During the normal production periods (years 2-10), the number of animals sold were 38 non-breeding gilts, 60 dry

sows, 2,177 market hogs, and 11 culled boars. Standard animal performance data and estimates on the number of animals sold per group from each litter are presented in Table 11. A summary of the number of animals sold annually during normal year is presented in Table 12.

## X. LIVESTOCK INCOME

Cash receipts were separated as income during start-up year and income during normal years. In year 1, as well as years 2-10, there was some variability in prices due to the hog price sequence.

The sale classes were non-breeding gilts, dry sows, market hogs, and cull boars. Income from a given class was based on the estimated liveweight, price per hundredweight, and the number of animals sold. Total annual income was the sum of incomes from the respective sale classes for each price sequence. During the start-up year incomes from price sequences A, B, and C were $4,851, $5,406, and $6,728, respectively. A summary of the estimated livestock incomes for the start-up year is shown in Table 13. Livestock receipts for normal years were $226,680, $282,280, and $203,541 beginning at price sequences A, B, and C on the hog price cycle. A summary of the projected income streams from livestock sales during normal years of operations with price sequences A, B, and C is presented in Table 14.

Table 11. Standard Animal Performance Data and Estimated Number of Animals Sold Per Litter for Each Group of Sows on the Representative Farrow-to-Finish Swine Farm

| Item | Standard | Death | Culled | Replacement | Annual Estimates |
|---|---|---|---|---|---|
| | | | Number | | |
| Total no. of females in breeding herd | 47 | | | | |
| Conception rate | 80% | | | | |
| No. gilts bred | 38 | | | | |
| Gilts not bred | | | 9 | | 9 cull nonbreeding gilts sold |
| No. of pigs per litter | 10 | | | | 380 pigs farrowed |
| No. of pigs weaned/litter | 7.7 | 87 | | | 293 pigs weaned |
| Mortality rate (wean-market) | 1.5% | 4 | | | 289 hogs averaging 230 lbs. |
| Cull sows | 10% | | 4 | | 4 dry sows sold |
| Gilts kept for replacement | | | | 13 | |
| Boars | 5 | | | | |
| Cull boars | 40% | | 2 | 2 | 2 cull boars |

Source: Estimates were calculated from the technical coefficients used in organizing the representative swine farm.

Table 12. Standard Animal Performance Data and Estimated Number of Animals Sold during a Normal Year for the 150 Sow-Unit, 2-Litter, Farrow-to-Finish Representative Swine Operation

| Item | Standard | Death | Culled | Replacement | Annual Estimates |
|---|---|---|---|---|---|
| | | | Number | | |
| Total no. of females in breeding herd | 188 head | | | | |
| Conception rate | 80% | | | | |
| No. sows bred | 150 | | | | |
| Nonbreeding females | 20% | | 38 | | 38 nonbreeding gilts sold |
| No. litters per sow per year | 2 litters | | | | 300 litters |
| No. pigs per litter | 10 head | | | | 3000 pigs farrowed |
| No. pigs weaned per litter | 7.7 head | | | | 2310 pigs weaned |
| Mortality rate (wean-market) | 1.5% | 35 | | | 2275 hogs averaging 230 lbs. |
| Cull sows | 40% | | 60 | | 60 cull sows sold |
| Gilts kept for replacement | | | | 98 | 2177 hogs sold 230 lbs. |
| Boars | 22 | | | | |
| Cull boars | 50% | | 11 | 11 | 11 cull boars sold |

[a]The farm was kept at full production for the second year of operation through the tenth.

Source: Annual estimates were calculated from the technical coefficient used in designing the representative swine farm.

Table 13. Estimated Livestock Income from the Representative Swine Farm during the Start-Up Year for Hog Price Sequences A, B, and C

| Rotation | No. of Animals Sold | Weight | Price | Total | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| | | (lbs.) | ($/cwt.)[a] | | (Dollars) | | | | | | | | | | | |
| Non-breeding gilts | 36 | 300 | 32 | 3,452 | -- | -- | -- | -- | -- | -- | 862 | 1,724 | -- | -- | 862 | -- |
| Dry sows | 4 | 350 | 32 | 447 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | |
| Market hogs | 0 | 230 | 38 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 447 |
| Cull boars | 8 | 375 | 32 | 952 | -- | -- | -- | -- | -- | -- | 238 | 476 | -- | -- | 238 | -- |
| Total sales Sequence A | | | | 4,851 | -- | -- | -- | -- | -- | -- | 1,000 | 2,208 | -- | -- | 1,100 | 447 |
| Total sales Sequence B | | | | 5,406 | -- | -- | -- | -- | -- | -- | 1,227 | 2,454 | -- | -- | 1,227 | 498 |
| Total sales Sequence C | | | | 6,728 | -- | -- | -- | -- | -- | -- | 1,527 | 3,054 | -- | -- | 1,527 | |

[a]Prices for culled animals were estimated at 16 percent lower than market hogs.

Table 14. Estimated Livestock Sales from the Representative Swine Farm during Years of Full Production for Hog Price Sequences A, B, and C

| Sale Category | No. of Animals Sold Annually | Weight | Price | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | (lbs.) | ($/cwt.) | | | | | | | | | |
| Nonbreeding gilts[a] | 38 | 300 | 31.92 | 4,053 | 5,047 | 3,639 | 4,053 | 5,047 | 3,639 | 4,053 | 5,047 | 3,639 |
| Dry sows[a] | 60 | 425 | 31.92 | 9,065 | 11,289 | 8,140 | 9,065 | 11,289 | 8.140 | 9.065 | 11,289 | 8,140 |
| Market hogs | 2,177 | 230 | 38.00 | 211,900 | 263,874 | 190,270 | 211,900 | 263,874 | 190,270 | 211,900 | 263,874 | 190,270 |
| Cull boars[a] | 11 | 425 | 31.92 | 1,662 | 2,070 | 1,492 | 1,662 | 2,070 | 1,492 | 1,662 | 2,070 | 1,492 |
| Total sales sequence A[b] | | | | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 | 203,541 |
| Total sales sequence B[b] | | | | 282,280 | 203,541 | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 | 203,541 | 226,680 |
| Total sales sequence C[b] | | | | 203,541 | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 |

[a]Prices for culled animals were estimated at 16 percent lower than market hog prices.

[b]Total sales were based on estimates of the number of animals sold annually from each sales category and the price sequences according to the different starting point on the hog price cycle.

## XI. ON-FARM CAPITAL EXPENSES

All of the on-farm capital investment items were assumed to be completed by middle of year one. Further on-farm capital investments were not added during the study. The number of units, specifications, and cost of buildings, machinery, pastures, roads and waste disposal system were assumed adequate and reasonable for a 150 sow-unit, 2-litter operation. Capital investments were based on estimates for new facilities and initial purchase of breeding stock. A detailed listing of capital investment items and cost are summarized in Table 15. Total capital investment was estimated at $201,042.

## XI. OPERATING EXPENSES

The start-up year operating expenses were estimated at $41,763. Operating expenses remained unchanged for the remaining period at $168,535 per year. Total operating cost consisted of direct cost and annual fixed cost. Direct cost covered all those items which were assumed to be used up within a production period, for example, feed, veterinary services, and electricity. Other costs under operating expenses were the annual fixed costs which included estimates on insurance, taxes, and repairs. Estimated operating expenses for year 1 and years 2-10 are shown in Table 16.

Table 15. Estimated Capital Investment and Annual Fixed Cost for the Representative 150 Sow-Unit, 2-Litter Farrow-to-Finish Operation

| Description | | No. of Units Needed | Investment: Cost per Unit ($) | Investment: Estimated Cost New ($) | Investment: Average Cost[a] ($) | Annual Fixed Cost: Annual Depreciation[b] ($) | Annual Fixed Cost: Fuel and Other[c] ($) | Annual Fixed Cost: Insurance[d] ($) | Annual Fixed Cost: Taxes[e] ($) | Annual Fixed Cost: Annual Repair[f] ($) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | ---Dollars--- | | | | | | | |
| Building | | | | | | | | | | |
| Farrowing house and equipment | 80 pens 5'x20' | 8000 sq.ft. | 8 | 64,000 | 32,000 | 6,400 | | 1,280 | 320 | 480 |
| Finishing houses and equipment | 33 pens 11'x18' | 6534 sq.ft. | 7 | 45,738 | 22,869 | 4,574 | | 915 | 229 | 343 |
| Milling room | | 400 sq.ft. | 1,500 | 1,500 | 750 | 150 | | 30 | 8 | 11 |
| Feed storage bins | 6 ton hopper | 3 | 1,000 | 3,000 | 1,500 | 300 | | 60 | 15 | 23 |
| Soybean meal bins | 11 ton hopper | 1 | 1,500 | 1,500 | 750 | 150 | | 30 | 8 | 11 |
| Corn bin | 3500 bu | 2 | 5,500 | 11,000 | 5,500 | 1,100 | | 220 | 55 | 83 |
| Miscellaneous augers | | set | 2,000 | 2,000 | 1,000 | 200 | | 40 | 10 | 15 |
| Incinerator | | 1 | 400 | 400 | 200 | 40 | | 8 | 2 | 3 |
| Total building and equipment | | | | 129,138 | 64,569 | 12,914 | | 2,583 | 647 | 969 |
| Machinery and equipment | | | | | | | | | | |
| Grinder mixer | | 1 | 1,500 | 1,500 | 750 | 150 | | 30 | 8 | 11 |
| Pick up truck | 1/2 farm share | | 3,000 | 3,000 | 1,500 | 300 | 400 | 60 | 15 | 23 |
| Scale | | 1 | 1,000 | 1,000 | 500 | 100 | | 20 | 5 | 8 |
| Watering - Pump | | 1 | 800 | 800 | 400 | 80 | | 16 | 4 | 6 |
| Well | | 1 | 4,000 | 4,000 | 2,000 | 400 | | 80 | 20 | 30 |
| Farm tools | | 1 set | 700 | 700 | 350 | 70 | | 14 | 35 | 5 |
| Total machinery and equipment | | | | 11,000 | 5,500 | 1,100 | | 220 | 87 | 83 |
| Pasture | | | | | | | | | | |
| Feeder | 4-hole metal feeders | 4 | 200 | 800 | 400 | 80 | | 16 | 4 | 6 |
| Fencing | Woven-wire | 880 yds | 10 | 8,800 | 4,400 | 880 | | 176 | 44 | 66 |
| Pasture shelters | Portable | 8 | 500 | 4,000 | 2,000 | 400 | | 80 | 20 | 30 |
| Pasture establishment | 4 animal/ac | 53 acs | 60 | 3,180 | 1,590 | 318 | | 64 | 16 | 24 |
| Watering nipples | Pipe and | 8 unit | 50 | 400 | 200 | 40 | | 8 | 2 | 3 |
| Total Pasture | | | | 17,180 | 8,590 | 1,718 | | 344 | 86 | 129 |
| Lagoon and piping | | | 9,500 | 9,500 | 4,750 | 950 | | 190 | 48 | 71 |
| Farm road | | | 6,000 | 6,000 | 3,000 | 600 | | 120 | 30 | 45 |
| Gilts purchases | Opening stock | 224 | 126 | 28,224 | 28,224 | 1,617 | | -- | 282 | -- |
| | | | | 43,724 | 35,974 | 3,167 | | 310 | 360 | 116 |
| | | | | 201,042 | | 18,899 | 400 | 3,457 | 1,180 | 1,297 |

[a] Average cost was calculated by dividing estimated new cost by two.

[b] Depreciation was computed by dividing new cost by the projected useful life of the capital investment items.

[c] Farm share for pick up truck, 2000 miles a year at $0.20 per mile.

[d] Four percent of average cost.

[e] One percent of average cost.

[f] Annual repairs, 1.5 percent of average cost.

Table 16. Estimated Operating Expenses for Start-Up Year and Years Two-Ten for the 150 Sow-Unit, 2-Litter, Farrow-to-Finish Representative Farm

| Item | Unit | Cost per Unit ($) | Start-up Cost Year 1 ($) | Cost for 150 Sow-Units Years 2-10 ($) |
|---|---|---|---|---|
| Corn | 186.46 bu. | 2.90 | 11,400 | 81,110 |
| Soybean supplement | 24.06 cwt. | 12.00 | 5,986 | 43,308 |
| Premix | 3.61 cwt. | 20.00 | 1,221 | 10,830 |
| Land | 70.00 ac. | 45.00 | 3,150 | 3,150 |
| Pasture maintenance (on 3-yrs. rotation) | 18.00 ac. | 60.00 | -- | 1,080 |
| Veterinary service and medication | sow unit | 10.00 | 805 | 1,500 |
| Marketing at $1.50/head | 2,286.00 head | 1.50 | 73 | 3,429 |
| Electricity | 150.00 sow units | 6.00 | 600 | 900 |
| Telephone/Communication | | | 500 | 500 |
| Legal fees | | | 600 | 600 |
| Fuel and others | farm share | | 400 | 400 |
| Insurance | | | 1,720 | 3,457 |
| Property taxes | | | 590 | 1,180 |
| Repairs | | | -- | 1,297 |
| Purchased boars | 11.00 boars | 450.00 | 13,500 | 4,950 |
| Transporting livestock-in | 11.00 boars | 2.00 | 508 | 22 |
| Hired labor full-time | 40 hr. wk. | 4.80/hr. | -- | 9,360 |
| Social Security | 6% of income | | -- | 562 |
| Miscellaneous supplies | | | 700 | 900 |
| Total | | | 41,763 | 168,535 |

# CHAPTER IV

## RESULTS OF THE ANALYSIS

The results of the analysis are discussed in two sections. One of the main points of the discussion in each section is to assess the feasibility or infeasibility of the different cash flow situations analyzed for the representative farm over the ten-year planning horizon.

The results in section one pertains to cash flow situations in which the swine-farm operator provided 100 percent of the required initial capital outlay--debt-free situations. The variable changes made were: (1) income streams based on the hog price sequences designated A, B, and C, and (2) owner's opportunity cost or saving rates of 7, 10, and 13 percent. The corresponding after tax saving rates were 5.60, 8.00, and 10.40 percent, respectively. In evaluating these cash flow situations, the net present value (NPV) and rate of return to equity associated with each cash flow situation were estimated to determine the investment solution. Projects or cash flow situations with positive NPV and rate of return to equity greater than the saving rate were considered feasible or "acceptable" for investment. Those projects with negative NPV and rate of return to equity less than the saving rate were considered infeasible and therefore would not be acceptable for investment.

In section two, the loan repayment capacity of the representative swine farm is discussed. The combinations of variable changes

were: (1) equity level was 50, 40, 30, and 20 percent of the long-term capital requirement, (2) income streams based on the hog price sequences and designated A, B, and C, and (3) interest rates on long-term loans at 8, 11, and 14 percent with short and intermediate loans at 9, 12, and 15 percent, respectively. Opportunity costs on equity contributions were at 7, 10, and 13 percent or 2 percent lower than the short-term loan rates. The after tax saving rates were 5.60, 8.00, and 10.40 percent, respectively. In each cash flow situation, all other factors were held constant except the combination of variables being analyzed. The NPV and IRR concepts were also used in determining the investment solution.

## I. SECTION I: RATES OF RETURN WHEN THE REPRESENTATIVE FARM WAS ONE HUNDRED PERCENT EQUITY FINANCED

The initial capital outlays for the representative swine farm, at 100 percent equity financing, were estimated at $249,820, $249,265, and $247,943 for income streams A, B, and C (Tables 17, 18, and 19). These totals were comprised of funds for on-farm capital investment which was estimated at $201,042 plus additional funds as working capital which were estimated at $48,778, $48,233, and $46,901 for income streams A, B, and C, respectively. Nine cash flows representing debt-free situations were projected over the ten-year planning period.

Additional working capital was required only during the first year of operation. The estimated working capital during the first year of operation was the difference between total cash receipts and expenses

Table 17. Results of Net Cash Flow Analysis for the Representative Swine Farm with One Hundred Percent Equity Contributions, Income Streams Based on Hog Price Sequences A, B, and C and a Saving Rate of 7 Percent

| Percent Equity Financed | Income Stream | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | Dollars | | | | | | | | | |
| 100 | A | (249,820)[a] | 46,279 | 131,236 | 157,329 | 202,601 | 294,888 | 330,145 | 385,095 | 487,602 | 577,368 |
| 100 | B | (249,265)[a] | 90,103 | 113,892 | 156,731 | 246,450 | 278,862 | 330,940 | 430,415 | 473,262 | 583,341 |
| 100 | C | (247,943)[a] | 23,140 | 67,791 | 152,529 | 179,814 | 226,345 | 319,962 | 356,623 | 413,056 | 569,525 |

[a]The total initial equity outlay was comprised of the total on-farm capital investment plus additional funds required to operate the farm during the first year of operation. The difference in the initial equity outlay was due to the difference in livestock sales based on the hog price sequence. Further equity contributions were not required, by the operator, after the first year of operation. From the second through the tenth year of operation the net cash equity at the end of each year was allowed to accumulate and was reinvested at a savings rate of 7 percent.

Table 18. Results of Net Cash Flow Analysis for the Representative Swine Farm with 100 Percent Equity Contributions, Income Streams Based on Hog Price Sequences A, B, and C and A Saving Rate of 10 Percent

| Percent Equity Financed | Income Stream | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | (Dollars) | | | | | | | | | |
| 100 | A | (249,820)[a] | 46,279 | 132,346 | 161,678 | 211,074 | 308,901 | 352,357 | 417,008 | 531,311 | 636,276 |
| 100 | B | (249,265)[a] | 90,103 | 116,055 | 161,802 | 255,688 | 294,887 | 354,940 | 464,277 | 520,163 | 645,353 |
| 100 | C | (247,943)[a] | 23,140 | 67,129 | 153,441 | 184,460 | 235,679 | 335,475 | 381,057 | 448,004 | 617,182 |

[a]The total initial equity outlay was comprised of the total on-farm capital investment plus additional funds required to operate the farm during the first year of operation. The difference in the initial equity outlay was due to the difference in livestock sales based on the hog price sequence. Further equity contributions were not required, by the operator, after the first year of operation. From the second through the tenth year of operation the net cash equity at the end of each year was allowed to accumulate and was reinvested at a savings rate of 10 percent.

Table 19. Results of Net Cash Flow Analysis for the Representative Swine Farm with 100 Percent Equity Contributions, Income Streams Based on Hog Price Sequences A, B, and C and A Saving Rate of 13 Percent

| Percent Equity Financed | Income Stream | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | (Dollars) | | | | | | | | | |
| 100 | A | (249,820)[a] | 46,279 | 133,457 | 166,080 | 219,814 | 323,617 | 376,017 | 451,584 | 579,491 | 702,218 |
| 100 | B | (249,265)[a] | 90,103 | 118,217 | 166,973 | 265,280 | 311,612 | 380,482 | 500,994 | 571,841 | 714,889 |
| 100 | C | (247,943)[a] | 23,140 | 68,902 | 157,009 | 192,081 | 248,520 | 303,615 | 353,935 | 427,206 | 604,973 |

[a]The total initial equity outlay was comprised of the total on-farm capital investment plus additional funds required to operate the farm during the first year of operation. The difference in the initial equity outlay was due to the difference in livestock sales based on the hog price sequence. Further equity contributions were not required, by the operator, after the first year of operation. From the second through the tenth year of operation the net cash equity at the end of each year was allowed to accumulate and was reinvested at a savings rate of 13 percent.

plus deductions for living expenses and social security. Additional working capital was not required from years 2-10 since the net cash balances were positive. The cumulative equity for each cash flow situation is presented in Tables 17, 18, and 19, respectively.

At the 7 percent savings rate before taxes, all cash flows with 100 percent equity financing provided feasible solutions based on the NPV and IRR criteria. The NPV from income streams A, B, and C were $85,002, $89,020, and $82,330, respectively (Table 20). The after tax rates of return to equity associated with these cash flows were 8.74, 8.87, and 8.67 percent (Table 20).

When considering each cash flow situation as an independent project, the cash flow with income stream "B" was ranked higher than income streams A and C because of its higher rate of return to equity and net present value. By using the same ranking criteria income stream "A" was ranked after "B." Income stream "C" was considered the lowest ranked alternative.

When the saving rate was increased from 7 to 10 percent, all the cash flow situations provided feasible solutions based on the NPV and IRR investment decision criteria. Under the assumptions and description of this study, at the 10 percent saving rate, these projects would be qualified for investment. Farmers would have a tendency toward not saving their monies at the 8 percent after tax interest rate but instead invest in swine production. The expected net present values for income streams A, B, and C were $44,894, $49,658, and $37,930, respectively (Table 21). The after tax rates of return to equity from income streams A, B, and C were 9.80, 9.98, and 9.55 percent (Table 21).

Table 20. Results of the Net Present Value Analysis for the Representative Swine Farm with 100 Percent Equity Contributions, Income Streams Based on the Hog Price Sequence and a Saving Rate of 7 Percent

| Owner's Equity (Total Farm Investment) | Initial Contribution | Cash Flow Income Sequences | Cumulative Owner's Equity At End of the Tenth Year | Present Value[a] Discounted at a Savings Rate of 5.60 Percent | Net Present[b] Value (NPV) of Equity | Rate of Return to Equity After Taxes | Investment Solution |
|---|---|---|---|---|---|---|---|
| Percent | Dollars | | Dollars | Dollars | Dollars | Percent | |
| 100 | 249,820 | A | 577,368 | 334,822 | 85,002 | 8.74 | feasible |
| 100 | 249,265 | B | 583,341 | 338,285 | 89,020 | 8.87 | feasible |
| 100 | 247,943 | C | 569,525 | 330,273 | 82,330 | 8.67 | feasible |

[a]After taxes discounted interest rate equal to the interest rate for saving multiply by one minus the income tax rate = 7(1 - .2) = 5.60 percent. The 20 percent tax rate was based on income averaging. Taxes were paid each year based on the amount of taxable income.

[b]Net present value on equity after taxes equal to the discounted present value at the end of the tenth year minus the owner's initial equity contribution.

Table 21. Results of the Net Present Value Analysis for the Representative Swine Farm with 100 Percent Equity Contributions, Income Streams Based on the Hog Price Sequences and a Saving Rate of 10 Percent

| Owner's Equity (Total Farm Investment) | Initial Contribution | Cash Flow Income Sequences | Cumulative Owner's Equity At End of the Tenth Year | Present Value[a] Discounted at a Savings Rate of 8.00 Percent | Net Present[b] Value (NPV) of Equity | Rate of Return to Equity After Taxes | Investment Solution |
|---|---|---|---|---|---|---|---|
| Percent | Dollars | | Dollars | Dollars | Dollars | Percent | |
| 100 | 249,820 | A | 636,276 | 294,719 | 44,899 | 9.80 | feasible |
| 100 | 249,265 | B | 645,353 | 298,923 | 49,658 | 9.98 | feasible |
| 100 | 247,943 | C | 617,182 | 285,875 | 37,932 | 9.55 | feasible |

[a]After taxes discounted interest rate equal to the interest rate for saving multiply by one minus the tax rate = 10 (1 - .2) = 8.00 percent. The 20 percent tax rate was based on income averaging. Taxes were paid each year based on the amount of taxable income.

[b]Net present value and equity after taxes equal to the discounted present value at the end of the tenth year minus the owner's initial equity contribution.

At the 13 percent saving rate the investment solutions were feasible for income streams A and B but infeasible for income stream C. The rate of return to equity and net loss in present value are presented in Table 22.

## II. SECTION II: EFFECTS OF OWNER'S EQUITY CONTRIBUTIONS, INCOME STREAMS AND INTEREST RATES ON THE LOAN REPAYMENT CAPACITY ON THE REPRESENTATIVE SWINE FARM

The total long-term capital required to establish the swine farm was $172,818. At the 50, 40, 30, and 20 percent level of equity contributions to long-term financing the initial capital outlay provided by the operator were $86,409, $69,127, $51,845, and $34,564, respectively. At these levels of equity contributions the corresponding long-term loans were $86,409, $103,691, $120,973, and $138,254, respectively. The intermediate loan used for the purchasing of the initial breeding herd was $28,224. A summary of the distribution of owner equity, long-term loans, and intermediate loans is presented in Table 23.

In order to evaluate the effects of the different equity contributions, income streams, and interest rates on the loan repayment capacity, a total of 36 cash flow situations were projected and analyzed. Initial owner's equity contribution and the cumulative equity at the end of the tenth year are shown for each cash flow situation in Tables 24, 25, and 26. See Appendix D for notes on cash flows.

Table 22. Results of the Net Present Value Analysis for the Representative Swine Farm with 100 Percent Equity Contributions, Income Streams Based on the Hog Price Sequence and a Saving Rate of 13 Percent

| Owner's Equity (Total Farm Investment) | Initial Contribution | Cash Flow Income Sequences | Cumulative Owner's Equity At End of the Tenth Year | Present Value[a] Discounted at a Savings Rate of 5.60 Percent | Net Present[b] Value (NPV) of Equity | Rate of Return to Equity After Taxes | Investment Solution |
|---|---|---|---|---|---|---|---|
| Percent | Dollars | | Dollars | Dollars | Dollars | Percent | |
| 100 | 249,820 | A | 702,218 | 261,085 | 11,265 | 10.89 | feasible |
| 100 | 249,265 | B | 714,889 | 265,796 | 16,531 | 11.11 | feasible |
| 100 | 247,943 | C | 604,973 | 224,929 | (23,014) | 9.33 | infeasible |

[a]After taxes discounted interest rate equal to the interest rate for saving multiply by one minus the tax rate = 13 (1 - .2) = 10.4 percent. The 20 percent tax rate was based on income averaging. Taxes were paid each year based on the amount of taxable income.

[b]Net present value and equity after taxes equal to the discounted present value at the end of the tenth year minus the owner's initial equity contribution.

Table 23. A Distribution of the Long Term Loans, Intermediate Loans, and Owner's Equity Contributions for the Representative Swine Farm

| Investment | Owner-Operator Contribution Equity | | Borrowed Capital | | | |
|---|---|---|---|---|---|---|
| | | | Long-Term | | Intermediate | |
| Dollars | Percent | Dollars | Percent | Dollars | Percent | Dollars |
| 201,040 | | | | | | |
| | 50 | 86,409 | 50 | 86,409 | 100 | 28,224 |
| | 40 | 69,127 | 60 | 103,691 | 100 | 28,224 |
| | 30 | 51,845 | 70 | 120,973 | 100 | 28,224 |
| | 20 | 34,564 | 80[a] | 138,254 | 100 | 28,224 |

[a]Usually lenders tend to restrict loans to 80 percent or less of asset value for long term financing. Apart from intermediate and long term loans, some additional funds were borrowed as short term loan during the first year.

TABLE 24. Results of the Net Cash Flow Analysis for the Representative Swine Farm with Different Combinations of Equity Contributions, Income Streams Based on Hog Price Sequences A, B, and C, Interest Rates at 9 Percent for Short and Intermediate Loans, 8 Percent for Long Term Loans, and a Saving Rate of 7 Percent

| Percent Equity Financed | Income Stream | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | Dollars | | | | | | | | | |
| 50 | A | (70,962) | (52,141) | 0 | 0 | 0 | 64,508 | 86,864 | 128,190 | 216,310 | 290,884 |
| 50 | B | (70,382) | (2,753) | (2,121) | 0 | 30,446 | 50,894 | 90,206 | 176,199 | 204,810 | 299,857 |
| 50 | C | (69,000) | (73,141) | (65,328) | (1,377) | 0 | 0 | 62,587 | 84,835 | 126,047 | 266,443 |
| 40 | A | (73,850) | (58,262) | 0 | (608) | 0 | 39,536 | 60,494 | 120,344 | 186,905 | 259,832 |
| 40 | B | (73,270) | (8,796) | (11,695) | 0 | 4,642 | 23,646 | 61,432 | 145,814 | 172,723 | 265,793 |
| 40 | C | (71,589) | (91,129) | (75,903) | (14,137) | (12,975) | 0 | 37,044 | 57,862 | 97,564 | 236,365 |
| 30 | A | (76,740) | (64,384) | (4,503) | (8,094) | 0 | 14,526 | 34,083 | 73,464 | 157,453 | 228,731 |
| 30 | B | (77,045) | (15,236) | (21,348) | (9,877) | 0 | 0 | 33,421 | 131,353 | 157,453 | 249,848 |
| 30 | C | (74,778) | (85,384) | (73,475) | (12,315) | (15,455) | (687) | 24,395 | 44,505 | 83,459 | 221,470 |
| 20 | A | (79,629) | (70,505) | (13,144) | (19,718) | (8,713) | 0 | 7,538 | 44,422 | 127,852 | 197,472 |
| 20 | B | (79,049) | (18,870) | (26,870) | (17,555) | 0 | 0 | 12,403 | 94,039 | 118,049 | 208,236 |
| 20 | C | (77,696) | (91,564) | (82,072) | (24,264) | (30,585) | (19,214) | 0 | 15,646 | 52,984 | 189,289 |

Note: As income was earned, the entire earning was paid on outstanding loan balances. A zero in the cash flow means that cash was not available for equity accumulation at the end of the year, after advance payments on loans. Net cash equity for accumulation occurred only after the short-term, intermediate, and long-term loans were fully repaid.

TABLE 25. Results of the Net Cash Flow Analysis for the Representative Swine Farm with Different Combinations of Equity Contributions, Income Streams Based on Hog Price Sequences A, B, and C, Interest Rates at 12 Percent for Short and Intermediate Loans, 11 Percent for Long Term Loans, and a Saving Rate of 10 Percent

| Percent Equity Financed | Income Stream | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | Dollars | | | | | | | | | |
| 50 | A | (74,489) | (61,279) | 0 | (001) | 0 | 45,766 | 68,171 | 110,086 | 199,355 | 277,764 |
| 50 | B | (73,901) | (9,304) | (11,242) | 0 | 16,315 | 36,364 | 75,735 | 162,736 | 194,499 | 293,636 |
| 50 | C | (72,500) | (82,190) | (68,470) | (5,224) | (4,178) | 0 | 54,193 | 77,272 | 119,915 | 262,846 |
| 40 | A | (77,833) | (68,463) | (8,875) | (13,494) | 0 | 17,593 | 37,744 | 77,225 | 164,345 | 239,953 |
| 40 | B | (77,244) | (15,546) | (20,844) | (8,719) | 0 | 8,426 | 45,562 | 130,149 | 159,305 | 255,627 |
| 40 | C | (75,843) | (89,373) | (79,764) | (19,174) | (22,450) | (7,881) | 22,759 | 43,333 | 93,250 | 223,248 |
| 30 | A | (81,175) | (75,645) | (18,848) | (25,948) | (15,655) | 0 | 7,019 | 44,042 | 128,507 | 201,248 |
| 30 | B | (80,587) | (21,477) | (30,201) | (21,643) | 0 | 0 | 15,753 | 97,955 | 124,535 | 218,075 |
| 30 | C | (79,184) | (96,555) | (91,057) | (32,510) | (39,484) | (29,039) | 0 | 10,161 | 47,436 | 184,569 |
| 20 | A | (84,518) | (82,828) | (28,424) | (39,156) | (32,616) | 0 | 0 | 11,246 | 93,088 | 162,995 |
| 20 | B | (83,930) | (27,712) | (40,339) | (34,835) | 0 | 0 | 0 | 65,203 | 89,163 | 179,873 |
| 20 | C | (82,528) | (103,738) | (102,350) | (45,746 | (56,538) | (50,056) | 0 | 0 | 11,644 | 145,913 |

Note: As income was earned, the entire earning was paid on outstanding loan balances. A zero in the cash flow means that cash was not available for equity accumulation at the end of the year, after advance payments on loans. Net cash equity for accumulation occurred only after the short-term, intermediate, and long-term loans were fully repaid.

Table 26. Results of the Net Cash Flow Analysis for the Representative Swine Farm with Different Combinations of Equity Contributions, Income Streams Based on Hog Price Sequences A, B, and C, Interest Rates at 15 Percent for Short and Intermediate Loans, 14 Percent for Long Term Loans, and a Saving Rate of 13 Percent

| Percent Equity Financed | Income Stream | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | Dollars | | | | | | | | | |
| 50 | A | (78,786) | (71,515) | (11,405) | (14,392) | 0 | 24,328 | 45,599 | 86,603 | 175,572 | 257,395 |
| 50 | B | (77,492) | (16,067) | (20,911) | (8,286) | 463 | 19,255 | 57,719 | 144,763 | 178,451 | 280,587 |
| 50 | C | (76,768) | (92,333) | (85,279) | (23,066) | (27,111) | (12,383) | 24,123 | 45,375 | 86,556 | 228,895 |
| 40 | A | (81,898) | (78,999) | (21,684) | (28,834) | (18,530) | 0 | 11,593 | 49,260 | 135,325 | 211,859 |
| 40 | B | (81,301) | (23,007) | (32,356) | (23,354) | 0 | 0 | 23,102 | 106,446 | 136,260 | 234,008 |
| 40 | C | (79,880) | (99,817) | (97,549) | (37,614) | (45,041) | (34,991) | 0 | 8,613 | 45,971 | 184,090 |
| 30 | A | (85,705) | (87,283) | (32,625) | (44,782 | (38,110) | 0 | 0 | 10,752 | 92,812 | 164,925 |
| 30 | B | (85,109) | (30,997) | (45,209) | (38,715) | 0 | 0 | 0 | 67,524 | 93,290 | 186,569 |
| 30 | C | (83,688) | (108,102) | (110,740) | (55,875) | (69,221) | (60,377) | (8,714) | (6,660) | 2,096 | 135,651 |
| 20 | A | (89,514) | (95,568) | (44,390) | (61,734) | (57,997) | (10,583) | (16,839) | (869) | 49,217 | 116,796 |
| 20 | B | (88,918) | (39,283) | (58,401) | (54,707) | (8,537) | (16,400) | (6,442) | 27,602 | 49,216 | 137,911 |
| 20 | C | (87,496) | (116,386) | (123,931) | (74,467) | (73,782) | (90,315) | (41,562) | (45,300) | (31,197) | 83,019 |

Note: As income was earned, the entire earning was paid on outstanding loan balances. A zero in the cash flow means that cash was not available for equity accumulation at the end of the year, after advance payments on loans. Net cash equity for accumulation occurred only after the short-term, intermediate, and long-term loans were fully repaid.

Three levels of interest rates for borrowed funds and corresponding saving rates were examined.

First Level

At the first level of borrowing, interest rate for short and intermediate loans was 9 percent, long-term loans 8 percent, and the saving rate was 7 percent. At these interest rates, the net present value was positive in each cash flow situation. Also, the rates of return to equity from the swine enterprise were greater than the 5.6 percent after taxes saving rate. Under these cash flow situations there would be a tendency for operators to invest in swine production within the 50-20 percent equity range instead of saving their funds at 7 percent.

From inspection, the net present values and rates of return to equity were generally higher in the leverage situations than in the debt-free situation, at the same 7 percent saving rate. This indicates that at the first level interest rate situations, the projects were within a positive leverage range and deriving benefits because of the tax shield generated by interest payments on investment loans. The higher net present value with increased leverage situations could be interpreted as compensation to operators for the increased financial risk associated with investment. The net present values and rates of return to equity for the representative farm when analyzed under the conditions of level I interest rates, equity contributions, and income streams are shown in Table 27.

Table 27. Results of the Net Present Value Analysis for the Representative Swine Farm for Different Combinations of Owner's Equity Contributions, Income Stream Based on the Hog Price Sequence with Interest Rate at 9 Percent for Short and Intermediate Loans, 8 for Long Term Loans, and a Saving rate of 7 Percent

| Owner's Equity (Long-Term Financing) | Initial Contribution | Cash Flow Income Sequence | Cumulative Owner's Equity At End of the Tenth Year | Present Value[a] Discounted at a Savings Rate of 5.60 Percent | Net Present[b] Value (NPV) of Equity | Rate of Return to Equity After Taxes | Investment Solution |
|---|---|---|---|---|---|---|---|
| Percent | Dollars | | Dollars | Dollars | Dollars | Percent | |
| 50 | 86,409 | A | 290,884 | 168,687 | 82,278 | 12.90 | feasible |
| 50 | 86,409 | B | 299,857 | 173,890 | 87,481 | 13.25 | feasible |
| 50 | 86,409 | C | 266,443 | 154,514 | 68,104 | 10.92 | feasible |
| 40 | 69,127 | A | 259,832 | 150,679 | 81,552 | 14.15 | feasible |
| 40 | 69,127 | B | 265,973 | 154,240 | 85,113 | 14.42 | feasible |
| 40 | 69,127 | C | 236,365 | 137,071 | 67,944 | 13.08 | feasible |
| 30 | 51,845 | A | 228,731 | 132,643 | 80,718 | 16.00 | feasible |
| 30 | 51,845 | B | 249,848 | 144,889 | 93,044 | 17.03 | feasible |
| 30 | 51,845 | C | 221,470 | 128,433 | 76,588 | 15.63 | feasible |
| 20 | 34,564 | A | 197,472 | 114,516 | 79.952 | 19.04 | feasible |
| 20 | 34,564 | B | 208,236 | 120,758 | 86,194 | 19.67 | feasible |
| 20 | 34,564 | C | 189,289 | 109,771 | 74,725 | 18.54 | feasible |

[a]After taxes discounted interest rate equal to the interest rate for saving multiply by one minus the income tax rate = 7 (1 - .2) = 5.60 percent. The 20 percent tax rate was based on income averaging. Taxes were paid each year based on the amount of taxable income.

[b]Net present value and equity after taxes equal to the discounted present value at the end of the tenth year minus the owner's initial equity contribution.

Second Level

At this level of interest rates, short and intermediate loans were 12 percent, long-term loans 11 percent, and saving rate was 10 percent. The range of equity contributions and income streams were unchanged. At the 10 percent saving rate with leverage, all projects within the 50-20 percent equity range were considered feasible with positive net present values and rates of return to equity greater than the 8 percent after taxes saving rate. These results were similar to the feasible solutions provided at the same 10 percent saving rates when the representative farm was 100 percent equity financed (Table 21, p. 60). The feasible solutions at the 10 percent saving rate for the 50-20 percent leverage range appear to indicate that the tax shield generated from interest payment on borrowed loans is still greater than the associated financial cost. Under the assumptions and description of this study, farmers would have a tendency to invest in swine production instead of saving their funds at the 10 percent rate. The net present values and rates of return to equity for the representative swine farm when analyzed under conditions of level II interest rates, equity contributions, and income streams are shown in Table 28.

Third Level

At the third level of interest rates, the income streams and percent of equity contributions were same as in interest levels one and two. However, the intermediate and short-term loan rates were

Table 28. Results of the Net Present Value Analysis for the Representative Swine Farm for Different Combinations of Owner's Equity Contributions, Income Stream Based on the Hog Price Sequence with Interest Rate at 12 Percent for Short and Intermediate Loans, 11 for Long Term Loans, and a Saving Rate of 10 Percent

| Owner's Equity (Long-Term Financing) | Initial Contribution | Cash Flow Income Sequence | Cumulative Owner's Equity At End of the Tenth Year | Present Value[a] Discounted at a Savings Rate of 8.00 Percent | Net Present[b] Value (NPV) of Equity | Rate of Return to Equity After Taxes | Investment Solution |
|---|---|---|---|---|---|---|---|
| Percent | Dollars | | Dollars | Dollars | Dollars | Percent | |
| 50 | 86,409 | A | 277,764 | 128,658 | 42,249 | 12.39 | feasible |
| 50 | 86,409 | B | 293,636 | 136,010 | 49,601 | 13.01 | feasible |
| 50 | 86,409 | C | 262,846 | 121,749 | 35,340 | 11.77 | feasible |
| 40 | 69,127 | A | 239,953 | 111,145 | 42,018 | 13.25 | feasible |
| 40 | 69,127 | B | 255,627 | 118,405 | 49,278 | 13.97 | feasible |
| 40 | 69,127 | C | 223,248 | 103,407 | 34,280 | 12.44 | feasible |
| 30 | 51,845 | A | 201,248 | 93,217 | 41,372 | 14.53 | feasible |
| 30 | 51,845 | B | 218,075 | 101,011 | 49,166 | 15.45 | feasible |
| 30 | 51,845 | C | 184,569 | 85,491 | 33,646 | 13.54 | feasible |
| 20 | 34,564 | A | 162,985 | 75,494 | 40,930 | 16.78 | feasible |
| 20 | 34,564 | B | 179,873 | 83,316 | 48,752 | 17.93 | feasible |
| 20 | 34,564 | C | 145,913 | 67,586 | 33,022 | 15.49 | feasible |

[a]After taxes discounted interest rate equals to the interest rate for saving multiply by one minus the income tax rate = 10 (1 - .2) = 8.00 percent. The 20 percent tax rate was based on income averaging. Taxes were paid each year based on the amount of taxable income.

[b]Net present value on equity after taxes equal to the discounted present value at the end of the tenth year of the owner's initial equity contribution.

increased to 15 percent, long-term to 14 percent, and the saving rate was increased to 13 percent. At the 13 percent before taxes saving rate, the investment solutions from the cash flow analyzed were generally feasible. Except for income stream "C" at the 50, 40, 30, and 20 percent equity contributions, all other cash flow situations were feasible based on the NPV and IRR criteria. All cash flows with income stream "C" were infeasible at the higher 14 and 15 percent interest rates with the basic representative farm situation unchanged.

From the results of cash flows A and B at the third level of interest rates, it appears that owner's equity would be increased at a greater rate by investing in swine production instead of saving at the 13 percent interest rate. While the benefits derived from tax shield were positive at the 7 and 10 percent saving rate for income stream C it also appears that the additional tax shield from interest deduction was outweighted by the additional benefits from saving, at the 13 percent interest rate. The net losses in present values and rates of return to equity from the representative swine farm when analyzed under level III interest rates, equity contributions, and income streams are shown in Table 29.

Payment of Debt Capital

During the early years of operation additional borrowings from lending institutions in the form of short-term loans were required to keep the farm operating and make annually scheduled payments on long-term and intermediate loans. These short-term loans generally peaked

Table 29. Results of the Net Present Value Analysis for the Representative Swine Farm for Different Combinations of Owner's Equity Contributions, Income Stream Based on the Hog Price Sequence with Interest Rate at 15 Percent for Short and Intermediate Loans, 14 for Long Term Loans, and a Saving Rate of 13 Percent

| Owner's Equity (Long-Term Financing) | Initial Contribution | Cash Flow Income Sequence | Cumulative Owner's Equity At End of the Tenth Year | Present Value[a] Discounted at a Savings Rate of 10.4 Percent | Net Present[b] Value (NPV) of Equity | Rate of Return to Equity After Taxes | Investment Solution |
|---|---|---|---|---|---|---|---|
| Percent | Dollars | | Dollars | Dollars | Dollars | Percent | |
| 50 | 86,409 | A | 257,395 | 95,699 | 9,290 | 11.53 | feasible |
| 50 | 86,409 | B | 280,587 | 104,322 | 17,913 | 12.50 | feasible |
| 50 | 86,409 | C | 228,895 | 85,103 | (1,306) | 10.23 | infeasible |
| 40 | 69,127 | A | 211,859 | 78,789 | 9,662 | 11.85 | feasible |
| 40 | 69,127 | B | 234,008 | 87,004 | 17,877 | 12.97 | feasible |
| 40 | 69,127 | C | 184,090 | 68,445 | (682) | 10.29 | infeasible |
| 30 | 51,845 | A | 164,925 | 61,319 | 9,474 | 12.27 | feasible |
| 30 | 51,845 | B | 186,569 | 69,366 | 17,521 | 13.66 | feasible |
| 30 | 51,845 | C | 135,651 | 50,435 | (1,410) | 10.10 | infeasible |
| 20 | 34,564 | A | 116,796 | 43,425 | 8,861 | 12.95 | feasible |
| 20 | 34,564 | B | 137,911 | 51,725 | 16,711 | 14.84 | feasible |
| 20 | 34,564 | C | 83,019 | 30,866 | (3,698) | 9.16 | infeasible |

[a]After taxes discounted interest rate equals to the interest rate for savings multiply by one minus the income tax rate = 13 (1 - .2) = 10.40 percent discounted interest rate. The 20 percent tax rate was based on income averaging. Taxes were paid each year based on the amount of taxable income.

[b]Net present value on equity after taxes equal to the discounted present value at the end of the tenth year of the owner's equity contribution.

during the first three years of operation (Tables 24, 25, and 26, pp. 64-66).

As income was earned, the entire earning was paid on outstanding loan balances, after deductions for taxes and living expenses. Outstanding short-term and intermediate loans were repaid before the long-term loans because of the higher interest rate associated with short and intermediate loans. The amount of short-term capital requirement tended to decline about one to three years before intermediate and long-term loans were fully repaid. By the end of the tenth year of operation, all loans were fully repaid for the 50-20 percent range of equity contribution on the long-term assets, 8-15 percent range of interest rates, and income streams sequences A, B, and C.

## III. RELATIONSHIP BETWEEN LEVERAGE AND THE LENGTH OF TIME IN REALIZING A POSITIVE AFTER TAX NET CASH INCOME FOR ACCUMULATION

From an analysis of the cash flows, there is an inverse relationship between levels of equity contributions and length of time before a positive after tax net cash income was realized. The length of time in realizing a positive after tax net cash income tended to increase at decreasing levels of owner's equity contributions (Tables 24, 25, and 26, pp. 64-66). On the other hand, there was a positive relationship among increasing debt capital, interest rates, and the length of time in realizing a positive after tax net cash income for accumulation (Tables 24, 25, and 26, pp. 64-66).

With all groupings of variable combinations considered, cash flow with income stream "B" consistently had a shorter period in realizing the first positive after tax net cash income. The range of time before cash flows with income stream "B" showed positive after tax net cash income was within the 5th through 8th year of operation (Tables 24, 25, and 26, pp. 64-66). For similar grouping of interest rates and equity contributions, the time range for cash flow with income stream "A" to realize the first positive after tax net cash income was within the 7th through 8th year of operation (Tables 24, 25, and 26, pp. 64-66). In case of cash flows with income stream "C," the range of time for the first positive after tax net cash income was within the 7th through 10th year of operation (Tables 24, 25, and 26, pp. 64-66).

## IV. LEVERAGE AND THE PRINCIPLE OF INCREASING RISK ASSOCIATED WITH SWINE PRODUCTION

This tendency of increasing length of time before the first positive after tax net cash income was realized indicated the effect of the principle of increasing risk associated with increasing leverage and interest rates. While the duration for the first positive after tax net cash income tended to increase with lower equity contributions, the rate of growth in net worth had a tendency of increasing at the higher leverage ratios (Tables 27, 28, and 29).

The after tax discounted interest rates for saving at 7, 10, and 13 percent were 5.60, 8.00, and 10.4 percent, respectively. When

income stream "B" was at 7 percent saving rate before taxes and equity contribution of 50 percent on long-term financing, the rate of return to equity after taxes and debt services was estimated at 13.25 percent. However, at the same 7 percent saving rate but with equity contribution on long-term capital lowered to 20 percent or 80 percent long-term capital borrowing, the rate of return to equity after taxes was 19.67 percent, indicating the effect of positive leverage (Table 27, p. 68). For income stream "C" at 13 percent saving rate before taxes and equity contribution of 50 percent of long-term assets, the rate of return to equity was 10.23 percent after taxes and debt services or a net loss in present value of $1,306 (Table 29). At the same 13 percent saving rate but with equity contribution lowered to 20 percent or 80 percent long-term borrowing instead of an increase as was observed with income stream "B," the rate of return to equity from income stream "C" was lowered to 9.16 percent with a net loss in present value of $3,698 (Table 29).

For income stream "C," the losses in net present values of $1,306 and $3,698 are further magnified because of the additional losses of interest associated with the equity over the ten years of operation. The greater the difference between the after tax rate of return to equity, when the after tax internal rate of return is less than the after tax saving rate, the more rapid would be the loss of owner's equity. On the other hand, for income streams "A" and "B," the higher rates of return to equity as leverage ratios were increased could be interpreted as compensation for the financial risk associated with leverage in swine production.

# CHAPTER V

# SUMMARY AND CONCLUSIONS

## I. SUMMARY OF STUDY

The loan repayment capacity of swine operations is of importance to individuals directly and indirectly associated with pork production. This study was undertaken to provide a framework for tracing the operation through time and estimating the debt carrying capacity of the farm firm.

The objectives of this study were: (1) to determine the rates of return to equity for a representative swine farm when 100 percent equity financed, (2) to examine the effects different combinations of income streams, interest rates, and owner equity contributions have on the debt servicing ability of the representative swine farm.

A representative farrow-to-finish operation was developed after analyzing and comparing data from swine research units at Ames Plantation in West Tennessee along with similar research reports in the Southeast.

Seventy acres of farmland were assumed for this study. Labor resource was scheduled to supply the equivalent of 4,576 hours annually. These hours were provided by family members of the operator along with one hired worker. On-farm capital investment contributions were generated both internally and externally. The management was assumed to

have the necessary skills and dedication to efficiently operate the representative farm.

As a consequence of determining the loan repayment capacity of the farm, sub-analyses involving herd stabilization, cost and revenue estimates, hog price cycle, and interest rates had to be developed. The number of animals sold annually, operating expenses, and total on-farm investment were held constant throughout the study. Even though total on-farm investment was the same, for all situations, the proportions of equity contributions to borrowed capital were varied accordingly. Three hog price sequences were used instead of a constant level pricing method. This approach was taken to better represent the fluctuation in income usually experienced by swine farmers.

## II. SUMMARY OF RESULTS

With operating facilities installed, the swine herd stabilization process was completed by the end of year one. For the second through the tenth year, 188 sows and gilts were kept in the breeding herd along with 22 mature boars. At 80 percent conception rate, approximately 150 sows and gilts farrowed twice annually. For the second to the tenth year, 38 non-breeding gilts, 60 dry sows, 2177 market hogs and 11 culled boars were sold annually. However, during the start-up year only 48 animals were sold.

Income from livestock sales was varied with respect to the sequence of prices on a repeating hog price cycle. For the start-up year, income from hog price sequences "A," "B," and "C" were $4,851,

$5,406, and $6,728, respectively. During the normal years, 2286 animals were sold annually with incomes of $226,680, $282,280, and $203,541 in repeating income sequences designated "A," "B," and "C," respectively. Additional incomes were received from sales of the liquidating breeding stock and on-farm facilities at the end of the tenth year.

It required about $201,042 to properly establish and equip the representative farrow-to-finish operation. About $172,818 of the total on farm capital investment fund was spent on farm buildings, machinery and equipment, pastures, lagoons and farm roads. An additional $28,224 was used to purchase the initial breeding stock. The total on-farm capital investment estimate was made under the assumption that the operator owned the land prior to farm establishment and the rent for the use of land was charged to the hog operation.

Operating expenses for the start-up year was estimated at $41,763. During normal years of operations, the operating expenses totalled $168,535 annually. Except in the start-up year, funds from livestock sales exceeded the annual total variable expenses.

At one hundred percent equity financing, the initial capital outlays for income streams A, B, and C were $249,820, $249,265, and $247,943, respectively. This total comprised of funds for on-farm capital investment which was estimated at $201,042 plus additional working capital of $48,778, $48,223, and $46,901 for income sequences A, B, and C, respectively.

When the reinvestment rate was 7 percent, each cash flow situation had a positive net present value and the rates of return to equity were

greater than the 5.6 percent after taxes rate. The net present values were $85,002, $89,020, and $82,330 while rates of return to equity after taxes were 8.74, 8.87, and 8.67 percent for income streams A, B, and C, respectively. When the reinvestment rates were increased to 10 and 13 percent the results from the cash flow analyzed were infeasible only for income stream C, based on the net present value and internal rate of return criteria.

In the leverage farm situations, three levels of interest rates for borrowing and reinvestment were analyzed. At the first level of interest rate, the short and intermediate loans were 9 percent, long-term loans 8 percent, and the reinvestment rate was 7 percent. At the second level of interest rate, short and intermediate loans were 12 percent, long-term loans 11 percent, and the reinvestment rate was 10 percent. At the third level of interest rate, short and intermediate loans were 15 percent, while the reinvestment rate was increased to 13 percent. At the first, second and third levels of interest rates the corresponding after tax reinvestment rates were 5.60, 8.00 and 10.40 percent, respectively. With the above interest rates for borrowing and reinvestment, the percent and amount of owner's equity contributions were $86,409, $69,127, $51,845, and $34,564 at 50, 40, 30, and 20 percent equity positions, respectively. The cash flow income streams were A, B, and C based on a repeating hog price sequence. At the low level, intermediate level, and peak of price cycle, prices for market hogs were $38.00, $42.32, and $52.70 per hundredweight.

Under the above conditions for the 7 and 10 percent reinvestment rates before taxes, with other factors held constant, each cash flow situation had positive net present values and rates of return to equity greater than the respective after taxes reinvestment rates. At the 13 percent reinvestment rate the cash flows for the representative swine farm were feasible for income streams A and B. However, for income stream C the cash flows were infeasible with negative returns to equity and rates of return less than the after tax saving rate.

## III. CONCLUSION

From the assumptions and results of this study it would appear that current swine producers in Tennessee with relatively debt-free farms are likely to continue their operations in the short-run. Inspite of wide variability in income streams, swine producers would be able to cover all variable costs during years of normal operation.

Beginning farmers starting at the low price level of the repeating hog price sequence and in a leverage situation are not expected to have a positive after tax net cash income for accumulation before the sixth year of operation. Farmers beginning their swine operation at the intermediate level of the hog price sequence and in a leverage situation could expect a positive after tax net cash income for accumulation about a year earlier or the fifth year of operation. For farmers beginning their swine operation when market hog prices are at the peak of the hog price sequence and in a leverage situation are not expected to show a positive after tax net cash income for accumulation before the seventh year of operation.

In spite of the length of time before farmers could expect a positive after tax net income, lenders could expect full repayment on all loans by the end of the tenth year. This is particularly true for those farmers starting the low and intermediate level of the repeating hog price sequence.

Farmers could improve their cash flow situation and increase net worth by operating their farm within a 50-20 percent equity range with interest rate for long term loans at 14 percent and intermediate and short term loans at 15 percent providing farmers begin their operation at the low and intermediate levels of the hog price sequence. In this study, the rates of return to equity were relatively higher in most leverage situations than in the debt-free situations. However, as the interest rates on borrowed funds were increased to the higher 14 and 15 percent levels, it was more profitable for farmers initiating their swine operation at the peak of the price cycle to save their capital at 13 percent rather than investing in swine production. With increasing interest rates, and interest in tax management, farmers should also weigh their reinvestments in swine production against off-farm investment opportunities to make better use of capital resources.

It also appears that farmers could improve their cash flow and loan repayment capacity by timing their production to coincide with the expected high prices in the hog price sequence.[a] Farmers who ignore the hog price sequence and its impact on income and investment are likely to encounter less profitable results.

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[a]This recommendation is with caution because if a large number of farmers increase production at the same time, there is a tendency of increasing supply of market hogs and without an increasing demand, prices would tend to be lowered.

Further study is needed to determine what effects the financial structure used in the study would have on different sizes of swine farms. This would help to establish a threshold for feasible size commercial farrow-to-finish operations.

# BIBLIOGRAPHY

BIBLIOGRAPHY


1. Baker, C. B., "Introduction to Economic Growth of the Agricultural Firm." Technical Bulletin 86, Washington: College of Agricultural Research Center, Washington State University, February 1977, pp. 2-3.

2. Baumol, W. J., Economic Theory and Operations Analysis, 3rd edition, Prentice-Hall, 1972.

3. Barry, P. J., "Capital Sources, Cost and Financial Structure," in Publications for Financial Management in Agriculture, No. 82E-209, Department of Agricultural Economics, University of Illinois, Urbana. Champaign, March 1982, p. 8.

4. Barry, J. P., J. A. Hopkin, and C. B. Baker, Financial Management in Agriculture, second edition, Danville: The Interstate Printers and Publishers, Inc., 1979, pp. 30, 146-156, 185-186.

5. _____, Financial Management in Agriculture, third edition, Danville: The Interstate Printers and Publishers, Inc., 1983, pp. 24, 306, 425.

6. Bedel, Alvin Andrew, "A Study of Potential Farm Growth and Survival for Representative Farms in West Tennessee," Unpublished Ph.D. Dissertation, The University of Tennessee, Knoxville, June 1975.

7. Crews, J. R., N. R. Martin, F. B. Saunders, and S. J. Brannen, Economic Analysis of Farrow-to-Finish Swine Production Systems, Georgia Coastal Plain, Research Report No. 314, Agricultural Experiment Station, The University of Georgia, Athens, Georgia, May 1979.

8. Doll, J. P., and F. Orazem, Production Economics, Theory with Application, Columbus: Grid, Inc., 1978, pp. 173-338.

9. Farm Credit Service, Farm Credit Administration, Congressional and Public Affairs Division, Circular 49, Washington: Farm Credit Administration, April 1982, p. 1.

10. Garland, C. D., and E. H. Hudson, Cash Flow Planning and Management, Publication No. 933, Agricultural Extension Service, The University of Tennessee, Knoxville, 1980.

11. Gittinger, J. P., Economic Analysis of Agricultural Projects, second edition, Baltimore: The John Hopkins University Press, 1982.

12. James, S. C., and E. Stoneberg, Farm Accounting and Business Analysis, Ames: Iowa State University Press, 1976.

13. Kay, R. D., Farm Management, Planning, Control and Implementation, New York: McGraw-Hill Book Company, 1981.

14. Lee, W. F., M. D. Boehlje, A. G. Nelson, and W. G. Murray, Agricultural Finance, seventh edition, Ames: The Iowa State University Press, 1980, pp. 32-37.

15. Myers, S., and R. Brealey, Principles of Corporate Finance, New York: McGraw-Hill Book Company, 1981, p. 63.

16. Plain, R. L., and J. E. Williams, "Adaptive Planning Under Price Uncertainty in Pork Production," Southern Journal of Agricultural Economics, December 1981.

17. Pond, W. G., and J. H. Maner, Swine Production in Temperate and Tropical Environments, San Francisco: W. H. Freeman and Company, 1974, pp. 208-209.

18. Ray, Robert Malcolm, "An Economic Analysis of Swine Production in the Tennessee Watershed of Tennessee," unpublished Ph.D. Dissertation, The University of Tennessee, Knoxville, March 1977.

19. Ray, R. M., R. E. Lidvall et al., "A Comparison of Three Farrow-to-Finish Pork Production Systems," Tennessee Farm and Home Science, No. 116, Agricultural Experimental Station, The University of Tennessee, Knoxville, December 1980, pp. 2-6.

20. Ray, R. M., and H. N. Walch, Farm Planning Manual, Publication E. C. 622, Agricultural Extension Service, The University of Tennessee, Knoxville, April 1981, pp. 115-120.

21. Spruill, D. G., C. R. Weathers and C. M. Stanislaw, "Pork Production Systems with Business Analysis, The High-Investment, High Intensity Confinement System," Pork Industry Handbook No. PlH-83, Cooperative Extension Service, Purdue University, West Lafayette, Indiana, October 1982.

22. Tennessee Department of Agriculture, Tennessee Agricultural Statistics, Annual Bulletin T-19, 1982, pp. 39, 88, 97.

23. Thompson, J. L., and G. D. Hanson, "A Stimulation Study of Maximum Feasible Farm Debt Burdens by Farm Type," American Journal of Agricultural Economics, Vol. 62, No. 4, November 1980, pp. 727-732.

24. Tweeten, L. G., Foundation of Farm Policy, second edition, Lincoln: University of Nebraska Press, 1979, pp. 166-168.

25. U.S. Bureau of Census, Census of Agriculture, Volume 1, Part 31, Tennessee State and County Data, Washington, D.C.: Government Printing Office, 1959, p. 9; 1969, p. 5; 1978, p. 14.

26. U.S. Department of Agriculture, Agricultural Statistics, 1982, Washington, D.C.: United States Government Printing Office, 1982, pp. 40, 450.

27. U.S. Department of Agriculture, Economic Research Service, Agricultural Outlook, Washington, D.C.: Government Printing Office, December 1983, p. 32.

28. U.S. Department of Agriculture, Agriculture Economic Research Service, Livestock and Meat Statistics, Washington, D.C.: Government Printing Office, October 1983, p. 122.

29. U.S. Department of Treasury, Internal Revenue Service: Package X 1980, Washington, D.C.: United States Government Printing Office, 1980, p. 91.

30. U.S. Department of Commerce, 1980 Census Bureau of the Census, Washington, D.C.: United States Government Printing Office, 1980.

31. Van Horne, J. C., Fundamentals of Financial Management, third edition, Englewood Cliffs: Prentice Hall, Inc., 1977.

# APPENDIXES

APPENDIX A

FEATURES RELATING TO THE DIFFERENT PHASES IN THE LIFE CYCLE OF THE FARM FIRM

| Stages | Features |
|---|---|
| Establishment | Net liquidity very low |
| | Need for capital is great |
| | Short on capital |
| Expansion | Strong on capital |
| | High living expenses |
| | Increase use of credit |
| Consolidation | Growth continues |
| | Strong financial position |
| | Family needs less |
| | Debt reduction |
| Transfer | Manager very experienced |
| | Low in energy |
| | Lots of capital |
| | Teaches and involves son in business but retain option to transfer to son or sell |

Source: Barry, J. P., J. A. Hopkin, and C. B. Baker, Financial Management in Agriculture, second edition, Danville: The Inter State Printers and Publishers, Inc., 1983, pp. 24, 425.

## APPENDIX B

## SCHEDULES BREEDING AND MARKETING ACTIVITIES FOR THE 150, SOW-UNITS, 2-LITTER, FARROW-TO-FINISH OPERATION

| Activity | Date and Group | Month | | | | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | J | F | M | A | M | J | J | A | S | O | N | D | |
| Select Replacement Gilts | Jan, Feb-March, May, June-July July, Aug-Sept, Nov, Dec | C1 | D1 | | | A2 | | B2<br>C2 | D2 | | | A1 | B1 | Gilts were selected about 2 months before breeding |
| Buy Boars | Jan, May | -- | | | -- | | | | | | | | | |
| Breeding | Groups A1 and B1: Jan & Feb-March<br>Groups A2 and B2: July & Aug-Sept<br>Groups C1 and D1: March, April-May<br>Groups C2 and D2: Sept, Oct-Nov | A1 | B1 | C1 | D1 | | | A2 | B2 | C2 | D2 | | | Breeding interval was assumed to be 42 days |
| Farrowing | Groups A1 and B1: April-May, June<br>Groups A2 and B2: Oct-Nov, Dec<br>Groups C1 and D1: June-July, Aug<br>Groups C2 and D2: Dec-Jan, Feb | | | D2 | | A1<br>C1 | B1 | D1 | | | A2 | | B2<br>C2 | Averaged about 11 days |
| Weaning | Groups A1 and B1: June, July-Aug<br>Groups A2 and B2: Dec, Jan-Feb<br>Groups C1 and D1: Aug, Sept-Oct<br>Groups C2 and D2: Feb, March-April | B2<br>C2 | | D2 | | | A1 | B1<br>C1 | | D1 | | | A2 | 6-8 weeks allowed for weaning |
| Sell Market Hogs | Groups A1 and B1: Oct-Nov, Dec-Jan<br>Groups A2 and B2: April-May, May-June<br>Groups C1 and D1: Dec-Jan, Jan-Feb.<br>Groups C2 and D2: May-June, July-Aug | B1<br>C1<br>D1 | D1 | | A2 | A2<br>B2<br>C2 | B2<br>C2 | D2 | D2 | | A1 | A1 | B1<br>C1 | Market hogs were sold at 6-7 months and averaged 230 lbs liveweight |

# APPENDIX C

## CALENDAR OF ACTIVITIES IN A FARROW-TO-FINISH SYSTEM

| Stages of Production | Days from Breeding | Management Activities |
|---|---|---|
| Prebreeding | -14 to -7 | Mix gilts with sows and allow boars fence-line contact with sows and gilts |
| | | Increase feed to sows and gilts by about one pound per day for 1 to 2 weeks |
| | -2 | Spray for lice and mange |
| Gestation | 0 | Start breeding, rotating boars daily |
| | 21-24 | Remove boars |
| | 35-60 | Pregnancy check, and sell any open females |
| | 105 | Worm sows with broad-spectrum wormer |
| | | Clean and prepare farrowing pens |
| | 108-110 | Wash sows with warm water and soap, spray for lice and mange, and move to farrowing pens |
| | | Start feeding 3 to 4 pounds of 15.78 percent crude portion ration and continue until 2 to 3 days after farrowing |
| | | Do not allow visitors near farrowing houses |
| | 112 | Prepare heat for piglets |
| | | Complete all other preparations for farrowing and be ready to assist sows having problems in delivery |

APPENDIX C (Continued)

| Stages of Production | Days from Breeding | Management Activities |
|---|---|---|
| Farrowing-Nursery | 0-1 | Make sure piglets are nursing in a warm environment and comfortable |
| | | Dip navel cord in mild iodine solution |
| | | Clip needle teech |
| | | Ear notch gilts from good litters of 9 or more piglets |
| | | Complete farrowing records |
| | | Observe sows for MMA (mastrititis, metrititus, agulactca) |
| | 1-3 | Transfer piglets to equalize litters |
| | | Give iron shots |
| | 3-14 | Castrate males |
| | 7-10 | Provide creed feed for piglets |
| | 14-21 | Give second iron shots, if needed |
| | 42-56 | Wean pigs; sows and gilts returned to pasture lots to be rebred |
| | | Weaners stay in pens for an additional two weeks |
| | | Worm pigs with a broad-spectrum wormer and spray for lice and mange |
| | 60-68 | Reworm weaners with a wormer other than the one used the last period |
| Growing-Finishing | 72 | Transfer pigs to finishing houses |
| | 150 | Select replacement gilts from those ear-notched at birth |

APPENDIX C (Continued)

| Stages of Production | Days from Breeding | Management Activities |
|---|---|---|
| | 150-206 | Observe withdrawal regulations for feed additives and market hogs at an average of 230 pounds |

# APPENDIX D

## NET CASH FLOW ANALYSES FOR THE REPRESENTATIVE SWINE FARM WITH OWNER EQUITY CONTRIBUTION OF 50 PERCENT ON LONG TERM ASSETS, INCOME STREAM BASED ON HOG PRICE SEQUENCE A, INTEREST RATES AT 9 PERCENT FOR SHORT AND INTERMEDIATE LOANS, 8 PERCENT FOR LONG TERM LOANS, AND A REINVESTMENT RATE OF 7 PERCENT

| Item | Years 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dollars | | | | | | | | | |
| Sources of Operational Fund | | | | | | | | | | |
| Livestock sales | 4,851 | 226,680 | 282,280 | 203,540 | 226,680 | 282,280 | 203,541 | 226,080 | 282,280 | 203,541 |
| Owner contribution--capital investment 55[a] | 86,409 | - | - | - | - | - | - | - | - | - |
| Borrowed funds--livestock purchases 100%[b] | 28,224 | - | - | - | - | - | - | - | - | - |
| Borrowed funds--capital investment 50%[c] | 86,409 | - | - | - | - | - | - | - | - | - |
| Salvage value--livestock | - | - | - | - | - | - | - | - | - | 55,637 |
| TOTAL OPERATIONAL SOURCES | 205,893 | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 | 203,541 | 226,680 | 282,280 | 259,178 |
| Operational Uses of Fund | | | | | | | | | | |
| Owner contribution--capital investment 50% | 86,409 | - | - | - | - | - | - | - | - | - |
| Borrowed funds--livestock purchases 100% | 28,224 | - | - | - | - | - | - | - | - | - |
| Borrowed funds--capital investment 50% | 86,409 | - | - | - | - | - | - | - | - | - |
| Operating expenses--excluding depreciation[d] | 41,763 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 |
| TOTAL OPERATIONAL SOURCES | 242,805 | 168,535 | 158,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 | 168,535 |
| Net cash balance before taxes, social securities, living expenses, and debt service | (36,902) | 58,145 | 113,745 | 35,006 | 58,145 | 113,745 | 35,006 | 58,145 | 113,745 | 90,643 |
| Interest earned[e] | - | - | - | - | - | - | 4,516 | 6,080 | 8,973 | 15,142 |
| Net cash balance before allowances | (36,912) | 58,145 | 113,746 | 35,006 | 58,145 | 113,745 | 39,522 | 64,225 | 122,718 | 105,785 |
| Income Tax Allowances | | | | | | | | | | |
| Depreciation | 9,450 | 18,899 | 18,899 | 18,899 | 18,899 | 18,899 | 18,899 | 18,899 | 18,899 | 18,899 |
| Interest payment | 9,511 | 14,785 | 12,037 | 5,140 | 3,903 | 1,236 | - | - | - | - |
| Net operating loss (sources-uses) | 36,912 | - | - | - | - | - | - | - | - | - |
| Amount of tax deductable C/F from previous years[f] | - | 24,461 | 31,412 | - | - | - | - | - | - | - |
| TOTAL TAX ALLOWANCES | 55,873 | 58,145 | 62,348 | 24,039 | 22,802 | 20,135 | 18,899 | 18,899 | 18,899 | 18,899 |
| Taxable income | - | - | 51,397 | 10,967 | 35,343 | 93,610 | 20,623 | 45,326 | 103,819 | 86,886 |
| Income tax at 20% | - | - | 10,279 | 2,193 | 7,069 | 18,722 | 4,125 | 9,065 | 20,746 | 17,377 |
| Income after taxes | (36,912) | 58,145 | 103,466 | 32,813 | 51,076 | 95,023 | 35,397 | 55,160 | 101,954 | 88,408 |
| Ending cash balance from previous year B/F | - | - | - | - | - | - | 64,508 | 86,864 | 128,192 | 216,310 |
| Net cash before deductions for social security, family living, and debt service | (36,912) | 58,145 | 103,466 | 32,813 | 51,076 | 95,023 | 99,905 | 142,024 | 230,144 | 304,718 |
| Social security at 8.1%[g] | 130 | 130 | 2,098 | 888 | 2,098 | 2,098 | 1,305 | 2,098 | 2,098 | 2,098 |
| Family living expenses | 11,736 | 11,736 | 11,736 | 11,736 | 11,736 | 11,736 | 11,736 | 11,736 | 11,736 | 11,736 |
| Loan Repayment | | | | | | | | | | |
| Short term loan--principal | - | 70,962 | 52,141 | - | - | - | - | - | - | - |
| Intermediate loan--principal | 4,032 | 4,032 | 4,032 | 3,347 | - | - | - | - | - | - |
| Long term loan--peincipal | 8,641 | 8,641 | 8,641 | 8,641 | 8,641 | 8,641 | - | - | - | - |
| TOTAL PRINCIPAL | 12,673 | 83,635 | 64,814 | 11,988 | 8,641 | 8,641 | | | | |
| Short term loan--interest at 9% | 3,056 | 6,387 | 4,693 | - | - | - | - | - | - | - |
| Intermediate loan--interest at 9% | 1,270 | 2,177 | 1,814 | 301 | - | - | - | - | - | - |
| Long term loan--interest at 8% | 5,185 | 6,221 | 5,530 | 4,839 | 3,903 | 1,236 | - | - | - | - |
| TOTAL INTEREST | 9,511 | 14,785 | 12,037 | 5,140 | 3,903 | 1,236 | - | - | - | - |
| Net cash balance available for advanced loan repayment[h] | - | - | 12,781 | 3,061 | 24,698 | 71,312 | - | - | - | - |
| Advance payment--intermediate principal | - | - | 12,781 | - | - | - | - | - | - | - |
| Advance payment--long term loan principal | - | - | - | 3,061 | 24,698 | 71,312 | - | - | - | - |
| Accumulated net cash equity | (70,962) | (52,141) | 0[i] | 0[i] | 0[i] | 64,508 | 86,864 | 128,190 | 216,310 | 290,884 |

[a] Owner equity contribution was the total on-farm capital investment minus livestock purchases multiplied by percent of equity contribution. See Table 15.

[b] Intermediate loan was the total cost for the initial breeding herd (28,224). See Table 15.

[c] Long term loan was the total on-farm capital investment minus livestock purchases multiplied by percent of borrowed funds. See Table 15.

[d] Total operating expense during the start-up year was estimated at $41,763, and stabilized at $168,535 during years of full production. See Table 15.

[e] The amount of interest earned when accumulated funds from previous years were reinvested at the rate of 7 percent.

[f] Unclaimed tax allowances which could be carried forward. See 1980 income tax regulations on operating loss.

[g] When taxable income was $1,600 or less, then social security was estimated at $1,600 multiplied by .081 = $130. When taxable income was $25,900 or more, then social security was $25,900 multiplied by .081 = $2,098. When taxable income was within the range of $1,600 to $25,900, then social security tax equal to the taxable amount was multiplied by .081. See 1980 regulations on social security.

[h] As income was earned, the entire earning was paid on outstanding loan balances. Net cash equity for accumulation occurred only after the short-term, intermediate, and long-term loans were fully repaid.

[i] A zero in the cash flow means that cash was not available for equity accumulation at the end of the year, after payments on loans.

# VITA

Clayton M. Williams, son of Charles and Mildred Williams, was born in Fyrish Village, Guyana, on September 27, 1946. He attended Victoria High School for four years, graduating in May 1966. He entered the Guyana School of Agriculture in September 1966, and graduated with a Certificate in Agriculture in May 1968. In September 1968, he entered Tuskegee Institute, Alabama, receiving a diploma in Beef Cattle Ranch Management in August 1970. In 1970 the author returned to Guyana and worked with the Extension Service of the Ministry of Agriculture as a livestock assistant. In May 1971, he accepted an appointment as a credit analyst with the Livestock Project Division, Bank of Guyana. In June 1975 the author accepted a managerial position with the Livestock Development Company in Guyana.

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