AN ECONOMIC STUDY OF THE SUPPRESSION OF THE LONE STAR TICK, AMBLYOMMA AMERICANUM (LINNAEUS), ON CATTLE IN OKLAHOMA

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CHAPTER I

INTRODUCTION

Overview

Oklahoma, the United State's forty-sixth state, comprises a total area of 44,748,000 acres (U.S. Department of Agriculture, 1977). Having the highest beef per acre density ratio in the nation, the area of this state used as pasture or rangeland makes up approximately 3 percent of the total pasture or rangeland area of the continental United States (U.S. Department of Agriculture, 1982). Although this figure may appear insignificant, beef was the top valued agricultural commodity for the state in 1982 (Oklahoma Department of Agriculture 1983) and with a value of 2,079 million dollars (U.S. Department of Agriculture, 1982) the state's value of cattle production ranked sixth in the nation the same year.

Livestock production has been a tradition to this part of the west. Large herds of cattle were driven from Texas to the northern markets of Kansas. Those driving herds from Texas, crossed the Indian Territory which is now known as Oklahoma. The federal government was pressured into opening the land for homesteading. At precisely noon, on 22 April 1889, settlers entered the region in a historical land rush that was the beginning of cattle operations in Oklahoma (Billington, 1952).

Approximately 59.5 percent, or 26,611,000 acres, of the state are used in either pasture, range or non-commercial forestland (U.S. Department of Agriculture, 1977). Non-commercial forestland is defined as land:

1. having a minimum of 10 percent forest trees of any size,
2. not developed for nonforest use, and
3. that may provide sufficient plant growth for livestock grazing.

These lands are predominantly used for livestock grazing. Grazing values are based on feeding capacity or stocking rate and vary with management practices and rainfall.

The foraging ability of cattle make foragelands, which have few alternative uses, a major source of feed. The per unit production of beef on these lands varies with the type and density of grasses, forbs, and browse available for grazing.

Livestock production on rangeland is hindered by numerous anthropod pests such as various types of and life stages of flies, ticks and lice. A USDA publication (1965) reported that tick associated losses cost cattlemen $60 million and sheep producers $.47 million annually. Losses attribute to severe tick infestations include feeding lesions susceptible to secondary bacterial infections, "tick worry," hide damage, decreased milk production, severe weight loss, disease transmission, and death. Byford (1983) found that the lone star tick _Amblyomma_ _americanum_ (Linnaeus) reduces the rate of weight gain in cattle. This tick is well established throughout Oklahoma.

The Problem

Hooker, et al. hypothesized in 1912 that the lone star tick was of greater importance as a pest of man than any other tick species in the eastern and southern states. Since that time, a voluminous amount of information has accumulated that suggests that this species is an important vector of several diseases, alters livestock productivity, is harmful to wildlife, and is so annoying to man within certain areas of its range that it can influence economic development.

The lone star tick is of particular economic interest in Oklahoma. It is one of the most economically important tick species in the Ozark Mountain region (Calhoun, 1954; Drummond, 1967; and Hair and Howell, 1970). The region, which includes portions of eastern Oklahoma contains dense woodlands which are conducive to the pest's existence. Lone star tick parasitism alters livestock growth, aids disease transmission and can be fatal to hosts (Bolte et al., 1970; and Williams, 1976). Therefore, the existence of this pest should be recognized when evaluating alternative uses of the rangeland.

Livestock management systems which use tick control measures based upon chemicals have been developed. Dips or sprays applied to the hide of cattle serve for a limited control period. This method is laborious, provides only minimal protection, and has not been subjected to economic analysis.

Two cultural methods may be used to control lone star ticks. The first involves habitat modification which can be used to disrupt the sensitive balance between temperature and relative humidity required by the tick (Hoch et al., 1971a and 1971b). This approach combines herbicide applications with mechanical clearing of brush. When compared to conventional spray treatments, this method can significantly reduce the lone star tick population (Meyer et al., 1982). The second cultural control method is the introduction of a tick resistant strain of cattle. Tick resistance in various breeds of cattle has been extensively investigated in the United States (Strother et al., 1974) and in Australia (Wilkinson, 1962; Hewetson, 1968; Wharton et al., 1969; and Utech et al., 1978). Research indicates that Brahman (*Bos indicus*) and Brahman X Hereford (*Bos taurus*) cattle are more resistant to lone star tick infestations than purebred Hereford cattle (Strother et al., 1974). The economics of these cultural control measures have not been investigated.

Two independently controlled research programs were conducted in the eastern part of Oklahoma to study the effect of lone star ticks on cattle. The first study was initiated in 1979 by Dr. Donald R. Barnard, an entomologist working for the USDA, ARS at the Kerr Foundation, Inc. facilities. The study was designed to identify the relationship between the growth of pastured preweaner Angus calves and the number of ticks carried. The second study was initiated in 1980 by Ronnie L. Byford, a Ph.D. graduate student at Oklahoma State University under the direction of Dr. Jakie A. Hair. It was designed to identify the influence of cattle breed, pasture condition, and acaricide use on the naturally occurring populations of lone star ticks. In addition, data were generated which could be used to analyze the relationship between tick attachment and stocker weight gain. This type of information is essential for economic analysis of alternative breed-pasture-acaricide combinations.

The purpose of this study is to use the biological data generated from the experiments conducted by Barnard and Byford to conduct a comprehensive economic analysis of alternative livestock production strategies given the presence of lone star ticks. The economic viability of the proposed control measures has not been analyzed.

The overall objective of this study is to investigate the economics of alternative grazing strategies for ranchers and farmers in eastern Oklahoma with consideration of the existence of the lone star tick. More specifically the objectives are to:

1. estimate the relationship between lone star tick attachments and live weight gain,

2. estimate the difference in live weight gain between Brahman X Hereford and purebred Hereford stockers for alternative levels of lone star tick attachment,

3. estimate the differences in stocker gain with alternative levels of lone star tick attachment between improved pasture and native pasture,

4. estimate the interactions among the alternative breeds, pastures and acaricides, and

5. estimate the optimal enterprise mix for a farm in a lone star tick infested environment, considering Hereford and F_1 Hereford X Brahman stocker and cow-calf enterprises, improved and native pasture, and use and nonuse of acaricides.

Study Areas

The stocker study site consisted of 900 acres of timbered land located in the Cherokee Wildlife Refuge, Cherokee County, Oklahoma.

The cow-calf study site consisted of 62 acres of improved pasture provided by the Kerr Foundation, Inc. in Leflore County, Oklahoma (Figure 1).

Organization

The second chapter includes a review of economic theory and statistical methods pertinent to this study. The discussion initially focuses on the theory of production economics and its application to farm management through the use of linear programming. Statistical methods dealing with first order autocorrelation, heteroscedasticity, and corrected R^2 values are also covered.

Chapter III includes analysis deriving economic threshold levels of lone star ticks on preweaner calves. The chapter initially reviews the development of the data used in the analysis, then a damage model is defined, and treatment costs are determined. The economic threshold levels are then estimated for three types of acaricide.

In Chapter IV an analysis of the stocker experiment is presented. Data collection is reviewed, followed by development of a model. The chapter is concluded with a diagnosis of the model.

Chapter V presents an application of the relationships identified in Chapters III and IV in a whole farm study. Enterprise budgets are developed for specific scenarios. In the final chapter, Chapter VI, the major implications of the study are presented and future avenues of research explored.

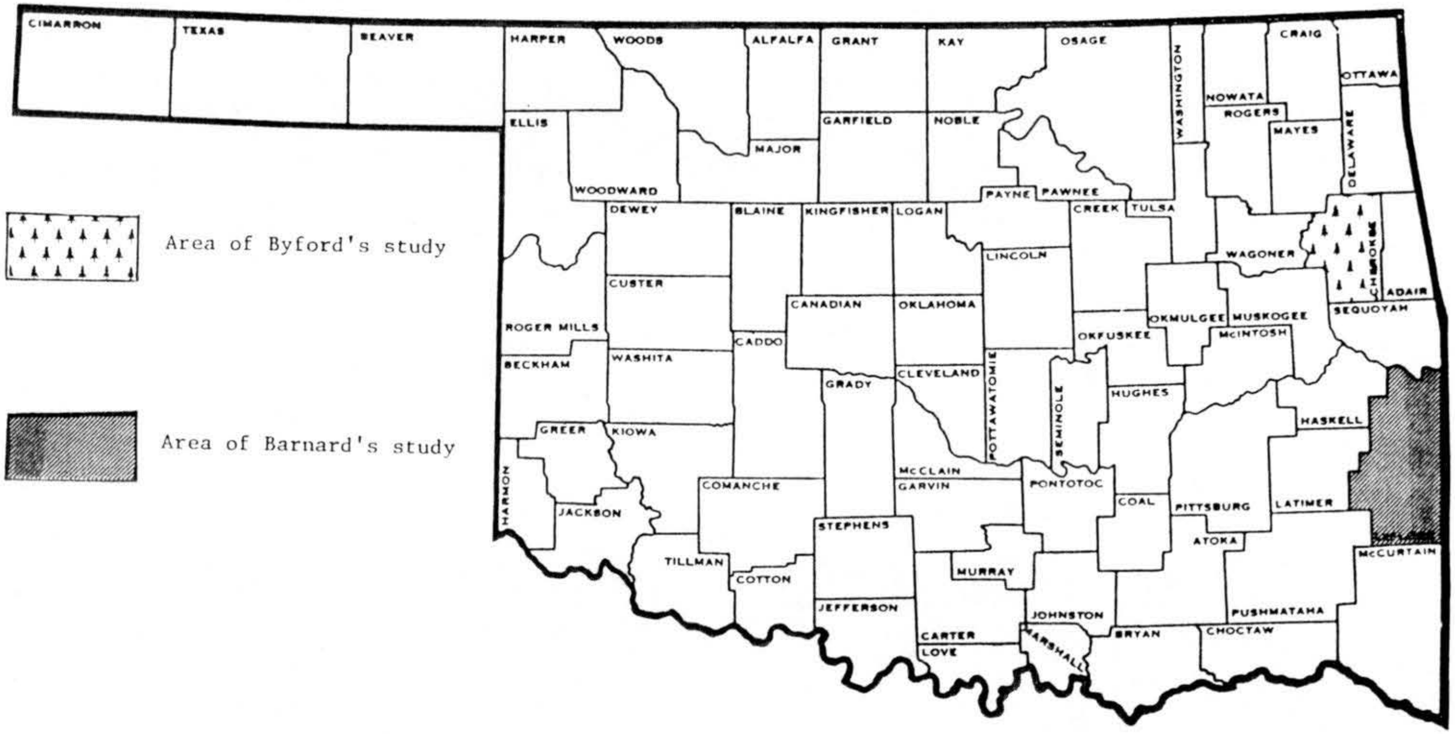

Figure 1. Map of Oklahoma Showing the Relative Locations of the Study Areas

CHAPTER II

THEORETICAL CONSIDERATIONS AND STATISTICAL METHODS

Economic Theory

An economic evaluation of the control of an agricultural pest is a micro-economic issue in the field of production economics. Production economics integrates the study of values, technical efficiency, and normative and positive aspects of production, at the firm or aggregate level. Theory can be used to determine the optimal quantities of inputs purchased and output sold where the prices of goods bought and sold are given parameters and individuals earn their incomes by selling factors of production, or outputs.

Production functions show the technical relationship between inputs and outputs per unit of time assuming optimal use of the inputs:

$$Y = f(X_1 | X_2 \; . \; . \; . \; X_n) \qquad (1)$$

where

Y is output,

X_1 is a variable input, and

X_2 through X_n are fixed inputs in the production process. Resource use is technically rational when resources cannot be rearranged in any way to give a greater product for the same set of resources (i.e., the producer is on the production function) and resources cannot be rearranged in any way to give the same product with a smaller outlay of any input (Heady, 1952). Technically irrational production may occur when resources are nondivisible or limited, or when imperfect knowledge exists.

Prices of resources and products, along with the production function, determine the profitability of production:

$$\Pi = P_y*Y - (Px_1*X_1 + Px_2*X_2 + \dots + Px_n*X_n) \quad (2)$$

where

Π is profit,

P_y is the output price,

Y is output, and

Px_i is the input price associated with input i at level X_i.

The product price multiplied by the output level gives total revenue. The sum of the input prices times the input level is total cost (variable cost plus fixed cost). The profit function can be rewritten as:

$$\Pi = TR - TC \quad (3)$$

where

Π is profit,

TR is total revenue, and

TC is total cost.

Producers will operate in the short run if variable costs can be recovered and will continue operating in the long run if both variable and fixed costs can be recovered.

Factor-product problems concern the allocation of one input among two or more alternative uses. Input supply is constrained so the input will be used in producing output yielding the highest returns (an economic principle related to opportunity costs). The efficient combination of resources is least-cost and occurs when the law of diminishing returns is operating for each resource. Inputs will be added so long as the value of the resulting output or additional returns is greater than the added costs (i.e., up to the point where marginal value product (MVP) is equal to marginal input cost). In mathematical notation:

$$\partial Y/\partial X_i = Px_i/Py \tag{4}$$

where

$\partial Y/\partial X_i$ is the partial derivative of the production function for Y with respect to the variable input X_i,

Px_i is the input price, and

P_y is the output price.

The second order condition for optimization requires that the marginal physical product of the i^{th} factor in producing the product is diminishing but positive.

Factor-factor problems are solved by finding least-cost resource combinations for production of a predetermined level of output. One input is substituted for another as long as the cost of the added input is less than the cost of the input which is replaced while the output level is maintained. Mathematically:

$$\partial X_{ij}/\partial X_{kj} = Px_k/Px_i \tag{5}$$

where

$\partial X_{ij}/\partial X_{kj}$ is the marginal rate of substitution (MRS) of input X_i for input X_k in the production of output j,

Px_k is the price of input X_k, and

Px_i is the price of input X_i.

Optimization conditions require that the MRS of X_k for X_i be decreasing and that the ratios of the MVP of input X_i in the production of j to the price of X_i and the MVP of input X_k in the production of j to the price of X_k are equal.

In product-product problems, no input prices are involved in choosing which of two products to produce with given resources. One product is substituted for another as long as the value of the added output is greater than the value of the output which is replaced while costs are constant. Mathematically, the equilibrium condition states:

$$\partial Y_{ij}/\partial Y_{in} = Py_n/Py_j \qquad (6)$$

where

$\partial Y_{ij}/\partial Y_{in}$ shows the rate of product transformation (RPT) between products j and n using resource base i, and

Py_n and Py_j are prices of the two outputs, n and j.

Generalized Production Equilibrium Conditions

Producers seeking to maximize profits are confronted with problems more complex than the single factor-product, factor-factor, or product-product cases. Generalized equilibrium conditions for the multiple factor-multiple product case with all factors variable are:

1. $\partial Y_j/\partial X_i = Px_i/Py_j$ for all i and j,
2. $\partial X_{ij}/\partial X_{kj} = Px_k/Px_i$ for all $i \neq k$,
3. $\partial Y_{ij}/\partial Y_{in} = Py_n/Py_j$ for all j and n.

When resources are limited, or not variable, they are used in production where they will give the greatest return. In equilibrium, the MVP of variable resources will equal the resource price while the MVP of fixed resources will equal the opportunity cost, or shadow price, of the resource. When problems involve different time periods and elements of risk, values used in comparison must be discounted.

Application to Farm Management

Farm operators, like other decision makers, must allocate resources, some fixed and some variable, to a manageable number of activities. A great variety of production alternatives exist while possible resource combinations approach infinity. Agricultural economists use budgeting and linear programming (LP) to facilitate economic problem solving. Continuous production functions (Equation 1) can be approximated by alternative production processes in several enterprise budgets. LP can then be used to select the enterprise combination which maximizes profits (Equation 2). The LP process, a procedure analogous to calculus applied to continuous data, is applied to discrete processes described by enterprise budgets.

Linear Programming

In mathematical terms, linear programming is a procedure used for maximizing or minimizing a linear objective function subject to linear restraints. The objective of whole farm planning is maximization of the objective function. The restraints are the amounts of the fixed resources. LP is a systematic method of selecting the most profitable farm plan from among possible alternatives (Beneke and Winterboer, 1973). Three quantitative components are required:

1. A specific or numerical objective function.
2. Several alternative activities or processes.

3. Limited resources or other restrictions.

The primal problem in summation notation is to maximize:

$$Z = \sum_{j=1}^{n} C_j x_j \qquad (7)$$

Subject to

$$\sum_{j=1}^{n} a_{ij} x_j \leq b_i \qquad \text{for all } i,\ i = 1, 2, 3\ldots, m \qquad (8)$$

and

$$x_j \geq 0 \qquad \text{for all } j \qquad (9)$$

where

Z is the value of the objective function,

C_j is the net return of the j^{th} activity,

x_j is the level of the j^{th} activity,

a_{ij} is a technical coefficient of the amount of i^{th} resource required per unit of the j^{th} activity, and

b_i is a resource or activity level for the i^{th} resource.

The objective function in farm management problems is generally profit maximization subject to constraints and fixed factors, but it may be any goal of an operator that can be designated numerically. An activity is defined as a particular way of combining a maximum of m variable factors for the production of a unit of output (Naylor and Vernon, 1969). The four types of activities are: real, intermediate, disposal, or artificial. Real activities represent production, marketing, or factor acquisition. Intermediate activities represent production of products used within the firm in another product to be marketed, for instance, crops or pasture grown on the farm for use in livestock feed. Disposal activities are included in LP problems to allow for non-use of resources. Artificial activities are used with activities that have minimum or equality constraints. Restrictions may be physical, institutional, or subjective and may be maximums, minimums, or equalities.

A standard LP model has seven basic assumptions:

1. Additivity of resources and activities.
2. Linearity of objective function.
3. Nonnegativity of decision variables.
4. Divisibility of activities and resources.
5. Finiteness of activities and resource restrictions.
6. Proportionality of activity levels to resources.
7. Single valued expectations (Agrawal and Heady, 1972).

However, several of LP's basic assumptions can be relaxed through variations of mathematical programming. LP's usefulness can be extended through modifications such as integer, mixed integer, parametric, and nonlinear programming. Integer or mixed integer programming can be used for problems requiring that solutions employ quantities in whole units. Parametric programming can be used for sensitivity analysis of input-output coefficients, resource supplies, or prices of resources or products. Nonlinear programming models are applied to situations in which the objective function or constraints are not linear and the firm faces increasing or decreasing returns to scale.

A common agricultural LP application is in selecting the optimal organization of enterprises for a farm. Heady and Dillon (1961) state that most firms are successful in allocating variable inputs within one enterprise but that selecting enterprise combinations is done more loosely. A production possibilities frontier is formed as the program determines production possibility equations defining all possible combinations of enterprises that can be produced with the given resources and inputs. The frontier encloses the area of feasible solutions. Points along the frontier are evaluated to find the optimal combination. The solution is at the point where the feasible area just touches the highest possible iso-revenue line. This point is ordinarily at a corner on the production frontier. The optimal solution may change with changes in technical efficiency or relative revenues in each enterprise, and consequently the input limitations that act as constraints may change.

Statistical Methods

The cost of livestock relative to budgeted funds forced both entomological researchers (Barnard and Byford) to conduct their experiments with a limited number of animals, and to use the same animals to identify multiple data points. The use of multiple observations from the same experimental units may result in correlation between the independent variables and the error terms of an ordinary least squares regression model. This is called autocorrelation (Johnson, 1984). This problem arises due to each animal having an inherited factor for growth potential which is recognized in successive data readings.

Another statistical problem associated with the stocker study (Chapter IV), is heteroscedasticity. Most, but not all observations represented 28 day intervals. Intuitively, a measurement taken at a

21 day interval should carry less weight in the analysis than observations taken at 28 day intervals.

Several control measures including habitat modification (brush control), use of tick resistant (Brahman-Hereford) stockers, and acaricides, were evaluated in the stocker study. The statistical significance of these control measures is evaluated in a linear regression model. Because a relatively large number of independent variables are used in the model, an adjusted R^2 value is computed.

The remainder of this chapter includes a discussion of the statistical methods used to correct data for first order autocorrelation and heteroscedasticity. The method used to compute the R^2 value adjusted for degrees of freedom is also described. The following standard regression model is considered:

$$Y_t = a + bX_t + e_t \qquad (10)$$

with $E(e_t) = 0$ and $E(ee') = V$

where

Y_t = the dependent variable ($t = 1, 2, 3, \ldots, T$)

a = the intercept term

b = the parameter's coefficient

X_t = the independent variable

e_t = the stochastic disturbance term

E = the expectation operator

V = variance of all disturbance terms

Correction for First Order Autocorrelation

When the off-diagonal elements of the variance-covariance matrix of the disturbance terms are non-zero, the disturbances are said to be autocorrelated. This type of autocorrelation can be corrected through generalized least squares to provide Best Linear Unbiased Estimators (BLUE). If the disturbance for an animal's first data point is positive, then the next data point's disturbance has a greater probability of being positive. In like manner, if the disturbance for the first data point is negative, then the next data point's disturbance has a greater probability of being negative.

There are several methods used to correct data for first order autocorrelation. The procedure used in this study is the Prais-Winsten Two-Step Method (Johnston, 1984). As the name indicates, there are two stages used in this procedure to correct the problem. The first stage involves identification of the estimated parameter "rho hat" ($\hat{\rho}$) representing the relationship between the disturbance terms. This parameter is then used in the second stage of the procedure to transform the data.

The first stage uses Equation (10) as we assume that the disturbance e_t has a first order autoregressive error structure

$$\hat{e}_t = \rho \hat{e}_{t-1} + U_t \qquad (11)$$

with $-1 < \rho < 1$ and $U_t \sim (0, S_u^2)$ and $e_t \sim (0, S_U^2/(1-\hat{\rho}^2))$

To identify the value of ρ, ordinary least squares is applied to equation (10) and the estimated disturbance terms ($\hat{e}_1$, $\hat{e}_2$, $\hat{e}_3$, ..., $\hat{e}_t$) are observed. Estimated values are indicated by the presence of a hat placed above the character. These observed disturbance terms are used to estimate rho (as $\hat{\rho}$) through the following:

$$\hat{\rho} = \frac{\sum_{t=1}^{n} \hat{e}_t \hat{e}_{t-1}}{\sum_{t=2}^{n} \hat{e}_{t-1}} \qquad (12)$$

The second stage of the Prais-Winsten procedure places $\hat{\rho}$ into the following transformation matrix:

$$T = \begin{bmatrix} \sqrt{1-\hat{\rho}^2} & 0 & 0 & 0 & 0 \\ -\hat{\rho} & 1 & 0 & 0 & 0 \\ 0 & -\hat{\rho} & 1 & 0 & 0 \\ 0 & 0 & -\hat{\rho} & 0 & 0 \\ 0 & 0 & 0 & -\hat{\rho} & 1 \end{bmatrix} \quad (13)$$

The T matrix is square. The size of the T matrix is determined by the number of observations identified for each animal. Therefore, if 4 observations were collected from each of ten animals during a year, then the T matrix would be a 4 X 4 square matrix. If, in addition to the observations received one year for these ten animals, another 7 animals each provided five observations the following year then the transformation procedure would require two T matrices of sizes 4 X 4 and 5 X 5. Each matrix would be applied to the sets of observations (4 or 5) individually. A Kronecker product of an identity matrix of size K X K and T_{jxj} yields the T matrix for year i.

let K = number of animals in year i,

let j = number of observations per animal in year i,

T_{jxj} = the transformation matrix for an individual animal.

Data transformation requires premultiplication of the dependent variable (Y) vector and the independent variable (X) matrix by the T matrix. The transformed data is then represented in a transformed equation (10) to which the ordinary least squares is then applied. The resulting regression coefficients are efficient estimators of the appropriate parameters.

Correction for Heteroscedasticity

Heteroscedasticity occurs when the variance of the disturbance terms is not constant. The variances of the disturbance terms are not constant for the observations in a set of data used in this study because the time between observations is not equal. The time between observations is in units of days which are known. Correction factors are developed on this basis. The transformation matrix used to correct for this problem consists of a principle diagonal of the inverse of the square root of the correction factors. Transformation of the data by this matrix will result in generalized least squares parameters which are "BLUE."

The matrix used to transform the data for heteroscedasticity is:

$$Z = \begin{bmatrix} 1/\sqrt{K_1} & 0 & 0 & 0 & 0 \\ 0 & 1/\sqrt{K_2} & 0 & 0 & 0 \\ 0 & 0 & 1/\sqrt{K_3} & 0 & 0 \\ 0 & 0 & 0 & 1/\sqrt{K_4} & 0 \\ 0 & 0 & 0 & 0 & 1/\sqrt{K_5} \end{bmatrix} \qquad (14)$$

where

K represents the correction factor.

Corrected R^2

R^2 is recognized as providing an overall index of how well the dependent variable can be explained by all the independent variables. As additional regressors are added to the model, the R^2 value indicates how helpful they are in explaining the variation in the dependent variable by noting how much they cause an increase in R^2.

But, R^2 is dependent upon the number of independent variables included in the regression model. As more independent variables are added to the regression equation, R^2 can never lower and is likely to raise. The inclusion of an irrelevant regressor will increase R^2 somewhat. Thus, it is often desirable to correct R^2 for the number of variables included in the model. Corrected R^2, is defined as:

$$\text{Corrected } R^2 = 1 - [\{1-R^2\}\frac{T-1}{T-K}] \qquad (15)$$

where

T = the total number of observations,

K = the total number of variables including the intercept, and

R^2 = the model's R^2 value before correction.

CHAPTER III

ESTIMATING THE ECONOMIC THRESHOLD LEVEL OF LONE STAR TICKS ON PREWEANER CALVES

Introduction

Identification of the pest population level at which the amount of damage caused by a pest is equal to the cost of control is essential for economic analysis. The economic injury level (EIL) is that population density level at which the damage is equal to the cost of control. The economic threshold level (ETL) is the population density level at which the adopted control measure is to be initiated to prevent the population density level from reaching the EIL (Figure 2). If the adopted control measure is instantaneously effective, then the ETL and EIL occur at the same population density level (Headley, 1972). The difference between the ETL and EIL depends upon the type of control measure used and the time required for that control measure to take effect.

Referring to economic injury levels, Poston et al. (1983) state "The concept serves as the economic foundation in decision-making processes," and "...economic injury levels have often been the weakest component in management programs. Very few firm, research-based EIL's have been established." The objective of the research reported in this chapter is to estimate an economic threshold level of the lone star tick on preweaner Angus (Bos taurus) calves.

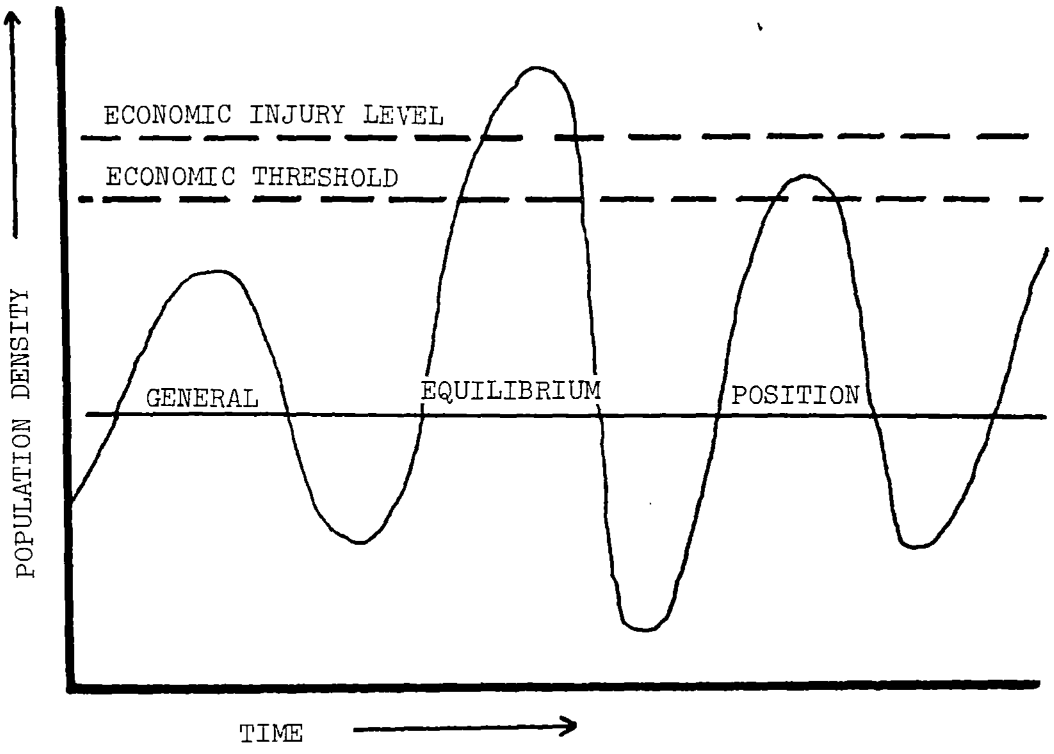

Figure 2. Graph Illustrating the Relationship Between a Theoretical Anthropod Population and the Economic Threshold and Economic Injury Levels

Development of Biological Data

Four types of information are required to identify an economic threshold level. They are control costs, product market value, proportionate injury per individual pest, and product response to injury (usually measured as a reduction in yield or quality) (Stone and Pedigo, 1972). Headley (1972) identifies the ETL by utilizing these determinants to establish the damage, pest population and time functions. The present study employs the above determinants and functions (with the exception of the time function) through the stages designated in Figure 3. It is assumed that the effect of the acaricide on the tick is instantaneous. Thus, a time function is not used. This simplifies the process of identifying the ETL for livestock.

Several practical problems are encountered with livestock that make it difficult to identify the ETL. For example, livestock are relatively expensive experimental subjects. In addition, a study of livestock under range conditions is complicated by the mobility of the animals and the inability to control extraneous factors. Then again, a study involving livestock under laboratory conditions is likely to fail to simulate vital pest-host interactions. Thus, a study was designed to identify the ETL for the control of lone star ticks on preweaner calves under range conditions.

The experiment was conducted on 62 acres of an improved pasture which is part of a privately owned ranch in the Ozark Mountain region (Figure 1). The bermuda grass/tall fescue pasture was sprayed with an acaricide and all wooded sections of the pasture were mechanically

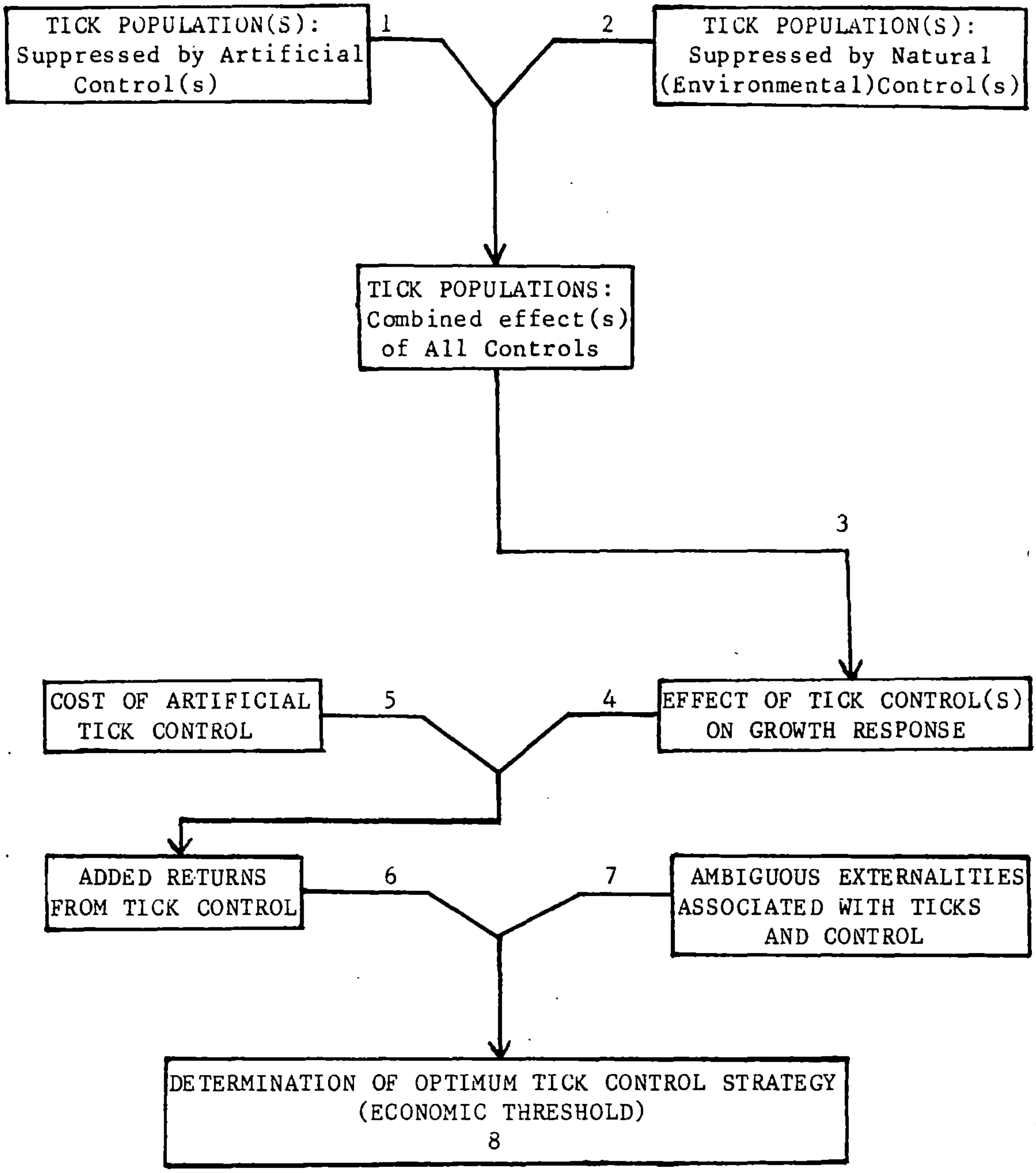

Figure 3. Stages by Which the Economic Threshold Level is Identified

cleared to provide a tick-free foraging environment. The absence of ticks was verified by the periodic use of attractant traps and by frequent examination of both cows and calves for attached ticks.

Factors other than dam heredity and tick numbers per calf were constant for all cow-calf pairs. The experiment was replicated over a two year period. Thirteen cows were included in the first year and 13 in the second. The cows were relatively homogeneous and typical of those in the region. They were artificially inseminated such that all calves had the same sire. The cow-calf pairs were assigned randomly to either a tick free (control) group or a tick infested (treatment) group. Alternative numbers of ticks were "planted" on the cows and calves in the treatment group. All calves were weighed in 28-day intervals. Each interval was considered a season. Thus, influences on calf growth resulting from differences in weather and pasture quality could be isolated. A total of 11 seasons of data were collected over the two sets of time periods.

Damage Model

In the absence of environmental shocks, the rate of gain of preweaner calves is relatively constant (National Academy of Science, 1984). Thus, the rate of gain achieved during each of the seasons was used as the dependent variable. Tick counts on the infested cattle averaged 60.4 ticks per head per season with a standard deviation of 35.8 ticks per head per season and a range of 3 to 150 ticks per head per season. The following regression model was used to estimate the influence of ticks on rate of gain for the preweaner calves.

$$Y = f(X, S_i, XS_i) + e \qquad (1)$$

where

Y = the rate of gain in pounds per animal per day,

X = the number of lone star ticks attached ($X = 0,1,2,\ldots,150$),

S_i = seasonal dummy variables ($i = 1,2,3,\ldots,11$),

XS_i = the interaction between ticks and season,

e = the stochastic error term.

Because weight gains were taken from the same animals every 28 days, correlation between observations from one season to the next could be expected. Autocorrelation estimates were identified by using the Prais-Winsten Two Step method (Johnston, 1984) described in Chapter II. The data were transformed to provide efficient estimates of the regression coefficients. Linear, quadratic, and semilog functional forms were used (Goldberger, 1964). All regression coefficients on the season by tick interaction terms (XS_i) were insignificant for all functional forms and thus were dropped.

The semilog and linear forms are presented. The resulting coefficients of the regression model for the semilog form are listed in the left-hand portion of Table I. The regression coefficient on the tick number variable is -0.0747. This indicates that, for example, an average of 50 lone star ticks attached over the 100 day tick period which normally occurs from mid-March through late-June can reduce weight gain by 29 pounds per calf.

The resulting coefficients of the regression model for the linear form are listed in the right-hand portion of Table I. The regression coefficient on the tick number variable is -0.0039. This indicates that, for example, an average of 50 lone star ticks attached over the 100 day period can reduce weight gain by 19.5 pounds per calf.

TABLE I

DAMAGE MODELS DEVELOPED FROM BARNARD'S DATA FOR ESTIMATION OF ECONOMIC THRESHOLD LEVELS[a]

	SEMILOG MODEL	LINEAR MODEL[b]
Regression Parameter	Estimated Regression Coefficient(lbs)	Estimated Regression Coefficient(lbs)
Intercept	1.7919(14.04)	1.7857(14.37)
ln(Ticks)	-0.0747(-3.71)	
Ticks		-0.0039(-3.68)
Season 1	0.5337(3.22)	0.4739(2.82)
Season 2	0.6482(3.95)	0.5844(3.53)
Season 3	0.7563(4.61)	0.8036(4.90)
Season 4	-0.0506(0.31)	-0.0431(-0.26)
Season 5	0.1135(0.69)	0.0803(0.49)
Season 6	0.1683(1.00)	0.0982(0.59)
Season 7	0.3397(2.04)	0.2834(1.72)
Season 8	0.1709(1.03)	0.1332(0.82)
Season 9	0.6712(4.18)	0.6833(4.29)
Season 10	0.3410(2.39)	0.3178(2.19)
DF = 109	$R^2 = 0.9598$ CORRECTED $R^2 = 0.9553$	$R^2 = 0.9552$ CORRECTED $R^2 = 0.9502$

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[a] The values listed within parenthesis are 't' values.

[b] Linear working model: ADG = 2.0962 - 0.0039(X)

Tick damage has been reported as has having a linear relationship to tick numbers in both European (Little, 1963) and Brahman X European cattle (Turner and Short, 1972). Following with previous literature, it is assumed within this study that the relationship between tick damage and tick numbers is linear.

Table II contains estimates (for the linear form) of the cost of the damage inflicted on preweaner calves over the 100 day tick season. The cost is included for alternative levels of infestation at alternative calf prices. For example, an average attachment of 50 ticks over the 100 day season would cost $15.51 per calf if calf prices are $80/cwt.

Treatment Costs

Tick control consists of both cattle handling and acaricide (pesticide) application costs. Cattle gathering and handling costs vary with pasture size, stocking rates, pasture condition and terrain. Three pasture sizes (80, 160, and 240 acres) and three pasture conditions were assumed to estimate treatment costs. The three pasture conditions include

1. well developed 'good' pasture which has little to no brush or gullies,
2. 'poor' pasture which has a density of brush per acre at greater than 30 percent and a density of greater than one gully per 10 acres, and
3. 'average' pasture which is between 'good' and 'poor'.

Stocking rates typical for the region were assumed.

TABLE II

ESTIMATED DAMAGE (LINEAR FORM) INFLICTED BY LONE STAR TICKS ON PREWEANER CALVES OVER THE 100 DAY TICK SEASON

Number of Female Ticks	Value of Calf (@ $70/cwt)			
	$60	$70	$80	$90
	($/calf)			
25	5.81	6.78	7.75	8.72
50	11.63	13.57	15.51	17.44
75	17.44	20.35	23.26	26.17
100	23.26	27.14	31.01	34.89
125	29.07	33.92	38.77	43.61
150	34.89	40.70	46.52	52.33

Three types of acaricide were considered based on their cost effectiveness ranking established by Barnard and Jones (1981). Dioxathion, Toxaphene-Lindane and Stirofos were identified as the most cost effective acaricides of the eight currently available for use. Their cost effectiveness ranking was based upon the cost of treatment as well as the percent control. Average percentage control of Dioxathion, Toxaphene-Lindane and Stirofos were rated at 95, 94 and 98 percent, respectively.

The combined costs of cattle gathering and treatment application are summarized in Table III (see Appendix A for development of values). The cost of each acaricide over the three pasture sizes at each of the three conditions is included. The cost estimates are based upon the assumption that the producer will apply ten treatments per head during the 100 day tick season.

ETL Analysis

Figure 4 provides a graphical representation of the value added to a preweaner calf weighing 400-500 pounds during the tick season (100 days):

1. without ticks or control,
2. with the damaging effects of ticks for alternative numbers of ticks but without control,
3. less the average cost of controlling with Stirofos when ticks are not present, and
4. with ticks and Stirofos control.

Line A represents the value added in the absence of ticks. The distance between line A and line B represents the average cost of

TABLE III

TOTAL TREATMENT COSTS[a] FOR A COW-CALF UNIT DURING THE TICK SEASON[b]

Pasture Conditions[c]	Acaricide	- - - Pasture Size (Acres) - - - 80	160	240
GOOD	Dioxathion	5.85	6.74	6.74
GOOD	Stirofos	7.87	8.76	8.76
GOOD	Toxaphene-Lindane	4.71	5.60	5.60
AVERAGE	Dioxathion	6.74	8.54	9.44
AVERAGE	Stirofos	8.76	10.56	11.45
AVERAGE	Toxaphene-Lindane	5.60	7.40	8.29
POOR	Dioxathion	8.54	11.22	13.91
POOR	Stirofos	10.56	13.24	15.93
POOR	Toxaphene-Lindane	7.40	10.08	12.77

[a] Total seasonal treatment cost per cow-calf unit (TC) is defined as: TC = (2 head) X (10 treatments) X (cost of round-up per head + treatment cost per head). Values for the cost of round-up per head and treatment cost per head are listed in Appendix A.

[b] Values may differ due to rounding.

[c] Pasture Conditions: GOOD - Improved pasture or land with little to no brush and gullies; AVERAGE - Land containing less than 30 percent brush coverage and no more than one gully per 10 acres; POOR - Land containing greater than 30 percent brush coverage and more than one gully per 10 acres.

control using Stirofos. Curve C represents the value added to tick infested calves that are treated for alternative levels of infestation, less treatment costs. Curve D indicates the value added to a tick infested calf with alternative numbers of ticks. As noted, Stirofos is only 98 percent effective.

The distance between each set of curves indicates a difference in returns to the beef producer due to varying management or environmental factors. The distance between A and D indicates a loss of beef returns caused by ticks at alternative levels of infestation if control measures are not taken. The distance between A and B represents the cost of control. The distance between A and C indicates the loss resulting from ticks at alternative tick levels when control measures are taken. The distance between C and D indicates the returns to the control measure above the cost of control for alternative levels of infestation. Losses resulting from the ticks that survive the acaricide applications are indicated by the distance between B and C.

Economic Threshold

If acaricides were 100 percent effective, the ETL would be at the point at which lines B and D intersect (Figure 4). Therefore, the damage caused by the tick population unaffected by the acaricide treatments must be accounted for. To adjust the ETL for this control slippage, the pest population was determined for the acaricide as though it were 100 percent effective. Then the number of pests represented as the ETL was then multiplied by the amount of slippage. The result is subtracted from the ETL at 100 percent. The ETLs for

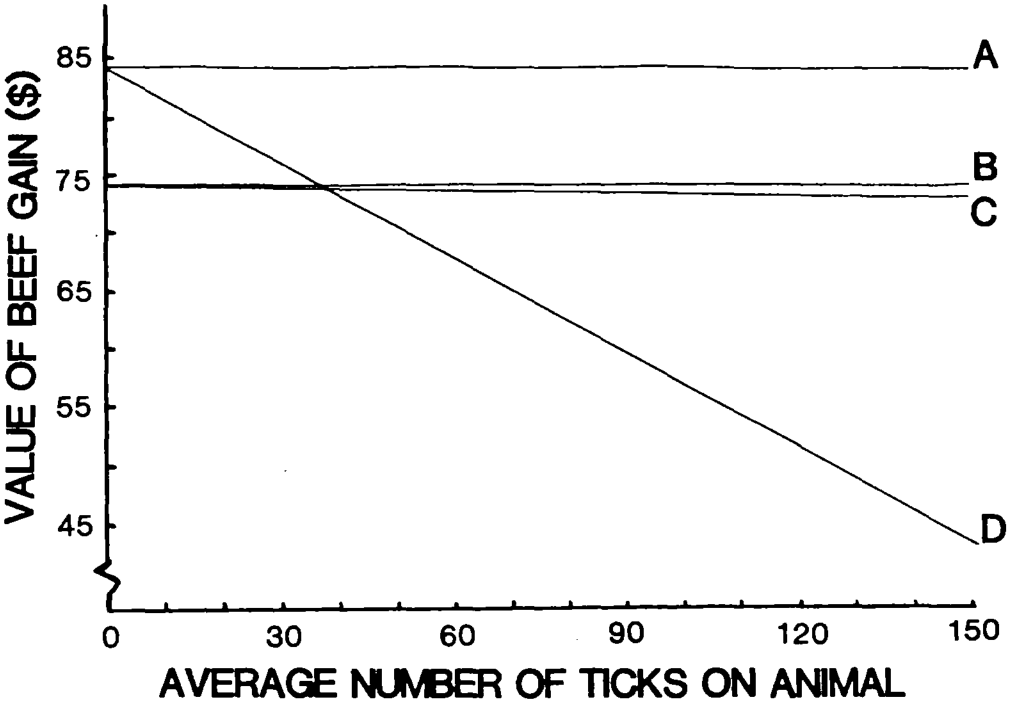

Figure 4. Graphical Representation Used to Identify the Economic Threshold Level Using the Linear Form

are 29.8, 38.0, and 25.5 for Dioxathion, Stirofos, and Toxaphene-Lindane, respectively. Thus, a constant attachment rate of 26-38 ticks over the tick season is estimated to cause damage equal to the estimated control costs.

Ranking of Acaricides

The acaricides were ranked according to their cost and percent effectiveness with respect to tick damage and returns to beef gains. Curve C (value of beef with ticks and control) can be compared across acaricides to identify cost efficiency. A curve C_K (K = D, S, or T-L; indicating the acaricide used) was constructed for each acaricide and presented along with line A in Figure 5. The most cost efficient acaricide will have the least amount of area between lines A and C_K. Given the data, a cost efficiency ranking places Toxaphene-Lindane, Dioxathion, and Stirofos in descending order.

Summary

Analysis of the response of preweaner calves to alternative levels of lone star ticks was conducted. The estimated responses were used in conjunction with various control costs (using acaricidal control methods) to derive estimated values for ETLs. Thus, a tick population density range at which expected damage equals control costs has been estimated. An extension of the study identifying the optimal control package using alternative control practices is presented in Chapter V.

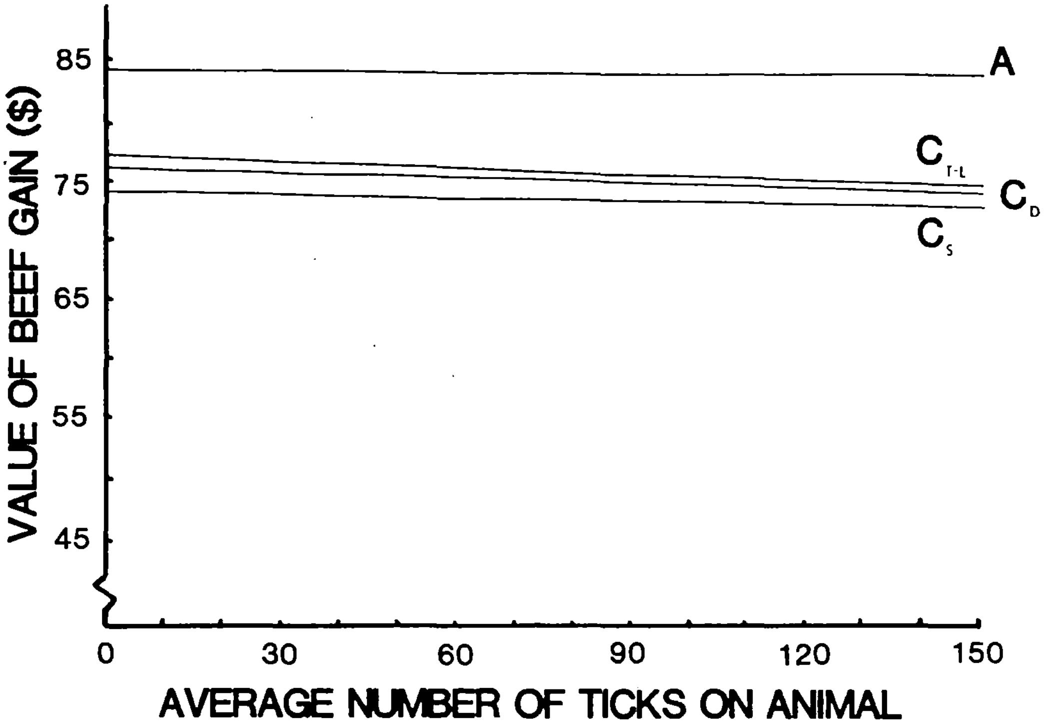

Figure 5. Graphical Representation Used to Identify Acaricide Efficiency of the Linear Form

CHAPTER IV

ESTIMATING THE INFLUENCE OF LONE STAR TICKS ON THE GROWTH OF STOCKER CATTLE

Introduction

In the previous chapter, results of a study specifically designed to determine the damage caused by lone star ticks on preweaner calves and the influence of pesticide control measures were presented. This chapter includes a review of biological studies of lone star ticks and a description of the study from which data are used to estimate the influence of lone star ticks on the growth of stocker cattle. These data are used to generate regression estimates which are presented. Thus, the general objective of this chapter is to present a discussion of alternative measures of lone star tick control, and to identify additional production parameters essential for conducting a comprehensive economic analysis which considers alternatives to acaricides for the control of lone star ticks.

Lone Star Tick Control

Hoch et al. (1971b) investigated the impact of several control measures for the lone star tick. They concluded that several control approaches can considerably reduce all stages of the lone star tick in treated areas. Control measures considered were:

1. clearing of undergrowth vegetation through mechanical means,
2. clearing of undergrowth vegetation through mechanical means, plus acaricidal applications,
3. the use of acaricides with existing vegetation,
4. clearing of undergrowth vegetation through mechanical means, plus the use of herbicides, and
5. the use of herbicides with existing vegetation.

They concluded that because larvae are very susceptible to the various treatments, it might be possible to reduce resident tick populations to insignificant numbers within several years. Only the incursion of wide-ranging hosts would re-infest the treated areas. However, even if this did occur, it may not be possible for new populations to become established since habitat conditions might be unfavorable for eggs and/or larvae. Their conclusion indicated that pesticidal applications may be necessary only on rare occasions. However, they did not conduct an economic analysis of the alternatives.

Byford (1983) compared stocker cattle gain under varying management strategies for control of lone star ticks. Control strategies in combination and individually were:

1. habitat modification and pasture forage improvement,
2. introducing Brahman cattle (host resistance), and
3. selective use of acaricides (chemical control).

The literature on each of these management strategies with reference to the economic analysis utilizing data derived from the stocker study is quite expansive. For this reason, the literature for each management strategy will be dealt with individually. In all cases no economic analyses were conducted for any of the studies presented.

Habitat Modification and Pasture Forage Improvement

A study conducted by Hoch et al. (1971a) found that after 3 years of treatment, the "herbicide and clearing" treatment reduced larval populations by 90 percent on a seasonal basis when this treatment was compared to a control area. Based on their data it seems that populations of the lone star tick within woodlots can be reduced by vegetative modification. Soil moisture and/or relative humidity seem to be the most important elements required for tick survival. Higher temperatures in the treated areas are factors which also appear to be of importance because a correlation between this parameter and humidity and soil moisture appears to normally exist.

A study was conducted in an effort to evaluate various integrated procedures for control of lone star tick in recreational areas by Clymer et al. (1970). Their control methods used various mechanical and chemical treatments in suppressing lone star tick populations in or around simulated recreational areas. They found that acaricide-treated plots proved most effective on a short-term basis, but herbicide-treated plots had the added features of decreasing animal utilization and thereby reducing the number of possible hosts present in the area. An urgent need for an integrated tick control program adaptable throughout the United States as well as the Ozark Region was hypothesized. The treatments were ranked for efficacy as follows: mechanical clearing plus an acaricide, acaricide only, mechanical clearing plus a herbicide, herbicide only, and mechanical clearing only. Some reduction in tick numbers was obtained in all the plots which were mechanically cleared. The plots receiving clearing and acaricide demonstrated the most effective control of lone star tick. The application of acaricides to unaltered vegetation provided more effective control than the herbicides applied in the same manner. However, the herbicide has the added feature of "cleaning up" the area and increasing its productive use. An integrated program consisting of one or more means of environmental alteration by mechanical and/or chemical treatment appeared to be possible in area tick control. They mentioned that this same program could be altered and applied to area control in pastures too.

Host Resistance

A change in the level of host resistance of a herd can be achieved by either increasing the average resistance level or by reducing the decline of resistance during times of nutritional stress. The present study considers the alternative of increasing the average resistance level of the herd by introducing the Brahman (*Bos indicus*) strain. Although known to have poor performance in the winter and produce lower grade meat, the Brahman cattle are well recognized for their inherent adaptability to hot-humid areas, length of productive life, ease of calving and resistance to external parasites. Strother et al. (1974) tested the resistant ability of purebred Brahman, purebred Hereford and F_1 Brahman X Hereford crossbred cattle to lone star tick. Using four cattle of each breed they found that purebred Hereford steers were considerably less resistant than both the Brahman X Hereford crossbred steers and the purebred Brahman steers.

Garris et al. (1979) compared the lone star tick populations on both purebred breeds under field conditions. They also measured the effects of the two breeds of cattle on the biotic potential of the tick. They observed that Brahman animals carried fewer ticks of all stages than Herefords agreeing with American (Strother et al., 1974; Stacey et al., 1978; Williams et al., 1977) and Australian (O'Kelly and Spiers, 1976; Wagland, 1975, 1978a, b) researchers. They noted that the effect of the Hereford breed on the biotic potential of lone star tick was not at a level as great as occurred with Brahmans.

The most economical cattle breed placed into tick infested pastures is not necessarily the most resistant animal (pure Brahman). Certain production characteristics are considered to be inversely related to tick resistance and Brahman content. When compared to a pure European breed (Bos taurus), the profitability of the following Brahman characteristics on pasture is questioned:

1. grade quality,
2. average daily gain,
3. seasonal stress and the effects on gain, and finally
4. price differential received at the sale barn because the cattle generally produce a lower grade meat.

These characteristic differences have been studied and provide the following results.

Grade Quality. Cundiff et al. (1982) report that feedlot gains of half-blood Brahman steers when compared to Hereford X Angus crossbreeds are particularly less efficient in grade quality due to their lack of marbling. Another study conducted at the Texas

Agricultural Experiment Station (Lusby) compared yield grades of Hereford, Brahman, and Hereford X Brahman (50 percent) crossbreed stockers weighing in the 700 to 800 pound range. Their results show that Hereford, Brahman, and Hereford X Brahman crossbred were given average yield grades of 3.15, 2.45, and 2.90, respectively, with the consumer preferring the higher grade. There is a tradeoff in grade quality when the Brahman strain is introduced into a herd.

Average Daily Gain (ADG). The ADG of one breed being lower than the ADG of another does not necessarily imply that the breed with the lower ADG would require greater costs. This is because the ADG measurement ignores the amount of feed required for the resulting gain. Further, Brahman cows are generally heavier and require more energy for maintenance per cow unit. Therefore, ADG is not necessarily the best performance measurement to be used when comparing between breeds. Feed efficiency measurements identify the amount of feed required for gain which allows more of a pure comparison between breeds. The problem with feed comparison studies is that measurements of feed intake require a feedlot setting where feed intake is relatively easy to record. Attempting to identify feed efficiency of cattle on pasture is difficult. The obvious problem that a researcher deals with is getting an accurate measurement of feed intake while the animal is foraging. Since data of this type is not available, for the purpose of this study a comparison of ADGs between breeds is made.

A study conducted at the Texas Agricultural Experiment Station (Lusby) identified ADG for Hereford, Brahman and Hereford X Brahman (50 percent) crossbred cattle while the cattle were on a growing ration. Their results show that the ADG for Hereford, Brahman, and

Hereford X Brahman cross are 2.36, 2.04, and 2.24 pounds, respectively. This indicates that the expected loss in ADG caused by introducing the Hereford-Brahman strain versus Hereford is 0.12 pounds. Another study (Babcock and Franke, 1978) conducted in Louisiana in 1978 identified the feedlot performance of eleven types of pure and crossbred cattle during a 200 day period. Their results show that the ADG for Hereford, Brahman, and Hereford (3/8) X Brahman (5/8) crosses are 2.78, 2.24, and 2.66 pounds, respectively. These results agree with the Texas study in that ADG declined by 0.12 pounds for the Hereford X Brahman crossbred cattle relative to the pure Hereford.

A comparison of the performance of these breeds in a pasture setting is undocumented, but it is reasonable to assume that the ADG's while not measuring the same, would be related in the same fashion as indicated above.

Seasonal Stress. Several studies have been conducted to compare the seasonal effects to British, Brahman, and British X Brahman crossbred cattle. Boyles et al. (1984) reported that a group of straightbred Angus steers gained 0.21 pounds per day more than Brahman X Angus steers during a 184 day winter feeding trial. It was assumed that the stress caused by winter's lower temperatures affected those cattle with the Brahman strain more then those pure British breeds.

A study conducted in Louisiana (Franke, 1978) compared the seasonal effects of Hereford, Brahman and Hereford (3/4) X Brahman (1/4) crossbred cattle. These cattle were wintered on pasture and given 5 pounds of supplement per head per day until April, then placed on improved grasses. Results indicate that during the six months of the winter period Hereford, Hereford X Brahman and Brahman gained an average of 126, 92 and 81 pounds, respectively, indicating that the Hereford strain is better equipped to handle the winter temperatures. The six month summer period reversed the breed gains. During this period Brahman, Hereford X Brahman, and Hereford gained 209, 192 and 169 pounds, respectively, indicating that the Brahman strain is showing its tolerance to heat. By summing the two periods to identify an annual gain between the breeds, Hereford, Brahman, and Hereford X Brahman crosses gained an average of 295, 290, and 284 pounds, respectively during the year. The annual performance indicates a very slight difference between breeds.

Therefore, studies indicate that Brahman and their crosses do not do as well as pure British breeds during the winter months, but gain more rapidly during the summer months. Alternatively, the British breeds do not gain as well as the Brahman during the summer months, but gain better than Brahman during the winter months. Thus, a producer's decision as to which breed to utilize might depend on the season and whether or not winter wheat pasture is an important component of the resource base.

Price Differential. A study conducted in the Fall of 1981 in Kansas (Lambert 1982, and Lambert et al., 1983) compared prices received at the sale barn according to breed. Brahman and Longhorn crosses were grouped together. Results indicate that there is a price difference between Hereford steers and the group containing Brahman cattle. The pure Herefords averaged approximately $1 per hundred weight or 2.4 percent more than the Brahman steer group did. It was pointed out though that the season in which cattle are being sold may have an impact on the price of a specific breed. Thus, if this is the cause of the price difference in Lambert's study, then the Brahman cattle would naturally sell at a lower price because of their low tolerance to winter's cold.

The final choice of average herd resistance or Brahman content is therefore a compromise that takes into account these characteristics, as well as the availability and effectiveness of other tick control measures.

Chemical Control

Reports by Mount et al. (1968, 1970) and Clymer et al. (1970) have demonstrated that a number of organic phosphate pesticides are highly effective against lone star ticks. Mount et al. (1968) reported that a number of these organic phosphate materials are more effective than DDT for control of lone star ticks. Lindane (USDA 1963, 1966) and other chlorinated hydro-carbons have also produced suitable results when applied for tick control.

Barnard and Jones (1981) report that when acaricide applications for control of the lone star tick are a part of the tick control program, they are repeated at 3 to 5-week intervals between March and September in southeastern Oklahoma. But, with no substantive basis existing in regards to the choice of acaricide to be used by the individual producer or for the timing of treatments; producers have generally relied upon empirical observation and word of mouth to determine these factors. Therefore, a study was conducted by Barnard and Jones (1981) for the purpose of determining the field efficacy of several Environmental Protection Agency (EPA)-registered and USDA-suggested acaricides which were then used to control the lone star tick on cattle in southeastern Oklahoma. These efficacy data and current costs were then used to determine the cost effectiveness of each acaricide. Data from this study can help determine the role of acaricides in integrated control programs for lone star ticks. Cost effectiveness of these materials was determined by ranking them in descending order of percent control at 24 hour and at 7 days posttreatment and then ranking the cost of treatment per head for each acaricide in ascending order. Dioxathion and toxaphene-lindane were the most cost effective of the acaricides studied, and ronnel was the least cost effective. Spray applications of all acaricides killed the majority of ticks attached to the host at the time of treatment. Nevertheless, no treatment provided satisfactory control at 7 days post-treatment. The data indicates that reinfestation of cattle by the lone star tick commences shortly after treatment and that little or no residual acaricidal activity persists after 1 week. This infers that these acaricides are efficacious in the field in southeastern Oklahoma for much shorter periods than has been observed elsewhere (Drummond and Medley, 1965; Drummond et al., 1960; and Drummond and Gladney, 1978).

Factors that influence acaricide efficacy are climate, persistence of the acaricide on the hair coat, method of application (Wharton et al., 1970), cattle behavior, and tick reinfestation pressure. Persistent rainfall can dislodge acaricide residues within a short time after application. Moreover, cattle frequently immerse themselves in water impounded in stock tanks and ponds and in streams during the daytime, an activity that increases with the onset of hot weather and which hastens the removal of acaricide residues from the hair coat and skin.

Presentation of Study Analyzed

The livestock industry in much of the Ozark Mountain region is represented by producers pasturing tick-susceptible English breeds of cattle on tick-infested rangeland. These cattle generally receive no treatment for lone star ticks.

Although current recommendations for lone star tick control on livestock have been shown to effectively reduce and control severe infestations, the feasibility and practicality of these treatment regimens have not been demonstrated. A study conducted by Byford (1983) generated data which could be used to estimate stocker cattle response to habitat modification, pasture forage improvement, host resistance, and acaricides.

The influence of these management components against lone star ticks was evaluated with regard to the effects on populations of the free-living and parasitic life stages within the management areas, and animal health and performance in comparison to the management system. In addition, forage production and the frequency of white-tailed deer utilization within the management area were monitored. The deer act as hosts reintroducing the tick to areas which have been cleared of their presence.

Stocker cattle growth under twelve separable tick control programs was evaluated (Figure 6). These control procedures included purebred Hereford or Hereford X Brahman (50 percent) crossbred cattle on native or improved pasture, with or without acaricide applications. The study area was divided into four contiguous tracts of land, 225 acres each. Two tracts were designated for native pasture while the remaining two were prepared as improved pasture. Land-moving equipment and herbicides were used to eliminate trees and brush for the "improved" pasture. This resulted in 90-95 percent reduction of brush and trees within these tracts. The improved pastures were seeded with Kentucky 31 tall fescue (Festuca arundinacea), and perennial ryegrass (Lolium perenne). Both of these forages were planted at a rate of 17.9 pounds per acre. An additional 10 acres within the improved pasture areas were seeded with arrowleaf clover (Trifolium vesiculosum) along the side of the pastures bordering the unimproved study units at a rate of 19.6 pounds per acre. These improved pastures were fertilized the year preceding the study's commencement. Acaricide applications to the cattle consisted of two concentration rates of the experimental acaricide Amitraz^R [N'-(2,4-Dimethylphenyl)-N-{{2,4-Dimethylphenyl)imino}methyl} -N-methylmethanimidamide] at selected times during the tick season. Amitraz^R was mixed at concentrations of 0.0125 and 0.0250% active ingredient.

Data were collected over the 1981-82 two year period at approximately 7 day intervals. In 1981, data collection occurred from June 10 to August 13 while in 1982, collection occurred from May 4 to August 10. Data collection was preceded by taking pre-study

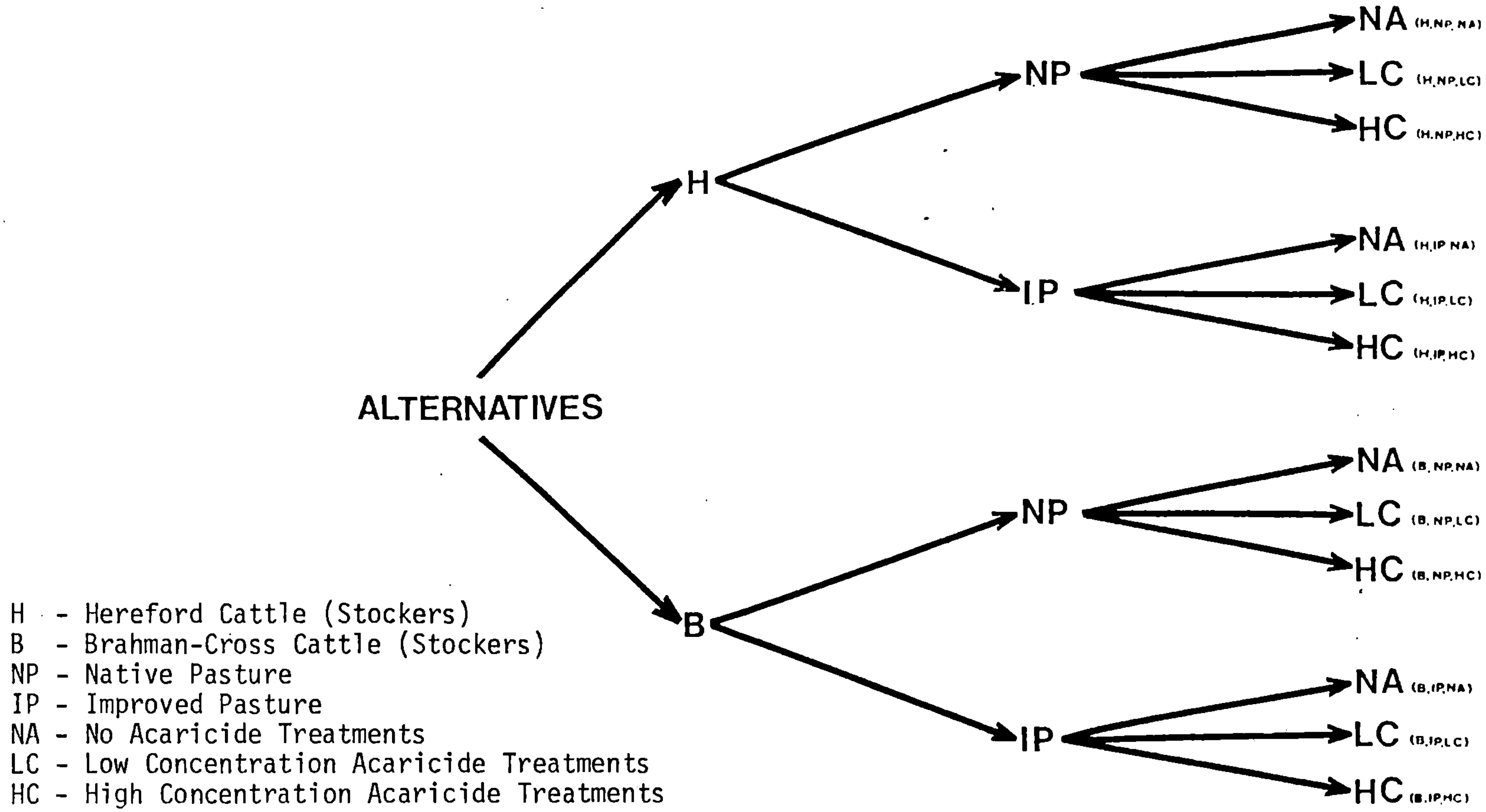

Figure 6. Alternative Tick Control Programs Evaluated in the Stocker Study

observations during 1980. During the 1980 season, a number of parameters were measured without disturbance for collection of base-line data. Parameters such as tick population and activity, forage production, and wildlife utilization were recorded. During 1981 and 1982, 32 purebred Hereford heifers, averaging 569 pounds, and 32 F_1 Brahman X Hereford heifers, averaging 500 pounds, were purchased and divided into four groups of 16 animals with each breed represented on both improved and unimproved pastures. For acaricide treatments the cattle in each study unit were divided into two treatment groups and a single control group consisting of four to six animals each. The cattle were not treated according to a schedule. Control measures were individually taken when the infestation level on each of the treatment groups reached approximately 50 percent of that on the control animals.

The results of these management strategies substantiated earlier studies (Wharton et al., 1969; Hoch et al., 1971a & b) indicating that lone star tick control is obtained with habitat modification and utilization of resistant cattle. Habitat modification of the study units by mechanical and chemical means produced a microenvironment unsuitable for lone star tick development, activity and survival. As a result of 90-95 percent overstory reduction and elimination of undesirable regrowth of brush and broadleaf plants, an increase in sunlight penetration theoretically caused higher temperatures and lower humidities to occur within the tick's microenvironment. Consequently, a reduction in the free-living and parasitic life stages as well as an increase in the productive capacity of the forageland was realized.

The study units receiving habitat modification yielded significantly fewer ticks than the wooded study units. Comparisons between these study units when Hereford cattle were utilized, demonstrated that the improved study unit yielded 88-94 percent fewer lone star ticks than the unimproved study unit. With Brahman X Hereford cattle inhabiting these study units, results demonstrated that the improved study unit supported 75-91 percent fewer ticks than the unimproved study unit.

The greatest influence on the free-living lone star tick population resulted from the combination of habitat modification and Brahman X Hereford cattle. Within the unimproved study units, the use of Brahman X Hereford cattle resulted in a 35-45 percent reduction of the lone star tick population when compared to the use of Hereford cattle. The number of lone star ticks collected from the improved study units demonstrated that the study unit pasturing Brahman X Hereford cattle supported 26-43 percent fewer ticks than the study unit pasturing pure Hereford cattle.

As a result of this vegetative alteration and utilization of Brahman X Hereford cattle, the parasitic life stage population was greatly affected. Periodic examination of cattle inhabiting these study units demonstrated that cattle pastured on the improved study units supported significantly fewer lone star ticks than those on the unimproved study units.

Model Development

The stocker study was not specifically designed to provide parameters essential for economic analysis. The data contain problems which were corrected through the statistical procedures described in Chapter II. For example, consecutive weighings from the same cattle during each year's study required a correction for first order autocorrelation. The data also required correction for heteroscedasticity caused by the nonsynchronous manner in which the observations were recorded.

The rate of daily gain achieved during each of the seasons was used as the dependent variable. The following regression model was used to estimate the influence of ticks, breed of cattle, acaricide treatments, and habitat modification and forage improvement on the rate of gain for stocker heifers:

$$Y = f(X, Z, P, A_i, S_j, XZ, XP, XA_i, ZP, ZA_i, PA_i) + e$$

where

Y = the rate of gain in pounds per animal per day,

X = the number of lone star ticks attached ($X=0,1, 2,...,150$),

Z = cattle breed dummy variable ($Z=1$ if Brahman; $= 0$ otherwise),

P = pasture dummy variable ($P=1$ if improved pasture; $= 0$ otherwise),

A_i = acaricide treatment dummy variable ($i = 1,2$) ($A_1 = 1$ if high concentration; 0 otherwise: $A_2 = 1$ if low concentration; 0 otherwise),

S_j = seasonal dummy variables ($j = 1,7$) ($S_j=1$ if Season j; 0 otherwise),

XZ = interaction term between ticks and cattle breed,

XP = interaction term between ticks and pasture,

XA_i = interaction term between ticks and acaricide treatments,

ZP = interaction term between cattle breed and pasture,

ZA_i = interaction term between cattle breed and acaricide treatment,

PA_i = interaction term between pasture and acaricide treatment,

e = stochastic error term.

Linear and semilog functional forms were used. Results from the semilog form indicated statistical insignificance for most of the terms. The estimates of the parameters for the full linear model, along with t statistics, are listed in Table IV as model number 1.

In the statistical analysis using model number 1, estimates for many of the variables are not significantly different from zero. The number of terms within the model was methodically reduced to produce varying estimates which could be compared. Thus, models 2-7 were estimated (Table IV).

In comparing models 1-7, estimates for the tick variable are consistently negative at -0.003 pounds per day or less, while their corresponding t statistics are insignificant. The negative sign is as expected. From a statistical standpoint a larger t-value for the estimate would be encouraging. Additional efforts to break the data down further (not reported) by periods in which ticks are active and periods where they are not, provided little change in regression estimates from tick active periods.

In an effort to identify the reasons for the lack of statistical significance of the regression coefficient on tick numbers the following arguments are provided:

1. The tick's active period is from mid-March to late-June. The study was conducted from June 10 to August 13, 1981, and May 4 to August 10, 1982. Weather and distance to the research site from

TABLE IV

ESTIMATED EQUATIONS FOR THE IMPACT OF TICKS AND SEVERAL OF THEIR CONTROL MEASURES ON THE AVERAGE DAILY GAIN OF STOCKER CATTLE UNDER RANGE CONDITIONS[a]

Explanatory Variable[b]	MODEL NUMBER						
	1	2	3	4	5	6	7
INTERCEPT	0.25669 (1.77)[c]	0.26182 (1.97)	0.22697 (1.81)	0.22025 (1.76)	0.20360 (1.62)	0.20869 (1.66)	0.18358 (1.63)
TICKS(X)	-0.00305 (-0.96)	-0.00260 (-0.84)	-0.00202 (-0.71)	-0.00185 (-0.65)	-0.00108 (-0.38)	-0.00134 (-0.48)	-0.00075 (-0.28)
BREED(Z)	-0.37381 (-0.59)	0.13895 (0.24)	0.23906 (2.39)	0.17451 (1.80)	0.26060 (2.86)	0.29421 (4.24)	0.30058 (4.38)
PASTURE(IP)	0.34331 (0.54)	0.00130 (0.00)	0.21773 (2.20)	0.15622 (1.63)	0.01291 (0.17)	-0.00493 (-0.07)	0.00181 (0.03)
CONC. ACAR(HC)	-0.31304 (-1.49)	-0.04520 (-2.04)	-0.04924 (-2.32)	-0.02060 (-1.25)	-0.01122 (-0.69)	-0.01415 (-0.93)	
DILUTE ACAR(LC)	-0.38251 (-1.86)	-0.02321 (-1.04)	-0.02605 (-1.20)	-0.00198 (-0.13)	0.00569 (0.37)	0.00398 (0.27)	
(X)x(Z)	0.00093 (0.51)	0.00154 (0.92)	0.00100 (0.67)	0.00106 (0.70)	0.00084 (0.55)		
(X)x(IP)	-0.00280 (-1.91)	-0.00281 (-1.93)	-0.00334 (-2.60)	-0.00316 (-2.45)			
(X)x(HC)	0.00066 (2.04)	0.00055 (1.97)	0.00058 (2.11)				
(X)x(LC)	0.00051 (1.79)	0.00037 (1.46)	0.00039 (1.54)				
(Z)x(IP)	0.34171 (1.51)	0.05313 (0.33)					
(Z)x(NP)	0.35799 (1.65)	0.00304) (0.03)					
(H)x(IP)	-0.03651 (-0.30)	0.02627 (0.23)					
(Z)x(HC)	0.00250 (0.06)						
(Z)x(LC)	0.02041 (0.50)						
(Z)x(NO)	-0.25317 (-1.92)						
(H)x(HC)	0.04989 (1.27)						
(H)x(LC)	0.06653 (1.72)						

TABLE IV (Continued)

Explanatory Variable[b]	MODEL NUMBER						
	1	2	3	4	5	6	7
SEA1	0.84725 (2.60)	0.83707 (2.69)	0.81239 (3.39)	0.89481 (3.75)	0.69935 (3.10)	0.74024 (3.48)	0.72269 (3.41)
SEA2	0.38889 (1.62)	0.30274 (1.34)	0.26503 (1.53)	0.31891 (1.86)	0.29817 (1.73)	0.31119 (1.82)	0.31076 (1.82)
SEA3	0.38156 (2.70)	0.38997 (2.77)	0.39726 (2.84)	0.43670 (3.14)	0.42476 (3.04)	0.43555 (3.15)	0.43554 (3.15)
SEA4	0.61677 (1.75)	0.47555 (1.41)	0.39168 (1.76)	0.43882 (1.97)	0.49184 (2.21)	0.48652 (2.19)	0.49667 (2.25)
SEA5	1.46476 (6.29)	1.38749 (6.30)	1.38910 (6.90)	1.53072 (8.00)	1.38051 (7.59)	1.41467 (8.28)	1.40001 (8.26)
SEA6	0.96160 (6.59)	0.96575 (6.70)	0.97746 (6.88)	0.1.06025 (7.69)	0.98459 (7.28)	1.00718 (7.82)	0.99906 (7.80)
SEA7	0.66573 (3.92)	0.66988 (3.95)	0.67762 (4.02)	0.73089 (4.40)	0.67730 (4.10)	0.69058 (4.22)	0.68551 (4.20)
R^2	0.765	0.762	0.762	0.757	0.752	0.753	0.752
CORRECTED R^2	0.752	0.752	0.753	0.749	0.745	0.746	0.746

[a] n = 452

[b] Variable definitions in alphabetical order: H is the dummy variable representing the Hereford breed; HC is the dummy variable representing the Higher Concentration of acaricide Amitraz^R used at 0.0250% AI; IP is the dummy variable representing the Improved Pastures; LC is the dummy variable representing the Lower Concentration of acaricide Amitraz^R used at 0.0125% AI; NO is the dummy variable representing the absence of acaricide use; NP is the dummy variable representing the Native Pasture; Sea1-Sea7 are the dummy variables representing the time periods in Seasons that data collection occurred; Z is the dummy variable representing the F_1 Brahman(Zebu) X Hereford breed.

[c] Numbers in parenthesis below coefficients are 't' statistics.

Stillwater, Oklahoma produced the major problems in controlling the pest earlier in its active period. Thus, the greater bulk of the tick's annual active period was missed by the study.

2. A tick free "control group" of cattle was not available for analysis. Thus, the data range is relatively narrow.

3. Tick attachment occurred naturally. Therefore, the tick counts represented the number of ticks attached on the day of the count, without knowledge of the length of attachment.

It is felt for these reasons, that the effect of tick attachment on the stockers is not realized from the data to achieve a highly statistically significant estimate. The study was not designed to identify the effects of ticks on beef, but to identify the effects of various control measures on the naturally occurring tick populations. The analysis does indicate significance of the various control measures and their degree of assistance to the stocker producers in eastern Oklahoma.

Thus, even though not exhibiting strong statistical significance, the estimates may be of practical significance and may be compared with the estimate presented in Chapter III. Note, that model 3 has a greater number of significant variables than the remaining models. Excluding the significance of the seasonal variables, models 5-7 indicate that only the breed variable is statistically significant at an alpha level of .05 percent. Model 4 indicates statistical significance for the tick-pasture interaction term. The statistical significance levels of model 2 are not as strong as those found in model 3. Therefore, model 3 is selected to describe the data set.

Campbell (1977) reported that 100 stable flies reduced feedlot cattle gains by 0.48 pounds per day. This estimate is very similar to the damage function estimated for ticks on preweaner calves (Chapter III). Also, if the twelve tick control strategies (Figure 6) are separately estimated from model 3 of Table IV, many of the resulting damage functions are relatively equal to the two previously mentioned. Thus, although the design of the stocker study data collection contained some short- comings, the regression estimates of model 3 are consistent with previous results.

Model Diagnosis

Model 3 identified in Table IV is used to separately identify the effects of twelve strategies for the control of lone star tick identified in Figure 6. The strategy effects are as follows:

1. Purebred Hereford on native pasture without acaricide treatments----> Y = 0.8408 - 0.0020(X).

2. Purebred Hereford on native pasture with the high concentration of acaricide treatment----> Y = 0.7915 - 0.0014(X).

3. Purebred Hereford on native pasture with the low concentration of acaricide treatment----> Y = 0.8147 - 0.0016(X).

4. Purebred Hereford on improved pasture without acaricide treatments----> Y = 1.0585 - 0.0054(X).

5. Purebred Hereford on improved pasture with the high concentration of acaricide treatment----> Y = 1.0093 - 0.0048(X).

6. Purebred Hereford on improved pasture with the low concentration of acaricide treatment----> Y = 1.0325 - 0.0050(X).

7. F_1 Brahman X Hereford crosses on native pasture without acaricide treatments----> Y = 1.0800 - 0.0010(X).

8. F_1 Brahman X Hereford crosses on native pasture with the high concentration of acaricide treatment----> Y = 1.0306 - 0.0004(X).

9. F_1 Brahman X Hereford crosses on native pasture with the low concentration of acaricide treatment----> Y = 1.0538 - .0006(X).

10. F_1 Brahman X Hereford crosses on improved pasture without acaricide treatments----> Y = 1.2976 - .0044(X).

11. F_1 Brahman X Hereford crosses on improved pasture with the high concentration of acaricide treatment----> Y = 1.2483 - 0.0038(X).

12. F_1 Brahman X Hereford crosses on improved pasture with the low concentration of acaricide treatment----> Y = 1.2715 - 0.0040(X).

Representation of each strategy's results from the data are graphically presented in Figure 7.

The trends identified in Figure 7, with a constant attachment rate of 90 ticks throughout the 100 day tick season, indicate:

1. The F_1 Brahman X Hereford crossbred cattle gained more than pure Herefords. This is expected due to the season the study was conducted.

2. In general, the low concentration of Amitraz^R was associated with higher gains then the high concentration of the same chemical. The high concentration may act as an irritant to the cattle as well as the ticks.

In the next chapter, the information obtained from this model and the preweaner calf model of Chapter III are incorporated into a comprehensive whole farm linear programming model to identify economically optimal production strategies when breed, pasture type, acaricide, tick effect, and alternative cropping enterprises are considered.

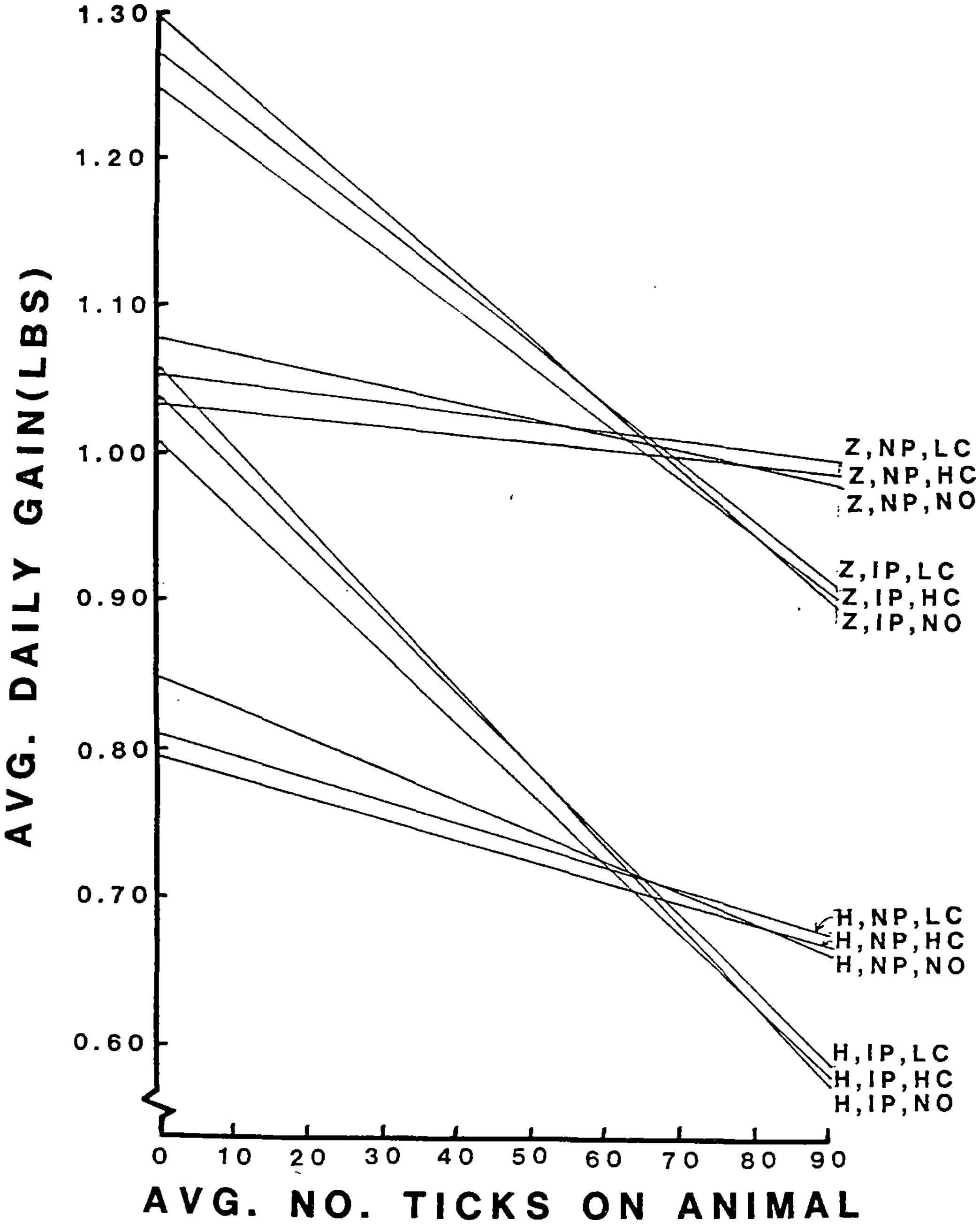

Figure 7. Graphical Results of the Tick Control Strategies Identified in the Stocker Study

CHAPTER V

WHOLE FARM STUDY

Introduction

The final stage of this study involves incorporating the coefficients identified in Chapters III and IV as representative of lone star tick damages on beef in a linear programming model. The objective function of the model is to maximize returns to a set of resources subject to imposed constraints. Alternative production enterprises considered within the model include:

1. cropping enterprises,
2. Hereford and Brahman-cross cattle fall and spring cow-calf enterprises,
3. Hereford and Brahman-cross stocker enterprises,
4. native and improved pastures,
5. use and non-use of acaricides, and
6. marketing activities to reflect alternative timing of sales of calves and stockers.

Figure 8 represents some of the alternatives available to producers confronted with lone star tick infestation. These steps can be taken in combination or independently.

This chapter reports on the construction of models used to compare the various production alternatives. The data are assigned to

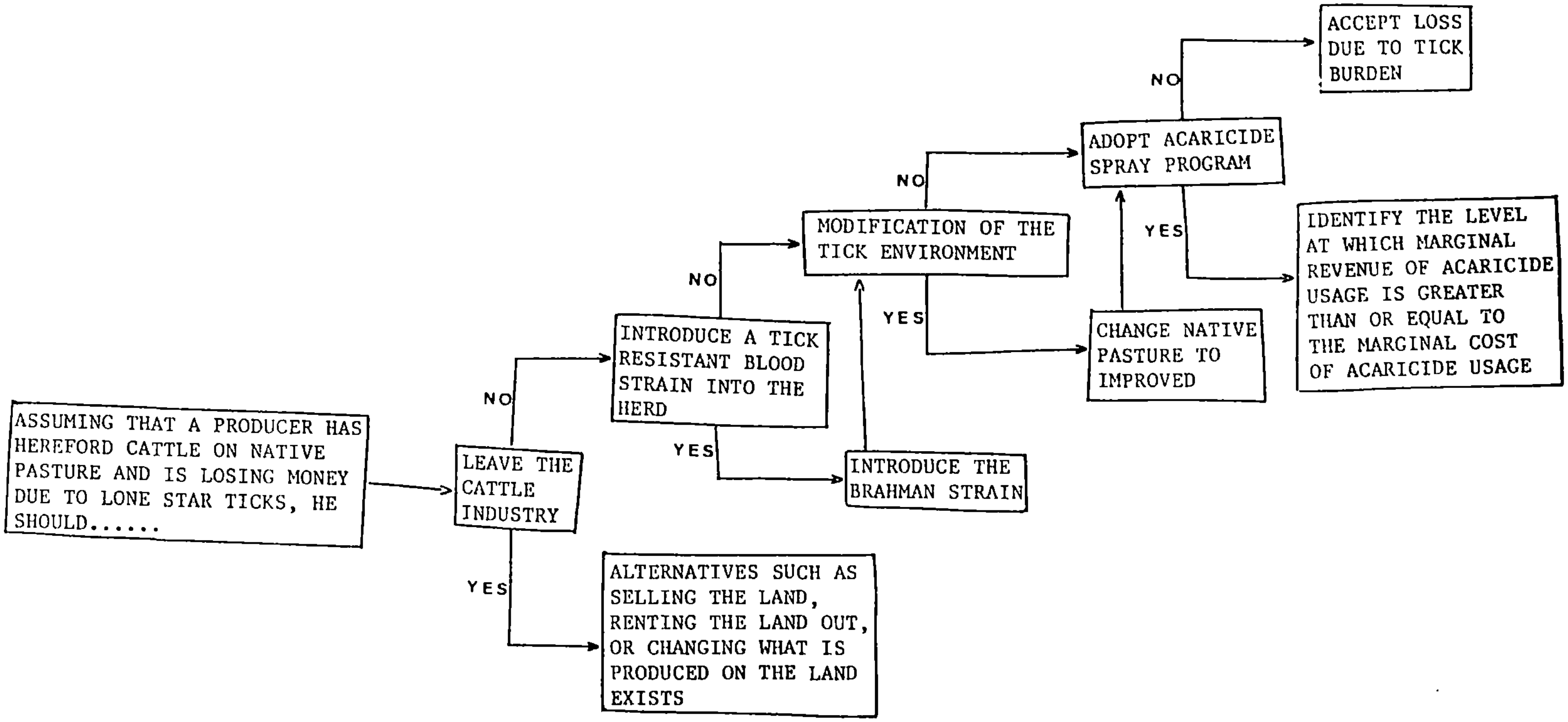

Figure 8. Stages Through Which a Producer can Control Lone Star Tick

several models representing alternative production strategies for producers confronted with tick infested range. The models are then analyzed and diagnosed.

Enterprise Budget Development

The representative area in this study is LeFlore County in Oklahoma. This county is used because it is fairly representative of the surrounding areas. The land base is primarily of the land class order Ultisol. The land is further classified to be in the great group Hapludults with the key soil represented as a Hartsells loam (Gray and Roozitalab, 1976). This land is used in cropland (77,148 acres), range (76,650 acres), pasture (129,523 acres), and forest (452,547 acres) (U.S. Department of Agriculture, 1970). The cropland is primarily seeded in wheat (15,000 acres producing an average of 35.6 bushels per acres), hay (43,600 acres producing an average of 1.44 tons per acre), and soybeans (13,000 acres producing an average of 14.4 bushels per acre) (Oklahoma Department of Agriculture, 1983).

Budgets for the various production alternatives were generated with the Oklahoma State University Enterprise Budget Generator (Kletke, 1972 and 1979) from base budgets which were developed for the southeast district of Oklahoma. The study's base budgets representing three cropping, four pasture and three livestock enterprises are included in Appendix B. The Oklahoma State University price vectors, equipment and machinery complements for that district were used when applicable. Production data and operating inputs were recorded by month with relevant names, prices, units, and item codes included.

The assumed resource base is representative of relatively small farm in the southeast district of Oklahoma (Walker and Minnick, 1977). The farm consists of 300 acres of land; 80 percent pasture (240 acres) and 20 percent cropland (60 acres). Buying and renting land are not allowed nor are grazing purchases.

Crop enterprise alternatives are wheat and soybean. Livestock enterprise alternatives are cow-calf (spring and fall calving) and stocker steers (buy September 15 and sell July 15). Pasture enterprise alternatives are native pasture with or without broadleaf weed control, fescue pastures with nitrogen applied at 0 and 160 pounds, fescue and bermuda combined pastures with nitrogen applied at 160 and 240 pounds, and bermuda pasture with various levels of nitrogen applied under continuous and rotation grazing systems.

Using Anderson's (1974) and Anderson and Walker's (1977) report, the base pasture and livestock budgets (Appendix B) were converted from hay production and consumption in units of animal unit months (AUMS) to hay production and consumption in units of hundred weights (cwt). The converted budgets represent cattle feed requirements and pasture production levels in the form of dry matter (DM) and digestible protein (DP). Anderson supplies a variety of combinations of monthly feedstuff requirements for cattle. Feed and hay listed in the production section of the crop and pasture budgets and the operation inputs section of livestock budgets are expressed in terms of dry matter, energy content, and digestible protein. Grain and hay yields are southeast Oklahoma averages for the years 1979 through 1983.

Grazing rows are identified as digestible protein (DP) or dry matter (DM). DM is identified according to energy quality as high (2.6), medium (2.2), or low (1.8) energy quality. High or medium energy DM can be used to satisfy livestock low energy DM requirements. Also high energy DM can be used to satisfy medium or low energy DM requirements.

Examples of pasture DM 2.6 are:

1. small grain forages, and
2. lovegrass in early spring with 100 pounds per acre applied nitrogen.

Examples of the pasture DM 2.2 category are:

1. bermuda grass in the spring,
2. fescue with less than 200 pounds per acre of nitrogen, and
3. native pastures in early spring and summer, or the entire growing season, with 100 pounds per acre of nitrogen.

Pasture DM 1.8 is produced by warm season forage deferred for winter grazing and under low applications of nitrogen in the late summer and fall.

Transfer rows and activities are added so that hay and DP can be purchased to supplement what is available through pasture or hay production enterprises. High, medium and low energy hay can be purchased for $70, $60, and $50 per ton, respectively. No storage costs are included for hay produced on the farm and fed later. A protein supplement (44 percent DP) can be purchased in any period for $13/cwt of DM.

Hay produced or purchased can be allocated to DM and DP rows for any pasture period. All hay is assumed to contain 90 percent DM.

Coefficients in the DP rows differ among pastures because DP content differs.

Production levels and product prices for the wheat and soybean enterprises are based on Oklahoma's most recent five year average prices as recorded in the 1983 Oklahoma Agricultural Statistics. Most of the cattle prices are based on differentials and price relationships established from previous research (see below development of Cattle Weights and Prices).

Capital constraints and costs are classified as operating and intermediate. Operating capital provided by the owner is $5,000. Operating and intermediate capital can be borrowed at 15.0 percent interest. An upper limit for borrowing is set at $50,000 for operating capital and enough intermediate capital to cover the needs of the farmer. Results from Walker and Minnick (1977) indicate that the $50,000 limit set for operating capital is adequate for the representative farm.

Each month is classified as a labor period. There are 300 hours of labor available per month at no charge. Additional labor can be purchased at $5.00 per hour.

Some budgets include tick control through the use of acaricide treatments. Tick control applications are assumed to occur a total of ten times over the tick season. Cost of tick control per treatment per head is assumed to be $0.441. This value is the sum of the average costs of cattle gathering and acaricide cost reported in Appendix A. An assumption within the analysis is that when acaricide treatments occur, tick control is 100 percent effective. Thus, slippage in acaricidal control is assumed to be zero.

It is assumed that feedstuff requirements for cow-calf and stocker budgets be fulfilled by pasture DM 2.2 quality. The pasture budgets included in the analysis are described in Table V. Pastures of higher quality feedstuffs are capable of being substituted for lower quality feedstuff requirements. But, pastures of lower quality feedstuffs cannot be substituted for higher quality feedstuff requirements. Protein supplements are available to livestock if needed to satisfy protein requirements.

Livestock budgets were prepared to represent each of the following situations:

1. reduced weight gains resulting from ticks,
2. additional costs resulting from the use of acaricides, and
3. adjustments in gains resulting from selling animals prior to the tick season (stockers and fall calves only).

Thus, the primary differences among the livestock budgets are in weight and selling price due to the seasonal, age, sex, and breed differences. Budgets were modified so that feed consumption would represent appropriate breed, sex, and age of cattle. Because of these modifications, the development of cattle weight and prices are described. Table VI lists the various weights and prices developed and utilized in this analysis.

Cattle Weight

The base-line data for the weight difference between breed types are developed from Franke's (1978) study that was designed to estimate the influence of breed on winter and summer gains. He reported results of a comparison of straightbred Herefords and the backcrossed

TABLE V

DESCRIPTION OF PASTURES UTILIZED IN THE WHOLE FARM ANALYSIS

Pasture Type	Pasture Description
A	Wheat - Grazeout
B	Wheat, Graze and Harvest
C	Native Pasture, Continuous Grazing, Nitrogen Level = 0,
D	Native Pasture, Continuous Grazing, Nitrogen Level = 0, Broad Leaf Weed Control W/2,4-D
E	Fescue Pasture, Grazed December thru May, Rotation Grazing, Nitrogen Level = 0
F	Fescue Pasture, Grazed December thru May, Nitrogen Level = 160
G	Fescue and Bermuda Combination Hay and Pasture, Custom Harvest, Rotation Grazing, Nitrogen Level = 160
H	Fescue and Bermuda Combination Hay and Pasture, Custom Harvest, Rotation Grazing, Nitrogen Level = 240
I	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Continuous Grazing, Nitrogen Level = 0
J	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Continuous Grazing, Nitrogen Level = 25
K	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Continuous Grazing, Nitrogen Level = 50
L	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Continuous Grazing, Nitrogen Level = 100
M	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Rotating Grazing, Nitrogen Level = 0
N	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Rotating Grazing, Nitrogen Level = 50
O	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Rotating Grazing, Nitrogen Level = 100
P	Bermuda Grass Pasture and Hay, Custom Harvest and Haul, Rotating Grazing, Nitrogen Level = 200

TABLE VI

CATTLE WEIGHTS AND PRICES UTILIZED IN THE WHOLE FARM ANALYSIS

	Fall Calves				Spring Calves				Stockers			
	Hereford		Brahman		Hereford		Brahman		Hereford		Brahman	
	Steer	Heifer	Steer	Heifer	Steer	Heifer	Steer	Heifer	Steer	Heifer	Steer	Heifer
Weaning Weight (lbs)	430.5	410.0*	516.6	492.0*	430.5	410.0*	516.6	492.0*				
Winter Gain (lbs)									132.2	126.0*	96.6	92.0*
Summer Gain (lbs)									177.5	169.0*	201.6	192.0*
Weight Loss Due to Ticks (lbs)	58.5	58.5	42.7	42.7	58.5	58.5	42.7	42.7	35.0	33.3	25.5	24.3
Weight Loss Due to no Tick Season (lbs)	224.3	213.6	269.1	252.5					112.8		119.2	
Selling Weight w/o Ticks (lbs)	430.5	410.0	516.6	492.0	430.5	410.0	516.6	492.0	780.2		764.6	
Selling Weight w/Ticks (lbs)	372.0	351.5	473.9	449.3	372.0	351.5	473.9	449.3	746.9		740.3	
Sell Early Weight w/o Tick Season (lbs)	206.2	196.4	247.5	239.5					667.4		645.4	
Purchase Price at 500lbs in Sept ($/cwt)									67.88[b]		66.28	

TABLE VI (Continued)

	Fall Calves				Spring Calves				Stockers			
	Hereford		Brahman		Hereford		Brahman		Hereford		Brahman	
	Steer	Heifer	Steer	Heifer	Steer	Heifer	Steer	Heifer	Steer	Heifer	Steer	Heifer
Sell Price for Weight in June, ($/cwt)	84.37[b]	69.50[b]	82.63	69.54								
Sell Price for Weight w/o Tick Season in March, ($/cwt)	91.96[b]	75.47[b]	90.07	75.51					74.42[b]		74.14	
Sell Price for Weight in July, ($/cwt)									66.59[b]		62.98	
Sell Price for Weight in Oct. ($/cwt)					78.85[b]	64.62[b]	77.62	64.25				

*Franke (1978)

[a] Stockers are purchased at 500 lbs.

[b] U.S. Department of Agriculture, Agricultural Marketing Service, Livestock and Seed Division, Livestock Detail Quotations (Weekly) Oklahoma City, 1979-1983.

Hereford (75 percent) X Brahman (25 percent). Although Franke's group of cattle does not perfectly represent this study's cattle type (i.e., F_1 Hereford X Brahman), his study provides results containing seasonal gain differences between types which are appropriate to the present study. He also reports heifer weaning weights at 8 months of age. Table VII lists the values used in this study which are taken from Franke's report.

Lusby (No date) reports that the difference in weight between sexes at 205 days, is that a steer's weight will equal 1.05 times that of a heifer's weight. Assuming this holds through maturity and within each breed. Franke's heifer weaning weights and seasonal gain can be adjusted to represent steer weights for both breed types.

Stocker Weight at Time of Sale. Stockers of both breed types are purchased in the beginning of September at 500 pounds and sold the following year in mid-July. Thus, to identify the July selling weights for the different breed types, the full winter gains and 5/6 of the summer gains reported by Franke are added to the respective starting weights. Therefore, in July, Hereford stocker steers which are ready for the feedlot will weigh {500 pounds + 132.3 pounds + 5/6(177.5 pounds)} = 780.2 pounds. Brahman-cross stocker steers which are ready for the feedlot will weigh {500 pounds + 96.6 pounds + 5/6(201.6 pounds)} = 764.6 pounds.

Tick Effect on Anticipated Weight Gain.

1. Calves: Measured as reduction in rate of gain, the tick damage coefficient estimated in Chapter III (linear model) for Bos taurus calves is incorporated into a weight loss model consisting of

TABLE VII

INFLUENCE OF BREED ON WINTER AND SUMMER GAINS (LBS) OF HEIFERS DEVELOPED BY FRANKE, 1978

Breed Type	Weaning Weight 8 mo.	Winter Gains 6 mo.	Summer Gains 6 mo.
Hereford	410	126	169
Hereford (75%) X Brahman (25%)	492	92	192

tick number and days of attachment. It is assumed that this is representative of what would occur equally to both sexes of the Hereford breed. It is also assumed that a tick effect involves attachment of 150 ticks. Constant attachment of 150 ticks over the tick season's 100 day period is assumed when ticks are present. Therefore, the change in weight caused by the presence of ticks to these calves is -0.0039 X 150 ticks X 100 days = -58.5 pounds.

To estimate the coefficient for tick weight loss to Brahman-cross calves, a ratio is created from the estimated tick loss coefficient identified in Chapter IV representing each cattle breed on both native pasture and improved pasture without acaricide use. It is assumed that the difference in tick loss at the stocker stage of development also exists in the same proportion at the calf stage. To create the ratio the following values are defined:

a. Hereford cattle - from Chapter IV's model 3 diagnosis 1 and 4, the average coefficient for tick damage is (-0.0020 - 0.0054)/2 = -0.0037.

b. Brahman-cross cattle - from Chapter IV's model 3 diagnosis 7 and 10, the coefficient for tick damage is (-0.0010 - 0.0044)/2 = -0.0027.

Using these averages to create a ratio representing Brahman-cross damage relative to Hereford (-0.0027/-0.0037 = 0.7297) implies that Brahman-cross cattle suffer approximately 73 percent of the damage of Herefords. Assuming that this weight loss difference can be applied to calves, as well as stocker cattle, the Brahman-cross calves would gain approximately 0.7297 X 58.5 pounds = 42.7 pounds less during the tick season with a constant attachment rate of 150 ticks. The corresponding tick weight losses to the calves are subtracted from the weaning weights identified by Franke.

2. Stocker cattle: Coefficients for breed on native pasture and improved pasture without the use of acaricides in Chapter IV are used to estimate the weight loss to heifer stockers caused by a constant attachment of 90 ticks over the 100 day tick season. Weight effect due to the tick attachment is:

a. Hereford stocker heifers ---> 100 days X 90 ticks/day X -0.0037 pounds/tick = 33.3 pounds less gain.

b. Brahman-cross stockers ---> 100 days X 90 ticks/day X -0.0027 pounds/tick = 24.3 pounds less gain.

It is assumed that the tick effect of the steers is a 1.05 multiple of those tick effects to the respective heifers.

Stocker Weights Without the Tick Season. One production strategy is to sell the cattle at or before the onset of the tick season (mid-March). Selling stocker cattle in mid-March rather than in mid-July would cost the producer approximately 122 days of gain. Therefore, using Franke's winter and summer gains, it is assumed that the producer would lose 30 days of winter gain and 92 days of summer gain. Assume that the winter and summer growth periods consist of 180 days each. The following average daily gains (ADG) are developed:

a. Winter ADG for Hereford stocker steers ---> 132.2 pounds/180 days = 0.7350 pounds per day.

b. Summer ADG for Hereford stocker steers ---> 177.5 pounds/180 days = 0.9861 pounds per day.

c. Winter ADG for Brahman-cross stocker steers ---> 96.6 pounds/180 days = 0.5367 pounds per day.

d. Summer ADG for Brahman-cross stocker steers ---> 201.6 pounds/180 days = 1.1200 pounds per day.

Therefore, anticipated gain not received by the producer for selling cattle when the tick season begins are:

a. Hereford stocker steers ---> 30 days X 0.7350 pounds per day + 92 days X 0.9861 pounds per day = 112.8 pounds.

b. Brahman-cross stocker steers ---> 30 days X 0.5367 pounds per day + 92 days X 1.1200 pounds per day) = 119.2 pounds.

These values are subtracted from the respective July selling weights without ticks to derive the selling weights in mid-March.

Calf Weights Without Tick Season. Fall calves are sold at the end of June in the base budget. Therefore, the producer loses approximately 107 days of weight gain if the cattle are sold in mid-March. This situation is applied only to the fall calf enterprise. The spring calf enterprise is omitted from this situation because the calves would be too young to sell at the mid-March sale date.

The constant identified in the linear working model of Table I (i.e, 2.0962 pounds/day) represents ADG without the tick effect. This value is used to represent the ADG for Hereford steer calves without a tick effect. This value is multiplied by the 107 day period to develop the total weight gain sacrificed for Hereford steer calves sold at the time the tick seasons begins (i.e., 2.0962 pounds.day X 107 days = 224.3 pounds).

Assuming that weight and growth rate are linearly related (Lusby), the ADG for Hereford heifer calves without a tick effect would be 1/1.05 X 2.0962 pounds per day = 1.9964 pounds. Thus, the weight gain sacrificed for Hereford heifer calves sold at the time the tick season begins is 1.9964 pounds per day X 107 days = 213.6 pounds.

The weight of Brahman-cross calves sold at the time the tick season begins is more difficult to identify because the study analyzed in Chapter III does not consist of a Brahman-cross cow-calf situation. Using Franke's weaning weights for the two breed types, a weaning weight ratio for the heifer calves is assumed to also be the ratio between the ADG's for the same heifers. Therefore, the weaning weight ratio is 492.0 pounds/410.0 pounds = 1.2000 and the ADG of the Brahman-cross calves are:

Heifers ---> 1.2000 X 1.9664 pounds = 2.3597 pounds.

Steers ---> 1.2000 X 2.0962 pounds = 2.5154 pounds.

Therefore, the weight loss to producers for selling Brahman-cross calves at the beginning of the tick season is:

Heifers ---> 2.3597 pounds per day X 107 days = 252.5 pounds.

Steers ---> 2.5154 pounds per day X 107 days = 269.1 pounds.

Cattle Prices

Monthly average cattle prices received by farmers in Oklahoma from 1979 through 1983 are used (U. S. Department of Agriculture, 1979-83) and assumed to represent the average prices received for Hereford cattle. The difference in prices between Hereford and Brahman-cross cattle are estimated through ratios developed from the price differences identified by Lambert (1982). Prices received for Brahman and their crosses are grouped together in his report (Table VIII). It is assumed that the prices for this group represent relative prices for all cattle exhibiting the Brahman ear hump.

TABLE VIII

AVERAGE FALL KANSAS PRICES RECEIVED FOR HEREFORD CATTLE AND BRAHMAN AND BRAHMAN-CROSSES (LAMBERT, 1982)[a]

Breed Type	Average Price/Cwt.											
	Steer						Heifer					
	< 400	400-499	500-599	600-699	700-799	800-899	< 400	400-499	500-599	600-699	700-799	800-899
Hereford	66.98 (794)	64.00 (1414)	61.87 (1287)	60.71 (1687)	61.35 (1742)	59.97 (572)	57.38 (938)	54.74 (1307)	53.57 (609)	54.00 (960)	54.14 364	52.86 (87)
Brahman & Crosses	65.6 (138)	63.00 (117)	60.41 (117)	60.48 (50)	58.02 (77)	60.68 (46)	57.41 (128)	54.43 (112)	53.75 (57)	52.10 (66)	54.46 (20)	53.00 (3)

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[a] Values in parentheses represent number of head in the group from which the average price is derived.

Therefore, these prices are used to reflect the relative prices expected for the Brahman-cross used in this analysis. The price ratios are developed by dividing the average price per hundred-weight of Hereford by the average price per hundred-weight of Brahman and their crosses. Lambert's data were gathered by trained evaluators at fifteen cooperating auctions in Kansas during October and November of 1981. Traits evaluated and recorded were prices, weight, time of sale, sex, breed, horns, frame, muscle, fleshing, health, fill, uniformity, and lot size. Lambert's data are only available for fall sale prices. The price differences established through the use of Lambert's report are assumed to hold throughout the year.

Whole Farm Analysis

A total of 34 budgets (Appendix C) were prepared for this analysis (4 crop, 14 pasture, and 16 livestock) from the ten base budgets (Appendix B). As previously described, the 34 prepared budgets were adjusted to include DM and DP requirements and production levels using Anderson's (1974) report. The Oklahoma Farm and Ranch Management System (OKFARMS) program (Kletke and Moehle, and Moehle and Kletke) was used to generate the initial linear programming tableau from data contained in the enterprise budgets and a data set specifying the resource base and input and output prices. The Mathematical Programming System Extended (MPSX) (IBM Corporation, 1971) algorithm is used to maximize the objective function. The initial tableau was modified and additional MPSX solutions were computed to analyze the effect of changes in prices and restrictions. Output from the program is used to evaluate the economic consequences of alternative production strategies for producers confronted with lone star tick infestations.

The analysis in this study is conducted for four different scenarios. The initial situations represented in the scenarios are:

1. Hereford cow-calf, Hereford stocker cattle, and native pasture enterprises; management has no interest in, or resources for, crop production or using Brahman-cross cattle.

2. Hereford cow-calf, Hereford stocker cattle, and native pasture enterprises; management has resources to produce crops but not to use Brahman-cross cattle.

3. Hereford cow-calf, Hereford stocker cattle, and native pasture enterprises; management has no resources for crop production but could use Brahman-cross cattle.

4. Hereford cow-calf, Hereford stocker cattle, and native pasture enterprises; resources area available for both crop production and use of Brahman-cross cattle.

Each scenario enables enterprise activities that are prevalent in southeast Oklahoma. Within each scenario, the base situation is increasingly complicated as additional production activities are made available to determine their ability to compete. Each scenario contains five sets of analysis. Analysis of the base situation followed by an analysis occurring after each additional production activity is considered within the scenario. Production activities added to the base situation are tick control via acaricide use, selling of livestock at the onset of the tick season, broadleaf weed control on native pasture, and improved pastures. The sequence in which activities are assigned to a model, thereby increasing the complexity of that model, is arbitrary.

Tables IX through XII list the descriptive results of each analysis according to its respective scenario. Within each table are listed the optimal production mix for livestock, pasture, and crop enterprises. Some of the resources used for the optimal mix, along with miscellaneous purchases to compensate defined needs are also listed. Returns to family labor, family capital, land, overhead, risk, and management are listed to provide a scale from which to compare alternative strategies. The production mix possibilities for each model are also listed. These possibilities are imposed on the specific models in the form of constraints.

Following, are descriptions of each scenario, definitions of each model analyzed within each scenario, and an interpretive summary of the results of each scenario.

Scenario I

This scenario consists of a land base of 240 acres which can be used for pasture. This situation represents ranches with no cropping activities and no Brahman-cross livestock activities. The results of this scenario are reported in Table IX.

Model A. This model consists only of Hereford cow-calf and stocker steer activities on native pasture without broadleaf weed control. Ticks are present and reduce gain. Analysis indicates that the ranches should not stock the tick infested range.

Model B. This model contains acaricide control activities, plus those activities used in Model A. Analysis again indicates that it is not economical to stock tick infested native pasture.

TABLE IX

RESULTS OF SCENARIO I

	Model A	Model B	Model C	Model D	Model E
PRODUCTION MIX					
LIVESTOCK					
Hereford					
Stocker (Hd)					214
Cow-Calf Units (Spring)					
Cow-Calf Units (Fall)					
Brahman-Cross					
Stocker					
Cow-Calf Units (Spring)					
Cow-Calf Units (Fall)					
CROPS					
Wheat (BU)					
Soybean (BU)					
Hay (TON)					160.0
RESOURCES USED					
Land					
No. Acres in Crops					
No. Acres in Pasture					240(57.1)*
Pasture Type (Table VI)					F
Labor (Annual No. Hours)					829.0
Capital - Operating ($)					5,000.0
Intermediate ($)					17,699.1

TABLE IX (Continued)

	Model A	Model B	Model C	Model D	Model E
MISCELLANEOUS PURCHASES					
Hay (TON)					
Operating Capital ($)					30,155.2
Ticks Present?	Yes	Yes	Yes	Yes	No
Acaricides Used?	No	No	No	No	No
Sold Before Tick Season:	No	No	No	No	Yes
Returns to Land, Labor, Capital Overhead, Risk and Management ($)	-0-	-0-	-0-	-0-	14,455.1
Production Mix Possibilities					
	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Acaricide Use	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Acaricide Use i)No tick season	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Acaricide Use i)No tick season j)Brush Control	#a)Do Nothing b)Native Pasture c)No Brush Control #d)Hereford #e)Cow-Calf f)Stocker #g)With ticks h)Acaricide Use #i)No tick season j)Brush Control #k)Improved Pastures

*Values in parenthesis are marginal values ($) of the products (MVP).
#Indicates selected production mix.

Model C. The situation identified in Model B is expanded by including all Hereford cow-calf and stocker activities in which the calves and stockers are sold at the onset of the tick season. Thus, some of the livestock activities would not be affected directly by tick damage. Analysis indicates that this alternative does not alter the optimal solution.

Model D. To this point, all activities have used a native pasture without broadleaf weed control. Added to the activities included thus far is a native pasture with broadleaf weed control. This analysis is constructed to determine the impact of a broadleaf weed control program. However, analysis indicates that no production activities are included in the optimal solution at nonzero levels.

Model E. The introduction of numerous activities representing improved pastures occurs with this model. Pastures E-P from Table V are included as possible alternatives to be added to the optimal enterprise mix. Analysis indicates that this increases the producer's returns to family resources, overhead, risk, and management. With this added source of forage, production enterprises enter the optimal solution at nonzero levels. Hereford stocker steers and fescue pasture with 160 pounds of nitrogen per acre per year are included. Ticks are not controlled because these stockers are sold at the onset of the tick season. It is important to note that these results do not indicate whether or not it is economical to convert native pasture to improved pasture. For this particular model, the improved pasture is assumed to be established.

Summary of Scenario I. For producers with native tick infested pasture, the analysis indicates the following:

1. Acaricides are not profitably employed under the present conditions, and

2. Livestock activities considered are not economically viable.

If improved pastures are available, stockers should be produced and sold at the onset of the tick season.

Scenario II

This scenario consists of a land base of 240 acres of pasture land plus 60 acres of cropland. This situation is an extension of Scenario I by adding cropland and crop activities. Potential crops are wheat and soybeans. Brahman-cross cattle activities are not included. The results of this scenario are summarized in Table X.

Model F. The base situation consists of 240 acres of native pasture, 60 acres of cropland, and Hereford cow-calf and stocker activities. Ticks are present and their damage is recognized in lowered cattle gain rates. The cow-calf, native pasture, wheat grazeout, soybeans, and wheat grazing and harvest activities are included in the optimal solution.

Model G. The base situation described in Model F is expanded by adding Hereford cow-calf and stocker activities which include the use of acaricides. Results of the model indicate that the wheat grazeout, wheat grazing and harvest, soybean, native pasture, stocker, and spring cow-calf activities are all included in the optimal enterprise mix. Livestock activities which include acaricides were

TABLE X

RESULTS OF SCENARIO II

	Model F	Model G	Model H	Model I	Model J
PRODUCTION MIX					
LIVESTOCK					
Hereford					
Stocker (Hd)		15	10	10	244
Cow-Calf Units (Spring)	23	24	25	25	
Cow-Calf Units (Fall)					
Brahman-Cross					
Stocker					
Cow-Calf Units (Spring)					
Cow-Calf Units (Fall)					
CROPS					
Wheat (BU)	1579.1	1276.2	1732.4	1732.4	1956.0
Soybean (BU)	311.6	92.2			
Hay (TON)					160.9
RESOURCES USED					
Land					
No. Acres in Crops	57(60.4)*	41.7(60.3)	53.1(97.1)	53.1(97.1)	60(82.3)
Acres in Pasture	3 40 240(14.5)	18.3 36.6 240(17.2)	6.9 53.1 240(11.1)	6.9 53.1 240(11.1)	60 237.6 2.4(57.3)
Pasture Type (Table VI)	A B C	A B C	A B C	A B C	B F H
Labor (Annual No. Hours)	346.7	394.4	375.6	375.6	1,042.2
Capital - Operating ($)	1,388.9	5,000.0	3,119.1	3,119.1	5,000.0
Intermediate ($)	24,602.0	25,175.5	25,523.0	25,523.0	23,999.3

TABLE X (Continued)

	Model F	Model G	Model H	Model I	Model J
MISCELLANEOUS PURCHASES					
Hay (TON)	3.6	4.9	4.6	4.6	
Operating Capital ($)					35,582.8
Ticks Present?	Yes	Yes	Yes	Yes	No
Acaricides Used?	No	Yes	Cow-calf	Cow-calf	No
Sold Before Tick Season:	No	No	Stockers	Stockers	Yes
Returns to Land, Labor, Capital, Overhead, Risk and Management ($)	7,101.0	7,821.0	8,479.4	8,479.4	19,440.5
Production Mix Possibilities					
	a)Do Nothing #b)Native Pasture #c)No Brush Control #d)Hereford #e)Cow-Calf #f)Stocker #g)With ticks #h)Crops	a)Do Nothing #b)Native Pasture #c)No Brush Control #d)Hereford #e)Cow-Calf #f)Stocker #g)With ticks #h)Crops #i)Acaricide Use	a)Do Nothing #b)Native Pasture #c)No Brush Control #d)Hereford #e)Cow-Calf #f)Stocker #g)With ticks #h)Crops #i)Acaricide Use #j)No tick season	a)Do Nothing #b)Native Pasture #c)No Brush Control #d)Hereford #e)Cow-Calf #f)Stocker #g)With ticks #h)Crops #i)Acaricide Use #j)No tick season k)Brush Control	a)Do Nothing b)Native Pasture c)No Brush Control #d)Hereford e)Cow-Calf #f)Stocker g)With ticks #h)Crops i)Acaricide Use #j)No tick season k)Brush Control #l)Improved Pastures

*Values in parenthesis are marginal values ($) of the Products (MVP).
#Indicates selected production mix.

selected. By introducing the use of acaricides to the basic situation, returns to unpaid family resources, overhead, risk, and management have increased by approximately $700 or 10 percent over that obtained with model F. The MVP for pasture land increased by $2.7 or 19 percent.

Model H. The situation identified in Model G is expanded by adding all Hereford cow-calf and stocker activities in which the livestock are sold at the onset of the tick season. These livestock activities would not be affected directly by tick damage, but the calves and stockers would lose the opportunity to gain weight during the tick season. Analysis indicates that the optimal enterprise mix includes wheat grazeout, wheat grazing and harvest, native pasture, spring cow-calf activities, and stockers sold prior to the tick season. Cow-calf activities have tick control through acaricide use. By introducing the activities in which livestock are sold at the onset of the tick season, returns to unpaid family resources, overhead, risk, and management have increased by approximately $700 or 8 percent relative to model G.

Model I. Added to the activities established thus far is a native pasture with broadleaf weed control. This analysis is constructed to determine if efforts to control broadleaf weeds are economics for the modelled farm. Analysis indicates that this alternative adds nothing to the optimal solution identified in Model H.

Model J. Numerous types of improved pasture activities are added with this model. Pastures E-P from Table V are added as potential alternatives to the optimal enterprise mix. Analysis indicates that this increases the producer's returns to family resources, overhead, risk, and management by approximately $11,000 or 129 Percent. With this added source of forage, the optimal enterprise mix shifts to producing only stocker livestock activities feeding on various diets including native, fescue, and fescue/bermuda pastures. These stockers are sold prior to the onset of the tick season. The cropping activity has shifted to 100 percent grazing and harvesting wheat. The cost of preparing land for establishing improved pastures has not been considered.

Summary of Scenario II. For producers who have tick infested native pasture and resources for producing Hereford cattle (or any other *Bos taurus* breed) with cropping activities, the analysis indicates the following:

1. The use of acaricides can be profitably employed in the production process.
2. Selling stockers prior to the onset of the tick season will increase returns.
3. It is not economical to adopt broadleaf weed control on native pasture.
4. Availability of improved pastures will increase returns.

Scenario III

This scenario consists of a land base of 240 acres, all of which are allocated to pasture production. This situation is an extension of Scenario I by adding the Brahman-cross livestock activities. The results for this scenario are reported in Table XI.

Model K. The basic situation consists of 240 acres of native pasture, and Hereford and Brahman-cross cow-calf and stocker activities. Ticks are present and their damage is recognized in reductions in rate of weight gains achieved by calves and stockers. Analysis indicates that it is not economical to stock the tick infested native pasture.

Model L. The basic situation is expanded by including all Hereford and Brahman-cross cow-calf and stocker activities which include the use of acaricides. Analysis again indicates that stocking is not economical.

Model M. The situation identified in Model L is expanded by including all Hereford and Brahman cow-calf and stocker activities in which the livestock are sold at the onset of the tick season. Thus, these livestock activities would not be affected by tick damage but may lose a profitable position in the optimal enterprise mix since they are sold earlier and at lighter weights. However, the analysis again indicates that stocking under these circumstances is not economical.

Model N. All prior models for this scenario include native pasture activities without broadleaf weed control. For model N, a native pasture activity with broadleaf weed control is included. Inclusion of this activity does not alter the optimal solution.

Model O. For this model, pastures E-P from Table V are included as activities in the model. Analysis indicates that this

TABLE XI

RESULTS OF SCENARIO III

	Model K	Model L	Model M	Model N	Model O
PRODUCTION MIX					
LIVESTOCK					
Hereford					
Stocker (Hd)					213
Cow-Calf Units (Spring)					
Cow-Calf Units (Fall)					
Brahman-Cross					
Stocker					
Cow-Calf Units (Spring)					
Cow-Calf Units (Fall)					
CROPS					
Wheat (BU)					
Soybean (BU)					
Hay (TON)					160.5
RESOURCES USED					
Land					
No. Acres in Crops					
No. Acres in Pasture					240(571)*
Pasture Type (Table VI)					F
Labor (Annual No. Hours)					830.3
Capital - Operating ($)					5,000.0
Intermediate ($)					17,908.0

TABLE XI (Continued)

	Model K	Model L	Model M	Model N	Model O
MISCELLANEOUS PURCHASES					
Hay (TON)					
Operating Capital ($)					30,079.0
Ticks Present?	Yes	Yes	Yes	Yes	No
Acaricides Used?	No	No	No	No	No
Sold Before Tick Season:	No	No	No	No	Yes
Returns to Land, Labor, Capital, Overhead, Risk and Management ($)	-0-	-0-	-0-	-0-	14,461.0
Production Mix Possibilities	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Brahman-Cross	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Brahman-Cross i)Acaricides	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Brahman-Cross i)Acaricides j)No tick season	#a)Do Nothing b)Native Pasture c)No Brush Control d)Hereford e)Cow-Calf f)Stocker #g)With ticks h)Brahman-Cross i)Acaricides j)No tick season k)Brush Control	#a)Do Nothing b)Native Pasture c)No Brush Control #d)Hereford e)Cow-Calf #f)Stocker g)With ticks h)Brahman-Cross i)Acaricides #j)No tick season k)Brush Control #l)Improved Pastures

*Values in parenthesis are marginal values ($) of the products (MVP).
#Indicates selected production mix.

increases the producer's returns to family capital, land, labor, overhead, risk, and management. The optimal enterprise mix includes Hereford stocker steers, and fescue pasture. The stockers are sold prior to the onset of tick season.

Summary of Scenario III. For producers who have native pasture but not cropland analysis indicates the following:

1. Acaricides are not profitably employed under the modelled conditions.

2. Broadleaf weed control is not profitably employed under the modelled conditions.

3. No livestock production activities are economically optimal unless improved pastures are available.

4. If improved pastures are available, Hereford stockers should be used and sold prior to the onset of the tick season.

5. Given a choice between Hereford and Brahman-cross cattle, the Hereford cattle are chosen for the optimal mix and sold prior to the onset of the tick season.

Scenario IV

This scenario consists of a land base of 240 acres of pasture land and 60 acres of cropland. This situation includes all activities of Scenario I as well as the Brahman-cross livestock activities and cropping activities. Thus, this scenario combines those extensions to Scenario I reported in Scenarios II and III. Results are reported in Table XII.

TABLE XII

RESULTS OF SCENARIO IV

	Model P	Model Q	Model R	Model S	Model T
PRODUCTION MIX					
LIVESTOCK					
Hereford					
Stocker (Hd)			12	12	244
Cow-Calf Units (Spring)					
Cow-Calf Units (Fall)					
Brahman-Cross					
Stocker			8	8	
Cow-Calf Units (Spring)	25	25	23	23	
Cow-Calf Units (Fall)					
CROPS					
Wheat (BU)	1393.5	1393.5	1551.3	1551.3	1956.0
Soybean (BU)	353.0	353.0			
Hay (TON)					161.0
RESOURCES USED					
Land					
No. Acres in Crops	55.3(60.4)	52.3(60.4)	47.6(91.9)	47.6(91.9)	60(82.3)
No. Acres in Pasture	7.7 33.2 240(19.5)*	7.7 33.2 240(21.4)	12.4 47.6 240(15.8)	12.4 47.6 240(15.8)	60 238 25(57.3) 2
Pasture Type (Table VI)	A B C	A B C	A B C	A B C	B F G H
Labor (Annual No. Hours)	362.7	362.7	394.8	394.8	1041. 0
Capital - Operating ($)	1,404.9	1,426.8	5,000.0	5,000.0	5,000.0
Intermediate ($)	25,922.2	25,921.1	24,457.0	24,457.0	23,999.3

TABLE XII (Continued)

	Model P	Model Q	Model R	Model S	Model T
MISCELLANEOUS PURCHASES					
Hay (TON)	3.8	3.8	4.9	4.9	
Operating Capital ($)					35,582.8
Ticks Present?	Yes	Yes	Yes	Yes	No
Acaricides Used?	No	Yes	Cow-Calf	Cow-Calf	No
Sold Before Tick Season:	No	No	Hereford	Hereford	Yes
Returns to Land, Labor, Capital, Overhead, Risk and Management ($)	8,295.9	8,761.9	9,541.1	9,541.4	19,440.5
Production Mix Possibilities	a)Do Nothing #b)Native Pasture #c)No Brush Control d)Hereford #e)Cow-Calf f)Stocker #g)With ticks #h)Brahman-Cross #i)Crops	a)Do Nothing #b)Native Pasture #c)No Brush Control d)Hereford #e)Cow-Calf f)Stocker #g)With ticks #h)Brahman-Cross #i)Crops #j)Acaricide Use	a)Do Nothing b)Native Pasture c)No Brush Control #d)Hereford #e)Cow-Calf #f)Stocker #g)With ticks #h)Brahman-Cross #i)Crops #j)Acaricide Use #k)No tick season	a)Do Nothing b)Native Pasture c)No Brush Control #d)Hereford #e)Cow-Calf #f)Stocker #g)With ticks #h)Brahman-Cross #i)Crops #j)Acaricide Use #k)No tick season #l)Brush Control	a)Do Nothing b)Native Pasture c)No Brush Control #d)Hereford e)Cow-Calf #f)Stocker g)With ticks h)Brahman-Cross #i)Crops j)Acaricide Use #k)No tick season l)Brush Control #m)Improved Pastures

*Values in parenthesis are marginal values ($) of the products (MVP).
#Indicates selected production mix.

Model P. The base situation consists of 240 acres of native pasture, 60 acres of cropland, and Hereford and Brahman-cross cow-calf and stocker activities. Ticks are present and reduce rates of gain. Analysis indicates that the spring Brahman-cross cow-calf, soybean, wheat, and native pasture activities are included in the optimal solution. The optimal cropping mix consists of wheat grazing and harvesting, and soybean production.

Model Q. The situation modelled in Model P is expanded by including livestock activities which include the use of acaricides. Analysis indicates that the optimal enterprise mix identified in Model P did not change with the exception of adopting tick control through the use of acaricides and selling calves at heavier weights. By introducing the use of acaricides to the basic situation, returns to family resources, overhead, risk, and management have increased by approximately $450 or 6 percent, and the MVP for pasture land has increased by approximately $2 per acre or 10 percent.

Model R. The situation identified in Model Q is expanded by adding livestock activities in which the fall calves and stockers are sold at the onset of the tick season. These activities would not be affected directly by tick damage. However, they reflect sales at lower weights. Analysis indicates that this alternative brings both Brahman-cross and Hereford stocker steers into the optimal production mix. The optimal mix includes native pasture, wheat grazeout, wheat grazing and harvest, Brahman-cross and Hereford stockers, and the spring Brahman-cross cow-calf activities which reflects the use of acaricides.

Model S. For this model, a native pasture which includes broadleaf weed control was added to the activities of model R. Analysis indicates that the addition of this activity does not change the optimal mix from that identified in Model R.

Model T. The previous model is expanded by including pastures E-P from Table VI. The optimal enterprise combination includes wheat grazing and harvest, fescue, and fescue/bermuda hay and pasture, and Hereford stockers sold at the onset of the tick season.

Summary of Scenario IV. For all producers with cropland as well as tick infested native pasture, the analysis indicates the following:

1. Acaricides should be applied to spring cow-calf activities.
2. Broadleaf weed control is not profitably employed under the modelled conditions.
3. Hereford stocker activities come into the optimal production mix and stockers are sold at the onset of the tick season.
4. Improved pastures increase returns to overhead, risk, and management relative to native pasture, if the improvements have been made. However, the costs and benefits of converting native range to improved ranges was not analyzed.
5. Given a choice between Hereford and Brahman-cross cattle, the Brahman-cross cattle are selected to be kept throughout the tick season while Hereford activities are selected to be sold at the onset of the tick season.

Summary of Whole Farm Analysis

A whole farm analysis was conducted with linear programming. Technical coefficients presented in Chapters III and IV, current prices, and price and weight ratios established from previously conducted research were used. A base scenario was studied, which was then expanded to complete a total of twenty situations. The objective of the analysis was to identify the most profitable stocking strategies for an established lone star tick infested farm in southeastern Oklahoma. Results can be summarized as follows.

1. When cow-calf activities are chosen, the spring calving activities are chosen over the fall calving activities. A possible reason for this may be the timing of the availability of forage and seasonality of prices.

2. When acaricide use is available, this activity is optimal, provided the livestock are not sold at the onset of the tick season. This is consistent with the analysis conducted in Chapter III.

3. When activities which reflect sales prior to the tick season are available, Hereford stockers are sold at the onset of the tick season, while Brahman-cross stockers are carried throughout the tick season.

4. When cropland is not included in the resource base (as in Scenarios I and III) it is not economical to stock tick infested native pasture. The estimated tick effects derived in Chapters III and IV are too high to allow profitable beef production on the native pastures given the budgeted prices.

5. Broadleaf weed control on native pasture is not profitable.

6. For the comprehensive model (Model T), the optimal enterprise mix consists of running Hereford stockers through the winter months until the onset of the tick season, at which time the stockers should be sold.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

Summary

The primary objective of this study was to investigate the economics of alternative grazing strategies for livestock producers in eastern Oklahoma with consideration of the existence of the lone star tick. A brief history of Oklahoma's beef production was discussed. Applicable literature was reviewed while current studies on tick control, effects of ticks on cattle, cattle growth under various conditions, growth response of various cattle breeds and economic threshold levels were cited. A discussion of some of the economic theory and statistical methods pertinent to this study was presented. The discussion initially focused on the theory of production economics and its application to farm management through the use of linear programming techniques. This was followed by a review of statistical methods dealing with first order autocorrelation, heteroscedasticity, and corrected R^2 values.

The primary objective was accomplished through stages of analysis. The first stage consisted of estimating lone star tick population levels at which the damage caused by specific population level equals the cost of controlling the pest (ETL). This was followed by estimating lone star tick damage functions under various tick control programs. The values established in these analyses were then applied in a whole farm planning framework to estimate the optimal production strategies under tick infested conditions. Following, are results of each stage and analysis presented in this study.

Estimating Economic Threshold Levels (ETL)

It was assumed that the first step in estimating the economically optimal control program for lone star ticks would be in estimating that population level at which "damage caused" equals "cost of control." Biological data were corrected for first order autocorrelation due to multiple data points being collected from the same animals. Damage models were estimated in both semilog and linear form. Treatment and handling costs were estimated and combined. Considering three acaricides individually, the ETL's ranged from 25.5 to 38.0 ticks. The linear model was used in previous research (Turner and Short, 1972; and Little, 1963) and was adopted in this study. The acaricides used were ranked according to their cost and percent effectiveness with respect to tick damage and returns to beef gains.

Estimating the Economically Optimal Integrated Control Program

Data derived from a study of stocker cattle growth response were corrected for first order autocorrelation and heteroscedasticity. The experimental design included Hereford and Brahman-Hereford crossbred stockers, native and improved pasture, high concentration acaricide, low concentration acaricide, and no acaricide use.

The trends identified from the analysis indicate:

1. Brahman-cross cattle gained more than purebred Herefords.

2. In general, the low concentration of acaricide treatment was associated with higher gains than the high concentration of the same chemical. The high concentration may act as an irritant to the cattle as well as the ticks.

Results of analysis indicated that the production mix consisting of Brahman-cross cattle with no acaricide on improved pasture result in the greatest gain.

Whole Farm Analysis

A whole farm analysis was conducted using linear programming. Technical coefficients presented in Chapters III and IV, current prices, and price and weight ratios established from previously conducted research were utilized. A base scenario was studied, which was then expanded to complete a total of twenty whole farm situations. The objective of the analysis was to identify the most profitable crop and stocking strategies for an established farm in southeastern Oklahoma. The following are results that came into the optimal enterprise mix consistently:

1. When cow-calf activities were chosen, the spring calving activities were selected over the fall calving activities. A possible reason for this may be the timing of the availability of forage and seasonality of prices.

2. Activities which included acaricide use were selected, provided the livestock were not sold at the onset of the tick season. This is consistent with the analysis conducted in Chapter III.

3. When activities which permitted selling livestock prior to the tick season were available, Hereford stockers were sold at the onset of the tick season, while Brahman-cross stockers were carried throughout the tick season.

4. When cropping activities were not allowed (as in Scenarios I and III), profits were not recognized until improved pastures were introduced. A possible reason for this is that the estimated tick effects derived in Chapters III and IV are too high to allow profitable beef production on the native pasture.

5. Broadleaf weed control on native pasture was not profitable.

6. Given all the situations, budgeted prices, and resource base, the optimal enterprise mix consists of running Hereford stockers through the winter months until the onset of the tick season, at which time the stockers should be sold.

Recommendations

Many problems are faced by researchers attempting to identify the damaging affects of lone star ticks on *Bos taurus* and *Bos indicus* cattle. Several major questions remain to be addressed in future research endeavors. Following is a list of potential future research projects which would assist in expanding the knowledge base regarding economically optimal strategies:

1. What factor does compensatory gain have in the weight loss caused by the lone star tick? If compensatory gain is 100 percent within a limited time frame, then this pest's damaging effects may only be in the transmission of diseases.

2. What are the price differences between Bos taurus and Bos indicus throughout the year? Recognizing the heat tolerance of the Brahman breed and cold tolerance of the British breeds, farmers should be willing to pay relatively more for the British breeds at fall sales if all other factors are constant across breed. Likewise, farmers should be willing to pay relatively more for cattle showing Brahman characteristics at spring sales. Lambert's (1982) study should be extended to identify seasonal price differences between cattle breeds for all seasons. The results of such a study could change the outcome of the whole farm analysis conducted in this study.

3. Additional entomological research is needed to verify the effects of ticks on stocker cattle. This study should be conducted before, during, and after the tick season. The establishment of a control group consisting of cattle remaining free of ticks throughout the study is imperative. In addition, compensatory gains after the tick season should be documented.

4. The whole farm planning model should be extended to include stocking activities that reflect purchase in July and sale in February.

5. The whole farm planning model should be extended to include integer activities which reflect the cost of converting tick infested native range into improved pastures.

As in any economic analysis, results depend upon assumptions included in the analysis. An attempt was made to justify all of the assumptions made in this study. The results of this study are only as good as the data and assumptions placed within. The author feels that all assumption made were realistic given the present set of research data available.

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APPENDIXES

APPENDIX A

ACARICIDE TREATMENT COST DEVELOPMENT

TABLE XIV

TIME AND COST[a] ASSOCIATED WITH THE GATHERING OF 25 BEEF FOR THE CONTROL OF TICKS

Pasture Condition[b]	Pasture Size (Acres) 80 (Min)	($)	($/Hd)	160 (Min)	($)	($/Hd)	240 (Min)	($)	($/Hd)
Good	30	3.36	0.13	40	4.48	0.18	40	4.48	0.18
Average	40	4.48	0.18	60	6.72	0.27	70	7.84	0.31
Poor	60	6.72	0.27	90	10.08	0.40	120	13.44	0.54

[a] Values are identified for two cowboys working at minimum wage ($3.36/hr) to gather a herd of 25 cattle. A herd of up to 50 cattle and as few as 5 head are assumed to take the same amount of time on the size and type of pasture in question.

[b] The designation of the condition of the land is based on the degree of brush density and number of gullies which would require checking for beef. "Good" indicates improved pasture or land with little to no brush and gullies. "Average" indicates land containing less than 30 percent brush coverage and no more than one gully per 10 acres. "Poor" indicates land which contains more than 30 percent brush coverage and more than one gully per 10 acres.

TABLE XV

ACARICIDES AND COSTS[a] USED IN THE STUDY

Acaricide	Percent Concentrate	Percent Control	Cost( )/Head/Treatment
Dioxathion	15.0	95	15.8
Stirofos	35.0	98	25.9
Toxaphene-Lindane	31.5	94	10.1

[a] The recommended volume of four liters/animal for the control of ticks is used to identify the costs. Thus, the use of 8 liters/cow-calf unit is required for tick control to be effective on the calf because of the cow-calf nursing relationship. The cost on a per-head basis of an individual control treatment would be the sum of the respective values of Tables XIV and XV. To represent the control of ticks on both cow and calf this value would be doubled, and to represent ten treatments over the tick season the resulting value would be represented ten times. Thus, control cost per cow-calf unit = (Number of cattle) x (Number of treatments) x (Treatment cost + Gathering Time).

APPENDIX B

BASE BUDGETS USED IN WHOLE FARM ANALYSIS

APPENDIX B

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COW-CALF COST & RETURNS/PER COW, 100 COW UNIT                                  11897218
SPRING CALVING, NATIVE GRASS                                                   03 '' 85
                                                                              SOUTHEAST
-----------------------------------------------------------------------------------------
    OPERATING INPUTS.                        UNITS    PRICE   QUANTITY     VALUE YOUR VALUE


      41-45% PRO  SUP.                       LBS      0 100    252 000     25.20 __________
      TAME GRASS HAY                         TONS     0 000      1 120      0 00 __________
      SALT & MIN.                            LBS      0 090     26 880      2 42 __________
      VET & MED                              DOL      5 000      1.000      5 00 __________
      HAULING & MKTG.                        CWT      0.750      4.220      3.16 __________
      PERSONAL TAXES                         HD       2.000      1 030      2.06 __________
      LIVESTOCK SUPP                         HD       3 250      1 000      3 25 __________
      PARASITE CONTROL                       DOL      3 500      1.000      3.50 __________
      ANNUAL OPERATING CAPITAL               DOL.     0 140     20 356      2 85 __________
      MACHINERY LABOR                        HR.      4 000      3.420     13 68 __________
      EQUIPMENT LABOR                        HR.      4 000      0 540      2 16 __________
      LIVESTOCK LABOR                        HR.      4.000      5.650     22 60 __________
      MACHINERY FUEL,LUBE,REPAIRS            DOL.                          20 14 __________
      EQUIPMENT FUEL,LUBE,REPAIRS            DOL.                           1.64 __________

    TOTAL OPERATING COST                                                  107 66 __________
-----------------------------------------------------------------------------------------
    FIXED COSTS                                    AMOUNT     VALUE                YOUR VALUE
      MACHINERY
        INTEREST AT 14 00%                          33.09      4 63                __________
        DEPR., TAXES INSURANCE                                 6.63                __________
      EQUIPMENT
        INTEREST AT 14.00%                          77.70     10.88                __________
        DEPR., TAXES INSURANCE                                 7.82                __________
      LIVESTOCK
          BEEF COW                              624.00                  __________
          BEEF BULL                              27.00                  __________
          BEEF HEIFER                            66.00                  __________
        INTEREST AT 14.00%                         717.00    100.38                __________
        DEPR., TAXES INSURANCE                                11.90                __________
      LAND
        PASTURE               9.82 AUMS                        0.00                __________
        INTEREST AT  0.00%                           0 00      0 00                __________
        TAXES                                                  0.00                __________

    TOTAL FIXED COST                                                      142 24 __________
-----------------------------------------------------------------------------------------
    PRODUCTION:                              UNITS    PRICE   QUANTITY     VALUE YOUR VALUE
      STR CALVES(4-500                       CWT.    72.000      1.849    133 13 __________
      HFR CALVES(4-500                       CWT.    66.000      1.255     82.86 __________
      COMMERCIAL COWS                        CWT.    43.000      0 950     40.85 __________
      AGED BULLS                             CWT.    46.000      0.160      7 36 __________

    TOTAL RECEIPTS                                                        264.20 __________
-----------------------------------------------------------------------------------------

    RETURNS ABOVE TOTAL OPERATING COSTS                                   156.54 __________

    RETURNS ABOVE ALL COSTS EXCEPT
        OVERHEAD,RISK,AND MANAGEMENT                                       14.30 __________
-----------------------------------------------------------------------------------------
NATIVE OR BERMUDA PASTURES & HAY UTILIZED                      EDDINGS, GERLOFF, BARNES
ASSUMES 86% CALF CROP
SUPP. 41% COTTONSEED MEAL                                      03/28/85        0000030110

PROCESSED BY DEPT  OF AGRI. ECON  - OKLAHOMA STATE UNIVERSITY
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APPENDIX B (Continued)

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BUDGET IDENTIFICATION NUMBER 11893218, STR 8        ANNUAL CAPITAL MONTH 10        BUDGET RECORD NUMBER 327
                                                                                          BUDGET FILE

COW CALF COST & RETURNS PER COW  100 COW UNIT                             11893218
SPRING CALVING  NATIVE GRASS                                              03/11/89
                                                                          SOUTHEAST

                        1     2     3     4     5     6     7     8     9    10    11    12     13      14    15   16   17   18
                       JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC   PRICE  WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                        CODE CODE
PRODUCTION                                   NUMBER OF UNITS
  1 STR CALVES(4-500)  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.43  0.00  0.00 -1.000  4.300  16    7    3    C
  2 HFR CALVES(4-500)  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.37  0.00  0.00 -1.000  4.090  16    8    2    C
  3 COMMERCIAL COWS    0.00  0.02  0.00  0.00  0.00  0.04  0.00  0.04  0.00  0.00  0.00  0.00 -1.000  8.900  16   17    2    C
  4 AGED BULLS         0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.01  0.00  0.00  0.00  0.00 -1.000 16.000  16   20    3    C

OPERATING INPUTS                             RATE/UNIT                                       PRICE  NUMBER UNIT ITEM TYPE CONT
                                                                                                    UNITS CODE CODE
 11 41-45% PRO  SUP   30.00 80.00 80.00 45.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 30.00 -1.000  1.120  12  119    3    C
 13 TAME GRASS HAY     0.20  0.30  0.20  0.10  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.20 -1.000  1.120   3   84    3    C
 14 PASTURE            0.24  0.20  0.30  0.70  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.24 -1.000  1.120  10  190    3    C
 15 SALT & MIN        10.00  0.00  0.00  4.00  0.00  0.00 10.00  0.00  0.00  0.00  0.00  0.00 -1.000  1.120  12  103    3    C
 16 VET & MED          0.00  0.25  0.00  0.00  0.00  0.80  0.00  0.00  0.00  0.00  0.25  0.00  5.000  1.000  19  416    2    C
 17 HAULING & MKTG     0.00  0.10  0.00  0.00  0.00  0.30  0.00  0.84  0.00  3.11  0.00  0.00  0.780  1.000  16  489    3    C
 18 PERSONAL TAXES     0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  1.00  2.000  1.000   1  442    3    0
 19 LIVESTOCK SUPP     0.00  0.00  0.25  0.00  0.00  0.25  0.00  0.00  0.25  0.00  0.00  0.25  5.250  1.000   1  417    3    0
 21 PARASITE CONTROL   0.00  0.25  0.00  0.00  0.00  0.50  0.00  0.00  0.00  0.00  0.25  0.00  3.800  1.000  15  418    3    C

MACHINERY REQUIREMENTS                       HOURS                                           XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                          UNIT CODE
 36 PICKUP  5 TON      0.25  0.30  0.30  0.20  0.15  0.15  0.15  0.15  0.15  0.30  0.15  0.25  0.000  0.000   0   11    4    C
 37 STOCK TRAILER      0.00  0.08  0.00  0.00  0.00  0.08  0.00  0.08  0.00  0.20  0.00  0.00  0.000  0.000  11   88    4    C

EQUIPMENT REQUIREMENTS                                                                      NUMBER PROPORT XXX EQUIP TYPE XXXX
                                                                                            UNITS  OF COST      CODE
 38 4-WIRE FENCE                                                                            8.000  0.010   0     1    5    0
 39 LOT FENCE                                                                              16.000  0.100   0     2    5    0
 44 MISC  EQUIP                                                                             1.000  0.010   0    24    5    0

LIVESTOCK INVESTMENT
 40 BEEF COW                                                                                1.000  1.000   0    51    5    0
 41 BEEF BULL                                                                               0.030  1.000   0    53    5    0
 42 BEEF HEIFER                                                                             0.120  1.000   0    52    5    0


 49 LIVESTOCK LABOR    0.80  0.80  0.80  0.48  0.40  0.40  0.40  0.40  0.40  0.70  0.40  0.80

-----------------------------------------------------------------------------------------------------------------------------
                              MONTHLY SUMMARY OF RECEIPTS AND EXPENDITURES
  CATEGORY           YEAR UNIT    JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC         TOTAL
TOTAL RECEIPTS          1 DOL    0.00   8.17   0.00   0.00   0.00  18.34   0.00  22.70   0.00 315.00   0.00   0.00        364.20
TOTAL VARIABLE COST     1 DOL    6.24  11.61   8.75   6.87   1.18   8.80   3.18   1.88   1.88   6.18   3.20   8.10         66.37
-----------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL          1 DOL    1.47   1.76   2.87   3.15   3.25   2.46   2.64   0.83   1.00   0.80   0.38   0.89         20.36
-----------------------------------------------------------------------------------------------------------------------------
                              LABOR REQUIREMENTS
MACHINERY LABOR         1 HOUR   0.30   0.42   0.26   0.24   0.18   0.24   0.18   0.24   0.18   0.50   0.18   0.30          3.42
LIVESTOCK LABOR         1 HOUR   0.80   0.80   0.80   0.48   0.40   0.40   0.40   0.40   0.40   0.70   0.40   0.80          6.78
EQUIPMENT LABOR         1 HOUR   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05          [illegible]
   TOTAL LABOR          1 HOUR   0.84   1.06   0.80   0.73   0.62   0.66   0.62   0.68   0.62   1.24   0.62   0.84          [illegible]
-----------------------------------------------------------------------------------------------------------------------------
                              MACHINERY REQUIREMENTS BY MONTH
PICKUP  5 TON              HOUR  0.25   0.25   0.30   0.20   0.15   0.20   0.15   0.20   0.15   0.30   0.15   0.25          [illegible]
STOCK TRAILER       1 0 3 HOUR   0.00   0.08   0.00   0.00   0.00   0.08   0.00   0.08   0.00   0.20   0.00   0.00          0.35
-----------------------------------------------------------------------------------------------------------------------------
                    NO        MONTHLY EQUIPMENT REQUIREMENTS AS A PROPORTION OF THE ITEMS WHOLE FARM USE
4-WIRE FENCE        8 0 1 MILE  0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008   0.0100
LOT FENCE          16 0 1 FEET  0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083   0.1000
BEEF COW            1 0 1 CWT   0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833   1.0000
BEEF BULL           0 0 1 CWT   0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833   1.0000
BEEF HEIFER         0 1 1 CWT   0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833   1.0000
MISC  EQUIP         1.0 1 NO    0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008   0.0100
         THE FINAL ENTRY IN EACH ROW REPRESENTS THE PROPORTION OF THE ITEMS TIME ALLOCATED TO THE BUDGET UNIT
-----------------------------------------------------------------------------------------------------------------------------
                              MACHINERY FIXED AND VARIABLE COST PER HOUR               TOTAL
    MACHINE        CODE    DEPR     INSUR     TAX   TOTAL FIXED  REPAIR    FUEL     LUB    VARIABLE     INT      HR/TIME
PICKUP  5 TON       11     1.88     0.08     0.14      2.08       2.30     4.11     0.62     6.83      1.38      1.00
STOCK TRAILER       88     1.77     0.12     0.38      2.27       1.14     0.00     0.00     1.14      2.94      1.00
-----------------------------------------------------------------------------------------------------------------------------
                              ANNUAL COST SUMMARY FOR EQUIPMENT AND LIVESTOCK
LINE                                  LIST   DEPREC-            INSUR-                       FUEL    HOURS TOT OWN- TOT OPER-
NO      ITEM           SIZE  UNIT    PRICE   IATION  INTEREST    ANCE    TAXES  REPAIRS AND LUBE     LABOR ERSHP/YR ATING/YR
  1 4-WIRE FENCE       1.00 MILE   2400.00   96.00    180.00     7.20    12.00    24.00     0.00      1.00   115.20    24.00
  2 LOT FENCE          1.00 FEET  - 22.00     1.10      1.54     0.07     0.11     0.27     0.00      0.30     1.28     0.27
 51 BEEF COW           8.50 CWT    650.00    10.40     87.38     0.00     0.00     0.00     0.00      0.00    10.40     0.00
 53 BEEF BULL         16.00 CWT   1000.00    50.00    126.00     0.00     0.00     0.00     0.00      0.00    50.00     0.00
 52 BEEF HEIFER        8.00 CWT    550.00     0.00     77.00     0.00     0.00     0.00     0.00      0.00     0.00     0.00
 24 MISC  EQUIP      100.00 NO      20.00     2.00      1.40     0.06     0.10     0.20     0.00      1.00     2.16     0.20
-----------------------------------------------------------------------------------------------------------------------------
                              ANNUAL CHARGES MADE IN THIS BUDGET FOR EQUIPMENT AND LIVESTOCK
LINE                            NUMBER  PROPOR  OWNERSHP OPERATING INTEREST LABOR HOURS
NO      ITEM           SIZE  UNIT   ITEMS  CHARGED  CHARGES  CHARGES  CHARGES  CHARGED
  1 4-WIRE FENCE       1.00 MILE    8.00    0.01     3.78     1.20     8.40     0.08
  2 LOT FENCE          1.00 FEET   16.00    0.10     2.04     0.44     3.46     0.48
 51 BEEF COW           8.50 CWT     1.00    1.00    10.40     0.00    87.38     0.00
 52 BEEF BULL         16.00 CWT     0.03    1.00     1.50     0.00     3.78     0.00
 53 BEEF HEIFER        8.00 CWT     0.12    1.00     0.00     0.00     9.24     0.00
 24 MISC  EQUIP      100.00 NO      1.00    0.01     0.02     0.00     0.01     0.01
-----------------------------------------------------------------------------------------------------------------------------
        COLUMN        1     2       3       4      5      6      7        8      9      10     11     12      13     14    15    16
NAME OF MACHINE     CODE  WIDTH  INITIAL  SPEED  FIELD   RC1    RC2      RC3   HOURS  YEARS   RFV1   RFV2  PURCHASE FUEL HOURS  HP
                          (FEET)   LIST   (MPH) EFFIC-                          USED  OWNED                  PRICE   TYPE  OF
                                  PRICE          ENCY                         ANNUALLY                                    LIFE
PICKUP  5 TON        11    0.5    11000    20.0   0.60   0.80  0.001885  1.40   800     5.0  0.600  0.885   11000    1   4000  130
STOCK TRAILER        88    5.0     3800    10.0   0.17   0.60  0.002910  1.30   100    20.0  0.635  0.885    3800    0   2000    0
-----------------------------------------------------------------------------------------------------------------------------
    COLUMN---       1     2    3     4       5        6       7       8       9      10      11
                                                                   SALVAGE REPAIR FUEL &  ANNUAL
                                            LIST  PURCHASE  YEARS  PROP OF  PROP  LUB AS  HOURS
ITEM NAME         CODE   SIZE UNIT TYPE    PRICE    PRICE    LIFE   LIST OF LIST  PROP    LABOR
4-WIRE FENCE        1    1.00  18  2.00  2400.00  2400.00   25.00   0.000  0.250  0.000    1.00
LOT FENCE           2    1.00  19  2.00    22.00    22.00   20.00   0.000  0.250  0.000    0.30
MISC  EQUIP        24  100.00   1  2.00    20.00    20.00   10.00   0.000  0.100  0.000    1.00
BEEF COW           51    8.50  16  1.00   650.00   650.00    5.00   0.820  0.000  0.000    0.00
BEEF HEIFER        52    8.00  16  1.00   550.00   550.00    6.00   1.000  0.000  0.000    0.00
BEEF BULL          53   16.00  16  1.00  1000.00  1000.00    4.00   0.800  0.000  0.000    0.00
-----------------------------------------------------------------------------------------------------------------------------
         NATIVE OR BERMUDA PASTURES & HAY UTILIZED                 EDDINGS  GERLOFF  BARNES     MACHINERY COMPLEMENT   8
         ASSUMES 86% CALF CROP                                                                  EQUIPMENT COMPLEMENT   5
         SUPP  41% COTTONSEED MEAL                                 03/28/89    0000000110               PRICE VECTOR   8

                     LINE CHANGE          LINE CHANGE          LINE CHANGE          LINE CHANGE          LINE CHANGE
GENERAL NAME CHANGE->417  LIVESTOCK SUPP   418  PARASITE CONTROL
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APPENDIX B (Continued)

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COW-CALF COST & RETURNS / PER COW, 100 COW UNIT                            118934'8
FALL CALVING, NATIVE GRASS                                                 08/0' 84
                                                                          SOUTHEAST
-----------------------------------------------------------------------------------
    OPERATING INPUTS                    UNITS     PRICE  QUANTITY      VALUE YOUR VALUE


      41-45% PRO  SUP                   LBS       0 185   554 400     102 56 __________
      GRASS HAY                         TONS     52 000     1 075      55 91 __________
      SALT & MIN                        LBS       0 090    26 880       2 42 __________
      VET & MED                         DOL       5 000     1.000       5 00 __________
      HAULING & MKTG                    CWT       2 250     4 230       9 52 __________
      PERSONAL TAXES                    HD        2.000     1 030       2 06 __________
      LVSTOCK SUPPLIES                  HD.       3 250     1 000       3.25 __________
      HERD BULLS                        CWT     100 000     0 160      16 00 __________
      PARASITE CONTROL                  DOL.      3 500     1 000       3.50 __________
      ANNUAL OPERATING CAPITAL          DOL.      0 140    67 112       9 40 __________
      MACHINERY LABOR                   HR        4.250     3.420      14.53 __________
      EQUIPMENT LABOR                   HR.       4.250     0 540       2 29 __________
      LIVESTOCK LABOR                   HR        4 250     5.850      24.86 __________
      MACHINERY FUEL,LUBE,REPAIRS       DOL                            21.09 __________
      EQUIPMENT FUEL,LUBE,REPAIRS       DOL                             1 64 __________

    TOTAL OPERATING COST                                              274.04 __________
-----------------------------------------------------------------------------------
  . FIXED COSTS                                 AMOUNT     VALUE             YOUR VALUE
      MACHINERY
        INTEREST AT 14.00%                       44.35      6.21
                                                                             __________
        DEPR , TAXES INSURANCE                              7 83             __________
      EQUIPMENT
        INTEREST AT 14.00%                       77.70     10.88             __________
        DEPR , TAXES INSURANCE                              7.82             __________
      LIVESTOCK
          BEEF COW                           624.00                __________
          BEEF BULL                           27.00                __________
          BEEF HEIFER                         66.00                __________
        INTEREST AT 14.00%                      717.00    100 38             __________
        DEPR , TAXES INSURANCE                             11.90             __________
      LAND
        PASTURE              10.14 AUMS                     0.00             __________
        INTEREST AT  0.00%                        0.00      0.00             __________
        TAXES                                               0.00             __________

    TOTAL FIXED COST                                                  145 02 __________
-----------------------------------------------------------------------------------
    PRODUCTION:                         UNITS     PRICE  QUANTITY      VALUE YOUR VALUE
      STR CALVES(4-500                  CWT.     72.000     1.849     133.13 __________
      HFR CALVES(4-500                  CWT.     64.000     1.255      80.35 __________
      COMMERCIAL COWS                   CWT.     41.000     0.950      38.95 __________
      AGED BULLS                        CWT.     46.000     0.160       7.36 __________

    TOTAL RECEIPTS                                                    259 79 __________
-----------------------------------------------------------------------------------

    RETURNS ABOVE TOTAL OPERATING COSTS                               -14.25 __________

    RETURNS ABOVE ALL COSTS EXCEPT
        OVERHEAD,RISK,AND MANAGEMENT                                 -159.27 __________
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NATIVE OR BERMUDA PASTURES & HAY UTILIZED                  EDDINGS, GERLOFF, BARNES
ASSUMES 86% CALF CROP
SUPP  IS 41% COTTONSEED MEAL                               06/13/84      0000000110
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APPENDIX B (Continued)

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 -  BUDGET IDENTIFICATION NUMBER   8824180 888 8      ANNUAL CAPITAL MONTH  6      BUDGET RECORD NUMBER 333
                                                                                          BUDGET

      COW-CALF COST & RETURNS   PER COW  100 COW UNIT                          18834 8
      FALL CALVING  NATIVE GRASS                                               30 07 84
                                                                              SOUTHEAST

                         1     2     3     4     5     6     7     8     9    10    11    12     13     14    15   16   17  18
                        JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC   PRICE WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                        CODE CODE
PRODUCTION                                    NUMBER OF UNITS
  1 STR CALVES(4-500   0.00  0.00  0.00  0.00  0.00  0.43  0.00  0.00  0.00  0.00  0.00  0.00 -1.000  4.300  16    7    2
  2 HFR CALVES(4-500   0.00  0.00  0.00  0.00  0.00  0.31  0.00  0.00  0.00  0.00  0.00  0.00 -1.000  4.050  16    8    2
  3 COMMERCIAL COWS    0.00  0.03  0.00  0.00  0.00  0.03  0.00  0.04  0.00  0.00  0.00  0.00 -1.000  9.500  16   18    2
  4 AGED BULLS         0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.01  0.00  0.00  0.00 -1.000 16.000  16   20    2

OPERATING INPUTS                              RATE/UNIT                                        PRICE NUMBER UNIT ITEM TYPE CONT
                                                                                                     UNITS CODE CODE
 11 41-45% PRO. SUP   90.00 90.00 90.00 45.00  0.00  0.00  0.00  0.00  0.00  0.00 90.00 90.00 -1.000  1.120  12  115    3
 12 GRASS HAY          0.33  0.33  0.33  0.11  0.00  0.00  0.00  0.00  0.00  0.00  0.38  0.38 -1.000  1.120   3   83    3    0
 14 PASTURE            0.33  0.33  0.33  0.68  1.00  1.00  1.00  1.00  1.00  1.00  0.69  0.69 -1.000  1.120  10  150    3    0
 15 SALT & MIN        10.00  0.00  0.00  4.00  0.00  0.00 10.00  0.00  0.00  0.00  0.00  0.00 -1.000  1.120  12  103    3    0
 16 VET & MED          0.00  0.25  0.00  0.00  0.00  0.50  0.00  0.00  0.00  0.00  0.25  0.00  5.000  1.000  15  416    3    0
 17 HAULING & MKTG     0.00  0.28  0.00  0.00  0.00  3.40  0.00  0.38  0.18  0.00  0.00  0.00  2.250  1.000  16  485    3    0
 18 PERSONAL TAXES     0.00  0.00  0.30  0.00  0.00  0.00  0.30  0.00  0.00  0.00  0.00  1.00  2.000  1.000   1  443    3    0
 19 LVSTOCK SUPPLIES   0.00  0.00  0.25  0.00  0.00  0.25  0.00  0.00  0.25  0.00  0.00  0.25  3.250  1.000   1  417    3    0
 20 HERD BULLS         0.00  0.00  0.00  0.00  0.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000 16.000  16   18    3    0
 21 PARASITE CONTROL   0.00  0.25  0.00  0.00  0.00  0.50  0.00  0.00  0.00  0.25  0.00  0.00  3.800  1.000  15  418    3    0

MACHINERY REQUIREMENTS                        HOURS                                            XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                            UNIT CODE
 26 PICKUP             0.25  0.30  0.30  0.20  0.15  0.50  0.15  0.15  0.15  0.15  0.15  0.25  0.000  0.000   0   11    4    0
 27 STOCK TRAILER      0.00  0.08  0.00  0.00  0.00  0.20  0.00  0.08  0.08  0.00  0.00  0.00  0.000  0.000  11   99    4    0

EQUIPMENT REQUIREMENTS                                                                        NUMBER PROPORT XXX EQUIP TYPE XXXX
                                                                                               UNITS OF COST      CODE
 38 4-WIRE FENCE                                                                               5.000  0.010   0     1    5    0
 39 LOT FENCE                                                                                 16.000  0.100   0     2    5    0
 44 MISC  EQUIP                                                                                1.000  0.010   0    24    5    0

LIVESTOCK INVESTMENT
 40 BEEF COW                                                                                   1.000  1.000   0    51    5    0
 41 BEEF BULL                                                                                  0.030  1.000   0    53    5    0
 42 BEEF HEIFER                                                                                0.120  1.000   0    52    5    0


 49 LIVESTOCK LABOR    0.55  0.55  0.55  0.50  0.40  0.70  0.40  0.40  0.40  0.40  0.50  0.50

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                              MONTHLY SUMMARY OF RECEIPTS AND EXPENDITURES
  CATEGORY          YEAR UNIT    JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP     OCT     NOV     DEC        TOTAL
TOTAL RECEIPTS         1 DOL     0.00   11.68    0.00    0.00    0.00  259.10    0.00   18.54    7.38    0.00    0.00    0.00      296.70
TOTAL VARIABLE COST    1 DOL    35.02   37.55   35.19   17.73   17.23   16.64    2.24    2.48    2.81    3.11   25.79   28.15      223.94
---------------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL         1 DOL     7.59    8.74   12.66   14.15   15.90    0.00    0.19    0.00    0.00    0.18    2.23    4.67       67.11
---------------------------------------------------------------------------------------------------------------------------------
                              LABOR REQUIREMENTS
MACHINERY LABOR        1 HOUR    0.30    0.42    0.36    0.24    0.18    0.60    0.18    0.24    0.24    0.18    0.18    0.30        3.42
LIVESTOCK LABOR        1 HOUR    0.55    0.55    0.55    0.50    0.40    0.70    0.40    0.40    0.40    0.40    0.50    0.50        5.85
EQUIPMENT LABOR        1 HOUR    0.08    0.08    0.08    0.08    0.08    0.08    0.08    0.08    0.08    0.08    0.05    0.05        0.94
   TOTAL LABOR         1 HOUR    0.90    1.01    0.95    0.78    0.62    1.34    0.62    0.66    0.66    0.62    0.72    0.84        9.81
---------------------------------------------------------------------------------------------------------------------------------
                              MACHINERY REQUIREMENTS BY MONTH
PICKUP                   HOUR    0.25    0.25    0.30    0.20    0.15    0.50    0.15    0.20    0.20    0.15    0.15    0.25        2.88
STOCK TRAILER      ( 0.2)HOUR    0.00    0.08    0.00    0.00    0.00    0.20    0.00    0.08    0.08    0.00    0.00    0.00        0.35
---------------------------------------------------------------------------------------------------------------------------------
                   NO         MONTHLY EQUIPMENT REQUIREMENTS AS A PROPORTION OF THE ITEMS WHOLE FARM USE
4-WIRE FENCE      5.0 1 MILE  0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008     0.0100
LOT FENCE        16.0 1 FEET  0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083 0.0083     0.1000
BEEF COW          1.0 1 CWT   0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833     1.0000
BEEF BULL         0.0 1 CWT   0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833     1.0000
BEEF HEIFER       0.1 1 CWT   0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833 0.0833     1.0000
MISC  EQUIP       1.0 1 HD    0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008     0.0100
        THE FINAL ENTRY IN EACH ROW REPRESENTS THE PROPORTION OF THE ITEMS TIME ALLOCATED TO THE BUDGET UNIT
---------------------------------------------------------------------------------------------------------------------------------
                              MACHINERY FIXED AND VARIABLE COST PER HOUR                  TOTAL
   MACHINE          CODE      DEPR      INSUR      TAX    TOTAL FIXED  REPAIR     FUEL     LUB     VARIABLE      INT      HR/TIME
PICKUP               11       2.13      0.08      0.22       2.43       2.20      4.45     0.67      7.32       1.89       1.00
STOCK TRAILER        99       2.21      0.10      0.28       2.60       0.68      0.00     0.00      0.68       2.37       1.00
---------------------------------------------------------------------------------------------------------------------------------
                              ANNUAL COST SUMMARY FOR EQUIPMENT AND LIVESTOCK
LINE                                   LIST    DEPREC-            INSUR-                          FUEL      HOURS TOT OWN- TOT OPER-
NO       ITEM           SIZE  UNIT     PRICE   IATION  INTEREST    ANCE      TAXES  REPAIRS AND LUBE      LABOR ERSHP YR ATING YR
  1 4-WIRE FENCE        1.00 MILE   2400.00    96.00    168.00     7.20     12.00    24.00     0.00       1.00   115.20    24.00
  2 LOT FENCE           1.00 FEET     22.00     1.10      1.54     0.07      0.11     0.27     0.00       0.30     1.28     0.27
 51 BEEF COW            9.50 CWT     650.00    10.40     87.36     0.00      0.00     0.00     0.00       0.00    10.40     0.00
 53 BEEF BULL          16.00 CWT    1000.00    50.00    126.00     0.00      0.00     0.00     0.00       0.00    50.00     0.00
 52 BEEF HEIFER         8.00 CWT     550.00     0.00     77.00     0.00      0.00     0.00     0.00       0.00     0.00     0.00
 24 MISC  EQUIP       100.00 HD       20.00     2.00      1.40     0.08      0.10     0.20     0.00       1.00     2.16     0.20
---------------------------------------------------------------------------------------------------------------------------------
                              ANNUAL CHARGES MADE IN THIS BUDGET FOR EQUIPMENT AND LIVESTOCK
LINE                                  NUMBER   PROPOR  OWNERSHP OPERATING INTERST LABOR HOURS
NO       ITEM           SIZE  UNIT    ITEMS   CHARGED  CHARGES   CHARGES  CHARGES  CHARGED
  1 4-WIRE FENCE        1.00 MILE      5.00     0.01      5.76      1.20     8.40     0.05
  2 LOT FENCE           1.00 FEET     16.00     0.10      2.04      0.44     2.46     0.48
 51 BEEF COW            9.50 CWT       1.00     1.00     10.40      0.00    87.36     0.00
 53 BEEF BULL          16.00 CWT       0.03     1.00      1.50      0.00     3.78     0.00
 52 BEEF HEIFER         8.00 CWT       0.12     1.00      0.00      0.00     9.24     0.00
 24 MISC  EQUIP       100.00 HD        1.00     0.01      0.02      0.00     0.01     0.01
---------------------------------------------------------------------------------------------------------------------------------
          COLUMN        1      2       3       4      5      6        7       8      9     10      11     12      13     14     15    16
NAME OF MACHINE       CODE  WIDTH  INITIAL   SPEED  FIELD  RC1      RC2     RL3   HOURS  YEARS   RFV1   RFV2  PURCHASE  FUEL  HOURS  HP
                            (FEET)   LIST    (MPH)  EFFIC-                        USED   OWNED                  PRICE   TYPE    OF
                                    PRICE           ENCY                         ANNUALLY                                      LIFE
PICKUP                 11    0.5    11000    20.0   0.95   0.60  0.001385   1.40   500    8.0   0.600  0.885   11000     1    4000  130
STOCK TRAILER          99   16.0     2800    20.0   0.90   0.60  0.002510   1.30   100   10.0   0.635  0.895    2800     0    2000    0
---------------------------------------------------------------------------------------------------------------------------------
    COLUMN--->          1       2    3     4        5        6         7       8       9      10      11
                                                                              SALVAGE REPAIR  FUEL & ANNUAL
                                                   LIST   PURCHASE   YEARS   PROP OF  PROP   LUB AS  HOURS
ITEM NAME            CODE    SIZE UNIT TYPE      PRICE     PRICE     LIFE    LIST OF LIST    PROP    LABOR
4-WIRE FENCE            1    1.00  18  2.00    2400.00   2400.00    25.00    0.000   0.250   0.000    1.00
LOT FENCE               2    1.00  19  2.00      22.00     22.00    20.00    0.000   0.250   0.000    0.30
MISC  EQUIP            24  100.00   1  2.00      20.00     20.00    10.00    0.000   0.100   0.000    1.00
BEEF COW               51    9.50  16  1.00     650.00    650.00     9.00    0.820   0.000   0.000    0.00
BEEF HEIFER            52    8.00  16  1.00     550.00    550.00     6.00    1.000   0.000   0.000    0.00
BEEF BULL              53   16.00  16  1.00    1000.00   1000.00     4.00    0.800   0.000   0.000    0.00
---------------------------------------------------------------------------------------------------------------------------------
            NATIVE OR BERMUDA PASTURES & HAY UTILIZED                  EDDINGS  GERLOFF  BARNES     MACHINERY COMPLEMENT   8
            ASSUMES 86% CALF CROP                                                                   EQUIPMENT COMPLEMENT   8
            SUPP  IS 41% COTTONSEED MEAL                               06/13/84       0000000110          PRICE VECTOR   8

                         LINE CHANGE             LINE CHANGE                LINE CHANGE              LINE CHANGE              LINE CHANGE
GENERAL NAME CHANGE--> 18  CULL COWS             417  LVSTOCK SUPPLIES      83  GRASS HAY            418  PARASITE CONTROL 150  PASTURE
***NO COMPLEMENT CHANGES HAVE BEEN STORED WITH THIS BUDGET***

BUDGET 918824180 888 8 HAS BEEN STORED IN CASH FLOW SUMMARY FILE LOCATION NUMBER  333 FILE NUMBER  1
```

APPENDIX B (Continued)

```
BERMUDA GRASS PASTURE & HAY                                                 83890301
CONVENTIONAL BALE                                                         03 [illegible] 85
CUSTOM HARVEST & HAUL                                                      SOUTHEAST
    ----------------------------------------------------------------------- -------
    OPERATING INPUTS                  UNITS     PRICE   QUANTITY      VALUE YOUR VALUE


      NITROGEN (N)                    LBS       0 250   200 000       50 00 __________
      PHOSPH (P2O5)                   LBS       0 260    80 000       20 80 __________
      POTASH (K2O)                    LBS       0 130   120 000       15 60 __________
      RNTFERTSPRD/ACRE                ACRE      1.250     1 000        1.25 __________
      HAULING                         TONS      7 250     5 000       36 25 __________
      SWATHE & BALE                   TONS     23.000     5.000      115 00 __________
      ANNUAL OPERATING CAPITAL        DOL.      0.140     6 539        0 82 __________
      LABOR CHARGES                   HR        4.000     0 047        0.19 __________
      MACHINERY FUEL,LUBE,REPAIRS     ACRE                            .0.20 __________

    TOTAL OPERATING COST                                             240.21 __________
    ------------------------------------------------------------------------------
    FIXED COSTS                                 VALUE YOUR VALUE


      MACHINERY
        INTEREST AT 14.0%             DOL.      0 145 __________
       .DEPR.,TAXES,INSUR             DOL.      0.135 __________
      LAND
        INTEREST AT  0.0%             DOL.      0.000 __________
        TAXES                         DOL.      0.000 __________

    TOTAL FIXED COSTS                           0.28  __________
    ------------------------------------------------------------------------------
    PRODUCTION:                       UNITS     PRICE   QUANTITY      VALUE YOUR VALUE


      BERMUDA HAY                     TONS     65.000     5.000      325.00 __________
      PASTURE                         AUMS      0.000     1.250        0.00 __________


    TOTAL RECEIPTS                                                   325.00 __________
    ------------------------------------------------------------------------------
    RETURNS ABOVE TOTAL OPERATING COSTS                               84.79 __________

    RETURNS ABOVE ALL COSTS EXCEPT
        OVERHEAD,RISK AND MANAGEMENT                                  84.51 __________
    ------------------------------------------------------------------------------
                                                                    EDDINGS,GERLOFF

                                                         03/28/85      0000000110

          PROCESSED BY DEPT. OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
        PROGRAM DEVELOPED BY DEPT. OF AGRI. ECON. OKLAHOMA STATE UNIVERSITY


RETURNS ABOVE TOTAL OPERATING COSTS
WHEN THE QUANTITY OF BERMUDA HAY      RANGES FROM   4.00 TO  6.00
 AND THE PRICE OF    BERMUDA HAY      RANGES FROM  59.00 TO 71.00

                              QUANTITY OF BERMUDA HAY

                                4.00       4.50       5.00       5 50       6 00

                          ..................................................  ......
                  59.00 .      26 04      40.42      54 79      69 17      83 54
                        .
                  62.00 .      38.04      53 92      69 79      85 67     101.54
PRICE OF                .
BERMUDA HAY       65.00 .      50.04      67.42      84.79     102.17     119.54
                        .
                  68.00 .      62.04      80 92      99.79     118 67     137 54
                        .
                  71 00 .      74 04      94 42     114 79     135 17     155 54
                        .
             RETURNS NOT ADJUSTED FOR EFFECT OF YIELD CHANGES ON COSTS
```

APPENDIX B (Continued)

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BUDGET IDENTIFICATION NUMBER  [illegible] BOP 0        ANNUAL CAPITAL MONTH  5        BUDGET RECORD NUMBER 109
                                                                                       BUDGET FILE   1

BERMUDA GRASS PASTURE & HAY                                          [illegible]
CONVENTIONAL BALE                                                    03 11 85
CUSTOM HARVEST & HAUL                                                SOUTHEAST

                        1     2     3     4     5     6     7     8     9    10    11    12     13      14    15   16   17   18
                       JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC   PRICE  WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                      CODE CODE
PRODUCTION                                  NUMBER OF UNITS
  1 BERMUDA HAY        0.00  0.00  0.00  0.00  0.37  2.95  0.00  1.33  0.00  0.95  0.00  0.00 -1.000   0.000   3   83    2    0
  3 PASTURE            0.25  0.25  0.25  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.25  0.25  0.000   0.000  10  180    2    0

OPERATING INPUTS                            RATE/UNIT                                        PRICE  NUMBER UNIT ITEM TYPE CONT
                                                                                                     UNITS CODE CODE
 11 NITROGEN (N)       0.00  0.00  0.00  0.00200.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000   0.000  12  211    3    0
 12 PHOSPH (P2O5)      0.00  0.00  0.00  0.00 80.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000   0.000  13  214    3    0
 13 POTASH (K2O)       0.00  0.00  0.00  0.00120.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000   0.000  12  216    3    0
 14 DRY FERT SPRD ACRE 0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000   0.000   7  362    3    0
 15 HAULING            0.00  0.00  0.00  0.00  0.37  2.85  0.00  1.33  0.00  0.95  0.00  0.00  7.290   0.000   3  306    3    0
 16 SWATHE & BALE      0.00  0.00  0.00  0.00  0.37  2.89  0.00  1.33  0.00  0.95  0.00  0.00 -1.000   0.000   3  308    3    0

MACHINERY REQUIREMENTS                      TIMES OVER                                       XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                          UNIT CODE
 43 DRY FERT SPRD      0.00  0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.000   0.000   3   68    4    0

------------------------------------------------------------------------------------------------------------------------------
                             MONTHLY SUMMARY OF RECEIPTS AND EXPENSES
      CATEGORY         UNIT      JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP     OCT     NOV     DEC        TOTAL
TOTAL RECEIPTS         ACRE     0.00    0.00    0.00    0.00   17.85  103.25    0.00   [illegible]  0.00  [illegible]  0.00  0.00   [illegible]
TOTAL EXPENSES         ACRE     0.00    0.00    0.00    0.00  [illegible] [illegible] 0.00 [illegible] 0.00  [illegible]  0.00  0.00   [illegible]
RETURNS TO LAND  LABOR  CAPITAL  MACHINERY  OVERHEAD  RISK  AND MANAGEMENT                                                   [illegible]
------------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL         DOL      0.00    0.00    0.00    0.00  [illegible] 0.00    0.00    0.00    0.00    0.00    0.00    0.00     [illegible]
------------------------------------------------------------------------------------------------------------------------------
                             LABOR REQUIREMENTS BY MONTH
MACHINERY LABOR        HR       0.00    0.00    0.00    0.00    0.05    0.00    0.00    0.00    0.00    0.00    0.00    0.00        0.05
------------------------------------------------------------------------------------------------------------------------------
                             MACHINERY FIXED AND VARIABLE COSTS PER HOUR                         TOTAL
   MACHINE         CODE      DEPR      INSUR      TAX    TOTAL FIXED  REPAIR     FUEL     LUB   VARIABLE     INT     HR/TIME
TRACTOR              3       2.45      0.15      0.36       3.18       1.90      2.98     0.43     4.81      3.62      1.00
DRY FERT SPRD       68       0.00      0.00      0.00       0.00       0.00      0.00     0.00     0.00      0.00      0.04
------------------------------------------------------------------------------------------------------------------------------
                      ITEM          TIMES LABOR  MACHINE FUEL,OIL,LUB ,  FIXED COSTS
  OPERATION           NO     DATE   OVER  HOURS  HOURS   REPAIR PER ACRE  PER ACRE
------------------------------------------------------------------------------------------------------------------------------
DRY FERT SPRD        3 68    MAY    1.00  0.047  0.039      0.20              0.28
    TOTAL                                 0.047  0.039      0.20              0.28
------------------------------------------------------------------------------------------------------------------------------
         COLUMN       1     2       3       4      5       6       7        8       9      10      11      12       13      14     15    16
NAME OF MACHINE     CODE  WIDTH  INITIAL  SPEED  FIELD    RC1     RC2      RC3    HOURS   YEARS   RFV1    RFV2  PURCHASE  FUEL  HOURS  HP
                          (FEET)  LIST    (MPH)  EFFIC-                           USED    OWNED                   PRICE   TYPE   OF
                                  PRICE          IENCY                          ANNUALLY                                        LIFE
TRACTOR               3   80.0   23800     4.5   0.88    0.90  0.000031   1.90   600     10.0   0.680   0.920    23800     3   10000   80
DRY FERT SPRD        68   60.0       0     5.3   0.67    0.75  0.000031   1.90    90     30.0   0.980   0.865        0     0    1000    0
------------------------------------------------------------------------------------------------------------------------------
                                                                  EDD/HRS,BERLOFF    MACHINERY COMPLEMENT   6
                                                                                     EQUIPMENT COMPLEMENT   0
                                                      03/28/85        0000000110          PRICE VECTOR      0

                        LINE CHANGE              LINE CHANGE                 LINE CHANGE        LINE CHANGE        LINE CHANGE
GENERAL NAME CHANGE-->306  HAULING               308  SWATHE & BALE

                         PV CL   VALUE        PV CL   VALUE          PV CL   VALUE      PV CL   VALUE      PV CL   VALUE      PV CL   VALUE
MACH COMP CHGS-->68   3   0.000000  68 13   0.000000
```

APPENDIX B (Continued)

```
WHEAT - LOAM SOILS                                                      76890101
                                                                        08/01/84
                                                                       SOUTHEAST
   ----------------------------------------------------------------------------
   OPERATING INPUTS                   UNITS     PRICE  QUANTITY     VALUE YOUR VALUE


     WHEAT SEED                       BU.       4 300     1 500      6 45 _________
     NITROGEN (N)                     LBS       0 270    51 000     13 77 _________
     PHOSPH (P205)                    LBS       0 250    46.000     11.50 _________
     RNTFERTSPRD/TON                  ACRE      4 000     2 000      8.00 _________
     ANNUAL OPERATING CAPITAL         DOL       0 140    25.371      3 55 _________
     LABOR CHARGES                    HR        4 250     1 181      5 02 _________
     MACHINERY FUEL.LUBE.REPAIRS      ACRE                           9.85 _________

   TOTAL OPERATING COST                                             58 14 _________
   ----------------------------------------------------------------------------
   FIXED COSTS                                  VALUE YOUR VALUE


     MACHINERY
       INTEREST AT 14 0%              DOL.     17 945 _________
       DEPR.,TAXES.INSUR.             DOL.     19 740 _________
     LAND
       INTEREST AT  0.0%              DOL.      0 000 _________
       TAXES                          DOL       0.000 _________

   TOTAL FIXED COSTS                           37 68  _________
   ----------------------------------------------------------------------------
   PRODUCTION:                        UNITS     PRICE  QUANTITY     VALUE YOUR VALUE


     WHEAT                            BU        3.200    30.000     96 00 _________
     PASTURE                          AUMS      0.000     0.800      0.00 _________


   TOTAL RECEIPTS                                                   96.00 _________
   ----------------------------------------------------------------------------
   RETURNS ABOVE TOTAL OPERATING COSTS                              37 86 _________

   RETURNS ABOVE ALL COSTS EXCEPT
       OVERHEAD.RISK AND MANAGEMENT                                  0.18 _________
   ----------------------------------------------------------------------------
100# OF 18-46-0 FERT APPLIED                                     EDDINGS.GERLOFF

                                                        06/13/84       0000000110

      PROCESSED BY DEPT  OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
  PROGRAM DEVELOPED BY DEPT. OF AGRI. ECON. OKLAHOMA STATE UNIVERSITY


RETURNS ABOVE TOTAL OPERATING COSTS
WHEN THE PRICE OF    WHEAT              RANGES FROM   2.80 TO  3 60
 AND THE QUANTITY OF WHEAT              RANGES FROM  26.00 TO 34.00

                          PRICE OF    WHEAT

                              2.80      3.00      3 20      3.40      3.60

                     **************************************************
                26.00 *      14.66     19.86     25.06     30.26     35 46
                      *
                28 00 *      20.26     25.86     31 46     37 06     42 66
                      *
QUANTITY OF           *
WHEAT           30.00 *      25.86     31.86     37.86     43 86     49 86
                      *
                32 00 *      31 46     37.86     44 26     50 66     57.06
                      *
                34 00 *      37 06     43.86     50 66     57 46     64 26
                      *
        RETURNS NOT ADJUSTED FOR EFFECT OF YIELD CHANGES ON COSTS
```

APPENDIX B (Continued)

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        BUDGET IDENTIFICATION NUMBER  78890101W BOE 8          ANNUAL CAPITAL MONTH  8          BUDGET RECORD NUMBER 241
                                                                                                      BUDGET FILE    1

        WHEAT - LOAM SOILS                                                                 78890101
                                                                                           DR 01,84
                                                                                           SOUTHEAST

                           1      2      3      4      5      6      7      8      9     10     11     12      13      14    15   16   17   18
                          JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC   PRICE  WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                                       CODE CODE
PRODUCTION                                       NUMBER OF UNITS
  1 WHEAT                 0 00   0 00   0 00   0 00   0 00  30 00   0 00   0 00   0 00   0 00   0 00   0 00 -1 000  0 000    2   76    2    0
  2 PASTURE               0 20   0 20   0 20   0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 10   0 10 -1 000  0 000   10  150    2    0

OPERATING INPUTS                                   RATE/UNIT                                             PRICE  NUMBER UNIT ITEM TYPE CONT
                                                                                                                 UNITS CODE CODE
11 WHEAT SEED             0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   1 50   0 00   0 00   0 00 -1 000  0 000    2  178    3    0
12 NITROGEN (N)           0 00   0 00  33 00   0 00   0 00   0 00   0 00   0 00  18 00   0 00   0 00   0 00 -1 000  0 000   12  211    3    0
13 PHOSPH (P205)          0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00  46 00   0 00   0 00   0 00 -1 000  0 000   12  214    3    0
14 POTASH (K20)           0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00 -1 000  0 000   12  216    3    0
15 BNTFERTSPRD/TON        0 00   0 00   1 00   0 00   0 00   0 00   0 00   0 00   1 00   0 00   0 00   0 00 -1 000  0 000    7  361    3    0

MACHINERY REQUIREMENTS                                TIMES OVER                                         XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                                       UNIT CODE
38 TANDEM DISK            0 00   0 00   0 00   0 00   0 00   1 00   0 00   0 00   1 00   0 00   0 00   0 00  0 000  0 000    3   38    4    0
39 DRILL WO/FERT          0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   1 00   0 00   0 00   0 00  0 000  0 000    3   60    4    0
40 SP COMBINE-GRAIN       0 00   0 00   0 00   0 00   0 00   1 00   0 00   0 00   0 00   0 00   0 00   0 00  0 000  0 000    0   16    4    0
41 TRUCK                  0 00   0 00   0 00   0 00   0 00   0 20   0 00   0 00   0.00   0 00   0 00   0 00  0 000  0 000   10   10    4    0
42 DRY FERT SPREAD        0 00   0 00   1.00   0 00   0 00   0 00   0 00   0 00   1 00   0 00   0.00   0.00  0.000  0 000    3   68    4.   0

---------------------------------------------------------------------------------------------------------------------------------------------
                                    MONTHLY SUMMARY OF RECEIPTS AND EXPENSES
      CATEGORY            UNIT      JAN      FEB      MAR      APR      MAY      JUN      JUL      AUG      SEP      OCT      NOV      DEC          TOTAL
TOTAL RECEIPTS            ACRE     0 00     0 00     0 00     0 00     0 00    96 00     0 00     0 00     0 00     0 00     0 00     0 00          96 00
TOTAL EXPENSES            ACRE     0 00     0 00    13 14     0 00     0 00     6 98     0 00     0 00    29 45     0 00     0 00     0 00          49 57
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT                                                                    46 43
---------------------------------------------------------------------------------------------------------------------------------------------

ANNUAL CAPITAL            DOL         2 45     2 45     3 55     3 55     3 55     0 00     0 00     0 00     2 45     2 45     2 45     2 45     25 37
---------------------------------------------------------------------------------------------------------------------------------------------
                                    LABOR REQUIREMENTS BY MONTH
MACHINERY LABOR           HR        0 00     0 00     0 09     0 00     0 00     0 69     0 00     0 00     0 45     0 00     0 00     0 00          1 18
---------------------------------------------------------------------------------------------------------------------------------------------
                                    MACHINERY FIXED AND VARIABLE COSTS PER HOUR                            TOTAL
     MACHINE             CODE        DEPR       INSUR        TAX     TOTAL FIXED  REPAIR       FUEL        LUB      VARIABLE       INT        HR/TIME
TRACTOR(3)                  3        2 47        0 14        0 35        2 95       1 39        3 11       0 47        4 97         3 17         1 00
TRUCK                      10        4 20        0 15        0 42        4 77       4 20       10 12       1 52       15 84         3 53         1 00
SP COMBINE-GRAIN           16       48 06        3 07        5 70       52 83       5 40        5 55       0 83       11 78        48 26         0 26
TANDEM DISK                38        6 09        0 26        0 74        7 09       1 38        0 00       0 00        1 38         8 10         0 12
DRILL WO/FERT              60        6 75        0 29        0 82        7 86       2 03        0 00       0 00        2 03         8 76         0 22
DRY FERT SPREAD            68        2 34        0 10        0 28        2 72       0 60        0 00       0 00        0.60         2 28         0 04
---------------------------------------------------------------------------------------------------------------------------------------------

                      ITEM         TIMES LABOR  MACHINE FUEL,OIL,LUB ,  FIXED COSTS
   OPERATION           NO    DATE  OVER  HOURS  HOURS   REPAIR PER ACRE  PER ACRE
---------------------------------------------------------------------------------------------------------------------------------------------
TANDEM DISK          3,38    SEP   1 00  0 139  0 115      0 79           2 29
DRILL WO/FERT        3,60    SEP   1.00  0.261  0 215      1 61           4 60
DRY FERT SPREAD      3,68    SEP   1.00  0 047  0 039      0 23           0 48
DRY FERT SPREAD      3,68    MAR   1.00  0 047  0 039      0 23           0 48
TANDEM DISK          3,38    JUN   1 00  0.139  0 115      0 79           2.29
SP COMBINE-GRAIN       16    JUN   1 00  0 308  0 257      3 03          25 93
TRUCK               10,10    JUN   0 20  0 240  0 200      3 17           1 86
    TOTAL                                1 181  0 978      9 85          37 68
---------------------------------------------------------------------------------------------------------------------------------------------
       COLUMN          1      2       3        4       5       6        7        8       9       10       11      12       13     14     15     16
NAME OF MACHINE      CODE   WIDTH  INITIAL   SPEED   FIELD    RC1      RC2      RC3    HOURS   YEARS    RFV1    RFV2   PURCHASE  FUEL  HOURS   HP
                           (FEET)   LIST     (MPH)  EFFIC-                             USED    OWNED                     PRICE   TYPE    OF
                                    PRICE            ENCY                             ANNUALLY                                    .     LIFE
TRACTOR(3)             3    60 0   21000      4 8   0 88    0.90  0 000631  1 60     800    10 0    0 880   0 920    21000      3   10000   80
TRUCK                 10     3 0   21000     20 0   0 88    0 80  0 001585  1 40     500     8 0    0 670   0 860    21000      1    4000  175
SP COMBINE-GRAIN      16    16 0   57000      3 0   0 67    0 33  0 000251  1 80     100    10 0    0 635   0 895    57000      2    2000  107
TANDEM DISK           38    18 0    7400      4 8   0 83    0 65  0 000251  1 80     100    10 0    0 600   0 885     7400      0    2000    0
DRILL WO/FERT         60    13 3    4100      4 0   0.72    0 75  0 000631  1 60      90    10 0    0 600   0 885     4100      0    1000    0
DRY FERT SPREAD       68    60 0    1400      5 3   0 67    0 75  0 000251  1 80      50    10 0    0 560   0.885     1400      0    1000    0
---------------------------------------------------------------------------------------------------------------------------------------------
          100% OF 18-46-0 FERT APPLIED                                       EDDINGS GERLOFF      MACHINERY COMPLEMENT    8
                                                                                                  EQUIPMENT COMPLEMENT    8
                                                              06/13/84       0000000110                 PRICE VECTOR      8

***NO NAME CHANGES HAVE BEEN STORED WITH THIS BUDGET***

***NO COMPLEMENT CHANGES HAVE BEEN STORED WITH THIS BUDGET***
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APPENDIX B (Continued)

```
WHEAT & SOYBEAN                                                          76R9C201
SOUTHEAST OKLA                                                           08/01/84
LOAM SOILS                                                              SOUTHEAST
---------------------------------------------------------------------------------
    OPERATING INPUTS                    UNITS     PRICE  QUANTITY      VALUE YOUR VALUE


      WHEAT SEED                        BU        4.300     1 500       6 45 __________
      SOYBEAN SEED                      LBS       0 420    60.000      25 20 __________
      NITROGEN (N)                      LBS       0 270    66 000      17 82 __________
      PHOSPH (P2O5)                     LBS       0 250    61.000      15 25 __________
      POTASH (K2O)                      LBS       0 130    30 000       3.90 __________
      RNTFERTSPRD/TON                   ACRE      4 000     3 000      12 00 __________
      LIME                              TONS     15 000     0 330       4 95 __________
      HERB-SOYBEANS                     ACRE      6 750     1 000       6 75 __________
      TRUCKING                          BU        0.150    45 000       6 75 __________
      ANNUAL OPERATING CAPITAL          DOL       0 140     4.111       0 58 __________
      LABOR CHARGES                     HR        4 250     3.558      15 12 __________
      MACHINERY FUEL.LUBE.REPAIRS       ACRE                           25 63 __________

    TOTAL OPERATING COST                                              140 40 __________
    -----------------------------------------------------------------------------
    FIXED COSTS                                   VALUE YOUR VALUE


      MACHINERY
        INTEREST AT 14.0%               DOL.     45.020 __________
        DEPR .TAXES.INSUR.              DOL.     48.695 __________
      LAND
        INTEREST AT  0.0%               DOL       0.000 __________
        TAXES                           DOL       0.000 __________

    TOTAL FIXED COSTS                            93.71  __________
    -----------------------------------------------------------------------------
    PRODUCTION:                         UNITS     PRICE  QUANTITY      VALUE YOUR VALUE


      WHEAT                             BU        3.200    27.000      86 40 __________
      SOYBEANS                          BU        7.700    18.000     138 60 __________
      PASTURE                           AUMS      0 000     0.700       0.00 __________


    TOTAL RECEIPTS                                                    225.00 __________
    -----------------------------------------------------------------------------
    RETURNS ABOVE TOTAL OPERATING COSTS                                84.60 __________

    RETURNS ABOVE ALL COSTS EXCEPT
        OVERHEAD.RISK AND MANAGEMENT                                   -9.11 __________
---------------------------------------------------------------------------------
HERBICIDE IS TREFLAN                                              EDDINGS.GERLOFF
TWO TONS LIME APPLIED EVERY SIX YEARS
100# OF 18-46-0 FERT APPLIED                             06/13/84      0000000110

       PROCESSED BY DEPT  OF AGRI. ECON  - OKLAHOMA STATE UNIVERSITY
   PROGRAM DEVELOPED BY DEPT. OF AGRI  ECON. OKLAHOMA STATE UNIVERSITY
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APPENDIX B (Continued)

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BUDGET IDENTIFICATION NUMBER [illegible]        ANNUAL CAPITAL MONTH [illegible]        BUDGET RECORD NUMBER [illegible]
                                                                                         BUDGET [illegible]

WHEAT & SOYBEAN                                                           [illegible]
SOUTHEAST OKLA                                                            30 OCT 84
LOAM SOILS                                                                SOUTHEAST

                        1      2      3      4      5      6      7      8      9     10     11     12     13      14     15    16    17   18
                      JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC  PRICE  WEIGHT   UNIT  ITEM  TYPE CONT
LINE                                                                                                                   CODE  CODE
PRODUCTION                                 NUMBER OF UNITS
 1 WHEAT             0.00   0.00   0.00   0.00   0.00  27.00   0.00   0.00   0.00   0.00   0.00   0.00 -1.000   0.000     2    76    2    0
 2 SOYBEANS          0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00  18.00   0.00   0.00 -1.000   0.000     2    88    2    0
 3 PASTURE           0.00   0.00   0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.25 -1.000   0.000    10   150    2    0

OPERATING INPUTS                           RATE UNIT                                                   PRICE  NUMBER   UNIT  ITEM  TYPE CONT
                                                                                                               UNITS   CODE  CODE
11 WHEAT SEED        0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   1.50   0.00   0.00 -1.000   0.000     2   176    3    0
12 SOYBEAN SEED      0.00   0.00   0.00   0.00   0.00  60.00   0.00   0.00   0.00   0.00   0.00   0.00 -1.000   0.000    12   198    3    0
13 NITROGEN (N)      0.00   0.00  33.00   0.00   0.00   5.00   0.00   0.00   0.00  18.00   0.00   0.00 -1.000   0.000    12   211    3    0
14 PHOSPH (P2O5)     0.00   0.00   0.00   0.00   0.00  15.00   0.00   0.00   0.00  46.00   0.00   0.00 -1.000   0.000    12   214    3    0
15 POTASH (K2O)      0.00   0.00   0.00   0.00   0.00  30.00   0.00   0.00   0.00   0.00   0.00   0.00 -1.000   0.000    12   216    3    0
16 CSTFERTSPRD TON   0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00   0.00   1.00   0.00   0.00 -1.000   0.000     7   361    3    0
17 LIME              0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.33   0.00   0.00   0.00   0.00 -1.000   0.000     3   231    3    0
18 HERB SOYBEANS     0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00   0.00   0.00   0.00   0.00  6.750   0.000     7   258    3    0
19 TRUCKING          0.00   0.00   0.00   0.00   0.00  27.00   0.00   0.00   0.00  18.00   0.00   0.00  0.150   0.000     2   481    3    0

MACHINERY REQUIREMENTS                     TIMES OVER                                                  XXXXX   XXXXX  POWER  MACH  TYPE CONT
                                                                                                                       UNIT  CODE
38 TANDEM DISK       0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   2.00   0.00   0.00  0.000   0.000     5    38    4    0
39 LISTER            0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00   0.00   0.00   0.00   0.00  0.000   0.000     3    48    4    0
40 PLANTER 4 ROW     0.00   0.00   0.00   0.00   0.00   3.00   0.00   0.00   0.00   0.00   0.00   0.00  0.000   0.000     3    64    4    0
41 DRILL NO FERT     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00  0.000   0.000     3    60    4    0
42 SP COMBINE-GRAIN  0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00   0.00   1.00   0.00   0.00  0.000   0.000     0    16    4    0
43 DRY FERT SPREAD   0.00   0.00   1.00   0.00   0.00   1.00   0.00   0.00   0.00   1.00   0.00   0.00  0.000   0.000     3    69    4    0
44 STALK SHREDDER    0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00  0.000   0.000     3    78    4    0
45 SPRAYER           0.00   0.00   0.00   0.00   0.00   1.00   0.00   0.00   0.00   0.00   0.00   0.00  0.000   0.000     1    72    4    0

------------------------------------------------------------------------------------------------------------------------------------------
                            MONTHLY SUMMARY OF RECEIPTS AND EXPENSES
     CATEGORY        UNIT    JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC          TOTAL
TOTAL RECEIPTS       ACRE   0.00   0.00   0.00   0.00   0.00  96.40   0.00   0.00   0.00 138.60   0.00   0.00         235.00
TOTAL EXPENSES       ACRE   0.00   0.00  13.14   0.00   0.00  67.33   0.00   4.96   0.00  39.27   0.00   0.00         124.70
RETURNS TO LAND  LABOR  CAPITAL  MACHINERY, OVERHEAD, RISK, AND MANAGEMENT                                              110.30
------------------------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL       DOL    0.00   0.00   1.10   1.10   1.10   0.00   0.00   0.41   0.41   0.00   0.00   0.00           4.11
------------------------------------------------------------------------------------------------------------------------------------------
                            LABOR REQUIREMENTS BY MONTH
MACHINERY LABOR      HR     0.00   0.00   0.05   0.00   0.00   2.40   0.00   0.00   0.00   1.11   0.00   0.00           3.56
------------------------------------------------------------------------------------------------------------------------------------------
                            MACHINERY FIXED AND VARIABLE COSTS PER HOUR                                   TOTAL
    MACHINE          CODE     DEPR     INSUR      TAX   TOTAL FIXED  REPAIR      FUEL       LUB      VARIABLE     INT     HR/TIME
TRACTOR(1)             1      1.41      0.08     0.20      1.69       0.79       2.07      0.31       3.18       1.81      1.00
TRACTOR(3)             3      2.47      0.14     0.35      2.96       1.39       3.11      0.47       4.97       3.17      1.00
TRACTOR(5)             5      3.88      0.21     0.55      4.64       2.19       5.18      0.78       8.15       4.99      1.00
SP COMBINE-GRAIN      16     48.06      2.07     2.70     52.83       5.40       5.55      0.83      11.78      48.26      0.28
TANDEM DISK           38      6.08      0.26     0.74      7.08       1.38       0.00      0.00       1.38       6.10      0.12
LISTER                48      3.43      0.15     0.42      3.99       0.70       0.00      0.00       0.70       3.43      0.30
PLANTER 4 ROW         64      5.17      0.32     0.53      6.02       2.64       0.00      0.00       2.64       5.18      0.41
DRILL NO/FERT         60      6.75      0.39     0.82      7.96       2.03       0.00      0.00       2.03       6.78      0.32
DRY FERT SPREAD       69      2.34      0.10     0.28      2.72       0.80       0.00      0.00       0.80       2.28      0.04
STALK SHREDDER        78      5.43      0.23     0.64      6.30       8.75       0.00      0.00       8.75       5.30      0.18
SPRAYER               72      1.48      0.06     0.18      1.72       0.34       0.00      0.00       0.34       1.48      0.21
------------------------------------------------------------------------------------------------------------------------------------------
                     ITEM          TIMES  LABOR  MACHINE  FUEL OIL LUB    FIXED COSTS
   OPERATION          NO    DATE   OVER   HOURS   HOURS  REPAIR PER ACRE  PER ACRE
------------------------------------------------------------------------------------------------------------------------------------------
TANDEM DISK         5.38    OCT    2.00   0.278   0.230       2.38           5.47
DRILL NO/FERT       3.60    OCT    1.00   0.261   0.215       1.61           4.60
SP COMBINE-GRAIN      16    OCT    1.00   0.308   0.257       3.02          25.93
DRY FERT SPREAD     3.69    OCT    1.00   0.047   0.039       0.23           0.45
STALK SHREDDER      3.78    OCT    1.00   0.214   0.177       2.51           3.24
DRY FERT SPREAD     3.69    MAR    1.00   0.047   0.039       0.23           0.45
LISTER              3.48    JUN    1.00   0.310   0.257       1.58           3.63
PLANTER 4 ROW       3.64    JUN    3.00   1.490   1.231      10.01          22.08
SP COMBINE-GRAIN      16    JUN    1.00   0.308   0.257       3.07          25.93
DRY FERT SPREAD     3.69    JUN    1.00   0.047   0.039       0.23           0.49
SPRAYER             1.72    JUN    1.00   0.348   0.205       0.79           1.45
     TOTAL                                3.356   2.845      25.63          93.71
------------------------------------------------------------------------------------------------------------------------------------------
          COLUMN      1      2        3        4      5       6        7        8      9      10      11      12      13      14     15     16
NAME OF MACHINE     CODE  WIDTH   INITIAL   SPEED  FIELD    RC1      RC2      RC3   HOURS   YEARS   RFV1    RFV2  PURCHASE  FUEL  HOURS   HP
                         (FEET)    LIST    (MPH)  EFFIC-                            USED   OWNED                   PRICE   TYPE    OF
                                   PRICE          IENCY                           ANNUALLY                                        LIFE
TRACTOR(1)            1    40.0    12000     4.5   0.88    0.90  0.000631   1.80    600    10.0   0.680   0.920   12000     3   10000   40
TRACTOR(3)            3    60.0    21000     4.5   0.88    0.90  0.000631   1.60    600    10.0   0.680   0.920   21000     3   10000   60
TRACTOR(5)            5   100.0    33000     4.5   0.88    0.90  0.000631   1.60    600    10.0   0.680   0.920   33000     3   10000  100
SP COMBINE-GRAIN     16    16.0    57000     3.0   0.67    0.33  0.000251   1.80    100    10.0   0.635   0.895   57000     3    2000  107
TANDEM DISK          38    18.0     7400     4.8   0.83    0.65  0.000251   1.80    100    10.0   0.600   0.885    7400     0    2000    0
LISTER               48    12.0     2500     4.0   0.67    0.80  0.002510   1.30     60    10.0   0.600   0.885    2500     0    2000    0
DRILL NO/FERT        60    13.3     4100     4.0   0.72    0.75  0.000631   1.60     50    10.0   0.600   0.885    4100     0    1000    0
PLANTER 4 ROW        64     6.0     4400     5.0   0.67    0.75  0.000631   1.60     70    10.0   0.600   0.885    4400     0    1000    0
DRY FERT SPREAD      69    60.0     1400     5.3   0.67    0.75  0.000251   1.80     50    10.0   0.560   0.885    1400     0    1000    0
SPRAYER              72    12.0      900     5.0   0.67    0.65  0.000251   1.80     50    10.0   0.600   0.885     900     0    1000    0
STALK SHREDDER       78    12.0     5200     4.6   0.81    1.80  0.002510   1.30     80    10.0   0.560   0.885    5200     0    1000    0
------------------------------------------------------------------------------------------------------------------------------------------
          HERBICIDE IS TREFLAN                                                     EDDINGS GERLOFF      MACHINERY COMPLEMENT   8
          TWO TONS LIME APPLIED EVERY SIX YEARS                                                         EQUIPMENT COMPLEMENT   6
          100# OF 18-46-0 FERT APPLIED                           06/13/84          0000000117                   PRICE VECTOR   8

****NO NAME CHANGES HAVE BEEN STORED WITH THIS BUDGET****

****NO COMPLEMENT CHANGES HAVE BEEN STORED WITH THIS BUDGET****
```

APPENDIX B (Continued)

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SOYBEANS, UPLAND                                                        98892101
OWNED EQUIPMENT                                                         03/11/85
                                                                       SOUTHEAST
     ---------------------------------------------------------------------------
     OPERATING INPUTS                 UNITS    PRICE  QUANTITY     VALUE YOUR VALUE


       SOYBEAN SEED                   LBS      0 300   45 000      13 50 __________
       NITROGEN (N)                   LBS      0 250   10 000       2 50 __________
       PHOSPH (P2O5)                  LBS.     0 260   40.000      10 40 __________
       POTASH (K2O)                   LBS      0 130   40.000       5 20 __________
       LIME                           TONS    20 000    0.330       6 60 __________
       PREPLANT HERB                  ACRE     7 500    1 000       7 50 __________
       POST-EMERG HERB                ACRE     3 000    1.000       3.00 __________
       ANNUAL OPERATING CAPITAL       DOL      0 140   26.698       3.74 __________
       LABOR CHARGES                  HR       4 000    2 546      10 18 __________
       MACHINERY FUEL,LUBE,REPAIRS    ACRE                         19 93 __________

     TOTAL OPERATING COST                                          82 56 __________
     ---------------------------------------------------------------------------
     FIXED COSTS                               VALUE YOUR VALUE


       MACHINERY
         INTEREST AT 14 0%            DOL     26 568 __________
         DEPR.,TAXES,INSUR.           DOL.    28.565 __________
       LAND
         INTEREST AT  0.0%            DOL.     0.000 __________
         TAXES                        DOL.     0.000 __________

     TOTAL FIXED COSTS                        55.13  __________
     ---------------------------------------------------------------------------
     PRODUCTION:                      UNITS    PRICE  QUANTITY     VALUE YOUR VALUE


       SOYBEANS                       BU.      6.250   20.000     125.00 __________
       -------------------------------------------------------------------------
     RETURNS ABOVE TOTAL OPERATING COSTS                           42.44 __________

     RETURNS ABOVE ALL COSTS EXCEPT
         OVERHEAD,RISK AND MANAGEMENT                             -12.69 __________
     ---------------------------------------------------------------------------
PREPLANT HERBICIDE IS TREFLAN. POST-EMERGE FOR BROAD LEAF WEED   GERLOFF,EDDINGS
CONTROL. PREPLANT HERBICIDE APPLICATION INCLUDES DISCING OPERATION.
1.0 TON LIME APPLIED EVERY 3 YEARS                      04/04/85      0000000110

       PROCESSED BY DEPT. OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
   PROGRAM DEVELOPED BY DEPT. OF AGRI. ECON. OKLAHOMA STATE UNIVERSITY


RETURNS ABOVE TOTAL OPERATING COSTS
WHEN THE QUANTITY OF SOYBEANS          RANGES FROM  16.00 TO 24.00
 AND THE PRICE OF    SOYBEANS          RANGES FROM   5.65 TO  6.85

                        QUANTITY OF SOYBEANS

                           16.00     18.00     20.00     22.00     24.00

                     **************************************************
                5.65 *      7 84     19.14     30.44     41.74     53.04
                     *
                5.95 *     12.64     24.54     36.44     48.34     60.24
PRICE OF             *
SOYBEANS        6 25 *     17.44     29 94     42 44     54 94     67 44
                     *
                6.55 *     22.24     35.34     48 44     61.54     74.64
                     *
                6.85 *     27 04     40 74     54 44     68.14     81.84
                     *
          RETURNS NOT ADJUSTED FOR EFFECT OF YIELD CHANGES ON COSTS
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APPENDIX B (Continued)

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BUDGET IDENTIFICATION NUMBER  98802'010 800 9        ANNUAL CAPITAL MONTH 10          BUDGET RECORD NUMBER 209
                                                                                               BUDGET FILE    1

SOYBEANS  UPLAND                                                      98802'01
OWNED EQUIPMENT                                                       03.11.85
                                                                     SOUTHEAST

                   1     2     3     4     5     6     7     8     9    10    11    12     13      14     15   16   17   18
                  JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC   PRICE  WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                  CODE CODE
PRODUCTION                               NUMBER OF UNITS
  1 SOYBEANS     0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00 20 00  0 00  0 00 -1 000   0 000   7   90   2    0

OPERATING INPUTS                         RATE UNIT                                         PRICE  NUMBER UNIT ITEM TYPE CONT
                                                                                                   UNITS CODE CODE
11 SOYBEAN SEED  0 00  0 00  0 00  0 00 45 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00 -1 000   0 000  12  198   3    0
12 NITROGEN (N)  0 00  0 00  0 00  0 00 10 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00 -1 000   0 000  12  211   3    0
13 PHOSPH (P2O5) 0 00  0 00  0 00  0 00 40 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00 -1 000   0 000  12  214   3    0
14 POTASH  K2O)  0 00  0 00  0 00  0 00 40 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00 -1 000   0 000  12  216   3    0
15 LIME          0 00  0 33  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00 -1 000   0 000   3  231   3    0
16 PREPLANT HERB 0 00  0 00  0 00  0 00  1 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  7 500   0 000   7  294   3    0
17 POST-EMERG HERB 0 00 0 00 0 00  0 00  0 00  0 00  1 00  0 00  0 00  0 00  0 00  0 00  3 000   0 000   7  252   3    0

MACHINERY REQUIREMENTS                   TIMES OVER                                        XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                        UNIT CODE
38 TANDEM DISK   0 00  0 00  0 00  0 00  2 00  0 00  0 00  0 00  0 00  0 00  1 00  0 00  0 000   0 000   5   38   4    0
41 PLANTER 4 ROW 0 00  0 00  0 00  0 00  1 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 000   0 000   3   64   4    0
42 ROW CULTIVATOR 0 00 0 00  0 00  0 00  1 00  1 00  0 00  0 00  0 00  0 00  0 00  0 00  0 000   0 000   3   46   4    0
43 SP COMBINE GRAIN 0 00 0 00 0 00 0 00  0 00  0 00  0 00  0 00  0 00  1 00  0 00  0 00  0 000   0 000   0   15   4    0
44 TRUCK 2 0 TON 0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 00  0 20  0 00  0 00  0 000   0 000   0   10   4    0
45 SPRAYER       0 00  0 00  0 00  0 00  1 00  0 00  1 00  0 00  0 00  0 00  0 00  0 00  0 000   0 000   1   72   4    0

-------------------------------------------------------------------------------------------------------------------------
                             MONTHLY SUMMARY OF RECEIPTS AND EXPENSES
      CATEGORY       UNIT     JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC        TOTAL
TOTAL RECEIPTS       ACRE    0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00   0 00 129 00   0 00   0 00       129 00
TOTAL EXPENSES       ACRE    0 00   6 80   0 00   0 00  47 03   1 48   3 86   0 00   0 00   8 30   1 35   0 00        68 83
RETURNS TO LAND  LABOR, CAPITAL, MACHINERY  OVERHEAD  RISK  AND MANAGEMENT                                             86 37
-------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL        DOL     0 11   0 86   0 86   0 86   4 90   4 71   5 03   5 03   5 03   0 00   0 11   0 11        26 70
-------------------------------------------------------------------------------------------------------------------------
                             LABOR REQUIREMENTS BY MONTH
MACHINERY LABOR       HR      0 00   0 00   0 00   0 00   1 27   0 28   0 28   0 00   0 00   0 82   0 12   0 00         3 95
-------------------------------------------------------------------------------------------------------------------------
                             MACHINERY FIXED AND VARIABLE COSTS PER HOUR                    TOTAL
    MACHINE        CODE      DEPR      INSUR      TAX    TOTAL FIXED  REPAIR     FUEL     LUB   VARIABLE    INT     HR/TIME
TRACTOR              1      11 48      0 45      1 04      12 97      0 80      1 92     0.29     3 11     10 84     1.00
TRACTOR              3       2 65      0 15      0 38       3 18      1 80      2 88     0 43     4 61      3 42     1.00
TRACTOR              5       8 11      0 28      0 72       9 12      2 88      5 28     0 78     8 98      8 57     1 00
TRUCK 2.0 TON       10       8.20      0 18      0 52       8 90      8.30      8 28     1 40    18.88      4 27     1 00
SP COMBINE GRAIN    15      32 08      1 47      4 08      37 58     11 08      4 48     0 87    15 20     34 33     0 32
TANDEM DISK         38       6 22      0 30      0 87       7 38      3 88      0 00     0 00     3 88      8 81     0 10
PLANTER 4 ROW       64       1 88      0 08      0 23       2 20      1 72      0 00     0.00     1.72      1 88     0 41
ROW CULTIVATOR      46       1.37      0 08      0 28       1 78      0 84      0 00     0 00     0 84      2 14     0 24
SPRAYER             72       1 25      0 08      0 28       1.87      0 78      0 00     0 00     0 78      1 81     0 21
-------------------------------------------------------------------------------------------------------------------------
                   ITEM          TIMES  LABOR  MACHINE FUEL OIL,LUB    FIXED COSTS
   OPERATION        NO    DATE   OVER   HOURS   HOURS  REPAIR PER ACRE  PER ACRE
TANDEM DISK        5.38   NOV    1 00   0 118   0 098       1 35          2 78
TANDEM DISK        5.38   MAY    2 00   0 238   0 197       2 71          5 57
PLANTER 4 ROW      3.64   MAY    1 00   0 487   0 410       2 88          4 88
ROW CULTIVATOR     3 46   MAY    1 00   0 284   0 238       1 48          3 85
SPRAYER            1.72   MAY    1 00   0 248   0 208       0 86          6 02
ROW CULTIVATOR     3.46   JUN    1 00   0.284   0 238       1 48          3 85
SPRAYER            1.72   JUL    1 00   0 248   0 205       0 84          6 02
SP COMBINE GRAIN     15   OCT    1 00   0 379   0 316       5 11         33 71
TRUCK 2 0 TON        10   OCT    0.20   0 240   0 200       3 19          2 08
    TOTAL                               2 646   2 108      19 83         68 13
-------------------------------------------------------------------------------------------------------------------------
         COLUMN       1      2       3       4      5       6       7        8      9      10      11      12      13      14     15     16
NAME OF MACHINE     CODE   WIDTH  INITIAL  SPEED  FIELD   RC1      RC2      RC3   HOURS  YEARS   RFV1    RFV2  PURCHASE  FUEL  HOURS   HP
                          (FEET)   LIST    (MPH)  EFFIC-                          USED   OWNED                  PRICE   TYPE    OF
                                   PRICE          ENCY                          ANNUALLY                                        LIFE
TRACTOR               1    40 0   15800     4 0   0 75    0 90  0 000631  1 80   150     8 0   0 680   0 920   15800      3    8000    40
TRACTOR               3    60 0   22800     4 5   0 84    0 90  0 000631  1 60   600    10 0   0 680   0 920   22600      3   10000    80
TRACTOR               5   110 0   43500     4 8   0 84    0 90  0 000631  1 80   800    10 0   0 680   0 920   43500      3   10000   110
TRUCK 2 0 TON        10     2 0   26000    20.0   0 88    0.90  0 001985  1.40   800     8 0   0 870   0 860   26000      1    4000   175
SP COMBINE GRAIN     15    13 0   73000     3 0   0 67    0 33  0 000251  1 80   180    10 0   0 835   0 885   73000      3    3000    83
TANDEM DISK          38    21 0   13000     4 8   0 83    0 68  0 000251  1 80   150    12 0   0 800   0 885   13000      0    2000     0
ROW CULTIVATOR       46    12 0    2800     3 8   0 76    0 55  0 000251  1 80   100    20 0   0 800   0 885    2800      0    2000     0
PLANTER 4 ROW        64     6 0    2300     5 0   0 67    0 75  0 000631  1 80   100    10 0   0 800   0 885    2300      0    1000     0
SPRAYER              72    12 0    1300     5 0   0 67    0 60  0 002510  1.30    90    20 0   0 800   0 885    1300      0    1000     0
-------------------------------------------------------------------------------------------------------------------------
           PREPLANT HERBICIDE IS TREFLAN  POST-EMERGE FOR BROAD LEAF WEED   GERLOFF 300INGS    MACHINERY COMPLEMENT   8
           CONTROL  PREPLANT HERBICIDE APPLICATION INCLUDES DISCING OPERATION                  EQUIPMENT COMPLEMENT   8
           1 0 TON LIME APPLIED EVERY 3 YEARS                       04/04/85      0000000110           PRICE VECTOR   8

                 LINE CHANGE              LINE CHANGE            LINE CHANGE         LINE CHANGE          LINE CHANGE
GENERAL NAME CHANGE--252  POST-EMERG HERB  294  PREPLANT HERB

***NO COMPLEMENT CHANGES HAVE BEEN STORED WITH THIS BUDGET***
```

APPENDIX B (Continued)

```
NATIVE PASTURE. MAINTENANCE                                        85890104
                                                                   03/11/85
                                                                  SOUTHEAST
    -----------------------------------------------------------------------
    OPERATING INPUTS              UNITS    PRICE   QUANTITY     VALUE YOUR VALUE

      2-4-D                       ACRE     1.400    0.250       0.35 _________
      ANNUAL OPERATING CAPITAL    DOL      0.140    0.047       0.01 _________
      LABOR CHARGES               HR       4.000    0.062       0.25 _________
      MACHINERY FUEL,LUBE,REPAIRS ACRE                          0.22 _________

    TOTAL OPERATING COST                                        0.82 _________
    -----------------------------------------------------------------------
    FIXED COSTS                            VALUE YOUR VALUE

      MACHINERY
        INTEREST AT 14.0%         DOL.     0.693 _________
        DEPR.,TAXES,INSUR         DOL.     0.813 _________
      LAND
        INTEREST AT  0.0%         DOL.     0.000 _________
        TAXES                     DOL.     0.000 _________

    TOTAL FIXED COSTS                      1.51  _________
    -----------------------------------------------------------------------
    PRODUCTION:                   UNITS    PRICE   QUANTITY     VALUE YOUR VALUE

      PASTURE                     AUMS     0.000    1.580       0.00 _________
    -----------------------------------------------------------------------
    RETURNS ABOVE TOTAL OPERATING COSTS                        -0.82 _________

    RETURNS ABOVE ALL COSTS EXCEPT
        OVERHEAD,RISK AND MANAGEMENT                           -2.33 _________
    -----------------------------------------------------------------------
2-4-D APPLIED EVERY FOURTH YEAR                         GERLOFF,ROHMANN,EDDINGS

                                                       04/04/85      0000000110

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      PROGRAM DEVELOPED BY DEPT. OF AGRI. ECON. OKLAHOMA STATE UNIVERSITY
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        BUDGET IDENTIFICATION NUMBER  85890104 BOB 8        ANNUAL CAPITAL MONTH  4        BUDGET RECORD NUMBER 192
                                                                                                BUDGET FILE   *

        NATIVE PASTURE  MAINTENANCE                                        85890104
                                                                           03/11/85
                                                                           SOUTHEAST

                        1     2     3     4     5     6     7     8     9    10    11    12     13      14    15   16   17   18
                      JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC  PRICE  WEIGHT  UNIT ITEM TYPE CONT
LINE                                                                                                        CODE CODE
PRODUCTION                                 NUMBER OF UNITS
 1 PASTURE           0.10  0.10  0.10  0.10  0.20  0.20  0.20  0.12  0.12  0.12  0.12  0.10  0.000   0.000   10  190    2    0

OPERATING INPUTS                           RATE UNIT                                         PRICE  NUMBER  UNIT ITEM TYPE CONT
                                                                                                    UNITS   CODE CODE
11 2-4-D             0.00  0.00  0.00  0.00  0.25  0.00  0.00  0.00  0.00  0.00  0.00  0.00  1.400   0.000    7  251    2    0

MACHINERY REQUIREMENTS                          TIMES OVER                                   XXXXX  XXXXX  POWER MACH TYPE CONT
                                                                                                            UNIT CODE
38 SPRAYER           0.00  0.00  0.00  0.00  0.25  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.000   0.000    1   72    4    0

--------------------------------------------------------------------------------------------------------------------------------
                          MONTHLY SUMMARY OF RECEIPTS AND EXPENSES
     CATEGORY       UNIT     JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC           TOTAL
TOTAL RECEIPTS      ACRE     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00           0.00
TOTAL EXPENSES      ACRE     0.00   0.00   0.00   0.00   0.97   0.00   0.00   0.00   0.00   0.00   0.00   0.00           0.97
RETURNS TO LAND  LABOR, CAPITAL, MACHINERY, OVERHEAD  RISK  AND MANAGEMENT                                             -0.97
--------------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL      DOL      0.00   0.00   0.00   0.00   0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00           0.08
--------------------------------------------------------------------------------------------------------------------------------
                          LABOR REQUIREMENTS BY MONTH
MACHINERY LABOR     HR       0.00   0.00   0.00   0.00   0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.00           0.06
--------------------------------------------------------------------------------------------------------------------------------
                          MACHINERY FIXED AND VARIABLE COSTS PER HOUR                  TOTAL
  MACHINE       CODE     DEPR      INSUR      TAX    TOTAL FIXED  REPAIR     FUEL      LUB     VARIABLE     INT      HR/TIME
TRACTOR           1     11.48      0.45      1.04      12.97      0.90      1.92      0.29      3.11      10.34      1.00
SPRAYER          72      1.23      0.08      0.26       1.57      0.78      0.00      0.00      0.78       1.91      0.21
--------------------------------------------------------------------------------------------------------------------------------
                 ITEM         TIMES LABOR MACHINE FUEL,OIL,LUB..  FIXED COSTS
  OPERATION       NO    DATE  OVER  HOURS  HOURS  REPAIR PER ACRE  PER ACRE
--------------------------------------------------------------------------------------------------------------------------------
SPRAYER          1,72   MAY   0.25  0.062  0.061       0.22          1.51
     TOTAL                          0.062  0.061       0.22          1.51
--------------------------------------------------------------------------------------------------------------------------------
       COLUMN       1      2       3       4      5      6      7         8      9      10     11     12      13      14    15    16
NAME OF MACHINE   CODE  WIDTH  INITIAL  SPEED  FIELD   RC1    RC2       RC3  HOURS  YEARS   RFV1   RFV2  PURCHASE  FUEL  HOURS  HP
                        (FEET)  LIST    (MPH)  EFFIC-                         USED  OWNED                  PRICE   TYPE   OF
                                PRICE          ENCY                         ANNUALLY                                      LIFE
TRACTOR             1    40.0   15600    4.0   0.75   0.90  0.000031   1.80   180    8.0   0.680  0.920   15600     3   5000   40
SPRAYER            72    12.0    1300    9.0   0.67   0.60  0.002510   1.30    50   20.0   0.600  0.885    1300     0   1000    0
--------------------------------------------------------------------------------------------------------------------------------
        2-4-D APPLIED EVERY FOURTH YEAR                             GERLOFF,ROHMANN,EDDINGS   MACHINERY COMPLEMENT  8
                                                                                              EQUIPMENT COMPLEMENT  8
                                                                    04/04/85     0000000110         PRICE VECTOR  8

***NO NAME CHANGES HAVE BEEN STORED WITH THIS BUDGET***

***NO COMPLEMENT CHANGES HAVE BEEN STORED WITH THIS BUDGET***
```

APPENDIX B (Continued)

```
FESCUE & BERMUDA COMBINATION HAY & PASTURE                                    8309'102
BOTTOMLAND                                                                    03'11/85
CUSTOM HARVEST                                                               SOUTHEAST
------------------------------------------------------------------------------------
    OPERATING INPUTS.                  UNITS     PRICE   QUANTITY      VALUE YOUR VALUE


      NITROGEN (N)                     LBS.      0 250   240.000       60 00 __________
      PHOSPH (P205)                    LBS.      0 260    60 000       15 60 __________
      POTASH (K20)                     LBS.      0.130    80.000       10 40 __________
      RNTFERTSPRD/ACRE                 ACRE      1.250     4 000        5.00 __________
      1/10 EST  COST                   ACRE     95 000     0.100        9.50 __________
      HAY HARVEST EXP.                 TONS     23 000     2.000       46 00 __________
      ANNUAL OPERATING CAPITAL         DOL.      0.140    28.796        4.03 __________
      LABOR CHARGES                    HR.       4.000     0.187        0.75 __________
      MACHINERY FUEL,LUBE,REPAIRS      ACRE                             0.82 __________

    TOTAL OPERATING COST                                              152.10 __________
------------------------------------------------------------------------------------
    FIXED COSTS                                  VALUE YOUR VALUE


      MACHINERY
        INTEREST AT 14.0%              DOL.      0.582 __________
        DEPR.,TAXES,INSUR.             DOL.      0.541 __________
      LAND
        INTEREST AT  0.0%              DOL.      0.000 __________
        TAXES                          DOL.      0.000 __________

    TOTAL FIXED COSTS                            1.12  __________
------------------------------------------------------------------------------------
    PRODUCTION:                        UNITS     PRICE   QUANTITY      VALUE YOUR VALUE


      BERMUDA HAY                      TONS     65.000     2.000      130.00 __________
      PASTURE                          AUMS      0.000    11.000        0.00 __________


    TOTAL RECEIPTS                                                    130.00 __________
------------------------------------------------------------------------------------
    RETURNS ABOVE TOTAL OPERATING COSTS                               -22 10 __________

    RETURNS ABOVE ALL COSTS EXCEPT
        OVERHEAD,RISK AND MANAGEMENT                                  -23.22 __________
------------------------------------------------------------------------------------
                                                                     EDDINGS,GERLOFF

                                                          03/28/85       0000100110

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RETURNS ABOVE TOTAL OPERATING COSTS
WHEN THE QUANTITY OF BERMUDA HAY      RANGES FROM   1.50 TO  2.50
 AND THE PRICE OF    BERMUDA HAY      RANGES FROM  59.00 TO 71.00

                          QUANTITY OF BERMUDA HAY

                            1.50       1.75       2.00       2.25       2.50

                       ...................................................
                59 00 .    -52.10     -43 10     -34 10     -25.10     -16 10
                      .
                62.00 .    -47.60     -37.85     -28.10     -18.35      -8.60
PRICE OF              .
BERMUDA HAY     65.00 .    -43.10     -32.60     -22.10     -11.60      -1.10
                      .
                68 00 .    -38.60     -27.35     -16 10      -4 85       6 40
                      .
                71.00 .    -34 10     -22.10     -10 10       1 90      13.90
                      .
           RETURNS NOT ADJUSTED FOR EFFECT OF YIELD CHANGES ON COSTS
```

APPENDIX B (Continued)

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BUDGET IDENTIFICATION NUMBER  838911020 808 8        ANNUAL CAPITAL MONTH  5          BUDGET RECORD NUMBER 117
                                                                                             BUDGET FILE    1
         /

FESCUE & BERMUDA COMBINATION HAY & PASTURE                                  83891102
BOTTOMLAND                                                                  03/11/85
CUSTOM HARVEST                                                              SOUTHEAST

                        1     2     3     4     5     6     7     8     9    10    11    12     13     14     15   16   17   18
                       JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC   PRICE  WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                       CODE CODE
PRODUCTION                                    NUMBER OF UNITS
  1 BERMUDA HAY        0.00  0.00  0.00  0.00  1.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000  0.000   3   83   2    0
  2 PASTURE            0.50  0.50  1.00  1.25  1.25  1.00  1.00  0.75  1.25  1.00  0.75  0.75 -1.000  0.000  10  150   2    0

OPERATING INPUTS                              RATE/UNIT                                      PRICE  NUMBER UNIT ITEM TYPE CONT
                                                                                                    UNITS CODE CODE
11 NITROGEN (N)        0.00 60.00  0.00  0.00 80.00  0.00 60.00  0.00 60.00  0.00  0.00  0.00 -1.000  0.000  12  311   3    0
12 PHOSPH (P2O5)       0.00  0.00  0.00  0.00 60.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000  0.000  12  314   3    0
13 POTASH (K2O)        0.00  0.00  0.00  0.00 80.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000  0.000  12  316   3.   0
14 BNTFERTSPRD/ACRE    0.00  1.00  0.00  0.00  1.00  0.00  1.00  0.00  1.00  0.00  0.00  0.00 -1.000  0.000   7  362   3    0
15 1/10 EST. COST      0.00  0.00  0.00  0.00  0.00  0.10  0.00  0.00  0.00  0.00  0.00  0.00 95.000  0.000   7  294   3    0
17 HAY HARVEST EXP     0.00  0.00  0.00  0.00  1.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00 -1.000  0.000   3  308   3    0

MACHINERY REQUIREMENTS                        TIMES OVER                                     XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                          UNIT CODE
40 DRY FERT SPRD       0.00  1.00  0.00  0.00  1.00  0.00  1.00  0.00  1.00  0.00  0.00  0.00  0.000  0.000   3   69   4    0


--------------------------------------------------------------------------------------------------------------------------
                                 MONTHLY SUMMARY OF RECEIPTS AND EXPENSES
     CATEGORY          UNIT      JAN     FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC        TOTAL
TOTAL RECEIPTS         ACRE      0.00    0.00   0.00   0.00  65.00  65.00   0.00   0.00   0.00   0.00   0.00   0.00      130.00
TOTAL EXPENSES         ACRE      0.00   16.45   0.00   0.00  65.45  32.90  16.45   0.00  16.45   0.00   0.00   0.00      147.32
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT                                                -17.32
--------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL         DOL.      2.74    4.11   4.11   4.11   0.00   0.00   1.37   1.37   2.74   2.74   2.74   2.74       28.80
--------------------------------------------------------------------------------------------------------------------------
                                 LABOR REQUIREMENTS BY MONTH
MACHINERY LABOR        HR.       0.00    0.05   0.00   0.00   0.05   0.00   0.05   0.00   0.05   0.00   0.00   0.00        0.19
--------------------------------------------------------------------------------------------------------------------------
                                 MACHINERY FIXED AND VARIABLE COSTS PER HOUR                     TOTAL
     MACHINE           CODE      DEPR      INSUR.      TAX   TOTAL FIXED  REPAIR     FUEL     LUB.    VARIABLE    INT.     HR/TIME
TRACTOR                  3       2.65      0.15       0.36      3.16       1.50      2.88     0.43      4.81      3.42      1.00
DRY FERT SPRD           69       0.00      0.00       0.00      0.00       0.00      0.00     0.00      0.00      0.00      0.04
--------------------------------------------------------------------------------------------------------------------------

                       ITEM          TIMES LABOR MACHINE FUEL,OIL,LUB .  FIXED COSTS
  OPERATION             NO    DATE   OVER  HOURS  HOURS  REPAIR PER ACRE  PER ACRE
--------------------------------------------------------------------------------------------------------------------------
DRY FERT SPRD          3.68   JUL    1.00  0.047  0.039      0.20          0.28
DRY FERT SPRD          3.68   SEP    1.00  0.047  0.039      0.20          0.28
DRY FERT SPRD          3.68   FEB    1.00  0.047  0.039      0.20          0.28
DRY FERT SPRD          3.68   MAY    1.00  0.047  0.039      0.20          0.28
      TOTAL                                0.187  0.155      0.82          1.12
--------------------------------------------------------------------------------------------------------------------------
         COLUMN         1     2       3       4     5      6      7        8     9      10      11     12      13      14    15    16
NAME OF MACHINE       CODE  WIDTH  INITIAL  SPEED FIELD   RC1    RC2      RC3  HOURS  YEARS   RFV1   RFV2  PURCHASE  FUEL HOURS  HP
                            (FEET)   LIST   (MPH) EFFIC-                       USED   OWNED                  PRICE   TYPE  OF
                                    PRICE         IENCY                       ANNUALLY                                    LIFE
TRACTOR                  3   60.0   22600    4.5  0.88   0.80  0.000621  1.60   600   10.0   0.680  0.920   22600     3   10000  80
DRY FERT SPRD           69   60.0     0      5.0  [illegible] 0.75 [illegible] 1.60 50 20.0  0.560  0.885     0       0   [illegible] [illegible]
--------------------------------------------------------------------------------------------------------------------------
                                                                 EQUINOS.GERLOFF    MACHINERY COMPLEMENT   8
                                                                                    EQUIPMENT COMPLEMENT   8
                                                          03/28/89       0000100110         PRICE VECTOR   8

                     LINE CHANGE         LINE CHANGE          LINE CHANGE          LINE CHANGE          LINE CHANGE
GENERAL NAME CHANGE->308  HAY HARVEST EXP

                     BY CL      VALUE    BY CL     VALUE    BY CL     VALUE      BY CL     VALUE     BY CL     VALUE     BY CL     VALUE
MACH COMP CHGS-->68. 3.    0.000000 68 13.    0.000000
```

APPENDIX C

VALUES USED IN LP ANALYSIS (TRANCOL)

APPENDIX C

Column Headings

(Numbers within parentheses indicate element positions within heading)

PAST(1-4), (4-7), and PAS(5-7)---> PASTURE
NP(5&6)---> NATIVE PASTURE
BC(7&8)---> WITH BRUSH CONTORL
GRAZ(1-4) and GRZ(1-3)---> GRAZING
WO(5&6), (6&7) and (7&8)---> WITHOUT BRUSH CONTROL OR ACARICIDE USE
FES(1-3) and (4-6)---> FESCUE PASTURE
1 or 2(8)---> PASTURE 5 or 6, respectively (Table V)
FESCBRM(1-7) and FSBM(4-7)---> FESCUE/BERMUDA PASTURE
1 or 2(8)---> PASTURE 7 or 8, respectively (Table V)
SEL(1-3)---> SELL
BERM(1-4) and (4-7)---> BERMUDA PASTURE
1 to 8(8)---> BERMUDA PASTURES 9-16, respectively (Table V)
H(1)---> HEREFORD
S(2)---> STOCKER
OT(3&4)---> ZERO TICKS
W(5)---> WITH ACARICIDE USE
C(2)---> COW-CALF
S(3)---> SPRING CALVING
B(1)---> BRAHMAN-CROSS
F(3)---> FALL CALVING
WT(3&4)---> WITH TICKS
WHTGZOUT---> WHEAT GRAZEOUT (Pasture 1, Table V)
SOYWTSOY---> SOYBEAN-WHEAT-SOYBEAN CROPPING
WHTGZHAR---> WHEAT, GRAZE & HARVEST (Pasture 2, Table V)
GZWHEAT2---> GRAZE PASTURE 2
NT(3&4)---> SOLD PRIOR TO THE TICK SEASON. Thus, NO TICKS

Row Headings

PASTLAND---> PASTURE LAND
CROPLAND---> CROPPING LAND
LABOR01-12---> JANUARY - DECEMBER LABOR
CAPITAL1-3---> OPER, INTER, and LT CAPITAL respectively
HRF(1-3) and HR(1&2)---> HEREFORD
STR(3-5) and (4-6)---> STEER
CF(6&7)---> CALF
HFR(3-5)---> HEIFER
BRA(1-3) and BR(1&2)---> BRAHMAN-CROSS

APPENDIX C

```
             PASTNPBC    GRAZNPBC    PASTNPWO    GRAZNPWO    FESPAST1    GRZFESC1    FESPAST2     GRZFES2      1....1
OBJ1           .49400-       .           .           .       72.56000-       .       52.56000-       .        OBJ1
OBJ2          1.30700-       .           .           .       72.83000-       .       52.83000-       .        OBJ2
OBJ3          1.30700-       .           .           .       72.83000-       .       52.83000-       .        OBJ3
PASTLAND      1.00000        .        1.00000        .        1.00000        .        1.00000        .        PASTLAND
LABORW02         .           .           .           .         .04700        .         .04700        .        LABORW02
LABORW05       .06200        .           .           .           .           .           .           .        LABORW05
LABORW09         .           .           .           .         .04700        .         .04700        .        LABORW09
CAPITAL1       .04100        .         .02900        .       41.07000        .       31.90300        .        CAPITAL1
CAPITAL2      4.95200        .           .           .        2.07800        .        2.07800        .        CAPITAL2
GTRAN001      1.00000-    1.00000        .           .           .           .           .           .        GTRAN001
GTRAN002         .           .        1.00000-    1.00000        .           .           .           .        GTRAN002
GTRAN003         .           .           .           .        1.00000-    1.00000        .           .        GTRAN003
GTRAN004         .           .           .           .           .           .        1.00000-    1.00000     GTRAN004
WINTDM22         .           .           .           .           .        8.69000-       .        7.54000-    WINTDM22
SPGDM22          .        2.30000-       .        2.30000-       .       10.30000-       .        8.93000-    SPGDM22
SUMDM22          .        3.21000-       .        3.21000-       .        1.44000-       .        1.25000-    SUMDM22
FALLDM22         .        1.10000-       .        1.10000-       .       11.66000-       .       10.12000-    FALLDM22
WINTDM18         .        3.27000-       .        2.18000-       .           .           .           .        WINTDM18
FALLDM18         .        1.09000-       .        1.09000-       .           .           .           .        FALLDM18
WINTDP           .         .03000-       .         .02000-       .        1.01000-       .         .62000-    WINTDP
SPGDP            .         .17000-       .         .17000-       .        1.19000-       .         .57000-    SPGDP
SUMMDP           .         .18000-       .         .18000-       .         .17000-       .         .08000-    SUMMDP
FALLDP           .         .07000-       .         .08000-       .        1.34000-       .         .81000-    FALLDP
FESCHAY          .           .           .           .           .         .77000-       .         .67000-    FESCHAY

             FESCBRM1    GRZFSBM1    FESCBRM2    GRZFSBM2    BERMPAS1    GRZBERM1    BERMPAS2    GRZBERM2      2....1
OBJ1         92.96000-       .      120.55000-       .       37.77000-       .       44.02000-       .        OBJ1
OBJ2         93.49900-       .      121.08900-       .       37.91000-       .       44.16000-       .        OBJ2
OBJ3         93.49900-       .      121.08900-       .       37.91000-       .       44.16000-       .        OBJ3
PASTLAND      1.00000        .        1.00000        .        1.00000        .        1.00000        .        PASTLAND
LABORW02       .04700        .         .04700        .           .           .           .           .        LABORW02
LABORW05       .04700        .         .04700        .         .04700        .         .04700        .        LABORW05
LABORW07       .04700        .         .04700        .           .           .           .           .        LABORW07
LABORW09       .04700        .         .04700        .           .           .           .           .        LABORW09
CAPITAL1     19.90500        .       54.02000        .       52.61400        .       48.96800        .        CAPITAL1
CAPITAL2      4.15700        .        4.15700        .        1.03900        .        1.03900        .        CAPITAL2
GTRAN005      1.00000-    1.00000        .           .           .           .           .           .        GTRAN005
GTRAN006         .           .        1.00000-    1.00000        .           .           .           .        GTRAN006
GTRAN007         .           .           .           .        1.00000-    1.00000        .           .        GTRAN007
GTRAN008         .           .           .           .           .           .        1.00000-    1.00000     GTRAN008
WINTDM22         .        3.55000-       .        4.36000-       .           .           .           .        WINTDM22
SPGDM22          .       11.88000-       .       16.83000-       .        5.41000-       .        6.52000-    SPGDM22
SUMDM22          .        3.94000-       .       14.63000-       .           .           .           .        SUMDM22
FALLDM22         .        5.94000-       .        9.60000-       .           .           .           .        FALLDM22
SUMMDM18         .        5.94000-       .           .           .        6.02000-       .        8.07000-    SUMMDM18
FALLDM18         .           .           .           .           .        5.07000-       .        7.52000-    FALLDM18
WINTDP           .         .33000-       .         .40000-       .           .           .           .        WINTDP
SPGDP            .         .98000-       .        1.42000-       .         .38000-       .         .46000-    SPGDP
SUMMDP           .         .56000-       .         .83000-       .         .33000-       .         .44000-    SUMMDP
FALLDP           .         .45000-       .         .73000-       .         .15000-       .         .22000-    FALLDP
BRMFESHY         .         .52000-       .         .85000-       .           .           .           .        BRMFESHY
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APPENDIX C (Continued)

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           BERMPAS3    GRZBERM3   BERMPAS4    GRZBERM4   BERMPAS5    GRZBERM5   BERMPAS6    GRZBERM6    3....1
OBJ1       50.27000-      .       62.77000-      .       47.45000-      .       68.72000-      .        OBJ1
OBJ2       50.41000-      .       62.91000-      .       47.59000-      .       68.86000-      .        OBJ2
OBJ3       50.41000-      .       62.91000-      .       47.59000-      .       68.86000-      .        OBJ3
PASTLAND    1.00000       .        1.00000       .        1.00000       .        1.00000       .        PASTLAND
LABORW05     .04700       .         .04700       .         .04700       .         .04700       .        LABORW05
CAPITAL1   49.48900       .       50.53000       .       33.44700       .       43.86400       .        CAPITAL1
CAPITAL2    1.03900       .        1.03900      . .       1.03900       .        1.03900       .        CAPITAL2
GTRAN009    1.00000-   1.00000        .          .           .          .           .          .        GTRAN009
GTRAN010      .           .        1.00000-   1.00000        .          .           .          .        GTRAN010
GTRAN011      .           .           .          .        1.00000-   1.00000        .          .        GTRAN011
GTRAN012      .           .           .          .           .          .        1.00000-   1.00000    GTRAN012
SPGDM22       .        7.50000-       .       9.75000-       .       4.89000-       .        8.76000-   SPGDM22
SUMDM22       .           .           .          .           .       1.63000-       .        8.76000-   SUMDM22
FALLDM22      .           .           .          .           .          .           .         .68000-   FALLDM22
SUMMDM18      .        9.28000-       .       9.09000-       .       3.26000-       .          .        SUMMDM18
FALLDM18      .        8.68000-       .      12.87000-       .        .38000-       .          .        FALLDM18
SPGDP         .         .53000-       .        .73000-       .        .36000-       .         .56000-   SPGDP
SUMMDP        .         .50000-       .        .51000-       .        .27000-       .         .49000-   SUMMDP
FALLDP        .         .24000-       .        .36000-       .        .04000-       .         .04000-   FALLDP
BRMHAY        .           .           .          .           .        .32000-       .         .61000-   BRMHAY

           BERMPAS7    GRZBERM7   BERMPAS8    GRZBERM8   HSOTW3      HCSOTW1    BSOTW3      BCSOTW1     4....1
OBJ1       87.58000-      .      124.07000-      .       33.81700-  36.89800-  33.81700-  36.89800-   OBJ1
OBJ2       87.72000-      .      124.21000-     . .      44.44900-  63.24800-  44.44900-  63.24800-   OBJ2
OBJ3       87.72000-      .      124.21000-      .       44.44900-  63.24800-  44.44900-  63.24800-   OBJ3
PASTLAND    1.00000       .        1.00000       .           .          .           .          .        PASTLAND
LABORW01      .           .           .          .         .33400     .84500      .33400     .84500    LABORW01
LABORW02      .           .           .          .         .33400    1.06500      .33400    1.06500    LABORW02
LABORW03      .           .           .          .         .33400     .90500      .33400     .90500    LABORW03
LABORW04      .           .           .          .         .33400     .73500      .33400     .73500    LABORW04
LABORW05     .04700       .         .04700       .         .33400     .62500      .33400     .62500    LABORW05
LABORW06      .           .           .          .         .33400     .68500      .33400     .68500    LABORW06
LABORW07      .           .           .          .         .62400     .62500      .62400     .62500    LABORW07
LABORW08      .           .           .          .           .        .68500        .        .68500    LABORW08
LABORW09      .           .           .          .         .62400     .62500      .62400     .62500    LABORW09
LABORW10      .           .           .          .         .33400    1.34500      .33400    1.34500    LABORW10
LABORW11      .           .           .          .         .33400     .62500      .33400     .62500    LABORW11
LABORW12      .           .           .          .         .33400     .84500      .33400     .84500    LABORW12
CAPITAL1   31.26000       .       49.33300       .      216.78900   11.70000   212.12000   10.21200    CAPITAL1
CAPITAL2    1.03900       .        1.03900       .       84.05900  827.78500    84.05900  827.78500    CAPITAL2
HRFSTR1       .           .           .          .        7.70400-      .           .          .        HRFSTR1
HRFSTR2       .           .           .          .        5.10000       .           .          .        HRFSTR2
HAY18         .           .           .          .         .08000     .15700      .08000     .15700    HAY18
SALT          .           .           .          .       25.00000   26.88000    26.29000   28.22400    SALT
HRSTRCF1      .           .           .          .           .       1.87200-       .          .        HRSTRCF1
HRHFRCF1      .           .           .          .           .       1.27100-       .          .        HRHFRCF1
HRFCOW1       .           .           .          .           .        .95000-       .          .        HRFCOW1
HRFBULL1      .           .           .          .           .        .16000-       .          .        HRFBULL1
BRASTR1       .           .           .          .           .          .        7.60300-      .        BRASTR1
BRASTR2       .           .           .          .           .          .        5.10000       .        BRASTR2
BRSTRCF1      .           .           .          .           .          .           .       2.24600-   BRSTRCF1
BRHFRCF1      .           .           .          .           .          .           .       1.52500-   BRHFRCF1
BRACOW1       .           .           .          .           .          .           .       1.14200-   BRACOW1
BRABULL1      .           .           .          .           .          .           .        .19200-   BRABULL1
GTRAN013    1.00000-   1.00000        .          .           .          .           .          .        GTRAN013
GTRAN014      .           .        1.00000-   1.00000        .          .           .          .        GTRAN014
WINTDM22      .           .           .          .       10.58000    9.10600    11.10000    9.56500    WINTDM22
SPGDM22       .       12.04000-       .      17.70000-   13.89000   25.85000    14.16000   27.14900    SPGDM22
SUMDM22       .       12.03000-       .      17.68000-    3.96000   30.01600     3.71000   31.50600    SUMDM22
FALLDM22      .        1.03000-       .       1.37000-    8.51000    2.43000     8.94000    2.56500    FALLDM22
WINTDM18      .           .           .          .           .       8.26600        .       8.68000    WINTDM18
FALLDM18      .           .           .          .           .      16.19500        .      17.01300    FALLDM18
WINTDP        .           .           .          .         .82000     .82900      .86000     .87400    WINTDP
SPGDP         .         .88000-       .       1.30000-    1.17000    1.50100     1.20000    1.59000    SPGDP
SUMMDP        .         .72000-       .       1.14000-     .32000    1.87000      .32000    1.97100    SUMMDP
FALLDP        .         .06000-       .        .08000-     .68000     .65000      .71000     .68300    FALLDP
BRMHAY        .         .82000-       .       1.20000-       .          .           .          .        BRMHAY
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APPENDIX C (Continued)

	BSWT5	BCSWT1	WHTGZOUT	GZWHEAT1	SOYWTSOY	SOYBEANS	HSWT3	HCSWT1	5....1
OBJ1	29.40700-	31.95800-	60.50000-	.	117.99600-	77.87600-	29.40700-	31.95800-	OBJ1
OBJ2	40.03900-	58.30900-	69.12700-	.	140.60800-	96.06000-	40.03900-	58.30900-	OBJ2
OBJ3	40.03900-	58.30900-	69.12700-	.	140.60800-	96.06000-	40.03900-	58.30900-	OBJ3
CROPLAND	.	.	1.00000	.	1.00000	1.00000	.	.	CROPLAND
LABORW01	.33400	.84500	.	.	.	.	.33400	.84500	LABORW01
LABORW02	.33400	1.06500	.	.	.	.	.33400	1.06500	LABORW02
LABORW03	.33400	.90500	.04700	.	.02300	.	.33400	.90500	LABORW03
LABORW04	.33400	.73500	.	.	.28700	.57400	.33400	.73500	LABORW04
LABORW05	.33400	.62500	.	.	.	1.77900	.33400	.62500	LABORW05
LABORW06	.33400	.68500	.13500	.	1.92400	.28800	.33400	.68500	LABORW06
LABORW07	.62400	.62500	.57400	.	.53600	.24800	.62400	.62500	LABORW07
LABORW08	.	.68500	.	.	.	.	.	.68500	LABORW08
LABORW09	.62400	.62500	.73000	.	.	.	.62400	.62500	LABORW09
LABORW10	.33400	1.34500	.	.	.48100	.	.33400	1.34500	LABORW10
LABORW11	.33400	.62500	.	.	.	.	.33400	.62500	LABORW11
LABORW12	.33400	.84500	.	.	.	.	.33400	.84500	LABORW12
CAPITAL1	211.14700	9.31500	24.88800	.	3.97100	25.77900	216.23800	10.28800	CAPITAL1
CAPITAL2	84.05900	827.78500	61.87600	.	159.58200	126.90700	84.05900	827.78500	CAPITAL2
HRFSTR1	.	.	.	.	.	.	7.37100-	.	HRFSTR1
HRFSTR2	.	.	.	.	.	.	5.10000	.	HRFSTR2
HAY18	.06000	.15700	.	.	.	.	.08000	.15700	HAY18
PROTSUPP	2.42000	.	.	.	.	.	.	.	PROTSUPP
SALT	26.29000	28.22400	.	.	.	.	25.00000	26.88000	SALT
HRSTRCF1	.	.	.	.	.	.	.	1.62200-	HRSTRCF1
HRHFRCF1	.	.	.	.	.	.	.	1.09100-	HRHFRCF1
HRFCOW1	.	.	.	.	.	.	.	.91700-	HRFCOW1
HRFBULL1	.	.	.	.	.	.	.	.15700-	HRFBULL1
BRASTR1	7.36000-	.	.	.	.	.	.	.	BRASTR1
BRASTR2	5.10000	.	.	.	.	.	.	.	BRASTR2
BRSTRCF1	.	2.05900-	.	.	.	.	.	.	BRSTRCF1
BRHFRCF1	.	1.39400-	.	.	.	.	.	.	BRHFRCF1
BRACOW1	.	1.11800-	.	.	.	.	.	.	BRACOW1
BRABULL1	.	.19000-	.	.	.	.	.	.	BRABULL1
WHEAT	.	.	.	.	16.30000-	.	.	.	WHEAT
SOYBEANS	.	.	.	.	18.40000-	18.40000-	.	.	SOYBEANS
GTRAN015	.	.	1.00000-	1.00000	.	.	.	.	GTRAN015
WINTDM22	3.85000	9.56500	.	.	.	.	10.58000	9.10600	WINTDM22
SPGDM22	14.57000	27.14900	.	.	.	.	13.89000	25.85000	SPGDM22
SUMDM22	2.89000	31.50600	.	.	.	.	3.96000	30.01600	SUMDM22
FALLDM22	.	2.56500	.	.	.	.	8.51000	2.43000	FALLDM22
WINTDM18	4.10000	8.68000	.	.	.	.	.	8.26600	WINTDM18
SUMMDM18	1.20000	.	.	.	.	.	.	.	SUMMDM18
FALLDM18	7.26000	17.01300	.	.	.	.	.	16.19500	FALLDM18
WINTDP	.78000	.87400	.	1.80000-	.	.	.82000	.82900	WINTDP
SPGDP	1.23000	1.59000	.	1.94000-	.	.	1.17000	1.50100	SPGDP
SUMMDP	.34000	1.97100	.	.	.	.	.32000	1.87000	SUMMDP
FALLDP	.61000	.68300	.	1.66000-	.	.	.68000	.65000	FALLDP
WINTDM26	.	.	.	11.66000-	.	.	.	.	WINTDM26
SPGDM26	.	.	.	14.60000-	.	.	.	.	SPGDM26
FALLDM26	.	.	.	8.72000-	.	.	.	.	FALLDM26

APPENDIX C (Continued)

	WHTGZHAR	GZWHEAT2	BCFOTW1	BCFWT1	HCFWT1	HCFOTW1	BSNT3	BCFNT1	6....1
OBJ1	81.73900-	.	43.25000-	38.31100-	38.31100-	43.25000-	27.59000-	37.40300-	OBJ1
OBJ2	90.72300-	.	69.60000-	64.66100-	64.66100-	69.60000-	37.40400-	63.34400-	OBJ2
OBJ3	90.72300-	.	69.60000-	64.66100-	64.66100-	69.60000-	37.40400-	63.34400-	OBJ3
CROPLAND	1.00000	.	.	.	.	.	.	.	CROPLAND
LABORW01	.	.	.89500	.89500	.89500	.89500	.33400	.89500	LABORW01
LABORW02	.	.	1.01500	1.01500	1.01500	1.01500	.33400	1.01500	LABORW02
LABORW03	.04700	.	.95500	.95500	.95500	.95500	.57400	1.19500	LABORW03
LABORW04	.	.	.78500	.78500	.78500	.78500	.21400	.72500	LABORW04
LABORW05	.	.	.62500	.62500	.62500	.62500	.21400	.62500	LABORW05
LABORW06	.20500	.	1.34500	1.34500	1.34500	1.34500	.21400	.92500	LABORW06
LABORW07	.57400	.	.62500	.62500	.62500	.62500	.26400	.62500	LABORW07
LABORW08	.	.	.68500	.68500	.68500	.68500	.	.68500	LABORW08
LABORW09	.80100	.	.68500	.68500	.68500	.68500	.62400	.68500	LABORW09
LABORW10	.	.	.62500	.62500	.62500	.62500	.33400	.62500	LABORW10
LABORW11	.	.	.72500	.72500	.72500	.72500	.33400	.72500	LABORW11
LABORW12	.	.	.84500	.84500	.84500	.84500	.33400	.84500	LABORW12
CAPITAL1	25.01800	.	10.37000	9.99900	10.53100	10.90200	125.44400	9.57000	CAPITAL1
CAPITAL2	64.67400	.	827.78500	827.78500	827.78500	827.78500	80.41300	825.96200	CAPITAL2
HAY18	.	.	.	.	.	.	.07000	.	HAY18
SALT	.	.	28.22400	28.22400	26.88000	26.88000	15.78000	28.22400	SALT
HRFCOW1	.	.	.	.	.95000-	.95000-	.	.	HRFCOW1
HAY22	.	.	.21300	.21300	.21300	.21300	.	.21300	HAY22
BRASTR2	.	.	.	.	.	.	5.10000	.	BRASTR2
BRACOW1	.	.	1.14200-	1.14200-	.	.	.	.	BRACOW1
HRSTRCF2	.	.	.	.	1.62200-	1.87200-	.	.	HRSTRCF2
HRHFRCF2	.	.	.	.	1.09100-	1.27100-	.	.	HRHFRCF2
HRFBULL2	.	.	.	.	.16000-	.16000-	.	.	HRFBULL2
HERDBULL	.	.	.16000	.16000	.16000	.16000	.	.16000	HERDBULL
BRSTRCF2	.	.	2.24600-	2.03800-	.	.	.	.	BRSTRCF2
BRHFRCF2	.	.	1.52500-	1.39300-	.	.	.	.	BRHFRCF2
BRABULL2	.	.	.19200-	.19200-	.	.	.	.	BRABULL2
WHEAT	32.60000-	.	.	.	.	.	.	.	WHEAT
BRASTR3	.	.	.	.	.	.	6.46800-	.	BRASTR3
BRSTRCF3	.	.	.	.	.	.	.	1.08900-	BRSTRCF3
BRHFRCF3	.	.	.	.	.	.	.	.73600-	BRHFRCF3
BRACOW2	.	.	.	.	.	.	.	1.14200-	BRACOW2
BRABULL3	.	.	.	.	.	.	.	.19200-	BRABULL3
GTRAN016	1.00000-	1.00000	.	.	.	.	.	.	GTRAN016
WINTDM22	.	.	26.71200	26.71200	25.43500	25.43500	8.87000	26.71200	WINTDM22
SPGDM22	.	.	35.26900	35.26900	33.58900	33.58900	.	.	SPGDM22
SUMDM22	.	.	.	.	.	.	1.27000	.	SUMDM22
FALLDM22	.	.	25.70400	25.70400	24.48300	24.48300	8.94000	25.70400	FALLDM22
SPGDM18	.	.	.	.	.	.	.	20.19400	SPGDM18
SUMMDM18	.	.	20.21600	20.21600	19.25300	19.25300	.	20.21600	SUMMDM18
WINTDP	.	.83000-	1.88200	1.88200	1.78100	1.78100	.68000	1.88200	WINTDP
SPGDP	.	.	2.19500	2.19500	2.09400	2.09400	.	.70600	SPGDP
SUMMDP	.	.	.70600	.70600	.67200	.67200	.12000	.70600	SUMMDP
FALLDP	.	.88000-	1.37800	1.37800	1.29900	1.29900	.71000	1.37800	FALLDP
WINTDM26	.	4.36000-	.	.	.	.	.	.	WINTDM26
FALLDM26	.	4.63000-	.	.	.	.	.	.	FALLDM26

APPENDIX C (Continued)

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               HCFNT1       HSNT3    LHIREJAN    LHIREFEB    LHIREMAR    LHIREAPR    LHIREMAY    LHIREJUN      7....1
OBJ1         36.72100-   27.59000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-  OBJ1
OBJ2         62.35500-   37.40400-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-  OBJ2
OBJ3         62.35500-   37.40400-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-  OBJ3
LABORW01       .89500      .33400     1.00000-       .           .           .           .           .      LABORW01
LABORW02      1.01500      .33400        .        1.00000-       .           .           .           .      LABORW02
LABORW03      1.01500      .57400        .           .        1.00000-       .           .           .      LABORW03
LABORW04       .72500      .21400        .           .           .        1.00000-       .           .      LABORW04
LABORW05       .62500      .21400        .           .           .           .        1.00000-       .      LABORW05
LABORW06       .92500      .21400        .           .           .           .           .        1.00000-  LABORW06
LABORW07       .62500      .26400        .           .           .           .           .           .      LABORW07
LABORW08       .68500        .           .           .           .           .           .           .      LABORW08
LABORW09       .68500      .62400        .           .           .           .           .           .      LABORW09
LABORW10       .62500      .33400        .           .           .           .           .           .      LABORW10
LABORW11       .72500      .33400        .           .           .           .           .           .      LABORW11
LABORW12       .84500      .33400        .           .           .           .           .           .      LABORW12
CAPITAL1      9.52400   128.25800     2.50000     2.50000     2.50000     2.50000     2.50000     2.50000   CAPITAL1
CAPITAL2    824.59500    80.41300        .           .           .           .           .           .      CAPITAL2
HRFSTR2         .         5.10000        .           .           .           .           .           .      HRFSTR2
HAY18           .          .07000        .           .           .           .           .           .      HAY18
SALT         26.88000    15.00000        .           .           .           .           .           .      SALT
HAY22          .21300        .           .           .           .           .           .           .      HAY22
HERDBULL       .16000        .           .           .           .           .           .           .      HERDBULL
HRSTRCF3       .90800-       .           .           .           .           .           .           .      HRSTRCF3
HRHFRCF3       .60900-       .           .           .           .           .           .           .      HRHFRCF3
HRFCOW2        .95000-       .           .           .           .           .           .           .      HRFCOW2
HRFBULL3       .16000-       .           .           .           .           .           .           .      HRFBULL3
HRFSTR3         .         6.63000-       .           .           .           .           .           .      HRFSTR3
WINTDM22     25.43500     8.46000        .           .           .           .           .           .      WINTDM22
SUMDM22         .         1.36000        .           .           .           .           .           .      SUMDM22
FALLDM22     24.48300     8.51000        .           .           .           .           .           .      FALLDM22
SPGDM18      19.21900        .           .           .           .           .           .           .      SPGDM18
SUMMDM18     19.25300        .           .           .           .           .           .           .      SUMMDM18
WINTDP        1.78100      .65000        .           .           .           .           .           .      WINTDP
SPGDP          .67200        .           .           .           .           .           .           .      SPGDP
SUMMDP         .67200      .11000        .           .           .           .           .           .      SUMMDP
FALLDP        1.29900      .68000        .           .           .           .           .           .      FALLDP

             LHIREJUL    LHIREAUG    LHIRESEP    LHIREOCT    LHIRENOV    LHIREDEC    BOROPCAP    BORINCAP      8....1
OBJ1          5.00000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-     .15000-       .      OBJ1
OBJ2          5.00000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-     .15000-     .15000-  OBJ2
OBJ3          5.00000-    5.00000-    5.00000-    5.00000-    5.00000-    5.00000-     .15000-     .15000-  OBJ3
LABORW07      1.00000-       .           .           .           .           .           .           .      LABORW07
LABORW08        .         1.00000-       .           .           .           .           .           .      LABORW08
LABORW09        .            .        1.00000-       .           .           .           .           .      LABORW09
LABORW10        .            .           .        1.00000-       .           .           .           .      LABORW10
LABORW11        .            .           .           .        1.00000-       .           .           .      LABORW11
LABORW12        .            .           .           .           .        1.00000-       .           .      LABORW12
CAPITAL1      2.50000     2.50000     2.50000     2.50000     2.50000     2.50000     1.00000-       .      CAPITAL1
CAPITAL2        .            .           .           .           .           .           .        1.00000-  CAPITAL2
MCAP1LV1        .            .           .           .           .           .        1.00000        .      MCAP1LV1
MCAP2LV1        .            .           .           .           .           .           .        1.00000   MCAP2LV1

             SLHRSTR1    BYHRSTR1    BY18HAY1    BYPROSUP      BYSALT    SLHSRCF1    SLHHFCF1     SLHCOW1      9....1
OBJ1         66.59000    67.88000-   50.00000-     .13000-     .09000-   78.85000    64.62000    39.65600   OBJ1
OBJ2         66.59000    67.88000-   50.00000-     .13000-     .09000-   78.85000    64.62000    39.65600   OBJ2
OBJ3         66.59000    67.88000-   50.00000-     .13000-     .09000-   78.85000    64.62000    39.65600   OBJ3
HRFSTR1       1.00000        .           .           .           .           .           .           .      HRFSTR1
HRFSTR2         .         1.00000-       .           .           .           .           .           .      HRFSTR2
HAY18           .            .        1.00000-       .           .           .           .           .      HAY18
PROTSUPP        .            .           .        1.00000-       .           .           .           .      PROTSUPP
SALT            .            .           .           .        1.00000-       .           .           .      SALT
HRSTRCF1        .            .           .           .           .        1.00000        .           .      HRSTRCF1
HRHFRCF1        .            .           .           .           .           .        1.00000        .      HRHFRCF1
HRFCOW1         .            .           .           .           .           .           .        1.00000   HRFCOW1
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APPENDIX C (Continued)

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             SLHBULL1    BY22HAY1    SLBRSTR1    BYBRASTR    SLBSRCF1    SLBHFCF1    SLBRCOW1    SLBRBUL1    10....1
OBJ1         53.41000    60.00000-   62.98000    66.28000-   77.62000    64.28000    39.76000    54.04000   OBJ1
OBJ2         53.41000    60.00000-   62.98000    66.28000-   77.62000    64.28000    39.76000    54.04000   OBJ2
OBJ3         53.41000    60.00000-   62.98000    66.28000-   77.62000    64.28000    39.76000    54.04000   OBJ3
HRFBULL1      1.00000        .           .           .           .           .           .           .      HRFBULL1
HAY22            .        1.00000-       .           .           .           .           .           .      HAY22
BRASTR1          .           .        1.00000        .           .           .           .           .      BRASTR1
BRASTR2          .           .           .        1.00000-       .           .           .           .      BRASTR2
BRSTRCF1         .           .           .           .        1.00000        .           .           .      BRSTRCF1
BRHFRCF1         .           .           .           .           .        1.00000        .           .      BRHFRCF1
BRACOW1          .           .           .           .           .           .        1.00000        .      BRACOW1
BRABULL1         .           .           .           .           .           .           .        1.00000   BRABULL1

             SLHSRCF2    SLHHFCF2    SLHBUL2     BYHRDBUL    SLBSRCF2    SLBHFCF2    SLBRBUL2    SLWHEAT1    11....1
OBJ1         84.37000    69.50000    56.43000   100.00000-   82.63000    69.54000    57.10000     3.75400   OBJ1
OBJ2         84.37000    69.50000    56.43000   100.00000-   82.63000    69.54000    57.10000     3.75400   OBJ2
OBJ3         84.37000    69.50000    56.43000   100.00000-   82.63000    69.54000    57.10000     3.75400   OBJ3
HRSTRCF2      1.00000        .           .           .           .           .           .           .      HRSTRCF2
HRHFRCF2         .        1.00000        .           .           .           .           .           .      HRHFRCF2
HRFBULL2         .           .        1.00000        .           .           .           .           .      HRFBULL2
HERDBULL         .           .           .        1.00000-       .           .           .           .      HERDBULL
BRSTRCF2         .           .           .           .        1.00000        .           .           .      BRSTRCF2
BRHFRCF2         .           .           .           .           .        1.00000        .           .      BRHFRCF2
BRABULL2         .           .           .           .           .           .        1.00000        .      BRABULL2
WHEAT            .           .           .           .           .           .           .        1.00000   WHEAT

             SLSOYBEN    SLFESHAY    SLBRFSHY    SLBRMHAY    SLBRSTR2    SLBSRCF3    SLBHFCF3    SLBRCOW2    12....1
OBJ1          6.36800    40.00000    40.00000    40.00000    74.14000    90.07000    75.51000    43.07000   OBJ1
OBJ2          6.36800        .           .           .       74.14000    90.07000    75.51000    43.07000   OBJ2
OBJ3          6.36800        .           .           .       74.14000    90.07000    75.51000    43.07000   OBJ3
SOYBEANS      1.00000        .           .           .           .           .           .           .      SOYBEANS
BRASTR3          .           .           .           .        1.00000        .           .           .      BRASTR3
BRSTRCF3         .           .           .           .           .        1.00000        .           .      BRSTRCF3
BRHFRCF3         .           .           .           .           .           .        1.00000        .      BRHFRCF3
BRACOW2          .           .           .           .           .           .           .        1.00000   BRACOW2
FESCHAY          .        1.00000        .           .           .           .           .           .      FESCHAY
BRMFESHY         .           .        1.00000        .           .           .           .           .      BRMFESHY
BRMHAY           .           .           .        1.00000        .           .           .           .      BRMHAY

             SLBRBUL3    SLHSRCF3    SLHHFCF3    SLHCOW2     SLHBULL3    SLHFRSTR    BYPROSP1    BYPROSP2    13....1
OBJ1         42.96000    91.96000    75.47000    42.96000    56.43000    74.42000    29.55000-   29.55000-  OBJ1
OBJ2         42.96000    91.96000    75.47000    42.96000    56.43000    74.42000    29.55000-   29.55000-  OBJ2
OBJ3         42.96000    91.96000    75.47000    42.96000    56.43000    74.42000    29.55000-   29.55000-  OBJ3
CAPITAL1         .           .           .           .           .           .       14.77500    14.77500   CAPITAL1
BRABULL3      1.00000        .           .           .           .           .           .           .      BRABULL3
HRSTRCF3         .        1.00000        .           .           .           .           .           .      HRSTRCF3
HRHFRCF3         .           .        1.00000        .           .           .           .           .      HRHFRCF3
HRFCOW2          .           .           .        1.00000        .           .           .           .      HRFCOW2
HRFBULL3         .           .           .           .        1.00000        .           .           .      HRFBULL3
HRFSTR3          .           .           .           .           .        1.00000        .           .      HRFSTR3
WINTDP           .           .           .           .           .           .        1.00000-       .      WINTDP
SPGDP            .           .           .           .           .           .           .        1.00000-  SPGDP
MXBYPA01         .           .           .           .           .           .        1.00000        .      MXBYPA01
MXBYPA02         .           .           .           .           .           .           .        1.00000   MXBYPA02
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APPENDIX C (Continued)

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           BYPROSP3   BYPROSP4   FHYTO18    BRFSTO18   BERMTO18   TRANSF01   TRANSF02   TRANSF03     14....1
OBJ1       29.55000-  29.55000-      .          .          .          .          .          .      OBJ1
OBJ2       29.55000-  29.55000-      .          .          .          .          .          .      OBJ2
OBJ3       29.55000-  29.55000-      .          .          .          .          .          .      OBJ3
CAPITAL1   14.77500   14.77500       .          .          .          .          .          .      CAPITAL1
HAY18          .          .      50.00000-  50.00000-  50.00000-      .          .          .      HAY18
SPGDM22        .          .          .          .          .       1.00000-      .       1.00000   SPGDM22
FALLDM22       .          .          .          .          .          .       1.00000-      .      FALLDM22
SPGDM18        .          .          .          .          .          .          .       1.00000-  SPGDM18
SUMMDP      1.00000-      .          .          .          .          .          .          .      SUMMDP
FALLDP         .       1.00000-      .          .          .          .          .          .      FALLDP
FESCHAY        .          .        .90000       .          .          .          .          .      FESCHAY
BRMFESHY       .          .          .        .90000       .          .          .          .      BRMFESHY
BRMHAY         .          .          .          .        .90000       .          .          .      BRMHAY
SPGDM26        .          .          .          .          .       1.00000       .          .      SPGDM26
FALLDM26       .          .          .          .          .          .       1.00000       .      FALLDM26
MXBYPA03    1.00000       .          .          .          .          .          .          .      MXBYPA03
MXBYPA04       .       1.00000       .          .          .          .          .          .      MXBYPA04

           TRANSF04   TRANSF05   TRANSF06   TRANSF07   TRANSF08   RHS1                               15....1
PASTLAND       .          .          .          .          .      240.00000  PASTLAND
CROPLAND       .          .          .          .          .       60.00000  CROPLAND
LABORW01       .          .          .          .          .      300.00000  LABORW01
LABORW02       .          .          .          .          .      300.00000  LABORW02
LABORW03       .          .          .          .          .      300.00000  LABORW03
LABORW04       .          .          .          .          .      300.00000  LABORW04
LABORW05       .          .          .          .          .      300.00000  LABORW05
LABORW06       .          .          .          .          .      300.00000  LABORW06
LABORW07       .          .          .          .          .      300.00000  LABORW07
LABORW08       .          .          .          .          .      300.00000  LABORW08
LABORW09       .          .          .          .          .      300.00000  LABORW09
LABORW10       .          .          .          .          .      300.00000  LABORW10
LABORW11       .          .          .          .          .      300.00000  LABORW11
LABORW12       .          .          .          .          .      300.00000  LABORW12
CAPITAL1       .          .          .          .          .      5000.0000  CAPITAL1
CAPITAL2       .          .          .          .          .      500000.00  CAPITAL2
MCAP1LV1       .          .          .          .          .      50000.000  MCAP1LV1
MCAP2LV1       .          .          .          .          .      500000.00  MCAP2LV1
WINTDM22       .       1.00000-      .       1.00000       .          .      WINTDM22
SUMDM22        .          .       1.00000-      .       1.00000       .      SUMDM22
FALLDM22    1.00000       .          .          .          .          .      FALLDM22
WINTDM18       .          .          .       1.00000-      .          .      WINTDM18
SUMMDM18       .          .          .          .       1.00000-      .      SUMMDM18
FALLDM18    1.00000-      .          .          .          .          .      FALLDM18
WINTDM26       .       1.00000       .          .          .          .      WINTDM26
SUMMDM26       .          .       1.00000       .          .          .      SUMMDM26
MXBYPA01       .          .          .          .          .      200.00000  MXBYPA01
MXBYPA02       .          .          .          .          .      200.00000  MXBYPA02
MXBYPA03       .          .          .          .          .      200.00000  MXBYPA03
MXBYPA04       .          .          .          .          .      200.00000  MXBYPA04
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VITA

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