EVALUATING RISK MANAGEMENT STRATEGIES
IN A FARM PLANNING MODEL

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CHAPTER I

INTRODUCTION

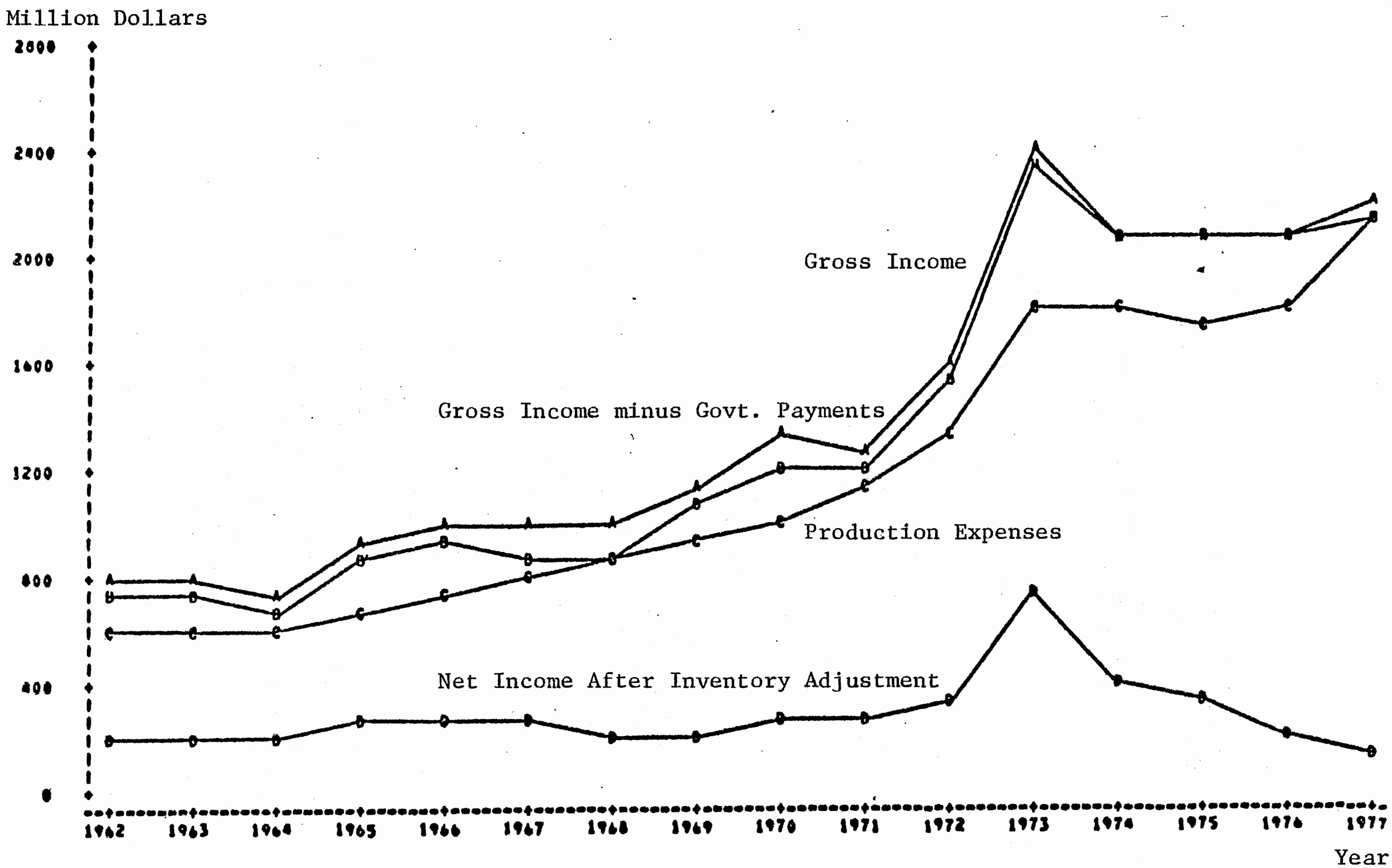
The Problem

Elements of risk pervade every phase of economic activity. Most economic decisions are made under imperfect knowledge because individual decision makers are not aware of the complete set of alternative actions available to them or the possible outcomes associated with each action. This is especially true for the decisions faced by farm operators. The natural and economic environments within which farmers operate interact to complicate decision making. Weather, insects and weeds make planting, fertilizer, herbicide and insecticide decisions extremely difficult and cause yields to fluctuate widely. The competitive market within which farmers operate subjects them to wide fluctuations in prices. Institutional policies such as government farm programs and trade agreements, inflation and credit arrangements affect prices and costs of production. In recent years, the simultaneous fluctuation of a number of these factors has resulted in gross and net income instability for farm operators in Oklahoma and the U.S. farmers, lenders and policy makers have become increasingly concerned regarding the potential impact of income instability on the economic viability of farm firms and the future structure of agriculture.

The problems on which this study focuses are price and yield variability and their effects on net farm income for Oklahoma farm operators. Since the 1970's price variability has increased greatly for all kinds of agricultural commodities. These increases are attributed to expanded and unpredictable fluctuations in agricultural exports, devaluation of the U.S. dollar, fluctuation in energy supplies, variation in world production, and government farm programs. The price variability problem is statewide, regional, national and international in scope.

Figure 1 shows the farm income situation faced by Oklahoma farmers from 1962-1977. Net income after inventory adjustments increased very little from 1962 to 1972. This stability was due in a large part to major price and income support programs and stable foreign demand. However, there was a considerable income in 1973 caused mainly by unpredictable fluctuations in foreign demand. Since 1973, net farm income has been gradually declining. These figures conceal the greater variability of net farm income at the individual farm level. Fluctuating crop and livestock yields and prices coupled with rising fuel, fertilizer, labor and land costs have increased income variability and, thus, risk at the farm level.

Many individual farmers produce only one crop, or at most a few related crops and livestock enterprises. A complete or partial failure of a particular crop affects the amount available for sale and, thereby net farm income. However, if the individual farmer has a good crop in a year when most other farmers have poor crop yields, his net farm income will rise.



Source: This graph was plotted from data reported in State Farm Income Statistics, Supplement to Statistical Bulletin No. 609, U.S. Department of Agriculture, Economics, Statistics, and Cooperative Service, Washington, D.C., p. 33.

Figure 1. Oklahoma Aggregate Farm Income

Factor and product prices at the farm level are subject to variability from a variety of sources exogenous to the farmer. The farm decision maker incurs price or market risk when he plants a crop or buys stocker cattle for wheat pasture. He does not know what may happen to livestock or crop prices during the production period.

Methods of Managing Production and Marketing Risk

As is discussed above, risks arising out of production and marketing affect net farm income. Therefore, risk plays an important role in farm decision making. Risk is inherent in production and marketing decisions and cannot be eliminated. However, several methods of dealing with production and marketing risk are available to producers. Some of these methods which are frequently advocated are: government farm programs, diversification, forward contracting, hedging on the futures market, crop-share versus cash rent, and crop insurance. These methods of handling production and marketing risk may not be applicable to every type of agricultural producer.

One method that may be used by farmers is to participate in some type of government farm program to avoid or minimize risks arising out of production or marketing. There is a program for disaster payments in case of prevented planting or low yields and a price support program to protect the farmer from an adverse price decline. These farm programs do not entail a direct cost, but the farmer may have to comply with some amount of acreage setaside requirements.

Diversification is another strategy used in handling risk under certain conditions. Diversification involves producing more than one commodity during a production period. This strategy generally reduces income variability by adding new enterprises to the existing organization of production. It may also refer to the selection of "safe" enterprises and multiple marketing decisions involving the selling of commodities at different times during the crop year. Diversification may be considered as an intra-firm risk management strategy.

Forward contracting, hedging on the futures market, crop-share rental arrangements and insurance are all inter-firm risk management strategies. These methods deal with the transfer of risk to other economic units more willing and/or better able to bear risks. Forward contracting transfers price risk to the forward contractor, e.g., the local grain elevator. Hedging on the futures market transfers price risk to speculators. Crop-share rental arrangements transfer some of the production and cost risk to the landlord. Insurance transfers certain kinds of production risk to insurance companies, e.g., a farmer can purchase crop insurance against wind or hail damage.

Objectives of the Study

The primary purpose of this analysis is to determine and evaluate risk efficient farm plans for a number of the more important production, marketing, and risk management strategies available to farm operators in the study area. Risk efficient farm plans are defined as those minimizing total negative gross margin deviation (TND) for a given level of expected total gross margin (E). Risk efficient farm plans are also defined as those having minimum gross margin standard deviation for a given level of expected total gross margin since TND can be, and is, transformed into an estimate of gross margin standard deviation.

The specific objectives are to:

1. Develop and analyze the necessary data to determine the price, yield, cost of production, and net income variability for the important production alternatives in the study area.
2. Determine the impact on net return variability of alternative marketing and risk management strategies.
3. Construct a farm planning model to determine risk efficient farm plans from among the production, marketing and risk management alternatives available to producers in the area.
4. Evaluate the potential tradeoffs between expected total gross margin and gross margin variability under alternative assumptions regarding risk management strategies available to producers.

Description of Study Area

The area selected for this analysis is a part of the Low Rolling Plains of Oklahoma, and is composed of eight counties which are located in the southwestern part of the state. These counties are Caddo, Comanche, Cotton, Greer, Harmon, Jackson, Kiowa, and Tillman. There are three experimental research stations and 14 weather reporting stations in the area (Figure 2). The experiment stations are located at Altus, Mangum, and Tipton, which are in Jackson, Greer, and Tillman counties, respectively.

The study area is characterized by low annual precipitation. The average annual precipitation is 27.1 inches (Curry). The monthly average precipitation varies from a low of 0.82 inches in January to a high of 4.7 inches in May.

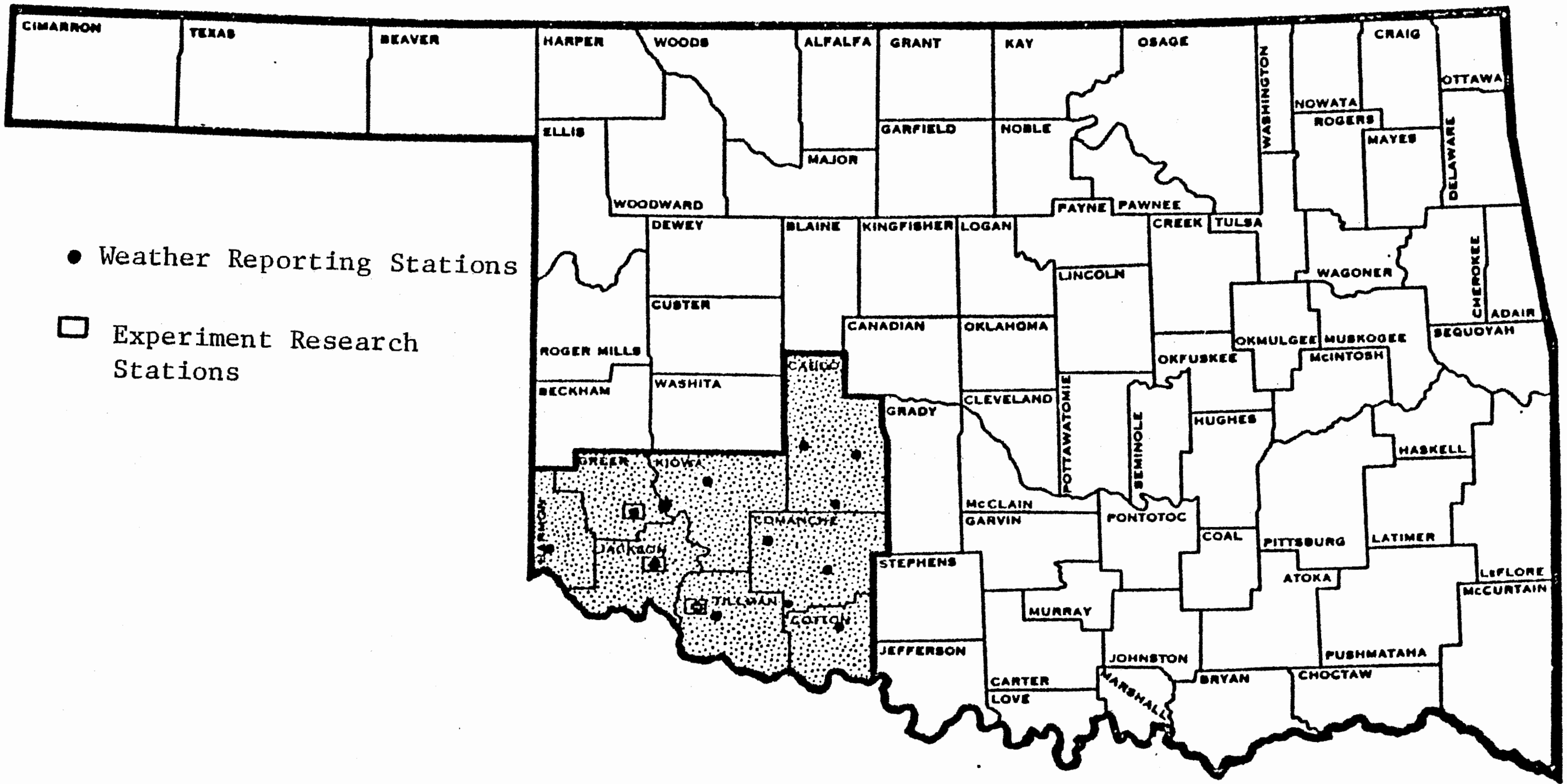


Figure 2. Map of Oklahoma With Shaded Area Indicating the Counties Included in This Study

Precipitation from June through September is 3.14, 2.47, 2.33, and 3.5 inches, respectively. The amount of precipitation is important for both dryland and irrigated farming. The average annual precipitation of the study area decreases as one moves across from east to west. The average annual precipitation at Altus, Mangum and Tipton is 24.9 inches, 24.6 inches, and 25.9 inches, respectively.

The southwestern part of Oklahoma was selected as the study area because a wider range of production and marketing alternatives are available, including wheat, grain sorghum, cotton, and alfalfa produced under irrigated and dryland conditions. Price and yield variability are both important, particularly under dryland conditions. In addition, the data on yields, prices, and cost of production, which are essential for risk analysis, were readily available.

The study area has both dryland and irrigated farms, but dryland farming predominates. According to census data, the number of dryland and irrigated farms have been decreasing since 1954 while the average size per farm has been increasing (U.S. Department of Commerce, 1954; 1959; 1964; 1969; and 1974).

The soils of the study area can be classified into three broad groups: clay, loam, and sandy. Each of these groups can be found extensively in relatively homogeneous blocks throughout the study area. However, historical crop yield data are not available for different soil groups.

The crops grown in the area are wheat, cotton, grain and forage sorghum, hay, oats, barley, peanuts, rye, corn, and soybeans. However, most of the crop acreage is devoted to wheat, cotton, and sorghum production (Oklahoma Agricultural Statistics). In addition to crop enterprises, the principal livestock enterprises are cow-calf and stocker heifers and steers for winter wheat pasture.

Organization of Thesis

The following chapter presents a review of the relevant literature and the theoretical development. Chapter III discusses data needs and develops the planning model used to determine the risk efficiency frontiers for the representative farms. Measures of expectations are specified and cost and expected gross margin data and input-output parameters for alternative production enterprises are developed. Chapter IV develops the risk management strategies and the cost and gross margin data necessary to analyze these risk strategies. A series of risk efficient farm plans are determined for the representative farms for each risk management strategy using different measures of expectations and levels of expected total gross margin. The risk efficient farm plans are presented and discussed in Chapter V. Chapter VI summarizes the analysis and draws conclusions, and discusses the implications of the study and the need for further research.

CHAPTER II

LITERATURE REVIEW AND THEORETICAL DEVELOPMENT

Alternative Measures of Risk

Risk can be defined in many different ways by economists and researchers. Markowitz discussed six possible measures of risk. The measures are: (1) the standard deviation; (2) the semi-variance; (3) the expected value of loss; (4) the expected absolute deviation; (5) the probability of loss; and (6) the maximum loss. Using these measures of risk, the decision maker maximizes the expected value of some utility function by selecting a portfolio based on its expected return and (1) standard deviation, (2) semi-variance, (3) expected value of loss, (4) expected absolute deviation, (5) probability of loss, or (6) maximum loss. He concluded that the best portfolio is based on its expected return and standard deviation (or variance). He also stated that a portfolio based on its expected return and the semi-variance, which considers variability below the expected return, could be at least as good as the portfolio based on its expected return and standard deviation. He further concluded that portfolios selected on the basis of expected loss, expected absolute deviation, or probability of loss are not very reliable for a conservative decision maker because the portfolios may be speculative. The use of maximum loss as a measure of risk is ruled out because it is not consistent with the assumption of utility maximization (Markowitz, p. 293).

According to Young and Findeis the two most widely used definitions of risk are: (1) standard deviation or variance, and (2) "chance of loss" or the probability (α) that random net income (π) will fall below some critical or "disaster" level (d). This second definition can be expressed mathematically as Pr $(\pi \leq d) = \alpha$. The first definition is consistent with quadratic programming models. The second definition is more inclined towards "safety-first" models of Roy, Telser, and Kataoka. These models represent alternatives to the mean-variance approach to choice under risk. The safety-first approach assumes that the decision maker concerned with the ability to prevent total disaster rather than with the possibility of small losses and gains (Boisvert and Jensen).

The most widely used measure of risk is the variance or standard deviation. Both of these measures can indicate the degree of variability of enterprise returns. However, variability and risk are not necessarily synonymous since variability includes returns above the expected level as well as below. Among farm operators, an enterprise is not generally considered "risky" when the return is above the expected level of return.

Other measures of risk have been attempted by researchers (Hadar and Russell; Hanoch and Levy; and Rothschild and Stiglitz). One plausible method of estimating risk is based on the variate difference method (Tintner). This technique has been applied to agricultural crops in California, North Carolina, and Wyoming to measure variability in price, yield and income (Carter and Dean; Mathia; and Yahya and Adams). This technique assumes that economic time series data consist of mathematical and random components. Since the mathematical part can be predicted, the measure of variability is concerned only with the random or unpredictable part of the time series data. The mathematical component is effectively eliminated by a series of finite differencing. Tintner suggested the use of the standard error procedure to determine at which difference the mathematical component has been eliminated. He states that when the standard error ratio becomes and remains less than three, the mathematical component has been eliminated thus leaving an estimate of the random component (Tintner).

Darcovich and Heady proposed a number of alternative price and yield expectation models. The models are: (1) the average price and yield model, (2) the normal model, (3) the cumulative yield model, (4) the random price and yield model, (5) the current-year price and yield model, (6) the moving-average price and yield model, (7) the weighted-moving-average price model, (8) the trend and reverse-trend price models, (9) farm outlook price model, (10) the parallel price model, and (11) the futures price models.

The two that are popular are the average price and yield model and the moving-average (included the weighted-moving-average) models. An expectation model based on the average or mean of the series implicitly assumes that each of the past observations is of equal importance. One problem with this type of expectation model is the selection of the appropriate length of the data series. The longer the data series the more difficult it is to argue that the expected value is the mean of the series since that would assume the decision maker has an infinite memory. It may be argued that recent events should be weighted more heavily than earlier events and that the expectation model should be of the moving-average type. Just argues that it is also possible that decision makers may weight past events equally (p. 18). Darcovich and

Heady proposed 5-year moving average and weighted 5-year moving average models. Carter and Dean also suggested a moving average as a possible expectation model. Patrick and Eisgruber used a price expectation model with weights of .7, .2, and .1 for the last three years, with the last year being most heavily weighted. Fisher and Tanner tested various expectation models and found that farmers formulate their expectations based on a weighted average of past prices with the weights declining exponentially over time.

The expectation models presented above represent ways of formulating expected yields and prices separately. They can also represent different ways of eliminating the mathematical component from the random component in time series data. In other words, besides forecasting purposes these models may represent alternative ways of estimating variability using historical data.

Discussion of expectation models for production costs, gross margin, and enterprise return are relatively sparse in the literature. For short-run risk analysis such as this, expectation models on production costs are not really necessary since many production costs are known with certainty at the time of decision making (e.g., harvesting time) so that they have relatively little effect on risk (Just, p. 18). Hazell, Chen and Baker, and Just combined prices and yields to calculate actual returns. Hazell and Chen and Baker used the arithmetic mean of the actual return series as the expected return. Hazell used negative deviations from the mean as a measure of risk. Hazell and Scandizzo showed that farm decision makers have rational expectations in the Muthian sense if direct forecasts of net return per acre are made instead of forecasting of price and yield separately. Thus it seems plausible that an expectation model can be formulated for gross margin or enterprise return in the same manner as in price and yield expectation models since expected gross margin or expected return is calculated on the basis of expected yield, expected price, and expected cost.

It has been shown that expectation models and measures of risk are interrelated since the choice of the expectation model will affect the measure of risk. The choice of the appropriate expectation model and measure of risk is still unresolved. However, Young evaluated several measures of risk based on historical data that are used in various studies. He found that the equally weighted moving average and the constantly adjusted weighted moving average (CAWMA) models provide reasonable results but the simple and weighted moving average models were better than the other models based on theoretical and empirical criteria.

In this analysis, risk or variability in net farm income is defined as the difference between the actual and the expected net farm income. The expected net farm income may be defined in terms of the mean of the historical series, an equally weighted moving average of recent years, an unequally weighted moving average of recent years, or other similar measures. In each instance, once the expected net farm income is defined, variability of net farm income is defined as the deviation between the expected net farm income and the actual net farm income which occurred.

Theory of Choice Under Risk

Prescribing or predicting decision behavior under risk is difficult. It involves choosing from among a number of alternatives for which the consequences are associated with a probability distribution. Utility analysis provides a system whereby consistent choices among risky alternatives are simplified and evaluated. The central theorem of utility analysis, and its function in decision analysis, is known as Bernoulli's principle, sometimes called, the expected utility theorem. This principle named after Daniel Bernoulli who as early as 1738 suggested that the optimal behavior of the decision maker is that which maximizes expected utility. He assumed that utility was cardinally measurable and that the decision maker should maximize his expected utility (Sommer).

In 1944, Von Neumann and Morgenstern showed that the concept of cardinally utility follows logically from the assumption of a small number of simple postulates, and that if these postulates are fulfilled then utility is measurable up to a positive linear transformation. The postulates are: (1) Complete-Ordering and Transitivity, (2) Continuity, and (3) Independence (Halter and Dean). These postulates provide a sufficient framework for deducing Bernoulli's principle for the case of risky alternatives with singledimensioned outcomes and with slight but reasonable extension of the postulates for risky prospects with multi-dimensioned outcomes. Further, this principle provides the means by which risky prospects are ranked in order of preference, the most preferred prospect being the one with the highest expected utility (Anderson et al.).

According to Bernoulli's principle, if a decision maker accepts the postulates of ordering and transitivity, continuity, independence, there exists a utility function for the decision maker that reflects his preferences for outcomes and a subjective probability distribution that reflects his personal judgment of the choices confronting him (Anderson et al.). If the decision maker's choices are consistent with the above postulates, then for every altenrative A there exists a corresponding utility U(A). If the alternatives represent different levels of income π then the result is a utility function for income.

Figure 3 represents three utility functions each of which associates a utility value with each of the risky alternatives. The utility value designates the rank of the altenratives in order of the preference of the decision maker. The most preferred alternative has the highest utility value (Dillon, p. 10). These utility functions depict the risk behavior of three types of decision makers (Halter and Dean, pp. 45-46).

All three functions are monotonically increasing, i.e., if $\pi_1 > \pi_2$ implies $U(\pi_1) > U(\pi_2)$. The implication of increasing monotonicity is the neoclassical axiom that more income is preferred to less, i.e., $\partial U/\partial\pi > 0$. However, the marginal utility obtained from an extra dollar of income varies among the three decision makers. Although the first derivative of the utility function, $U(\pi)$, is positive, the second derivative may be negative ($\partial^2U/\partial\pi^2 < 0$), zero ($\partial^2U/\partial\pi^2 = 0$), or positive ($\partial^2U/\partial\pi^2 > 0$) which implies that the marginal utility of extra income is decreasing, constant, or increasing. Decision makers with the above utility functions are characterized as risk averse, risk neutral, or risk lovers, respectively.

The purpose of this study is "normative", that is, to prescribe to farm operators decision they "should" make under conditions of risk in order to be consistent with their risk preferences. The preferences of a decision maker can be denoted in the form of a polynomial utility function that can be expressed as a Taylor series expansion of $U(\pi)$

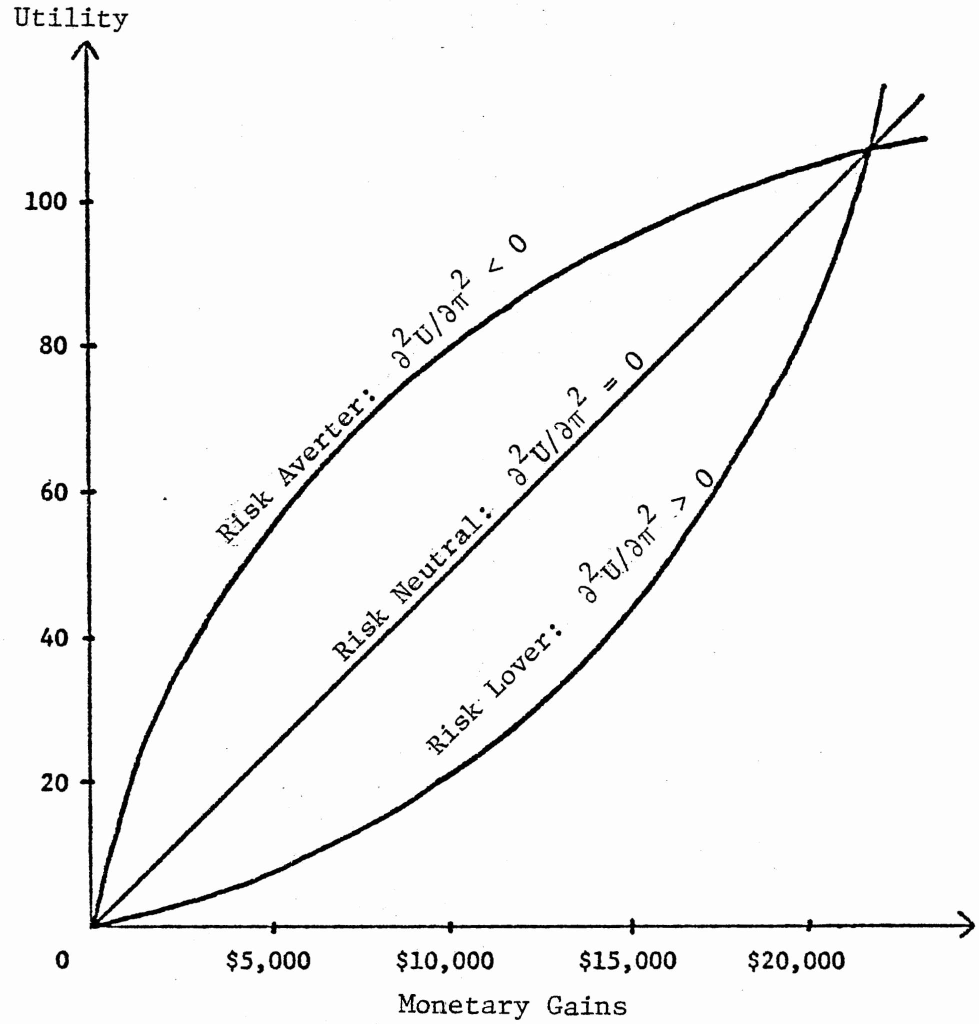


Figure 3. Three Utility Functions

about the fixed value of expected income $E(\pi)$. The expected utility of any alternative A is derived by taking the mathematical expectation of both sides of the Taylor series expansion equation. The first moment about the origin is the mean, $E(\pi)$. The first moment about the mean is equal to zero. The second, third, and fourth moments about the mean are variance, skewness, and kurtosis, respectively (Halter and Dean, p. 100).

In order to determine the degree of the polynomial function to calculate the expected utility for any alternative depends on the number of moments of the random variable π, and the number of derivatives that can be obtained from the utility function. If the random variable π is normally distributed, for most decision makers moments beyond the third one play no great role in decision making (Anderson et al., p. 92). Therefore, only the first three terms of the Taylor expansion series are used to calculate the expected utility. Since the second term of the expansion is equal to zero, the utility function may be described as quadratic:

$$U = U(E, V) \tag{1}$$

where U equals expected utility, and E equals expected income and V is the variance of expected income or risk.

If the decision maker's utility function can be described as quadratic, in such a case, all the remaining moments beyond the third (skewness, kurtosis, etc.) are ignored. Moreover, if the decision maker has a quadratic utility function, then the functional arguments of expected utility are expected income and variance of income as stated in equation (1).

Equation (1) implies a utility surface in three dimensions U, E, and V. An E-V indifference curve is described by holding U constant:

$$U^o = U^o(E, V) \tag{2}$$

All points on U^o yield the same level of utility. Holding U constant at different values give a system of E-V indifference curves (Figure 4). With expected income and variance of income as arguments in the decision maker's utility function, higher expected income and low income variance provide greater expected utility.

Whole-Farm Planning Models

Linear Programming

Various types of mathematical programming models have been used as whole-farm planning tools to aid farm operators in decision making. Of these models, linear programming (LP) is the most widely used. Basically, the LP maximizing model may be expressed as follows:

$$\text{Maximize } z = \sum_{j=1}^{n} c_j x_j \tag{3}$$

$$\text{subject to } \sum_{j=1}^{n} a_{ij} x_j \ (\leq = \geq) b_i \tag{4}$$

$$\text{and } x_j \geq 0 \tag{5}$$

$$(i = 1, 2, \ldots, m;\ j = 1, 2, \ldots, n)$$

where z is usually net farm income, c_j is the per unit net return of the jth farm enterprise, x_j is the level of the jth enterprise, a_{ij} is the amount of the ith resource required for a unit of the jth enterprise and b_i is the quantity of the ith resource available.

However, the usefulness of LP as a farm planning tool has been questioned. LP assumes that all the parameters (c_j, a_{ij}, and b_i) of

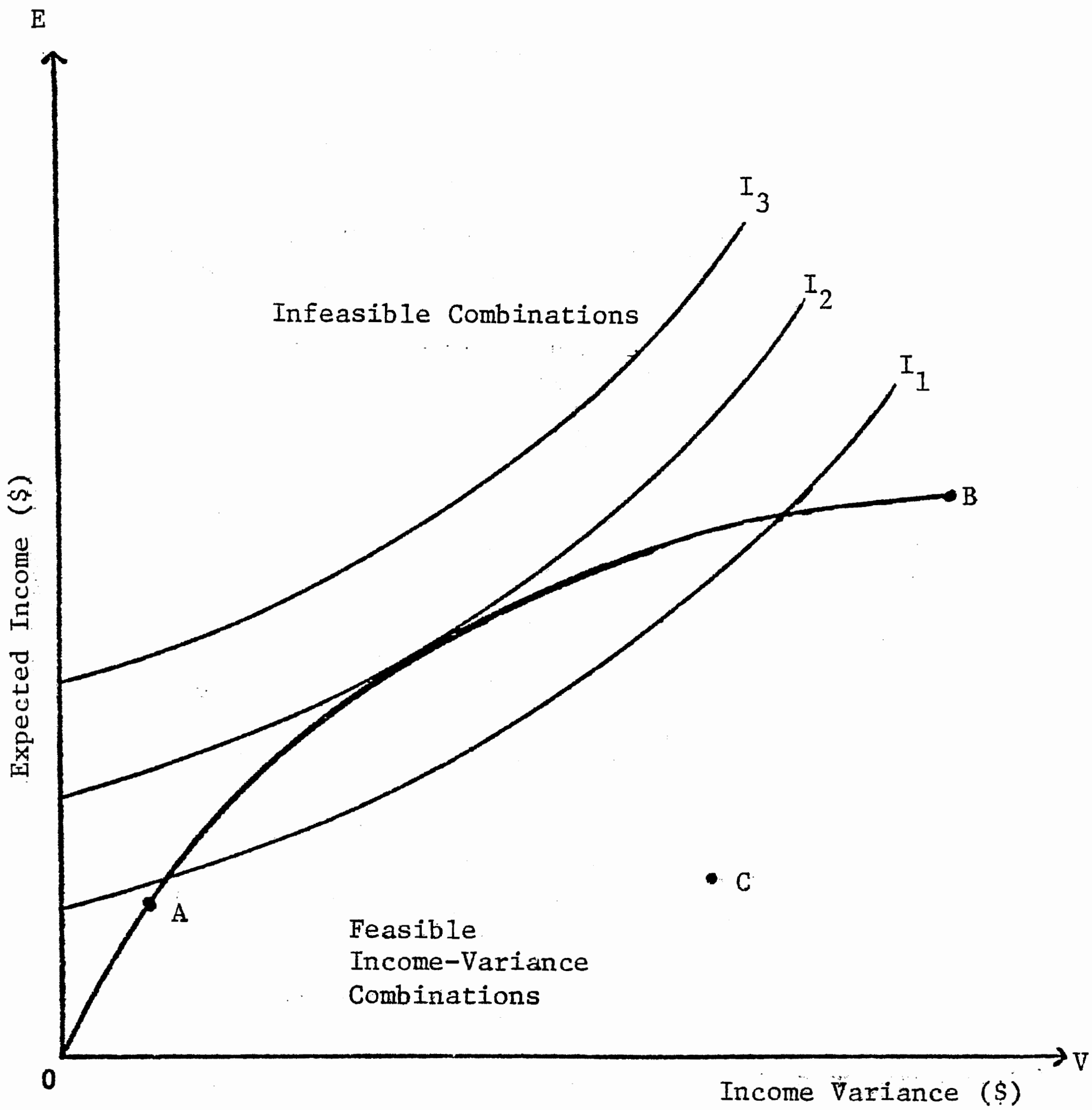


Figure 4. The Mean-Variance System and the Risk Efficiency Frontier

the model are known with certainty. When it is applied to the farm planning problem it results in an optimal plan which will maximize net farm income subject to a set of linear farm constraints. The optimal plan may have a rather large variance of net farm income, however, the decision maker is assumed to be risk neutral. The optimal farm plan derived using LP may be quite different from the organization of production of a risk adverse farm operator.

When a LP farm planning model is extended to include income variance or risk, the decision maker is assumed to be a risk averter rather than risk neutral. A risk averter is a decision maker who maximizes expected income subject to income variance and the set of linear farm constraints or that the decision maker minimizes income variance subject to expected income and the farm constraints. However, the inclusion of income variance in a basic LP model, expressed as a constraint or an objective function, is not a linear but a quadratic expression. The problem becomes a quadratic risk programming problem.

Quadratic Risk Programming

Specifically, quadratic risk programming is a technique for solving problems which maximizes or minimizes a quadratic objective function subject to a set of linear constraints. Risk is considered only in regards to the enterprise net returns c_j, and a_{ij} and b_i still assumed being known with certainty. The quadratic risk programming problem may be formulated as follows:

$$\text{Minimize } V = \sum_{j=1}^{n} \sum_{k=1}^{n} x_j x_k \sigma_{jk} \tag{6}$$

$$\text{subject to } \sum_{j=1}^{n} f_j x_j = E \tag{7}$$

$$(0 \leq E \leq E_{max})$$

$$\text{and } \sum_{j=1}^{n} a_{ij} x_j \ (\leq = \geq) b_i \tag{8}$$

$$(i = 1, 2, \ldots, m)$$

$$x_j \geq 0 \quad (j = 1, 2, \ldots, n) \tag{9}$$

where n = the number of enterprises;

x_j = the level of the jth enterprise;

x_k = the level of the kth enterprise;

σ_{jk} = the covariance of gross margins (gross returns per acre minus variable costs per acre) between the jth and kth enterprise when $j \neq k$ and the variance coefficient of gross margins for the jth enterprise when $j = k$;

f_j = the expected gross margin of the jth enterprise;

E = the expected total gross margin and can be specified between 0 and the maximum expected total gross margin, E_{max}, of the basic LP solution;

a_{ij} = the technical requirements of the jth enterprise for the ith constraint; and

m = the number of constraints.

The enterprise mix problem is to determine risk efficient farm plans that minimize expected variance (V) for a given level of expected gross margin (E). Quadratic risk programming may be used to derive a series of farm plans that minimizes expected variance for parametric increases in the level of expected gross margin. The solutions derived represent a set of risk efficient farm plans which outline the E-V risk efficiency frontier (Figure 4). Any farm plan that is not on the risk efficiency frontier is not a risk efficient farm plan.

One application of quadratic risk programming is portfolio analysis. Portfolio analysis attempts to determine an efficient resource allocation across an array of risky alternatives in such a way that the decision maker's utility is maximized. Markowitz was the first to suggest that the portfolio choice problem can be formulated as a quadratic programming problem. The portfolio choice model offers a valuable decision criterion for selecting efficient portfolios. He described an efficient portfolio as one with maximum expected return (E) and minimum variance (V), or one with minimum variance for a given expected return. A number of these E-V combinations outline the E-V efficiency frontier. The decision maker is assumed to maximize expected utility by selecting a portfolio that lies somewhere on this E-V efficiency frontier.

Freund demonstrated how to incorporate income variances and covariances in a programming model to determine the E-V efficiency frontier. It was the first application of quadratic programming to a farm planning problem although Heady discussed earlier its application in the selection of an enterprise mix. Later Heady and Candler illustrated the E-V indifference system (Figure 4) by introducing it into a production framework. They posited that a risk averter takes risk into consideration in determining the optimum plan. That is, risk aversion may lead to the selection of a plan with a lower but more stable income. They reason that for any given farm plan there is a minimum income variance that can be obtained for any given income level, or alternatively, for any given income variance there is a maximum expected income that can be obtained.

This E-V indifference curve is convex downward, and describes a risk averter as one who prefers a combination of higher expected income and lower income variance. It has often been suggested that the E-V model of efficient portfolio selection can be adapted as a farm planning tool. Consequently, there are several practical applications of quadratic programming to farm planning under risk (Heady and Candler; Heifner; Stovall; How and Hazell; Feldstein; Bauer; Scott and Baker; Capstick; Lin, Dean, and Moore; Kliebenstein and Scott; Barry and Willmann; Whitson et al.; Wiens; Buccola and French; and, Robison and Barry).

Quadratic programming offers considerable potential in farm planning under risk. However, its use is constrained by data on income variances and covariances which are not always available and difficulties with quadratic programming algorithms (Anderson et al., p. 203). To circumvent the above difficulties, some progress has been made by various extensions of the basic LP model to deal with risk in the elements of the objective function. This was accomplished by using absolute deviation as a measure of risk instead of variance. Absolute deviation is a linear measure not quadratic.

Linear Risk Programming

Several linear programming models have been developed as an alternative to quadratic programming in deriving an E-V risk efficiency frontier. These include separable programming (Thomas et al.), marginal risk constraint linear programming (Chen and Baker), focus-loss technique and chance-constrained programming (Boussard and Petit; and Kennedy and Francisco), discounting gross margins using a linear programming risk simulator (Driver and Stackhouse), the use of MOTAD (Minimization of Total Absolute Deviation) developed by Hazell, and MOTAD with Rinocco (Risky Input-Output Coefficients) developed by Wicks and Guise.

The use of Hazell's MOTAD shows considerable promise as a farm planning tool (Thompson and Hazell; Hazell and Scandizzo; Schurle and Ervin; Brink and McCarl; Roetheli; and Kaiser and Robinson). The MOTAD model is formulated to determine a set of risk efficient farm plans based on the expected income-mean absolute income deviation (E-A) criterion, which approximates the E-V approach. Hazell defines the mean absolute income deviation as:

$$A = \frac{1}{s} \sum_{h=1}^{s} \sum_{j=1}^{n} \left| (c_{hj} - g_j)\, x_j \right| \qquad (10)$$

where A = an unbiased estimator of the population mean absolute income deviation;

s = the number of years of sample observations;

n = the number of activities;

c_{hj} = the gross margin (gross returns per acre minus variable costs per acre) for the jth activity on the hth sample observation;

g_j = the sample mean gross margin for the jth activity; and

x_j = the level of the jth activity.

Hazell argues that using A as a measure of risk, it is reasonable to consider E and A as the crucial parameters in the selection of a farm plan and to define efficient E-A farm plans as those having minimum mean absolute income deviation for given expected income level E. The E-A criterion has an important advantage over the E-V criterion in that E-A farm plans are easily derived with most linear programming algorithms having parametric options. Hazell converts A to a legitimate linear programming objective function by formulating the MOTAD model based on minimizing only the sum of the absolute values of the negative total gross margin deviations. The mathematical formulation of MOTAD is as follows:

$$\text{Minimize} \quad \sum_{h=1}^{s} y_h^- \tag{11}$$

$$\text{subject to} \quad \sum_{j=1}^{n} (c_{hj} - g_j)\, x_j + y_h^- \geq 0 \tag{12}$$

$$(\text{for } h = 1, 2, \ldots, s)$$

$$\text{and} \quad \sum_{j=1}^{n} f_j x_j = E \qquad (0 \leq E \leq E_{max}) \tag{13}$$

$$\sum_{j=1}^{n} a_{ij} x_j \ (\leq = \geq) b_i \tag{14}$$

$$(\text{for } i = 1, 2, \ldots, m)$$

$$x_j,\ y_h^- \geq 0 \tag{15}$$

$$(\text{for all } h \text{ and } j)$$

where y_h^- = absolute values of the negative total gross margin deviations;

s = the number of years of sample observations;

n = the number of activities in the basic linear programming model;

c_{hj} = the gross margin for the jth activity on the hth sample observation;

g_j = the sample mean gross margin for the jth activity;

x_j = the level of the jth activity;

f_j = the expected gross margin of the jth activity; and

E = the expected total gross margin and can be specified between 0 and the maximum expected total gross margin, E_{max}, of the basic LP solution.

MOTAD can be modified to derive an E-V or E-σ efficiency frontier. This is accomplished by transforming the mean absolute income deviation (A) into an estimate of variance (V) or standard deviation (σ) (Hazell and Scandizzo). The E-σ frontier shows the expected total gross margin-risk tradeoff situation associated with a series of farm plans for given farm resources. The farm operator can then select one of these risk efficiency farm plans that is consistent with his goals and risk preferences. The MOTAD model can also be modified to use other measures of expectation and risk. Brink used negative deviations from a 5-year moving average as a measure of risk and called his model an LP-TND model.

In this study, a MOTAD model is developed and used in the analysis of risk efficiency farm plans. This model is an extension of a basic LP model to include risk in activity gross margins. The model is presented in the following chapter.

CHAPTER III

MODEL AND DATA DEVELOPMENT

In this analysis, an adaptation of Hazell's MOTAD model is utilized for evaluating selected risk management strategies under alternative measures of risk. The MOTAD model may be solved by a linear programming algorithm and offers computational and cost advantages over quadratic programming. The objective of the MOTAD model is to minimize the summed total negative deviation over all years, subject to a set of linear resource constraints and to a constraint on expected gross margins. The model may be formulated as follows:

$$\text{Minimize} \quad Ld^{-}, \tag{7}$$

$$\text{Subject to:} \quad AX \leq B, \tag{8}$$

$$DX + Id^{-} \geq 0 \tag{9}$$

$$C'X = \lambda \tag{10}$$

and

$$X, d^{-}, \geq 0 \tag{11}$$

where X represents an enterprise decision vector, A is a matrix of input coefficients, B is a resource vector, and C is a row vector of expected gross margins. D is a deviation matrix representing the difference between actual gross margins and expected gross margins in a particular year. The vector d^{-} represents the total negative deviations summed over all risky enterprises. The elements of d^{-} are summed over t years and multiplied by L, a row vector of ones, to give a measure of summed total negative deviations over t years. I is an identity matrix of the number of years in the study period. The scalar, λ, is used to parameterize the expected total gross margin constraint level. Table 1 presents the initial tableaux of the model.

There are two steps in this modelling process. First, the problem is formulated in a profit maximizing framework, which is to determine the maximum expected total gross margin subject to the given resource constraints. Second, the problem is redefined as a minimizing problem and is formulated as in equations (1) through (5) above. That is, to minimize total negative deviations subject to the resource constraints and a given expected total gross margin level. In this step, however, through the use of parametric programming a sequence of farm plans can be determined for a given number of expected total gross margin levels.

The resulting farm plans can be derived in two ways. One approach is to parameterize the maximum expected total gross margin determined in the first step in arbitrary decrements to some specified minimum expected total gross margin level. The other approach is to arbitrarily select some minimum expected total gross margin level and parameterize in arbitrary increments up to the maximum expected total gross margin. Both of these approaches result in identical farm plans.

If Ld^- is used as a measure of risk, then the selection of a farm plan is defined by the parameters E-TND (or Ld^-). That is, farm plans having minimum total negative deviation for a given expected total gross margin level. However, if risk is defined in terms of variance or standard deviation, then Ld^- is converted into an estimate of standard deviation by multiplication by the constant K, which is calculated, based on the work of Hazell, Hazell and Scandizzo, Simmons and Pomareda, and Brink and McCarl as:

TABLE 1

THE INITIAL TABLEAUX OF THE LP-MOTAD MODEL

Resources or Restrictions	X_1	X_2	X_3	.	.	.	.	X_m	d_1^-	d_2^-	d_3^-	.	.	.	.	.	d_t^-	Constraints
Objective (TND)									1	1	1	.	.	.	.	.	1	Minimize
Resource 1	a_{11}	a_{12}	a_{13}	.	.	.	.	a_{1n}										$\leq B_1$
Resource 2	a_{21}	a_{22}	a_{23}	.	.	.	.	a_{2n}										$\leq B_2$
Resource 3	a_{31}	a_{32}	a_{33}	.	.	.	.	a_{3n}										$\leq B_3$
"	.	.	.	.	.	.	.	.										"
"	.	.	.	.	.	.	.	.										"
"	.	.	.	.	.	.	.	.										"
Resource m	a_{m1}	a_{m2}	a_{m3}	.	.	.	.	a_{mn}										$\leq B_m$
Year 1	D_{11}	D_{12}	D_{13}	.	.	.	.	D_{1n}	1									≥ 0
Year 2	D_{21}	D_{22}	D_{23}	.	.	.	.	D_{2n}		1								≥ 0
Year 3	D_{31}	D_{32}	D_{33}	.	.	.	.	D_{3n}			1							≥ 0
"	.	.	.	.	.	.	.					.						"
"	.	.	.	.	.	.	.						.					"
"	.	.	.	.	.	.	.							.	.			"
Year t	D_{t1}	D_{t2}	D_{t3}	.	.	.	.	D_{tn}								.	1	≥ 0
Gross Margins	C_1	C_2	C_3	.	.	.	.	C_n										$= \lambda$

$$K = \frac{2}{t}\sqrt{\frac{t \cdot \pi}{2(t-1)}} \tag{12}$$

where t = number of years in the series,

π = a mathematical constant equals 3.14286.

$$\text{Mean Absolute Deviation} = \text{MAD} = \frac{2}{t} \cdot Ld^{-} \tag{13}$$

$$\text{Standard Deviation} = \sqrt{\frac{t \cdot \pi}{2(t-1)}} \cdot \text{MAD} \tag{14}$$

Thus, the model can determine E-A farm plans as in MOTAD, E-TND plans as in Brink and McCarl, or E-V or E-σ as in Hazell and Scandizzo. The model derives a set of efficient farm plans in terms of minimum risk, as measured by Ld^{-} or standard deviation, for a given level of expected total gross margin. Depending on his preference for risk, the farmer can select from the set of farm plans that will maximize his utility. Since farmers have different risk preference functions and these farm plans represent different levels of risk, it is the individual farmer who can select that plan.

Expectation Models

In this study, three expectation models are used to calculate expected gross margins. The expectation models may be considered as expectation hypotheses. They are not tested for purposes of predicting farmers' behavior. The models calculated expected gross margins based on: (1) the mean; (2) a three-year unequally weighted moving average (UWMA); and (3) a three-year equally weighted moving average (EWMA). The mean expectation model calculated expected gross margins as the mean of the historical data series (1965-1977):

$$\text{Mean:} \quad \hat{Y}_t = \frac{\sum_{i=1}^{t} Y_i}{t} \tag{15}$$

where the Y_is are the actual gross margins for year i and Y_t is the expected gross margin for year t. Risk or variation is measured as negative deviation from the mean. This is the approach used in quadratic programming and MOTAD. In the initial tableaux in Table 1, expected gross margins are represented by Cs and deviations by D_{ij} (i = 1, 2, ..., t; j = 1, 2, ..., n). For example, C_1 represents the expected gross margins to enterprise X_1 and D_{11} is the deviation between actual gross margins and expected gross margins in year 1.

The second expectations model uses a three-year moving average with weights of .5 for the most recent year and .3 and .2 for the two previous years:

$$\text{UWMA(3):} \quad \hat{Y}_t = .5Y_{t-1} + .3Y_{t-2} + .2Y_{t-3} \tag{16}$$

where the Ys are the actual gross margins for years t-1, t-2, and t-3 and $\hat{Y}_t$ is the expected gross margin for year t. Risk is measured as negative deviation from this moving average. Using UWMA(3) to calculate expected gross margins, in Figure 5 the Cs and D_{ij}s have different values than when the mean is used. All the Cs represent expected gross margins for 1977 for the different enterprises. The deviations are the deviations from the moving average.

The third expectations model uses a three-year equally weighted moving average:

$$\text{EWMA(3):} \quad \hat{Y}_t = (Y_{t-1} + Y_{t-2} + Y_{t-3})/3 \tag{17}$$

where the Ys are the actual gross margins for years t-1, t-2, and t-3 and $\hat{Y}_t$ is the expected gross margin for year t. Risk is measured as negative deviation this moving average.

Brink and McCarl used a five-year moving average of gross margins to calculate expected gross margin with risk measured as negative deviation from the five-year moving average.

The choice of the length and weights of the three-year moving average are based on the assumption that the immediate past is indicative of the immediate future. Furthermore, a farmer may identify with such past events by either an equally weighted expectation model or one with some type of declining weighting scheme.

Land Resource Situation

The MOTAD model is applied to two hypothetical farm resource situations in Southwest Oklahoma. The dryland farm consists of 1,500 acres of land of which 1,200 acres are dry cropland and 300 acres are in unimproved native pasture. The irrigated farm contains 1,120 acres, 800 of which are dry cropland and 320 are irrigated cropland. However, only 280 irrigated acres are actually used for crops. The remaining 40 acres are unsuitable for crop cultivation because of hindrance factors such as roads, ponds, small wood patches, etc. Seventy percent equity in the land is assumed in the analysis.

Sources of Data

The data for this study are obtained from published results of variety tests for the different crops, Oklahoma State University computerized budgets for the crop and livestock enterprises considered to develop cost of production series and gross margin series, and interviews and consultations with experiment station and extension personnel for purposes of validation. The crop budgets are soil specific (Tables 87 to 109).

Management and Labor

The above farm resource situations are defined as family farm operations with the farm operator being both manager and laborer. The level of management is assumed to be above average, and approximates what is currently being done by the best farm operators in the area. The total annual hours of labor available by the farmer is 2,500. The crop year is divided into four periods: January-March (475 hours), April-June (700 hours), July-September (750 hours), and October-December (575 hours) (Walker and Minnick). Additional labor hours required during peak periods are assumed available and can be hired at $3.00 an hour.

Capital and Interest

The annual operating capital required for each enterprise is calculated in the budgets. Annual operating capital is the average amount which the enterprise will need throughout the year in the study area. Capital is not a constraint in the model. The total annual operating capital needed is assumed available and can be borrowed at eight and a half percent per annum.

Machinery Complements

A typical machinery and equipment complement is defined for the study area with the assistance of area farm management specialists (Table 2). Each budget attributed costs for machinery needed to produce an acre of the crop.

TABLE 2

MACHINERY SPECIFICATIONS AND HOURLY COST DATA IN SOUTHWEST OKLAHOMA BUDGETS 1977

	Machine	Size	Purchase Price	Salvage Value	Years Owned	Annual Hours Used	Depr./ Hour	Insur./ Hour	Taxes/ Hour	Total Fixed Cost/ Hour	Total Variable Cost/Hour	Interest/ Hour	Performance Rate in Hr./Ac.
1.	Tractor	225 HP	$50,000	$16,400	10	600	$5.60	$0.33	$0.83	$ 6.76	$9.00	$4.70	---[a]
2.	Tractor	125 HP	25,750	8,110	10	600	2.94	0.17	0.43	3.54	4.78	2.40	---[a]
3.	Chisel	41 ft.	10,700	2,100	10	200	4.30	0.19	0.54	5.03	3.86	2.72	0.06
4.	Drill	26.6 ft.	6,250	1,210	10	100	5.04	0.22	0.63	5.89	4.45	3.17	0.11
5.	M.B. Flow	6.6 ft.	3,500	380	15	100	2.08	0.12	0.35	2.55	3.57	1.65	0.38
6.	Offset Disk	28 ft.	12,000	2,300	10	100	9.70	0.43	1.20	11.33	2.42	6.08	0.09
7.	Rollover M.B. Plow	9 ft.	5,600	1,300	10	50	8.60	0.41	1.12	10.13	1.24	5.86	0.23
8.	Rotary Mower	13.3 ft.	3,500	620	10	50	5.76	0.25	0.70	6.71	5.48	3.50	0.16
9.	Sprayer	20 ft.	4,000	815	10	50	6.37	0.29	0.80	7.46	1.72	4.09	0.18
10.	Springtooth	54 ft.	5,000	950	10	100	4.05	0.18	0.50	4.73	1.01	2.53	0.04
11.	6 Row Cultivator	20 ft.	3,500	700	10	100	2.80	0.13	0.35	3.28	1.13	1.78	0.14
12.	6 Row Planter	20 ft.	4,700	920	10	70	5.40	0.24	0.67	6.31	2.51	3.41	0.12
13.	7R 2 Bar Lister	23.3 ft.	1,000	210	10	100	0.79	0.04	0.10	0.93	0.86	0.52	0.11
14.	Pickup	0.5 HP	5,400	1,440	8	500	0.99	0.04	0.11	1.14	2.50	0.58	----

[a]Tractor hours used to produce a crop equals total machine hours times 1.1.

Source: From the printouts of the OSU crop and livestock budgets of Southwest Oklahoma.

Crop and Livestock Enterprises

Eight crop activities and five livestock enterprises are considered in this study. The crops are: alfalfa, barley, oats, wheat, cotton (dryland and irrigated) and grain sorghum (dryland and irrigated). Alfalfa is not sold but used to feed livestock. The livestock enterprises are heifers and stocker steers:

March Heifers: buy at 400 lbs. (actually at 408 lbs. to take care of the 2 percent death loss assumed) on October 15 and sell at 544 lbs. on March 1. The weight gain is assumed at 1.2 lbs. per day from November 1 through March 1.

May Heifers: is the same as March heifers except they are sold at 660 lbs. on May 15. The weight gain is assumed at 1.1 lbs. from October 15 through March 1 and 1.5 lbs. from March 1 through May 15.

March Steers: buy at 400 lbs., with a 2 percent death loss assumed, on October 1 and sell at 568 lbs. on March 1. The weight gain assumed from October 15 through March 1 is 1.4 lbs. per day.

May Steers: by at 300 lbs., adjusted for an assumed death loss of 3 percent, on October 15 and sell at 568 lbs. on May 15. The weight gain is assumed at 1.1 lbs. per day from November 1 through March 1 and 1.6 lbs. per day from March 1 through May 15.

Summer Steers: buy at 500 lbs. on May 1 and sell at 690 lbs. on October 1. The death loss and the weight gained are assumed at 2 percent and 1.2 lbs. per day respectively.

The pasture activity considered related to unimproved native pasture. The native pasture is grazed only by March heifers, March steers, and summer steers. Wheat pasture is used only by March heifers and steers from November to February. Alfalfa is used by these three livestock enterprises. In this analysis, a wheat grazeout activity is defined. This alternative accommodates the fact that farmers may practice wheat grazeout when the price of wheat is very low relative to the prices of heifers and steers. Only May heifers and steers compete for the wheat grazeout activity. May heifers and steers do not use alfalfa.

Derivation of Enterprise Cost and Gross Margins

Yield and Price Series

Annual yield data for the different crops are obtained from published results of varietal tests conducted at the experimental stations at Altus, Mangum, and Tipton. Efforts to obtain all yield data from a single station proved unsuccessful. Alfalfa, cotton and grain sorghum (both dryland) varietal test yields are obtained from the results for the Mangum experiment station, where the soil type is described as Meno Sandy Loam. Barley, oats, wheat, and irrigated cotton yields are from the Altus experiment station that has Hollister Tillman Clay Loam soil. Irrigated grain sorghum yields are from the Tipton experiment station that has Tipton Silt Loam soil. Varietal test results for different soil types in the study area are unavailable. Therefore, this study assumes that the yields obtained are appropriate for different soil types throughout the study area.

Annual yields for individual crops are computed on the basis of the average of the highest top third yielding varieties that are tested each year (Capstick). The rationale for this is that the top third of the varieties tested would include most of the varieties that are actually used by farmers throughout the study area. The variety yield data are averages of three or four replications.

Aggregated county or state data, which are available, are not used because they underestimate yield variabilities at the farm level (Freund; Eisgruber and Shuman). Experimental data yields are used in estimating annual yields because they tend to approximate the variability experienced by individual farmers of the area. It is recognized that experimental data may underestimate farm yield variabilities since the test is carried out under more controlled and pampered conditions than on the farm. However, it is an empirical question as to which of the two sets of data underestimates farm yield variabilities more. It is felt that experimental data, which is less aggregated, underestimates yield variability the least.

Alfalfa, barley, and oat yield varietal test data are available for only 13 years (1965-1977). Yields on wheat and irrigated grain sorghum are available for only 16 years (1962-1977). Dryland cotton and dryland grain sorghum yields are available for 21 years (1954-1977). Irrigated cotton yields are available for 24 years (1954-1977). Cottonseed data are not directly available from the published cotton varietal test results. The seed data are obtained from the cotton specialist.[1] The grain sorghum data yields are calculated from the top third yielding varieties of the medium and late maturity (Groups II and III) varieties. The results of both groups are combined and averaged. Reliable data on yields do not exist prior to 1954. This study used the yield series from 1962-1977 (Table 3).

A test was undertaken for the different yield series to see whether or not the underlying random process that generated the yield series can be assumed to be invariant with respect to time. A simple linear regression equation is estimated for each crop. Only in the alfalfa yield series is trend significant. The resulting estimated equation is used to adjust the alfalfa yield series having significant trend values at the 5 percent level on the basis of the mean of the entire series (Table 4).

Crop and livestock prices used are current mid-month prices prevailing in Oklahoma and approximate those received by southwest Oklahoma farmers (Tables 6, 7, and 8). Price support or certificate payments are not included in these prices. Livestock and crop prices are adjusted to the 1967 price level using the Index of Prices Paid by Farmers (Table 9). Simple regression equations are used to test the adjusted 1967 price series for trend at the 5 percent level (Tables 10 through 13). Neither crop nor livestock prices had significant trend values.

Cost of Production Series

Cost of production data for the different crop and livestock activities are not available for the entire period 1962-1977. The 1977 livestock and crop budgets for southwest Oklahoma are available and are used to extrapolate production costs for individual enterprises back to 1962 (see Tables 81 through 109 for these 1977 livestock and crop budgets). These extrapolated cost of production series are obtained by the Index of Prices Paid by Farmers. These resulting production costs

TABLE 3

HISTORIC CROP YIELDS PER ACRE FOR SOUTHWEST OKLAHOMA, 1962-1977

Year	Dryland							Irrigated		
	Alfalfa	Barley	Oats	Wheat	Cotton Lint	Cotton Seed	Grain Sorghum	Cotton Lint	Cotton Seed	Grain Sorghum
	(tons/ac.)	(bu./ac.)	(bu./ac.)	(bu./ac.)	(lbs./ac.)	(lbs./ac.)	(cwt./ac.)	(lbs./ac.)	(lbs./ac.)	(cwt./ac.)
1962	--[a]	--[a]	--[a]	26.9	496.3	843.2	20.6	177.8	360.9	42.2
1963	--	--	--	44.5	256.9	457.9	0.0	1090.4	1938.2	39.1
1964	--	--	--	31.7	250.1	427.8	18.6	763.5	1474.7	33.8
1965	1.51	0.0	36.8	25.4	253.9	426.2	19.2	339.0	640.3	53.0
1966	3.37	58.8	77.8	38.7	0.0	0.0	20.4	566.5	1123.6	48.7
1967	1.39	51.8	65.5	26.9	367.0	598.3	22.1	0.0	0.0	50.0
1968	2.17	0.0	0.0	0.0	135.0	274.1	24.6	383.0	767.5	41.6
1969	2.12	76.5	96.8	42.8	532.6	983.0	23.3	677.4	1298.8	55.7
1970	4.25	59.8	52.0	28.9	316.3	551.7	19.8	523.3	887.0	55.0
1971	3.89	0.0	0.0	0.0	370.7	655.5	18.1	243.1	494.6	58.2
1972	3.26	8.0	18.6	2.3	142.0	267.7	22.4	345.7	595.5	67.1
1973	4.24	11.0	31.0	23.9	0.0	0.0	30.1	986.7	1663.0	62.5
1974	4.05	50.9	61.8	43.2	202.0	299.6	21.1	468.7	914.0	50.2
1975	4.00	44.5	58.4	32.5	193.7	383.2	27.7	364.5	663.5	60.7
1976	4.58	49.7	99.8	37.9	215.5	423.2	18.2	471.2	803.4	42.3
1977	4.99	47.7	94.0	47.0	455.2	906.0	21.4	626.3	1356.9	40.1

[a]Yield data for alfalfa, barley, and oats for the years 1962-1964 are not available.

Source: Various issues of Alfalfa Variety Tests in Oklahoma, Winter Barley, Oat and Triticale Tests, Winter Wheat Variety Tests, Cotton Variety Tests, and Performance Test of Hybrid Sorghums and Corn in Oklahoma, Department of Agronomy,,Oklahoma State University.

TABLE 4

LINEAR TREND ANALYSIS OF CROP YIELD DATA[a]

Crop	Number of Years[b]	$\hat{\beta}_0$	$\hat{\beta}_1$	Expected Yield	Standard Deviation	R-Square	t-value	Prob. > |t|
Alfalfa[c]	13	0.83	0.25	3.37	0.70	0.69	4.90[g]	0.00
Barley[d]	13	25.32	1.00	35.28	28.13	0.02	0.48	0.64
Oats[d]	13	28.81	2.45	53.27	34.54	0.08	0.96	0.36
Dryland Cotton Lint[e]	16	297.66	-4.23	261.70	161.16	0.02	-0.48	0.64
Dryland Cotton Seed[e]	16	494.58	-3.06	468.59	294.06	0.00	-0.19	0.85
Dryland Grain Sorghum[f]	16	15.32	0.61	20.48	5.90	0.20	1.89	0.08
Irrigated Cotton Lint[e]	16	507.29	-0.66	501.69	294.04	0.00	-0.04	0.97
Irrigated Cotton Seed[e]	16	945.74	-1.10	936.37	527.45	0.00	-0.04	0.97
Irrigated Grain Sorghum[f]	16	46.39	0.53	51.17	9.15	0.08	1.00	0.34
Wheat[d]	16	25.46	0.30	28.14	17.18	0.01	0.30	0.77

[a]The regression equation is $\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X$, where $\hat{Y}$ is yield per acre and X is year with 1962 equal to 1.

[b]The 13-year yield series begins from 1965-1977. The 16-year series begins from 1962-1977.

[c]Tons per acre.

[d]Bushels per acre.

[e]Pounds per acre. Cotton yields have been declining over recent years (Matzer, p. 51). Thus, the reason for the negative sign.

[f]Hundredweight per acre.

[g]Trend is significant at the 5 percent level.

are expressed in nominal dollars. For purposes of this analysis, it is assumed that this index gives a good indication of farm production cost trends through time.

TABLE 5

ALFALFA YIELD DATA ADJUSTED FOR LINEAR TREND, 1965-1977

Year	Alfalfa
	(tons/ac.)
1962	----[a]
1963	----
1964	----
1965	3.03
1966	4.64
1967	2.41
1968	2.93
1969	2.63
1970	4.51
1971	3.89
1972	3.01
1973	3.74
1974	3.29
1975	2.99
1976	3.31
1977	3.47

[a]Yield data are not available for these years.

To give details of the procedure used in deriving estimates of total variable costs, the wheat budget is used. In 1977, the total variable cost of producing an acre of wheat is \$45.87, which is obtained by adding total operating cost and annual operating capital cost, \$44.42 + \$1.45 = \$45.87, (Table 95). However, before using the index to extrapolate the

TABLE 6

SELECTED MONTHLY OKLAHOMA PRICES OF FARM CROPS
IN NOMINAL DOLLARS, 1962-1977

Year	June Barley	June Oats	November Cotton Lint	November Cotton Seed	October Grain Sorghum
	($/bu.)	($/bu.)	(¢/lb.)	($/ton)	($/cwt.)
1962	0.90	0.69	29.4	47.00	1.71
1963	0.87	0.75	29.8	54.00	1.76
1964	0.74	0.66	28.2	47.00	1.91
1965	0.85	0.68	26.5	45.00	1.82
1966	0.93	0.71	18.5	65.00	1.83
1967	0.99	0.76	20.6	57.00	1.73
1968	0.84	0.73	21.5	49.00	1.63
1969	0.77	0.66	18.5	44.00	1.91
1970	0.76	0.62	20.5	58.00	2.05
1971	1.12	0.77	26.5	60.00	1.80
1972	0.97	0.77	22.0	47.00	2.13
1973	1.30	0.95	50.0	100.00	4.09
1974	1.87	1.32	35.0	139.00	5.60
1975	2.16	1.65	43.5	91.00	4.47
1976	2.14	1.65	70.5	101.00	3.75
1977	1.42	1.32	44.2	65.00	2.98

Source: Various issues of Oklahoma Agricultural Statistics, Oklahoma Crop and Livestock Reporting Service, Oklahoma City.

TABLE 7

OKLAHOMA MONTHLY WHEAT PRICES IN NOMINAL DOLLARS, 1962-1978

Year	June	July	August	September	October	November	December	January	February	March	April	May
	($/bu.)											
1962	2.00	2.01	2.01	2.01	2.00	2.03	2.05	1.86	1.88	1.91	1.94	1.95
1963	1.83	1.83	1.83	1.86	1.96	2.02	2.03	2.04	2.10	2.11	2.16	1.99
1964	1.42	1.38	1.39	1.43	1.47	1.52	1.51	2.06	2.07	1.93	2.06	1.98
1965	1.26	1.30	1.42	1.40	1.41	1.46	1.45	1.46	1.46	1.40	1.36	1.30
1966	1.63	1.81	1.80	1.80	1.62	1.67	1.72	1.47	1.47	1.48	1.47	1.51
1967	1.52	1.44	1.43	1.40	1.44	1.42	1.44	1.64	1.54	1.69	1.60	1.60
1968	1.25	1.22	1.20	1.19	1.25	1.28	1.26	1.46	1.46	1.46	1.32	1.31
1969	1.17	1.14	1.12	1.22	1.25	1.27	1.29	1.26	1.25	1.25	1.21	1.22
1970	1.20	1.21	1.27	1.41	1.41	1.43	1.42	1.29	1.29	1.28	1.29	1.24
1971	1.47	1.39	1.37	1.35	1.38	1.37	1.41	1.42	1.41	1.39	1.40	1.44
1972	1.35	1.40	1.67	1.95	2.06	2.04	2.51	1.40	1.41	1.41	1.45	1.45
1973	2.42	2.50	4.40	4.70	4.30	4.38	4.86	2.58	1.96	2.20	2.30	2.30
1974	3.48	4.07	4.03	4.03	4.69	4.55	4.60	5.35	5.58	4.78	3.93	3.33
1975	2.87	3.39	3.73	3.85	3.78	3.39	3.22	4.00	3.76	3.41	3.41	3.11
1976	3.36	3.40	2.93	2.84	2.52	2.38	2.34	3.36	3.63	3.58	3.43	3.29
1977	1.99	2.06	2.05	2.19	2.32	2.52	2.54	2.43	2.45	2.33	2.23	2.05
1978	----[a]	----	----	----	----	----	----	2.55	2.59	2.71	2.87	2.87

[a]The wheat marketing year begins June 1 of the harvesting year and ends May 31 of the following year. Since this study terminated with the 1977 crop, wheat prices after May 1978 were not needed for this analysis.

Source: Various issues of Oklahoma Agricultural Statistics, Oklahoma Crop and Livestock Reporting Service, Oklahoma City.

TABLE 8

SELECTED MONTHLY PRICES OF CHOICE OKLAHOMA LIVESTOCK IN NOMINAL DOLLARS, 1961-1978

Year	Buy				Sell				
	May	October			March		May		October
	Steers	Heifers	Steers	Steers	Heifers	Steers	Heifers	Steers	Steers
1961	---[a]	24.29	27.09	27.25	---[a]	24.85	(23.28)[b]	24.69	---[a]
1962	29.10	26.88	30.42	30.05	23.45	25.50	23.28	25.53	25.75
1963	28.80	24.31	27.12	26.56	23.56	25.38	23.25	25.00	23.31
1964	23.25	18.97	22.65	22.60	20.89	22.75	17.47	19.66	20.20
1965	25.12	22.40	27.13	27.20	18.68	21.35	21.03	23.81	24.08
1966	31.06	24.26	28.62	28.66	25.34	28.46	24.28	26.78	25.09
1967	29.69	24.50	28.47	28.62	22.84	24.89	23.56	26.20	25.62
1968	30.96	25.48	29.81	29.81	24.15	26.52	24.71	27.90	26.44
1969	37.12	28.96	33.90	33.90	26.68	29.95	29.46	32.83	30.07
1970	37.59	31.64	36.98	36.98	31.81	35.08	30.00	32.02	31.88
1971	38.24	35.09	41.04	41.05	30.49	33.32	29.96	33.44	35.75
1972	43.60	42.05	49.36	52.89	34.07	40.16	34.62	40.94	43.05
1973	62.05	51.17	62.04	66.72	47.24	56.34	46.05	56.12	51.87
1974	42.83	25.17	30.16	30.83	40.25	45.45	34.78	39.83	28.69
1975	32.55	26.29	34.99	34.99	22.48	27.16	27.99	32.55	36.13
1976	48.26	31.04	40.09	40.09	33.62	40.37	37.59	44.79	35.53
1977	46.85	35.54	44.09	44.09	33.81	41.35	36.20	43.41	40.00
1978	68.20	---[b]	---[b]	77.40	47.94	55.45	54.58	62.72	63.98

[a]Data not needed for the analysis.

[b]Data not available. Price for 1962 is assumed for 1961.

Source: USDA Annual Livestock and Meat Statistics, Washington, D.C.: Livestock Detailed Quotations for Oklahoma, USDA Agricultural Marketing Service, Livestock Division.

rest of the cost of production series, the 1977 cost of custom combine and custom hauling must be separated from the rest of the TVC component, i.e., TVC = \$45.87 - \$7.50 (custom combine) - \$4.70 (custom hauling) = \$33.67. This separation is done so that in years of no or low yields, the farmer may not harvest the wheat and thus combining and hauling costs are not incurred. The TVC estimate for wheat for 1976 is demonstrated in four steps:

1) Divide \$33.67 by the 1977 index number and multiply by the 1976 index number: (\$33.67)(191)/202 = \$31.84.
2) Divide \$7.50 by the 1977 index number and multiply by the 1976 index number: (\$7.50)(191)/202 = \$7.09.
3) Multiply the cost of custom hauling a bushel, 10 cents a bushel in 1977, by the actual wheat yield for 1976 and then divide the result by the 1977 index number, the result is multiplied by the 1976 index number: (\$0.10)(37.9)(191)/202 = \$3.58.
4) Total variable cost is obtained by adding (1), (2), and (3): \$31.84 + \$7.09 + \$3.58 = \$42.51.

Similarly, the total variable cost for any other year from 1962-1975 can be obtained by using the index and actual wheat yield of the year under consideration by using the procedure outlined above. Tables 14 and 15 present the estimated total variable cost of production for individual crop and livestock enterprises. The resulting estimated nominal TVC series is then expressed in 1967 dollars in order to calculate actual gross margins.

TABLE 9

ANNUAL INDEX OF PRICES PAID BY FARMERS, 1962-1978

Year	Index[a]
1962	90.0
1963	91.0
1964	92.0
1965	94.0
1966	99.0
1967	100.0
1968	103.0
1969	108.0
1970	112.0
1971	118.0
1972	125.0
1973	144.0
1974	164.0
1975	180.0
1976	191.0
1977	202.0
1978	219.0

[a]1967 = 100.0

Source: Agricultural Prices: Annual Summary 1978, p. 15; Agricultural Prices: Annual Summary 1977, pp. 6-14; Agricultural Prices: Annual Summary 1976, pp. 6-15; Agricultural Prices: Annual Summary 1974, pp. 10-11, Crop Reporting Board, Statistical Reporting Service, USDA, Washington, D.C.

Actual Gross Margins

Estimated gross margins for the five livestock enterprises are calculated by multipying selling weight times adjusted Oklahoma mid-month market price per pound less total variable cost, which is in 1967 dollars. Total variable cost includes buying cost plus costs for all operating inputs plus interest charge on annual operating capital. The buying and

TABLE 10

ADJUSTED MONTHLY PRICES OF SELECTED FARM CROPS IN OKLAHOMA TO 1967 PRICE LEVEL, 1962-1977[a]

Year	June Barley	July Oats	November Lint	Cotton Seed	October Grain Sorghum	June Wheat	July Wheat	August Wheat	Sept. Wheat	Oct. Wheat	Nov. Wheat	Dec. Wheat	Jan. Wheat	Feb. Wheat	March Wheat	April Wheat	May Wheat
	($/bu.)	($/bu.)	(¢/lb.)	($/ton)	($/cwt.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)	($/bu.)
1962	1.00	0.77	32.7	52.22	1.90	2.22	2.23	2.23	2.23	2.22	2.26	2.28	2.07	2.09	2.12	2.16	2.17
1963	0.96	0.82	32.7	59.34	1.93	2.01	2.01	2.01	2.04	2.15	2.22	2.23	2.24	2.31	2.32	2.37	2.19
1964	0.80	0.72	30.7	51.09	2.08	1.54	1.50	1.51	1.55	1.60	1.65	1.64	2.24	2.25	2.10	2.24	2.15
1965	0.90	0.72	28.2	47.87	1.94	1.34	1.38	1.51	1.49	1.50	1.55	1.54	1.55	1.55	1.49	1.45	1.38
1966	0.94	0.72	18.7	65.66	1.85	1.65	1.83	1.82	1.82	1.64	1.69	1.74	1.48	1.48	1.49	1.48	1.53
1967	0.99	0.76	20.6	57.00	1.73	1.52	1.44	1.43	1.40	1.44	1.42	1.44	1.64	1.54	1.69	1.60	1.60
1968	0.82	0.71	20.9	47.57	1.58	1.21	1.18	1.17	1.16	1.21	1.24	1.22	1.42	1.42	1.42	1.28	1.27
1969	0.71	0.61	17.1	40.74	1.77	1.08	1.06	1.04	1.13	1.16	1.18	1.19	1.17	1.16	1.16	1.12	1.13
1970	0.68	0.55	18.3	51.79	1.83	1.07	1.08	1.13	1.26	1.26	1.28	1.27	1.15	1.15	1.14	1.15	1.11
1971	0.95	0.65	22.5	50.85	1.53	1.25	1.18	1.16	1.14	1.17	1.16	1.19	1.20	1.19	1.18	1.19	1.22
1972	0.78	0.62	17.6	37.60	1.70	1.08	1.12	1.34	1.56	1.65	1.63	2.01	1.12	1.13	1.13	1.16	1.16
1973	0.90	0.66	34.7	69.44	2.84	1.68	1.74	3.06	3.26	2.99	3.04	3.38	1.79	1.36	1.53	1.60	1.60
1974	1.14	0.80	21.3	84.76	3.41	2.12	2.48	2.46	2.46	2.86	2.77	2.80	3.26	3.40	2.91	2.40	2.03
1975	1.20	0.92	24.2	50.56	2.48	1.59	1.88	2.07	2.14	2.10	1.88	1.79	2.22	2.09	1.89	1.89	1.73
1976	1.12	0.86	36.9	52.88	1.96	1.76	1.78	1.53	1.49	1.32	1.25	1.23	1.76	1.90	1.87	1.80	1.72
1977	0.70	0.65	21.9	32.18	1.48	0.99	1.02	1.01	1.08	1.15	1.25	1.26	1.20	1.21	1.15	1.10	1.01
1978													1.16	1.18	1.24	1.31	1.31

[a]The Index of Prices Paid by Farmers in the U.S. (1967 = 100.0) is used to adjust the price series.

TABLE 11

LINEAR TREND ANALYSIS OF ADJUSTED OKLAHOMA CROP PRICES, 1962-1978[a]

Crop	Month	Number of Years	$\hat{\beta}_0$	$\hat{\beta}_1$	Expected Price	Standard Deviation	R-Square	t-Value	Prob. > $\|t\|$
Barley	June	16	0.87	0.005	0.91	0.16	0.02	0.54	0.60
Oats	June	16	0.72	0.001	0.72	0.10	0.00	0.11	0.92
Cotton Lint	Nov.	16	26.65	-0.202	24.93	6.82	0.02	-0.55	0.59
Cotton Seed	Nov.	16	54.57	-0.159	53.22	13.04	0.00	-0.22	0.83
Grain Sorghum	Oct.	16	1.77	0.027	2.00	0.51	0.06	0.98	0.34
Wheat	June	16	1.71	-0.024	1.51	0.39	0.08	-1.13	0.28
Wheat	July	16	1.67	-0.014	1.56	0.46	0.02	-0.55	0.59
Wheat	Aug.	16	1.67	-0.002	1.66	0.60	0.00	-0.07	0.95
Wheat	Sept.	16	1.68	0.003	1.70	0.62	0.00	0.07	0.94
Wheat	Oct.	16	1.70	0.002	1.71	0.61	0.00	0.06	0.96
Wheat	Nov.	16	1.76	-0.01	1.72	0.60	0.00	-0.17	0.86
Wheat	Dec.	16	1.78	-0.01	1.76	0.66	0.00	-0.05	0.96
Wheat	Jan.	16	1.76	0.00	1.77	0.69	0.00	0.02	0.99
Wheat	Feb.	16	1.75	-0.00	1.75	0.72	0.00	-0.02	0.98
Wheat	March	16	1.76	-0.01	1.70	0.59	0.00	-0.20	0.85
Wheat	April	16	1.78	-0.01	1.66	0.50	0.02	-0.49	0.63
Wheat	May	16	1.74	-0.02	1.60	0.41	0.04	-0.74	0.47

[a] The regression equation is $\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X$, where $\hat{Y}$ is the adjusted price per unit and X is year 1962 equals 1.

TABLE 12

LIVESTOCK PRICES ADJUSTED TO THE 1967 PRICE LEVEL, 1962-1977[a]

	Buy				Sell				
	May	October			October	March		May	
Year	Steers	Heifers	Steers	Steers	Steers	Heifers	Steers	Heifers	Steers
	($/cwt.)								
1962	32.33	26.99	30.28	30.10	28.61	26.06	28.33		28.37
1963	31.65	29.54	33.02	33.43	25.62	25.89	27.89	25.55	27.47
1964	25.27	26.42	28.87	29.48	21.96	22.71	24.73	18.99	21.37
1965	26.72	20.18	24.04	24.10	25.62	19.87	22.71	22.37	25.33
1966	31.37	22.63	27.47	27.40	25.34	25.60	28.75	24.53	27.05
1967	29.69	24.26	28.66	28.62	25.62	22.84	24.89	23.56	26.20
1968	30.06	23.79	27.79	27.64	25.67	23.44	25.75	23.99	27.09
1969	34.37	23.59	27.60	27.60	27.84	24.70	27.73	27.28	30.40
1970	33.56	25.86	30.27	30.27	28.46	28.40	31.32	26.79	28.59
1971	32.41	26.71	31.34	31.34	30.30	25.84	28.24	25.39	28.34
1972	34.88	28.07	32.84	32.83	34.44	27.26	32.13	27.70	32.75
1973	43.09	29.20	36.73	34.28	36.02	32.81	39.13	31.98	38.97
1974	26.12	31.20	40.68	37.83	17.49	24.54	27.71	20.60	24.29
1975	18.08	13.98	17.13	16.76	20.07	12.49	15.09	15.55	18.08
1976	25.27	13.76	18.32	18.32	18.60	17.60	21.14	19.68	23.45
1977	23.19	15.37	19.85	19.85	19.80	16.74	20.47	17.92	21.49

[a]The Index of Prices Paid by Farmers (1967 = 100.0) is used for adjusting the price series.

TABLE 13

LINEAR TREND ANALYSIS OF ADJUSTED LIVESTOCK PRICES, 1962-1977[a]

Livestock	Number of Years	$\hat{\beta}_0$	$\hat{\beta}_1$	Expected Price	Standard Deviation	R-Square	t-Value	Prob.>|t|	Action	Weight
May Steers	16	32.26	-0.28	29.88	5.82	0.05	-0.89	0.39	Buy	5.0 cwt.
October Heifers	16	28.11	-0.50	23.85	5.09	0.19	-1.81	0.09	Buy	4.0 cwt.
October Steers	16	31.28	-0.34	28.43	6.33	0.06	-0.98	0.35	Buy	3.0 cwt.
October Steers	16	31.66	-0.42	28.11	5.70	0.12	-1.35	0.20	Buy	4.0 cwt.
October Steers	16	28.01	-0.27	25.72	5.33	0.06	-0.93	0.37	Sell	6.9 cwt.
March Heifers	16	26.48	-0.34	23.55	4.82	0.11	-1.32	0.21	Sell	5.44 cwt.
March Steers	16	28.46	-0.22	26.63	5.55	0.04	-0.72	0.48	Sell	5.68 cwt.
May Heifers	16	25.77	-0.25	23.61	4.19	0.08	-1.12	0.28	Sell	6.6 cwt.
May Steers	16	27.86	-0.12	26.83	5.03	0.01	-0.45	0.66	Sell	5.68 cwt.

[a]The regression equation is $\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X$, where $\hat{Y}$ is adjusted price per hundreweight and X is year with 1962 equal 1.

TABLE 14

ESTIMATED TOTAL VARIABLE COST OF PRODUCTION IN NOMINAL DOLLARS
FOR SELECTED CROPS IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Dryland								Irrigated	
	Alfalfa	Barley	Oats	Cotton	Grain Sorghum	Wheat	Wheat Graze-Out	Native Pasture	Cotton	Grain Sorghum
	($/ac.)									
1962	---[a]	---[a]	---[a]	54.71	15.38	19.54	14.39	0.28	63.25	37.79
1963	---	---	---	42.03	10.32	20.55	14.55	0.28	114.60	37.93
1964	---	---	---	42.11	15.54	20.19	14.71	0.29	97.52	37.86
1965	39.57	14.76	20.01	43.24	15.94	20.34	15.03	0.29	75.30	40.47
1966	54.10	22.10	23.09	30.21	16.90	22.07	15.83	0.31	93.05	42.21
1967	37.26	21.98	22.71	52.90	17.24	21.71	15.99	0.31	59.44	42.76
1968	42.55	16.17	16.23	39.92	18.01	17.17	16.46	0.32	85.28	43.19
1969	42.09	25.05	26.20	68.04	18.75	24.30	17.26	0.34	108.81	46.79
1970	60.07	25.05	24.69	55.79	19.06	24.43	17.90	0.35	102.31	48.45
1971	57.58	18.52	18.59	62.69	19.88	19.67	18.86	0.37	87.63	51.42
1972	52.42	24.76	25.49	48.97	21.59	25.62	19.98	0.39	100.65	55.57
1973	68.59	28.73	30.25	43.95	25.97	31.05	23.02	0.45	172.24	63.36
1974	72.36	35.97	36.95	70.26	28.11	36.93	26.22	0.51	144.36	70.16
1975	75.21	38.90	40.25	76.20	32.03	39.58	28.77	0.56	147.00	78.88
1976	84.57	41.77	46.62	83.40	32.19	42.51	30.53	0.60	168.41	80.22
1977	91.96	43.98	48.73	117.73	34.69	45.87	32.29	0.63	197.20	84.40

[a]Yield data are unavailable for these years.

TABLE 15

ESTIMATED TOTAL VARIABLE COST OF PRODUCTION IN NOMINAL DOLLARS FOR SELECTED LIVESTOCK ENTERPRISES IN SOUTHWEST OKLAHOMA, 1962-1977

Year	March Heifers	May Heifers	March Steers	May Steers	Summer Steers
			($/head)		
1962	111.12	112.42	122.76	98.11	157.81
1963	121.82	123.14	136.48	106.92	156.38
1964	111.47	112.80	123.15	96.29	128.18
1965	89.95	91.31	105.19	84.36	137.93
1966	104.61	106.04	124.14	99.35	168.75
1967	112.33	113.78	130.36	104.01	161.86
1968	113.71	115.20	130.15	104.35	168.65
1969	118.38	119.94	136.30	108.80	200.59
1970	133.11	134.73	153.53	122.06	203.41
1971	144.85	146.55	166.91	132.51	207.35
1972	159.86	161.66	184.43	146.16	235.42
1973	190.79	192.87	220.98	185.69	331.50
1974	230.67	233.04	275.41	231.51	235.56
1975	126.73	129.33	147.51	123.08	184.81
1976	132.76	135.53	168.71	137.64	266.08
1977	153.61	156.53	191.02	155.10	260.04

selling weight are constant throughout the period. For example, in the March heifer choice enterprise, it is assumed that the farmer buys at 400 lbs. on October 15 and sells at 544 lbs. on March 1. The weight gain is assumed at 1.2 lbs. per day from November 1 to March 1. The estimated gross return in 1970 is $154.50 [5.44 cwt. x $28.40 (1970 March adjusted price for choice heifers)]. This price series is for choice stocker heifers weighing between 5 to 7 hundredweight. Gross margin is obtained by subtracting total variable cost from gross return ($154.50 - $118.85 = $35.66). The procedure is similar for the other years and the other livestock and crop enterprises (Table 18). The resulting series are then inflated to reflect 1977 dollars (Table 17), by using the Index of Prices Paid by Farmers and for Family Living Items, e.g., $35.66 ÷ 55.2 x 100 = $64.60 (Table 16). It is felt that farmers can better relate to dollars in a more recent or current period rather than dollars in a more distant period, e.g., a farmer can better relate to the current purchasing power of a 1977 dollar versus the current purchasing power of a 1967 dollar.

Estimated annual gross margins for each crop are calculated under a free-market and a farm program scenario. The annual gross margin is a return to land, labor, capital, machinery, overhead, risk and management. Crops grown under a free-market scenario are sold at market price without the benefit of government program payments. Crops grown under a farm program scenario benefit from disaster and deficiency payments in addition to the market value for which they are sold. Estimated gross margin per acre on an annual basis is calculated by multiplying actual annual yield per acre times adjusted Oklahoma mid-month market price per unit less total variable cost, which is in

1967 dollars and is comprised of costs for all operating inputs plus interest charge on annual operating capital. The resulting estimated gross margin series expressed in 1967 dollars are then inflated to reflect 1977 dollars by using the Index of Prices Paid by Farmers and for Family Living Items. These estimated annual gross margins for each crop are presented in the next chapter where the selected risk management scenarios are discussed.

TABLE 16

INDEX OF PRICES PAID BY FARMERS, FAMILY LIVING ITEMS, 1962-1977

Year	Index[a]
1962	50.3
1963	50.8
1964	51.4
1965	52.5
1966	54.1
1967	55.2
1968	57.5
1969	60.2
1970	63.0
1971	65.2
1972	68.0
1973	73.5
1974	83.4
1975	91.7
1976	97.2
1977	100.0

[a]1977 = 100.0

Source: Farm Income Statistics, Statistical Bulletin No. 576, ERS-USDA, July 1977, p. 33.

TABLE 17

ESTIMATED GROSS MARGINS IN 1967 DOLLARS FOR SELECTED LIVESTOCK ENTERPRISES IN SOUTHWEST OKLAHOMA, 1962-1977

Year	March Heifers	May Heifers	March Steers	May Steers	Summer Steers
	($/head)				
1962	18.28	45.81	24.54	52.11	22.07
1963	6.97	33.31	8.44	38.55	4.89
1964	2.36	2.72	6.60	16.72	12.17
1965	12.42	50.52	17.11	54.13	30.02
1966	33.58	54.75	37.89	53.29	4.42
1967	11.92	41.72	11.02	44.80	14.91
1968	17.15	46.49	19.88	52.54	13.38
1969	24.78	68.98	31.31	71.92	6.38
1970	35.66	56.49	40.82	53.40	14.79
1971	17.81	43.38	18.94	48.67	33.33
1972	20.39	53.46	34.94	69.10	49.30
1973	45.97	77.12	68.79	92.41	18.34
1974	-7.14	-6.15	-10.52	-3.22	-22.93
1975	-2.46	30.78	3.75	34.33	35.83
1976	26.25	58.94	31.72	61.14	-10.95
1977	15.01	40.79	21.71	45.28	7.90

TABLE 18

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR SELECTED LIVESTOCK ENTERPRISES IN SOUTHWEST OKLAHOMA, 1962-1977

Year	March Heifers	May Heifers	March Steers	May Steers	Summer Steers
			($/head)		
1962	33.11	82.99	44.45	94.45	39.98
1963	12.63	60.35	15.29	69.84	8.87
1964	4.28	4.93	11.95	30.28	22.04
1965	22.49	91.53	30.99	98.05	54.39
1966	60.82	99.19	68.64	96.55	8.00
1967	21.59	75.58	19.96	81.16	27.02
1968	31.07	84.22	36.02	95.18	24.24
1969	44.89	124.96	56.72	130.28	11.56
1970	64.60	102.34	73.96	96.75	26.79
1971	32.27	78.58	34.30	88.17	60.37
1972	36.93	96.85	63.30	125.18	89.32
1973	83.28	139.72	124.61	167.42	33.22
1974	-12.93	-11.15	-19.06	-5.83	-41.54
1975	-4.46	55.76	6.80	62.20	64.90
1976	47.55	106.77	57.47	110.75	-19.84
1977	27.19	73.89	39.33	82.03	14.32
Mean[a]	35.02	86.02	45.62	94.45	27.13
UWMA(3)[b]	19.85	67.88	26.96	72.87	1.24
EWMA(3)[c]	10.05	50.46	15.07	55.71	1.17
Standard Deviation	25.39	38.80	33.43	39.61	32.04

[a]These figures are based on a 13-year series, 1965-1977.

[b]These figures are based on a 3-year unequally weighted moving average (UWMA). These are expected gross margins for 1977.

[c]These figures are based on a 3-year equally weighted moving average (EWMA). These are expected gross margins for 1977.

FOOTNOTE

[1]Dr. Laval Verhalen, the cotton specialist in the Department of Agronomy, Oklahoma State University, willingly provided his field book which contained the necessary information from which the estimated cotton seed yield can be calculated. The calculation procedure he suggested is:

Weight of Seed Cotton = (Weight of Lint ÷ Percent Picked Lint)

Weight of Seed = Weight of Seed Cotton - Weight of Lint.

CHAPTER IV

RISK MANAGEMENT STRATEGIES

Several risk management strategies are available to farmers in the study area. However, the choice of risk strategy depends on the individual preference of the farmer. Some of the strategies which are frequently advocated are: diversification, forward contracting, hedging on the futures market, crop-share versus cash rent, government farm programs, and crop insurance. The strategies considered in this analysis are: sale at harvest, diversification, multiple marketing, forward contracting, the 1978 Farm Program, wheat hail insurance and crop-share versus cash rent.

Harvest Sale and Multiple Marketing

For the harvest sale strategy, all crops are marketed at their respective harvest time: barley, oats and wheat in June, grain sorghum in October, and cotton in November. Table 19 presents estimated gross margins for all harvest sale crop activities, except wheat.

Depending on his financial obligations, the farmer has the option of selling all or part of his production at harvest or selling periodically throughout the crop year. In this analysis, wheat can be sold periodically throughout the marketing year from June through May. The reason for considering only wheat for the multiple marketing scenario is because wheat is the most important crop in the study area and the

TABLE 19

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR SELECTED ENTERPRISES
IN SOUTHWESTERN OKLAHOMA, 1962-1977

	Dryland							Irrigated	
Year	Native Pasture	Alfalfa	Barley	Oats	Cotton	Grain Sorghum	Grazeout Wheat	Cotton	Grain Sorghum
	($/ac.)								
1962	0.56	(83.74)[a]	(21.49)[a]	(30.94)[a]	223.49	39.94	28.61	-5.02	69.18
1963	0.55	(83.74)	(21.49)	(30.94)	93.36	-20.55	28.64	522.96	61.19
1964	0.56	(83.74)	(21.49)	(30.94)	75.74	39.48	28.62	300.15	52.80
1965	0.55	75.37	-28.44	9.43	64.80	36.76	28.63	55.76	108.26
1966	0.57	100.00	59.69	59.23	-55.29	37.44	29.26	88.37	85.98
1967	0.56	67.50	53.09	49.03	72.01	38.03	28.97	-107.67	79.23
1968	0.56	74.01	-28.44	-28.55	-7.35	38.73	28.63	27.88	43.11
1969	0.56	69.92	56.37	63.02	87.42	43.26	28.67	75.62	100.11
1970	0.56	95.35	33.14	11.88	40.50	34.82	28.41	49.60	103.97
1971	0.57	88.32	-28.44	-28.55	84.78	19.65	28.93	-12.84	82.38
1972	0.57	77.09	-24.58	-16.05	-16.59	37.69	29.38	-15.36	126.11
1973	0.61	93.32	-18.22	-0.99	-55.29	122.19	31.32	508.53	241.85
1974	0.61	86.76	65.39	48.75	23.49	99.29	31.44	91.91	232.61
1975	0.61	92.02	57.58	56.82	25.67	92.21	31.37	42.04	193.32
1976	0.62	87.01	61.22	111.26	85.27	34.09	31.41	193.82	74.11
1977	0.63	91.96	21.05	66.99	101.25	26.27	32.29	110.93	31.82
Mean[b]	0.58	83.74	21.49	30.94	34.67	50.80	29.90	85.28	115.60
UWMA(3)[c]	0.61	85.46	60.96	82.43	55.03	64.57	31.40	127.90	141.57

TABLE 19 (Continued)

Year	Dryland Native Pasture	Dryland Alfalfa	Dryland Barley	Dryland Oats	Dryland Cotton	Dryland Grain Sorghum	Dryland Grazeout Wheat	Irrigated Cotton	Irrigated Grain Sorghum
	($/ac.)								
EWMA(3)[d]	0.61	85.26	61.40	72.28	44.81	75.20	31.41	109.26	166.68
Standard Deviation	0.03	9.19	36.33	38.32	68.79	33.64	1.37	179.29	63.72

[a]The number in parenthesis is the mean of the series, 1965-1977. The mean is substituted for the missing observations in order to make the series for all enterprises of the same length. Native pasture, alfalfa, and grazeout wheat are total variable cost series.

[b]Expected gross margins are based on the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

state. Multiple marketing of wheat involves additional costs for storage, shrinkage, etc. In this study, wheat is assumed to be stored at the local elevator. Table 20 presents storage costs, excluding interest charge, per bushel for the study period. Interest charge is taken into consideration in estimating gross margins for wheat for July through May. It is assumed that there is no shrinkage or damage if wheat is stored for later sale. Table 21 presents the estimated gross margins in 1977 dollars for the sale of wheat in June through May.

TABLE 20

AVERAGE COST FOR STORING WHEAT IN GREER, JACKSON, AND TILLMAN COUNTIES, SOUTHWEST OKLAHOMA, 1965-1977

Year	Wheat
	(¢/bu./mth.)
1965	1.00[a]
1966	1.00
1967	1.00
1968	1.00
1969	1.00
1970	1.00
1971	1.00
1972	1.00
1973	1.25
1974	1.50
1975	1.50
1976	1.50
1977	1.50

[a]Storage rate excluding interest charge applies to the marketing year, June 1 through May 31.

Source: Marketing Division, Oklahoma State Department of Agriculture.

TABLE 21

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR MULTIPLE WHEAT MARKETING ALTERNATIVES FOR SOUTHWEST OKLAHOMA, 1962-1977[a]

Year	Sell Wheat											
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
	($/ac.)											
1962	68.85	69.08	68.79	68.47	67.63	69.19	69.75	67.35	70.27	70.25	72.14	62.79
1963	121.13	120.71	120.26	122.20	130.56	135.66	135.89	136.08	136.25	123.49	134.07	126.08
1964	48.67	46.07	46.32	48.25	50.72	53.17	52.14	46.47	45.94	41.94	39.06	34.41
1965	22.46	24.05	29.76	28.53	28.65	30.58	29.72	26.52	26.05	26.01	25.02	26.75
1966	75.29	87.54	86.45	86.02	72.94	75.95	78.94	71.37	63.77	73.67	66.71	66.02
1967	34.74	30.58	29.81	28.02	29.61	28.26	28.82	27.39	26.90	26.39	19.02	17.96
1968	-30.20	-30.21	-30.26	-30.34	-30.46	-30.60	-30.77	-30.99	-31.23	-31.50	-31.80	-32.14
1969	42.98	41.03	39.05	45.56	47.39	48.41	48.63	44.93	44.30	42.88	42.96	39.14
1970	16.51	16.75	19.07	25.53	25.16	25.80	24.85	20.71	19.68	18.63	18.59	19.56
1971	-30.20	-30.21	-30.26	-30.34	-30.46	-30.60	-30.77	-30.99	-31.23	-31.50	-31.80	-32.14
1972	-32.63	-32.50	-31.65	-30.83	-30.60	-30.84	-29.45	-30.60	-32.66	-32.24	42.96	-32.64
1973	33.67	35.99	92.83	101.14	89.06	90.81	105.10	99.42	104.97	83.22	60.56	43.93
1974	125.12	152.69	150.50	149.84	180.45	172.68	174.27	128.09	117.09	100.59	99.70	86.26
1975	53.78	70.40	81.10	84.70	81.80	68.26	62.36	59.94	67.50	65.03	60.16	54.68
1976	80.52	81.37	63.65	60.31	48.01	42.55	40.50	37.71	37.65	32.75	28.50	21.47
1977	43.16	45.06	43.53	48.78	53.99	61.73	61.78	52.42	53.24	57.45	62.47	61.50
Mean[b]	33.48	37.89	41.81	43.61	43.50	42.54	43.38	36.61	35.85	33.18	29.83	26.18
UWMA(3)[c]	81.42	92.34	86.26	85.53	84.64	76.29	73.81	62.46	62.49	56.00	52.24	44.39
EWMA(3)[d]	86.47	101.49	98.42	98.28	103.42	94.50	92.38	72.25	74.08	66.12	62.79	54.14
Standard Deviation	47.48	51.99	52.39	52.76	56.47	55.73	56.74	50.46	50.15	46.04	46.40	43.37

[a]These gross margin figures are defined as gross returns minus total variable cost including the appropriate storage costs and interest charge.

[b]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

Forward Contracting

The multiple marketing strategies considered the farm-firm as retaining the risk-bearing function. However, the farmer does not have to retain all of the risks arising out of production and marketing. Some risk can be shifted to other economic units, such as the wheat marketing firms. One method of dealing with the risk of downward price changes is the use of forward contracting.

A forward contract is one in which the farmer agreed to deliver a specified quantity and quality of wheat to the elevator operator at a specified future date with prices determined at the time of the negotiating of the contract. A contract results when an agreement is reached, and is binding on both farmer and the elevator operator.

Facing the farmer, who tries to secure the highest possible price for his wheat, is the elevator operator who attempts to buy wheat at the lowest possible price in order to resell at a higher price. Thus, in negotiating a forward contract, the elevator operator may require from the farmer a guaranteed delivery date of a specific grade of wheat which is mutually acceptable to both of them. In the event the grade is not as agreed to in the contract, the farmer has some leeway to choose the grade he is to deliver. In this case, it is the custom for both parties to specify in the contract a mutually acceptable scale of premiums or discounts compared to a predetermined standard grade.

It is assumed in this study that the farmer will negotiate a cash forward contract with his local elevator operator on the second Friday in March because by then he would have an intuitive estimate of his expected crop production. He will forward contract at most 320 acres of wheat, which represent about 10,000 bushels of wheat. This restriction is placed because farmers in the area, if they contract, will not contract their entire wheat crop. If the farmer contracts, he is assumed to deliver the wheat to the local elevator operator on the second Friday in June. The price per bushel used for forward contracting is based on the July futures at Kansas City on the second Friday in March adjusted for transportation to the Gulf. Relatively few elevator operators in the study area engage in forward contracting. Moreover, if they do, it is a common practice to offer about 10 cents a bushel less than the expected price. This is a safety margin for the protection of the elevator operator. Adjustment for this safety margin has not been made in this analysis. Table 22 presents prices and gross margins for forward contracting.

Crop-Share Versus Cash Rent

Another method of shifting some of the risk is renting land either on a crop-share and/or cash rent basis. In both farming situations in addition to own land, renting land for cash or on a crop-share basis are also considered. It is assumed that cropland is available for rent on a cash or crop-share basis in the study area.

Table 23 shows the cropland cash rent on a per acre basis for Oklahoma from 1962-1977. In the study area, under crop-share rent, the landlord gets one-third of the crop in the case of small grains and assumes one-third of the fertilizer and insecticide costs. He is entitled to one-third of the wheat pasture. He assumes one-fourth of the insecticide, fertilizer, and ginning costs for cotton and gets

TABLE 22

GROSS MARGINS FOR FORWARD CONTRACTING IN MARCH FOR JUNE DELIVERY, 1962-1977

Year	Gross Margins in 1977 Dollars
	($/ac.)
1962	63.99
1963	146.12
1964	80.83
1965	29.37
1966	64.06
1967	43.03
1968	-30.20
1969	49.18
1970	20.18
1971	-30.20
1972	-32.43
1973	27.19
1974	186.94
1975	71.45
1976	88.06
1977	56.78
Mean[a]	41.80
UWMA(3)[b]	102.85
EWMA(3)[c]	115.48
Standard Deviation	59.31

[a]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[b]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[c]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

TABLE 23

CROPLAND CASH RENT AND FARM REAL ESTATE VALUES PER ACRE IN OKLAHOMA, 1962-1978

Year	Cash Rent[a]	Adjusted Rent[b]	Farm Real Estate Values
	($/ac.)		
1962	7.51	10.61	93.00
1963	8.04	10.71	102.00
1964	8.46	11.08	109.00
1965	9.36	11.64	124.00
1966	9.89	11.41	133.00
1967	11.22	12.51	143.00
1968	11.68	12.62	157.00
1969	12.17	12.16	163.00
1970	12.56	11.90	173.00
1971	9.49	8.54	183.00
1972	13.71	11.27	195.00
1973	15.15	10.62	221.00
1974	19.30	11.68	267.00
1975	20.50	11.10	307.00
1976	22.50	11.29	339.00
1977	25.40	11.88	374.00
1978	24.30	12.02	402.00

[a]Cropland cash rent data for Oklahoma are not available from 1962-1966. Values are predicted for these years using the regression equation:

$$\hat{Y} = \underset{(1.68)}{1.959} + \underset{(13.24)}{0.05967X} \quad (R^2 = 0.946)$$

where X represents farm real estate values per acre in Oklahoma.

[b]Adjusted to the 1967 price level and for trend.

Source: Cash rent data are obtained from various issues of <u>Farm Real Estate Market Development</u>, USDA Farm real estate values are obtained from "Oklahoma Farmland Prices--Past, Present, and Future." Cecil D. Maynard and H. E. Ward, OSU Extension Fact Sheet No. 141, Oklahoma State University Cooperative Extension Service.

one-fourth of the cotton crop. Irrigation and water district assessment costs are also shared one-fourth between landlord and tenant.

Alfalfa is grown only on own land because it is a multiyear crop. All other crops can be grown on rented land.

Cash renting is done in the study area. Most irrigated crops are crop-shared. Tables 24 and 25 present the gross margins for the selected cash rent crops.

When renting land is considered in both dryland and irrigated farm situations, the amount of owned land is reduced by 50 percent with the option of renting the other 50 percent on a crop-share or cash rent basis or some combination thereof. This risk management strategy is different from those mentioned earlier in that the amount of land owned by the farmer and also his financial situation are redefined. In the case of the dryland farm situation, the owned land is reduced from 1,200 acres to 600 acres. The maximum amount of dryland cropland that can be rented cannot exceed 600 acres. The native pasture remains unchanged at 300 acres. In the irrigated farm situation, owned dryland is reduced from 800 acres to 400 acres and owned irrigated land is reduced from 320 acres to 160 acres with the option of renting an additional 400 dryland acres and 160 irrigated acres. Tables 26 and 27 show the gross margins for the crop-share enterprises.

Government Farm Programs

Some of the major goals of the Food and Agriculture Act of 1977 are higher prices, greater price stability, and higher farm incomes (Harshbarger and Duncan, pp. 9-12). This farm program abandons the acreage allotments of previous farm programs which induced farmers to

TABLE 24

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR SELECTED CASH RENT CROPS IN SOUTHWEST OKLAHOMA, 1962-1977

	Dryland				Irrigated	
Year	Barley	Oats	Cotton	Grain Sorghum	Cotton	Grain Sorghum
	($/ac.)					
1962	(0.77)[a]	(10.22)[a]	204.27	20.72	-24.24	49.96
1963	(0.77)	(10.22)	73.59	-40.31	503.19	41.43
1964	(0.77)	(10.22)	55.67	19.41	280.08	32.73
1965	-49.52	-11.66	43.71	15.67	34.67	87.17
1966	38.91	38.45	-76.06	16.66	67.59	65.20
1967	30.43	26.37	49.35	15.36	-130.34	56.57
1968	-51.30	-51.41	-30.22	15.87	5.02	20.25
1969	34.34	40.99	65.39	21.23	53.60	78.08
1970	11.58	-9.68	18.95	13.26	28.05	82.41
1971	-43.91	-44.02	69.30	4.18	-28.31	66.90
1972	-44.99	-36.47	-37.00	17.28	-35.78	105.70
1973	-37.46	-20.23	-74.53	102.95	489.29	222.61
1974	44.23	27.59	2.33	78.13	70.75	211.45
1975	37.47	36.71	5.56	72.10	21.93	173.21
1976	40.77	90.81	64.81	13.63	173.37	53.66
1977	-0.47	45.46	79.73	4.74	89.41	10.30
Mean[b]	0.77	10.22	13.95	30.08	64.56	94.88
UWMA(3)[c]	40.47	61.94	34.54	44.07	107.41	121.08
EWMA(3)[d]	40.82	51.70	24.23	54.62	88.68	146.11
Standard Deviation	35.78	37.83	69.13	33.61	179.64	63.95

[a]The number in parenthesis is the mean of the series, 1965-1977. The mean is substituted for the missing observations in order to make the series for all enterprises of the same length.

[b]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

TABLE 25

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR CASH RENT MULTIPLE WHEAT MARKETING ALTERNATIVES IN SOUTHWEST OKLAHOMA, 1962-1977[a]

Year	Sell Wheat											
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
	($/ac.)											
1962	49.63	49.85	49.52	49.12	48.19	49.64	50.05	47.47	50.19	49.94	51.58	41.94
1963	101.36	100.93	100.45	102.31	110.58	115.56	115.64	115.66	115.62	102.63	112.96	104.69
1964	28.60	25.99	26.19	28.05	30.43	32.76	31.58	25.74	25.01	20.78	17.64	12.72
1965	1.37	2.96	8.62	7.32	7.35	9.16	8.15	4.78	4.10	3.83	2.59	4.04
1966	54.51	66.75	65.62	65.12	51.94	54.84	57.68	49.93	42.13	51.79	44.58	43.62
1967	12.08	7.91	7.09	5.23	6.74	5.26	5.67	4.07	3.38	2.64	-4.98	-6.33
1968	-53.06	-53.09	-53.18	-53.33	-53.53	-53.79	-54.12	-54.50	-54.95	-55.45	-56.01	-56.63
1969	20.95	18.99	16.96	23.41	25.14	26.05	26.12	22.25	21.41	19.75	19.59	15.48
1970	-5.05	-4.82	-2.55	3.85	3.38	3.91	2.81	-1.50	-2.74	-4.02	-4.31	-3.62
1971	-45.67	-45.69	-45.78	-45.94	-46.14	-46.40	-46.73	-47.11	-47.56	-48.06	-48.62	-49.24
1972	-53.05	-52.93	-52.12	-51.38	-51.23	-51.59	-50.35	-51.68	-53.94	-53.75	-54.04	-54.68
1973	14.43	16.74	73.53	81.77	69.61	71.24	85.37	79.52	84.87	62.88	39.98	23.07
1974	103.96	131.52	129.29	128.55	159.07	151.19	152.63	106.27	95.07	78.33	77.20	63.47
1975	33.67	50.28	60.94	64.47	61.47	47.82	41.76	39.17	46.53	43.82	38.71	32.94
1976	60.07	60.90	43.14	39.73	27.34	21.77	19.56	16.60	16.33	11.20	6.70	-0.61
1977	21.63	23.53	21.96	27.13	32.25	39.88	39.77	30.24	30.86	34.84	39.61	38.36
Mean[b]	12.76	17.16	21.04	22.76	22.57	21.49	22.18	15.23	14.27	11.37	7.77	3.84
UWMA(3)[c]	60.93	71.84	65.71	64.92	63.93	55.47	52.83	41.31	41.14	34.41	30.40	22.27
EWMA(3)[d]	65.90	80.90	77.79	77.58	82.63	73.59	71.32	54.01	52.64	44.45	40.87	31.93
Standard Deviation	47.34	51.86	52.37	52.73	56.39	55.65	56.68	50.44	50.16	46.00	46.36	43.28

[a]These gross margin figures are defined as gross returns minus total variable cost including the appropriate storage costs and interest charge.

[b]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

TABLE 26

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR SELECTED CROP-SHARE ENTERPRISES IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Dryland				Irrigated	
	Barley	Oats	Cotton	Grain Sorghum	Cotton	Grain Sorghum
	($/ac.)					
1962	(8.14)[a]	(14.32)[a]	157.34	20.13	-18.43	29.99
1963	(8.14)	(14.32)	62.95	-16.96	365.28	24.83
1964	(8.14)	(14.32)	49.84	19.94	202.57	19.51
1965	-22.56	0.05	41.58	18.08	24.98	55.54
1966	32.52	32.21	-45.07	18.46	46.38	40.86
1967	28.31	25.74	45.46	18.76	-93.03	36.27
1968	-22.56	-22.08	-10.94	19.08	3.49	12.56
1969	29.77	34.18	54.79	22.19	35.33	49.92
1970	14.70	1.24	22.51	16.74	17.89	52.54
1971	-22.56	-22.08	54.99	6.68	-25.17	37.89
1972	-22.43	-16.48	-17.96	18.52	-28.45	66.66
1973	-18.26	-6.75	-45.07	74.67	355.85	144.48
1974	36.57	25.66	11.29	59.86	50.35	139.01
1975	31.53	31.17	13.04	54.73	14.35	112.07
1976	33.82	66.42	57.44	16.35	126.75	33.29
1977	6.96	36.92	66.21	10.92	62.50	5.09
Mean[b]	8.14	14.32	19.10	27.31	45.48	60.47
UWMA(3)[c]	33.68	47.69	34.89	36.57	77.75	78.97
EWMA(3)[d]	33.97	41.08	27.26	43.65	63.82	94.79
Standard Deviation	23.08	24.36	49.81	21.97	130.97	42.32

[a]The number in parenthesis is the mean of the series, 1965-1977. The mean is substituted for the missing observations in order to make the series for all enterprises of the same length.

[b]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

TABLE 27

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR CROP-SHARE MULTIPLE WHEAT MARKETING ALTERNATIVES IN SOUTHWEST OKLAHOMA, 1962-1977[a]

Year	Sell Wheat											
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
	($/ac.)											
1962	39.98	40.14	39.94	39.72	39.14	40.18	40.53	38.90	40.85	40.81	42.04	35.75
1963	74.49	74.21	73.91	75.20	80.78	84.19	84.33	84.44	84.53	75.95	83.02	77.64
1964	26.32	24.58	24.74	26.03	27.67	29.30	28.59	24.77	24.40	21.70	19.74	16.60
1965	8.95	10.02	13.84	13.00	13.07	14.35	13.76	11.59	11.26	11.21	10.52	11.65
1966	43.95	52.16	51.42	51.13	42.35	44.36	46.34	41.25	36.14	42.75	38.05	37.57
1967	17.13	14.35	13.82	12.62	13.67	12.75	13.11	12.13	11.79	11.42	6.46	5.72
1968	-23.36	-23.37	-23.41	-23.47	-23.56	-23.67	-23.80	-23.96	-24.14	-24.35	-24.58	-24.83
1969	22.18	20.87	19.54	23.90	25.11	25.78	25.91	23.41	22.98	21.99	22.02	19.44
1970	4.85	5.02	6.57	10.89	10.63	11.05	10.39	7.60	6.89	6.16	6.11	6.73
1971	-23.36	-23.37	-23.41	-23.47	-23.56	-23.67	-23.80	-23.96	-24.14	-24.35	-24.58	-24.83
1972	-27.28	-27.19	-26.63	-26.09	-25.94	-26.12	-25.21	-26.00	-27.39	-27.14	-27.19	-27.45
1973	16.50	18.06	56.13	61.69	53.59	54.75	64.30	60.48	64.18	49.58	34.38	23.21
1974	77.20	95.68	94.20	93.75	114.25	109.03	110.08	79.12	71.73	60.65	60.03	51.00
1975	29.72	40.86	48.02	50.43	48.47	39.39	35.41	33.77	38.82	37.14	33.85	30.15
1976	47.48	48.05	36.17	33.92	25.67	22.00	20.61	18.72	18.66	15.35	12.48	7.75
1977	22.17	23.45	22.42	25.93	29.41	34.58	34.59	28.31	28.84	31.64	34.97	34.30
Mean[b]	16.63	19.58	22.21	23.40	23.32	22.66	23.21	18.65	18.12	16.31	14.04	11.57
UWMA(3)[c]	48.10	55.42	51.33	50.84	50.23	44.62	42.94	35.32	35.32	30.95	28.40	23.12
EWMA(3)[d]	51.47	61.53	59.46	59.37	62.80	56.81	55.37	43.87	43.07	37.71	35.45	29.63
Standard Deviation	30.98	34.03	34.31	34.54	37.06	36.56	37.25	33.01	32.80	30.01	30.26	28.22

[a]These gross margin figures are defined as gross returns minus total variable cost including the appropriate storage costs and interest charge.

[b]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are expected gross margins for 1977.

cultivate different crops on specified acreages irrespective of market prices and supply-demand relationships of alternative crops. In fact, the program features a system of commodity loans and target prices which provides price and income protection to primary agricultural producers. In addition, there are provisions for acreage set asides to reduce total harvested acreage, thus reducing the accumulation of surpluses.

The farmer has the option of participating in government farm programs. It is assumed that if he participates in the 1978 Farm Program, then 20 percent of the harvested barley and wheat acres, and 10 percent of the harvested grain sorghum acreage must be set aside in order to be eligible for deficiency and disaster payments. The farmer also has to comply with a normal crop acreage restriction. There are no set aside requirements for cotton and oats under the 1978 Farm Program. According to the Oklahoma Agricultural, Stabilization and Conservation Service (ASCS) oats is not considered a normal crop in Southwest Oklahoma. The reason is that oats represent a very small acreage of the total crop acreage. Therefore, disaster and deficiency payments are not calculated for oats. The total amount of deficiency payments which a farmer can receive under the 1978 Farm Program is $40,000. This limitation does not apply to loans or purchases, or to payments for either prevented planting or low yield disaster loss (U.S. Department of Agriculture, Agricultural, Stabilization and Conservation Service, 1978a and 1978c).

Normal farm yields must be calculated before deficiency and disaster payments can be determined. Normal farm yields for all the crops (barley, cotton, wheat, and grain sorghum) and for the entire study period are not available. Furthermore, normal farm yields for irrigated cotton and irrigated grain sorghum would be particularly difficult to estimate. Therefore, the farm program scenario analyzed in this study applied only to the dryland farm.

Normal farm yields are calculated for barley, wheat, and grain sorghum using reported Jackson county data (Table 28). The procedure used by the Oklahoma Agricultural, Stabilization and Conservation Service in 1978 to calculate normal farm yields using reported county data were as follows:

1. Calculate the average of a 5-year (t-5 to t-1) county data.
2. If the actual county yield data in any of the years in t-5 to t-1 is less than 90 percent of the average calculated in step (1), substitute the 90 percent value of the average for the actual county yield for that year.
3. If the actual county yield in any of the years t-5 to t-1 is more than 110 percent of the average for the actual county yield for that year, substitute the 110 percent value of the average for the actual county yield for that year.
4. Calculate the mean of the new 5-year data series (t-5 to t-1) created in steps (2) and (3) to obtain the normal farm yield for year t.

Although this procedure is used in 1978, other methods are used in previous years to calculate normal farm yields. The problem of estimating normal farm yields for previous years is simplified by assuming that the 1978 procedure is used. Since the above procedure is applied to reported average county data, the estimated normal yields for wheat, barley and grain sorghum are the same for all farms in the study area. In the case of cotton, normal yields are calculated using the above method on the actual farm yields of the individual farmer rather

TABLE 28

SELECTED CROP YIELDS FOR JACKSON COUNTY SOUTHWEST OKLAHOMA, 1957-1977[a]

Year	Barley	Oats[b]	Grain Sorghum	Wheat
	(bu./ac.)	(bu./ac.)	(cwt./ac.)	(bu./ac.)
1957	19.0	23.0	12.9	13.4
1958	22.1	38.6	19.3	28.6
1959	30.1	18.0	19.0	13.5
1960	19.5	28.6	23.2	31.1
1961	27.2	30.8	23.6	26.6
1962	17.3	12.0	23.4	16.3
1963	19.9	25.2	32.1	20.0
1964	17.9	20.5	26.4	17.6
1965	28.1	33.6	23.4	23.1
1966	27.0	39.5	29.7	20.7
1967	23.1	15.9	26.5	13.2
1968	28.6	38.8	22.1	21.0
1969	39.8	49.9	28.5	27.1
1970	36.6	37.5	24.9	24.0
1971	26.4	30.4	23.3	20.8
1972	26.7	21.7	17.6	14.0
1973	28.1	38.0	21.9	24.7
1974	19.0	25.8	21.0	15.6
1975	25.6	33.3	28.7	23.4
1976	33.9	44.5	20.3	20.3
1977	23.5	33.0	20.6	22.3

[a]Normal Farm Yields are calculated for barley, grain sorghum, and wheat using reported Jackson county data.

[b]Oats are used to predict missing yields for barley, 1957-1960. The regression equation is:

$$\hat{Y} = \underset{(3.63)}{10.297} + \underset{(5.91)}{0.513}\ X \quad (R^2 = 0.69)$$

where X represents oat yields for Jackson county.

Source: Various issues of <u>Oklahoma Agricultural Statistics</u>, Oklahoma Crop and Livestock Reporting Service.

than reported average county data. The actual cotton yields used in this study are considered as the actual farm yields of an individual farm. Depending on actual farm yields, estimated normal yields for cotton may not be the same for all farms. Normal farm yields for wheat, barley, cotton, and grain sorghum are presented in Tables 33, 35, 37, and 39, respectively.

Deficiency payments for wheat, barley and grain sorghum are based on the difference between the established target price and the higher of the five month weighted U.S. average price received by all farmers, or the national loan rate. Target prices, average prices, loan rates, and deficiency payment per unit for wheat, barley, cotton, and grain sorghum are presented in Tables 29, 30, 31, and 32, respectively. If the U.S. weighted average market price received by farmers, as determined by the Secretary of Agriculture, is below the target price during the first five months of the marketing year (June through October for wheat and barley; October through February for grain sorghum; and average price for the 1978 calendar year for cotton), deficiency payments will be made to eligible producers.

The allocation factor enters the calculation of deficiency payments. The allocation factor is determined by dividing the national program acreage of (e.g., wheat) by the number of acres that the Secretary of Agriculture estimates that are harvested and only applies to a farmer participating in the 1978 Farm Program. The allocation factor cannot exceed 100 percent nor be less than 80 percent. The allocation factor for wheat, cotton, and grain sorghum in 1978 were 100 percent but 82.4 percent for barley.

TABLE 29

TARGET PRICES, FIVE-MONTH U.S. WEIGHTED AVERAGE, AND LOAN RATES FOR WHEAT IN 1967 DOLLARS, 1962-1978

Year	Target Price	5-Month Average	Loan Rate	Deficiency Payment
	($/bu.)			
1962	1.55	2.27	1.07	--
1963	1.55	2.03	1.07	--
1964	1.55	1.49	1.07	0.06
1965	1.55	1.44	1.07	0.11
1966	1.55	1.65	1.07	--
1967	1.55	1.39	1.07	0.16
1968	1.55	1.20	1.07	0.35
1969	1.55	1.16	1.07	0.39
1970	1.55	1.19	1.07	0.36
1971	1.55	1.14	1.07	0.41
1972	1.55	1.41	1.07	0.14
1973	1.55	2.74	1.07	--
1974	1.55	2.49	1.07	--
1975	1.55	1.98	1.07	--
1976	1.55	1.43	1.07	0.12
1977	1.55	1.14	1.07	0.41
1978[a]	3.40	2.90	2.35	0.50

[a]Nominal 1978 dollars.

Source: U.S. Department of Agriculture. "Wheat--1978 Program." Agricultural Stabilization and Conservation Service, January, 1978c.

TABLE 30

TARGET PRICES, FIVE-MONTH U.S. WEIGHTED AVERAGE, AND LOAN RATES FOR BARLEY IN 1967 DOLLARS, 1962-1978

Year	Target Price	5-Month Average	Loan Rate	Deficiency Payment
	($/bu.)			
1962	1.03	1.02	0.75	0.01
1963	1.03	0.99	0.75	0.04
1964	1.03	1.04	0.75	--
1965	1.03	1.09	0.75	--
1966	1.03	1.07	0.75	--
1967	1.03	1.01	0.75	0.02
1968	1.03	0.90	0.75	0.13
1969	1.03	0.82	0.75	0.21
1970	1.03	0.87	0.75	0.16
1971	1.03	0.84	0.75	0.19
1972	1.03	0.97	0.75	0.06
1973	1.03	1.48	0.75	--
1974	1.03	1.71	0.75	--
1975	1.03	1.35	0.75	--
1976	1.03	1.18	0.75	--
1977	1.03	0.89	0.75	0.14
1978[a]	2.25	1.85	1.63	0.40

[a]Nominal 1978 dollars.

Source: U.S. Department of Agriculture. "Feed Grains--1978 Program." Agricultural Stabilization and Conservation Service, January, 1978a.

TABLE 31

TARGET PRICES, ANNUAL U.S. WEIGHTED AVERAGE, AND LOAN RATES FOR COTTON IN 1967 DOLLARS, 1962-1978

Year	Target Price	Annual Average	Loan Rate	Deficiency Payment
	($/lb.)			
1962	0.24	0.3527	0.22	--
1963	0.24	0.3519	0.22	--
1964	0.24	0.3220	0.22	--
1965	0.24	0.2982	0.22	--
1966	0.24	0.2085	0.22	0.0315
1967	0.24	0.2539	0.22	--
1968	0.24	0.2138	0.22	0.0262
1969	0.24	0.1939	0.22	0.0461
1970	0.24	0.1952	0.22	0.0448
1971	0.24	0.2379	0.22	0.0021
1972	0.24	0.2176	0.22	0.0224
1973	0.24	0.3083	0.22	--
1974	0.24	0.2604	0.22	--
1975	0.24	0.2839	0.22	--
1976	0.24	0.3340	0.22	--
1977	0.24	0.2579	0.22	--
1978[a]	0.52		0.48	

[a]Nominal 1978 dollars.

Source: U.S. Department of Agriculture. "Upland Cotton--1978 Program." Agricultural Stabilization and Conservation Service, January, 1978b.

TABLE 32

TARGET PRICES, FIVE-MONTH U.S. WEIGHTED AVERAGE, AND LOAN RATES FOR GRAIN SORGHUM IN 1967 DOLLARS, 1962-1978

Year	Target Price	5-Month Average	Loan Rate	Deficiency Payment
	($/cwt.)			
1962	1.86	2.02	1.55	--
1963	1.86	1.91	1.55	--
1964	1.86	2.03	1.55	--
1965	1.86	1.87	1.55	--
1966	1.86	1.84	1.55	0.02
1967	1.86	1.77	1.55	0.09
1968	1.86	1.64	1.55	0.22
1969	1.86	1.77	1.55	0.09
1970	1.86	1.82	1.55	0.04
1971	1.86	1.59	1.55	0.27
1972	1.86	1.96	1.55	--
1973	1.86	2.65	1.55	--
1974	1.86	3.03	1.55	--
1975	1.86	2.35	1.55	--
1976	1.86	1.90	1.55	--
1977	1.86	1.55	1.55	0.31
1978[a]	4.07		3.39	

[a]Nominal 1978 dollars.

Source: U.S. Department of Agriculture. "Feed Grains--1978 Program." Agricultural Stabilization and Conservation Service, January, 1978a.

Disaster payments are made to wheat, barley, cotton, and grain sorghum producers who are prevented from planting or harvesting due to drought, flood or other natural disaster or condition exogenous to the farmer. Payments for wheat, barley and grain sorghum are calculated by multiplying 75 percent of the normal farm yield times one-third of the target price. Low yield payments are made if the farmer's yield is below 60 percent of the normal farm yield. The payment rate for low yield is 50 percent of the target price. Disaster payment for cotton, in the case of prevented planting and low yields, is based on 75 percent of the normal farm yield times 17.3 cents per pound of lint (U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, 1978b). Tables 33, 35, 37, and 39 present yields eligible for disaster and deficiency payments. Tables 34, 36, 38, and 40 present total disaster and deficiency payments per acre that the farmer received.

Estimated annual gross margins for the farm program crops are presented in Table 41. These gross margin figures are obtained by adding total payments (deficiency plus disaster payments received per acre under the 1978 Farm Program) to the gross margin series of the same crops under the free-market scenario. Under the farm program scenario, the producer is eligible for disaster and deficiency payments but still sells his crops on the free-market. Therefore, gross margins under the farm program should reflect gross margins realized from market sale plus deficiency and disaster payments when eligible.

Crop Insurance

Adverse weather, disease, insects, and other biological pests may increase yield risk substantially. All farms in the study area which

TABLE 33

ACTUAL AND NORMAL WHEAT YIELD FOR JACKSON COUNTY
SOUTHWEST OKLAHOMA, 1962-1977

Year	Actual Yield[a]	Normal Farm Yield	Yields for Disaster Payments[b]	Yields for Deficiency Payments[c]
	(bu./ac.)			
1962	26.9	23.1	--	--
1963	44.5	23.7	--	--
1964	31.7	21.2	--	21.2
1965	25.4	21.9	--	21.9
1966	38.7	20.6	--	--
1967	26.9	19.5	--	19.5
1968	0.0	19.2	11.5	7.7
1969	42.8	19.5	--	19.5
1970	28.9	21.4	--	21.4
1971	0.0	21.5	12.9	8.6
1972	2.3	21.5	10.6	10.9
1973	23.9	21.6	--	--
1974	43.2	22.7	--	--
1975	32.5	20.0	--	--
1976	37.9	19.9	--	19.9
1977	47.0	19.7	--	19.7

[a]These wheat yield data are obtained from variety test reports and used in other parts of this study.

[b]Yields for disaster payments represent 60 percent of Normal Farm Yield.

[c]Yields for deficiency payments do not include yields for disaster payments.

TABLE 34

PAYMENTS IN 1977 DOLLARS FOR FARM PROGRAM WHEAT IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Disaster Payments	Deficiency Payments	Total Payment
	($/ac.)		
1962	---	---	---
1963	---	---	---
1964	---	2.32	2.32
1965	---	4.37	4.37
1966	---	---	---
1967	---	5.66	5.66
1968	16.16	4.90	21.06
1969	---	13.79	13.79
1970	---	13.97	13.97
1971	18.12	6.40	24.52
1972	14.90	2.76	17.66
1973	---	---	---
1974	---	---	---
1975	---	---	---
1976	---	4.33	4.33
1977	---	14.64	14.64

TABLE 35

ACTUAL AND NORMAL BARLEY YIELDS FOR JACKSON COUNTY SOUTHWEST OKLAHOMA, 1962-1977

Year	Actual Yield[a]	Normal Farm Yield	Yields for Disaster Payments[b]	Yields for Deficiency Payments[c]
	(bu./ac.)			
1962	0.0	23.3	14.0	9.3
1963	55.7	23.0	--	23.0
1964	56.7	22.3	--	--
1965	0.0	19.7	11.8	--
1966	58.8	21.7	--	--
1967	51.8	21.6	--	21.6
1968	0.0	23.2	13.9	9.3
1969	76.5	25.5	--	25.5
1970	59.8	28.5	--	28.5
1971	0.0	30.5	18.3	12.2
1972	8.0	30.4	10.2	20.2
1973	11.0	31.0	7.6	--
1974	50.9	30.9	--	--
1975	44.5	27.2	--	--
1976	49.7	25.8	--	--
1977	47.7	26.7	--	26.7

[a]Barley yield data are obtained from variety test reports and used in other parts of this study.

[b]Yields for disaster payments represent 60 percent of Normal Farm Yield.

[c]Yields for deficiency payments do not include yields for disaster payments.

TABLE 36

PAYMENTS IN 1977 DOLLARS FOR FARM PROGRAM BARLEY IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Disaster Payments	Deficiency Payments	Total Payments
	($/ac.)		
1962	13.06	0.15	13.21
1963	---	1.38	1.38
1964	---	--	---
1965	11.02	--	11.02
1966	---	--	---
1967	---	0.65	0.65
1968	12.97	1.81	14.78
1969	---	8.01	8.01
1970	---	6.81	6.81
1971	17.08	3.46	20.54
1972	9.51	1.81	11.32
1973	7.08	--	7.08
1974	---	--	---
1975	---	--	---
1976	---	--	---
1977	---	5.58	5.58

TABLE 37

ACTUAL AND NORMAL COTTON YIELDS FOR JACKSON COUNTY
SOUTHWEST OKLAHOMA, 1962-1977

Year	Actual Yield[a]	Normal Farm Yield[b]	Yields for Disaster Payments[c]	Yields for Deficiency Payments[d]
	(lb./ac.)			
1962	496.3	261.7	--	--
1963	256.9	277.3	--	--
1964	250.1	289.2	--	--
1965	253.9	287.0	--	--
1966	0.0	285.6	214.2	71.4
1967	367.0	252.8	--	--
1968	135.0	239.1	--	194.8
1969	532.6	205.1	--	205.1
1970	316.3	256.9	--	256.9
1971	370.7	275.6	--	275.6
1972	142.0	348.5	119.4	229.1
1973	0.0	302.7	227.0	--
1974	202.0	277.8	6.4	--
1975	193.7	205.4	--	--
1976	215.5	184.1	--	--
1977	455.2	154.9	--	--

[a]These cotton yield data are obtained from variety test reports and used in other parts of this study.

[b]Calculated from actual yield data.

[c]Yields for disaster payments represent 75 percent of Normal Farm Yield.

[d]Yields for deficiency payments do not include yields for disaster payments.

TABLE 38

PAYMENTS IN 1977 DOLLARS FOR FARM PROGRAM COTTON IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Disaster Payments	Deficiency Payments	Total Payments
	($/ac.)		
1962	---	---	---
1963	---	---	---
1964	---	---	---
1965	---	---	---
1966	30.65	4.08	34.72
1967	---	---	---
1968	6.34	9.24	15.58
1969	---	17.14	17.14
1970	---	20.85	20.85
1971	---	1.05	1.05
1972	17.08	9.30	26.38
1973	32.48	---	32.48
1974	0.92	---	0.92
1975	---	---	---
1976	---	---	---
1977	---	---	---

TABLE 39

ACTUAL AND NORMAL GRAIN SORGHUM YIELDS FOR JACKSON COUNTY SOUTHWEST OKLAHOMA, 1962-1977

Year	Actual Yield[a]	Normal Farm Yield	Yields for Disaster Payments[b]	Yields for Deficiency Payments[c]
	(cwt./ac.)			
1962	20.6	19.8	--	--
1963	0.0	21.8	13.1	--
1964	18.6	23.7	--	--
1965	19.2	25.0	--	--
1966	20.4	25.0	--	25.0
1967	22.1	26.9	--	26.9
1968	24.6	27.6	--	27.6
1969	23.3	25.5	--	25.5
1970	19.8	26.1	--	26.1
1971	18.1	26.5	--	26.5
1972	22.4	25.0	--	--
1973	30.1	23.4	--	--
1974	21.1	23.3	--	--
1975	27.7	21.9	--	--
1976	18.2	22.3	--	--
1977	21.4	21.4	--	21.4

[a]Grain Sorghum yields are obtained from variety test reports and used in other parts of this study.

[b]Yields for disaster payments represent 60 percent of Normal Farm Yield.

[c]Yields for deficiency payments do not include yields for disaster payments.

TABLE 40

PAYMENTS IN 1977 DOLLARS FOR FARM PROGRAM GRAIN SORGHUM IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Disaster Payments	Deficiency Payments	Total Payments
		($/ac.)	
1962	---	---	---
1963	22.07	---	22.07
1964	---	---	---
1965	---	---	---
1966	---	0.91	0.91
1967	---	4.38	4.38
1968	---	11.00	11.00
1969	---	4.17	4.17
1970	---	1.88	1.88
1971	---	12.97	12.97
1972	---	---	---
1973	---	---	---
1974	---	---	---
1975	---	---	---
1976	---	---	---
1977	---	12.01	12.01

TABLE 41

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR SELECTED DRYLAND FARM PROGRAM CROPS IN SOUTHWEST OKLAHOMA, 1962-1977

Year	Barley	Cotton	Grain Sorghum	Wheat[e] June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	Contracted Wheat[f]
	($/ac.)															
1962	34.70	223.49	39.94	68.85	69.08	68.79	68.47	67.63	69.19	69.75	67.35	70.27	70.25	72.14	62.79	63.99
1963	22.87	93.36	1.52	121.13	120.71	120.26	122.20	130.56	135.66	135.89	136.08	136.25	123.49	134.07	126.08	146.12
1964	21.49	75.74	39.48	50.99	48.39	48.64	50.57	53.04	55.49	54.46	48.79	48.26	44.26	41.38	36.73	83.15
1965	-17.42	64.80	36:76	26.83	28.42	34.13	32.90	33.02	34.95	34.09	30.89	30.42	30.38	29.39	31.12	33.74
1966	59.69	-20.56	38.35	75.29	87.54	86.45	86.02	72.94	75.95	78.94	71.37	63.77	73.67	66.71	66.02	64.06
1967	53.74	72.01	42.41	40.40	36.24	35.47	33.68	35.27	33.92	34.48	33.05	32.56	32.05	24.68	23.62	48.69
1968	-13.66	8.23	49.73	-9.14	-9.15	-9.20	-9.28	-9.40	-9.54	-9.71	-9.93	-10.17	-10.44	-10.74	-11.08	-9.14
1969	64.38	104.56	47.43	56.77	54.82	52.84	59.35	61.18	62.20	62.42	58.72	58.09	56.67	56.75	52.93	62.97
1970	39.95	61.35	36.70	30.48	30.72	33.04	39.50	39.13	39.77	38.82	34.68	33.65	32.60	32.56	33.53	34.15
1971	-7.90	85.83	32.62	-5.68	-5.69	-5.74	-5.82	-5.94	-6.08	-6.25	-6.47	-6.71	-6.98	-7.28	-7.62	-5.68
1972	-13.26	9.79	37.69	-15.53	-15.40	-14.55	-13.73	-13.50	-13.74	-12.35	-13.50	-15.56	-15.14	-15.17	-15.54	-15.33
1973	-11.14	-22.81	122.19	33.67	35.99	92.83	101.14	89.06	90.81	105.10	99.42	104.97	83.22	60.56	43.93	27.19
1974	65.39	24.41	99.29	125.12	152.69	150.50	149.84	180.45	172.68	174.27	128.09	117.09	100.59	99.70	86.26	186.94
1975	57.58	25.67	92.21	53.78	70.40	81.10	84.70	81.80	68.26	62.36	59.94	67.50	65.03	60.16	54.68	71.45
1976	61.22	85.27	34.09	84.85	85.70	67.98	64.64	52.34	46.88	44.83	42.04	41.98	37.08	32.83	25.80	92.39
1977	26.63	101.25	38.28	57.80	59.70	58.17	63.42	68.63	76.37	76.42	67.06	67.88	72.09	77.11	76.14	71.42
Mean[a]	28.09	46.14	54.44	42.66	47.08	51.00	52.80	52.69	51.73	52.57	45.80	45.04	42.37	39.02	35.37	50.99
UWMA(3)[b]	60.96	55.22	64.57	83.58	94.51	88.42	87.70	86.80	78.45	75.98	64.62	64.66	58.17	54.40	46.56	105.02
EWMA(3)[c]	61.40	45.12	75.20	87.92	102.93	99.86	99.73	104.86	95.94	93.82	76.69	75.52	67.57	64.33	55.58	116.93
Standard Deviation[d]	31.57	60.10	29.86	40.99	45.51	45.32	45.80	50.01	49.36	50.39	43.82	43.44	39.27	40.11	37.31	53.38

[a]These figures are based on a 13-year series, 1965-1977.

[b]These figures are based on a 3-year unequally and equally weighted moving average.

[c]These are expected gross margins for 1977.

[d]Calculated on the entire data series, 1962-1977.

[e]Produced on own land.

[f]Contracted in March for June delivery.

experience these conditions are affected in varying degrees. These areas are designated as high-risk areas because of their great production variability. Although production variability affects both the farmer and society, it is the individual farmer who is affected most. He may be prevented from planting due to bad weather, a total or partial failure of his crop directly affects the amount he can sell. Thus, the individual farmer is vulnerable to risk in yield and farm income due to adverse weather conditions. When yields are low, farm income is inadequate to cover production costs and can consequently create financial difficulties. The difficulties may not be so great if a year of low yields were followed by a year that had normal or above normal yields.

The use of crop insurance is one method the individual farmer can use for protection from certain kinds of production risks. Insurance companies specialize in bearing risk. They can assume certain specified risks formerly borne by the farmer. There are two main kinds of crop insurance available to farmers: all-risk and crop-hail insurance (Nelson et al., p. 196).

Federal Crop Insurance (FCI)

All-risk crop insurance is a method of socializing farm production risks if it is actuarally sound. This insurance is provided through the Federal Crop Insurance Corporation (FCIC), a federal government agency that was established in 1938 (Nelson et al., p. 196). FCI is available in the study area. However, farmer participation in this insurance had been very low according to the county extension agent. The reason for this is the premium is too costly, which gives rise to the current controversy as to how much of the cost of this program be borne by the public. In addition, the availability of competitive private insurance and government farm programs make the FCI program less attractive. The government farm programs provide for disaster and deficiency payments at no cost except complying to some stipulated provisions in the program.

Currently, all risk crop insurance covers all natural hazards such as hail, drought, floods, fire, windstorm, frost, insect damage, and disease. The intention of FCI is to help farmers recover their production costs rather than compensate them for the full value of the crop. Thus, the coverage varies by crops and price elections.

FCI must be bought on or before a specific date prior to the planting date. FCI protection policy is automatically renewed from one year to the next, unless the farmer or the FCI cancels it. The farmer may cancel the policy any year he wishes, but by keeping it continuously in force he also earns a more favorable rate for successive years without losses on many crops.

FCI offers many benefits besides reducing risk. Crop insurance is good collateral in that it gives cash value to a growing crop before the crop is harvested. It assures the farmer that even if he should lose his crop he will still have income to repay money borrowed to invest in that crop. If the farmer is cash renting additional acres, all-risk crop insurance gives the assurance of obtaining cash to pay the rent. Furthermore, the FCI premium is a deductible business expense on both federal and state income tax returns. It minimizes the risk otherwise involved in forward contracting or hedging a crop that has not been harvested.

Crop-Hail Insurance (CHI)

Crop-hail insurance (CHI) can be purchased through private insurance companies and Production Credit Associations (PCAs). CHI provides protection against hail damage for growing crops. Protection may also be extended to include fire or wind damages (Nelson et al., p. 196). Unlike Federal All-Risk Crop Insurance which must be purchased before planting time, CHI can be purchased any time up to harvest.

The decision whether or not to buy insurance should be based on the farmer's knowledge about the probability distribution of yields and historical weather data. He would usually have greater knowledge about the yield distribution at the time of hail insurance purchase than at planting time. Furthermore, from historical weather data and past experiences he would know the frequency and proportion of hail damage he is likely to suffer. For example, based on information provided by a claims adjuster for the Altus area, an individual wheat farmer in the Altus area is likely to experience hail damage in 2 years out of every 5 or 6 years. Furthermore, if he experiences hail damage, he is likely to suffer a loss of 20 to 30 percent of his crop.

CHI premiums depend on the amount of coverage and the probability of hail damage in the area. In this study, hail insurance is analyzed for wheat only. It is assumed that the 1978 rates apply for the study period. The amount of coverage is $40.00 per acre of wheat, and the premium is $11.00 per acre. These figures are extrapolated backwards using the Index of Prices Paid by Farmers to obtain coverages and premiums for the study period. Indemnities are made on the basis of the amount of hail damage. For example if a farmer suffers 20 percent hail damage and coverage is $40.00 per acre, the indemnity would be $8.00 per acre, irrespective of what the actual value of the crop might have been (Nelson et al., p. 196).

Indemnities are calculated on the assumption of a 20 percent hail damage. The expected yield per acre is calculated using the actual wheat yield data for the last 13 years (1965-1977) (Table 42), which is 26.9 bushels per acre. A 20 percent hail damage is equivalent to about 5.4 bushels per acre (26.9 bushels x 20). Payments are calculated for those four years that the negative deviation between actual and expected yield are the greatest.

According to the wheat varietal test results report for 1968, there is severe hail damage for that year. Hail damage data are not available for the other years. However, it is recognized that the frequency of hail damage reported for experimental data does not correspond with actual on the farm experience of hail damage, which is more frequent than the experimental data series indicate. Therefore, the years that hail payments are made are 1968, 1971, 1972, and 1973 (Table 42).

The total variable cost of producing wheat is increased by the insurance premium. The indemnities received for hail damage for the four years are $33.08, $33.08, $30.25, and $3.70, respectively. These figures are expressed in 1977 dollars. Table 43 presents gross margins series for wheat sold in June through May. Wheat hail insurance alternatives are not analyzed under the farm program scenario only under the free-market scenario. The reason is, under the farm program scenario, the farmer is eligible for disaster payments at no cost except he has to comply with set aside requirements. Wheat hail insurance under the farm program would require compliance for set asides and the cost of

TABLE 42

PREMIUMS AND INDEMNITIES IN 1977 DOLLARS FOR WHEAT HAIL INSURANCE IN SOUTHWEST OKLAHOMA, 1962-1978

Year	Premiums[a]	Indemnities
	---------------- ($/ac.)	----------------
1962	4.52	---
1963	4.57	---
1964	4.62	---
1965	4.72	---
1966	4.97	---
1967	5.02	---
1968	5.17	33.08
1969	5.42	---
1970	5.63	---
1971	5.93	33.08
1972	6.28	30.25
1973	7.23	3.70
1974	8.24	---
1975	9.04	---
1976	9.59	---
1977	10.15	---
1978	11.00	---

[a]Insurance premium is expressed in nominal dollars.

TABLE 43

ESTIMATED GROSS MARGINS IN 1977 DOLLARS FOR MULTIPLE MARKETING ALTERNATIVES AND HAIL INSURANCE FOR WHEAT IN SOUTHWEST OKLAHOMA, 1962-1977[a]

Year	Sell Wheat											
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
	($/ac.)											
1962	58.99	59.21	58.93	58.61	57.76	59.32	59.89	57.48	60.41	60.39	62.28	52.92
1963	111.26	110.84	110.40	112.34	120.69	125.79	126.03	126.22	126.38	113.62	124.21	116.21
1964	38.81	36.21	36.45	38.39	40.86	43.30	42.27	36.60	36.08	32.08	29.19	24.55
1965	12.59	14.19	19.90	18.67	18.79	20.71	19.86	16.65	16.18	16.15	15.15	16.89
1966	65.42	77.68	76.58	76.16	63.07	66.09	69.07	61.50	53.90	63.80	56.84	56.15
1967	24.87	20.72	19.94	18.16	19.75	18.39	18.95	17.52	17.04	16.53	9.16	8.09
1968	-6.98	-7.00	-7.04	-7.13	-7.24	-7.39	-7.56	-7.77	-8.01	-8.28	-8.59	-8.93
1969	33.11	31.16	29.18	35.70	37.52	38.54	38.77	35.07	34.44	33.01	33.10	29.27
1970	6.64	6.89	9.20	15.67	15.29	15.94	14.98	10.84	9.82	8.77	8.73	9.70
1971	-6.98	-7.00	-7.04	-7.13	-7.24	-7.39	-7.56	-7.77	-8.01	-8.28	-8.59	-8.93
1972	-12.24	-12.12	-11.27	-10.45	-10.21	-10.46	-9.07	-10.22	-12.27	-11.86	-11.89	-12.25
1973	27.51	29.82	86.66	94.97	82.90	84.65	95.23	93.25	98.80	77.05	54.40	37.77
1974	115.25	142.83	140.64	139.97	170.58	162.81	164.41	118.22	107.22	90.72	89.83	76.39
1975	43.91	60.53	71.24	74.84	71.93	58.40	52.49	50.07	57.64	55.16	50.30	44.81
1976	70.65	71.50	53.78	50.44	38.14	32.69	30.63	27.85	27.78	22.88	18.64	11.61
1977	33.29	35.20	33.67	38.91	44.13	51.86	51.91	42.55	43.38	47.59	52.61	51.64
Mean[b]	31.31	35.72	39.65	41.44	41.34	40.37	40.93	34.44	33.69	31.02	27.67	24.02
UWMA(3)[c]	71.55	82.48	76.39	75.67	74.77	66.43	63.94	52.59	52.63	46.13	42.38	34.53
EWMA(3)[d]	76.60	91.62	88.55	88.42	93.55	84.63	82.51	65.38	64.21	56.25	52.92	44.27
Standard Deviation	38.43	43.38	43.73	43.99	48.24	47.39	48.35	41.94	41.54	36.90	37.55	34.40

[a]These gross margin figures are defined as gross returns plus indemnities minus variable cost including the appropriate storage costs and interest charge plus insurance premiums.

[b]Expected gross margins are based on the mean of the 13-year series, 1965-1977.

[c]Expected gross margins are based on a 3-year unequally weighted moving average (UWMA). These are the expected gross margins for 1977.

[d]Expected gross margins are based on a 3-year equally weighted moving average (EWMA). These are the expected gross margins for 1977.

production is increased by the insurance premium. The result is that wheat hail insurance alternatives under the farm program become more costly than the other wheat activities and therefore would not enter in any of the solutions.

The final stage of this study is to apply the model using the data to analyze the risk management scenarios discussed above. The results of the analysis and risk efficient farm plans are presented in the following chapter.

CHAPTER V

THE ANALYSIS OF RISK EFFICIENT FARM PLANS

This chapter presents and discusses the risk efficient farm plans derived for both the dryland and irrigated farm situations for the selected risk management scenarios for which expected gross margins are calculated in the three ways described in Chapter III. Table 44 presents the risk management scenarios analyzed. The farm resource situations are redefined when crop-share and cash rent alternatives are analyzed for both the dryland and irrigated farms.

Farm plans that maximized expected total gross margins are determined by linear programming (LP). After the maximum expected total gross margin farm plans are determined, the basis LP models are extended to incorporate risk measured as deviation from an expected gross margin for each enterprise based on: (1) the sample mean, (2) a three-year unequally weighted moving average (UWMA), and (3) a three-year equally weighted moving average (EWMA) process. The MOTAD model is constructed by introducing the deviation matrix into the basic LP model. The model is tested by solving for the farm plan which yields the maximum expected total gross margin determined by the LP model. This plan coincides with the highest attainable point on the risk efficiency frontier. Other points on the risk efficiency frontier are obtained by decreasing the objective function value parametrically in arbitrary decrements of $3,000 expected total gross margins.

TABLE 44

RISK MANAGEMENT STRATEGIES ANALYZED

Strategies	Dryland Farm	Irrigated Farm
1. Harvest Sale	X	X
2. Harvest Sale Under the 1978 Government Farm Program	X	
3. Harvest Sale and Wheat Hail Insurance		X
4. Multiple Marketing	X	X
5. Multiple Marketing and Forward Contracting	X	X
6. Multiple Marketing and Forward Contracting Under the 1978 Government Farm Program	X	
7. Multiple Marketing, Forward Contracting, Crop-Share, and Cash Rent	X	X
8. Multiple Marketing, Forward Contracting, Crop-Share, Cash Rent, and Wheat Hail Insurance		X

The basic LP model maximizes expected total gross margin subject to the technical, resource, and non-negativity constraints. When the deviation matrix is introduced into the basic LP model, the resulting LP-MOTAD model minimizes total negative gross margin deviation (TND) constrained by the above constraints and expected total gross margin. For every expected total gross margin constraint specified, the LP-MOTAD model solves for the minimum TND value that will satisfy all the constraints. This TND value is transformed into an estimate of standard deviation, which is a measure of dispersion or variation in expected total gross margin. The coefficient of variation, also known as the coefficient of dispersion, is a measure of relative variability and is generally expressed as a percentage. Coefficients of variation are calculated by dividing the estimated standard deviation of a farm plan by the expected total gross margin of that plan and multiplying by 100. Risk efficient farm plans derived by the LP-MOTAD model can be evaluated in terms of TND, the estimated standard deviation, and the coefficient of variation.

The risk efficient farm plans presented in the tables are plans where significant changes occurred. Common expected total gross margin levels for the different risk management strategies and the different farm situations were selected for purposes of comparison. Farm plans that leave cropland idle are presented but not discussed. It is felt that the farm decision maker is not interested in a farm plan that leaves a proportion of cropland idle. Since this analysis assumes a free-market scenario and a farm program scenario, the farm decision maker may realistically select a farm plan that leaves cropland idle if he is participating in a set aside program. Plans that leave cropland idle represent lower expected total gross margin levels on the risk efficiency frontier and thus may not be considered rational alternatives by the decision maker.

Dryland Risk Efficient Farm Plans

The dryland farm refers to the farm situation that consists of 1200 acres of cropland and 300 acres of unimproved native pasture owned by the farmer. The livestock enterprises are March and May heifers, March and May steers, and summer steers. The crop activities are dryland alfalfa, barley, oats, wheat, cotton, and grain sorghum.

Harvest Sale

All crops, except alfalfa, are sold at their respective harvest time: barley, oats, and wheat in June, cotton in November, and grain sorghum in October.

Mean Expectation

The maximum expected total gross margin of the farm plan with marketing at harvest using the sample mean as the expected gross margin is $62,386.02 with TND at $190,895, standard deviation of $38,319, and coefficient of variation 61.42 percent (Table 45). The farm plan is specialized and consists of 83 summer steers on 300 acres of native pasture, 3.76 acres of alfalfa, and 1196.24 acres of grain sorghum.

The expected total gross margin - total negative gross margin deviation frontier is traced out by parameterizing the expected gross margin constraint from $60,000 to $15,000 in $3,000 decrements. Table 45 presents selected farm plans on this frontier. The risk efficient farm

TABLE 45

SUMMARY OF MOTAD RISK EFFICIENT DRYLAND FARM PLANS FOR HARVEST SALE STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels				
		$39,000	$45,000	$54,000	$60,000	$62,386.02[a]
March Steers	head	--	5.69	17.94	80.01	--
May Steers	head	116.27	79.40	19.83	--	--
Summer Steers	head	120.00	120.00	117.88	82.52	83.19
Native Pasture	acre	300.00	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.07	254.08	63.47	--	--
Alfalfa	acre	9.64	9.74	9.49	5.09	3.76
Cotton	acre	247.90	266.02	301.06	112.37	--
Grain Sorghum	acre	563.02	653.09	772.17	842.50	1,196.24
June Wheat	acre	--	17.07	53.81	240.04	--
Hire Labor (April-June)	hour	109.20	133.24	162.86	6.69	50.35
Idle Cropland	acre	7.37	--	--	--	--
Total Negative Deviation	$	69,272	82,909	103,669	147,858	190,895
Standard Deviation	$	13,905	16,642	20,810	29,680	38,319
Coefficient of Variation	%	35.65	36.98	38.54	49.47	61.42

[a]This is the farm plan maximizing expected total gross margin.

plan for $60,000 total gross margin illustrates the potential for reducing gross margin variability through diversification. By reducing the acreage of grain sorghum and adding wheat and cotton, expected total gross margin is reduced by $2,386.02 and standard deviation by $8,639. The coefficient of variation declined from 61.42 to 49.46 percent. At the $54,000 total gross margin level, grazeout wheat and March and May steers entered the solution and the standard deviation is further reduced to $20,810 and coefficient of variation is reduced to 38.54 percent. Between $54,000 and $39,999 expected total gross margin, the pattern of production changed little. Standard deviation is reduced and relative variability declined only slightly. At and below the $39,000 expected total gross margin level, cropland begins to remain idle.

UWMA Expectation

Expected gross margins are based on a 3-year moving average with weights of .5 for the most recent year and .3 and .2 for the two previous years. The maximum expected total gross margin for the harvest sale strategy is $106,671.38 with standard deviation of $69,467 and coefficient of variation is 65.12 percent. This production organization is specialized, and consists of 394 March steers, 6.81 acres of alfalfa and 1,193.10 acres of wheat (Table 46). The risk efficiency frontier attained under UWMA expectation is substantially higher under the moving average models than under mean expectations. The reason is higher actual gross margins associated with the most recent three years. When expected gross margins are calculated using both moving average processes, summer steers have a negative expected gross margin for 1977. Consequently,

TABLE 46

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR HARVEST SALE STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels				
		$39,000	$84,000	$93,000	$102,000	$106,671.38[a]
March Steers	head	--	--	71.27	146.87	393.98
May Steers	head	156.05	--	--	--	--
Grazeout Wheat	acre	499.36	--	--	--	--
Alfalfa	acre	--	--	1.23	2.54	6.81
Oats	acre	145.57	440.40	567.84	752.67	--
Cotton	acre	110.35	141.46	--	--	--
Grain Sorghum	acre	390.84	618.14	415.05	--	--
June Wheat	acre	--	--	215.88	444.79	1,193.19
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	172.55
Idle Cropland	acre	53.88	--	--	--	--
Total Negative Deviation	$	50,326	124,349	176,907	255,060	346,070
Standard Deviation	$	10,102	24,961	35,511	51,198	69,467
Coefficient of Variation	%	25.90	29.72	38.18	50.20	65.12

[a]This is the farm plan maximizing expected total gross margin.

summer steer and native pasture activities are excluded from the strategies involving both moving average expectations.

As the expected total gross margin constraint is parameterized from \$102,000 to \$39,000 in decrements of \$3,000, wheat acreage is reduced with oats and then grain sorghum and cotton added. By reducing the acreage of wheat and adding oats, expected total gross margin is reduced by \$6,671.38 and standard deviation by \$18,269 and coefficient of variation from 65.12 to 50.20 percent. At the \$93,000 total gross margin level, the production organization consists of wheat, oats, and grain sorghum. Standard deviation and coefficient of variation are reduced to \$35,511 and 38.18 percent, respectively. Between \$84,000 and \$42,000 expected total gross margin, the production organization consists of oats, cotton, and grain sorghum. Although there is a substantial amount of oats in the solutions, oats is not a major crop in the study area. Wheat does not enter in any of the solutions at and below the \$84,000 expected total gross margin level. At the \$39,000 total gross margin level, May steers and grazeout wheat entered the solution. Standard deviation and coefficient of variation are further reduced. Cropland begins to remain idle at and below the \$39,000 total gross margin level.

EWMA Expectation

Expected gross margins are based on a 3-year equally weighted moving average. The maximum expected total gross margin for the harvest sale strategy was \$108,013.96, with a standard deviation of \$66,307 and coefficient of variation of 61.39 percent (Table 47). This production organization is identical to the one determined for the UWMA expectation.

TABLE 47

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR HARVEST SALE STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels				
		$30,000	$84,000	$93,000	$102,000	$108,013.96[a]
March Steers	head	--	--	77.63	260.11	393.98
May Steers	head	170.69	--	--	--	--
Grazeout Wheat	acre	546.19	--	--	--	--
Alfalfa	acre	--	--	1.34	4.50	6.81
Oats	acre	98.18	396.07	289.10	108.38	--
Cotton	acre	115.56	167.27	--	--	--
Grain Sorghum	acre	337.40	636.66	674.46	299.36	--
June Wheat	acre	--	--	235.10	787.76	1,193.19
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	172.55
Idle Cropland	acre	102.67	--	--	--	--
Total Negative Deviation	$	37,387	121,677	165,325	244,484	330,328
Standard Deviation	$	7,505	24,424	33,186	49,076	66,307
Coefficient of Variation	%	25.02	29.08	35.68	48.11	61.39

[a]This is the farm plan maximizing expected total gross margin.

However, the producer is able to attain a slightly higher risk efficiency frontier.

By reducing the acreage of wheat and adding oats and grain sorghum, expected total gross margin is reduced by $6,013.96 to $102,000 and standard deviation by $17,231 and coefficient of variation from 61.39 to 48.11 percent. Comparing farm plans at the $93,000 and $84,000 expected total gross margin levels in Tables 46 and 47, relative variability is slightly reduced for this strategy. At and below the $84,000 expected total gross margin level, wheat does not enter any of the farm plans, which are comprised of oats, cotton and grain sorghum. Standard deviation and coefficient of variation are further reduced as the expected total gross margin constraint is reduced.

Harvest Sale-Farm Program

One risk management option available to farm operators is participation in government farm programs. Participation in the 1978 Farm Program is analyzed only for the dryland farm. Normal Farm Yield data needed for this type of analysis are not available for the irrigated crops. The crops analyzed under the 1978 Farm Program strategy are the same as for the free market scenario. Farmers participating in the program are required to set aside 10 percent of the harvested grain sorghum and 20 percent of the harvested barley and wheat acres to be eligible for deficiency and disaster payments. Total harvested acres cannot exceed normal farm acreage. There is no set aside requirement for oats and cotton. Deficiency and disaster payments are calculated for cotton but not oats. Oats and alfalfa are not considered farm program crops and thus are not eligible for payments.

The analysis of this strategy required that certain activities be left out of the model in order to satisfy the requirements of the 1978 Farm Program. The activities omitted are grazeout wheat and May heifers and May steers which utilize the grazeout wheat activity. Wheat cannot be grazed out under the 1978 Wheat Farm Program.

Mean Expectation

Farm plans derived for harvest sale with farm program participation are on a lower risk efficiency frontier than for the harvest sale strategy without farm program participation. The maximum expected total gross margin plan is $60,971.08 with a standard deviation of $32,415 and coefficient of variation of 53.16 percent (Table 48). The expected total gross margin of this plan is $1,414.94 less than the maximum expected total gross margin for harvest sale without farm program participation. The farm plan maximizing expected total gross margin for the harvest sale strategy with farm program participation using the mean consists of 83 head of summer steers utilizing 300 acres of native pasture, 3.76 acres of alfalfa, and 1,087.49 acres of grain sorghum. The set aside requirement of this farm plan is 108.75 acres which represent 10 percent of the harvested grain sorghum acreage.

When the expected total gross margin constraint is reduced to $57,000, the resulting production organization became more diversified and less risky. At this expected total gross margin level, the farm plan consists of March and summer steers, alfalfa, cotton, grain sorghum, and wheat. This plan illustrates that by reducing the grain sorghum acreage and adding March steers, cotton, and wheat expected total gross

TABLE 48

SUMMARY OF MOTAD RISK EFFICIENT DRYLAND FARM PLANS FOR HARVEST SALE UNDER A FARM PROGRAM STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels					
		$36,000	$48,000	$54,000	$57,000	$60,000	$60,971.08[a]
March Steers	head	21.09	20.49	20.18	20.02	54.08	--
Summer Steers	head	83.02	83.02	83.02	83.03	82.74	83.19
Native Pasture	acre	300.00	300.00	300.00	300.00	300.00	300.00
Alfalfa	acre	4.11	4.10	4.10	4.09	4.66	3.76
Cotton	acre	219.83	301.58	343.67	364.98	176.67	--
Grain Sorghum	acre	375.84	528.90	607.69	647.58	749.08	1,087.49
June Wheat	acre	63.28	61.47	60.53	60.06	162.24	--
Hire Labor (April-June)	hour	--	--	59.27	101.76	--	--
Set Aside	acre	50.25	65.18	72.87	76.77	107.35	108.75
Idle Cropland	acre	486.69	238.77	111.14	46.52	--	--
Total Negative Deviation	$	51,139	70,897	81,069	86,219	109,994	161,483
Standard Deviation	$	10,265	14,231	16,273	17,307	22,079	32,415
Coefficient of Variation	%	28.52	29.65	30.14	30.36	36.80	53.16

[a]This is the farm plan maximizing expected total gross margin.

margin was reduced by $3,971.08. Associated with the expected total gross margin reduction is a decline in the standard deviation of about $15,018 and a decline in the coefficient of variation of 22.8 percent.

Comparing farm plans at the $54,000 total gross margin level for the harvest sale strategy with and without the benefits of the farm program (Tables 45 and 48), relative variability is lower under the government program alternative. The coefficient of variation is 30.14 percent under the farm program and 38.54 percent without farm program participation. Results in Table 48 show that TND, standard deviation and relative variability are considerably lower under the harvest sale farm program strategy than without the farm program.

The results of this scenario show that considerable acres of cropland begin to remain idle at higher total gross margin levels than for harvest sale without farm program participation. For example, at the $57,000 expected total gross margin level, 76.77 acres are set aside and 46.52 acres of cropland remain idle. If a decision maker chooses this farm plan, a total of 123.29 acres (76.77 acres + 46.52 acres) would remain unused. Under the harvest sale strategy without farm program participation, cropland begins to remain idle at $39,999 expected total gross margin level. Below $39,999 in expected total gross margin, the acres of each activity in the production organizations declined proportionately with correspondingly slight declines in TND's, standard deviations and coefficients of variation.

UWMA Expectation

The maximum expected total gross margin for this strategy is $98,916 resulting from 1200 acres of oats (Table 49). The plan is highly specialized, however, the producer attained a lower risk efficiency

TABLE 49

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR HARVEST SALE UNDER A FARM PROGRAM STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels				
		$78,000	$84,000	$93,000	$96,000	$98,916.00[a]
Oats	acre	360.30	571.43	950.70	1,077.12	1,200.00
Cotton	acre	197.11	--	--	--	--
Grain Sorghum	acre	579.47	571.43	226.64	111.71	--
Set Aside	acre	57.94	57.14	22.66	11.17	--
Idle Cropland	acre	5.18	--	--	--	--
Total Negative Deviation	$	104,826	127,806	192,728	214,369	235,404
Standard Deviation	$	21,042	25,655	38,686	43,030	47,253
Coefficient of Variation	%	26.98	30.54	41.60	44.82	47.77

[a]This is the farm plan maximizing expected total gross margin.

frontier than the harvest sale strategy reported in Table 46. The standard deviation is $47,253 and coefficient of variation is 47.77 percent. By reducing the acreage in oats and adding 111.71 acres of grain sorghum, expected total gross margin is reduced by $2,916 to $96,000, standard deviation is reduced by $4,223 and the coefficient of variation declines from 47.77 to 44.82 percent. Comparing expected total gross margin at the $93,000 and $84,000 levels in Table 46 and 49, relative variability is slightly higher for this strategy than under sale at harvest. When the expected total gross margin constraint is reduced below $84,000, the farm plans consist of oats, cotton, and grain sorghum. Wheat does not enter any of the solutions for this strategy.

EWMA Expectation

The risk efficiency frontier derived for this strategy is considerably lower than the risk efficiency frontiers reported in Tables 47 and 49. The reason is that under the unequally weighted moving average, oats (not a government program commodity) is the only crop produced. No set aside acres are required for oats. Wheat is the primary crop produced when the equally weighted moving average is used. Approximately 200 acres must be set aside to participate in the Government Program. Income lost on the 200 set aside acres accounts for lower total gross margin under this alternative.

The maximum expected total gross margin of this scenario is $91,826.13 (Table 50). This farm plan consists of 329 March steers, 5.68 acres of alfalfa, and 995.27 acres of wheat. The standard deviation of this plan is $47,289 and a coefficient of variation of 51.50 percent. When the expected total gross margin level is reduced to $90,000 wheat

TABLE 50

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR HARVEST SALE UNDER A FARM PROGRAM STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels				
		$78,000	$84,000	$87,000	$90,000	$91,826.13[a]
March Steers	head	--	--	128.36	263.41	328.63
Alfalfa	acre	--	--	2.22	4.55	5.68
Oats	acre	344.36	540.69	276.53	--	--
Cotton	acre	198.04	6.62	--	--	--
Grain Sorghum	acre	587.42	593.35	413.42	216.50	--
June Wheat	acre	--	--	388.74	797.75	995.27
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	48.55
Set Aside	acre	58.74	59.34	119.09	181.20	199.05
Idle Cropland	acre	11.44	--	--	--	--
Total Negative Deviation	$	104,578	124,676	144,540	193,112	235,583
Standard Deviation	$	20,992	25,026	29,014	38,764	47,289
Coefficient of Variation	%	26.91	29.79	33.35	43.07	51.50

[a]This is the farm plan maximizing expected total gross margin.

acreage is reduced and grain sorghum added. Accompanying the $1,826.13 total gross margin reduction is a decline in the standard deviation of $8,525 and a decline in the coefficient of variation of 8.43 percent. At the $87,000 total gross margin level, the farm plan consists of oats, grain sorghum, wheat, alfalfa, and March steers. Below $87,000 expected total gross margin, the production organization consist of oats, cotton, and grain sorghum. Wheat does not remain in any of the solutions. Standard deviation and coefficient of variation are very close at the $84,000 expected total gross margin level for both moving average models (Tables 49 and 50).

Multiple Marketing

In this scenario, wheat can be marketed in any month from harvest in June through the following May. The marketing strategy used for the other crops (sale at their respective harvest time) remains unchanged. The main feature of this strategy is to determine when wheat would be marketed to minimize gross margin variability for a given level of expected total gross margin.

Mean Expectation

The maximum expected total gross margin for this production organization is $70,527.20 (Table 51). The production organization consists of 397 March steers, 80 summer steers, 300 acres of native pasture, 10.35 acres of alfalfa, and 1,189.65 acres of wheat sold in September. The standard deviation of this plan is $64,091 and the coefficient of variation is 90.88 percent. Multiple marketing increased the maximum expected total gross margin, thus permitting the producer to reach a

TABLE 51

SUMMARY OF MOTAD RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$39,000	$54,000	$60,000	$69,000	$70,527.20[a]
March Steers	head	--	17.94	78.13	306.73	396.55
May Steers	head	116.27	19.83	--	--	--
Summer Steers	head	120.00	117.88	82.54	80.62	79.86
Native Pasture	acre	300.00	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.06	63.47	--	--	--
Alfalfa	acre	9.64	9.49	5.06	8.86	10.35
Cotton	acre	247.90	301.06	249.05	--	--
Grain Sorghum	acre	563.02	772.17	711.51	270.94	--
June Wheat	acre	--	53.81	--	--	--
July Wheat	acre	--	--	--	--	--
September Wheat	acre	--	--	147.32	50.49	1,189.65
October Wheat	acre	--	--	--	852.48	--
December Wheat	acre	--	--	87.05	17.23	--
Hire Labor (April-June)	hour	109.20	162.86	62.06	--	--
Hire Labor (Oct.-Dec.)	hour	--	--	--	20.12	189.89
Idle Cropland	acre	7.38	--	--	--	--
Total Negative Deivation	$	69,272	103,669	140,044	269,853	319,286
Standard Deviation	$	13,905	20,810	28,111	54,168	64,091
Coefficient of Variation	%	35.65	38.54	46.85	78.51	90.88

[a]This is the farm plan maximizing expected total gross margin.

higher risk efficiency frontier than could be obtained under the sale at harvest or government program strategies. However, relative variability is also higher than at the other gross margin maximizing points.

When the expected total gross margin constraint is set at $69,000 the farm plan is more diversified and includes grain sorghum, and wheat sold in September and October. By reducing expected total gross margin by $1,527.20, the standard deviation and coefficient of variation declined by $9,923 and 12.37 percent, respectively. At the $60,000 total gross margin level, TND, standard deviation and relative variability are lower for the multiple marketing strategy than for the harvest sale alternative (Tables 45 and 51). However, at the same gross margin level, relative variability is lower under the farm program alternative than for the multiple marketing strategy (Tables 48 and 51). Between $45,000 and $63,000 total gross margin levels, wheat is sold in June, July, September, and December. At and below the $39,000 total gross margin level, wheat marketing activities do not enter in any of the farm plans. At this expected total gross margin level and less, cropland begins to remain idle.

UWMA Expectation

The producer attained a considerably higher risk efficiency frontier for multiple marketing compared to the harvest sale strategies with and without farm program participation. The maximum expected total gross margin is $119,701.01 with a standard deviation and coefficient of variation of $73,103 and 61.07 percent, respectively (Table 52). This production organization consists of 394 March steers, 6.81 acres of alfalfa, and 1,193.19 acres of wheat sold in July.

TABLE 52

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$39,000	$84,000	$93,000	$114,000	$119,701.01[a]
March Steers	head	--	--	62.30	280.42	393.98
May Steers	head	156.05	--	--	--	--
Grazeout Wheat	acre	499.36	--	--	--	--
Alfalfa	acre	--	--	1.08	4.84	6.81
Oats	acre	145.57	440.40	490.38	345.87	--
Cotton	acre	110.35	141.46	--	--	--
Grain Sorghum	acre	390.84	618.14	519.86	--	--
July Wheat	acre	--	--	188.68	849.29	1,193.19
Hire Labor (Oct.-Dec.)	hour	--	--	--	26.26	172.55
Idle Cropland	acre	53.88	--	--	--	--
Total Negative Deviation	$	50,326	124,349	162,261	303,817	364,182
Standard Deviation	$	10,102	24,961	32,571	60,985	73,103
Coefficient of Variation	%	25.90	29.72	35.02	53.50	61.07

[a]This is the farm plan maximizing expected total gross margin.

Wheat is sold in July at and above the $93,000 expected total gross margin level. Wheat marketing activities did not enter in any of the farm plans below the $93,000 expected total gross margin level. Relative variability is considerably lower at the $93,000 and $84,000 expected total gross margin level for this strategy compared to the harvest sale strategy with farm program participation. Relative variability is lower at the $93,000 total gross margin level for this strategy compared to the harvest sale strategy without farm program participation. However, at the $84,000 total gross margin level the farm plan is identical, and therefore relative variability is the same.

EWMA Expectation

The production organization maximizing expected total gross margin for the equally weighted moving average expectation model (Table 53) is identical to the production organization derived under the UWMA strategy reported in Table 52. The maximum expected total gross margin is $128,238.51 with a standard deviation of $87,645 and a coefficient of variation of 68.35 percent.

When the expected total gross margin constraint is parameterized, the farm plans derived are similar to those of the UWMA strategy presented in Table 52. They differed only in terms of magnitude and variability. For example, at the $93,000 and $84,000 expected total gross margin level the plans in Tables 52 and 53 are very similar but relative variability is slightly lower for this strategy.

TABLE 53

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$30,000	$84,000	$93,000	$126,000	$128,238.51[a]
March Steers	head	--	--	40.01	393.98	393.98
May Steers	head	170.69	--	--	--	--
Grazeout Wheat	acre	546.19	--	--	--	--
Alfalfa	acre	--	--	0.69	6.81	6.81
Oats	acre	98.18	396.08	314.23	--	--
Cotton	acre	115.56	167.27	--	--	--
Grain Sorghum	acre	337.40	636.65	763.91	--	--
July Wheat	acre	--	--	121.17	1,159.85	--
October Wheat	acre	--	--	--	33.34	1,193.19
Hire Labor (Oct.-Dec.)	hour	--	--	--	172.55	172.55
Idle Cropland	acre	102.67	--	--	--	--
Total Negative Deviation	$	37,387	121,677	156,430	349,332	436,631
Standard Deviation	$	7,505	24,424	31,400	70,122	87,645
Coefficient of Variation	%	25.02	29.08	33.76	55.65	68.35

[a]This is the farm plan maximizing expected total gross margin.

Multiple Marketing and Forward Contracting

Forward contracting of wheat in March with delivery made to the local elevator in June is used by a number of producers in the area wishing to share price risk. A multiple marketing and forward contracting alternative for wheat was evaluated. Producers typically contract only a portion of their wheat crop. Thus, an upper limit of 320 acres was placed on the number of acres which can be forward contracted during the production period.

Mean Expectation

The gross margin maximizing farm plan resulted in total expected gross margin of $70,527.20 with a standard deviation of $64,901 and coefficient of variation of 90.88 percent (Table 54). This production organization consists of 397 March steers, 80 summer steers, 300 acres of native pasture, 10.35 acres of alfalfa, and 1,189.65 acres wheat sold in September. The addition of forward contracting to the multiple marketing scenario did not increase expected total gross margin.

When the expected total gross margin level is set at $60,000, the production organization changed. Relative variability is reduced slightly compared to multiple marketing at this total gross margin level. This plan consists of 52 March steers, 83 summer steers, 300 acres of native pasture, 4.63 acres of alfalfa, 184.50 acres of cotton, 854.64 acres of grain sorghum, and 156.23 acres of contracted wheat. Standard deviation declined by $36,822 and coefficient of variation by 44.08 percent. This is the only farm plan evaluated that included forward contracting.

TABLE 54

SUMMARY OF MOTAD RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$39,000	$54,000	$57,000	$60,000	$70,527.20[a]
March Steers	head	--	17.94	13.27	52.08	396.55
May Steers	head	116.27	19.83	--	--	--
Summer Steers	head	120.00	117.88	83.08	82.76	79.86
Native Pasture	acre	300.00	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.06	63.47	--	--	--
Alfalfa	acre	9.64	9.49	3.98	4.63	10.35
Cotton	acre	247.90	301.06	320.45	184.50	--
Grain Sorghum	acre	563.02	772.17	835.77	854.64	--
June Wheat	acre	--	53.81	--	--	--
July Wheat	acre	--	--	30.10	--	--
September Wheat	acre	--	--	9.70	--	1,189.65
Contracted Wheat	acre	--	--	--	156.23	--
Hire Labor (April-June)	hour	109.20	162.86	160.82	65.37	--
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	189.89
Idle Cropland	acre	7.38	--	--	--	--
Total Negative Deviation	$	69,272	103,669	113,539	139,885	319,286
Standard Deviation	$	13,905	20,810	22,791	28,079	64,901
Coefficient of Variation	%	35.65	38.54	39.98	46.80	90.88

[a]This is the farm plan maximizing expected total gross margin.

At the $57,000 expected total gross margin level, wheat is sold in July and September. Wheat is sold in June at the $45,000 total gross margin level. At and below the $39,000 expected total gross margin level, wheat marketing activities did not enter in any of the farm plans. Cropland is left idle at and below this total gross margin level. At and below the $54,000 expected total gross margin level all farm plans are identical for both multiple marketing and multiple marketing and forward contracting scenarios.

UWMA Expectation

The maximum expected total gross margin of this scenario is $123,064.21 (Table 55). The producer attained a higher risk efficiency frontier than that presented in Table 52. The standard deviation of this plan is $74,532 and a coefficient of variation of 60.56 percent. The production organization consists of 394 March steers, 6.81 acres of alfalfa, 873.19 acres of wheat sold in July, and 320 acres of contracted wheat. Wheat is sold in July at the $108,000 expected total gross margin level and above. At the $93,000 total gross margin level and above, contracted wheat is included in the farm plans. At and below the $84,000 expected total gross margin level, wheat marketing activities are not included in any of the farm plans. Relative variability is slightly less at the $93,000 gross margin level for this scenario compared to the multiple marketing scenario in Table 52. However, at the $84,000 total gross margin level and less all the farm plans are identical and therefore variability is the same.

TABLE 55

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$39,000	$84,000	$93,000	$108,000	$123,064.21[a]
March Steers	head	--	--	44.17	176.60	393.98
May Steers	head	156.05	--	--	--	--
Grazeout Wheat	acre	499.36	--	--	--	--
Alfalfa	acre	--	--	0.76	3.05	6.81
Oats	acre	145.57	440.40	521.80	447.78	--
Cotton	acre	110.35	141.46	--	--	--
Grain Sorghum	acre	390.84	618.14	543.68	214.33	--
July Wheat	acre	--	--	--	214.84	873.19
Contracted Wheat	acre	--	--	133.76	320.00	320.00
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	172.55
Idle Cropland	acre	53.88	--	--	--	--
Total Negative Deviation	$	50,326	124,349	158,118	241,725	371,302
Standard Deviation	$	10,102	24,961	31,739	48,522	74,532
Coefficient of Variation	%	25.90	29.72	34.13	44.93	60.56

[a]This is the farm plan maximizing expected total gross margin.

EWMA Expectation

The maximum expected total gross margin of the risk efficiency frontier for this scenario is $132,097.71 (Table 56). This frontier is slightly higher than that presented in Table 53. The maximum expected total gross margin farm plan included 394 March steers, 6.81 acres of alfalfa, 873.19 acres of wheat sold in October, and 320 acres of contracted wheat. The standard deviation of this plan is $84,234 and the coefficient of variation is 63.77 percent.

Multiple wheat marketing activities do not enter in any of the solutions at and below the $102,000 expected total gross margin level. Contracted wheat does not enter in any of the farm plans at and below the $81,000 expected total gross margin level. Relative variability is very close for the farm plans at the $84,000 and $93,000 expected total gross margin levels for multiple marketing and forward contracting and multiple marketing.

Multiple Marketing and Forward Contracting-Farm Program

This farm program scenario analyzes the multiple marketing of wheat and forward contracting of wheat for harvest sale delivery. All crops, except wheat, are sold at their respective harvest time. The purpose of this scenario is to evaluate the effects of farm programs on farm plans derived for this strategy compared to farm plans for the free market scenario.

TABLE 56

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$30,000	$84,000	$93,000	$102,000	$129,000	$132,097.71[a]
March Steers	head	--	3.93	62.36	105.66	378.21	393.98
May Steers	head	170.69	--	--	--	--	--
Grazeout Wheat	acre	546.19	--	--	--	--	--
Alfalfa	acre	--	0.07	1.08	1.83	6.54	6.81
Oats	acre	98.18	368.92	319.90	375.38	15.08	--
Cotton	acre	115.56	187.24	153.98	43.85	--	--
Grain Sorghum	acre	337.40	631.87	536.19	458.94	32.94	--
July Wheat	acre	--	--	--	--	825.44	--
October Wheat	acre	--	--	--	--	--	873.19
Contracted Wheat	acre	--	11.90	188.85	320.00	320.00	320.00
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	145.65	172.55
Idle Cropland	acre	102.67	--	--	--	--	--
Total Negative Deviation	$	37,387	121,592	153,007	184,746	343,580	419,635
Standard Deviation	$	7,505	24,407	30,713	37,084	68,967	84,234
Coefficient of Variation	%	25.02	29.06	33.02	36.36	53.46	63.77

[a]This is the farm plan maximizing expected total gross margin.

Mean Expectation

Under this scenario, the producer attained a lower risk efficiency frontier than with the same strategy under the free market scenario of Table 54. The reason is that the set aside acres account for the reduced total gross margin. The maximum expected total gross margin attained for this scenario is $68,517.65 with a standard deviation of $46,849 and a coefficient of variation of 68.38 percent (Table 57). This production organization consists of 331 March steers, 80 summer steers utilizing 300 acres of native pasture, 9.26 acres of alfalfa, and 992.28 acres of wheat sold in September. Wheat is sold in September at the $60,000 total gross margin level and greater and in May at the $57,000 expected total gross margin level. Farm programs did result in different production plans compared to the free market plans. Wheat is sold in June, July and September compared to September and May under this scenario. Contracted wheat did not enter in any of the farm plans.

Comparing this scenario at the $57,000 and $60,000 expected total gross margin levels with the free market plans in Table 54, TND, standard deviation and relative variability are considerably lower for the farm program scenario. At the $57,000 total gross margin level and below, cropland is left idle.

UWMA Expectation

The risk efficiency frontier derived for multiple marketing and forward contracting with the producer participating in the government farm programs is considerably lower than that derived for multiple marketing and forward contracting without government farm programs presented in Table 55. The maximum expected total gross margin of this

TABLE 57

SUMMARY OF MOTAD RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING UNDER A FARM PROGRAM STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels			
		$57,000	$60,000	$66,000	$68,517.65[a]
March Steers	head	49.07	30.94	244.91	330.76
Summer Steers	head	82.78	82.93	81.14	80.41
Native Pasture	acre	300.00	300.00	300.00	300.00
Alfalfa	acre	4.58	4.28	7.83	9.26
Cotton	acre	402.45	394.28	210.27	--
Grain Sorghum	acre	543.46	627.31	91.10	--
September Wheat	acre	--	92.83	734.74	992.28
May Wheat	acre	147.21	--	--	--
Hire Labor (April-June)	hour	96.37	124.76	--	--
Hire Labor (Oct.-Dec.)	hour	--	--	--	65.54
Set Aside	acre	83.79	81.30	156.06	198.46
Idle Cropland	acre	18.51	--	--	--
Total Negative Deviation	$	85,734	94,059	173,247	233,393
Standard Deviation	$	17,209	18,881	34,776	46,849
Coefficient of Variation	%	30.19	31.47	52.69	68.38

[a]This is the farm plan maximizing expected total gross margin.

scenario is $105,654.35 with a standard deviation of $54,300 and a coefficient of variation of 51.39 percent (Table 58). The maximum expected total gross margin plan consists of 329 March steers, 5.68 acres of alfalfa, 675.26 acres of wheat sold in July, and 320 acres of contracted wheat.

Expected total gross margin, standard deviation and relative variability are reduced by decreasing the acreage of July wheat and adding some acres of oats, grain sorghum and cotton. It is found that relative variability at the $84,000 and $93,000 expected total gross margin levels in Tables 55 and 58 are about the same.

EWMA Expectation

The risk efficiency frontier derived for this scenario is higher than that reported in Table 58 but lower than that presented in Table 56. The total gross margin maximizing solution is $112,548.33, standard deviation is $60,808 and coefficient of variation is 54.03 percent (Table 59). This plan is almost identical to that in Table 58 except that wheat is sold in October instead of July in the above scenario. By producing 13.02 acres of grain sorghum, 608.47 acres of wheat sold in July, 56.27 acres of wheat sold in October, and 320 acres of contracted wheat, expected total gross margin is reduced by $1,548.33, standard deviation by $10,049, and coefficient of variation by 8.3 percent.

Wheat is sold in October at the $111,000 expected total gross margin level and greater and in July between $96,000 and $111,000 expected total gross margin levels. Wheat is contracted at the $90,000 total gross margin level and greater. Below the $90,000 total gross

TABLE 58

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING UNDER A FARM PROGRAM STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels					
		$78,000	$84,000	$87,000	$93,000	$102,000	$105,654.35[a]
March Steers	head	--	99.86	91.60	108.35	171.92	328.62
Alfalfa	acre	--	1.73	1.58	1.87	2.97	5.68
Oats	acre	360.30	152.08	228.23	364.39	482.84	--
Cotton	acre	197.11	217.38	160.79	--	--	--
Grain Sorghum	acre	579.47	423.54	433.19	399.96	81.26	--
July Wheat	acre	--	208.71	12.42	8.15	200.67	675.26
Contracted Wheat	acre	--	93.71	264.99	320.00	320.00	320.00
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	--	48.55
Set Aside	acre	63.12	102.85	98.80	105.63	112.26	199.06
Idle Cropland	acre	5.18	--	--	--	--	--
Total Negative Deviation	$	104,836	123,503	133,289	156,489	215,521	270,511
Standard Deviation	$	21,042	24,791	26,755	31,412	43,262	54,300
Coefficient of Variation	%	26.98	29.51	30.75	33.78	42.41	51.39

[a]This is the farm plan maximizing expected total gross margin.

TABLE 59

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING UNDER A FARM PROGRAM STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels					
		$78,000	$84,000	$93,000	$108,000	$111,000	$112,548.33[a]
March Steers	head	--	39.58	109.45	281.37	292.75	328.63
Alfalfa	acre	--	0.68	1.89	4.86	3.98	5.68
Oats	acre	344.36	309.61	238.39	47.49	--	--
Cotton	acre	198.04	168.79	117.65	--	--	--
Grain Sorghum	acre	587.42	524.60	403.90	113.69	13.02	--
July Wheat	acre	--	--	11.48	532.16	608.47	--
october Wheat	acre	--	--	--	--	56.27	675.27
Contracted Wheat	acre	--	119.88	320.00	320.00	320.00	320.00
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	--	48.55
Set Aside	acre	58.74	76.44	106.69	181.80	198.26	199.05
Idle Cropland	acre	11.44	--	--	--	--	--
Total Negative Deviation	$	104,578	120,819	147,022	227,795	252,873	302,932
Standard Deviation	$	20,992	24,252	29,512	45,726	50,759	60,808
Coefficient of Variation	%	26.91	28.87	31.73	42.34	45.73	54.03

[a]This is the farm plan maximizing expected total gross margin.

margin level, wheat marketing alternatives do not enter in any of the solutions. Relative variability is slightly lower at the $84,000 and $93,000 expected total gross margin levels for this scenario compared to the multiple marketing and farward contracting strategies using EWMA expectation in Table 56.

Multiple Marketing, Forward Contracting,
Crop-Share, and Cash Rent

The farm cropland resource situation is redefined under this scenario. The farm operator is assumed to own 600 acres of cropland with an option of renting an additional 600 acres on a crop-share or cash rent basis.

Mean Expectation

When multiple marketing, forward contracting, crop-share, and cash rent alternatives are analyzed simultaneously, the risk efficiency frontier determined is lower than the risk efficiency frontiers derived for multiple marketing and forward contracting under the free-market and farm program scenarios. The maximum expected total gross margin solution is $58,401.20, standard deviation is $52,749, and coefficient of variation is 90.32 percent (Table 60). TND and standard deviation are considerably lower than the total gross margin maximizing solution for multiple marketing and forward contracting under the free market scenario. However, relative variability is approximately the same. This production plan consists of 397 March steers, 80 summer steers utilizing 300 acres of native pasture, 10.35 acres of alfalfa, 589.65 acres of wheat sold in September, and 600 acres of crop-share wheat sold in September.

TABLE 60

SUMMARY OF MOTAD RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, AND CASH RENT STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$39,000	$48,000	$51,000	$54,000	$57,000	$58,401.20[a]
March Steers	head	25.12	82.16	156.43	234.56	314.54	396.55
May Steers	head	21.08	--	--	--	--	--
Summer Steers	head	120.00	82.50	81.88	81.22	80.55	79.86
Native Pasture	acre	300.00	300.00	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	67.45	--	--	--	--	--
Alfalfa	acre	10.08	5.13	6.36	7.66	8.99	10.35
Cotton	acre	--	--	76.80	73.57	--	--
Grain Sorghum	acre	522.47	594.87	516.84	415.10	247.38	--
September Wheat	acre	--	--	--	--	--	589.65
December Wheat	acre	--	--	--	--	343.63	--
Contracted Wheat	acre	--	--	--	103.67	--	--
Crop-Share Cotton	acre	321.93	335.11	130.72	--	--	--
Crop-Share Gr. Sorg.	acre	73.79	18.42	--	--	--	--
Crop-Share Wheat-June	acre	67.26	--	--	--	--	--
Crop-Share Wheat-Sept.	acre	--	246.47	222.41	74.43	510.53	600.00
Crop-Share Wheat-Dec.	acre	--	--	246.87	525.57	89.47	--
Crop-Share Wheat-May	acre	8.09	--	--	--	--	--
Hire Labor (April-June)	hour	91.82	91.21	--	--	--	--
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	34.88	189.89
Rentland	acre	471.07	600.00	600.00	600.00	600.00	600.00
Total Negative Deviation	$	76,191	110,685	129,653	164,087	218,313	262,784
Standard Deviation	$	15,294	22,218	26,025	32,937	43,822	52,749
Coefficient of Variation	%	39.22	46.29	51.03	61.00	76.88	90.32

[a]This is the farm plan maximizing expected total gross margin.

When the expected total gross margin level is set at $57,000, the plan is more diversified, including grain sorghum, and wheat sold in September and December. By reducing expected total gross margin by $1,401.20, standard deviation is reduced by $8,927, and coefficient of variation by 13.44 percent. Comparing this plan with the $57,000 total gross margin plan in Table 54, which presents the farm plans for multiple marketing and forward contracting strategies using mean expectation, it is found that TND, standard deviation and relative variability are almost doubled for this scenario. When expected total gross margin is further reduced, standard deviation and coefficient of variation are also reduced.

Wheat is forward contracted only in the farm plan at the $54,000 expected total gross margin level. Crop-share wheat is included in all the farm plans and is sold in June, September, December, and May. The amount of cropland rented began to decline at the $39,000 expected total gross margin level. Cropland is rented only on a crop-share basis.

UWMA Expectation

The expected total gross margin maximizing farm plan consists of 394 March steers, 6.81 acres of alfalfa, 273.19 acres of wheat sold in July, 320 acres of contracted wheat, and 600 acres of cash rent wheat sold in July (Table 61). Expected total gross margin of this plan is $110,764.21, standard deviation is $74,570, and coefficient of variation is 67.32 percent. The producer attained a lower risk efficiency frontier for this scenario compared to that derived for the multiple marketing and forward contracting scenario presented in Table 55. The reason is that under the cash rent alternatives rent is paid by the producer. This increases the cost of production of the crop which is grown on cash

TABLE 61

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, AND CASH RENT STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$42,000	$75,000	$84,000	$93,000	$105,000	$110,764.21[a]
March Steers	head	--	136.35	127.64	157.53	279.10	393.98
May Steers	head	81.30	--	--	--	--	--
Grazeout Wheat	acre	260.16	--	--	--	--	--
Alfalfa	acre	--	2.36	2.21	2.72	4.82	6.81
Oats	acre	--	173.25	--	--	--	--
Grain Sorghum	acre	339.84	400.19	287.84	277.28	--	--
July Wheat	acre	--	--	--	--	275.18	273.19
Contracted Wheat	acre	--	24.20	309.95	320.00	320.00	320.00
Crop-Share Oats	acre	300.66	--	--	--	--	--
Crop-Share Cotton	acre	150.26	211.26	157.19	--	--	--
Crop-Share Gr. Sorg.	acre	74.38	--	--	--	--	--
Crop-Share Wheat-July	acre	--	388.74	76.61	--	--	--
Cash Rent Oats	acre	--	--	247.02	412.20	349.91	--
Cash Rent Gr. Sorg.	acre	--	--	119.18	30.72	--	--
Cash Rent Wheat-July	acre	--	--	--	157.08	250.09	600.00
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	19.97	172.55
Rentland	acre	525.30	600.00	600.00	600.00	600.00	600.00
Total Negative Deivation	$	59,086	129,454	167,766	222,216	310,055	371,494
Standard Deviation	$	11,860	25,985	33,676	44,606	62,238	74,570
Coefficient of Variation	%	28.24	34.65	40.09	47.96	59.27	67.32

[a]This is the farm plan maximizing expected total gross margin.

rent cropland, thus reducing actual gross margin for that crop. The cost of production of crops grown on the producer's own land is lower than the cost of production of crops grown on cash rent land. The difference is the rent that is paid.

Contracted wheat is included in farm plans at the $75,000 expected total gross margin level and above. Wheat produced on owned land and sold in July is included in farm plans at the $105,000 total gross margin level and above. Crop-share wheat sold in July is included in farm plans between $69,000 and $90,000 total gross margin levels. Cash rent wheat sold in July is included in production plans at the $90,000 expected total gross margin level and above.

When expected total gross margin at the $84,000 and $93,000 levels in Tables 55 and 61 are compared, relative variability is found to be considerably higher for this scenario. These plans include both crop-share and cash rent alternatives. Crop-share alternatives involve the sharing of some of the production costs and the crops produced. The advantage of this alternative to the producer is that some of the risk is borne by the landlord in "bad" years. In "good" years, the disadvantage is to the producer because he has to share the benefits of high yields. Cash rent alternatives do not offer the advantage of sharing risk with the landlord. The producer bears all the risk in "bad" years and does not have to share the benefits of high yields and/or high prices with the landlord. The producer's obligation is to pay the cash rent whether he harvests a crop or not. Thus, the reason for the high variability is due to the cash rent alternatives in these farm plans.

EWMA Expectation

The production organization maximizing expected total gross margin consists of 394 March steers, 6.81 acres of alfalfa, 273.19 acres of wheat sold in October, 320 acres of forward contracted wheat, and 600 acres of cash rent wheat sold in October (Table 62). The expected total gross margin, standard deviation, and coefficient of variation are $119,623.71, $84,219, and 70.40 percent, respectively. The producer attained a lower risk efficiency frontier for this scenario compared to that of Table 56, in which farm plans for multiple marketing and forward contracting using an EWMA model are presented.

At the $117,000 expected total gross margin level, by including March steers, alfalfa, grain sorghum, wheat sold in July, contracted wheat, cash rent oats, and cash rent wheat sold in July, the standard deviation is $69,423, and coefficient of variation is 59.34 percent. When expected total gross margin is set at $99,000, contracted wheat and cash rent wheat sold in July were included in the plan. The standard deviation of this plan is $46,770, and coefficient of variation is 47.24 percent. Contracted wheat is in the farm plans at the $87,000 total gross margin level and greater. Crop-share wheat sold in July is included in the farm plans between $72,000 and $87,000, expected total gross margin levels.

When expected total gross margin at the $84,000 and $93,000 levels in Tables 56 and 62 are compared, it is found that relative variability is considerably higher for this scenario. The reason is the cash rent alternatives which increase rather than decrease variability.

TABLE 62

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT DRYLAND FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, AND CASH RENT STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$66,000	$72,000	$84,000	$93,000	$117,000	$119,623.71[a]
March Steers	head	--	53.84	138.07	128.06	382.13	393.98
Alfalfa	acre	--	0.93	2.39	2.20	6.61	6.81
Oats	acre	68.08	77.77	--	--	--	--
Grain Sorghum	acre	531.92	521.30	372.54	277.79	25.68	--
July Wheat	acre	--	--	--	--	247.71	--
October Wheat	acre	--	--	--	--	--	273.19
Contracted Wheat	acre	--	--	225.07	320.00	320.00	320.00
Crop-Share Oats	acre	369.89	--	--	--	--	--
Crop-Share Cotton	acre	215.84	252.78	198.80	--	--	--
Crop-Share Wheat-July	acre	--	163.06	193.10	--	--	--
Cash Rent Oats	acre	--	184.16	188.58	390.17	10.42	--
Cash Rent Grain Sorghum	acre	--	--	19.52	141.99	--	--
Cash Rent Wheat-July	acre	--	--	--	67.85	589.58	--
Cash Rent Wheat-October	acre	--	--	--	--	--	600.00
Hire Labor (Oct.-Dec.)	hour	--	--	--	--	152.15	172.55
Rentland	acre	585.73	600.00	600.00	600.00	600.00	600.00
Total Negative Deviation	$	98,371	117,531	160,012	199,407	345,850	419,563
Standard Deviation	$	19,746	23,592	32,119	40,027	69,423	84,219
Coefficient of Variation	%	29.92	32.77	38.24	43.04	59.34	70.40

[a]This is the farm plan maximizing expected total gross margin.

Irrigated Risk Efficient Farm Plans

The irrigated farm situation consists of 1120 acres of cropland, 320 of which are irrigated, and all is owned by the farm operator. The livestock enterprises analyzed are March and May heifers and March and May steers. Summer steers are not considered because this farm situation does not include native pasture. The crops analyzed are alfalfa, barley, oats, wheat, cotton (dryland and irrigated), and grain sorghum (dryland and irrigated). Farm program scenarios are not analyzed because normal farm yield data for irrigated crops are not available.

The farm resource situation is redefined under the scenarios that included crop-share and cash rent alternatives. The farmer is assumed to own 560 acres of cropland (instead of 1120 acres) with 160 acres of owned irrigated cropland (instead of 320 acres). An additional maximum 560 acres of cropland, 160 of which may be irrigated, can be rented on either a crop-share and/or cash rent basis.

Harvest Sale

Mean Expectation

The maximum expected total gross margin of the harvest sale irrigated scenario is $72,747.60 (Table 63). This plan is very specialized producing only grain sorghum (dryland and irrigated). The total negative gross margin deviation of this plan is $218,868, standard deviation is $43,934, and the coefficient of variation is 60.39 percent. When the total gross margin constraint is reduced to $72,000, the plan became more diversified and consists of 101 March steers, 1.75 acres of alfalfa, 4.38 acres of dryland cotton, 486.96 acres of dryland grain sorghum,

TABLE 63

SUMMARY OF MOTAD RISK EFFICIENT IRRIGATED FARM PLANS FOR HARVEST SALE STRATEGY

		Expected Total Gross Margin Levels				
Enterprise	Unit	$60,000	$63,000	$69,000	$72,000	$72,747.60[a]
March Steers	head	--	--	59.09	101.34	--
Alfalfa	acre	--	--	1.02	1.75	--
Dryland Cotton	acre	374.56	400.40	191.02	4.38	--
Dryland Gr. Sorg.	acre	307.63	345.50	429.02	486.96	800.00
Irrigated Gr. Sorg.	acre	276.54	280.00	280.00	280.00	280.00
June Wheat	acre	--	--	178.94	306.91	--
Hire Labor (April-June)	hour	162.71	212.65	96.46	--	86.80
Hire Labor (July-Sept.)	hour	31.02	54.33	32.12	3.01	--
Idle Dryland	acre	117.81	54.10	--	--	--
Idle Irrigated Land	acre	3.46	--	--	--	--
Total Negative Deviation	$	117,548	124,053	161,496	199,868	218,868
Standard Deviation	$	23,596	24,901	32,417	40,120	43,934
Coefficient of Variation	%	39.33	39.53	46.98	55.72	60.39

[a]This is the farm plan maximizing expected total gross margin.

280 acres of irrigated grain sorghum, and 306.91 acres of wheat sold in June. The TND of this plan is $199,868, standard deviation is $40,120, and coefficient of variation is 55.72 percent. The farm plans consist of dryland cotton and dryland and irrigated grain sorghum at the $63,000 expected total gross margin level and less. Irrigated cotton did not enter any of the farm plans. Irrigated land remains idle at and below the $60,000 expected total gross margin level.

Although the irrigated and dryland farms are not exactly the same size, the maximum expected income for the dryland harvest sale solution (Table 45) is $62,386.02. The standard deviation of that farm plan is $38,319 and relative variability is 61.42 percent. Standard deviation is higher for the maximum expected total gross margin farm plan of the irrigated scenario but relative variability is lower compared to the dryland maximum expected total gross margin farm plan.

UWMA Expectation

Under the unequally weighted moving average harvest sale scenario, the farm plan maximizing expected total gross margin consists of 263 March steers, 4.54 acres of alfalfa, 280 acres of irrigated grain sorghum, and 795.46 acres of June wheat (Table 64). Expected total gross margin of this plan is $110,865.25, standard deviation is $56,851, and coefficient of variation is 51.28 percent.

The production organization changes when the total gross margin constraint is set at $105,000. The plan consists of 36 March steers, 0.62 acre of alfalfa, 615.15 acres of oats, 75.06 acres of dryland grain sorghum, 280 acres of irrigated grain sorghum, and 109.17 acres of June wheat. The standard deviation is $32,856 and the coefficient of variation

TABLE 64

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR HARVEST SALE STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels					
		$48,000	$87,000	$96,000	$102,000	$105,000	$110,865.25[a]
March Steers	head	--	--	--	--	36.05	262.65
May Steers	head	163.19	44.93	10.15	--	--	--
Grazeout Wheat	acre	522.20	143.76	32.46	--	--	--
Alfalfa	acre	--	--	--	--	0.62	4.54
Oats	acre	201.50	434.79	488.68	628.42	615.15	--
Dryland Cotton	acre	76.87	153.03	167.81	54.42	--	--
Dryland Gr. Sorg.	acre	11.72	68.42	111.05	117.16	75.06	--
Irrigated Cotton	acre	23.42	1.76	--	--	--	--
Irrigated Gr. Sorg.	acre	197.17	278.24	280.00	280.00	280.00	280.00
June Wheat	acre	--	--	--	--	109.17	795.46
Hire Labor (Jan.-Mar.)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	17.93	15.40	--	--	12.23
Idle Dryland	acre	47.12	--	--	--	--	--
Total Negative Deviation	$	59,569	116,562	131,813	148,293	163,683	283,218
Standard Deviation	$	11,957	23,398	26,459	29,767	32,856	56,851
Coefficient of Variation	%	24.91	26.89	27.56	29.18	31.29	51.28

[a]This is the farm plan maximizing expected total gross margin.

is 31.29 percent. This, and the other farm plans, illustrate that risk can be reduced through diversification. Relative variability is reduced by 20 percent while gross margins are reduced by about 5 percent.

EWMA Expectation

Comparing this scenario using the UWMA and the EWMA expectations, the producer attained a slightly higher risk efficient frontier. However, the total gross margin maximizing farm plans are identical. The maximum expected total gross margin of this plan is $118,791.10, standard deviation is $56,421 and coefficient of variation is 47.50 percent (Table 65).

At and above the $105,000 total gross margin level, wheat is included in all the solutions. Below this total gross margin level, farm plans consist of oats, dryland cotton, and grain sorghum (dryland and irrigated). When farm plans at the $96,000, $102,000, and $105,000 expected total gross margin levels in Tables 64 and 65, relative variability is slightly less for these farm plans using the EWMA expectation.

Harvest Sale and Wheat Hail Insurance

In addition to sale at harvest, this scenario included a wheat activity that is insured against hail damage. The purpose of this part of the analysis is to evaluate private crop insurance as a stabilizing risk management alternative for farm operators. Details concerning the level of coverage and premium are provided in earlier sections.

Mean Expectation

The total gross margin maximizing farm plan is identical to the total gross margin maximizing farm plan derived under the harvest sale

TABLE 65

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR HARVEST SALE STRATEGY

Enterprise	Unit	Expected Total Gross Margin Levels					
		$33,000	$96,000	$102,000	$105,000	$108,000	$118,791.10[a]
March Steers	head	--	--	--	5.84	50.93	262.65
May Steers	head	186.42	15.14		--	--	--
Grazeout Wheat	acre	596.53	48.46	--	--	--	--
Alfalfa	acre	--	--	--	0.10	0.88	4.54
Oats	acre	126.08	459.00	553.61	649.14	409.24	--
Dryland Cotton	acre	98.00	168.42	105.47	6.78	--	--
Dryland Gr. Sorg.	acre	40.00	124.12	140.92	126.28	235.64	--
Irrigated Gr. Sorg.	acre	149.02	280.00	280.00	280.00	280.00	280.00
June Wheat	acre	--	--	--	17.70	154.24	795.46
Hire Labor (Jan.-Mar.)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	16.42	2.86	--	--	12.23
Idle Dryland	acre	70.37	--	--	--	--	--
Total Negative Deviation	$	39,307	128,087	141,348	153,031	172,883	281,080
Standard Deviation	$	7,890	25,711	28,373	30,718	34,703	56,421
Coefficient of Variation	%	23.91	26.78	27.82	29.26	32.13	47.50

[a]This is the farm plan maximizing expected total gross margin.

strategy using the mean expectation model. Crop insurance is not utilized. When expected total gross margin is set at $69,000, the insured wheat activity is included in the farm plan at 243.14 acres (Table 66). At the $69,000 total gross margin level, relative variability is lower when crop insurance is purchased than when wheat is not insured and is sold at harvest. The standard deviation and coefficient of variation of the harvest sale strategy are $32,417 and 46.98 percent (Table 63) compared to $30,968 and 44.88 percent for this strategy (Table 66). While reducing relative variability, wheat hail insurance did not increase the maximum expected income and, thus, does not move the producer to a higher risk efficiency frontier.

UWMA Expectation

The maximum expected total gross margin farm plan derived for this strategy is identical to the maximum expected total gross margin farm plan determined for the harvest sale strategy using the UWMA expectation model (Table 64). Above the $102,000 total gross margin level, non-insured wheat is included in all farm plans. At the $87,000 gross margin level and less, insured wheat is included in all farm plans (Table 67). At this gross margin level, relative variability is slightly lower for the crop insurance alternative (26.89 versus 26.87). The farm plans are identical at the $96,000 and $102,000 expected total gross margin levels in Tables 64 and 67 and therefore, relative variability is the same. It appears that the inclusion of crop hail insurance will reduce relative variability in the UWMA expectation model as it did in the mean expectation model.

TABLE 66

SUMMARY OF MOTAD RISK EFFICIENT IRRIGATED FARM PLANS FOR HARVEST SALE AND WHEAT HAIL INSURANCE STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels			
		$54,000	$63,000	$69,000	$72,747.60[a]
March Heifers	head	--	77.05	--	--
March Steers	head	64.23	18.00	80.28	--
May Steers	head	0.31	0.73	--	--
Grazeout Wheat	acre	0.98	2.34	--	--
Alfalfa	acre	1.13	1.63	1.39	--
Dryland Cotton	acre	352.84	398.45	154.18	--
Dryland Gr. Sorg.	acre	33.36	117.21	401.29	800.00
Irrigated Gr. Sorg.	acre	270.46	280.00	280.00	280.00
Insurance Wheat-June	acre	192.69	258.19	243.14	--
Hire Labor (April-June)	hour	20.23	135.78	58.83	86.80
Hire Labor (July-Sept.)	hour	--	65.07	27.17	--
Idle Dryland	acre	219.00	22.18	--	--
Idle Irrigated Land	acre	9.54	--	--	--
Total Negative Deviation	$	98,354	116,382	154,274	218,868
Standard Deviation	$	19,743	23,361	30,968	43,934
Coefficient of Variation	%	36.56	37.08	44.88	60.39

[a]This is the farm plan maximization expected total gross margin.

TABLE 67

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR HARVEST SALE AND WHEAT HAIL INSURANCE STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$33,000	$78,000	$87,000	$96,000	$102,000	$110,865.25[a]
March Steers	head	34.74	23.50	3.29	--	--	262.65
May Steers	head	148.51	79.53	45.06	10.15	--	--
Grazeout Wheat	acre	475.24	254.48	144.19	32.46	--	--
Alfalfa	acre	0.61	0.41	0.06	--	--	4.54
Oats	acre	42.94	330.34	427.98	488.68	628.42	--
Dryland Cotton	acre	103.02	146.65	155.47	167.81	54.42	--
Dryland Gr. Sorg.	acre	302.77	--	62.43	111.05	117.16	--
Irrigated Cotton	acre	--	--	--	--	--	--
Irr. Gr. Sorg.	acre	--	277.61	280.00	280.00	280.00	280.00
June Wheat	acre	--	--	--	--	--	795.46
Insurance Wheat-June	acre	104.23	70.51	9.87	--	--	--
Hire Labor (Jan.-March)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	16.14	16.96	15.40	--	12.23
Idle Dryland	acre	51.59	--	--	--	--	--
Total Negative Deviation	$	39,857	102,107	116,461	131,813	148,293	283,218
Standard Deviation	$	8,001	20,496	23,377	26,459	29,767	56,851
Coefficient of Variation	%	24.24	26.28	26.87	27.56	29.18	51.28

[a]This is the farm plan maximizing expected total gross margin.

EWMA Expectation

The farm plans derived at any expected total gross margin level for this scenario are identical to the farm plans derived under the EWMA harvest sale scenario. Insured wheat entered solutions at the $105,000 and $66,000 total gross margin levels and less (Table 68). Where insured wheat is not included in any of the farm plans, the solutions are identical to those of the harvest sale scenario. Wheat insurance reduced risk or relative variability at the $105,000 gross margin farm plan in Table 68 compared to the harvest sale plan in Table 65.

Multiple Marketing

This scenario analyzed wheat sold at multiple periods during the June to May period, in addition to harvest sale. The other crops are sold at their respective harvest time.

Mean Expectation

Maximum expected total gross margin is much higher under multiple marketing than under the harvest sale and the harvest sale and wheat insurance scenarios. Thus, multiple marketings permit the producer to move to a higher risk efficiency frontier. Relative variability is also higher for the plan which maximizes gross margins. The maximum expected total gross margin is $78,426.22, standard deviation is $56,778, and coefficient of variation is 72.40 percent (Table 69). The maximum expected total gross margin plan consists of 263 March steers, 4.54 acres of alfalfa, 280 acres of irrigated grain sorghum, and 795.46 acres of wheat sold in September. When the total gross margin level is set at

TABLE 68

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR HARVEST SALE AND WHEAT HAIL INSURANCE STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$30,000	$96,000	$102,000	$105,000	$108,000	$118,791.10[a]
March Steers	head	21.38	--	--	7.27	50.93	262.65
May Steers	head	182.98	15.14	--	--	--	--
Grazeout Wheat	acre	585.53	48.46	--	--	--	--
Alfalfa	acre	0.38	--	--	0.13	0.88	4.54
Oats	acre	70.23	459.00	553.61	652.42	409.24	--
Dryland Cotton	acre	95.11	168.42	105.57	1.50	--	--
Dryland Gr. Sorg.	acre	56.94	124.12	140.92	123.92	235.64	--
Irrigated Gr. Sorg.	acre	116.23	280.00	280.00	280.00	280.00	280.00
June Wheat	acre	--	--	--	--	154.24	795.46
Insurance Wheat-June	acre	64.15	--	--	22.03	--	--
Hire Labor (Jan.-Mar.)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	16.42	2.86	--	--	12.23
Idle Dryland	acre	91.43	--	--	--	--	--
Total Negative Deviation	$	35,344	128,087	141,348	152,765	172,883	281,080
Standard Deviation	$	7,095	25,711	28,373	30,665	34,703	56,421
Coefficient of Variation	%	23.65	26.78	27.82	29.21	32.13	47.50

[a]This is the farm plan maximizing expected total gross margin.

TABLE 69

SUMMARY OF MOTAD RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels $45,000	$63,000	$69,000	$75,000	$78,426.22[a]
March Steers	head	29.14	18.24	74.57	165.33	262.65
May Steers	head	0.14	0.09	--	--	--
Grazeout Wheat	acre	0.45	0.28	--	--	--
Alfalfa	acre	0.51	0.32	1.29	2.86	4.54
Barley	acre	8.04	--	--	--	--
Dryland Cotton	acre	294.35	429.11	311.28	92.71	--
Dryland Gr. Sorg.	acre	--	282.61	261.59	203.73	--
Irrigated Gr. Sorg.	acre	268.58	280.00	280.00	280.00	280.00
September Wheat	acre	--	--	--	500.71	795.46
December Wheat	acre	--	--	225.84	--	--
May Wheat	acre	87.40	54.73	--	--	--
Hire Labor (Jan.-March)	hour	--	--	--	1.43	65.67
Hire Labor (April-June)	hour	--	215.82	126.37	21.98	--
Hire Labor (July-Sept.)	hour	--	64.14	53.53	--	12.23
Idle Dryland	acre	409.25	32.95	--	--	--
Idle Irrigated Land	acre	11.42	--	--	--	--
Total Negative Deviation	$	85,914	123,946	155,842	218,583	282,857
Standard Deviation	$	17,246	24,880	31,282	43,876	56,778
Coefficient of Variation	%	38.32	39.49	45.34	58.50	72.40

[a]This is the farm plan maximizing expected total gross margin.

$69,000 wheat is sold in December. Comparing this plan with production plans at the $69,000 total gross margin level in Tables 63 and 66, reveals that the plans are quite different for the same total gross margin level. Relative variability for these farm plans at the $69,000 total gross margin level is very close but considerably lower than the multiple marketing dryland scenario. Wheat is sold in May at the $63,000 total gross margin level and less. Irrigated land remains idle at the $45,000 expected total gross margin level and less.

UWMA Expectation

The maximum expected total gross margin for this scenario using the UWMA expectation is $119,551.67 with a standard deviation of $61,861 and a coefficient of variation of 51.75 percent (Table 70). The maximum expected total gross margin farm plan consists of 263 March steers, 4.54 acres of alfalfa, 280 acres of irrigated grain sorghum, and 795.46 acres of wheat sold in July. Wheat is sold in July in all farm plans at and above the $108,000 expected total gross margin level. Below this total gross margin level, multiple marketing of wheat did not enter any of the solutions. Standard deviation and relative variability are reduced significantly at the $102,000 expected total gross margin level when compared to the farm plan at the $108,000 gross margin level. Farm plans are identical at the $102,000 expected total gross margin level and less for the harvest sale, harvest sale and wheat hail insurance, and multiple marketing scenarios using the UWMA expectation model.

TABLE 70

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$48,000	$87,000	$96,000	$102,000	$108,000	$119,551.67[a]
March Steers	head	--	--	--	--	55.76	262.65
May Steers	head	163.19	44.93	10.15	--	--	--
Grazeout Wheat	acre	522.20	143.76	32.46	--	--	--
Alfalfa	acre	--	--	--	--	0.96	4.54
Oats	acre	201.50	434.79	488.68	628.42	596.68	--
Dryland Cotton	acre	76.87	153.03	167.81	54.42	--	--
Dryland Gr. Sorg.	acre	11.72	68.42	111.05	117.16	33.50	--
Irrigated Cotton	acre	23.42	1.76	--	--	--	--
Irrigated Gr. Sorg.	acre	197.17	278.24	280.00	280.00	280.00	280.00
July Wheat	acre	--	--	--	--	168.86	795.46
Hire Labor (Jan.-Mar.)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	17.93	15.40	--	--	12.23
Idle Dryland	hour	47.12	--	--	--	--	--
Total Negative Deviation	$	59,569	116,562	131,813	148,293	175,285	308,180
Standard Deviation	$	11,957	23,398	26,459	29,767	35,185	61,861
Coefficient of Variation	%	24.91	26.89	27.56	29.18	32.58	51.75

[a]This is the farm plan maximizing expected total gross margin.

EWMA Expectation

The maximum expected total gross margin is $132,374.14 with a standard deviation of $73,245 and a coefficient of variation of 55.37 percent (Table 71). The producer attained a higher risk efficiency frontier compared to the UWMA frontier presented in Table 70. The total gross margin maximizing farm plan is identical to that which is derived using the UWMA expectation, except wheat is sold in October instead of July. Wheat is sold in July at the $129,000 expected total gross margin level and less.

Multiple Marketing and Forward Contracting

This scenario analyzed wheat sold periodically during the period June to May, in addition to the forward contracting of wheat for June delivery. The other crops are sold at their respective harvest time.

Mean Expectation

The solutions of this scenario (Table 72) are identical to those of multiple marketing presented in Table 69, except at the $75,000 expected total gross margin level. When the expected total gross margin is set at $75,000, 160.9 acres of wheat are sold in December and 291.33 acres of wheat are contracted for June delivery (Table 72). This is the only farm plan in which the forward contracting of wheat entered the solution. The farm plan at the $75,000 total gross margin level in Table 69, wheat is sold in September. At this total gross margin level, relative variability is slightly lower under multiple marketing and forward contracting alternatives than for multiple marketing without contracting.

TABLE 71

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$33,000	$96,000	$102,000	$111,000	$129,000	$132,274.14[a]
March Steers	head	--	--	--	63.53	244.73	262.65
May Steers	head	186.42	15.14	--	--	--	--
Grazeout Wheat	acre	596.53	48.46	--	--	--	--
Alfalfa	acre	--	--	--	1.09	4.23	4.54
Oats	acre	126.08	459.00	553.61	571.95	54.59	--
Dryland Cotton	acre	98.00	168.42	105.47	--	--	--
Dryland Gr. Sorg.	acre	40.00	124.12	140.92	34.53	--	--
Irrigated Gr. Sorg.	acre	149.02	--	280.00	280.00	280.00	280.00
July Wheat	acre	--	--	--	192.43	741.18	--
October Wheat	acre	--	--	--	--	--	795.46
Hire Labor (Jan.-March)	hour	--	--	--	--	45.21	65.67
Hire Labor (July-Sept.)	hour	--	16.42	--	--	10.03	12.23
Idle Dryland	acre	70.37	--	--	--	--	--
Total Negative Deviation	$	39,307	128,087	141,348	179,226	291,868	364,889
Standard Deviation	$	7,890	25,711	28,373	35,976	58,587	73,245
Coefficient of Variation	%	23.91	26.78	27.82	32.41	45.42	55.37

[a]This is the farm plan maximizing expected total gross margin.

TABLE 72

SUMMARY OF MOTAD RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$45,000	$63,000	$69,000	$75,000	$78,426.22[a]
March Steers	head	29.14	18.24	74.57	149.32	262.65
May Steers	head	0.14	0.09	--	--	--
Grazeout Wheat	acre	0.45	0.28	--	--	--
Alfalfa	acre	0.51	0.32	1.29	2.58	4.54
Barley	acre	8.04	--	--	--	--
Dryland Cotton	acre	294.35	429.11	311.28	38.54	--
Dryland Gr. Sorg.	acre	--	282.61	261.59	306.65	--
Irrigated Gr. Sorg.	acre	280.00	280.00	280.00	280.00	280.00
September Wheat	acre	--	--	--	--	795.46
December Wheat	acre	--	--	225.84	160.90	--
May Wheat	acre	87.40	54.73	--	--	--
Contracted Wheat	acre	--	--	--	291.33	--
Hire Labor (Jan.-March)	hour	--	--	--	--	65.67
Hire Labor (April-June)	hour	--	215.82	126.37	--	--
Hire Labor (July-Sept.)	hour	--	64.14	53.53	11.78	12.23
Idle Dryland	acre	409.25	32.95	--	--	--
Idle Irrigated Land	acre	11.42	--	--	--	--
Total Negative Deviation	$	85,914	123,946	155,842	212,141	282,857
Standard Deviation	$	17,246	24,880	31,282	42,583	56,778
Coefficient of Variation	%	38.32	39.49	45.34	56.78	72.40

[a]This is the farm plan maximizing expected total gross margin.

UWMA Expectation

The risk efficiency frontier attained by the producer for this scenario is slightly higher than the multiple marketing scenario presented in Table 70. The maximum expected total gross margin is $122,914.87, standard deviation is $64,441 and coefficient of variation is 51.62 percent (Table 73). This production organization includes 263 March steers, 4.54 acres of alfalfa, 280 acres of irrigated grain sorghum, 475.46 acres of wheat sold in July, and 320 acres of contracted wheat for June delivery. Wheat is sold in July at the $120,000 total gross margin level and above. Wheat is contracted at the $111,000 expected total gross margin level and above. Farm plans at the $102,000 total gross margin level and less are identical for both multiple marketing and multiple marketing and forward contracting using the UWMA expectation.

EWMA Expectation

The risk efficiency frontier attained for this scenario is slightly higher than the multiple marketing frontier reported in Table 71. The maximum expected total gross margin is $136,133.34, standard deviation is $69,833 and coefficient of variation is 51.30 percent (Table 74). The total gross margin maximizing farm plan for this scenario is identical to that of the multiple marketing scenario except that 475.46 acres of wheat are sold in October and 320 acres of wheat are forward contracted for June delivery. Wheat is contracted in farm plans at and above the $111,000 gross margin level. Relative variability is very close at the $102,000 total gross margin level for farm plans in Tables 71 and 74. Below this expected total gross margin level, farm plans are identical.

TABLE 73

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$48,000	$96,000	$102,000	$111,000	$120,000	$122,914.87[a]
March Steers	head	--	--	--	69.13	204.70	262.65
May Steers	head	163.19	10.14	--	--	--	--
Grazeout Wheat	acre	522.20	32.46	--	--	--	--
Alfalfa	acre	--	--	--	1.20	3.54	4.54
Oats	acre	201.50	488.68	628.42	566.47	176.50	--
Dryland Cotton	acre	76.87	167.81	54.42	11.71	--	--
Dryland Gr. Sorg.	acre	11.72	111.05	117.16	11.25	--	--
Irrigated Cotton	acre	23.42	--	--	--	--	--
Irrigated Gr. Sorg.	acre	197.17	280.00	280.00	280.00	280.00	280.00
July Wheat	acre	--	--	--	--	299.96	475.46
Contracted Wheat	acre	--	--	--	209.37	320.00	320.00
Hire Labor (Jan-March)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	15.40	--	--	5.12	12.23
Idle Dryland	acre	47.12	--	--	--	--	--
Total Negative Deviation	$	59,569	131,813	148,293	182,906	273,992	316,052
Standard Deviation	$	11,957	26,459	29,767	36,715	54,999	63,441
Coefficient of Variation	%	24.91	27.56	29.18	33.08	45.83	51.62

[a]This is the farm plan maximizing expected total gross margin.

TABLE 74

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING AND FORWARD CONTRACTING STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels						
		$33,000	$96,000	$102,000	$114,000	$117,000	$135,000	$136,133.34[a]
March Steers	head	--	--	12.29	65.82	87.34	260.43	262.65
May Steers	head	186.42	15.14	--	--	--	--	--
Grazeout Wheat	acre	596.53	48.46	--	--	--	--	--
Alfalfa	acre	--	--	0.21	1.14	1.51	4.50	4.54
Oats	acre	126.08	459.00	470.18	571.44	533.97	6.77	--
Dryland Cotton	acre	98.00	168.42	166.54	--	--	--	--
Dryland Gr. Sorg.	acre	40.00	124.12	125.84	28.09	--	--	--
Irrigated Gr. Sorg.	acre	149.02	280.00	280.00	280.00	280.00	280.00	280.00
July Wheat	acre	--	--	--	--	--	468.73	--
October Wheat	acre	--	--	--	--	--	--	475.46
Contracted Wheat	acre	--	--	37.23	199.33	264.52	320.00	320.00
Hire Labor (Jan.-Mar.)	hour	--	--	--	--	--	63.13	65.67
Hire Labor (July-Sept.)	hour	--	16.42	15.67	--	--	11.95	12.23
Idle Dryland	acre	70.37	--	--	--	--	--	--
Total Negative Deviation	$	39,307	128,087	141,224	184,877	196,810	309,627	347,894
Standard Deviation	$	7,890	25,711	28,348	37,111	39,506	62,152	69,833
Coefficient of Variation	%	23.91	26.78	27.79	32.55	33.77	46.04	51.30

[a]This is the farm plan maximizing expected total gross margin.

Multiple Marketing, Forward Contracting, Crop-Share and Cash Rent

The farm resource situation is redefined under this scenario. The farm operator owned 560 acres of cropland instead of 1120 acres, with 160 acres irrigated instead of 320 acres. The model is given the option of renting an additional 560 acres of cropland, including 160 irrigated acres on either a crop-share and/or cash basis.

Mean Expectation

The total gross margin maximizing solution is $67,441.42, a standard deviation of $49,584, and coefficient of variation of 73.52 percent (Table 75). This production organization consists of 263 March steers, 4.54 acres of alfalfa, 140 acres of irrigated grain sorghum, 395.46 acres of wheat sold in September (produced on owned land), 400 acres of crop-shared wheat sold in September, 140 acres of irrigated grain sorghum (produced on cash rented land). Crop-share wheat is also sold in December and May. Irrigated cropland is rented on a cash basis and used for irrigated grain sorghum. Multiple marketing of wheat (produced on owned land) is not included in any of the farm plans at and below the $63,000 total gross margin level. Contracted wheat is included only in the farm plan at the $63,000 total gross margin level at 56.14 acres.

UWMA Expectation

The maximum expected total gross margin solution is $111,846.27, standard deviation is $63,498, and coefficient of variation is 56.77 percent (Table 76). This plan included 75.46 acres of wheat (produced on owned land) sold in July, 320 acres of contracted wheat, and 400

TABLE 75

SUMMARY OF MOTAD RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, AND CASH RENT STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$54,000	$57,000	$60,000	$63,000	$67,441.42[a]
March Steers	head	40.34	133.33	132.08	150.61	262.65
May Steers	head	0.19	0.64	--	--	--
Grazeout Wheat	acre	0.62	2.04	--	--	--
Alfalfa	acre	0.71	2.35	2.28	2.60	4.54
Dryland Cotton	acre	198.05	296.23	278.00	129.01	--
Dryland Grain Sorghum	acre	200.62	99.38	119.71	212.25	--
Irrigated Grain Sorghum	acre	140.00	140.00	140.00	140.00	140.00
September Wheat	acre	--	--	--	--	395.46
Contracted Wheat	acre	--	--	--	56.14	--
Crop-Share Dryland Cotton	acre	271.78	--	--	--	--
Crop-Share Wheat-Sept.	acre	--	--	--	400.00	400.00
Crop-Share Wheat Dec.	acre	--	174.87	400.00	--	--
Crop-Share Wheat-May	acre	121.03	225.13	--	--	--
Cash Rent Irr. Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00
Hire Labor (Jan.-March)	hour	--	--	--	--	65.67
Hire Labor (April-June)	hour	222.04	57.04	50.28	--	--
Hire Labor (July-Sept.)	hour	77.06	54.56	51.42	27.24	12.23
Rent Dryland	acre	392.81	400.00	400.00	400.00	400.00
Rent Irrigated Land	acre	140.00	140.00	140.00	140.00	140.00
Total Negative Deviation	$	114,485	128,349	144,429	172,636	247,018
Standard Deviation	$	22,981	25,764	28,991	34,653	49,584
Coefficient of Variation	%	42.56	45.20	48.32	55.01	73.52

[a]This is the farm plan maximizing expected total gross margin.

TABLE 76

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, AND CASH RENT STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$72,000	$90,000	$96,000	$102,000	$111,846.27[a]
March Steers	head	--	70.43	74.41	87.09	262.65
May Steers	head	37.11	--	--	--	--
Grazeout Wheat	acre	120.68	--	--	--	--
Alfalfa	acre	--	1.22	1.29	1.51	4.54
Oats	acre	279.32	398.78	287.74	134.74	--
Dryland Gr. Sorg.	acre	--	--	--	--	--
Irrigated Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00
July Wheat	acre	--	--	--	--	75.46
Contracted Wheat	acre	--	--	110.97	263.75	320.00
Crop-Share Oats	acre	162.12	--	--	--	--
Crop-Share Dry. Cotton	acre	177.73	175.84	67.42	--	--
Crop-Share Wheat-July	acre	--	213.30	114.38	--	--
Cash Rent Oats	acre	2.61	10.86	218.20	400.00	--
Cash Rent Irr. Gr. Sorg.	acre	132.01	140.00	140.00	140.00	140.00
Cash Rent Wheat-July	acre	--	--	--	--	400.00
Hire Labor (Jan.-March)	hour	--	--	--	--	65.67
Hire Labor (April-June)	hour	--	22.05	1.94	--	12.23
Rent Dryland	acre	339.85	400.00	400.00	400.00	400.00
Rent Irrigated Land	acre	134.62	140.00	140.00	140.00	140.00
Total Negative Deviation	$	101,357	140,100	164,670	193,490	316,334
Standard Deviation	$	20,345	28,122	33,054	38,839	63,498
Coefficient of Variation	%	28.26	31.25	34.43	38.08	56.77

[a]This is the farm plan maximizing expected total gross margin.

acres of wheat (produced on cash rented land) sold in July. Wheat produced on cash rented land did not enter in any of the solutions at and below the $102,000 expected total gross margin level. Crop-share wheat sold in July is included in farm plans between the $90,000 and the $99,000 total gross margin levels. At the $102,000 total gross margin level and less, dry cropland is crop-shared rather than cash rented. Irrigated land is rented on a cash basis and is used for grain sorghum. Irrigated cotton is not included in any of the farm plans.

EWMA Expectation

The maximum expected total gross margin farm plan is $124,937.54, standard deviation of $69,820, and coefficient of variation of 55.88 percent (Table 77). This farm plan consists of 263 March steers, 4.54 acres of alfalfa, 75.46 acres of wheat (produced on owned land) sold in October, 320 acres of contracted wheat, irrigated grain sorghum (produced on owned land and cash rented land), and 400 acres of wheat (produced on cash rented land) sold in October. One important feature in the solutions of this scenario is that land is rented for cash instead of on a crop-share basis. When the total gross margin level is set at $123,000, the farm plan includes 75.06 acres of wheat (produced on owned land) and 365.46 acres of wheat (produced on cash rented land), both sold in July. Wheat is contracted at the $90,000 total gross margin level and greater. Land is rented for cash in all farm plans at the $90,000 level and greater. Crop-share alternatives entered solutions at the $96,000 total gross margin level and less. The amount of cropland rented begins to decline at the $84,000 level and less.

TABLE 77

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, AND CASH RENT STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$84,000	$96,000	$102,000	$111,000	$123,000	$124,937.54[a]
March Steers	head	--	29.40	59.43	130.35	251.31	262.65
Alfalfa	acre	--	0.51	1.03	2.25	4.34	4.54
Oats	acre	340.09	231.28	181.74	2.90	--	--
Dryland Gr. Sorg.	acre	59.91	79.18	37.26	--	--	--
Irrigated Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00	140.00
July Wheat	acre	--	--	--	74.77	75.66	--
October Wheat	acre	--	--	--	--	--	75.46
Contracted Wheat	acre	--	89.03	179.97	320.00	320.00	320.00
Crop-Share Oats	acre	137.03	--	--	--	--	--
Crop-Share Dry. Cotton	acre	202.62	74.58	--	--	--	--
Crop-Share Wheat-July	acre	--	--	--	--	--	--
Cash Rent Oats	acre	--	325.42	400.00	400.00	34.54	--
Cash Rent Irr. Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00	140.00
Cash Rent Wheat-July	acre	--	--	--	--	365.46	--
Cash Rent Wheat-October	acre	--	--	--	--	--	400.00
Hire Labor (Jan.-March)	hour	--	--	--	--	52.73	65.67
Hire Labor (July-Sept.)	hour	--	--	--	--	10.84	12.23
Rent Dryland	acre	339.65	400.00	400.00	400.00	400.00	400.00
Rent Irrigated Land	acre	140.00	140.00	140.00	140.00	140.00	140.00
Total Negative Deviation	$	117,509	156,472	179,877	222,891	302,418	347,829
Standard Deviation	$	23,588	31,409	36,107	44,741	60,705	69,820
Coefficient of Variation	%	28.08	32.72	35.40	40.31	49.35	55.88

[a]This is the farm plan maximizing expected total gross margin.

Multiple Marketing, Forward Contracting, Crop-Share, Cash Rent, and Wheat Hail Insurance

Mean Expectation

The total gross margin maximizing farm plan is identical to the plan under this scenario without wheat hail insurance alternatives. In this plan, wheat produced on owned land and crop-share wheat are sold in September (Table 78). At the $66,000 total gross margin level, 1.36 acres of wheat is sold in December, 261.53 acres of wheat are contracted, and 400 acres of crop-share wheat also sold in December. At the $60,000 and $63,000 total gross margin levels crop-share wheat is sold in September and December, and insurance wheat is also sold in December. Comparing the $60,000 and $63,000 expected total gross margin levels in Tables 75 and 78, relative variability is very close. At the $48,000 and $51,000 total gross margin levels, insurance wheat is sold in June and May.

UWMA Expectation

The farm plan maximizing expected total gross margin is identical to the maximizing farm plan reported in Table 76. Furthermore, farm plans above the $96,000 expected total gross margin level are identical for both scenarios (Table 79). The farm plan for this scenario at the $96,000 total gross margin level includes 71 March steers, 1.23 acres of alfalfa, 183.13 acres of oats, 140 acres of irrigated grain sorghum, 110.25 acres of contracted wheat, 105.39 acres of insurance wheat sold in July, 91.32 acres crop-share dryland cotton, 308.68 acres of oats

TABLE 78

SUMMARY OF MOTAD RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, CASH RENT, AND WHEAT HAIL INSURANCE STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels				
		$48,000	$60,000	$63,000	$66,000	$67,441.42[a]
March Steers	head	67.45	154.93	207.92	218.88	262.65
May Steers	head	0.32	--	--	--	--
Grazeout Wheat	acre	1.03	--	--	--	--
Alfalfa	acre	1.19	2.68	3.59	3.78	4.54
Oats	acre	--	--	--	--	--
Dryland Cotton	acre	195.44	299.19	166.69	2.18	--
Dryland Gr. Sorg.	acre	--	28.91	--	131.15	--
Irrigated Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00
September Wheat	acre	--	--	--	--	395.46
December Wheat	acre	--	--	--	1.36	--
Contracted Wheat	acre	--	--	--	261.53	--
Insurance Wheat-June	acre	170.72	--	--	--	--
Insurance Wheat-Dec.	acre	--	69.22	229.72	--	--
Insurance Wheat-May	acre	31.62	--	--	--	--
Crop-Share Dry. Cotton	acre	191.31	--	--	--	--
Crop-Share Wheat-Sept.	acre	--	--	310.61	--	400.00
Crop-Share Wheat-Dec.	acre	--	400.00	89.39	400.00	--
Cash Rent Irr. Gr. Sorg.	acre	131.13	140.00	140.00	140.00	140.00
Hire Labor (Jan.-March)	hour	--	--	21.53	39.54	65.67
Hire Labor (April-June)	hour	36.54	33.47	--	--	--
Hire Labor (July-Sept.)	hour	9.26	56.43	37.18	9.89	12.23
Rent Dryland	acre	191.30	400.00	400.00	400.00	400.00
Rent Irrigated Land	acre	131.13	140.00	140.00	140.00	140.00
Total Negative Deviation	$	94,360	144,052	171,268	213,904	247,018
Standard Deviation	$	18,941	28,916	34,379	42,937	49,584
Coefficient of Variation	%	39.46	48.19	54.57	65.06	73.52

[a]This is the farm plan maximizing expected total gross margin.

TABLE 79

SUMMARY OF UNEQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, CASH RENT, AND WHEAT HAIL INSURANCE STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$51,000	$72,000	$90,000	$96,000	$102,000	$111,846.27[a]
March Steers	head	29.85	7.59	64.38	71.20	87.09	262.65
May Steers	head	96.85	47.77	--	--	--	--
Grazeout Wheat	acre	309.92	152.87	--	--	--	--
Alfalfa	acre	0.53	0.14	1.11	1.23	1.51	4.54
Oats	acre	--	224.23	203.90	183.13	134.74	--
Dryland Gr. Sorg.	acre	--	--	--	--	--	--
Irrigated Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00	140.00
July Wheat	acre	--	--	--	--	--	75.46
Contracted Wheat	acre	--	--	--	110.25	263.75	320.00
Insurance Wheat-July	acre	89.55	22.76	194.99	105.39	--	--
Crop-Share Oats	acre	287.61	219.18	--	--	--	--
Crop-Share Dry Cotton	acre	163.09	189.53	221.36	91.32	--	--
Cash Rent Oats	acre	--	--	178.64	308.68	400.00	--
Cash Rent Irr. Gr. Sorg.	acre	52.05	131.29	140.00	140.00	140.00	140.00
Cash Rent Wheat-July	acre	--	--	--	--	--	400.00
Hire Labor (Jan.-March)	hour	--	--	--	--	--	65.67
Hire Labor (July-Sept.)	hour	--	--	29.96	6.08	--	12.23
Rent Dryland	acre	362.75	400.00	400.00	400.00	400.00	400.00
Rent Irrigated Land	acre	140.00	140.00	140.00	140.00	140.00	140.00
Total Negative Deviation	$	68,369	101,114	139,478	164,327	193,490	316,334
Standard Deviation	$	13,724	20,297	27,998	32,986	38,839	63,498
Coefficient of Variation	%	26.91	28.19	31.11	34.36	38.08	56.77

[a]This is the farm plan maximizing expected total gross margin.

(produced on cash rented land), and 140 acres of irrigated grain sorghum (produced on cash rented land). The standard deviation of this plan is $32,986 and the coefficient of variation is 34.36 percent. Relative variability for the farm plans at the $96,000 total gross margin level in Tables 76 and 79 are very close. Wheat hail insurance is included in farm plans at and below the $96,000 expected total gross margin level but did not reduce variability substantially.

EWMA Expectation

The farm plan maximizing expected total gross margin for this scenario is identical to the farm plan maximizing expected total gross margin reported in Table 77. Wheat contracted for June delivery is included in all farm plans at and above the $102,000 expected total gross margin level (Table 80). Wheat is sold in October in the total gross margin maximizing farm plan and in July at the $123,000 expected total gross margin level. Between $96,000 and $120,000 total gross margin levels, insured wheat is sold in July. Relative variability at the $96,000 and $102,000 expected total gross margin levels in Tables 77 and 80 are very close. Below the $96,000 total gross margin level, the farm plans for both scenarios are identical. Wheat hail insurance did not reduce variability substantially in the farm plans of this scenario compared to the farm plans in Table 77. Cash rent alternatives are in all the farm plans at the $96,000 gross margin level and greater. Crop-share activities begin to enter the solutions at the $96,000 gross margin level and less.

TABLE 80

SUMMARY OF EQUALLY WEIGHTED MOVING AVERAGE RISK EFFICIENT IRRIGATED FARM PLANS FOR MULTIPLE MARKETING, FORWARD CONTRACTING, CROP-SHARE, CASH RENT, AND WHEAT HAIL INSURANCE STRATEGIES

Enterprise	Unit	Expected Total Gross Margin Levels					
		$84,000	$96,000	$102,000	$120,000	$123,000	$124,937.54[a]
March Steers	head	--	49.57	83.31	228.12	251.31	262.65
May Steers	head	--	--	--	--	--	--
Grazeout Wheat	acre	--	--	--	--	--	--
Alfalfa	acre	--	0.86	1.44	3.94	4.34	4.54
Oats	acre	340.09	198.55	146.23	--	--	--
Dryland Gr. Sorg.	acre	59.91	50.47	--	--	--	--
Irrigated Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00	140.00
July Wheat	acre	--	--	--	--	75.66	--
October Wheat	acre	--	--	--	--	--	75.46
Contracted Wheat	acre	--	--	113.53	320.00	320.00	320.00
Insurance Wheat-July	acre	--	150.12	138.80	76.06	--	--
Crop-Share Oats	acre	137.03	--	--	--	--	--
Crop-Share Dry. Cotton	acre	202.62	42.78	--	--	--	--
Cash Rent Oats	acre	--	357.22	400.00	105.18	34.54	--
Cash Rent Irr. Gr. Sorg.	acre	140.00	140.00	140.00	140.00	140.00	140.00
Cash Rent Wheat-July	acre	--	--	--	294.82	365.46	--
Cash Rent Wheat-Oct.	acre	--	--	--	--	--	400.00
Hire Labor (Jan.-March)	hour	--	--	--	26.25	52.73	65.67
Hire Labor (July-Sept.)	hour	10.04	--	--	7.99	10.84	12.23
Rent Dryland	acre	339.65	400.00	400.00	400.00	400.00	400.00
Rent Irrigated Land	acre	140.00	140.00	140.00	140.00	140.00	140.00
Total Negative Deviation	$	117,509	156,054	179,623	280,704	302,418	347,829
Standard Deviation	$	23,588	31,325	36,056	56,346	60,705	69,820
Coefficient of Variation	%	28.08	32.63	35.35	46.96	49.35	55.88

[a]This is the farm plan maximizing expected total gross margin.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

The principal purpose of this study is to determine and evaluate risk efficient farm plans for a dryland and irrigated situation typical of farm operations in Southwest Oklahoma under alternative assumptions regarding risk management strategies available to the producer. Total gross margin maximizing farm plans are derived under the following assumptions: (1) farm operators will sell all crops at harvest; (2) farm operators will participate in the 1978 Government Farm Program and sell all crops at harvest; (3) farm operators will sell all crops at harvest except wheat which can be stored and marketed in any amount in any month of the crop year (June through the following May); (4) farmers will follow strategy (3) and in addition, participate in the 1978 Government Farm Program; (5) farmers will follow strategy (3) in combination with the forward contracting of wheat for June delivery; and (6) farmers will follow strategy (5) in combination with crop-share and cash rent alternatives.

The risk management strategies evaluated for the irrigated farm scenario are similar to the dryland farm scenario above, except that participation in the 1978 Government Farm Program is analyzed only for the dryland farm and wheat hail insurance alternatives analyzed only for the irrigated farm. The Farm Program alternative is analyzed only for the dryland farm because Normal Farm Yield data are not available for the irrigated crops. The total gross margin maximizing farm plans for the irrigated farm scenario are derived under the following assumptions: (1) farm operators will sell all crops at harvest; (2) farm operators will purchase hail insurance for wheat and sell all crops at harvest; (3) farm operators will sell all crops at harvest except wheat which can be stored and sold periodically in any quantity from June through May; (4) farmers will follow strategy (3) in combination with the forward contracting of wheat for June delivery; (5) farmers will follow strategy (3) in combination with the forward contracting of wheat for June delivery, and crop-share and cash rent alternatives; (6) farmers will follow strategy (5) in combination with hail insurance alternatives for wheat sold in any amount from June through May.

The data needed for this risk analysis are farm resources, historical yields, prices, production costs, and technical coefficients. Two hypothetical farm resource situations for Southwest Oklahoma are analyzed. The farmer has 70 percent equity in the land in both farm situations. The dryland farm consists of 1,500 acres, of which 1,200 acres are cropland and 300 acres are unimproved native pasture. The irrigated farm contains a total of 1,120 acres of cropland, of which 320 acres are irrigated. However, when crop-share and cash rent alternatives are analyzed, the farm situations are redefined. The dryland farm consists of 600 acres of owned cropland and 300 acres of native pasture with the option of renting on a crop-share and/or cash rent basis an additional 600 acres of cropland. The irrigated farm consists of 560 acres of cropland, 160 acres of which are irrigated, with the option of renting on a crop-share and/or cash rent basis an additional 560 acres of cropland, including 160 irrigated acres. The farmer is assumed to provide 2,500 hours of his own labor annually with the option of hiring additional labor if necessary. Capital is assumed available at market rates of interest.

Historical yield data (1962-1977) for the different crops are obtained from experimental variety test results for the study area. The crops considered are: alfalfa, barley, oats, wheat, dryland and irrigated cotton, and dryland and irrigated grain sorghum. Five livestock enterprises are analyzed: two heifer activities and three steer activities. Data on livestock weight gains are not available and thus no yield variability is incorporated for livestock.

Crop and livestock prices used are current Oklahoma mid-month prices. These prices are adjusted to the 1967 price level using the Index of Prices Paid by Farmers. Both yields and the adjusted price series are tested for trend using simple regression equations. Trend is removed from the alfalfa yield series which had significant trend values at the 5 percent level. Production cost data for the study period are not available. The Oklahoma State University computerized crop and livestock budgets for Southwest Oklahoma for 1977 are used to obtain cost estimates for the other years. Variable costs plus interest charge for 1977 are extrapolated backwards using the Index of Prices Paid by Farmers.

Enterprise gross margins, the difference between gross returns and total variable costs are calculated for the different enterprises. The resulting gross margin series are then expressed in 1977 dollars using the Index of Prices Paid for Family Living Items. The expected gross margins are calculated in three ways: (1) the mean of the historical series; (2) a three-year weighted moving average with weights of .5 for the most recent year and .3 and .2 for the two previous years; and (3) a three-year equally weighted moving average. Variability is calculated as deviations from the mean and from the two moving averages.

Risk efficient farm plans are derived using a linear programming (LP) algorithm, MPSX-370. These farm plans are obtained for all risk management strategies for both farm situations using the three expectation models. First, the total expected gross margin maximizing solution is determined for every strategy for both farm situations using the three expectation models. This maximum expected total gross margin farm plan corresponds to the highest point on the risk efficiency frontier. The next step is to incorporate the gross margin deviation matrix into the basic LP model. The objective of the resulting LP-MOTAD model is to minimize total negative gross margin deviation subject to the same constraints as in the basic LP model and a parametric constraint of expected total gross margin levels. This parametric constraint is derived from the maximum expected total gross margin in decrements of $3,000 to obtain the risk efficient farm plans. For every expected total gross margin level, the resulting farm plan has a corresponding total negative gross margin deviation value. This value, obtained from the objective function of the LP-MOTAD model, is transformed into an estimate of standard deviation. These two parameters, expected total gross margin and standard deviation outlines the risk efficiency frontier.

Summary of Dryland Farm Plan Results

The farm plans derived in this study are risk efficient in that they have minimum total negative gross margin deviation formulated by expectations in one of the three ways described earlier.

Mean Expectation

Risk efficient farm plans for the harvest sale strategy for the dryland farm scenario using the mean expectation are derived in $3,000 decrements from the maximum expected total gross margins to $39,000. The maximum expected total gross margin is $62,386.02, standard deviation of $38,319 and coefficient of variation of 61.42 percent. Wheat is sold only at the $45,000, $54,000, and $60,000 expected total gross margin levels. By reducing expected total gross margin, the farm plans become more diversified and total negative gross margin deviation, standard deviation and relative variation are reduced considerably. The production organization changed very little below the $39,000 expected total gross margin level at which cropland begins to remain idle.

Farm plans derived for harvest sale with Farm Program participation are on a slightly lower risk efficiency frontier than the harvest sale scenario without Farm Program participation. The maximum expected total gross margin is $60,971.08, standard deviation is $32,415 and coefficient of variation is 53.16 percent. Farm program wheat is included in all the farm plans between $36,000 and $60,000 total gross margin levels inclusive. Expected total gross margin and gross margin variability are reduced as the plans become diversified. Total negative gross margin deviation, standard deviation and relative variability are reduced considerably for the harvest sale and the 1978 Farm Program scenario compared to harvest sale without government participation.

The risk efficient farm plans derived for the multiple marketing of wheat with the other crops sold at their respective harvest are on a higher risk efficiency frontier than either of the two previous scenarios. The maximum expected total gross margin is $70,527.20, standard deviation is $64,091 and the coefficient of variation is 90.88 percent. Wheat is first sold in September, October, December and finally in July as the total gross margin constraint is reduced. When the $54,000 and the $60,000 expected total gross margin levels of all three scenarios are compared, relative variability is found to be the lowest for the harvest sale and Farm Program scenario. Cropland is left idle at the $39,000 expected total gross margin level and less when the mean and the UWMA expectation model is used. Cropland is left idle at the $30,000 expected total gross margin level and less when the EWMA expectation model is used.

The addition of forward contracting to this scenario does not change the maximum expected total gorss margin plan. The inclusion of forward contracting in this scenario reduced relative variability slightly compared to the multiple marketing scenario at common total gross margin levels. At and below the $54,000 expected total gross margin level, all the farm plans are identical for both multiple marketing and forward contracting and multiple marketing scenarios.

When the forward contracting and multiple wheat marketing alternative is analyzed under the 1978 Farm Program scenario, the producer attained a slightly lower risk efficiency frontier than for forward contracting and multiple wheat marketing without the Farm Program. This occurred because the set aside acres reduced expected total gross margins. Relative variability is reduced under the 1978 Farm Program scenario. The maximum expected total gross margin is $68,517.65 with a standard deviation of $46,849 and a coefficient of variation of 63.38 percent.

Wheat is sold in September at and above the $60,000 total gross margin level and in May at and below the $57,000 expected total gross margin level. Forward contracting does not enter in any of the solutions. Standard deviation and relative variability are reduced considerably when government farm program participation is added to multiple wheat marketing and forward contracting.

The farm resource situation is redefined when crop-share and cash rent alternatives are analyzed. The maximum expected total gross margin attained for multiple wheat marketing, forward contracting, crop-share, and cash rent alternatives is $58,401.20, standard deviation is $52,749 and coefficient of variation is 90.32 percent. Wheat produced on owned land is sold in December at the $57,000 total gross margin level and in September in the farm plan maximizing total gross margin. Crop-share wheat is sold in September at and above the $48,000 total gross margin level and in December between the $51,000 and $57,000 total gross margin levels inclusive. Below the $48,000 total gross margin level, wheat is sold in June and May. Contracted wheat is included only in the farm plan at the $54,000 total gross margin level. In this scenario, cropland is rented only on a crop-share basis.

Moving Average Expectations

The farm plan maximizing expected total gross margin for the harvest sale strategy using both moving average expectations is identical. However, the maximum expected total gross margin is different. The maximum expected total gross margin using the UWMA expectation is $106,671.38 with a standard deviation of $69,467 and a coefficient of variation of 65.12 percent. When the expected total gross margin constraint is set at decreasing levels both absolute and relative gross margin variability are reduced. The farm plans become more diversified. Harvest sale wheat is included in all farm plans at and above the $93,000 total gross margin level. Cropland begins to remain idle at the $39,000 expected total gross margin level and less.

When the EWMA expectation is used, the maximum expected total gross margin is $108,013.96 with a standard deviation of $66,307 and a coefficient of variation of 61.39 percent. The maximum expected total gross margin is slightly higher but lower absolute and relative variability are attained using the EWMA expectation. All the other plans for both moving average expectations are similar except that cropland begins to remain idle at and below the $30,000 expected total gross margin level when the EWMA expectation is used.

The maximum expected total gross margin of the harvest sale scenario under the 1978 Farm Program using the UWMA expectation is $98,916, a standard deviation of $47,253 and a coefficient of variation of 47.77 percent. This plan consists of only oats which is not a farm program crop. Wheat is not produced in any of the plans. As the plan becomes more diversified, absolute and relative gross margin variability are reduced. Variability is less for the harvest sale strategy without the Farm Program then with the Farm Program. This unexpected outcome is due to the presence in the solutions of oats, a non-Farm Program crop.

Using the EWMA expectation, the farm plan maximizing expected total gross margin for the harvest sale scenario with the 1978 Farm Program is $91,826.13 with a standard deviation of $47,829 and a coefficient of variation of 51.50 percent. Diversification reduced both the absolute and relative variability in these farm plans. Wheat is included in all farm plans at and above the $87,000 total gross margin level. The Farm Program alternative does not reduce variability since relative variability is higher for the farm plan at the $84,000 expected total gross margin level for the harvest sale scenario with the 1978 Farm Program. Cropland is left idle at the $78,000 expected total gross margin level.

The analysis of multiple wheat marketing alternatives with all other crops sold at their respective harvest time using the UWMA expectation results in a maximum expected total gross margin of $119,701.01 with a standard deviation of $73,103 and a coefficient of variation of 61.07 percent. Wheat is sold in July in all farm plans at and above the $93,000 expected total gross margin level. Gross margin variability is reduced considerably through diversification. The addition of forward contracting to this scenario results in a maximum expected total gross margin of $123,064.21, a standard deviation of $74,532 and a coefficient of variation of 60.56 percent. Forward contracting moves the producer to a higher risk efficiency frontier and reduces relative variability.

Wheat is sold in July in all farm plans at and above the $108,000 expected total gross margin level. Contracted wheat is included in all farm plans at and above the $93,000 total gross margin level. Diversified farm plans reduced absolute and relative variability considerably. When the $84,000 and $93,000 expected total gross margin levels are compared for both scenarios, it is found that forward contracting does not reduce gross margin variability significantly. Cropland begins to remain idle at the $39,000 total gross margin level and less for both scenarios.

Using the EWMA expectation for the multiple wheat marketing scenario, the maximum expected total gross margin is $128,238.51, standard deviation is $87,645 and coefficient of variation is 68.35 percent. Wheat is sold in July at and between the $93,000 and $126,000 total gross margin level; it is sold in October at the $126,000 total gross margin level and greater. When forward contracting is added to multiple wheat marketing, the producer attained a higher efficiency frontier and lower variability. The maximum expected total gross margin is $132,097.71 with a standard deviation of $84,234 and a coefficient of variation of 63.77 percent. Wheat is marketed in October in this plan and in July at the $129,000 expected total gross margin level. Wheat is forward contracted at and above the $84,000 total gross margin level. When plans at the $84,000 and $93,000 expected total gross margin levels for both scenarios are compared, relative variability is almost the same. Forward contracting does reduce variability. Cropland begins to remain idle at the $30,000 expected total gross margin level for both scenarios.

The farm plan maximizing expected total gross margin for multiple marketing and forward contracting under the 1978 Farm Program using the UWMA expectation is $105,654.35 with a standard deviation of $54,300 and a coefficient of variation of 51.39 percent. Wheat is forward contracted at and above the $84,000 gross margin level. The inclusion of the 1978 Farm Program alternative enabled the producer to attain a lower risk efficiency frontier. When farm plans at the $84,000 and $93,000 total gross margin levels for multiple marketing and forward contracting with and without the 1978 Farm Program are compared, it is found that relative variability is about the same. Cropland is left idle at the $78,000 expected total gross margin level and less.

The producer attains a lower risk efficiency frontier when multiple marketing and forward contracting under the 1978 Farm Program using the

EWMA expectation are compared to multiple marketing and forward contracting without the 1978 Farm Program. The maximum expected total gross margin is $112,548.33 with a standard deviation of $60,808 and a coefficient of variation of 54.03 percent for the multiple marketing and forward contracting strategy under the 1978 Farm Program. Wheat is sold in October in the maximizing plan and in July at the $111,000 expected total gross margin level. Contracted wheat is included in all the farm plans at and above the $84,000 total gross margin level. Relative variability is slightly reduced for this scenario at the $84,000 and $93,000 total gross margin level compared to multiple marketing and forward contracting. Cropland begins to remain idle at the $78,000 expected total gross margin level and less.

When multiple marketing, forward contracting, crop-share, and cash rent alternatives are analyzed using the UWMA expectation, the maximum expected total gross margin is $110,764.21, standard deviation is $74,570 and coefficient of variation is 67.32 percent. This plan includes contracted wheat and wheat (produced on owned land and cash rented land) sold in July. Wheat produced on owned land is sold in July in all the plans at and above the $105,000 total gross margin level. Wheat produced on crop-share land and sold in July is in all the farm plans at and between the $69,000 and $84,000 expected total gross margin levels inclusive. Wheat is contracted in all the farm plans at and above the $75,000 expected total gross margin level. Both cash rent and crop-share alternatives reduce variability as the expected income gross margin constraint is reduced. The amount of land rented begins to decline at the $42,000 expected total gross margin level and less.

When this same scenario is analyzed using the EWMA expectation, the maximum expected total gross margin is $119,623.71, standard deviation is $84,219 and coefficient of variation is 70.40 percent. This plan is identical for both scenarios except that wheat is sold in October instead of July. Wheat is sold in July only at the $117,000 expected total gross margin level. Contracted wheat is included in all the farm plans at and above the $84,000 expected total gross margin level. Both cash rent and crop share alternatives are included in the farm plans. Relative variability at the $84,000 and $93,000 expected total gross margin levels for both scenarios using both expectations is lower for this scenario compared to that in Table 61. The amount of land rented begins to decline at the $66,000 expected total gross margin level and less.

Summary of Irrigated Farm Plan Results

Mean Expectation

The maximum expected total gross margin attained for the harvest sale strategy is $72,747.60, standard deviation is $43,934, and coefficient of variation is 60.39 percent. Wheat is sold only at the $69,000 and $72,000 expected total gross margin levels. Irrigated grain sorghum is included in all of the farm plans. This suggests that irrigated grain sorghum reduced gross margin variability and increased expected total gross margin more than irrigated cotton, which is not included in any of the solutions. These plans also show that diversification does reduce gross margin variability and expected total gross margin. Moreover, the addition of a June wheat hail insurance activity to this scenario does not change the maximum expected total gross margin farm plan. The wheat hail insurance activity enters in all the farm plans at and below the $69,000 expected total gross margin level. This reduces gross margin variability slightly compared to the harvest sale strategy.

Multiple marketing alternatives enable the producer to attain a higher risk efficiency frontier. The maximum expected total gross margin is $78,426.22 with a standard deviation of $56,778 and relative variability of 72.40 percent. As the expected total gross margin level is reduced from its maximum value, wheat is sold in September, then December, and finally May. Gross margin variability is almost identical for farm plans at and below the $69,000 total gross margin level for this and the above strategies.

The addition of a wheat forward contracting activity (June delivery) to this scenario results in the same maximum expected total gross margin farm plan obtained for the multiple marketing alternatives. Thus, forward contracting does not move the producer to a higher risk efficiency frontier. Forward contracting is included only in the $75,000 total gross margin farm plan. Thus, gross margin variability is reduced slightly at this total gross margin level when compared to the multiple marketing alternative. All the other farm plans at the $69,000 expected total gross margin level and below are identical for both scenarios.

The analysis of multiple marketing, forward contracting, crop-share, and cash-rent alternatives simultaneously results in a farm plan yielding a $67,441.42 maximum expected total gross margin, with a standard deviation of $49,584, and a coefficient of variation of 73.52 percent. The farm situation is redefined for the scenarios that included crop-share and cash rent alternatives. Thus, a valid comparison with the above scenarios cannot be made. In this scenario, wheat produced on owned land is sold in September and, as the expected total gross margin is set at decreasing levels, crop-share wheat is sold in September, then December, and finally May. Forward contracting is included only in the farm plan at the $63,000 total gross margin level. Irrigated grain sorghum is produced on owned and cash rent land. The addition of multiple marketing and wheat hail insurance alternatives to this scenario does not change the maximum expected total gross margin farm plan. Wheat produced on owned land and crop-share land is sold in September and December as the expected total gross margin constraint is reduced. Insurance wheat is sold in June, then December, and May as the total gross margin level is reduced. In this scenario, wheat is forward contracted only at the $66,000 expected total gross margin level. The inclusion of wheat hail insurance alternatives do not reduce gross margin variability significantly.

Moving Average Expectations

The farm plan maximizing expected total gross margin derived for the harvest sale strategy using both moving average expectations are identical. However, their maximum expected total gross margins are different. The maximum expected total gross margin attained using the UWMA expectation is $110,865.25 with a standard deviation of $56,851 and a coefficient of variation of 51.28 percent. Using the EWMA expectation, the maximum expected total gross margin is $118,791.00 with a standard deviation of $56,421 and a coefficient of variation of 47.50 percent. This plan seems to indicate that using the UWMA expectation the maximum expected total gross margin is lower but gross margin variability slightly higher compared to the EWMA expectation. However, for farm plans at lower total gross margin levels, gross margin variability is slightly less for common total gross margin levels using the EWMA expectation. Wheat is included in farm plans at the $105,000 expected total gross margin level and above using both expectations. Irrigated grain sorghum (but not irrigated cotton) is included in all the farm plans using the EWMA expectation. Irrigated grain sorghum is included in all farm plans and irrigated cotton is included only in farm plans at and below the $87,000 expected total gross margin using the UWMA expectation. Diversification reduces gross margin variability and expected total gross margin using both moving average expectations. The addition of a wheat-hail insurance activity to this sceanrio does not change the maximum expected total gross margin farm plan derived for the harvest sale strategy using both moving average expectations. The wheat hail insurance activity enters the solutions at and below the $87,000 expected total gross margin level using the UWMA expectation. Using the EWMA expectation, it is included in the $105,000 expected total gross margin and at the $66,000 level and less. At the $96,000 and $102,000 expected total gross margin levels, gross margin variability is reduced very slightly using the EWMA expectation. However, at these levels the wheat hail insurance activity is not included in the farm plans. Therefore, the slight reduction in gross margin variability cannot be attributed to wheat hail insurance.

The maximum expected total gross margin obtained for multiple marketing alternatives using the UWMA expectation was $119,551.67 with a standard deviation of $61,861 and a coefficient of variation of 51.75 percent. Using the EWMA expectation it is $132,274.14, a standard deviation of $73,245, and a coefficient of variation of 55.37 percent.

Maximum expected total gross margin and gross margin variability are higher for the EWMA expectation. Wheat is sold only in July for the UWMA expectation but in July and October at the $129,000 total gross margin level and above. Gross margin variability is identical for farm plans at the $96,000 and $102,000 total gross margin levels for the harvest sale strategy and multiple marketing using both expectations.

The addition of forward contracting to multiple marketing alternatives enabled the producer to attain a maximum expected total gross margin of $122,914.87 with a standard deviation of $63,441, and a coefficient of variation of 51.62 percent using the UWMA expectation. Forward contracting is included in all the farm plans at and above the $111,000 total gross margin level. Using the UWMA expectation, the maximum expected total gross margin attained is $136,133.34 with a standard deviation of $69,833, and a coefficient of variation of 51.30 percent. Wheat is forward contracted at and above the $102,000 total gross margin level. Gross margin variability remained unchanged for both scenarios at the $96,000 and $102,000 expected total gross margin levels using both mvoing average expectations. Forward contracting does reduce gross margin variability.

The analysis of multiple marketing, forward contracting, crop-share, and cash rent alternatives simultaneously using the UWMA expectation results in a farm plan of $111,846.27 with a standard deviation of $63,498 and a coefficient of variation of 56.77 percent. The farm resource situation is redefined for the scenario that analyzed crop-share and cash rent alternatives. In this production organization, wheat produced on owned land and cash rent land is sold in July. Wheat is forward contracted at and above the $96,000 total gross margin level.

Crop-share wheat sold in July is included in the farm plans at the $90,000 and $96,000 total gross margin levels only. Irrigated grain sorghum is grown on owned and cash rent irrigated land. Diversification reduces gross margin variability and expected total gross margin. The addition of multiple marketing and wheat hail insurance alternatives to this scenario does not change the farm plan maximizing expected total gross margin. Farm plans at and above the $102,000 total gross margin level for both scenarios are identical. Insurance wheat sold in July is included in farm plans at and below the $96,000 total gross margin level. The inclusion of multiple marketing and wheat hail insurance alternatives does not reduce gross margin variability or increase expected total gross margin.

The maximum expected total gross margin for multiple marketing, forward contracting, crop-share, and cash rent alternatives using the EWMA expectation was $124,937.54 with a standard deviation of $69,820 and a coefficient of variation of 55.88 percent. Wheat produced on owned and cash rent land is sold in October. Wheat is sold in July in farm plans between $111,000 and $123,000 total gross margin levels inclusive. Wheat is forward contracted at the $90,000 total gross margin level and above. Irrigated grain sorghum is produced on owned and cash rent land. Gross margin variability and expected total gross margin are reduced as the farm plans become more diversified. The addition of multiple marketing and wheat hail insurance alternatives to the above scenario does not change the production plan maximizing expected total gross margin. Insurance wheat is sold in July and is included only in farm plans at and between $96,000 and $120,000 total gross margin levels inclusive. Gross margin variability at the $96,000 and $102,000 expected total gross margin level for both scenarios is almost identical. Wheat hail insurance alternatives reduced gross margin variability but do not increase expected total gross margin.

Conclusions

The farm plans derived using the mean expectation model indicate the potential for increasing expected total gross margin by storing wheat and marketing it periodically between June and December. Marketing wheat in January through May of the following calendar year does not appear to increase expected total gross margin or reduce gross margin variability. Income taxes are not accounted for in drawing this conclusion. This result could be different if the analysis was conducted using gross margins after taxes.

Strategies relating to diversification, forward contracting and government Farm Program participation are found to reduce gross margin variability and relative variability for a given level of expected total gross margin. The scenario which resulted in the lowest relative variability for a given level of expected total gross margin includes forward contracting a portion of the wheat produced for June delivery, multiple marketings of wheat and participation in the 1978 government Farm Program. Farm plans resulting from the scenario involving multiple marketing, forward contracting, crop-share and cash rent alternatives have high relative variability. Crop insurance for wheat hail damage reduces gross margin variability for a given level of expected total gross margin for the irrigated farm using the harvest sale strategy, but does not increase expected total gross margin or reduce relative variability compared to Farm Program participation.

Risk efficient farm plans are quite different when expected gross margins are defined as an unequally weighted and an equally weighted moving average of the most recent three years and variability is measured in terms of deviations from the moving average. Through diversification, these farm plans reduce variability in gross margins. Marketing wheat periodically, forward contracting and Farm Program participation reduce variability in gross margins for given levels of expected total gross margin. Wheat is marketed in June for the harvest sale strategy but in July for the multiple marketing scenario when the UWMA expectation is used. Wheat is sold in July and October when the EWMA expectation model is used.

Relative variability is reduced slightly more when the EWMA expectation is used in lieu of the UWMA process for all risk management scenarios. Relative variability differed very slightly between scenarios for given expected total gross margin levels for the EWMA results. However, the UWMA and EWMA farm plans are very similar, differing slightly in terms of their activity levels.

Sensitivity of Results

When the results of all three expectation models are compared, the maximum expected total gross margin of the LP-MOTAD model (deviations from the mean) is smaller than the maximum expected total gross margin of the moving average models. The EWMA results have the highest expected total gross margin. The moving average expectation models result in higher gross margins because they give more weight to recent years.

The farm plans derived for all the risk management scenarios for the three measures of expectation differ considerably. In all the results, March and May steers are profitable and thus appear in the final plan. However, the summer steer activity is only profitable for the mean expectation results. The summer steer activity does not come into the moving average solutions because the expected gross margin for 1977 is negative. Summer steer is not considered in the irrigated scenarios because there is no native pasture. The farm plans also differ in regards to the month when wheat is sold. In the farm plans using the mean expectation, wheat is sold in June, July, September, October, December, and in a few cases May depending on the scenarios and the level of expected total gross margin. The UWMA farm plans show July as the month when wheat is sold. Wheat is sold in July and October in the EWMA farm plans.

In all the farm plans starting at the maximum expected total gross margin and decreasing it in arbitrary decrements of $3,000 resulted in a reduction in risk as measured by either total negative gross margin deviation or the standard deviation. Lesser amounts of expected total gross margin have to be assumed by the decision maker to obtain a given decrease in risk. As the expected total gross margin level is reduced and variation in gross margin became important, the resulting farm plans become more diversified. Thus, different measures of variation will result in the selection of quite different risk efficient farm plans by the decision maker.

Implications of the Study

The LP-MOTAD production-marketing model used in this analysis is a more realistic farm planning model than conventional linear programming. The model is developed with flexibility in mind and has the potential for use in future farm planning research and extension activities. The model is relatively easy to understand and is expensive to run on the computer. It can be used to provide information for normative short-run decision making or can be formulated as a multi-period LP-MOTAD model. The model is a definite aid to whole farm planning since it has the advantage that all data and resource parameters can be modified and updated. It also has the advantage of deriving any number of farm plans using different formulations of expected gross margins and measures of risk. Additional risk management alternatives and expectation models can be evaluated and the results used to help farmers in Southwest Oklahoma in decision making. Also the results can be compared to what the farmers are actually doing to see where improvements can be made. Land classes and additional crop and livestock enterprises can be included and analyzed.

Limitations and Need for Future Research

Crop yield data are not actual farm data. Soil and weather conditions vary from one area of Southwest Oklahoma to another. Therefore, the yield variability measured using experimental data may not correspond to actual farm variability. The cost of production data is extrapolated and may not approximate the cost of production variability experienced on individual farms. Further, data on livestock weight gains are not available for the study area, and are assumed constant in the model. Thus, the livestock enterprises reflect only price variability.

The second limitation relates to the choice of expectation model and the appropriate measure of risk. An expectation model based on the mean of a series of past gross margins may be an unrealistic measure of a farmer's expectation. The longer the series, the more unrealistic the expectation becomes because it assumes that the farmer is endowed with an infinite memory, and does not take current trends into consideration. There are many other ways of measuring a farmer's expectation. If a more appropriate expectation model is one in which the most recent past is indicative of the immediate future, then the moving average approach may be appropriate. More research is needed to resolve questions of the lengths and weights (equal or unequal) of such a process and also to study how farm operators formulate their expectations and perceive risk. Risk can be measured in several ways besides variance and negative deviations from the mean or a moving average.

Future research should focus on interviews with farm operators to relate their expectations of future total gross margin to actual farm plans and farm plans selected using the LP-MOTAD model in which risk is measured in one of the three ways used in this study. More knowledge is required on the risk management practices of the farmers in the study area and the role and effects of government farm programs on decision making. Research is needed to understand the role of information in farm planning and how it is utilized by the decision maker.

Another topic for future research involves estimating risk preference functions. More information is needed to understand risk behavior of farm operators. It is often assumed that farm operators are risk averters. This behavioral assumption on the part of farm operators in general may be questionable. It may be argued that farmers are risk preferrers since farming is a very risky venture. The understanding of risk behavior is important for purposes of predicting farm plans and for policy making.

Dillon and Scandizzo made a study of subsistence farmers in Northeast Brazil and their results indicate that some farmers may be risk preferrers. It may be argued that if this type of risk behavior is possible in subsistence farming, it may be more likely where subsistence is not a major concern. It may be counter argued that the U.S. farmer or Southwest Oklahoma farmer has more to lose in the way of equity and thus would be more risk averse than the Brazilian subsistence farmer or perhaps that the crops in Northeast Brazil are more risky than the crops in the U.S. The importance of more research in the area of risk is evident.

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APPENDIX

LIVESTOCK AND CROP BUDGETS FOR

SOUTHWEST OKLAHOMA, 1977

TABLE 81

ESTIMATED PER UNIT PRODUCTION COSTS FOR CHOICE MARCH HEIFERS, SOUTHWEST OKLAHOMA, 1977

PRODUCTION	UNITS	QUANITY	WEIGHT	PRICE	VALUE/UNIT	VALUE
HFRS (5-7) CH	CWT.	1.00	5.44	0.0	0.0	0.0
TOTAL RECEIPTS						0.0

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE
HFR CALV(3-5) CH	CWT.	1.02	4.00	4.080	31.04	126.64
GRAZING	AUMS	1.89	1.00	1.890	0.0	0.0
MIXED FEED 1	CWT.	1.00	1.00	1.000	7.50	7.50
SALT & MIN.	LBS.	12.00	1.00	12.000	0.06	0.72
HAULING & MKTG.	HD.	1.00	1.00	1.000	8.50	8.50
VET MEDICINE	HD.	1.00	1.00	1.000	3.15	3.15
MACH. FUEL & LUBE						1.07
MACHINERY REPAIR COST						0.84
EQUIPMENT REPAIR						0.04
TOTAL OPERATING COST						148.46

RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT	-148.46

CAPITAL COST	PRICE	AMOUNT	VALUE
ANNUAL CPERATING CAPITAL	0.085	60.621	5.15
MACHINERY INVESTMENT	0.085	6.864	0.58
EQUIPMENT INVESTMENT	0.085	1.975	0.17
TOTAL INTEREST CHARGE			5.90

RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT	-154.36

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)	UNITS	VALUE
MACHINERY	DOL.	1.24
EQUIPMENT	DOL.	0.43
TOTAL OWNERSHIP COST		1.66

RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT	-156.03

LABOR COSTS	PRICE	HOURS	VALUE
MACHINERY LABOR	3.000	0.840	2.52
LIVESTOCK LABOR	3.000	1.350	4.05
TOTAL LABOR COST		2.190	6.57

RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT	-162.60

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TABLE 82

ESTIMATED PER UNIT PRODUCTION COSTS FOR CHOICE MAY HEIFERS, SOUTHWEST OKLAHOMA, 1977

PRODUCTION	UNITS	QUANITY	WEIGHT	PRICE	VALUE/UNIT	VALUE
HFRS (5-7) CH	CWT.	1.00	6.60	0.0	0.0	0.0
TOTAL RECEIPTS						0.0
OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE
HFR CALV(3-5) CH	CWT.	1.02	4.00	4.080	31.04	126.64
GRAZING	AUMS	3.39	1.00	3.390	0.0	0.0
MIXED FEED 1	CWT.	1.00	1.00	1.000	7.50	7.50
SALT & MIN.	LBS.	19.50	1.00	19.500	0.06	1.17
HAULING & MKTG.	HD.	1.00	1.00	1.000	8.50	8.50
VET MEDICINE	HD.	1.00	1.00	1.000	3.15	3.15
MACH. FUEL & LUBE						1.75
MACHINERY REPAIR COST						1.38
EQUIPMENT REPAIR						0.04
TOTAL OPERATING COST						150.14
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT						-150.14
CAPITAL COST			PRICE	AMOUNT		VALUE
ANNUAL OPERATING CAPITAL			0.085	75.147		6.39
MACHINERY INVESTMENT			0.085	11.277		0.96
EQUIPMENT INVESTMENT			0.085	1.975		0.17
TOTAL INTEREST CHARGE						7.51
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT						-157.65
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)						
MACHINERY	DOL.					2.03
EQUIPMENT	DOL.					0.43
TOTAL OWNERSHIP COST						2.46
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT						-160.11
LABOR COSTS			PRICE	HOURS		
MACHINERY LABOR			3.000	1.380		4.14
LIVESTOCK LABOR			3.000	1.900		5.70
TOTAL LABOR COST				3.280		9.84
RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT						-169.95

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TABLE 83

ESTIMATED PER UNIT PRODUCTION COSTS FOR CHOICE MARCH STEERS, SOUTHWEST OKLAHOMA, 1977

PRODUCTION	UNITS	QUANITY	WEIGHT	PRICE	VALUE/UNIT	VALUE
STOCKER STEERS	CWT.	1.00	5.68	0.0	0.0	0.0
TOTAL RECEIPTS						0.0

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE
STR CALV(3-5) CH	CWT.	1.02	4.00	4.080	40.09	163.57
GRAZING	AUMS	2.12	1.00	2.120	0.0	0.0
STARTER FEED	CWT.	1.00	1.00	1.000	7.50	7.50
SALT & MIN.	LBS.	12.50	1.00	12.500	0.06	0.75
TRUCKING	HD.	1.00	1.00	1.000	2.35	2.35
SALES COMM.	HD.	1.00	1.00	1.000	4.80	4.80
VET MEDICINE	HD.	1.00	1.00	1.000	3.15	3.15
UTILITIES	HD.	0.15	1.00	0.150	1.00	0.15
MACH. FUEL & LUBE						1.14
MACHINERY REPAIR COST						0.90
EQUIPMENT REPAIR						0.39
TOTAL OPERATING COST						184.70
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT						-184.70

CAPITAL COST	PRICE	AMOUNT	VALUE
ANNUAL OPERATING CAPITAL	0.085	74.388	6.32
MACHINERY INVESTMENT	0.085	7.355	0.63
EQUIPMENT INVESTMENT	0.085	1.975	0.17
TOTAL INTEREST CHARGE			7.12
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT			-191.82

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)	UNITS	VALUE
MACHINERY	DOL.	1.33
EQUIPMENT	DOL.	0.43
TOTAL OWNERSHIP COST		1.75
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT		-193.57

LABOR COSTS	PRICE	HOURS	VALUE
MACHINERY LABOR	3.000	0.900	2.70
LIVESTOCK LABOR	3.000	1.350	4.05
TOTAL LABOR COST		2.250	6.75
RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT			-200.32

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TABLE 84

ESTIMATED PER UNIT PRODUCTION COSTS FOR CHOICE MAY STEERS, SOUTHWEST OKLAHOMA 1977

PRODUCTION	UNITS	QUANITY	WEIGHT	PRICE	VALUE/UNIT	VALUE
STOCKER STEERS	CWT.	1.00	5.68	0.0	0.0	0.0
TOTAL RECEIPTS						0.0
OPERATING INPUTS	**UNITS**	**RATE PER UNIT**	**NUMBER OF UNITS**	**TOTAL UNITS**	**PRICE**	**VALUE**
STR CALV(3-5) CH	CWT.	1.03	3.00	3.090	40.09	123.88
GRAZING	AUMS	2.86	1.00	2.860	0.0	0.0
STARTER FEED	CWT.	1.00	1.00	1.000	7.50	7.50
SALT & MIN.	LBS.	18.50	1.00	18.500	0.06	1.11
TRUCKING	HD.	1.00	1.00	1.000	2.35	2.35
SALES COMM.	HD.	1.00	1.00	1.000	5.10	5.10
VET & MED.	HD.	1.00	1.00	1.000	4.50	4.50
UTILITIES	HD.	0.15	1.00	0.150	1.00	0.15
MACH. FUEL & LUBE						1.75
MACHINERY REPAIR COST						1.38
EQUIPMENT REPAIR						0.39
TOTAL OPERATING COST						148.12
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT						-148.12
CAPITAL COST			**PRICE**	**AMOUNT**		**VALUE**
ANNUAL OPERATING CAPITAL			0.085	82.099		6.98
MACHINERY INVESTMENT			0.085	11.277		0.96
EQUIPMENT INVESTMENT			0.085	1.975		0.17
TOTAL INTEREST CHARGE						8.10
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT						-156.22
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)						
MACHINERY	DOL.					2.03
EQUIPMENT	DOL.					0.43
TOTAL OWNERSHIP COST						2.46
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT						-158.68
LABOR COSTS			**PRICE**	**HOURS**		
MACHINERY LABOR			3.000	1.380		4.14
LIVESTOCK LABOR			3.000	1.900		5.70
TOTAL LABOR COST				3.280		9.84
RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT						-168.52

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TABLE 85

ESTIMATED PER UNIT PRODUCTION COSTS FOR CHOICE SUMMER STEERS, SOUTHWEST OKLAHOMA, 1977

PRODUCTION	UNITS	QUANITY	WEIGHT	PRICE	VALUE/UNIT	VALUE
STRS (5-7) CH	CWT.	1.00	6.90	0.0	0.0	0.0
TOTAL RECEIPTS						0.0

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE
STR CALV(3-5) CH	CWT.	5.00	1.02	5.100	46.85	238.94
GRAZING	AUMS	2.38	1.00	2.380	0.0	0.0
SALT & MIN.	LBS.	12.50	1.00	12.500	0.06	0.75
VET & MED.	HD.	1.00	1.00	1.000	3.00	3.00
TRUCKING	CWT.	11.90	1.00	11.900	0.25	2.97
SALES COMM.	HD.	1.00	1.00	1.000	3.50	3.50
MACH. FUEL & LUBE						1.14
MACHINERY REPAIR COST						0.90
EQUIPMENT REPAIR						0.17
TOTAL OPERATING COST						251.38
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT						-251.38

CAPITAL COST	PRICE	AMOUNT	VALUE
ANNUAL OPERATING CAPITAL	0.085	101.891	8.66
MACHINERY INVESTMENT	0.085	7.355	0.63
EQUIPMENT INVESTMENT	0.085	0.875	0.07
TOTAL INTEREST CHARGE			9.36
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT			-260.74

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)	UNITS	VALUE
MACHINERY	DOL.	1.33
EQUIPMENT	DOL.	0.19
TOTAL OWNERSHIP COST		1.51
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT		-262.25

LABOR COSTS	PRICE	HOURS	VALUE
MACHINERY LABOR	3.000	0.900	2.70
LIVESTOCK LABOR	3.000	1.500	4.50
TOTAL LABOR COST		2.400	7.20
RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT			-269.45

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TABLE 86

ESTIMATED PRODUCTION COSTS PER ACRE OF UNIMPROVED NATIVE PASTURE, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
PASTURE	AUMS	0.0	1.250	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
2-4-D	TONS	1.250	0.250	0.31
TRACTOR FUEL & LUBE	ACRE			0.14
TRACTOR REPAIR COST	ACRE			0.09
EQUIP. REPAIR COST	ACRE			0.08
TOTAL OPERATING COST				0.63
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-0.63
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	0.052	0.00
TRACTOR INVESTMENT		0.085	1.404	0.12
EQUIPMENT INVESTMENT		0.085	2.177	0.19
TOTAL INTEREST CHARGE				0.31
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-0.94
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			0.18
EQUIPMENT	HR.			0.34
TOTAL OWNERSHIP COST				0.51
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-1.45
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.055	0.16
TOTAL LABOR COST			0.055	0.16
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-1.61

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TABLE 87

ESTIMATED PRODUCTION COSTS PER ACRE OF GRAZEOUT WHEAT, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
GRAZING	AUMS	0.0	2.200	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
WHEAT SEED	BU.	3.300	1.330	4.39
18-46-0 FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	60.000	12.00
TRACTOR FUEL & LUBE	ACRE			2.76
TRACTOR REPAIR COST	ACRE			1.86
EQUIP. REPAIR COST	ACRE			1.34
TOTAL OPERATING COST				31.35
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-31.35
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	11.018	0.94
TRACTOR INVESTMENT		0.085	29.308	2.49
EQUIPMENT INVESTMENT		0.085	16.331	1.39
TOTAL INTEREST CHARGE				4.82
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-36.16
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			3.58
EQUIPMENT	HR.			2.58
TOTAL OWNERSHIP COST				6.16
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-42.32
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.583	1.75
TOTAL LABOR COST			0.583	1.75
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-44.07

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TABLE 88

ESTIMATED PRODUCTION COSTS PER ACRE OF DRYLAND ALFALFA, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
ALFALFA HAY	TONS	0.0	3.470	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
ALFALFA SEED	LBS.	1.450	4.000	5.80
PHOSPH (P2O5)	LBS.	0.120	60.000	7.20
INSECTICIDE	ACRE	10.500	1.000	10.50
WINDROWER	ACRE	5.250	3.470	18.22
BALER	BL.	0.350	104.100	36.43
CUSTOM COMBINE	ACRE	10.000	1.000	10.00
TRACTOR FUEL & LUBE	ACRE			0.54
TRACTOR REPAIR COST	ACRE			0.35
EQUIP. REPAIR COST	ACRE			0.24
TOTAL OPERATING COST				89.29
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-89.29
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	31.420	2.67
TRACTOR INVESTMENT		0.085	5.254	0.45
EQUIPMENT INVESTMENT		0.085	6.986	0.59
TOTAL INTEREST CHARGE				3.71
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-93.00
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			0.66
EQUIPMENT	HR.			1.07
TOTAL OWNERSHIP COST				1.73
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-94.73
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.205	0.61
OTHER LABOR	HR.	3.000	0.300	0.90
TOTAL LABOR COST			0.505	1.51
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-96.24

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TABLE 89

ESTIMATED PRODUCTION COSTS PER ACRE OF DRYLAND BARLEY, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
BARLEY	BU.	0.0	47.700	0.0
GRAZING	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
BARLEY SEED	BU.	3.000	1.500	4.50
STARTER FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	50.000	10.00
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	47.700	4.77
TRACTOR FUEL & LUBE	ACRE			3.12
TRACTOR REPAIR COST	ACRE			2.10
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				42.54
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-42.54
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	16.939	1.44
TRACTOR INVESTMENT		0.085	33.042	2.81
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				5.80
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-48.34
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			4.04
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				6.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-55.27
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.657	1.97
TOTAL LABOR COST			0.657	1.97
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-57.24

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TABLE 90

ESTIMATED PRODUCTION COSTS PER ACRE OF DRYLAND OATS, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
OATS	BU.	0.0	94.000	0.0
S.G. PASTURE	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
OAT SEED	BU.	2.800	2.000	5.60
18-46-0 FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	60.000	12.00
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	94.000	9.40
TRACTOR FUEL & LUBE	ACRE			1.41
TRACTOR REPAIR COST	ACRE			0.92
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				47.39
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-47.39
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	15.741	1.34
TRACTOR INVESTMENT		0.085	13.753	1.17
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				4.06
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-51.45
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			1.72
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				4.61
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-56.06
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.536	1.61
TOTAL LABOR COST			0.536	1.61
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-57.67

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TABLE 91

ESTIMATED PRODUCTION COSTS PER ACRE OF DRYLAND COTTON, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
COTTON LINT	LBS.	0.0	455.200	0.0
COTTON SEED	LBS.	0.0	906.000	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
COTTON SEED	LBS.	0.270	15.000	4.05
STARTER FERT	LBS.	0.100	100.000	10.00
PRE-MERGE HERB	LBS.	6.650	0.600	3.99
INSECTICIDE	ACRE	6.000	5.000	30.00
PROCESSING COST	CWT.	1.000	20.030	20.03
BAG, TIES, CKOFF	BL.	9.600	0.910	8.74
CUSTOM STRIP	LBS.	0.060	455.200	27.31
TRACTOR FUEL & LUBE	ACRE			4.94
TRACTOR REPAIR COST	ACRE			3.22
EQUIP. REPAIR COST	ACRE			3.10
TOTAL OPERATING COST				115.38
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-115.38
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	27.609	2.35
TRACTOR INVESTMENT		0.085	48.095	4.09
EQUIPMENT INVESTMENT		0.085	51.511	4.38
TOTAL INTEREST CHARGE				10.81
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-126.19
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			6.03
EQUIPMENT	HR.			7.91
TOTAL OWNERSHIP COST				13.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-140.13
LABOR COST:				
MACHINERY LABOR	HR.	3.000	1.874	5.62
TOTAL LABOR COST			1.874	5.62
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-145.75

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TABLE 92

ESTIMATED PRODUCTION COSTS PER ACRE OF COTTON USING WELL IRRIGATION ON CLAY LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
COTTON LINT	LBS.	0.0	626.300	0.0
COTTON SEED	CWT.	0.0	13.570	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
COTTON SEED	LBS.	0.400	25.000	10.00
HERBICIDE	ACRE	9.750	0.800	7.80
NITROGEN (N)	LBS.	0.200	60.000	12.00
PHOSPH (P2O5)	LBS.	0.120	57.000	6.84
INSECTICIDE	ACRE	6.000	6.000	36.00
PROCESSING COST	CWT.	1.000	27.560	27.56
BAG, TIES, CKOFF	BL.	9.600	1.250	12.00
HAND HOEING	HR.	3.000	1.000	3.00
COTTONPICKER	LBS.	0.060	626.300	37.58
TRACTOR FUEL & LUBE	ACRE			9.52
TRACTOR REPAIR COST	ACRE			6.40
EQUIP. REPAIR COST	ACRE			2.97
IRRIG. FUEL & LUBE	ACRE			18.36
IRRIG. REPAIR COST	ACRE			2.52
TOTAL OPERATING COST				192.55
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT				-192.55
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	54.718	4.65
TRACTOR INVESTMENT		0.085	100.963	8.58
EQUIPMENT INVESTMENT		0.085	55.168	4.69
IRRIGATION SYSTEM INVESTMENT		0.085	93.176	7.92
TOTAL INTEREST CHARGE				25.84
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-218.39
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			12.35
EQUIPMENT	HR.			8.64
IRRIGATION SYSTEM	HR.			10.44
TOTAL OWNERSHIP COST				31.42
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-249.81
LABOR COST:				
MACHINERY LABOR	HR.	3.000	2.007	6.02
OTHER LABOR	HR.	3.000	0.400	1.20
IRRIGATION LABOR	HR.	3.000	2.214	6.64
TOTAL LABOR COST			4.621	13.86
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-263.68

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TABLE 93

ESTIMATED PRODUCTION COSTS PER ACRE OF DRYLAND GRAIN SORGHUM, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
MILO	CWT.	0.0	21.400	0.0
SORGHUM STUBBLE	AUMS	0.0	0.200	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
GRAIN SORG SEED	LBS.	0.340	5.000	1.70
NITROGEN (N)	LBS.	0.200	40.000	8.00
PHOSPH (P205)	LBS.	0.120	30.000	3.60
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	CWT.	0.200	21.400	4.28
TRACTOR FUEL & LUBE	ACRE			4.37
TRACTOR REPAIR COST	ACRE			2.94
EQUIP. REPAIR COST	ACRE			1.41
TOTAL OPERATING COST				33.80
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-33.80
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	10.422	0.89
TRACTOR INVESTMENT		0.085	46.325	3.94
EQUIPMENT INVESTMENT		0.085	27.712	2.36
TOTAL INTEREST CHARGE				7.18
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-40.98
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			5.67
EQUIPMENT	HR.			4.37
TOTAL OWNERSHIP COST				10.03
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-51.01
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.921	2.76
TOTAL LABOR COST			0.921	2.76
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-53.77

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TABLE 94

ESTIMATED PRODUCTION COSTS PER ACRE OF GRAIN SORGHUM USING WELL IRRIGATION ON CLAY LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
MILO	CWT.	0.0	40.100	0.0
SORGHUM STUBBLE	AUMS	0.0	0.300	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
GRAIN SORG SEED	LBS.	0.340	8.000	2.72
HERBICIDE	LBS.	4.500	1.000	4.50
ANHYDROUS AMMON	LBS.	0.100	100.000	10.00
PHOSPH (P2O5)	LBS.	0.120	40.000	4.80
INSECTICIDE	ACRE	4.500	2.000	9.00
CUSTOM COMBINE	ACRE	8.500	1.000	8.50
CUSTOM HAULING	ACRE	0.200	40.100	8.02
TRACTOR FUEL & LUBE	ACRE			7.88
TRACTOR REPAIR COST	ACRE			5.30
EQUIP. REPAIR COST	ACRE			2.64
IRRIG. FUEL & LUBE	ACRE			16.32
IRRIG. REPAIR COST	ACRE			2.24
TOTAL OPERATING COST				81.93
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-81.93
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	29.016	2.47
TRACTOR INVESTMENT		0.085	83.577	7.10
EQUIPMENT INVESTMENT		0.085	49.171	4.18
IRRIGATION SYSTEM INVESTMENT		0.085	82.824	7.04
TOTAL INTEREST CHARGE				20.79
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-102.72
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			10.22
EQUIPMENT	HR.			7.70
IRRIGATION SYSTEM	HR.			9.28
TOTAL OWNERSHIP COST				27.20
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-129.92
LABOR COST:				
MACHINERY LABOR	HR.	3.000	1.662	4.98
OTHER LABOR	HR.	3.000	0.600	1.80
IRRIGATION LABOR	HR.	3.000	1.968	5.90
TOTAL LABOR COST			4.230	12.69
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-142.60

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TABLE 95

ESTIMATED PRODUCTION COSTS PER ACRE OF DRYLAND WHEAT, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
WHEAT	BU.	0.0	47.000	0.0
GRAZING	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
WHEAT SEED	BU.	3.300	1.000	3.30
18-46-0 FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	50.000	10.00
SPRAYER	ACRE	3.150	1.000	3.15
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	47.000	4.70
TRACTOR FUEL & LUBE	ACRE			3.12
TRACTOR REPAIR COST	ACRE			2.10
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				44.42
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-44.42
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	17.089	1.45
TRACTOR INVESTMENT		0.085	33.042	2.81
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				5.82
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-50.23
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			4.04
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				6.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-57.16
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.657	1.97
TOTAL LABOR COST			0.657	1.97
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-59.13

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TABLE 96

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE DRYLAND BARLEY, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
BARLEY	BU.	0.0	47.700	0.0
GRAZING	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
BARLEY SEED	BU.	3.000	1.500	4.50
STARTER FERT	CWT.	9.000	0.670	6.03
NITROGEN (N)	LBS.	0.200	33.500	6.70
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	47.700	4.77
TRACTOR FUEL & LUBE	ACRE			3.12
TRACTOR REPAIR COST	ACRE			2.10
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				36.27
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-36.27
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	13.611	1.16
TRACTOR INVESTMENT		0.085	33.042	2.81
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				5.52
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-41.79
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			4.04
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				6.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-48.71
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.657	1.97
TOTAL LABOR COST			0.657	1.97
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-50.68

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TABLE 97

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE DRYLAND OATS, LOAM-SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
OATS	BU.	0.0	94.000	0.0
S.G. PASTURE	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
OAT SEED	BU.	2.800	2.000	5.60
18-46-0 FERT	CWT.	9.000	0.670	6.03
NITROGEN (N)	LBS.	0.200	40.200	8.04
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	94.000	9.40
TRACTOR FUEL & LUBE	ACRE			1.41
TRACTOR REPAIR COST	ACRE			0.92
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				40.46
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-40.46
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	12.441	1.06
TRACTOR INVESTMENT		0.085	13.753	1.17
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				3.78
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-44.24
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			1.72
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				4.61
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-48.85
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.536	1.61
TOTAL LABOR COST			0.536	1.61
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-50.46

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TABLE 98

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE DRYLAND COTTON, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
COTTON LINT	LBS.	0.0	455.200	0.0
COTTON SEED	LBS.	0.0	906.000	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
COTTON SEED	LBS.	0.270	15.000	4.05
STARTER FERT	LBS.	0.100	75.000	7.50
PRE-MERGE HERB	LBS.	6.650	0.450	2.99
INSECTICIDE	ACRE	6.000	3.750	22.50
PROCESSING COST	CWT.	1.000	15.022	15.02
BAG, TIES, CKOFF	BL.	9.600	0.683	6.55
CUSTOM STRIP	LBS.	0.060	455.200	27.31
TRACTOR FUEL & LUBE	ACRE			4.94
TRACTOR REPAIR COST	ACRE			3.22
EQUIP. REPAIR COST	ACRE			3.10
TOTAL OPERATING COST				97.19
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-97.19
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	22.944	1.95
TRACTOR INVESTMENT		0.085	48.095	4.09
EQUIPMENT INVESTMENT		0.085	51.511	4.38
TOTAL INTEREST CHARGE				10.42
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-107.61
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			6.03
EQUIPMENT	HR.			7.91
TOTAL OWNERSHIP COST				13.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-121.54
LABOR COST:				
MACHINERY LABOR	HR.	3.000	1.874	5.62
TOTAL LABOR COST			1.874	5.62
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-127.16

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TABLE 99

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE COTTON USING WELL IRRIGATION ON CLAY LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
COTTON LINT	LBS.	0.0	626.300	0.0
COTTON SEED	CWT.	0.0	13.570	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
COTTON SEED	LBS.	0.400	25.000	10.00
HERBICIDE	ACRE	9.750	0.600	5.85
NITROGEN (N)	LBS.	0.200	45.000	9.00
PHOSPH (P205)	LBS.	0.120	42.750	5.13
INSECTICIDE	ACRE	6.000	4.500	27.00
PROCESSING COST	CWT.	1.000	20.670	20.67
BAG, TIES, CKOFF	BL.	9.600	0.938	9.00
HAND HOEING	HR.	3.000	1.000	3.00
COTTONPICKER	LBS.	0.060	626.300	37.58
TRACTOR FUEL & LUBE	ACRE			9.52
TRACTOR REPAIR COST	ACRE			6.40
EQUIP. REPAIR COST	ACRE			2.97
IRRIG. FUEL & LUBE	ACRE			18.36
IRRIG. REPAIR COST	ACRE			2.52
TOTAL OPERATING COST				167.00
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-167.00
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	46.880	3.98
TRACTOR INVESTMENT		0.085	100.963	8.58
EQUIPMENT INVESTMENT		0.085	55.168	4.69
IRRIGATION SYSTEM INVESTMENT		0.085	93.176	7.92
TOTAL INTEREST CHARGE				25.18
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-192.18
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			12.35
EQUIPMENT	HR.			8.64
IRRIGATION SYSTEM	HR.			10.44
TOTAL OWNERSHIP COST				31.42
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-223.60
LABOR COST:				
MACHINERY LABOR	HR.	3.000	2.007	6.02
OTHER LABOR	HR.	3.000	0.400	1.20
IRRIGATION LABOR	HR.	3.000	2.214	6.64
TOTAL LABOR COST			4.621	13.86
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-237.46

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TABLE 100

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE DRYLAND GRAIN SORGHUM, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
MILO	CWT.	0.0	21.400	0.0
SORGHUM STUBBLE	AUMS	0.0	0.200	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
GRAIN SORG SEED	LBS.	0.340	5.000	1.70
NITROGEN (N)	LBS.	0.200	26.800	5.36
PHOSPH (P2O5)	LBS.	0.120	20.100	2.41
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	CWT.	0.200	21.400	4.28
TRACTOR FUEL & LUBE	ACRE			4.37
TRACTOR REPAIR COST	ACRE			2.94
EQUIP. REPAIR COST	ACRE			1.41
TOTAL OPERATING COST				29.97
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-29.97
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	8.508	0.72
TRACTOR INVESTMENT		0.085	46.325	3.94
EQUIPMENT INVESTMENT		0.085	27.712	2.36
TOTAL INTEREST CHARGE				7.02
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-36.99
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			5.67
EQUIPMENT	HR.			4.37
TOTAL OWNERSHIP COST				10.03
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-47.02
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.921	2.76
TOTAL LABOR COST			0.921	2.76
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-49.78

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TABLE 101

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE GRAIN SORGHUM USING WELL IRRIGATION ON CLAY LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
MILO	CWT.	0.0	40.100	0.0
SORGHUM STUBBLE	AUMS	0.0	0.300	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
GRAIN SORG SEED	LBS.	0.340	8.000	2.72
HERBICIDE	LBS.	4.500	0.670	3.01
ANHYDROUS AMMON	LBS.	0.100	67.000	6.70
PHOSPH (P205)	LBS.	0.120	26.800	3.22
INSECTICIDE	ACRE	4.500	1.340	6.03
CUSTOM COMBINE	ACRE	8.500	1.000	8.50
CUSTOM HAULING	ACRE	0.200	40.100	8.02
TRACTOR FUEL & LUBE	ACRE			7.88
TRACTOR REPAIR COST	ACRE			5.30
EQUIP. REPAIR COST	ACRE			2.64
IRRIG. FUEL & LUBE	ACRE			16.32
IRRIG. REPAIR COST	ACRE			2.24
TOTAL OPERATING COST				72.59
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-72.59
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	24.187	2.06
TRACTOR INVESTMENT		0.085	83.577	7.10
EQUIPMENT INVESTMENT		0.085	49.171	4.18
IRRIGATION SYSTEM INVESTMENT		0.085	82.824	7.04
TOTAL INTEREST CHARGE				20.38
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-92.97
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			10.22
EQUIPMENT	HR.			7.70
IRRIGATION SYSTEM	HR.			9.28
TOTAL OWNERSHIP COST				27.20
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-120.17
LABOR COST:				
MACHINERY LABOR	HR.	3.000	1.662	4.98
OTHER LABOR	HR.	3.000	0.600	1.80
IRRIGATION LABOR	HR.	3.000	1.968	5.90
TOTAL LABOR COST			4.230	12.69
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-132.85

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TABLE 102

ESTIMATED PRODUCTION COSTS PER ACRE OF CROP-SHARE DRYLAND WHEAT, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
WHEAT	BU.	0.0	47.000	0.0
GRAZING	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
WHEAT SEED	BU.	3.300	1.000	3.30
18-46-0 FERT	CWT.	9.000	0.670	6.03
NITROGEN (N)	LBS.	0.200	33.500	6.70
SPRAYER	ACRE	3.150	0.670	2.11
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	47.000	4.70
TRACTOR FUEL & LUBE	ACRE			3.12
TRACTOR REPAIR COST	ACRE			2.10
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				37.11
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-37.11
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	13.415	1.14
TRACTOR INVESTMENT		0.085	33.042	2.81
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				5.50
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-42.61
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			4.04
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				6.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-49.54
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.657	1.97
TOTAL LABOR COST			0.657	1.97
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-51.51

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TABLE 103

ESTIMATED PRODUCTION COSTS PER ACRE OF CASH RENT DRYLAND BARLEY, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
BARLEY	BU.	0.0	47.700	0.0
GRAZING	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
BARLEY SEED	BU.	3.000	1.500	4.50
STARTER FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	50.000	10.00
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	47.700	4.77
TRACTOR FUEL & LUBE	ACRE			3.12
TRACTOR REPAIR COST	ACRE			2.10
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				67.94
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT				-67.94
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	40.222	3.42
TRACTOR INVESTMENT		0.085	33.042	2.81
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				7.78
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-75.72
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			4.04
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				6.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-82.64
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.657	1.97
TOTAL LABOR COST			0.657	1.97
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-84.62

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TABLE 104

ESTIMATED PRODUCTION COSTS PER ACRE OF CASH RENT DRYLAND OATS, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
OATS	BU.	0.0	94.000	0.0
S.G. PASTURE	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
OAT SEED	BU.	2.800	2.000	5.60
18-46-0 FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	60.000	12.00
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	94.000	9.40
TRACTOR FUEL & LUBE	ACRE			1.41
TRACTOR REPAIR COST	ACRE			0.92
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				72.79
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-72.79
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	39.024	3.32
TRACTOR INVESTMENT		0.085	13.753	1.17
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				6.04
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-78.83
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			1.72
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				4.61
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-83.44
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.536	1.61
TOTAL LABOR COST			0.536	1.61
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-85.04

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TABLE 105

ESTIMATED PRODUCTION COSTS PER ACRE OF CASH RENT DRYLAND COTTON, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
COTTON LINT	LBS.	0.0	455.200	0.0
COTTON SEED	LBS.	0.0	906.000	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
COTTON SEED	LBS.	0.270	15.000	4.05
STARTER FERT	LBS.	0.100	100.000	10.00
PRE-MERGE HERB	LBS.	6.650	0.600	3.99
INSECTICIDE	ACRE	6.000	5.000	30.00
PROCESSING COST	CWT.	1.000	20.030	20.03
BAG, TIES, CKOFF	BL.	9.600	0.910	8.74
CUSTOM STRIP	LBS.	0.060	455.200	27.31
TRACTOR FUEL & LUBE	ACRE			4.94
TRACTOR REPAIR COST	ACRE			3.22
EQUIP. REPAIR COST	ACRE			3.10
TOTAL OPERATING COST				140.78
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-140.78
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	50.892	4.33
TRACTOR INVESTMENT		0.085	48.095	4.09
EQUIPMENT INVESTMENT		0.085	51.511	4.38
TOTAL INTEREST CHARGE				12.79
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-153.57
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			6.03
EQUIPMENT	HR.			7.91
TOTAL OWNERSHIP COST				13.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-167.50
LABOR COST:				
MACHINERY LABOR	HR.	3.000	1.874	5.62
TOTAL LABOR COST			1.874	5.62
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-173.13

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TABLE 106

ESTIMATED PRODUCTION COSTS PER ACRE OF COTTON ON CASH RENT LAND USING WELL IRRIGATION ON CLAY LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
COTTON LINT	LBS.	0.0	626.300	0.0
COTTON SEED	CWT.	0.0	13.570	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
COTTON SEED	LBS.	0.400	25.000	10.00
HIRBICIDE	ACRE	9.750	0.800	7.80
NITROGEN (N)	LBS.	0.200	60.000	12.00
PHOSPH (P205)	LBS.	0.120	57.000	6.84
INSECTICIDE	ACRE	6.000	6.000	36.00
PROCESSING COST	CWT.	1.000	27.560	27.56
BAG, TIES, CKOFF	BL.	9.600	1.250	12.00
HAND HOEING	HR.	3.000	1.000	3.00
COTTONPICKER	LBS.	0.060	626.300	37.58
TRACTOR FUEL & LUBE	ACRE			9.52
TRACTOR REPAIR COST	ACRE			6.40
EQUIP. REPAIR COST	ACRE			2.97
IRRIG. FUEL & LUBE	ACRE			18.36
IRRIG. REPAIR COST	ACRE			2.52
TOTAL OPERATING COST				217.95
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-217.95
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	78.002	6.63
TRACTOR INVESTMENT		0.085	100.963	8.58
EQUIPMENT INVESTMENT		0.085	55.168	4.69
IRRIGATION SYSTEM INVESTMENT		0.085	93.176	7.92
TOTAL INTEREST CHARGE				27.82
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-245.77
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			12.35
EQUIPMENT	HR.			8.64
IRRIGATION SYSTEM	HR.			10.44
TOTAL OWNERSHIP COST				31.42
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-277.19
LABOR COST:				
MACHINERY LABOR	HR.	3.000	2.007	6.02
OTHER LABOR	HR.	3.000	0.400	1.20
IRRIGATION LABOR	HR.	3.000	2.214	6.64
TOTAL LABOR COST			4.621	13.86
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-291.06

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TABLE 107

ESTIMATED PRODUCTION COSTS PER ACRE OF CASH RENT DRYLAND GRAIN SORGHUM, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
MILO	CWT.	0.0	21.400	0.0
SORGHUM STUBBLE	AUMS	0.0	0.200	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
GRAIN SORG SEED	LBS.	0.340	5.000	1.70
NITROGEN (N)	LBS.	0.200	40.000	8.00
PHOSPH (P2O5)	LBS.	0.120	30.000	3.60
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	CWT.	0.200	21.400	4.28
TRACTOR FUEL & LUBE	ACRE			4.37
TRACTOR REPAIR COST	ACRE			2.94
EQUIP. REPAIR COST	ACRE			1.41
TOTAL OPERATING COST				59.20
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-59.20
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	33.706	2.86
TRACTOR INVESTMENT		0.085	46.325	3.94
EQUIPMENT INVESTMENT		0.085	27.712	2.36
TOTAL INTEREST CHARGE				9.16
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-68.36
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			5.67
EQUIPMENT	HR.			4.37
TOTAL OWNERSHIP COST				10.03
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-78.39
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.921	2.76
TOTAL LABOR COST			0.921	2.76
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-81.15

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TABLE 108

ESTIMATED PRODUCTION COSTS PER ACRE OF GRAIN SORGHUM ON CASH RENT LAND USING WELL IRRIGATION ON CLAY LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
MILO	CWT.	0.0	40.100	0.0
SORGHUM STUBBLE	AUMS	0.0	0.300	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
GRAIN SORG SEED	LBS.	0.340	8.000	2.72
HERBICIDE	LBS.	4.500	1.000	4.50
ANHYDROUS AMMON	LBS.	0.100	100.000	10.00
PHOSPH (P205)	LBS.	0.120	40.000	4.80
INSECTICIDE	ACRE	4.500	2.000	9.00
CUSTOM COMBINE	ACRE	8.500	1.000	8.50
CUSTOM HAULING	ACRE	0.200	40.100	8.02
TRACTOR FUEL & LUBE	ACRE			7.88
TRACTOR REPAIR COST	ACRE			5.30
EQUIP. REPAIR COST	ACRE			2.64
IRRIG. FUEL & LUBE	ACRE			16.32
IRRIG. REPAIR COST	ACRE			2.24
TOTAL OPERATING COST				107.33
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-107.33
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	52.300	4.45
TRACTOR INVESTMENT		0.085	83.577	7.10
EQUIPMENT INVESTMENT		0.085	49.171	4.18
IRRIGATION SYSTEM INVESTMENT		0.085	82.824	7.04
TOTAL INTEREST CHARGE				22.77
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-130.09
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			10.22
EQUIPMENT	HR.			7.70
IRRIGATION SYSTEM	HR.			9.28
TOTAL OWNERSHIP COST				27.20
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-157.29
LABOR COST:				
MACHINERY LABOR	HR.	3.000	1.662	4.98
OTHER LABOR	HR.	3.000	0.600	1.80
IRRIGATION LABOR	HR.	3.000	1.968	5.90
TOTAL LABOR COST			4.230	12.69
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-169.98

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TABLE 109

ESTIMATED PRODUCTION COSTS PER ACRE OF CASH RENT DRYLAND WHEAT, LOAM SOILS, SOUTHWEST OKLAHOMA, 1977

CATEGORY	UNITS	PRICE	QUANTITY	VALUE
PRODUCTION:				
WHEAT	BU.	0.0	47.000	0.0
GRAZING	AUMS	0.0	0.700	0.0
TOTAL RECEIPTS				0.0
OPERATING INPUTS:				
LAND RENT	DOL.	25.400	1.000	25.40
WHEAT SEED	BU.	3.300	1.000	3.30
18-46-0 FERT	CWT.	9.000	1.000	9.00
NITROGEN (N)	LBS.	0.200	50.000	10.00
SPRAYER	ACRE	3.150	1.000	3.15
CUSTOM COMBINE	ACRE	7.500	1.000	7.50
CUSTOM HAULING	BU.	0.100	47.000	4.70
TRACTOR FUEL & LUBE	ACRE			3.12
TRACTOR REPAIR COST	ACRE			2.10
EQUIP. REPAIR COST	ACRE			1.56
TOTAL OPERATING COST				69.82
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-69.82
CAPITAL COST:				
ANNUAL OPERATING CAPITAL		0.085	40.372	3.43
TRACTOR INVESTMENT		0.085	33.042	2.81
EQUIPMENT INVESTMENT		0.085	18.295	1.56
TOTAL INTEREST CHARGE				7.80
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-77.61
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)				
TRACTOR	HR.			4.04
EQUIPMENT	HR.			2.88
TOTAL OWNERSHIP COST				6.93
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-84.54
LABOR COST:				
MACHINERY LABOR	HR.	3.000	0.657	1.97
TOTAL LABOR COST			0.657	1.97
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-86.51

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VITA

Tillak Persaud

Candidate for the Degree of

Doctor of Philosophy

Thesis: EVALUATING RISK MANAGEMENT STRATEGIES IN A FARM PLANNING MODEL

Major Field: Agricultural Economics

Biographical:

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