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Economic Analysis of Dryland Wheat Tillage Practices in Box Elder County, Utah

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ECONOMIC ANALYSIS OF DRYLAND WHEAT TILLAGE

PRACTICES IN BOX ELDER COUNTY, UTAH

by

Michael Dale Bond

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ABSTRACT

Economic Analysis of Dryland Wheat Tillage

Methods in Box Elder County, Utah

by

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The purpose of this study was to determine the economic viability of various dryland wheat tillage systems, many of which were developed from years of cooperative research efforts.

In the study three conventional tillage methods were analyzed along with ten conservation tillage practices. The study farm consisted of 2000 acres, of which 1000 acres are classified as land 1 and its wheat yield is assumed to be 35 bushels per acre for non-continuous tillage methods and 23 bushels per acre for continuous tillage methods. The remaining 1000 acres are classed as land 2 and its assumed wheat yield is 30 bushels per acre for non-continuous tillage methods and 20 bushels per acre for continuous tillage practices.

The farm operating conditions were changed to allow for an economic evaluation of questions that a dryland farmer

would face. Questions such as: 1. do no-till chemical-fallow treatments have higher profits than do conventional tillage treatments; 2. will it pay for my farming enterprise to participate in the 1990 Farm Bills' Acreage Reduction Program (ARP); 3. what effect will be on returns to land, labor and management of a new 20-ft combine purchase, were analyzed using the Cost and Return Estimator (CARE) computer enterprise budgeting program developed for USDA-Soil Conservation Service (SCS) for each land class totaling 104 CARE budgets.

A computer linear programming optimization model was run using LINDO to examine the 104 CARE budgets for an optimal tillage practice. The results are as follows:

1. Under the study assumptions chemical-fallow (no-till) treatments have higher profits than do conventional tillage treatments, if conventional tillage equipment can be adapted to no-till tillage methods.

2. Participation in the government ARP set-aside will offset the higher machinery ownership costs and thus it would pay to participate.

3. The purchase of a new 20-ft combine or no-till Yielder drill as well as other major purchases could bankrupt a farming enterprise. It should be handled with CARE.

(106 pages)

CHAPTER I

INTRODUCTION

Traditional agricultural practices are coming under increasing environmental pressure to change to agricultural methods that reduce environmentally sensitive factors such as:

1. Soil erosion
2. Energy usage
3. Chemical use
4. Water use
5. Dust and other airborne nuisances.

The 1985 Food Security Act (FSA), commonly called the "1985 Farm Bill," reflected concern over soil erosion in its cross-compliance conservation requirements on Highly Erodible Land (HEL). In order to comply with the 1985 FSA and to increase their yields, many of Utah's dryland wheat farmers altered their tillage practices. The Food, Agriculture, Conservation and Trade Act (FACT), or 1990 Farm Bill, made minor changes to the 1985 Farm Bill but retained and strengthened the environmental and conservation provisions of the previous bill.

General Background Information

An individual farmer is a business manager, and like other business managers a farmer makes decisions based on information. In Figure 1, some sources of information or "signals" are shown.

Figure 1. Agricultural policy mix
Sources: Creason and Runge

The market environment provides prices directly (demand) or indirectly (derived demand) for commodities and inputs. Market prices provide basic information to the farmer to produce a crop. As an economic signal, prices are reasonably understood. Higher prices stimulate greater output, whereas lower prices signal the farmer to reduce output. Market prices reflect the forces of supply and demand at work, sometimes creating boom and bust business cycles. This instability is largely attributed to the inelastic nature of the supply and demand for agricultural products.

Farmers are price takers and can neither control prices nor automatically pass increases in costs to consumers. Agricultural prices and incomes are inherently unstable. Price instability leading to income instability is one reason many would use to justify a second source of signals, that of the United States Government.

Agricultural Policy

Since the Great Depression era of the 1930's U.S. agricultural policy has generally tried to reduce the problems associated with farm income instability. Again, we need to bring out the problems associated with an inelastic demand, meaning that people do not buy much more food when food prices fall. An inelastic supply means that farmers do not generally cut back on production when prices fall. With the farmers' continuous adoption of new technology, the result has been an increase in aggregate food production. This aggravates the problems of surplus production, which results in the accumulation of very large commodity stocks, falling prices, and reduced farm income.

The interaction between an inelastic demand and inelastic supply results in wild farm price gyrations. Short supplies generate very high prices. Surpluses, mean low prices and instability make correct farm management decisions difficult.

To address these problems the U.S. government passed some programs during the 1930's as temporary measures. These programs increased the prices for specific program crops such as corn and wheat to sustain farm income. Soon the temporary measures became fixed. The crop program target prices were manipulated by the U.S. government to provide income support, and thus income stability. By the 1950's an excess supply of program crops needed to be addressed and conservation became the justification to create supply restraint programs such as the "Soil Bank" and Conservation Reserve Program (CRP) (Creason and Runge).

The competitive market structure is an economic system which provides an environment for farmers and others to produce products. An economic or pricing system has been developed within the competitive economic system which transfers goods and services from the producers to consumers.

This economic system does not always allocate economic costs efficiently; one example is environmental depreciation such as soil erosion. An important note is that environmental depreciation does not always occur. A characteristic of soil erosion is that damage is not exclusive, meaning that a farmer is not the only agent who suffers damage from soil erosion. Soil erosion may contribute to water quality problems. Future generations may suffer lower crop yields from present soil erosion problems. The inherent failure of the market to price for environmental depreciation has caused some to demand state and federal government environmental regulations as one of the many tools in dealing with externalities. Justifying government regulations in dealing with the problem of externalities is beyond the scope of this study; however, government regulations are one of the methods used in the United States in dealing with externalities.

Government environmental restrictions such as limiting fertilizer applications, setting low soil erosion loss levels restraints, strict water quality standards, clean air standards, and restrictive pesticide use may also drive up marginal costs on the farm. These control measures may also decrease yields.

In a competitive market, farmers are price takers, because the farmer as an individual cannot set or influence the market price. The market price in this case is assumed to be the marginal revenue for the farmer. A farmer as a profit maximizer should manage his farm such that his marginal costs are not higher than the market price at the marginal level of activity. In this study the farmer is assumed to operate a profit maximizing business entity, that is, a farmer is assumed to produce where his controllable marginal costs (MC) equate to an estimated and uncontrollable marginal revenue (MR) or simply MC=MR. The farmer must make a forecast of market price, then decide if his or her costs are exceeded.

The environmental restrictions may raise marginal costs, costs that cannot be passed on to end users. Income support programs encourage higher production which raises the MR to an artificially high level. The farmer is now producing in a competitive market where inelastic supply and demand are at work.

Changing Technology

The traditional role of the private sector as well as university and extension agencies has been to find and disseminate new ways to improve crop yields that increase production. The farmer receives information or recommendations from University Extension offices, private consultants, feed dealers, fertilizer sales-persons, other farmers, national farm organizations and others. Some information concerns changes in technology. This change in technology usually reduces costs per unit of production. At the present time farmers need more information on crop yields, as well as "conservation" practices and the associated economic questions.

Years of research on topics such as soil losses, plant genetics, soil fertility, water requirements, conservation program, tillage methods, and fertilizer placement studies have been conducted. That costly research shows the physical aspects of growing crops. The additional information that farmers now need answers an economic question, would conservation tillage be profitable for my enterprise?

Justification

The 1990 Farm Bill modified the 1985 Farm Bill. Modifications such as freezing wheat target price at $4.00/bu for each of the 1991-1995 crops, and reducing the potential payment acreage by 15 percent of the crop acreage base are a few of the changes that were made. These modifications as well as other changes affect government payments to the producers. One of the critical issues during the 1981 and 1985 programs was for mid-sized dryland wheat farmers to participate in government programs for financial survival (Helms, Bailey, and Glover). The 1990 program lowers target prices and reduces payment acreage, forcing greater pressures on farm managers to make correct decisions.

Farmers need the information that a detailed enterprise budget can provide to make decisions in a dynamic market setting. This study compares the economic returns to management, land, and labor among tillage practices that wheat farmers can use. It also compares the effects of the tillage practices on the farmers' ability to meet the conservation requirements of the 1990 Farm Bill. Conservation practices may reduce damage to land, water and environmental resources.

A study by Helms, Bailey, and Glover addresses the issue of whether participation in specific government programs (set-aside and commodity loans) would significantly affect investments by dryland wheat farmers in new tillage technology and methods. Since the above study has investigated producer preferences for the adoption of tillage practices and preferences for participation or nonparticipation in the government programs under the 1981 and 1985 farm bills, questions about a risk analysis should be referred to this study as well as a study by Holmgren on the 1985 farm bill.

CHAPTER II

REVIEW OF LITERATURE

This chapter reviews the literature where linear programming methods have been used to analyze agricultural related decisions. The chapter is divided into two sections. The first part deals with a survey of the development of linear programming. The second section is a review of some of the large numbers of applications using linear programming.

Linear Programming

It has been over fifty years since British scientists began to work with a system to allocate the limited war resources in a optimal manner (Heady and Candler; Taha). Since that time agricultural economists and others have utilized, refined and expanded the linear programming methods for decision-making analyses (Hazell and Norton; Heady and Candler).

Dantzig in 1949 identified a model that was, " ... set of linear equations expressing the conditions which must be satisfied by the various levels of activity, X_i, in the dynamic system" (page 73). He also restricted the constraint variables to greater-than, less-than or equal to zero values. During the same year Koopmans reported, "The model specifies a number of productive activities, each of which is characterized by constant ratios between the quantities of goods (and services) absorbed and produced thereby" (page 74).

He goes on to say that "...the number of possible activities exceeds the number of desired end-products, thus permitting choice and substitution between production methods" (page 74).

Applications of Linear Programming

The decade of the 1950's brought about the application of linear programming to the agricultural sector. Much of the literature was "recipe or cook-book," such as the 1951 work by Waugh, "The Minimum-Cost Dairy Feed: An Application of Linear Programming." Waugh demonstrated in a linear programming model that the minimum nutrients required by dairy cows for milk production and maintenance could be met.

Boles used linear programming technology in a California farm management problem. He directed the model to find optimal resource allocations for a farm enterprise to maximize net cash returns. Cotton, potatoes, alfalfa, sugar beets and barley were the chosen crops. He used crop budgets in determining input values (per acre) for the model. A shortrun time frame was assumed whereby many assets were held fixed. In his analysis he introduced marginal value productivities of owned resources (land, labor and capital) as "shadow prices" for "an evaluation made as to the importance of removing that bottle-neck or limitation" (page 19). This innovation helped in answering long-run problems, such as farm expansion.

Swanson used linear programming techniques to develop a least-cost Illinois hog-feed ration. Unlike the earlier work by Waugh, Swanson allowed the price to change nonproportionally between his chosen ingredients, allowing for even greater flexibility in the model.

By 1956 crop rotations were combined with livestock enterprises to be analyzed using linear programming methods. Swanson incorporated corn-soybeans-oats-clover combinations with various yields for a corn-belt farm. Corn silage and hay were examined. All crops could be utilized for feed rations for hogs and/or calves or sold on the market. Objective function coefficients for pasture and corn silage were valued at zero, allowing the model to account for these activities. Some costs (e.g., overhead on machinery and equipment) were excluded, assuming that these costs would be the same for all plans.

Bishop used linear programming in his study of part-time family farm operations in the Southern Piedmont of North Carolina. Cotton, corn, oats, alfalfa and barley-milo crops were examined along with sheep, hogs, fall feeders, home milk cow, dairy cows, home eggs, layers, garden, rent land and non-farm work. The model's objective was to maximize net farm income. He found that the optimum was a combination of nonfarm employment and commercial egg production. The stability of the optimum depended on the aggregate production of eggs and the resulting egg price responses.

Katzman utilized linear programming in a minimum cost application in the formulation of a process cheese spread and in a broiler feed ration. Linear programming identified the least-cost production method for the cheese spread and the range at which the optimum would remain optimal, given material cost changes. In his broiler feed ration, the objective was to find the least-cost ration for the stated weight gain.

Puterbaugh, Kehrberg, and Dunbar used a linear programming model to analyze an Indiana farm problem. The crops used in rotations were corn, oats and meadow hay. Livestock operations included cow-calf, two-litter hog, and calf-feeding. They assumed that inputs and outputs were perfectly divisible and, therefore, the optimum condition could not be followed precisely because "in real life certain inputs and outputs cannot be broken into functional units" (page 481). The marginal cost for enterprises that formed the optimum combination was zero. Marginal costs of enterprises not taken into the optimum solution were either positive or zero. Marginal costs can be treated as indicators for "stability" of an optimum solution. If relatively large marginal cost changes in prices and/or production coefficients are needed before a change in the solution occurs, the optimum is looked upon as being stable.

Schrader and King applied a linear programming model concerned with the proposed location of a beef cattle feedlot under pure competition. The United States was divided into 20 regional marketing locations where beef equilibrium conditions (i.e., supply = demand) were specified for use in the model to obtain allocation and price solution.

Takayama and Judge proposed a linear programming model to analyze the U.S. agricultural sector. This short-run conceptual model maximizes consumer surplus as a basis for determining competitive price and allocation equilibrium conditions.

Kloth and Blakley used a technique of linear programming called "separable programming" in their study of the optimum dairy plant location with restrictions on economies of size and market-share. A nonlinear total cost curve (economies of size) was approximated by "piecewise linear functionals" (page 462). The result from the minimization problem, with the market-share restrictions, was that more milk would be processed locally.

Wade and Heady used linear programming to assess a national land use policy to combat agricultural nonpoint sedimentation sources. The model involved alternative tillage systems, crops and livestock enterprises. Soil losses were computed using the Universal Soil Loss Equation (USLE) for each crop and tillage practice. T-limit values were used for maximum soil loss allowances. Results indicate that the Western United States has much less soil loss due to limited rainfall.

Taylor and Frohberg used a linear programming model of crop production in the Corn Belt to estimate consumers' and producers' surplus. The model estimated the effects of various controls on nonpoint agricultural pollution sources.

Pope, Bhide, and Heady used linear programming to evaluate the net returns to farming for four types of farms in Iowa. Five tillage systems, three supporting practices and fifteen crop rotations on various soil mapping units were identified for study. The results showed that conservation tillage combined with contour planting is the most economical means of reducing soil erosion on most Iowa soils.

Wilde used linear programming to examine profitability of a vertically integrated confinement cow/calf operation in combination with the feeding operations. Enterprise budgets were used to obtain data cost coefficients. The LINDO linear programming software package was used to find the solution.

The Linear Programming Model (LP)

Linear programming was chosen as the mathematical tool for economic analysis. A linear programming model is useful for solving a problem that has certain characteristics. These include the following:

1. there is a function or objective to be minimized or maximized

2. there are limited resources to be used in the satisfaction of this function

3. there are many alternative ways to produce a product.

Linear programming determines an optimal combination of products or enterprises to use and the allocation of resources to those enterprises. It is simple to use and has been used extensively in the agricultural industry. It indicates the optimal tillage practice that should be used and also provides additional information concerning what resources are limiting the income potential of farm operations, and what resources are in excess. LP models also show the economic feasibility of obtaining additional units of the limiting resources.

Linear programming is useful in farm management analysis in evaluating how the results would change if changes occurred in product prices or technical efficiency, in effect testing the stability or sensitivity of the farm plan.

Additivity and Linearity Model Assumption

The additivity assumption specifies that the total amount of resources used must be the sum of the amount of resources used by each process. This assumption applies to products produced; the total output of two processes is equal to the sum of the output from each process. Interactions between processes are not allowed and complementary relationships are not recognized.

Linearity would imply that multiplying all inputs used in a process by a constant results in a constant change in the output of the process.

Divisibility Model Assumption

This assumption specifies that all resources and products can be produced in fractional amounts. Obviously some units cannot be completely divisible, one animal is one animal; as a result a certain amount of "rounding off" may occur and a practical interpretation of the results requires the judgment of the analyst.

Finiteness Model Assumption

This assumption specifies a limit to the number of alternative processes and resource restrictions that can be included in the analysis. Limits or bounds must be placed on the analysis.

Single-Value Expectations Model Assumption

This assumption specifies that all input and output coefficients and prices must be known with certainty. This assumption is required of almost all other analytical procedures used by farm managers, including budgeting and marginal analysis. This eliminates a significant dimension of risk. Prices and production coefficients can be varied in the linear programming framework, and this "sensitivity analysis" illustrates the resource allocation and income impacts of alternative scenarios of prices and production efficiencies. This is useful in evaluating the implications of price or production variability (Boehlje and Eidman; Schrage).

The linear programming model can be written using summation notation as in Equation 1:

(1)

$$Max\ \Pi = \sum_{j=1}^{n} c_j X_j$$

$$S.\ T.\ \sum_{J=1}^{n} a_{i_j} X_j \le b_i\ for\ i=1...m$$

$$X_j \ge 0\ for\ j = 1...n$$

Where:

X_j = the level of the jth production process or activity,

c_j = the forecasted gross margin of a unit of the jth activity,

a_{ij} = the amount of the ith resource required per unit of the jth activity,

b_i = the amount of the ith resource available (Hazell and Norton; Schrage).

Optimal Conditions

Additivity and proportionality lead to an aggregate production function relating the value of the objective function Z and to a set of fixed resources b. A production function used in this study is assumed to have constant returns to scale. Mathematically this can be written as Z=f(b), where constant return to scale means that if all of the fixed resources are increased proportionally by a factor of k, then the value of the objective function Z also increases by k as is shown by Equation 2 (Hazell and Norton; Chiang).

(2)

$$Z=\sum_j c_j X_j$$

In Equation 3 where the c_j coefficients are constants, then

(3)

$$kZ=\sum_j c_j (kX_j)$$

With a proportional increase by a factor k, the optimal activity also increases by k. In other words if all resources are doubled, then all of the activity levels in the optimal solution will also double, as well as the optimal value of the objective function Z. "Constant returns to scale always apply in a linear programming model" (Hazell and Norton, page 14).

Euler's Theorem

If Q= f(K,L) is linearly homogenous then Equation 4 applies:

(4)

$$K\frac{dQ}{dK}+L\frac{dQ}{dL}=Q$$

A production function that has the constant returns to scale has a property that can be defined by Euler's Theorem. It states that if each factor is valued at its marginal product, the sum of the factors multiplied by their marginal products is equal to total output. This implies that in the optimal solution to a linear programming model, the sum of each b_i multiplied by its marginal value product exactly exhausts the value of the objective function Z (Chiang; Hazell and Norton).

General Results of Linear Programming Models

Reduced cost is associated with each variable or activity. The value of the reduced cost is the amount that the activity must decrease its costs before it will be competitive with the activity in the optimal solution (Boehlje and Eidman). Variables in the optimal solution will have a reduced cost of zero. The reduced cost of an unused activity is the amount the objective function value will decrease if another unit of the activity is forced into the solution (Schrage).

Dual price has a quantity associated with each constraint and is referred to as the shadow price or dual price; it is a linear approximation of the marginal value product of a resource. Only scarce resources will have a positive marginal value product or dual price. A positive dual price means that increasing the right-hand side of the constraint will improve the objective function value. A negative dual price means that increasing the right-hand side will cause the objective function value to decrease, while zero dual price will not affect the objective function value (Schrage).

Range (sensitivity) analysis is performed on the optimal solution basis. An objective function value can be increased by changing a right-hand side if the dual price is positive, but this will not hold forever. As additional units of a scarce resource are made available for use, the marginal value product can only remain the same or decrease. Sensitivity analysis shows the allowable range the activity coefficients and right-hand sides can change without having an effect on the optimal solution. Generally, if the objective function coefficient of a variable is changed within the allowable range, the optimal value of the decision variable will remain unchanged. This holds even though the dual prices, reduced costs, and profitability of the solution may change (Schrage).

CHAPTER III

OBJECTIVES and PROCEDURES

Conservation tillage and low-input agriculture research have been supported by the Utah State Department of Agriculture, the Utah Energy Office, the Utah Association of Conservation Districts, the USDA-Soil Conservation Service, the Soil Science and Biometeorology Department at Utah State University and other groups. New cropping systems have been developed from this cooperative research, including optimal fertilizer placement techniques, the development of a no-till drill and moisture-saving chemical fallow techniques. The Department of Economics at Utah State University is also a member of this cooperative research effort and provides economic analysis of agricultural research.

The overall objective of this study is to determine the economic viability of new tillage systems and to test the cooperative research draft conclusions that the chemical-fallow (no-till) treatments are better both in conserving soil and increasing profits.

The general objective can be stated as a hypothesis.

H_o: That chemical-fallow (no-till) treatments have higher profits (net returns to land, labor and management) than do conventional tillage treatments.

H_a: Conservation tillage profits are not higher than conventional tillage profits.

The specific objectives are:

1. To evaluate profitability (returns to land, labor and management) of each tillage practice and account for input usage.

2. To evaluate physical units of soil, water and chemical outflows or residues that could become elements of social costs due to pesticide use and tillage practices.

3. To determine the consequences of alternative tillage practices by applying tests of yields, profitability and social costs.

Procedures

The specific objectives are interrelated and procedures to complete each objective are related and are summarized below.

Specific objective 1. To evaluate profitability (returns to land, labor and management) of each tillage practice and account for input usage. This requires the following activities.

1. Select physical parameters of the farm. In this case a 2000 acre farm is the assumed size. This is a fairly "typical" dryland farm found in Box Elder County, Utah.

2. Select tillage practices to be used in the study. The tillage systems developed by Rasmussen and Newhall were selected for the economic evaluations as part of the overall conservation tillage research program.

3. Obtain data on wheat yields, input prices, output prices, USLE soil loss coefficients and the necessary application rates. Much of this information can be obtained from the previous work by Rasmussen and Newhall. Local feed and seed dealers provided additional or specific information. Inputs such as insurance costs, machinery prices, etc. are also required and cost estimates were obtained from those specialty groups.

4. Prepare an enterprise cost and return budget for the various tillage and pesticide alternatives. Using the data coefficients generated by the enterprise budgets, a linear programming computer model accounted for input usage.

Specific objective 2. To evaluate physical units of soil, water and chemical outflows or residues that could become elements of social costs due to pesticide use and tillage practices. It was necessary to calculate the physical units such as soil loss, chemical deposition associated with selected sets of practices. A limited number of methods could have been used, but the Universal Soil Loss Equation (USLE) was selected for the soil losses associated with the selected tillage practices.

The local Agricultural Stabilization and Conservation County Committee office and personnel in the Department of Plant, Soils, and Biometeorology at USU assisted in the USLE calculations. It was assumed that the chemical deposition was directly related to the soil erosion. As the soil erodes it carries with it whatever chemical is attached to the soil particles.

Specific objective 3. To determine the consequences of alternative tillage practices by applying tests of yields, profitability and social costs. This required the following activities.

1. Develop a profit maximizing, linear programming model, constrained by land, monthly labor hours, machinery requirements, combine hours, government set-aside requirements (where applicable) and fallow practices.

2. Derive an optimal resource combination that corresponds to alternative tillage profit contributions under a set of assumptions, using a personal computer version of LINDO, a mathematical programming software routine.

3. Perform a sensitivity analysis to determine the stability of the various assumptions.

Study Area

The study area is the Bluecreek region located in north-central Box Elder County and is approximately 90 miles north of Salt Lake City, Utah. Elevation is 4,250 to 5,175 feet with annual precipitation of 15 to 17 inches. The frost-free season is 115-130 days and the annual mean temperature is 46° to 51°F. The soil is Timpanogos Silt Loam and Parleys Silt Loam and has a depth of about 17 inches with slopes of 1 to 6 percent. These soils are located on lake terraces and alluvial fans, foothills and mountain slopes in the Upland climate zone. They are well drained and have medium runoff and a moderate soil erosion hazard. This is typical of the conditions where dryland wheat is cultivated in north-central Utah (SCS). The assumed 2000 acre dryland farm was simulated, representing the conditions found in north-central Utah.

CHAPTER IV

TILLAGE METHODS and CARE BUDGETS

Utah wheat farmers use various tillage practices to grow their crop. The methods range from a conventional moldboard plow which overturns the soil, leaving little crop residue on the soil surface, to conservation methods such as no-till that do little to disturb the soil and leave much crop residue. Several tillage methods were selected (after visitations to several dryland wheat farmers in the surrounding study area) as potential candidates for an economic study of alternative and conventional tillages.

In keeping with the established cooperative research effort, Lyle Holmgren, Box Elder County Extension Agent, V.P. Rasmussen, R.L. Newhall and others were consulted for the final tillage systems to be analyzed. All of the thirteen chosen tillage systems have been investigated by either V. P. Rasmussen or R. L. Newhall and others as part of the ongoing cooperative conservation research.

Traditional tillages that use soil inversion such as the moldboard plow and disking systems are considered as conventional tillages. Chisel plow methods may be considered as a conventional tillage practice or as a conservation tillage practice. The moldboard plow and disks are generally used in the study as primary tillages in late fall. Chisel plow methods may be used at any non-harvest time. These three tillages are the mechanical methods used in a non-chemical fallow regime as shown in Table 1.

Table 1. Summary Table of Mechanical Fallow Tillage Systems for Weed Control used on Dryland Wheat Farms and in CARE Wheat Crop Enterprise Budgets (Conventional Tillage Systems)

CARE Tillage System #	1	2	3
Primary Tillage Implement	Moldboard plow	Disk plow	Chisel plow
Planting Implement	Deep Furrow Drill	Deep Furrow Drill	Deep Furrow Drill
Crop	Winter Wheat	Winter Wheat	Winter Wheat
Fallowing Implement	Rod Weeder 1 treatment	Rod Weeder 2 treatments	Rod Weeder 3 treatments
Yield Land 1 bu/ac	35	35	35
Yield Land 2 bu/acre	30	30	30

Conservation tillage is assumed to be a tillage system which leaves 20 to 30 percent ground cover after planting. Table 2 shows a no-till system, which is one method that may qualify as conservation tillage. It usually leaves more trash as ground cover than do conventional tillage systems. Weed control under no-till systems generally requires chemical applications of herbicides. No-till systems used in the study are assumed to qualify as conservation tillage and require herbicide applications.

Continuous cropping systems used in the study are assumed to be no-till systems, so qualify as conservation tillage practices.

Table 2. Summary Table of Conservation Tillage Systems using Chemical Fallow Methods for Weed Control on Dryland Wheat Farms and in CARE Wheat Crop Enterprise Budgets

CARE Tillage System #	4	5	6	13
Primary Tillage Implement	Chisel plow	No-till System	No-till System	No-till System
Planting Implement	Deep Furrow Drill (DF)	Deep Furrow Drill (DF)	20 foot Yielder Drill (Y)	12 foot Yielder Drill (Y)
Crop	Winter Wheat	Winter Wheat	Winter Wheat	Winter Wheat
Chemical Fallow Applications	2	2	2	2
Yield Land 1 bu/ac	35	35	35	35
Yield Land 2 bu/acre	30	30	30	30

(DF) Deep Furrow Conventional Grain Drill
(Y) Yielder No-Till Grain Drill

Continuous cropping systems may have lower yields than non-continuous systems, as shown in Tables 3 and 4, possibly due to moisture accumulations that may occur from fallowing.

CARE Crop Production Budgets

The Latin phrase "ceteris paribus" is a shorthand expression used by economists to express that all other factors are assumed to be constant as an independent variable acts upon a dependent variable.

Table 3. Summary Table of Continuous Cropped Fall Conservation Tillage Systems used on Dryland Wheat Farms and in CARE Wheat Crop Enterprise Budgets (No Fallow Treatments)

CARE Tillage System #	7	8	11
Primary Tillage Implement	No-till System	No-till System	No-till System
Planting Implement	Deep Furrow Drill (DF)	20 foot Yielder Drill (Y)	12 foot Yielder Drill (Y)
Crop	Winter Wheat	Winter Wheat	Winter Wheat
Yield Land 1 bu/acre	23	23	23
Yield Land 2 bu/acre	20	20	20

(DF) Deep Furrow Conventional Grain Drill
(Y) Yielder No-Till Grain Drill

Table 4. Summary Table of Continuous Cropped Spring Conservation Tillage Systems used on Dryland Wheat Farms and in CARE Wheat Crop Enterprise Budgets

CARE Tillage System #	9	10	12
Primary Tillage Implement	No-till System	No-till System	No-till Sytem
Planting Implement	Deep Furrow Drill (DF)	20 foot Yielder Drill (Y)	12 foot Yielder Drill (Y)
Crop	Spring Wheat	Spring Wheat	Spring Wheat
Yield Land 1 bu/acre	23	23	23
Yield Land 2 bu/acre	20	20	20

(DF) Deep Furrow Conventional Grain Drill
(Y) Yielder No-Till Grain Drill

Enterprise budgeting or partial budgeting apply the concept of ceteris paribus to help identify potential alternatives to maximize profitability of a farming operation. The budgets are easily changed to assist in estimating the difference in profit or loss that might occur when changing a farm plan. Partial budgets are helpful in analyzing changes such as participation in a government program, the purchase of a piece of equipment, or a shift in the cropping program.

The Cost and Return Estimator (CARE) (USDA, Soil Conservation Service) computer enterprise budgeting program was used to analyze thirteen tillage methods (Tables 1-4) under various scenarios used in the study. CARE is relatively easy to use and its reports are detailed in providing cost and input information as well as for estimating net returns that may occur with farm plan changes. Tables 1-4 have provided a brief summary of the thirteen tillage systems used in this study. They are the basis for eight scenarios totalling 104 CARE enterprise budgets.

Table 5 summarizes the eight scenarios or parameters that the study farm operates under. The study farm land is divided equally, 1000 acres of land 1 and 1000 acres of land 2. This was done to assist in the economic analyses of yield changes on returns to land, labor and management.

Equipment replacement is an economic concern that many wheat farmers face. In order to estimate the economic impact of a major equipment purchase on returns to land, labor and management, a 20-ft combine purchase was added as a change to the farm plan shown on Table 5.

Many dryland wheat farmers must estimate the economic impact on returns to land, labor and management from participating in the acreage reduction program (ARP). An assumption was made for CARE budgets to operate under the ARP and non-ARP parameters. These scenarios are shown on Table 5 as ARP or non-ARP.

Table 5. Summary of CARE Assumptions Under Scenarios 1-8

Basic CARE Assumptions	Land 1				Land 2			
Scenario	1	2	3	4	5	6	7	8
Yield Non-continuous	35	35	35	35	30	30	30	30
Yield Continuous	23	23	23	23	20	20	20	20
20ft Combine	X		X		X		X	
18ft Combine		X		X		X		X
Non-ARP	X	X			X	X		
ARP			X	X			X	X

(ARP) Participation in the Acreage Reduction Program
(X) Indicates usage in the scenario
(Non-ARP) Non-participation in the Acreage Reduction Program

Summary Results of CARE
Tillage Costs

Economic analyses of tillage costs can be categorized many various ways. One way is to assign costs into two broad categories, fixed costs (FC) and variable costs (VC). Fixed costs are those that do not change with the level of output and are therefore not a function of the level of output. They remain the same whether or not output is produced. Depreciation on buildings, taxes on the farm, insurance and interest payments on loans are examples of costs that are usually considered as fixed costs.

Variable costs are a function of the level of output, that is, they change with the level of output and do not occur unless the operator attempts to produce a product. Expenses for seed, pesticides, fuel, fertilizer, and harvesting are examples of variable costs.

Total costs (TC) are simply fixed costs plus variable costs or (TC = FC + VC).

Machinery ownership costs for an annual crop such as wheat should include depreciation, interest, taxes and insurance as these costs may be considered as a fixed cost in the decision-making time period (Boehlje and Eidman).

Ownership costs associated with machinery have been adjusted to account for reductions in acreage. This adjustment was made because CARE assigns ownership costs based on hours of machine time of expected use over the life of the machine which could result in identical per acre tillage costs for a 1000 acre planting or an 850 acre planting. However, for this study per acre machinery ownership costs for a 850 acre planting were adjusted to be higher than the per acre machinery ownership costs of 1000 acre planting. This adjustment has resulted in a higher per acre tillage system cost for participation in the government acreage reduction program (ARP) as shown in Table 6. For example, as shown in Table 6 (tillage system #1), (Moldboard Plow), 1000 acres (non-government) are planted and a new 20-ft combine used for harvesting), the tillage system cost is $80.63 per acre.

Tillage system cost for a moldboard plow (#1) under the ARP (850 acres) and 20-ft combine is $90.35 per acre as also shown on Table 6. The $9.72 per acre differences are machinery ownership costs that are no longer spread over 1000 acres. In other words, signing up for ARP will raise the moldboard plow tillage system costs by $9.72 per acre. The 18-ft combine ARP scenario for the moldboard plow has an $8.81 per acre tillage system cost increase. All thirteen tillage system per acre costs were increased by signing up for ARP whether 18-ft or 20-ft combine scenarios. Economies of size in agriculture indicate that the average total cost per unit of output for an enterprise initially declines as size increases and then reaches a relatively constant level. The average total costs decreased initially because of both technical efficiencies and pricing economies.

Table 6 shows the effects of signing up for the ARP. By signing up for the ARP technical efficiency is reduced. Alternatively, suppose a farmer wishes to expand from an existing 850 acre planting to 1000 acre planting, thus increasing technical efficiency of his operation. Then the difference between ARP and non-ARP costs becomes the initial per acre cost savings in taking advantage of economies of size.

Table 6. Summary of CARE Tillage Costs

CARE Tillage Systems	Scenarios 1-8 Tillage Systems Costs $/ac							
	1	2	3	4	5	6	7	8
#1	81	76	90	85	81	76	90	85
#2	80	76	90	84	80	76	90	84
#3	83	78	91	86	83	78	91	86
#4	66	62	74	69	66	62	74	69
#5	62	58	70	64	62	58	70	64
#6	88	83	99	93	88	83	99	93
#7	57	53	64	59	57	53	64	59
#8	82	78	93	88	82	78	93	88
#9	56	51	63	58	56	51	63	58
#10	81	76	92	86	81	76	92	86
#11	87	82	99	93	87	82	99	93
#12	86	81	98	92	86	81	98	92
#13	92	88	104	99	92	88	104	99

1. The tillage systems are defined in Tables 1-4.
2. Tillage systems costs are rounded to nearest dollar.
3. Scenarios 1-8 are defined in Table 5.

Summary of CARE Net Returns

Net returns (NR) to land, labor and management is computed by CARE as revenue (R) from grain sales less total costs plus labor costs or (NR = R - TC + labor costs). To arrive at a per acre net return the NR is divided by the number of acres planted. Revenue for non-ARP, non-continuous tillage system is computed as the (non-ARP) assumed wheat market price of $2.50/bu multiplied by the wheat yield (35 bu/acre on land 1). Under the ARP system, planted land is reduced by 15% as required by the 1990 Farm Bill and a wheat target base price of $4.00/bu (1990 Farm Bill) is used. After an adjustment has been made to the target base price, the final ARP price is $3.65/bu. Land 1 ARP revenue ranges from $86.45 to $132.91 for non-continuous tillage systems for scenarios 3 and 4, and is shown on Table 7 to range from $86 to $133 per acre which is due to rounding. Land 2 ARP revenue has a range from $75.34 to $114.66 per acre for non-continuous tillage systems for scenarios 7 and 8, but is shown on Table 7 to range from $75 to $115 which is due to rounding. The final net returns shown on Table 7 are for all 104 CARE wheat budgets (thirteen tillages times eight scenarios). The study farm is classified into two land classes, land 1 (tillages listed in Table 5 under scenarios 1 to 4) and land 2 (tillages listed in Table 5 under scenarios 5 to 8). Because of this division the total farm net return is a summation of the net returns from land 1 and the net returns from land 2.

The highest net return to land, labor and management on land 1 is tillage practice 5 (listed in Table 2) which has a net return of $67/acre shown in Table 7 under scenario 4. The highest net return on land 2 is tillage practice 5 and its net return is $48/acre, which is also shown in Table 7 under scenario 8.

Table 7. Summary of CARE Budget Net Returns

CARE Tillage Systems	Scenarios 1-8 Revenue and Net Returns $/ac							
	1	2	3	4	5	6	7	8
#1 R	92	92	132	133	80	80	114	114
#1 NR	12	17	42	48	-1	4	24	30
#2 R	92	92	133	133	80	80	114	114
#2 NR	12	17	42	48	-1	4	24	30
#3 R	93	93	133	133	80	80	115	115
#3 NR	9	14	41	47	-3	2	23	29
#4 R	91	91	131	131	78	78	113	113
#4 NR	24	29	57	62	12	17	38	44
#5 R	90	91	131	131	78	78	112	112
#5 NR	28	33	61	67	15	20	43	48
#6 R	91	91	131	131	78	78	113	113
#6 NR	3	8	32	38	-10	-5	14	20
#7 R	60	60	86	86	52	53	75	76
#7 NR	3	7	22	28	-5	0	11	17
#8 R	60	60	87	87	53	53	76	76
#8 NR	-22	-17	-7	-1	-23	-25	-18	-12
#9 R	60	60	86	86	52	53	75	75
#9 NR	4	9	23	29	-4	1	12	18
#10 R	61	60	87	87	53	53	76	76
#10 NR	-20	-16	-6	0	-28	-23	-17	-11
#11 R	61	61	87	87	53	53	76	76
#11 NR	-27	-22	-12	-6	-34	-29	-23	-17
#12 R	61	61	87	87	51	53	76	76
#12 NR	-25	-20	-10	-5	-35	-28	-21	-16
#13 R	91	91	131	132	79	79	113	113
#13 NR	-1	4	27	33	-14	-9	9	15

1. The tillage systems are defined in Tables 1-4.
2. (R) Tillage system revenue per acre.
3. (NR) Tillage system net returns per acre.
4. Tillage systems R and NR are rounded to nearest dollar.
5. Scenarios 1-8 are defined in Table 5.

The net return difference between land 1 and land 2 is \$18.25/acre. Wheat yield on land 1 is 35 bu/acre for tillage practice 5 and on land 2 the yield is 30 bu/acre. A 5 bu/acre difference multiplied by the ARP price of \$3.65 is \$18.25.

Specifications of the LP Model Based on CARE Budgets

The Cost and Return Estimator (CARE) computer enterprise budgeting program was used to assist in calculations of the LP data coefficients for returns to land, labor and management (c_j's) and resource requirements (a_{ij}'s). Resource availability (b_i's) was based on producer interviews and suppliers' recommendations.

Objective Function (c_j's) and Resource Requirements (a_{ij}'s)

In order to meet the single-value expectations requirement of a linear programming model, the CARE estimated net return values listed in Table 7 are used as the objective function coefficients (c_j's) to be maximized by the LP model.

Resource requirements coefficients are calculated from CARE budget reports and each tillage activity uses time (labor hours and machinery hours). Labor hours are accounted for by the monthly labor requirements and their costs are included in the objective function values. Machinery costs are also included in the objective function values for each tillage system. All input costs are included in the objective function values, as these values are reflected in return to land, labor and management.

The actual resource requirements (a_{ij}'s) used in the model are input per acre usage rates such as nitrogen lb/acre, wheat seed lb/acre, fuel gal/acre and machinery hours/acre. Labor, fuel and machinery (a_{ij}'s) values are calculated from CARE reports. For example, a moldboard plow tillage system has a total fuel requirement from pre-planting to harvesting listed at 6,451 gallons, which is divided by the number of acres planted (in this case 1000 acres); therefore, 6,452/1000 = 6.45 gals/acre as the fuel requirement (a_{ij}) for the moldboard plow tillage system. Labor and machinery hourly per acre rates are developed in the same manner using total required hours instead of gallons.

In the LP model land availability and labor hours have a right-hand-side (b_i's) value greater than zero. They are the only resources that are constrained by a right-hand-side value, as shown in Table 8. Zero value right-hand-side is assumed as accounting rows which allow the tillage method to use the unconstrained resource.

Table 8. Abbreviated structure of the LP model

CHAPTER V

GENERAL RESULTS FROM THE LP MODEL

The LP Model results in Table 9 show that returns to land, labor and management are maximized when 500 acres of land 1 and 350 acres of land 2 are planted in dryland wheat using a no-till DF tillage system (number 5), and participating in the ARP set-aside government program. The total return to land, labor and management is $48,980 (objective function value). Land 1 has 500 acres in fallow and 500 acres in wheat. Land 2 has 350 acres in wheat and 350 acres in fallow and 300 acres in ARP. The 300 ARP acres are continuously diverted out of wheat production.

Table 9. LP Model Variables in the Optimal Solution

Objective Function Value		$48,980
Variable	Value	Reduced Cost
X44	500 acres	.0000
X96	350 acres	.0000
SETACL2	150 acres	.0000
SAFL2C	150 acres	.0000
FALLOW1	500 acres	.0000
LAND1	1000 acres	.0000
FALLOW2	350 acres	.0000
LAND2	1000 acres	.0000

(X44) No-till DF tillage system using scenario 4 parameters
(X96) No-till DF tillage system using scenario 8 parameters
(SETACL2) Production land 2 assigned to ARP, chemical fallow
(SAFL2C) Fallow land 2 assigned to ARP, chemical fallow
(FALLOW1) 50% summer fallow land 1
(LAND1) Total acreage of land 1 available
(FALLOW2) 50% summer fallow land 2
(LAND2) Total acreage of land 2 available

Reduced Costs (Sensitivity)

Reduced cost is the amount the objective function value will decrease if another unit of an unused or non-optimal activity is forced into the solution, displacing an activity that is in the optimal solution. Appendix A shows the reduced cost associated with the thirteen tillage activities in the objective function under each scenario. Tillage practice number 5 (no-till DF) was chosen as the optimal tillage method under both land conditions. Their reduced cost is zero in Table 9.

Table 10 shows those scenarios (1-4) that required land 1 have reduced costs which are based on the optimal tillage practice using land 1. Reduced costs based on land 2 requirements (scenarios 5-8) are based on the optimal tillage practice using land 2.

The LP Model results of land 1 scenarios listed on Table 10 show that the Moldboard Plow tillage practice, depending on the combine used, would decrease the optimal solution by either $50.75 or $45.82 per acre of wheat when operating without the government program. Under an ARP set-aside on the government program, the reduction would be either $24.48 or $18.64 per acre of wheat.

The reduced costs for disk plow tillage practice shown on Table 10 are $50.52, $45.59, $24.16 and $18.35 per acre of wheat, again depending on the combine used and participation in the ARP program.

Table 10. LP Model Results of Reduced Cost of CARE Tillage Systems used on Land 1 Scenarios 1-4 (Sensitivity)

CARE Tillage System	Reduced Cost $ Per Acre			
ARP Participation	Non-ARP		ARP	
Combine Size	20 foot	18 foot	20 foot	18 foot
#1 Moldboard Plow	50.75	45.82	24.48	18.64
#2 Disk Plow	50.52	45.59	24.16	18.35
#3 Chisel Plow	38.06	33.11	10.09	4.25
#4 Chisel Plow Chemical Fallow	38.01	33.08	9.88	4.34
#5 No-till DF WW	34.42	29.47	5.88	.000
#6 No-till 20ft Y WW	59.39	54.46	34.68	28.78
#7 No-till DF SP	26.51	21.57	11.39	5.55
#8 No-till 20ft Y SP	51.42	46.49	40.18	34.35
#9 No-till DF Continuous WW	25.14	20.20	10.22	4.39
#10 No-till 20ft Y Continuous WW	49.53	44.99	38.91	33.09
#11 No-till 12ft Y Continuous WW	55.60	50.66	45.08	39.25
#12 No-till 12ft Y Continuous SP	54.08	49.14	43.79	37.96
#13 No-till 12ft Y WW	63.50	58.57	39.60	33.78

(ARP) Participation in Government Acreage Reduction Program
(Non-ARP) Non-participation in Acreage Reduction Program
(DF) Deep Furrow Grain Drill
(20ft Y) 20 foot Yielder Grain Drill
(12ft Y) 12 foot Yielder Grain Drill
(WW) Winter Wheat
(SP) Spring Wheat

The last conventional tillage system is the chisel plow which uses a mechanical summer fallow practice. Its reduced costs shown also on Table 10 are $38.06, $33.11, $10.09 and $4.25 per acre of wheat. Table 10 shows a reduced cost of $38.01, $33.08, $9.88 and $4.34 for a chisel plow tillage using chemical summer fallow practice on land 1.

The no-till DF (number 5) tillage system is chosen by the model as the optimal tillage practice. Its reduced costs listed on Table 10 are either $34.42 or $29.47 per acre for non-ARP. The difference is an opportunity cost for not participating in the ARP government program under this tillage practice. The reduced cost under ARP is $5.88, reflecting the purchase of the new 20-ft combine. The purchase of the new 20-ft combine will reduce the objective function value or returns to land, labor and management by $5.88 per acre on land 1.

Reduced costs on tillage systems using land 2, scenarios 5-8 are shown on Table 11. The difference between land 1 and land 2 is 5 bushels per acre. The optimal tillage system on land 2 is tillage system number 5; however, tillage system number 3 could have been selected as its reduced costs are shown on Table 11 as zero.

Table 11. LP Model Results of Reduced Costs of CARE Tillage Systems used on Land 2 Scenarios 5-8 (Sensitivity)

CARE Tillage System	Reduced Costs $ Per Acre			
ARP Participation	Non-ARP		ARP	
Combine Size	20 foot	18 foot	20 foot	18 foot
#1 Moldboard Plow	45.00	40.07	24.48	18.64
#2 Disk Plow	44.77	39.84	9.08	18.35
#3 Chisel Plow	32.31	27.36	25.17	.000
#4 Chisel Plow Chemical Fallow	32.26	27.33	9.88	4.07
#5 No-till DF WW	28.67	23.72	5.83	.000
#6 No-till 20ft Y WW	53.64	48.71	34.68	28.78
#7 No-till DF SP	24.88	19.94	13.22	7.38
#8 No-till 20 ft Y SP	49.79	44.86	42.01	36.18
#9 No-till DF WW Continuous	23.51	18.57	12.05	6.31
#10 No-till 20ft Y WW Continuous	48.30	43.36	40.74	34.92
#11 No-till 12ft Y Continuous WW	53.97	49.03	46.91	41.08
#12 No-till 12ft Y Continuous SP	54.45	47.51	45.48	39.79
#13 No-till 12ft Y WW	57.75	52.82	39.60	33.78

(ARP) Participation in Government Acreage Reduction Program
(Non-ARP) Non-participation in Acreage Reduction Program
(DF) Deep Furrow Grain Drill
(20ft Y) 20 foot Yielder Grain Drill
(12ft Y) 12 foot Yielder Grain Drill
(WW) Winter Wheat
(SP) Spring Wheat

Dual Prices and Surplus Values

Dual prices are also called shadow prices. They are linear approximations of the marginal value product of a resource.

Positive dual prices indicate that by increasing the right-hand side constraint, the objective function value will be improved by the value of the dual price. Table 12 shows the positive non-zero shadow prices for constrained row resources in the LP model.

Table 12. LP Model Results of Dual Prices for Constrained Row Resources

Resource	Rows	Dual Price $ Per Acre
Land 1	15	29.05
Land 2	16	19.92
ARP SET-ASIDE	33	56.70
ARP LAND 1 MECHANICAL FALLOW	36	9.94
ARP LAND 1 CHEMICAL FALLOW	37	37.47
ARP LAND 2 MECHANICAL FALLOW	38	19.07
ARP LAND 2 CHEMICAL FALLOW	39	28.35
FALLOW1	40	33.30
FALLOW2	41	24.18

(ARP) Acreage Reduction Program

Table 12 shows land 1 shadow price to be $29.05 per acre. If additional land 1 resources could be increased, then the objective function value would increase by $29.05 per acre unit. The approximate marginal value of land 1 for a year is $29.05 per acre and the approximate marginal value of land 2 is $19.05 per acre. An additional acre of land 2 would increase the objective function value by its shadow price of $19.92, which is also shown on Table 12. The marginal value of the U.S. government's Acreage Reduction Program is approximately $56.70 per acre, strong economic incentive to sign up for the 1990 program and to stay in. The earlier 1985 farm bill study by Helms reached much the same conclusions that "dryland grain producers in Box Elder County who are receiving substantial government payments appear to have a significant ablility to survive the current financial crisis in agriculture" (page 119).

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to determine the economic viability of the new tillage systems resulting from a cooperative research effort and to test the hypothesis that the chemical-fallow (no-till) treatments are better both in conserving soil and increasing profits.

One of the goals of the 1990 Farm Bill was to reduce soil erosion on highly erodible land. In order to accomplish this, the ARP was strengthened by requiring that residues be left on fallow land. The importance of participating in the 1985 program was illustrated by Helms. Not much has changed from the farmers' financial point of view from the previous farm bill. Participating in the 1990 program may make the farm better off financially, provided an inexpensive tillage system can be used which would meet 1990 program qualfications.

Under the study assumptions, chemical-fallow (no-till) treatments have higher profits than do conventional tillage treatments if conventional tillage equipment can be adapted to no-till methods. With the assumed yields being equal, specialized no-till drills are expensive and do not yield higher profits than conventional tillage practices.

Based on marginal analysis, as a profit maximizing entity the farmer should:

1. participate in ARP in order to increase farm survivability by reducing risk;

2. increase per acre wheat yields to reduce per acre fixed costs;

3. reduce conventional tillage costs or adapt conventional tillage equipment to no-till systems.

USLE soil loss coefficients closely duplicated the results of work done by Rassmussen and Newhall. The reader is referred to their work for soil erosion questions.

This study was conducted for one planting season that included both winter and spring wheat plantings. Other crops and farms in other locations could be analyzed.

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APPENDICES

Appendix A

The Linear Programming Model

Printout of the dryland wheat optimization model and sensitivity reports.

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MAX      11.6 X1 + 11.83 X2 + 9.22 X3 + 24.34 X4 + 27.93 X5 + 2.96 X6
       + 2.54 X7 - 22.37 X8 + 3.91 X9 - 20.48 X10 - 26.55 X11 - 25.03 X12
       - 1.15 X13 + 16.53 X14 + 16.76 X15 + 14.17 X16 + 29.27 X17 + 32.88
X18
       + 7.89 X19 + 7.48 X20 - 17.44 X21 + 8.85 X22 - 15.94 X23 - 21.61 X24
       - 20.09 X25 + 3.78 X26 + 42.13 X27 + 42.45 X28 + 41.44 X29 + 56.72
X30
       + 60.72 X31 + 31.93 X32 + 21.91 X33 - 6.88 X34 + 23.08 X35 - 5.61
X36
       - 11.78 X37 - 10.49 X38 + 27.01 X39 + 47.97 X40 + 48.26 X41
       + 47.28 X42 + 62.27 X43 + 66.61 X44 + 37.83 X45 + 27.75 X46 - 1.05
X47
       + 28.91 X48 + 0.21 X49 - 5.95 X50 - 4.66 X51 + 32.83 X52 - 0.9 X53
       - 0.67 X54 - 3.28 X55 + 11.84 X56 + 15.43 X57 - 9.54 X58 - 4.96 X59
       - 29.87 X60 - 3.59 X61 - 28.38 X62 - 34.05 X63 - 34.53 X64 - 13.65
X65
       + 4.03 X66 + 4.26 X67 + 1.67 X68 + 16.77 X69 + 20.38 X70 - 4.61 X71
       - 0.02 X72 - 24.94 X73 + 1.35 X74 - 23.44 X75 - 29.11 X76 - 27.59
X77
       - 8.72 X78 + 23.88 X79 + 24.2 X80 + 23.19 X81 + 38.47 X82 + 42.53
X83
       + 13.68 X84 + 10.96 X85 - 17.83 X86 + 12.13 X87 - 16.56 X88
       - 22.73 X89 - 21.3 X90 + 8.76 X91 + 29.72 X92 + 30.01 X93 + 29.03
X94
       + 44.29 X95 + 48.36 X96 + 19.58 X97 + 16.8 X98 - 12 X99 + 17.86 X100
       - 10.74 X101 - 16.9 X102 - 15.61 X103 + 14.58 X104 - 13.45 SETAML1
       - 4.17 SETACL1 - 13.45 SETAML2 - 4.17 SETACL2 - 13.45 SAFL1M
       - 4.17 SAFL1C - 13.45 SAFL2M - 4.17 SAFL2C - 6 X111 - 6 X112 - 6
X113
       - 6 X114 - 6 X115 - 6 X116
 SUBJECT TO
        2)   0.11 X1 + 0.11 X2 + 0.18 X3 + 0.08299999 X4 + 0.08299999 X5
       + 0.08299999 X6 + 0.0399 X7 + 0.0399 X8 + 0.112 X9 + 0.151 X10
       + 0.0399 X11 + 0.252 X12 + 0.0798 X13 + 0.11 X14 + 0.11 X15 + 0.18
X16
       + 0.08299999 X17 + 0.08299999 X18 + 0.08299999 X19 + 0.0399 X20
       + 0.0399 X21 + 0.112 X22 + 0.151 X23 + 0.0399 X24 + 0.252 X25
       + 0.0798 X26 + 0.109 X27 + 0.109 X28 + 0.18 X29 + 0.08299999 X30
       + 0.08299999 X31 + 0.08299999 X32 + 0.039 X33 + 0.039 X34 + 0.112
X35
       + 0.151 X36 + 0.039 X37 + 0.252 X38 + 0.079 X39 + 0.109 X40
       + 0.109 X41 + 0.179 X42 + 0.08299999 X43 + 0.08299999 X44
       + 0.08299999 X45 + 0.039 X46 + 0.039 X47 + 0.112 X48 + 0.151 X49
       + 0.039 X50 + 0.252 X51 + 0.079 X52 + 0.11 X53 + 0.11 X54 + 0.18 X55
       + 0.08299999 X56 + 0.08299999 X57 + 0.08299999 X58 + 0.039 X59
       + 0.039 X60 + 0.112 X61 + 0.151 X62 + 0.039 X63 + 0.252 X64
       + 0.079 X65 + 0.11 X66 + 0.11 X67 + 0.18 X68 + 0.08299999 X69
       + 0.08299999 X70 + 0.08299999 X71 + 0.039 X72 + 0.039 X73 + 0.112
X74
       + 0.151 X75 + 0.039 X76 + 0.252 X77 + 0.079 X78 + 0.109 X79
```

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+ 0.109 X80 + 0.18 X81 + 0.08299999 X82 + 0.08299999 X83
+ 0.08299999 X84 + 0.039 X85 + 0.039 X86 + 0.112 X87 + 0.151 X88
+ 0.039 X89 + 0.252 X90 + 0.079 X91 + 0.109 X92 + 0.109 X93
+ 0.179 X94 + 0.08299999 X95 + 0.08299999 X96 + 0.08299999 X97
+ 0.039 X98 + 0.039 X99 + 0.112 X100 + 0.151 X101 + 0.039 X102
+ 0.252 X103 + 0.079 X104 - X111 <=   250
  3)   0.0399 X1 + 0.0399 X2 + 0.0399 X3 + 0.0399 X4 + 0.0399 X5
+ 0.0399 X6 + 0.0399 X9 + 0.0399 X10 + 0.0399 X12 + 0.0399 X13
+ 0.0399 X14 + 0.0399 X15 + 0.0399 X16 + 0.0399 X17 + 0.0399 X18
+ 0.0399 X19 + 0.0399 X22 + 0.0399 X23 + 0.0399 X25 + 0.0399 X26
+ 0.0399 X27 + 0.0399 X28 + 0.0399 X29 + 0.0399 X30 + 0.0399 X31
+ 0.0399 X32 + 0.0399 X35 + 0.0399 X36 + 0.0399 X38 + 0.0399 X39
+ 0.0399 X40 + 0.0399 X41 + 0.0399 X42 + 0.0399 X43 + 0.0399 X44
+ 0.0399 X45 + 0.0399 X48 + 0.0399 X49 + 0.0399 X51 + 0.0399 X52
+ 0.0399 X53 + 0.0399 X54 + 0.0399 X55 + 0.0399 X56 + 0.0399 X57
+ 0.0399 X58 + 0.0399 X59 + 0.0399 X60 + 0.0399 X63 + 0.0399 X65
+ 0.0399 X66 + 0.0399 X67 + 0.0399 X68 + 0.0399 X69 + 0.0399 X70
+ 0.0399 X71 + 0.0399 X72 + 0.0399 X73 + 0.0399 X76 + 0.0399 X78
+ 0.0399 X79 + 0.0399 X80 + 0.0399 X81 + 0.0399 X82 + 0.0399 X83
+ 0.0399 X84 + 0.0399 X85 + 0.0399 X86 + 0.0399 X89 + 0.0399 X91
+ 0.0399 X92 + 0.0399 X93 + 0.0399 X94 + 0.0399 X95 + 0.0399 X96
+ 0.0399 X97 + 0.0399 X98 + 0.0399 X99 + 0.0399 X102 + 0.0399 X104
+ 0.069 SETAML1 + 0.069 SETAML2 + 0.069 SAFL1M + 0.069 SAFL2M - X112
<=   300
  4)   0.07 X1 + 0.07 X2 + 0.075 X3 + 0.0399 X4 + 0.0399 X5 + 0.0399
X6
+ 0.0399 X9 + 0.0399 X10 + 0.0399 X12 + 0.0399 X13 + 0.07 X14
+ 0.07 X15 + 0.075 X16 + 0.0399 X17 + 0.0399 X18 + 0.0399 X19
+ 0.0399 X22 + 0.0399 X23 + 0.0399 X25 + 0.0399 X26 + 0.07 X27
+ 0.07 X28 + 0.075 X29 + 0.0399 X30 + 0.0399 X31 + 0.0399 X32
+ 0.0798 X35 + 0.0798 X36 + 0.0399 X38 + 0.0399 X39 + 0.07 X40
+ 0.07 X41 + 0.07 X42 + 0.0399 X43 + 0.0399 X44 + 0.0399 X45
+ 0.0399 X48 + 0.0399 X49 + 0.0399 X51 + 0.0399 X52 + 0.07 X53
+ 0.07 X54 + 0.075 X55 + 0.0399 X56 + 0.0399 X57 + 0.0399 X58
+ 0.0399 X61 + 0.0399 X62 + 0.039 X64 + 0.039 X65 + 0.07 X66
+ 0.07 X67 + 0.075 X68 + 0.039 X69 + 0.039 X70 + 0.039 X71 + 0.039
X74
+ 0.039 X75 + 0.039 X77 + 0.039 X78 + 0.07 X79 + 0.07 X80 + 0.075
X81
+ 0.039 X82 + 0.039 X83 + 0.039 X84 + 0.039 X87 + 0.039 X88
+ 0.039 X90 + 0.039 X91 + 0.07 X92 + 0.07 X93 + 0.07 X94 + 0.039 X95
+ 0.039 X96 + 0.039 X97 + 0.039 X100 + 0.039 X101 + 0.039 X103
+ 0.039 X104 + 0.074 SETAML1 + 0.039 SETACL1 + 0.074 SETAML2
+ 0.039 SETACL2 + 0.074 SAFL1M + 0.039 SAFL1C + 0.074 SAFL2M
+ 0.039 SAFL2C - X113 <=   300
  5)   0.2 X1 + 0.276 X2 + 0.276 X3 + 0.2 X4 + 0.2 X5 + 0.2 X6 + 0.2
X7
+ 0.2 X8 + 0.0399 X9 + 0.0399 X10 + 0.2 X11 + 0.0399 X12 + 0.2 X13
+ 0.224 X14 + 0.298 X15 + 0.298 X16 + 0.224 X17 + 0.224 X18
+ 0.224 X19 + 0.224 X20 + 0.224 X21 + 0.0399 X22 + 0.0399 X23
+ 0.224 X24 + 0.0399 X25 + 0.224 X26 + 0.2 X27 + 0.276 X28 + 0.276
X29
+ 0.2 X30 + 0.2 X31 + 0.2 X32 + 0.2 X33 + 0.2 X34 + 0.039 X35
+ 0.039 X36 + 0.2 X37 + 0.039 X38 + 0.2 X39 + 0.224 X40 + 0.298 X41
+ 0.298 X42 + 0.224 X43 + 0.224 X44 + 0.224 X45 + 0.224 X46
+ 0.224 X47 + 0.039 X48 + 0.039 X49 + 0.224 X50 + 0.039 X51
+ 0.224 X52 + 0.2 X53 + 0.276 X54 + 0.276 X55 + 0.2 X56 + 0.2 X57
+ 0.2 X58 + 0.2 X59 + 0.2 X60 + 0.039 X61 + 0.039 X62 + 0.2 X63
+ 0.039 X64 + 0.2 X65 + 0.224 X66 + 0.298 X67 + 0.298 X68 + 0.224
X69
+ 0.224 X70 + 0.224 X71 + 0.224 X72 + 0.224 X73 + 0.039 X74
```

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     + 0.039 X75 + 0.224 X76 + 0.039 X77 + 0.224 X78 + 0.2 X79 + 0.276
X80
     + 0.276 X81 + 0.2 X82 + 0.2 X83 + 0.2 X84 + 0.2 X85 + 0.2 X86
     + 0.039 X87 + 0.039 X88 + 0.2 X89 + 0.039 X90 + 0.2 X91 + 0.224 X92
     + 0.298 X93 + 0.298 X94 + 0.224 X95 + 0.224 X96 + 0.224 X97
     + 0.224 X98 + 0.224 X99 + 0.039 X100 + 0.039 X101 + 0.224 X102
     + 0.039 X103 + 0.224 X104 + 0.074 SETAML1 + 0.039 SETACL1
     + 0.074 SETAML2 + 0.039 SETACL2 + 0.074 SAFL1M + 0.039 SAFL1C
     + 0.074 SAFL2M + 0.039 SAFL2C - X114 <=   300
       6)   0.075 X1 + 0.075 X2 + 0.154 X3 + 0.2 X9 + 0.2 X10 + 0.2 X12
     + 0.075 X14 + 0.075 X15 + 0.154 X16 + 0.224 X22 + 0.224 X23
     + 0.224 X25 + 0.074 X27 + 0.074 X28 + 0.154 X29 + 0.2 X35 + 0.2 X36
     + 0.2 X38 + 0.074 X40 + 0.07 X41 + 0.154 X42 + 0.224 X48 + 0.224 X49
     + 0.224 X51 + 0.075 X53 + 0.075 X54 + 0.154 X55 + 0.2 X61 + 0.2 X62
     + 0.2 X64 + 0.075 X66 + 0.075 X67 + 0.154 X68 + 0.224 X74 + 0.224
X75
     + 0.224 X77 + 0.074 X79 + 0.074 X80 + 0.154 X81 + 0.2 X87 + 0.2 X88
     + 0.2 X90 + 0.074 X92 + 0.07 X93 + 0.154 X94 + 0.224 X100 + 0.224
X101
     + 0.224 X103 + 0.074 SETAML1 + 0.074 SETAML2 + 0.074 SAFL1M
     + 0.074 SAFL2M - X115 <=   300
       7)   0.291 X1 + 0.222 X2 + 0.182 X4 + 0.112 X5 + 0.151 X6 + 0.112
X7
     + 0.151 X8 + 0.252 X11 + 0.252 X13 + 0.291 X14 + 0.222 X15 + 0.112
X16
     + 0.182 X17 + 0.112 X18 + 0.151 X19 + 0.112 X20 + 0.151 X21
     + 0.252 X24 + 0.252 X26 + 0.29 X27 + 0.222 X28 + 0.182 X30 + 0.112
X31
     + 0.156 X32 + 0.112 X33 + 0.151 X34 + 0.252 X37 + 0.252 X39
     + 0.291 X40 + 0.221 X41 + 0.112 X42 + 0.182 X43 + 0.112 X44
     + 0.151 X45 + 0.112 X46 + 0.151 X47 + 0.252 X50 + 0.252 X52
     + 0.291 X53 + 0.222 X54 + 0.182 X56 + 0.112 X57 + 0.151 X58
     + 0.112 X59 + 0.151 X60 + 0.252 X63 + 0.252 X65 + 0.291 X66
     + 0.222 X67 + 0.112 X68 + 0.182 X69 + 0.112 X70 + 0.151 X71
     + 0.112 X72 + 0.151 X73 + 0.252 X76 + 0.252 X78 + 0.29 X79 + 0.222
X80
     + 0.182 X82 + 0.112 X83 + 0.156 X84 + 0.112 X85 + 0.151 X86
     + 0.252 X89 + 0.252 X91 + 0.221 X93 + 0.112 X94 + 0.182 X95
     + 0.112 X96 + 0.151 X97 + 0.112 X98 + 0.151 X99 + 0.252 X102
     + 0.252 X104 - X116 <=   300
       8)   70 X3 + 70 X16 + 70 X29 + 70 X42 + 70 X55 + 70 X68 + 70 X80
     + 70 X94 >=   0
       9)   0.65 X1 + 0.65 X2 + 0.65 X3 + 0.65 X4 + 0.65 X5 + 0.65 X6
     + 0.65 X7 + 0.65 X8 + 0.65 X9 + 0.65 X10 + 0.65 X11 + 0.65 X12
     + 0.65 X13 + 0.65 X14 + 0.65 X15 + 0.65 X16 + 0.65 X17 + 0.65 X18
     + 0.65 X19 + 0.65 X20 + 0.65 X21 + 0.65 X22 + 0.65 X23 + 0.65 X24
     + 0.65 X25 + 0.65 X26 + 0.65 X27 + 0.65 X28 + 0.65 X29 + 0.65 X30
     + 0.65 X31 + 0.65 X32 + 0.65 X33 + 0.65 X34 + 0.65 X35 + 0.65 X36
     + 0.65 X37 + 0.65 X38 + 0.65 X39 + 0.65 X40 + 0.65 X41 + 0.65 X42
     + 0.65 X43 + 0.65 X44 + 0.65 X45 + 0.65 X46 + 0.65 X47 + 0.65 X48
     + 0.65 X49 + 0.65 X50 + 0.65 X51 + 0.65 X52 + 0.65 X53 + 0.65 X54
     + 0.65 X55 + 0.65 X56 + 0.65 X57 + 0.65 X58 + 0.65 X59 + 0.65 X60
     + 0.65 X61 + 0.65 X62 + 0.65 X63 + 0.65 X64 + 0.65 X66 + 0.65 X67
     + 0.65 X68 + 0.65 X69 + 0.65 X70 + 0.65 X71 + 0.65 X72 + 0.65 X73
     + 0.65 X74 + 0.65 X75 + 0.65 X76 + 0.65 X77 + 0.65 X78 + 0.65 X79
     + 0.65 X80 + 0.65 X81 + 0.65 X82 + 0.65 X83 + 0.65 X84 + 0.65 X85
     + 0.65 X86 + 0.65 X87 + 0.65 X88 + 0.65 X89 + 0.65 X90 + 0.65 X91
     + 0.65 X92 + 0.65 X93 + 0.65 X94 + 0.65 X95 + 0.65 X96 + 0.65 X97
     + 0.65 X98 + 0.65 X99 + 0.65 X100 + 0.65 X101 + 0.65 X102 + 0.65
X103
     + 0.65 X104 >=   0
      10)   X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8 + X9 + X10 + X11 + X12
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+ X13 + X14 + X15 + X16 + X17 + X18 + X19 + X20 + X21 + X22 + X23
+ X24 + X25 + X26 + X27 + X28 + X29 + X30 + X31 + X32 + X33 + X34
+ X35 + X36 + X37 + X38 + X39 + X40 + X41 + X42 + X43 + X44 + X45
+ X46 + X47 + X48 + X49 + X50 + X51 + X52 + X53 + X54 + X55 + X56
+ X57 + X58 + X59 + X60 + X61 + X62 + X63 + X64 + X65 + X66 + X67
+ X68 + X69 + X70 + X71 + X72 + X73 + X74 + X75 + X76 + X78 + X79
+ X80 + X81 + X82 + X83 + X84 + X85 + X86 + X87 + X88 + X89 + X90
+ X91 + X92 + X93 + X94 + X95 + X96 + X97 + X98 + X99 + X100 + X101
+ X102 + X103 + X104 >= 0

11) 1.08 X4 + 1.08 X5 + 1.08 X6 + 1.08 X13 + 1.08 X17 + 1.08 X18
+ 1.08 X19 + 1.08 X26 + 1.08 X30 + 1.08 X31 + 1.08 X32 + 1.08 X39
+ 1.08 X43 + 1.08 X44 + 1.08 X45 + 1.08 X52 + 1.08 X56 + 1.08 X57
+ 1.08 X58 + 1.08 X65 + 1.08 X70 + 1.08 X71 + 1.08 X78 + 1.08 X82
+ 1.08 X83 + 1.08 X84 + 1.08 X91 + 1.08 X95 + 1.08 X96 + 1.08 X97
+ 1.08 X104 + 1.08 SETACL1 + 1.08 SETACL2 + 1.08 SAFL1C + 1.08
SAFL2C
>= 0

12) 40 X1 + 40 X2 + 40 X4 + 40 X5 + 40 X6 + 40 X7 + 40 X8 + 40 X9
+ 40 X10 + 40 X11 + 40 X12 + 40 X13 + 40 X14 + 40 X15 + 40 X17
+ 40 X18 + 40 X19 + 40 X20 + 40 X21 + 40 X22 + 40 X23 + 40 X24
+ 40 X25 + 40 X26 + 40 X27 + 40 X28 + 40 X30 + 40 X31 + 40 X32
+ 40 X33 + 40 X34 + 40 X35 + 40 X36 + 40 X37 + 40 X38 + 40 X39
+ 40 X40 + 40 X41 + 40 X43 + 40 X44 + 40 X45 + 40 X46 + 40 X47
+ 40 X48 + 40 X49 + 40 X50 + 40 X51 + 40 X52 + 40 X53 + 40 X54
+ 40 X56 + 40 X57 + 40 X58 + 40 X59 + 40 X60 + 40 X61 + 40 X62
+ 40 X63 + 40 X64 + 40 X65 + 40 X66 + 40 X67 + 40 X69 + 40 X70
+ 40 X71 + 40 X72 + 40 X73 + 40 X74 + 40 X75 + 40 X76 + 40 X77
+ 40 X78 + 40 X79 + 40 X80 + 40 X82 + 40 X83 + 40 X84 + 40 X85
+ 40 X86 + 40 X87 + 40 X88 + 40 X89 + 40 X90 + 40 X91 + 40 X92
+ 40 X93 + 40 X95 + 40 X96 + 40 X97 + 40 X98 + 40 X99 + 40 X100
+ 40 X101 + 40 X102 + 40 X103 + 40 X104 >= 0

13) 60 X1 + 60 X2 + 60 X3 + 60 X4 + 60 X5 + 60 X6 + 60 X7 + 60 X8
+ 60 X9 + 60 X10 + 60 X11 + 60 X12 + 60 X13 + 60 X14 + 60 X15 + 60
X16
+ 60 X17 + 60 X18 + 60 X19 + 60 X20 + 60 X21 + 60 X22 + 60 X23
+ 60 X24 + 60 X25 + 60 X26 + 60 X27 + 60 X28 + 60 X29 + 60 X30
+ 60 X31 + 60 X32 + 60 X33 + 60 X34 + 60 X35 + 60 X36 + 60 X37
+ 60 X38 + 60 X39 + 60 X40 + 60 X41 + 60 X42 + 60 X43 + 60 X44
+ 60 X45 + 60 X46 + 60 X47 + 60 X48 + 60 X49 + 60 X50 + 60 X51
+ 60 X52 + 60 X53 + 60 X54 + 60 X55 + 60 X56 + 60 X57 + 60 X58
+ 60 X59 + 60 X60 + 60 X61 + 60 X62 + 60 X63 + 60 X64 + 60 X65
+ 60 X66 + 60 X67 + 60 X68 + 60 X69 + 60 X70 + 60 X71 + 60 X72
+ 60 X73 + 60 X74 + 60 X75 + 60 X76 + 60 X77 + 60 X78 + 60 X79
+ 60 X80 + 60 X81 + 60 X82 + 60 X83 + 60 X84 + 60 X85 + 60 X86
+ 60 X87 + 60 X88 + 60 X89 + 60 X90 + 60 X91 + 60 X92 + 60 X93
+ 60 X94 + 60 X95 + 60 X96 + 60 X97 + 60 X98 + 60 X99 + 60 X100
+ 60 X101 + 60 X102 + 60 X103 + 60 X104 >= 0

14) 6.45 X1 + 6.49 X2 + 6.9 X3 + 3.7 X4 + 3.09 X5 + 3.89 X6
+ 2.85 X7 + 3.65 X8 + 2.85 X9 + 3.65 X10 + 4.13 X11 + 4.3 X12
+ 4.3 X13 + 6.6 X14 + 6.67 X15 + 7 X16 + 3.9 X17 + 3.2 X18 + 4 X19
+ 3 X20 + 3.87 X21 + 3 X22 + 3.87 X23 + 4.3 X24 + 4.3 X25 + 4.5 X26
+ 6.45 X27 + 6.49 X28 + 6.9 X29 + 3.72 X30 + 3.09 X31 + 3.89 X32
+ 2.85 X33 + 3.65 X34 + 2.85 X35 + 3.65 X36 + 4.13 X37 + 4.13 X38
+ 4.35 X39 + 6.63 X40 + 6.67 X41 + 7 X42 + 3.9 X43 + 3.27 X44
+ 4.06 X45 + 3 X46 + 3.83 X47 + 3 X48 + 3.83 X49 + 4.31 X50 + 4.31
X51
+ 4.53 X52 + 6.45 X53 + 6.49 X54 + 6.9 X55 + 3.72 X56 + 3 X57
+ 3.89 X58 + 2.85 X59 + 3.65 X60 + 2.85 X61 + 3.65 X62 + 4.13 X63
+ 4.31 X64 + 4.35 X65 + 6.6 X66 + 6.67 X67 + 7 X68 + 3.9 X69
+ 3.27 X70 + 4 X71 + 3 X72 + 3.83 X73 + 3 X74 + 3.83 X75 + 4.31 X76
+ 4.31 X77 + 4.53 X78 + 6.45 X79 + 6.49 X80 + 6.9 X81 + 3.72 X82
+ 3 X83 + 3.89 X84 + 2.85 X85 + 3.65 X86 + 2.85 X87 + 3.65 X88

+ 4.13 X89 + 4.13 X90 + 4.35 X91 + 6.63 X92 + 6.67 X93 + 7 X94
+ 3.9 X95 + 3.27 X96 + 4 X97 + 3 X98 + 3.83 X99 + 3 X100 + 3.83 X101
+ 4.31 X102 + 4.31 X103 + 4.53 X104 + 2.68 SETAML1 + 0.223 SETACL1
+ 2.68 SETAML2 + 0.223 SETACL2 + 2.68 SAFL1M + 0.223 SAFL1C
+ 2.68 SAFL2M + 0.223 SAFL2C >= 0
15) X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8 + X9 + X10 + X11 + X12
+ X13 + X14 + X15 + X16 + X17 + X18 + X19 + X20 + X21 + X22 + X23
+ X24 + X25 + X26 + X27 + X28 + X29 + X30 + X31 + X32 + X33 + X34
+ X35 + X36 + X37 + X38 + X39 + X40 + X41 + X42 + X43 + X44 + X45
+ X46 + X47 + X48 + X49 + X50 + X51 + X52 + SETAML1 + SETACL1 +
SAFL1M
+ SAFL1C + FALLOW1 - LAND1 <= 0
16) X53 + X54 + X55 + X56 + X57 + X58 + X59 + X60 + X61 + X62 +
X63
+ X64 + X65 + X66 + X67 + X68 + X69 + X70 + X71 + X72 + X73 + X74
+ X75 + X76 + X77 + X78 + X79 + X80 + X81 + X82 + X83 + X84 + X85
+ X86 + X87 + X88 + X89 + X90 + X91 + X92 + X93 + X94 + X95 + X96
+ X97 + X98 + X99 + X100 + X101 + X102 + X103 + X104 + SETAML2
+ SETACL2 + SAFL2M + SAFL2C + FALLOW2 - LAND2 <= 0
17) 0.06 X1 + 0.06 X2 + 0.06 X14 + 0.06 X15 + 0.06 X27 + 0.06 X28
+ 0.06 X40 + 0.06 X41 + 0.06 X53 + 0.06 X54 + 0.06 X66 + 0.06 X67
+ 0.06 X79 + 0.06 X80 + 0.06 X92 + 0.06 X93 >= 0
18) 0.06 X1 + 0.06 X2 + 0.06 X14 + 0.06 X15 + 0.06 X27 + 0.06 X28
+ 0.06 X40 + 0.06 X41 + 0.06 X53 + 0.06 X54 + 0.06 X66 + 0.06 X67
+ 0.06 X79 + 0.06 X80 + 0.06 X92 + 0.06 X93 >= 0
19) 0.06 X1 + 0.06 X2 + 0.1346 X3 + 0.06 X4 + 0.06 X14 + 0.06 X15
+ 0.1346 X16 + 0.06 X17 + 0.06 X26 + 0.06 X27 + 0.1346 X28 + 0.06
X29
+ 0.06 X40 + 0.06 X41 + 0.127 X42 + 0.06 X43 + 0.06 X53 + 0.06 X54
+ 0.1346 X55 + 0.06 X56 + 0.06 X66 + 0.06 X67 + 0.134 X68 + 0.06 X69
+ 0.06 X79 + 0.06 X80 + 0.134 X81 + 0.06 X82 + 0.06 X92 + 0.6 X93
+ 0.127 X94 + 0.06 X95 + 0.06 SETAML1 + 0.06 SETAML2 + 0.06 SAFL1M
+ 0.06 SAFL2M >= 0
20) 0.067 X1 + 0.135 X2 + 0.2 X3 + 0.067 X14 + 0.135 X15 + 0.2
X16
+ 0.067 X27 + 0.135 X28 + 0.2 X29 + 0.067 X40 + 0.135 X41 + 0.2 X42
+ 0.067 X53 + 0.135 X54 + 0.2 X55 + 0.067 X66 + 0.135 X67 + 0.2 X68
+ 0.067 X79 + 0.135 X80 + 0.2 X81 + 0.067 X92 + 0.135 X93 + 0.2 X94
+ 0.204 SETAML1 + 0.204 SETAML2 + 0.204 SAFL1M + 0.204 SAFL2M
>= 0
21) 0.163 X1 + 0.163 X14 + 0.163 X27 + 0.163 X40 + 0.163 X53
+ 0.163 X66 + 0.163 X79 + 0.163 X92 >= 0
22) 0.1 X1 + 0.1 X2 + 0.1 X3 + 0.1 X4 + 0.1 X5 + 0.1 X7 + 0.1 X9
+ 0.1 X14 + 0.1 X15 + 0.1 X16 + 0.1 X17 + 0.1 X18 + 0.1 X20 + 0.1
X22
+ 0.1 X27 + 0.1 X28 + 0.1 X29 + 0.1 X30 + 0.1 X31 + 0.1 X33 + 0.1
X35
+ 0.1 X40 + 0.1 X41 + 0.1 X42 + 0.1 X43 + 0.1 X44 + 0.1 X46 + 0.1
X48
+ 0.1 X53 + 0.1 X54 + 0.1 X55 + 0.1 X56 + 0.1 X57 + 0.1 X59 + 0.1
X61
+ 0.1 X66 + 0.1 X67 + 0.1 X68 + 0.1 X69 + 0.1 X70 + 0.1 X72 + 0.1
X74
+ 0.1 X79 + 0.1 X80 + 0.1 X81 + 0.1 X82 + 0.1 X83 + 0.1 X85 + 0.1
X87
+ 0.1 X92 + 0.1 X93 + 0.1 X94 + 0.1 X95 + 0.1 X96 + 0.1 X98 + 0.1
X100
>= 0
23) 0.07 X1 + 0.07 X2 + 0.07 X3 + 0.14 X4 + 0.14 X5 + 0.14 X6
+ 0.07 X7 + 0.07 X8 + 0.07 X9 + 0.07 X10 + 0.07 X11 + 0.07 X12
+ 0.14 X13 + 0.07 X14 + 0.07 X15 + 0.07 X16 + 0.14 X17 + 0.17 X18
+ 0.14 X19 + 0.07 X20 + 0.07 X21 + 0.07 X22 + 0.07 X23 + 0.07 X24

+ 0.07 X25 + 0.14 X26 + 0.07 X27 + 0.07 X28 + 0.07 X29 + 0.148 X30
+ 0.148 X31 + 0.148 X32 + 0.07 X33 + 0.07 X34 + 0.07 X35 + 0.07 X36
+ 0.07 X37 + 0.07 X38 + 0.145 X39 + 0.07 X40 + 0.07 X41 + 0.07 X42
+ 0.148 X43 + 0.148 X44 + 0.148 X45 + 0.07 X46 + 0.07 X47 + 0.07 X48
+ 0.07 X49 + 0.07 X50 + 0.07 X51 + 0.145 X52 + 0.07 X53 + 0.07 X54
+ 0.07 X55 + 0.145 X56 + 0.145 X57 + 0.145 X58 + 0.07 X59 + 0.07 X60
+ 0.07 X61 + 0.07 X62 + 0.07 X63 + 0.07 X64 + 0.145 X65 + 0.07 X66
+ 0.07 X67 + 0.07 X68 + 0.145 X69 + 0.145 X70 + 0.145 X71 + 0.07 X72
+ 0.07 X73 + 0.07 X74 + 0.07 X75 + 0.07 X76 + 0.07 X77 + 0.145 X78
+ 0.07 X79 + 0.07 X80 + 0.07 X81 + 0.148 X82 + 0.148 X83 + 0.148 X84
+ 0.07 X85 + 0.07 X86 + 0.07 X87 + 0.07 X88 + 0.07 X89 + 0.07 X90
+ 0.145 X91 + 0.07 X92 + 0.07 X93 + 0.07 X94 + 0.148 X95 + 0.148 X96
+ 0.148 X97 + 0.07 X98 + 0.07 X99 + 0.07 X100 + 0.07 X101 + 0.07
X102
+ 0.07 X103 + 0.145 X104 + 0.07 SETACL1 + 0.07 SETACL2 + 0.07 SAFL1C
+ 0.07 SAFL2C >= 0
24) 0.46 X1 + 0.46 X2 + 0.5 X3 + 0.16 X4 + 0.1 X5 + 0.1 X7 + 0.1
X9
+ 0.23 X11 + 0.23 X12 + 0.23 X13 + 0.46 X14 + 0.46 X15 + 0.5 X16
+ 0.16 X17 + 0.1 X18 + 0.1 X20 + 0.1 X22 + 0.23 X24 + 0.23 X25
+ 0.23 X26 + 0.46 X27 + 0.46 X28 + 0.5 X29 + 0.165 X30 + 0.1 X31
+ 0.1 X33 + 0.1 X35 + 0.23 X37 + 0.23 X38 + 0.23 X39 + 0.46 X40
+ 0.46 X41 + 0.5 X42 + 0.165 X43 + 0.1 X44 + 0.1 X46 + 0.1 X48
+ 0.23 X50 + 0.23 X51 + 0.23 X52 + 0.46 X53 + 0.46 X54 + 0.5 X55
+ 0.165 X56 + 0.1 X57 + 0.1 X59 + 0.1 X61 + 0.23 X63 + 0.23 X64
+ 0.23 X65 + 0.46 X66 + 0.46 X67 + 0.5 X68 + 0.165 X69 + 0.1 X70
+ 0.1 X72 + 0.1 X74 + 0.23 X76 + 0.23 X77 + 0.23 X78 + 0.46 X79
+ 0.46 X80 + 0.5 X81 + 0.165 X82 + 0.1 X83 + 0.1 X85 + 0.1 X87
+ 0.23 X89 + 0.23 X90 + 0.23 X91 + 0.46 X92 + 0.46 X93 + 0.5 X94
+ 0.165 X95 + 0.1 X96 + 0.1 X98 + 0.1 X100 + 0.23 X102 + 0.23 X103
+ 0.23 X104 + 0.267 SETAML1 + 0.267 SETAML2 + 0.267 SAFL1M
+ 0.267 SAFL2M >= 0
25) 0.07 X1 + 0.07 X2 + 0.07 X3 + 0.14 X4 + 0.14 X5 + 0.14 X6
+ 0.07 X7 + 0.07 X8 + 0.07 X9 + 0.07 X10 + 0.07 X11 + 0.07 X12
+ 0.14 X13 + 0.07 X14 + 0.07 X15 + 0.07 X16 + 0.14 X17 + 0.14 X18
+ 0.14 X19 + 0.07 X20 + 0.07 X21 + 0.07 X22 + 0.07 X23 + 0.07 X24
+ 0.07 X25 + 0.14 X26 + 0.07 X27 + 0.07 X28 + 0.07 X29 + 0.148 X30
+ 0.148 X31 + 0.148 X32 + 0.07 X33 + 0.07 X34 + 0.07 X35 + 0.07 X36
+ 0.07 X37 + 0.07 X38 + 0.14 X39 + 0.07 X40 + 0.07 X41 + 0.07 X42
+ 0.148 X43 + 0.148 X44 + 0.148 X45 + 0.07 X46 + 0.07 X47 + 0.07 X48
+ 0.07 X49 + 0.07 X50 + 0.07 X51 + 0.145 X52 + 0.07 X53 + 0.07 X54
+ 0.07 X55 + 0.145 X56 + 0.145 X57 + 0.145 X58 + 0.07 X59 + 0.07 X60
+ 0.07 X61 + 0.07 X62 + 0.07 X63 + 0.07 X64 + 0.145 X65 + 0.07 X66
+ 0.07 X67 + 0.07 X68 + 0.145 X69 + 0.145 X70 + 0.145 X71 + 0.07 X72
+ 0.07 X73 + 0.07 X74 + 0.07 X75 + 0.07 X76 + 0.07 X77 + 0.145 X78
+ 0.07 X79 + 0.07 X80 + 0.07 X81 + 0.148 X82 + 0.148 X83 + 0.148 X84
+ 0.07 X85 + 0.07 X86 + 0.07 X87 + 0.07 X88 + 0.07 X89 + 0.07 X90
+ 0.145 X91 + 0.07 X92 + 0.07 X93 + 0.07 X94 + 0.148 X95 + 0.148 X96
+ 0.148 X97 + 0.07 X98 + 0.07 X99 + 0.07 X100 + 0.07 X101 + 0.07
X102
+ 0.07 X103 + 0.145 X104 + 0.07 SETACL1 + 0.07 SETACL2 + 0.07 SAFL1C
+ 0.07 SAFL2C >= 0
26) 0.0996 X2 + 0.0996 X15 + 0.0996 X28 + 0.0996 X41 + 0.0996 X54
+ 0.0996 X67 + 0.0996 X80 + 0.0996 X93 >= 0
27) 0.2 X14 + 0.2 X15 + 0.2 X16 + 0.2 X17 + 0.2 X18 + 0.2 X19
+ 0.2 X20 + 0.2 X21 + 0.2 X22 + 0.2 X23 + 0.2 X24 + 0.2 X25 + 0.2
X26
+ 0.2 X40 + 0.2 X41 + 0.2 X42 + 0.2 X43 + 0.2 X44 + 0.2 X45 + 0.2
X46
+ 0.2 X47 + 0.2 X48 + 0.2 X49 + 0.2 X50 + 0.2 X51 + 0.2 X52 + 0.2
X66

```
     + 0.2 X67 + 0.2 X68 + 0.2 X69 + 0.2 X70 + 0.2 X71 + 0.2 X72 + 0.2
X73
     + 0.2 X74 + 0.2 X75 + 0.2 X76 + 0.2 X77 + 0.2 X78 + 0.2 X92 + 0.2
X93
     + 0.2 X94 + 0.2 X95 + 0.2 X96 + 0.2 X97 + 0.2 X98 + 0.2 X99 + 0.2
X100
     + 0.2 X101 + 0.2 X102 + 0.2 X103 + 0.2 X104 >=   0
      28)    0.18 X1 + 0.18 X2 + 0.18 X3 + 0.18 X4 + 0.18 X5 + 0.18 X6
     + 0.18 X7 + 0.18 X8 + 0.18 X9 + 0.18 X10 + 0.18 X11 + 0.18 X12
     + 0.18 X13 + 0.18 X27 + 0.18 X28 + 0.18 X29 + 0.18 X30 + 0.18 X31
     + 0.18 X32 + 0.18 X33 + 0.18 X34 + 0.18 X35 + 0.18 X36 + 0.18 X37
     + 0.18 X38 + 0.18 X39 + 0.18 X53 + 0.18 X54 + 0.18 X55 + 0.18 X56
     + 0.18 X57 + 0.18 X58 + 0.18 X59 + 0.18 X60 + 0.18 X61 + 0.18 X62
     + 0.18 X63 + 0.18 X64 + 0.18 X65 + 0.18 X79 + 0.18 X80 + 0.18 X81
     + 0.18 X82 + 0.18 X83 + 0.18 X84 + 0.18 X85 + 0.18 X86 + 0.18 X87
     + 0.18 X88 + 0.18 X89 + 0.18 X90 + 0.18 X91 >=   0
      29)    0.07249999 X3 + 0.07249999 X17 + 0.07249999 X29 + 0.07249999
X42
     + 0.07249999 X55 + 0.07249999 X68 + 0.07249999 X81 + 0.07249999 X94
     >=   0
      30)    0.1375 X6 + 0.1375 X8 + 0.1375 X10 + 0.1375 X19 + 0.1375 X21
     + 0.1375 X23 + 0.1375 X32 + 0.1375 X34 + 0.1375 X36 + 0.1375 X45
     + 0.1375 X47 + 0.1375 X49 + 0.1375 X58 + 0.1375 X60 + 0.1375 X62
     + 0.1375 X71 + 0.1375 X73 + 0.1375 X75 + 0.1375 X84 + 0.1375 X86
     + 0.1375 X88 + 0.1375 X97 + 0.1375 X99 + 0.1375 X101 >=   0
      31)    0.1375 X6 + 0.1375 X8 + 0.1375 X10 + 0.1375 X19 + 0.1375 X21
     + 0.1375 X23 + 0.1375 X32 + 0.1375 X34 + 0.1375 X36 + 0.1375 X45
     + 0.1375 X47 + 0.1375 X49 + 0.1375 X58 + 0.1375 X60 + 0.1375 X62
     + 0.1375 X71 + 0.1375 X73 + 0.1375 X75 + 0.1375 X84 + 0.1375 X86
     + 0.1375 X88 + 0.1375 X97 + 0.1375 X99 + 0.1375 X101 >=   0
      32)    0.23 X11 + 0.23 X12 + 0.23 X13 + 0.23 X24 + 0.23 X25 + 0.23
X26
     + 0.23 X37 + 0.23 X38 + 0.23 X39 + 0.23 X50 + 0.23 X51 + 0.23 X52
     + 0.23 X63 + 0.23 X64 + 0.23 X65 + 0.23 X76 + 0.23 X77 + 0.23 X78
     + 0.23 X89 + 0.23 X90 + 0.23 X91 + 0.23 X102 + 0.23 X103 + 0.23 X104
     >=   0
      33)    0.075 X27 + 0.075 X28 + 0.075 X29 + 0.075 X30 + 0.075 X31
     + 0.075 X32 + 0.075 X33 + 0.075 X34 + 0.075 X35 + 0.075 X36
     + 0.075 X37 + 0.075 X38 + 0.075 X39 + 0.075 X40 + 0.075 X41
     + 0.075 X42 + 0.075 X43 + 0.075 X44 + 0.075 X45 + 0.075 X46
     + 0.075 X47 + 0.075 X48 + 0.075 X49 + 0.075 X50 + 0.075 X51
     + 0.075 X52 + 0.075 X79 + 0.075 X80 + 0.075 X81 + 0.075 X82
     + 0.075 X83 + 0.075 X84 + 0.075 X85 + 0.075 X86 + 0.075 X87
     + 0.075 X88 + 0.075 X89 + 0.075 X90 + 0.075 X91 + 0.075 X92
     + 0.075 X93 + 0.075 X95 + 0.075 X96 + 0.075 X97 + 0.075 X98
     + 0.075 X99 + 0.075 X100 + 0.075 X101 + 0.075 X102 + 0.075 X103
     + 0.075 X104 - 0.925 SETAML1 - 0.925 SETACL1 - 0.925 SETAML2
     - 0.925 SETACL2 + 0.075 SAFL1M + 0.075 SAFL1C + 0.075 SAFL2M
     + 0.075 SAFL2C + 0.075 FALLOW1 + 0.075 FALLOW2 <=   0
      34)    LAND1 =     1000
      35)    LAND2 =     1000
      36)    SETAML1 - SAFL1M <=   0
      37)    SETACL1 - SAFL1C <=   0
      38)    SETAML2 - SAFL2M <=   0
      39)    SETACL2 - SAFL2C <=   0
      40)    X1 + X2 + X3 + X4 + X5 + X6 + X13 + X14 + X15 + X16 + X17 +
X18
     + X19 + X26 + X27 + X28 + X29 + X30 + X31 + X32 + X39 + X40 + X41
     + X42 + X43 + X44 + X45 + X52 - FALLOW1 <=   0
      41)    X53 + X54 + X55 + X56 + X57 + X58 + X65 + X66 + X67 + X68 +
X69
     + X70 + X71 + X78 + X79 + X80 + X81 + X82 + X83 + X84 + X91 + X92
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+ X93 + X94 + X95 + X96 + X97 + X104 - FALLOW2 <= 0
END OF MODEL

Sensitivity Reports

LP OPTIMUM FOUND AT STEP 16

OBJECTIVE FUNCTION VALUE

1) 48980.0000

VARIABLE	VALUE	REDUCED COST
X1	.000000	50.757500
X2	.000000	50.527500
X3	.000000	38.060000
X4	.000000	38.017500
X5	.000000	34.427500
X6	.000000	59.397500
X7	.000000	26.512500
X8	.000000	51.422500
X9	.000000	25.142500
X10	.000000	49.532500
X11	.000000	55.602500
X12	.000000	54.082500
X13	.000000	63.507500
X14	.000000	45.827500
X15	.000000	45.597500
X16	.000000	33.110000
X17	.000000	33.087500
X18	.000000	29.477500
X19	.000000	54.467500
X20	.000000	21.572500
X21	.000000	46.492500
X22	.000000	20.202500
X23	.000000	44.992500
X24	.000000	50.662500
X25	.000000	49.142500
X26	.000000	58.577500
X27	.000000	24.480000
X28	.000000	24.160000
X29	.000000	10.092500
X30	.000000	9.889999
X31	.000000	5.889999
X32	.000000	34.680000
X33	.000000	11.395000
X34	.000000	40.185000
X35	.000000	10.225000
X36	.000000	38.915000
X37	.000000	45.085000
X38	.000000	43.795000
X39	.000000	39.600000
X40	.000000	18.640000
X41	.000000	18.350000
X42	.000000	4.252501
X43	.000000	4.340002
X44	500.000000	.000000
X45	.000000	28.780000
X46	.000000	5.555000
X47	.000000	34.355000
X48	.000000	4.395000
X49	.000000	33.095000
X50	.000000	39.255000

X51	.000000	37.965000
X52	.000000	33.780000
X53	.000000	45.007500
X54	.000000	44.777500
X55	.000000	32.310000
X56	.000000	32.267500
X57	.000000	28.677500
X58	.000000	53.647500
X59	.000000	24.887500
X60	.000000	49.797500
X61	.000000	23.517500
X62	.000000	48.307500
X63	.000000	53.977500
X64	.000000	54.457500
X65	.000000	57.757500
X66	.000000	40.077500
X67	.000000	39.847500
X68	.000000	27.360000
X69	.000000	27.337500
X70	.000000	23.727500
X71	.000000	48.717500
X72	.000000	19.947500
X73	.000000	44.867500
X74	.000000	18.577500
X75	.000000	43.367500
X76	.000000	49.037500
X77	.000000	47.517500
X78	.000000	52.827500
X79	.000000	24.480000
X80	.000000	9.082500
X81	.000000	25.170000
X82	.000000	9.889998
X83	.000000	5.830002
X84	.000000	34.680000
X85	.000000	13.220000
X86	.000000	42.010000
X87	.000000	12.050000
X88	.000000	40.740000
X89	.000000	46.910000
X90	.000000	45.480000
X91	.000000	39.600000
X92	.000000	18.640000
X93	.000000	18.350000
X94	.000000	.000000
X95	.000000	4.070000
X96	350.000000	.000000
X97	.000000	28.780000
X98	.000000	7.380001
X99	.000000	36.180000
X100	.000000	6.319999
X101	.000000	34.920000
X102	.000000	41.080000
X103	.000000	39.790000
X104	.000000	33.780000
SETAML1	.000000	.000000
SETACL1	.000000	18.250000
SETAML2	.000000	.000000
SETACL2	150.000000	.000000
SAFL1M	.000000	36.810000
SAFL1C	.000000	.000000
SAFL2M	.000000	18.560000
SAFL2C	150.000000	.000000

X111	.000000	6.000000
X112	.000000	6.000000
X113	.000000	6.000000
X114	.000000	6.000000
X115	.000000	6.000000
X116	.000000	6.000000
FALLOW1	500.000000	.000000
LAND1	1000.000000	.000000
FALLOW2	350.000000	.000000
LAND2	1000.000000	.000000

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	179.450000	.000000
3)	266.085000	.000000
4)	254.700000	.000000
5)	97.899990	.000000
6)	300.000000	.000000
7)	204.800000	.000000
8)	.000000	-.215393
9)	552.500000	.000000
10)	850.000000	.000000
11)	1242.000000	.000000
12)	34000.000000	.000000
13)	51000.000000	.000000
14)	2846.400000	.000000
15)	.000000	29.052500
16)	.000000	19.927500
17)	.000000	.000000
18)	.000000	.000000
19)	.000000	.000000
20)	.000000	.000000
21)	.000000	.000000
22)	85.000000	.000000
23)	146.800000	.000000
24)	85.000000	.000000
25)	146.800000	.000000
26)	.000000	.000000
27)	170.000000	.000000
28)	.000000	.000000
29)	.000000	.000000
30)	.000000	.000000
31)	.000000	.000000
32)	.000000	.000000
33)	.000000	56.700000
34)	.000000	29.052500
35)	.000000	19.927500
36)	.000000	9.945000
37)	.000000	37.475000
38)	.000000	19.070000
39)	.000000	28.350000
40)	.000000	33.305000
41)	.000000	24.180000

NO. ITERATIONS= 16

RANGES IN WHICH THE BASIS IS UNCHANGED:

		OBJ COEFFICIENT RANGES	
VARIABLE	CURRENT COEF	ALLOWABLE INCREASE	ALLOWABLE DECREASE
X1	11.600000	50.757500	INFINITY

X2	11.830000	50.527500	INFINITY
X3	9.220000	38.060000	INFINITY
X4	24.340000	38.017500	INFINITY
X5	27.930000	34.427500	INFINITY
X6	2.960000	59.397500	INFINITY
X7	2.540000	26.512500	INFINITY
X8	-22.370000	51.422500	INFINITY
X9	3.910000	25.142500	INFINITY
X10	-20.480000	49.532500	INFINITY
X11	-26.550000	55.602500	INFINITY
X12	-25.030000	54.082500	INFINITY
X13	-1.150000	63.507500	INFINITY
X14	16.530000	45.827500	INFINITY
X15	16.760000	45.597500	INFINITY
X16	14.170000	33.110000	INFINITY
X17	29.270000	33.087500	INFINITY
X18	32.880000	29.477500	INFINITY
X19	7.890000	54.467500	INFINITY
X20	7.480000	21.572500	INFINITY
X21	-17.440000	46.492500	INFINITY
X22	8.850000	20.202500	INFINITY
X23	-15.940000	44.992500	INFINITY
X24	-21.610000	50.662500	INFINITY
X25	-20.090000	49.142500	INFINITY
X26	3.780000	58.577500	INFINITY
X27	42.130000	24.480000	INFINITY
X28	42.450000	24.160000	INFINITY
X29	41.440000	10.092500	INFINITY
X30	56.720000	9.889999	INFINITY
X31	60.720000	5.889999	INFINITY
X32	31.930000	34.680000	INFINITY
X33	21.910000	11.395000	INFINITY
X34	-6.880000	40.185000	INFINITY
X35	23.080000	10.225000	INFINITY
X36	-5.610000	38.915000	INFINITY
X37	-11.780000	45.085000	INFINITY
X38	-10.490000	43.795000	INFINITY
X39	27.010000	39.600000	INFINITY
X40	47.970000	18.640000	INFINITY
X41	48.260000	18.350000	INFINITY
X42	47.280000	4.252501	INFINITY
X43	62.270000	4.340002	INFINITY
X44	66.610000	19.890000	4.252501
X45	37.830000	28.780000	INFINITY
X46	27.750000	5.555000	INFINITY
X47	-1.050000	34.355000	INFINITY
X48	28.910000	4.395000	INFINITY
X49	.210000	33.095000	INFINITY
X50	-5.950000	39.255000	INFINITY
X51	-4.660000	37.965000	INFINITY
X52	32.830000	33.780000	INFINITY
X53	-.900000	45.007500	INFINITY
X54	-.670000	44.777500	INFINITY
X55	-3.280000	32.310000	INFINITY
X56	11.840000	32.267500	INFINITY
X57	15.430000	28.677500	INFINITY
X58	-9.540000	53.647500	INFINITY
X59	-4.960000	24.887500	INFINITY
X60	-29.870000	49.797500	INFINITY
X61	-3.590000	23.517500	INFINITY
X62	-28.380000	48.307500	INFINITY
X63	-34.050000	53.977500	INFINITY

X64	-34.530000	54.457500	INFINITY
X65	-13.650000	57.757500	INFINITY
X66	4.030000	40.077500	INFINITY
X67	4.260000	39.847500	INFINITY
X68	1.670000	27.360000	INFINITY
X69	16.770000	27.337500	INFINITY
X70	20.380000	23.727500	INFINITY
X71	-4.610000	48.717500	INFINITY
X72	-.020000	19.947500	INFINITY
X73	-24.940000	44.867500	INFINITY
X74	1.350000	18.577500	INFINITY
X75	-23.440000	43.367500	INFINITY
X76	-29.110000	49.037500	INFINITY
X77	-27.590000	47.517500	INFINITY
X78	-8.720000	52.827500	INFINITY
X79	23.880000	24.480000	INFINITY
X80	24.200000	9.082500	INFINITY
X81	23.190000	25.170000	INFINITY
X82	38.470000	9.889998	INFINITY
X83	42.530000	5.830002	INFINITY
X84	13.680000	34.680000	INFINITY
X85	10.960000	13.220000	INFINITY
X86	-17.830000	42.010000	INFINITY
X87	12.130000	12.050000	INFINITY
X88	-16.560000	40.740000	INFINITY
X89	-22.730000	46.910000	INFINITY
X90	-21.300000	45.480000	INFINITY
X91	8.760000	39.600000	INFINITY
X92	29.720000	18.640000	INFINITY
X93	30.010000	18.350000	INFINITY
X94	29.030000	15.077500	4.252501
X95	44.290000	4.070000	INFINITY
X96	48.360000	4.597298	4.070000
X97	19.580000	28.780000	INFINITY
X98	16.800000	7.380001	INFINITY
X99	-12.000000	36.180000	INFINITY
X100	17.860000	6.319999	INFINITY
X101	-10.740000	34.920000	INFINITY
X102	-16.900000	41.080000	INFINITY
X103	-15.610000	39.790000	INFINITY
X104	14.580000	33.780000	INFINITY
SETAML1	-13.450000	36.810000	9.945000
SETACL1	-4.170000	18.250000	INFINITY
SETAML2	-13.450000	18.560000	19.070000
SETACL2	-4.170000	9.945000	18.250000
SAFL1M	-13.450000	36.810000	INFINITY
SAFL1C	-4.170000	18.250000	INFINITY
SAFL2M	-13.450000	18.560000	INFINITY
SAFL2C	-4.170000	9.945000	18.250000
X111	-6.000000	6.000000	INFINITY
X112	-6.000000	6.000000	INFINITY
X113	-6.000000	6.000000	INFINITY
X114	-6.000000	6.000000	INFINITY
X115	-6.000000	6.000000	INFINITY
X116	-6.000000	6.000000	INFINITY
FALLOW1	.000000	19.890000	8.790000
LAND1	.000000	INFINITY	INFINITY
FALLOW2	.000000	18.250000	9.945000
LAND2	.000000	INFINITY	INFINITY

RIGHTHAND SIDE RANGES

ROW	CURRENT	ALLOWABLE	ALLOWABLE

	RHS	INCREASE	DECREASE
2	250.000000	INFINITY	179.450000
3	300.000000	INFINITY	266.085000
4	300.000000	INFINITY	254.700000
5	300.000000	INFINITY	97.899990
6	300.000000	INFINITY	300.000000
7	300.000000	INFINITY	204.800000
8	.000000	26486.490000	.000000
9	.000000	552.500000	INFINITY
10	.000000	850.000000	INFINITY
11	.000000	1242.000000	INFINITY
12	.000000	34000.000000	INFINITY
13	.000000	51000.000000	INFINITY
14	.000000	2846.400000	INFINITY
15	.000000	968.827200	1000.000000
16	.000000	968.827200	823.529400
17	.000000	.000000	INFINITY
18	.000000	.000000	INFINITY
19	.000000	.000000	INFINITY
20	.000000	.000000	INFINITY
21	.000000	.000000	INFINITY
22	.000000	85.000000	INFINITY
23	.000000	146.800000	INFINITY
24	.000000	85.000000	INFINITY
25	.000000	146.800000	INFINITY
26	.000000	.000000	INFINITY
27	.000000	170.000000	INFINITY
28	.000000	.000000	INFINITY
29	.000000	.000000	INFINITY
30	.000000	.000000	INFINITY
31	.000000	.000000	INFINITY
32	.000000	.000000	INFINITY
33	.000000	150.000000	350.000000
34	1000.000000	968.827200	1000.000000
35	1000.000000	968.827200	823.529400
36	.000000	150.000000	.000000
37	.000000	.000000	1000.000000
38	.000000	150.000000	.000000
39	.000000	150.000000	700.000000
40	.000000	874.107100	1000.000000
41	.000000	700.000000	700.000000

Appendix B

CARE Summary Budgets

Moldboard Plow Winter Wheat Tillage System Number 1.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-	--- Power Unit --		--- Machinery ---				
Date	Operation Description	ance rate Acres/hr	Owner- ship	Opera- ting	Owner- ship	Opera- ting	Labor Cost	--- Cost Per --- Acre	Unit
	Pre-Harvest Activities								
04/25/91	Tandam Disk 40ft	15.709	1881.80	750.63	1569.90	202.25	420.14	4.825	0.161
06/25/91	Chisel plow with sweeps 36ft	15.709	1881.80	750.63	801.77	124.30	420.14	3.979	0.133
08/25/91	Caulkens weeder 36ft	14.727	2007.25	800.67	363.69	80.22	448.15	3.700	0.123
09/25/91	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.299
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
05/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
09/01/92	Moldboard plow 10-18 15ft	6.136	4817.40	1921.60	2084.90	352.51	1075.56	10.252	0.342
Pre-Harvest SubTotal			14654.21	5830.18	9138.24	964.48	3514.88	34.102	1.137
	Harvest Activities								
07/20/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320

Avenge		Pounds	650.00	3451.50	3.451	0.115
Insecticide-disyston		Pounds	1000.00	1290.00	1.290	0.043
	Labor Used					
Machinery Labor		Hours	787.48	4724.88	n/a	n/a
Other Labor		Hours	596.22	0.00	n/a	n/a
	Fuels Used					
Diesel		Gallons	6451.75	6451.75	n/a	n/a
Total Cost of Inputs				23941.50	23.941	0.798
	4. Other Operating Costs					
Interest On Operating Capital				3397.94	3.398	0.113
Crop Drying Costs				0.00	0.000	0.000
	5. Enterprise Costs					
Ownership Costs per Acre					39.497	1.317
Operating Costs per Acre					41.133	1.371
Total Enterprise Costs					80.629	2.688
6. Return to Land and Management					-5.629	-0.188

Disk Plow Tillage System Number 2.

1. Gross Receipts From Production

	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report

Date	Operation Description	Performance rate Acres/hr	Power Unit Ownership	Power Unit Operating	Machinery Ownership	Machinery Operating	Labor Cost	Cost Per Acre	Cost Per Unit
	Pre-Harvest Activities								
04/25/91	Tandam Disk 40ft	15.709	1881.80	750.63	1569.90	202.25	420.14	4.825	0.161
06/25/91	Chisel plow with sweeps 36ft	15.709	1881.80	750.63	801.77	124.30	420.14	3.979	0.133
07/25/91	Caulkens weeder 36ft	14.727	2007.25	800.67	363.69	80.22	448.15	3.700	0.123
08/15/91	Caulkens weeder 36ft	14.727	2007.25	800.67	363.69	80.22	448.15	3.700	0.123
09/25/91	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.299
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
05/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
09/01/92	Offset 23ft disk	10.036	2945.42	1174.89	1338.61	76.04	657.61	6.193	0.206
Pre-Harvest SubTotal			14789.48	5884.14	8755.64	768.24	3545.09	33.743	1.125
	Harvest Activities								
07/20/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report

	Units	Quantity	Total Costs	Cost Per Acre	Cost Per Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320
Avenge	Pounds	650.00	3451.50	3.451	0.115
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	792.51	4755.09	n/a	n/a
Other Labor	Hours	600.79	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	6497.65	6497.65	n/a	n/a
Total Cost of Inputs			23941.50	23.941	0.798

4. Other Operating Costs			
Interest On Operating Capital	3558.06	3.558	0.119
Crop Drying Costs	0.00	0.000	0.000
5. Enterprise Costs			
Ownership Costs per Acre		39.249	1.308
Operating Costs per Acre		41.181	1.373
Total Enterprise Costs		80.430	2.681
6. Return to Land and Management		-5.430	-0.181

Chisel Plow Tillage System Number 3.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-	--- Power Unit --		--- Machinery ---			--- Cost Per ---	
Date	Operation Description	ance rate Acres/hr	Owner- ship	Opera- ting	Owner- ship	Opera- ting	Labor Cost	Acre	Unit
			Pre-Harvest Activities						
04/15/91	Chisel plow with sweeps 36ft	11.455	2580.75	1029.43	1099.57	170.47	576.19	5.456	0.182
04/28/91	Chisel plow with sweeps 36ft	15.709	1881.80	750.63	801.77	124.30	420.14	3.979	0.133
06/10/91	Caulkens weeder 36ft	14.727	2007.25	800.67	363.69	80.22	448.15	3.700	0.123
07/15/91	Caulkens weeder 36ft	14.727	2007.25	800.67	363.69	80.22	448.15	3.700	0.123
08/15/91	Caulkens weeder 36ft	14.727	2007.25	800.67	363.69	80.22	448.15	3.700	0.123
08/28/91	Anhydrous Applicator	13.788	2144.01	855.22	762.23	579.68	478.68	4.820	0.161
09/22/91	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.299
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
05/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
Pre-Harvest SubTotal			16694.27	6643.94	8072.63	1320.32	3970.36	36.702	1.223
			Harvest Activities						
07/20/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
Anhydrous ammonia	Pounds	70000.00	10500.00	10.500	0.350
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
Avenge	Pounds	625.00	3318.75	3.319	0.111
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	863.39	5180.36	n/a	n/a
Other Labor	Hours	601.57	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	7144.07	7144.07	n/a	n/a

Total Cost of Inputs	24708.75	24.709	0.824
4. Other Operating Costs			
Interest On Operating Capital	4254.29	4.254	0.142
Crop Drying Costs	0.00	0.000	0.000
5. Enterprise Costs			
Ownership Costs per Acre		40.471	1.349
Operating Costs per Acre		44.381	1.479
Total Enterprise Costs		84.852	2.828
6. Return to Land and Management		-9.852	-0.328

Chisel Plow Chemical Fallow Tillage System Number 4.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-	--- Power Unit --		--- Machinery ---				
Date	Operation Description	ance rate Acres/hr	Owner- ship	Opera- ting	Owner- ship	Opera- ting	Labor Cost	--- Cost Per --- Acre	Unit
		Pre-Harvest Activities							
04/22/91	Sprayer 50ft	25.455	571.51	219.73	212.71	24.40	259.29	1.288	0.043
06/10/91	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
09/15/91	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.299
04/29/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
05/27/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
09/10/92	Chisel plow with sweeps 36ft	15.709	1881.80	750.63	801.77	124.30	420.14	3.979	0.133
Pre-Harvest SubTotal			7046.83	2779.84	5528.81	376.43	2069.67	17.802	0.593
		Harvest Activities							
07/25/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
Landmaster II	Pounds	1080.00	2181.60	2.182	0.073
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320
Avenge	Pounds	650.00	3451.50	3.451	0.115
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	546.61	3279.67	n/a	n/a
Other Labor	Hours	313.59	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	3729.80	3729.80	n/a	n/a
Total Cost of Inputs			26123.10	26.123	0.871

4. Other Operating Costs			
Interest On Operating Capital	3330.01	3.330	0.111
Crop Drying Costs	0.00	0.000	0.000
5. Enterprise Costs			
Ownership Costs per Acre		28.280	0.943
Operating Costs per Acre		38.163	1.272
Total Enterprise Costs		66.442	2.215
6. Return to Land and Management		8.558	0.285

No-till Deep Furrow Drill Winter Wheat Tillage System Number 5.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-ance rate	--- Power Unit --		--- Machinery ---		Labor	--- Cost Per ---	
Date	Operation Description	Acres/hr	Owner-ship	Opera-ting	Owner-ship	Opera-ting	Cost	Acre	Unit
		Pre-Harvest Activities							
04/20/91	Sprayer 50ft	25.455	571.51	219.73	212.71	24.40	259.29	1.288	0.043
06/15/91	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
09/20/91	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.299
04/25/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
05/15/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
Pre-Harvest SubTotal			5165.03	2029.21	4727.04	252.13	1649.53	13.823	0.461
		Harvest Activities							
07/25/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
Landmaster II	Pounds	1080.00	2181.60	2.182	0.073
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320
Avenge	Pounds	650.00	3451.50	3.451	0.115
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	476.59	2859.53	n/a	n/a
Other Labor	Hours	249.93	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	3091.19	3091.19	n/a	n/a
Total Cost of Inputs			26123.10	26.123	0.871

4. Other Operating Costs

Interest On Operating Capital	3291.69	3.292	0.110
Crop Drying Costs	0.00	0.000	0.000
5. Enterprise Costs			
Ownership Costs per Acre		25.596	0.853
Operating Costs per Acre		36.829	1.228
Total Enterprise Costs		62.425	2.081
6. Return to Land and Management		12.575	0.419

No-till 20 Foot Yielder Drill Winter Wheat Tillage System Number 6.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-	--- Power Unit --		--- Machinery ---			--- Cost Per ---	
Date	Operation Description	ance rate Acres/hr	Owner- ship	Opera- ting	Owner- ship	Opera- ting	Labor Cost	Acre	Unit
			Pre-Harvest Activities						
04/20/91	Sprayer 50ft	25.455	571.51	219.73	212.71	24.40	259.29	1.288	0.043
06/15/91	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
09/15/91	Yielder no-till drill 20ft	7.273	7989.99	2142.27	32134.09	2448.88	907.50	45.623	1.521
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
05/25/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
Pre-Harvest SubTotal			10144.14	2970.48	32935.86	2540.83	1884.81	50.476	1.683
			Harvest Activities						
07/25/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
Landmaster II	Pounds	1080.00	2181.60	2.182	0.073
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320
Avenge	Pounds	650.00	3451.50	3.451	0.115
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	515.80	3094.81	n/a	n/a
Other Labor	Hours	285.58	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	3890.46	3890.46	n/a	n/a
Total Cost of Inputs			26123.10	26.123	0.871

4. Other Operating Costs

Interest On Operating Capital	3728.92	3.729	0.124
Crop Drying Costs	0.00	0.000	0.000
5. Enterprise Costs			
Ownership Costs per Acre		58.784	1.959
Operating Costs per Acre		40.732	1.358
Total Enterprise Costs		99.516	3.317
6. Return to Land and Management		-24.516	-0.817

Continuous No-till Deep Furrow Drill Winter Wheat Tillage System Number 7.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	20.00	50.00
Total Receipts				50.00

2. Production Activities Report		Perform-ance rate	--- Power Unit --		--- Machinery ---			--- Cost Per ---	
Date	Operation Description	Acres/hr	Owner-ship	Opera-ting	Owner-ship	Opera-ting	Labor Cost	Acre	Unit
		Pre-Harvest Activities							
09/15/91	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.448
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.059
05/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.059
Pre-Harvest SubTotal			4065.97	1606.66	4317.97	205.21	1150.90	11.347	0.567
		Harvest Activities							
07/25/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.959
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.959

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.480
nitrogen	Pounds	40000.00	9600.00	9.600	0.480
Avenge	Pounds	650.00	3451.50	3.451	0.173
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.064
Labor Used					
Machinery Labor	Hours	393.48	2360.90	n/a	n/a
Other Labor	Hours	174.38	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	2858.50	2858.50	n/a	n/a
Total Cost of Inputs			23941.50	23.941	1.197

4. Other Operating Costs			
Interest On Operating Capital	2841.98	2.842	0.142
Crop Drying Costs	0.00	0.000	0.000

5. Enterprise Costs

Ownership Costs per Acre	24.088	1.204
Operating Costs per Acre	33.230	1.661
Total Enterprise Costs	57.318	2.866
6. Return to Land and Management	-7.318	-0.366

Continuous No-till 20 Foot Yielder Drill Winter Wheat Tillage System Number 8.

1. Gross Receipts From Production

	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	20.00	50.00
Total Receipts				50.00

2. Production Activities Report

Date	Operation Description	Performance rate Acres/hr	Power Unit Ownership	Power Unit Operating	Machinery Ownership	Machinery Operating	Labor Cost	Cost Per Acre	Cost Per Unit
	Pre-Harvest Activities								
09/20/91	Yielder no-till drill 20ft	7.273	7989.99	2142.27	32134.09	2448.88	907.50	45.623	2.281
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.059
05/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.059
Pre-Harvest SubTotal			9045.08	2547.93	32526.79	2493.91	1386.18	48.000	2.400
	Harvest Activities								
07/22/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.959
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.959

3. Material Usage Report

	Units	Quantity	Total Costs	Cost Per Acre	Cost Per Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.480
nitrogen	Pounds	40000.00	9600.00	9.600	0.480
Avenge	Pounds	650.00	3451.50	3.451	0.173
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.064
Labor Used					
Machinery Labor	Hours	432.70	2596.18	n/a	n/a
Other Labor	Hours	210.03	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	3657.77	3657.77	n/a	n/a
Total Cost of Inputs			23941.50	23.941	1.197

4. Other Operating Costs

	Total Costs	Cost Per Acre	Cost Per Unit
Interest On Operating Capital	3211.36	3.211	0.161
Crop Drying Costs	0.00	0.000	0.000

5. Enterprise Costs

Ownership Costs per Acre	57.276	2.864
Operating Costs per Acre	37.064	1.853
Total Enterprise Costs	94.340	4.717
6. Return to Land and Management	-44.340	-2.217

Continuous No-till Deep Furrow Drill Spring Wheat Tillage System Number 9.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-	--- Power Unit --		--- Machinery ---			--- Cost Per ---	
Date	Operation Description	ance rate Acres/hr	Owner-ship	Opera-ting	Owner-ship	Opera-ting	Labor Cost	Acre	Unit
			Pre-Harvest Activities						
04/04/92	Deep furrow drill 36 ft 3-12	9.818	3010.87	1201.00	3925.27	160.17	672.22	8.970	0.299
06/04/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
07/03/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
Pre-Harvest SubTotal			4065.97	1606.66	4317.97	205.21	1150.90	11.347	0.378
			Harvest Activities						
08/15/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320
Herbicide 2,4D	Pounds	650.00	1014.00	1.014	0.034
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	393.48	2360.90	n/a	n/a
Other Labor	Hours	174.38	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	2858.50	2858.50	n/a	n/a
Total Cost of Inputs			21504.00	21.504	0.717

4. Other Operating Costs			
Interest On Operating Capital	1378.43	1.378	0.046
Crop Drying Costs	0.00	0.000	0.000

5. Enterprise Costs

Ownership Costs per Acre	24.088	0.803
Operating Costs per Acre	29.329	0.978
Total Enterprise Costs	53.417	1.781
6. Return to Land and Management	21.583	0.719

Continuous No-till 20 Foot Yielder Drill Spring Wheat Tillage System Number 10.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	30.00	75.00
Total Receipts				75.00

2. Production Activities Report		Perform-ance rate	--- Power Unit --		--- Machinery ---		Labor	--- Cost Per ---	
Date	Operation Description	Acres/hr	Owner-ship	Opera-ting	Owner-ship	Opera-ting	Cost	Acre	Unit
		Pre-Harvest Activities							
04/04/92	Yielder no-till drill 20ft	7.273	7989.99	2142.27	32134.09	2448.88	907.50	45.623	1.521
06/01/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
07/05/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.040
Pre-Harvest SubTotal			9045.08	2547.93	32526.79	2493.91	1386.18	48.000	1.600
		Harvest Activities							
08/15/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.640

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.320
nitrogen	Pounds	40000.00	9600.00	9.600	0.320
Avenge	Pounds	650.00	3451.50	3.451	0.115
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.043
Labor Used					
Machinery Labor	Hours	432.70	2596.18	n/a	n/a
Other Labor	Hours	210.03	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	3657.77	3657.77	n/a	n/a
Total Cost of Inputs			23941.50	23.941	0.798

4. Other Operating Costs			
Interest On Operating Capital	1672.03	1.672	0.056
Crop Drying Costs	0.00	0.000	0.000

5. Enterprise Costs

Ownership Costs per Acre	57.276	1.909
Operating Costs per Acre	35.525	1.184
Total Enterprise Costs	92.801	3.093
6. Return to Land and Management	-17.801	-0.593

Continuous No-till 12 Foot Yielder Drill Winter Wheat Tillage System Number 11.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	23.00	57.50
Total Receipts				57.50

2. Production Activities Report		Perform-	--- Power Unit --		--- Machinery ---			--- Cost Per ---	
Date	Operation Description	ance rate Acres/hr	Owner-ship	Opera-ting	Owner-ship	Opera-ting	Labor Cost	Acre	Unit
		Pre-Harvest Activities							
09/20/91	Yielder Drill 12ft	4.364	6774.47	2702.26	26495.58	1081.15	1512.50	38.566	1.677
04/23/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.052
05/23/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.052
Pre-Harvest SubTotal			7829.56	3107.91	26888.28	1126.19	1991.18	40.943	1.780
		Harvest Activities							
07/25/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.834
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.834

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.417
nitrogen	Pounds	40000.00	9600.00	9.600	0.417
Avenge	Pounds	650.00	3451.50	3.451	0.150
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.056
Labor Used					
Machinery Labor	Hours	533.53	3201.18	n/a	n/a
Other Labor	Hours	301.69	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	4135.72	4135.72	n/a	n/a
Total Cost of Inputs			23941.50	23.941	1.041

4. Other Operating Costs			
Interest On Operating Capital	3180.21	3.180	0.138
Crop Drying Costs	0.00	0.000	0.000

5. Enterprise Costs

Ownership Costs per Acre	50.422	2.192
Operating Costs per Acre	36.831	1.601
Total Enterprise Costs	87.252	3.794
6. Return to Land and Management	-29.752	-1.294

Continuous No-till 12 Foot Yielder Drill Spring Wheat Tillage System Number 12.

1. Gross Receipts From Production	Unit	Price /Unit	Quantity	Value / Acre
wheat	Bushels	2.500	23.00	57.50
Total Receipts				57.50

Date	2. Production Activities Report Operation Description	Performance rate Acres/hr	--- Power Unit -- Ownership	Operating	--- Machinery --- Ownership	Operating	Labor Cost	--- Cost Per --- Acre	Unit
	Pre-Harvest Activities								
04/04/92	Yielder Drill 12ft	4.364	6774.47	2702.26	26495.58	1081.15	1512.50	38.566	1.677
06/01/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.052
07/05/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.052
Pre-Harvest SubTotal			7829.56	3107.91	26888.28	1126.19	1991.18	40.943	1.780
	Harvest Activities								
08/15/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.834
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.834

3. Material Usage Report	Units	Quantity	Total Costs	--- Cost Per --- Acre	Unit
Materials Used					
wheat seed	Pounds	60000.00	9600.00	9.600	0.417
nitrogen	Pounds	40000.00	9600.00	9.600	0.417
Avenge	Pounds	650.00	3451.50	3.451	0.150
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.056
Labor Used					
Machinery Labor	Hours	533.53	3201.18	n/a	n/a
Other Labor	Hours	301.69	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	4135.72	4135.72	n/a	n/a
Total Cost of Inputs			23941.50	23.941	1.041

4. Other Operating Costs	Total Costs	Acre	Unit
Interest On Operating Capital	1660.56	1.661	0.072
Crop Drying Costs	0.00	0.000	0.000

5. Enterprise Costs

Ownership Costs per Acre	50.422	2.192
Operating Costs per Acre	35.311	1.535
Total Enterprise Costs	85.733	3.728
6. Return to Land and Management	-28.233	-1.228

No-till 12 Foot Yielder Drill Winter Wheat Tillage System Number 13.

1. Gross Receipts From Production

	Unit	Price /Unit	Quantity	Value / Acre
Wheat	Bushels	2.500	35.00	87.50
Total Receipts				87.50

2. Production Activities Report

Date	Operation Description	Performance rate Acres/hr	Power Unit Ownership	Power Unit Operating	Machinery Ownership	Machinery Operating	Labor Cost	Cost Per Acre	Cost Per Unit
	Pre-Harvest Activities								
04/20/91	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.034
06/15/91	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.034
09/15/91	Yielder Drill 12ft	4.364	6774.47	2702.26	26495.58	1081.15	1512.50	38.566	1.102
04/20/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.034
05/25/92	Sprayer 50ft	27.576	527.55	202.83	196.35	22.52	239.34	1.189	0.034
Pre-Harvest SubTotal			8884.66	3513.56	27280.98	1171.23	2469.86	43.320	1.238
	Harvest Activities								
07/27/92	Combine 20ft.	5.455	15704.09	2273.56	0.00	0.00	1210.00	19.188	0.548
Harvest SubTotal			15704.09	2273.56	0.00	0.00	1210.00	19.188	0.548

3. Material Usage Report

	Units	Quantity	Total Costs	Cost Per Acre	Cost Per Unit
Materials Used					
Landmaster II	Pounds	1080.00	2181.60	2.182	0.062
wheat seed	Pounds	60000.00	9600.00	9.600	0.274
nitrogen	Pounds	40000.00	9600.00	9.600	0.274
Avenge	Pounds	650.00	3451.50	3.451	0.099
Insecticide-disyston	Pounds	1000.00	1290.00	1.290	0.037
Labor Used					
Machinery Labor	Hours	613.31	3679.86	n/a	n/a
Other Labor	Hours	374.22	0.00	n/a	n/a
Fuels Used					
Diesel	Gallons	4359.10	4359.10	n/a	n/a
Total Cost of Inputs			26123.10	26.123	0.746

4. Other Operating Costs

Interest On Operating Capital	3697.01	3.697	0.106
Crop Drying Costs	0.00	0.000	0.000
5. Enterprise Costs			
Ownership Costs per Acre		51.870	1.482
Operating Costs per Acre		40.458	1.156
Total Enterprise Costs		92.328	2.638
6. Return to Land and Management		-4.828	-0.138

Appendix C

CARE Budgets Machinery Complement

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Name ... Anhydrous Applicator          Machine Type ... Non Powered        Ownership Type ...... Owned
Purchase Price ......  13635.00        List Price  ....      13635.00    Date Purchased ...... 01/01/89
              Age When Purchased ..     0            Housing Space (sq ft)      0

        Ownership Costs                        Implements                        Power Units
Planned Life (Hours).  2000          Operating Width (ft).  50.00         Fuel Type ........... None
  Planned Use (Hours) .    200          Operating Speed (mph)   3.50         Horse Power Rating ..     0
 Starting Hours ......     0          Machine Efficiency ..   0.65        Lubricant Multiplier.   0.000
 Interest Rate .......    10.000                                          Fuel Multiplier .....   0.000
                                    Annual Taxes ........        0.08
          Insurance Cost ......    34.10        Machine Parameters ..  RC1   0.950    RC2  1.300
          Maintenance Costs ...  1598.52                               RFV1  0.600    RFV2 0.885
------------------------------------------------------------------------------------------------
Name ... Caulkens weeder 36ft          Machine Type ... Non Powered        Ownership Type ...... Owned
Purchase Price ......   8000.00        List Price  ....       8000.00    Date Purchased ...... 01/01/85
              Age When Purchased ..     0            Housing Space (sq ft)      0

        Ownership Costs                        Implements                        Power Units
Planned Life (Hours).  4000          Operating Width (ft).  36.00         Fuel Type ........... None
  Planned Use (Hours) .    170          Operating Speed (mph)   4.50         Horse Power Rating ..     0
 Starting Hours ......     0          Machine Efficiency ..   0.75        Lubricant Multiplier.   0.000
 Interest Rate .......    10.000                                          Fuel Multiplier .....   0.000
                                    Annual Taxes ........        0.04
          Insurance Cost ......    18.69        Machine Parameters ..  RC1   0.300    RC2  1.400
           Maintenance Costs ...   200.84                               RFV1  0.600    RFV2 0.8
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Name ... Chisel plow with sweeps 36ft   Machine Type ... Non Powered   Ownership Type ...... Owned
Purchase Price ...... 12000.00   List Price .... 12000.00   Date Purchased 01/01/87
Age When Purchased .. 0   Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	2000	Operating Width (ft).	36.00	Fuel Type	None
Planned Use (Hours) .	120	Operating Speed (mph)	4.50	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.85	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.06
Insurance Cost ...... 27.50   Machine Parameters .. RC1 0.380 RC2 1.400
Maintenance Costs ... 234.32   RFV1 0.600 RFV2 0.885

Name ... Combine 20ft.   Machine Type ... Power Unit   Ownership Type ...... Owned
Purchase Price ...... 111650.00   List Price .... 111650.00   Date Purchased 01/01/90
Age When Purchased .. 0   Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	2000	Operating Width (ft).	20.00	Fuel Type	Diesel
Planned Use (Hours) .	200	Operating Speed (mph)	3.00	Horse Power Rating ..	200
Starting Hours	0	Machine Efficiency ..	0.75	Lubricant Multiplier.	0.150
Interest Rate	10.000			Fuel Multiplier	0.044

Annual Taxes 0.66
Insurance Cost ...... 282.01   Machine Parameters .. RC1 0.120 RC2 2.100
Maintenance Costs ... 456.25   RFV1 0.640 RFV2 0.885

Name ... Deep furrow drill 36 ft 3-12   Machine Type ... Non Powered   Ownership Type ...... Owned
Purchase Price ...... 30000.00   List Price .... 30000.00   Date Purchased 01/01/87
Age When Purchased .. 0   Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	1200	Operating Width (ft).	36.00	Fuel Type	None
Planned Use (Hours) .	120	Operating Speed (mph)	3.00	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.75	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.18
Insurance Cost ...... 75.02   Machine Parameters .. RC1 0.540 RC2 2.100
Maintenance Costs ... 188.71   RFV1 0.600 RFV2 0.885

Name ... Grain combine 18ft | Machine Type ... Power Unit | Ownership Type ...... Owned
Purchase Price ...... 80000.00 | List Price .... 80000.00 | Date Purchased 01/01/86
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	3000	Operating Width (ft).	18.00	Fuel Type	Diesel
Planned Use (Hours) .	200	Operating Speed (mph)	3.00	Horse Power Rating ..	200
Starting Hours	0	Machine Efficiency ..	0.75	Lubricant Multiplier.	0.150
Interest Rate	10.000			Fuel Multiplier	0.044

Annual Taxes 0.44

Insurance Cost	187.41	Machine Parameters ..	RC1 0.120	RC2 2.100	
Maintenance Costs ...	326.91		RFV1 0.640	RFV2 0.885	

Name ... Harrow 36ft | Machine Type ... Non Powered | Ownership Type ...... Owned
Purchase Price ...... 2200.00 | List Price .... 2200.00 | Date Purchased 01/01/87
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	2000	Operating Width (ft).	36.00	Fuel Type	None
Planned Use (Hours) .	120	Operating Speed (mph)	5.00	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.80	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.01

Insurance Cost	5.04	Machine Parameters ..	RC1 0.300	RC2 1.400	
Maintenance Costs ...	33.92		RFV1 0.600	RFV2 0.885	

Name ... Moldboard plow 10-18 15ft | Machine Type ... Non Powered | Ownership Type ...... Owned
Purchase Price ...... 18230.00 | List Price .... 18230.00 | Date Purchased 01/01/89
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	2500	Operating Width (ft).	15.00	Fuel Type	None
Planned Use (Hours) .	200	Operating Speed (mph)	4.50	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.75	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.10

Insurance Cost	43.79	Machine Parameters ..	RC1 0.430	RC2 1.800	
Maintenance Costs ...	432.62		RFV1 0.600	RFV2 0.885	

Name ... Offset 23ft disk | Machine Type ... Non Powered | Ownership Type ...... Owned
Purchase Price ...... 16000.00 | List Price .... 16000.00 | Date Purchased 01/01/90
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	2500	Operating Width (ft).	23.00	Fuel Type	None
Planned Use (Hours) .	150	Operating Speed (mph)	4.50	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.80	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.09
Insurance Cost ...... 36.66 | Machine Parameters .. RC1 0.180 RC2 1.700
Maintenance Costs ... 114.48 | RFV1 0.600 RFV2 0.885

* * *

Name ... Sprayer 50ft | Machine Type ... Non Powered | Ownership Type ...... Owned
Purchase Price ...... 4140.00 | List Price .... 4140.00 | Date Purchased 01/01/90
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	1500	Operating Width (ft).	50.00	Fuel Type	None
Planned Use (Hours) .	100	Operating Speed (mph)	6.50	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.70	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.02
Insurance Cost ...... 9.64 | Machine Parameters .. RC1 0.150 RC2 1.000
Maintenance Costs ... 62.10 | RFV1 0.600 RFV2 0.885

* * *

Name ... Tandam Disk 40ft | Machine Type ... Non Powered | Ownership Type ...... Owned
Purchase Price ...... 29000.00 | List Price .... 29000.00 | Date Purchased 01/01/90
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	2000	Operating Width (ft).	40.00	Fuel Type	None
Planned Use (Hours) .	200	Operating Speed (mph)	4.50	Horse Power Rating ..	0
Starting Hours	0	Machine Efficiency ..	0.80	Lubricant Multiplier.	0.000
Interest Rate	10.000			Fuel Multiplier	0.000

Annual Taxes 0.17
Insurance Cost ...... 72.52 | Machine Parameters .. RC1 0.190 RC2 1.400
Maintenance Costs ... 578.89 | RFV1 0.600 RFV2 0.885

Name ... Tractor 225hp 4wd JD 8640 | Machine Type ... Power Unit | Ownership Type ...... Owned
Purchase Price ...... 84956.00 | List Price .... 84956.00 | Date Purchased 01/01/82
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	12000	Operating Width (ft).	0.00	Fuel Type	Diesel
Planned Use (Hours) .	300	Operating Speed (mph)	0.00	Horse Power Rating ..	228
Starting Hours	0	Machine Efficiency ..	0.80	Lubricant Multiplier.	0.150
Interest Rate	10.000			Fuel Multiplier	0.044

Annual Taxes 0.59
Insurance Cost ...... 184.90 | Machine Parameters .. RC1 0.010 RC2 2.000
Maintenance Costs ... 76.46 | RFV1 0.680 RFV2 0.920

Name ... Tractor 300hp Steiger KP-1325 | Machine Type ... Power Unit | Ownership Type ...... Owned
Purchase Price ...... 139817.00 | List Price .... 139817.00 | Date Purchased 01/01/86
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	12000	Operating Width (ft).	0.00	Fuel Type	Diesel
Planned Use (Hours) .	250	Operating Speed (mph)	0.00	Horse Power Rating ..	301
Starting Hours	0	Machine Efficiency ..	0.80	Lubricant Multiplier.	0.150
Interest Rate	10.000			Fuel Multiplier	0.044

Annual Taxes 0.94
Insurance Cost ...... 400.80 | Machine Parameters .. RC1 0.010 RC2 2.000
Maintenance Costs ... 87.39 | RFV1 0.680 RFV2 0.920

Name ... Tractor Case 870-70hp | Machine Type ... Power Unit | Ownership Type ...... Owned
Purchase Price ...... 14244.00 | List Price .... 14244.00 | Date Purchased 01/01/75
Age When Purchased .. 0 | Housing Space (sq ft) 0

Ownership Costs		Implements		Power Units	
Planned Life (Hours).	12000	Operating Width (ft).	0.00	Fuel Type	Diesel
Planned Use (Hours) .	100	Operating Speed (mph)	0.00	Horse Power Rating ..	70
Starting Hours	0	Machine Efficiency ..	0.85	Lubricant Multiplier.	0.150
Interest Rate	10.000			Fuel Multiplier	0.044

Annual Taxes 0.07
Insurance Cost ...... 30.27 | Machine Parameters .. RC1 0.012 RC2 2.000
Maintenance Costs ... 205.11 | RFV1 0.680 RFV2 0.920

Name ... Yielder Drill 12ft	Machine Type ... Non Powered	Ownership Type ...... Owned
Purchase Price 90000.00	List Price 90000.00	Date Purchased 01/01/90
Age When Purchased .. 0	Housing Space (sq ft) 0	
Ownership Costs	Implements	Power Units
Planned Life (Hours). 1200	Operating Width (ft). 12.00	Fuel Type .... None
Planned Use (Hours) . 120	Operating Speed (mph) 4.00	Horse Power Rating .. 0
Starting Hours 0	Machine Efficiency .. 0.75	Lubricant Multiplier. 0.000
Interest Rate 10.000		Fuel Multiplier 0.000
	Annual Taxes 0.53	
Insurance Cost 225.07	Machine Parameters ..	RC1 0.540 RC2 2.100
Maintenance Costs ... 566.13		RFV1 0.600 RFV2 0.885

Name ... Yielder no-till drill 20ft	Machine Type ... Non Powered	Ownership Type ...... Owned
Purchase Price 250000.00	List Price 250000.00	Date Purchased 01/01/90
Age When Purchased .. 0	Housing Space (sq ft) 0	
Ownership Costs	Implements	Power Units
Planned Life (Hours). 3000	Operating Width (ft). 20.00	Fuel Type .... None
Planned Use (Hours) . 120	Operating Speed (mph) 4.00	Horse Power Rating .. 0
Starting Hours 20	Machine Efficiency .. 0.75	Lubricant Multiplier. 0.000
Interest Rate 10.000		Fuel Multiplier 0.000
	Annual Taxes 1.35	
Insurance Cost 572.86	Machine Parameters ..	RC1 0.540 RC2 2.100
Maintenance Costs ... 2137.20		RFV1 0.600 RFV2 0.885

Appendix D

CARE Budgets Economic Parameters

G L O B A L   E C O N O M I C   &   P H Y S I C A L   P A R A M E T E R S   L I S T I N G

Fuel Parameters	Price($)
Gasoline (gal.) ...	0.950
Diesel (gal.)	1.000
LP Gas (gal.)	0.600
Natural Gas (mcf) .	0.005
Electricity (kwh) .	0.060

Wages	
Machinery Labor ...	0.00
Irrigation Labor ..	0.00
Other Labor	0.00

Energy Parameters	BTUs	Units
Gasoline	0	Gallon
Diesel	0	Gallon
LP Gas	0	Gallon
Natural Gas ..	0	1000 Cubic Feet
Electricity ..	0	Kilowatt Hours

Machinery Index Data	
Repairs	100.0
Depreciation	100.0
Taxes	100.0
Insurance	100.0
Finance	100.0

Interest Rates	
Operating Capital ..	10.000
Land Investment	10.000
Machine Interest ...	10.000

Labor Overhead Requirements	
General Implements ...	1.00
Power Unit	1.10
Self Propelled	1.20
Irrigation Equipment .	0.00

Miscellaneous Data	
Housing Cst($/sq-ft)	0.220
Tax Per $M Value ...	0.01
Insure Per $M Value.	4.25
Base Budget ID	BX01
Budget Year	1992