30S

ECONOMIC ANALYSIS OF REDUCED TILLAGE WHEAT AND GRAIN SORGHUM ROTATIONS IN WESTERN KANSAS

By

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Chapter One

INTRODUCTION

Overview

Interest in conservation tillage systems for producing wheat as well as row crops in the Great Plains[1] stems from the need to improve the storage of moisture in the soil, control erosion, and increase net revenue from cropping enterprises (Figure 1.1). A study compiled by Christensen (1984) reveals that Great Plains acreage in which some form of conservation tillage was practiced increased from 17,155,000 acres in 1973 to 42,548,000 acres by 1984.

Soil moisture is the biggest limiting factor in dryland crop production in Western Kansas as well as other areas of the Great Plains. Stewart and Musick (1982) point out that annual precipitation ranges from 50% below to 200% above the average level in parts of the region. This variation causes a skewed rainfall distribution as an exceptionally wet year pulls up the average more than the downward impact of dry years. As a result, in approximately 55 percent of the years Western Kansas will have less precipitation than the estimated average. Precipitation ranges from 16 inches in far West Kansas to 23 inches in the West Central portion of the state (Figure 1.2). In addition, this part of the Great Plains has low humidity and high winds which result in large moisture losses from evaporation.

Annual dryland cropping practices result in unstable production during many years across the Great Plains. Heavy rainfall over short -

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1) The Great Plains is defined as North Dakota, South Dakota, the western halves of Nebraska, Kansas, Oklahoma and Texas. New Mexico, and the eastern halves of Colorado, Wyoming, and Montana.

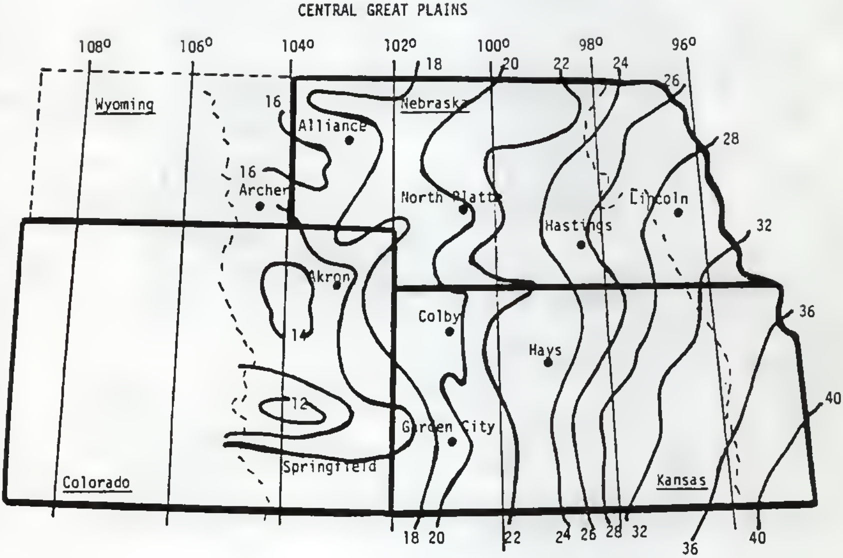
Figure 1.1

Area of Great Plains States with Less Than 20 Inches of Rainfall.

Source: Adapted from Climatic Atlas, U.S. Department of Commerce, Environmental Service Administration, Environmental Data Service, 1968.

Figure 1.2

Mean Annual Precipitation in the Central Great Plains.



Source: Summer Fallow in the Central Great Plains. USDA Report #17.

periods causes excessive water erosion which may be followed by lengthy dry spells with significant wind erosion.

Christensen (1984) also points out that approximately 16% of the land in the Great Plains is eroded by water at a rate which is greater than five tons/acre-year. Serious wind erosion occurs on approximately 23% of the cropland in the region.

The structure of Agriculture in the Great Plains has changed dramatically over the past 50 years. Technical advancements including more powerful equipment, genetic improvements in crop cultivars, greater use of fertilizer, etc., have helped increase crop yields, enabling fewer and fewer agricultural producers to increase the output of farm commodities. However, farmers have also faced substantial increases in the cost of production; mainly due to higher energy, equipment, labor and financing costs. Tweeten and Griffin (1976) found that prices paid for farm inputs were inflating faster than prices received by farmers. In 1983 and 1984, agricultural producers were plagued with the continued strength of the U.S. dollar relative to other currencies, which resulted in lower exports, and commodity prices. In addition, the slowing inflation rate as compared with the mid to late 1970's has lead to a decrease in the expected growth in net worth to landowners, and has reduced their borrowing potential. Also, recent public policy has reduced target and loan levels, which act as a price floor under given commodities (Penner, 1984). The result of this cost-price squeeze has been lower net farm incomes in recent years. Therefore, many producers are becoming more serious about the adoption of yield increasing cropping systems, along with more cost effective ways of production which increase net farm income, especially for land that with the use of traditional cropping practices produces a crop every other year.

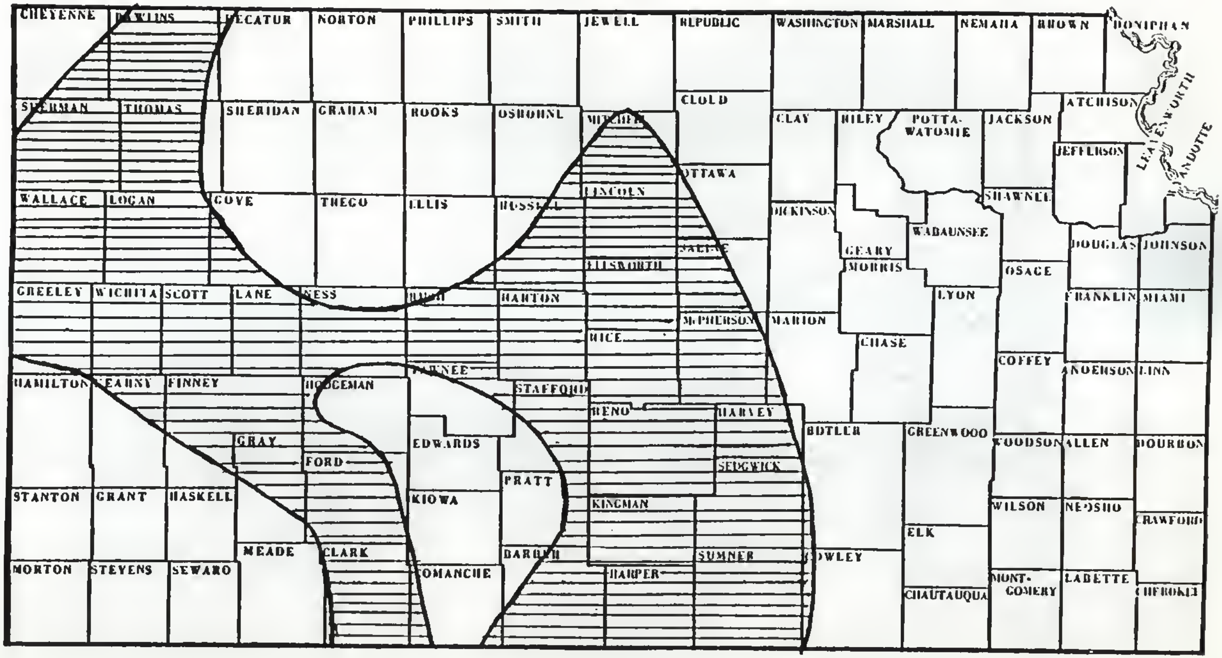
Additionally. more farm managers are considering converting land that is currently under irrigation to dryland. Reasons generally accepted for this are (1) rising energy costs make irrigated grain production more expensive than it was a decade ago and (2) declining water table levels in parts of the Ogallala Aquifer formation are making irrigation more economically prohibitive and in extreme cases technically impossible. Results of the Ogallala Aquifer Study in Kansas, indicate that compared to 1977 acreages total irrigated acres harvested in Western Kansas are estimated to decline 19% by 1985 and 52% by 1990 (Kansas Water Office, 1982). Therefore, the amount of land which will be available for dryland tillage practices will be increasing. Interest in alternative soil and water conservation practices is expected to rise along with the need for relevant economic and technical information necessary for widespread adoption of such practices as irrigation practices become more costly.

Statement of Problem

The main dryland cropping system in Western Kansas has historically been a conventional wheat-fallow rotation (Figure 1.3). Winter wheat (*Triticum aestivum L.*) is planted in September, and harvested the following June-July. The next 15 months the land is fallowed with vegetative growth (weeds) controlled by shallow cultivation. Some of the moisture received during this time is stored in the soil profile for use by the crop in the next growing season. Figure 1.4 is used to illustrate this two year cycle. Recently, due to economic and agronomic factors, farmers have shown considerable interest in increasing the moisture storage efficiency of fallow so that more intensive cropping systems may be adopted.

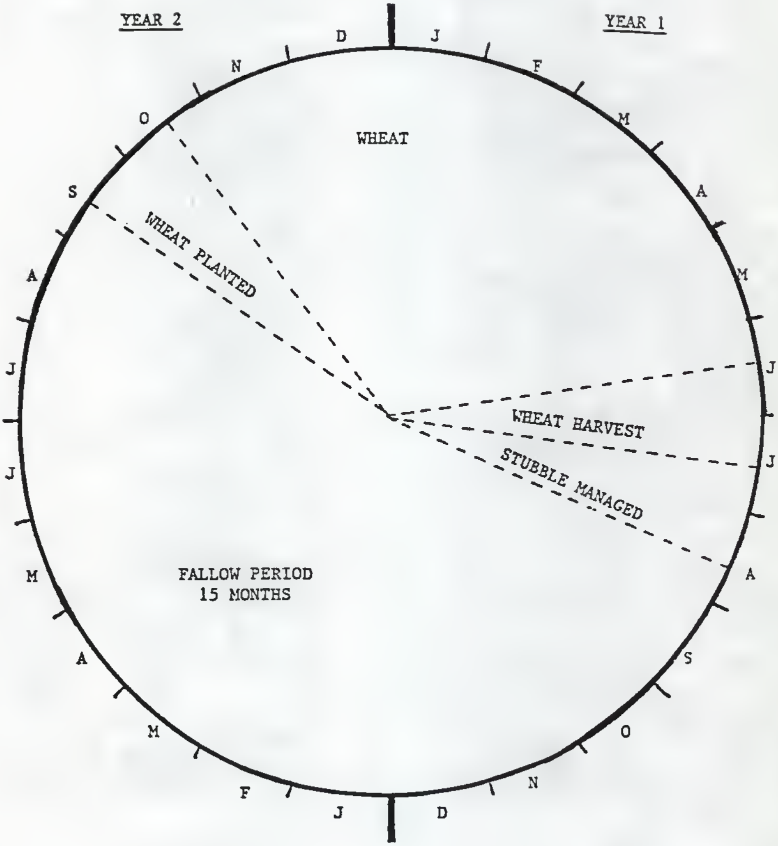
Figure 1.3

Area of Primary Wheat Production in Kansas.



Source: Lekner, R. M.S. Thesis, Kansas State University, Department of Agricultural Economics, 1984.

Figure 1.4
Time Circle for Wheat-Fallow.



"24-MONTH CLOCK"

2 Crops in Four Years

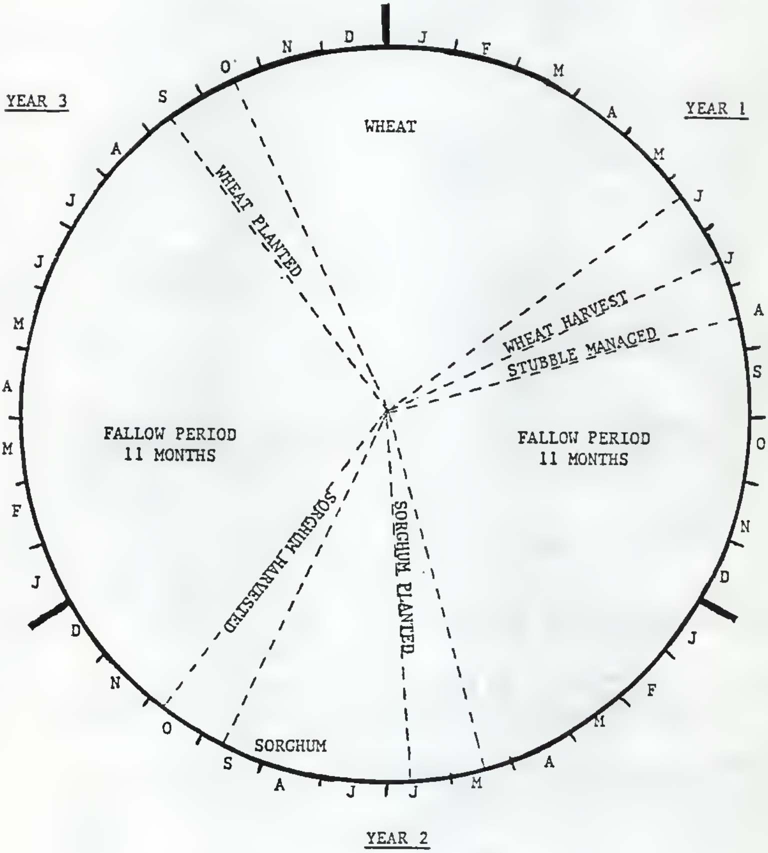
One of the more promising rotations being studied by agricultural experiment stations in the Southern Great Plains is the wheat-sorghum-fallow (WSF) cropping system. (Fenster, Gwin, Lawless, Norwood, Phillips, Thompson, Unger, and Wicks). This rotation allows two crops to be grown in a three year cycle, as shown in Figure 1.5. Winter wheat is sown in September for harvest the following June/July. Weeds are controlled after harvest usually with herbicides. After an eleven month fallow period grain sorghum [Sogrhum bicolor (L.) Moench] is planted into the standing wheat stubble in late May/early June for harvest in October. Then a second eleven month fallow period completes the cycle.

Much of the previous published research on the economics of conservation tillage is concentrated in the corn belt region (Doster, Giere, Jolly, Jose, Klemme, Rahm) where plow, chisel, disk, till-plant and no-till systems are used. However, these results are not applicable in the Great Plains region where farmers use one-way plows, v-blade sweeps, rodweeders, and mulch treaders, etc, for weed control and seedbed preparation. Moisture is the greatest limiting factor in crop production of this region, in which summer-fallowing land is used to store moisture for the next growing season. There have been many studies done on conventional and conservation wheat-fallow production (Fenster, Harris, Smika, Unger). These studies address agronomic concerns such as fertilizer, herbicide, and soil interactions on crop yield, etc, without including economic analysis.

Some studies have concentrated on the economics of various conventional, reduced, and no-till systems, (Epplin, Hinman, Johnson) but have not included yields--or have assumed yields to be equal between systems in their analysis.

Figure 1.5

Time Circle for Wheat-Sorghum-Fallow



"36-MONTH CLOCK"

2 Crops in three years

Killingsworth and Matulich (1981) argued that soil conservation recommendations to farmers have been largely ignored because economists have emphasied cost effectiveness, and neglected other factors underlying their adoption including the ability to bear risk. Therefore, a study which compares costs and returns of conventional and conservation tillage systems including annual yields and prices would be beneficial to Kansas agricultural producers, and related agribusiness.

The study will address the following questions: 1) What is the cropping system of wheat and/or sorghum which has the highest annual net returns in Western Kansas? 2) How much risk - measured by variance of yields and price - is involved with its adoption? 3) What are the cash flow requirements of the most profitable systems.

<u>Objective of Study</u>

The major objective of this study is to evaluate the economic potential and associated risks of conventional and conservation reduced tillage systems for wheat and sorghum in Western Kansas.

Specific objectives are:

1) Identify technically feasible conservation and reduced cropping systems which could potentially replace conventional tillage systems.

2) With recomendations from Agronomists, and Agricultural experiment station personnel, establish typical cropping practices which would be followed in each system including specific input levels.

3) Collect yield data from agricultural experiment stations for these cropping systems and their operating practices.

4) Define a representative "case" farm using Kansas State University Farm Management Data.

5) Establish an equipment complement that is capable of meeting tillage and planting requirements of the case farm within an optimum time period.

6) Estimate the variable and fixed costs for each system based on characteristics of a typical Western Kansas farm.

7) Compare the technical and economic requirements of each system.

8) Examine potential risk by variance of yields and net income for each system over the last eleven years using an enterprise budget framework.

9) Compare cash flow requirements of the most profitable systems.

<u>Study Area</u>

Yield data used in this study were collected at the Kansas State University Tribune Experiment Station, which is one mile west of Tribune in Greeley County. Kansas. Greeley County is in Western Kansas on the Colorado border, midway between Nebraska and Oklahoma (Figure 1.6). The land is nearly level to gently rolling between the Arkansas River to the south and the Smoky Hill River to the north.

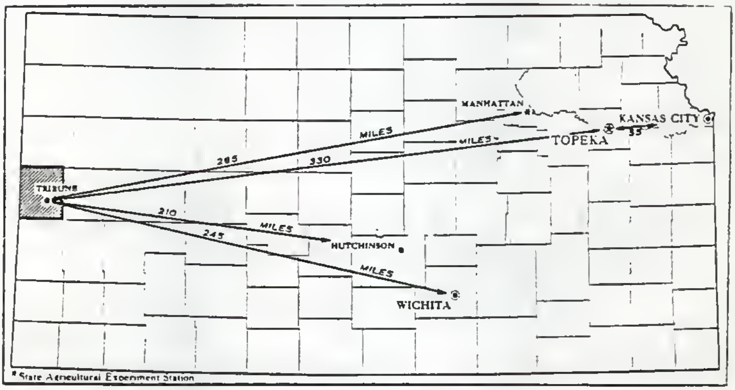
Agriculture is the major industry in Greeley County with wheat, grain sorghum. and cattle the main sources of income. Most of the acreage is cultivated. A small percentage of the acres are irrigated by deep wells which pump water out of the Ogallala Aquifer. The areas remaining in native grass are mostly on slopes adjacent to drainage ways.

<u>Soils</u>

The thick, fertile silt loam soils on the Tribune Experiment Station are typical of those on about four million acres of the High Plains of Western Kansas, Eastern Colorado, and the Oklahoma panhandle (Gwin et al., 1974). Soils of Greeley County occur in a pattern closely related to the land topography and can be divided into the general soil areas called soil associations or soil series. Richfield-Ulysses and Ulysses-Colby associations are the major soils in Greeley County. Richfield silt loam is the

Figure 1.6

Location of Greeley County in Kansas.



Source: "Soil Survey of Greeley County, Kansas," USDA, 1961.

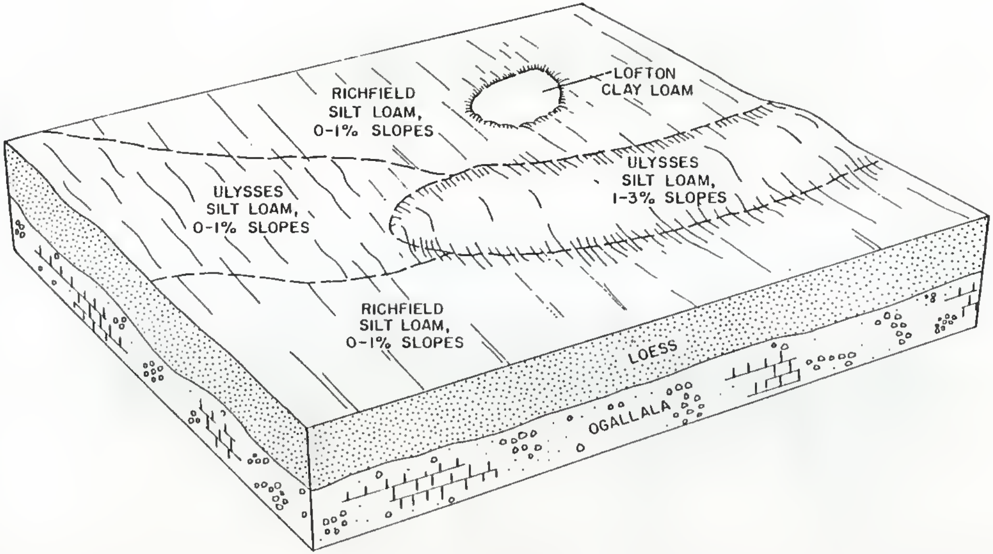
predominate soil series at the Tribune Experiment Station. The Richfield-Ulysses soils are members of the Great Chestnut and Aridic Ustolls soil groups. The soils of this association occupy nearly level to gently sloping tablelands of the county (Figure 1.7). McBee (1961) gives this summary of the Richfield soil association. These soils have developed in the deep, silty loess that mantles much of the High Plains and most of Greeley county. Richfield silt loam, the most extensive soil in the county, has a dark silt loam surface layer over a dark, somewhat more clayey subsoil that grades to light-colored, friable, calcareous loess at about 12 to 15 inches. It occupies the broad, nearly level areas that have poorly defined drainageways and a few small enclosed depressions or potholes. Lofton clay loam soil occupies these low areas. Nearly all of this area is used for cash crops of wheat and grain sorghum. Wind erosion is a hazard on the nearly level soils. Both wind and water erosion are hazards on gentle slopes. Water conservation is necessary for profitable crop production on all the soils in the area.

Climate

Greeley County has a semi-arid, continental climate characterized by abundant sunshine, low humidity, moderate winds, light precipitation and wide temperature ranges. Fortunately 80 percent of the annual precipitation occurs from April through September, the time most favorable for crop growth. The average monthly precipitation from the Tribune weather station is given in Figure 1.8. June has the greatest monthly rainfall of 2.67 inches. The 16.3 inches of annual precipitation does not show the significant variations of the weather (Figure 1.9). For example, July rainfall averages 2.57 inches, but only in 19 of the 60 years on record has the

Figure 1.7

Typical Section of the Richfield-Ulysses Soil Association.



Source: "Soil Survey of Greeley County, Kansas," USDA, 1961.

Figure 1.8

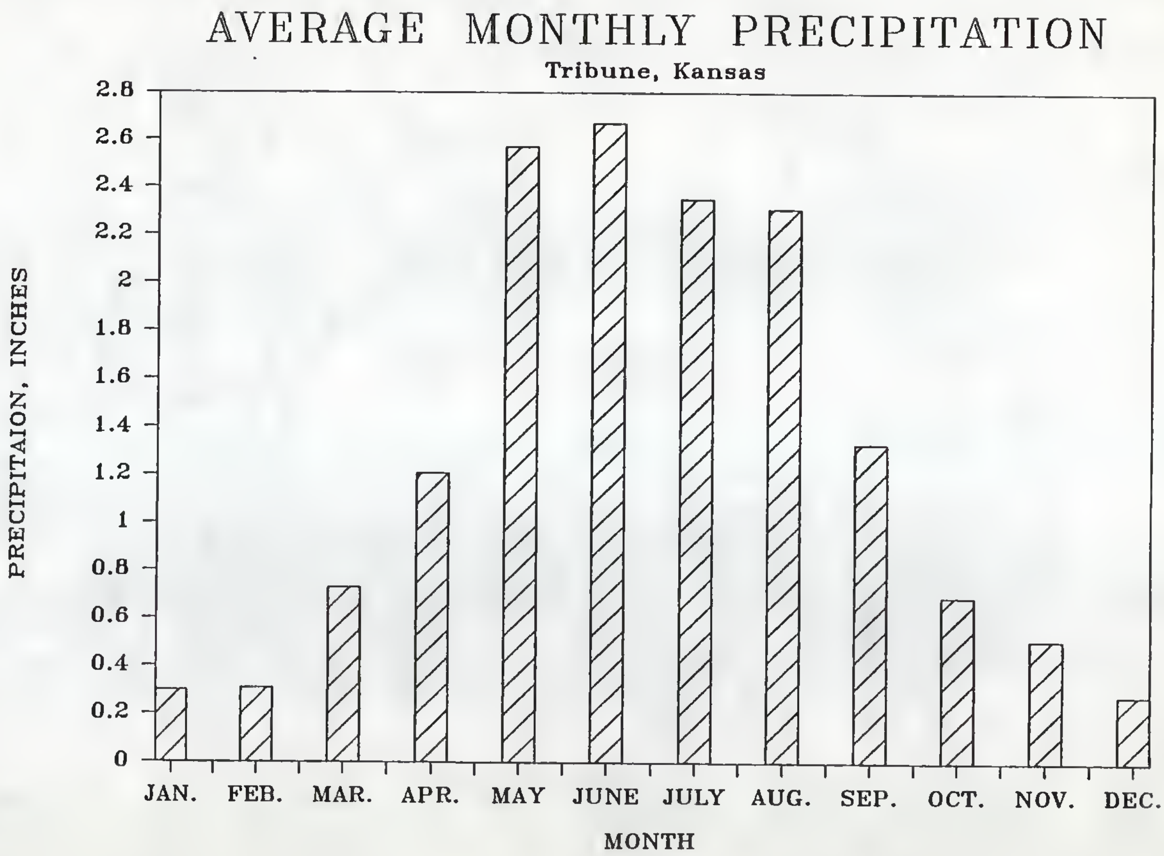
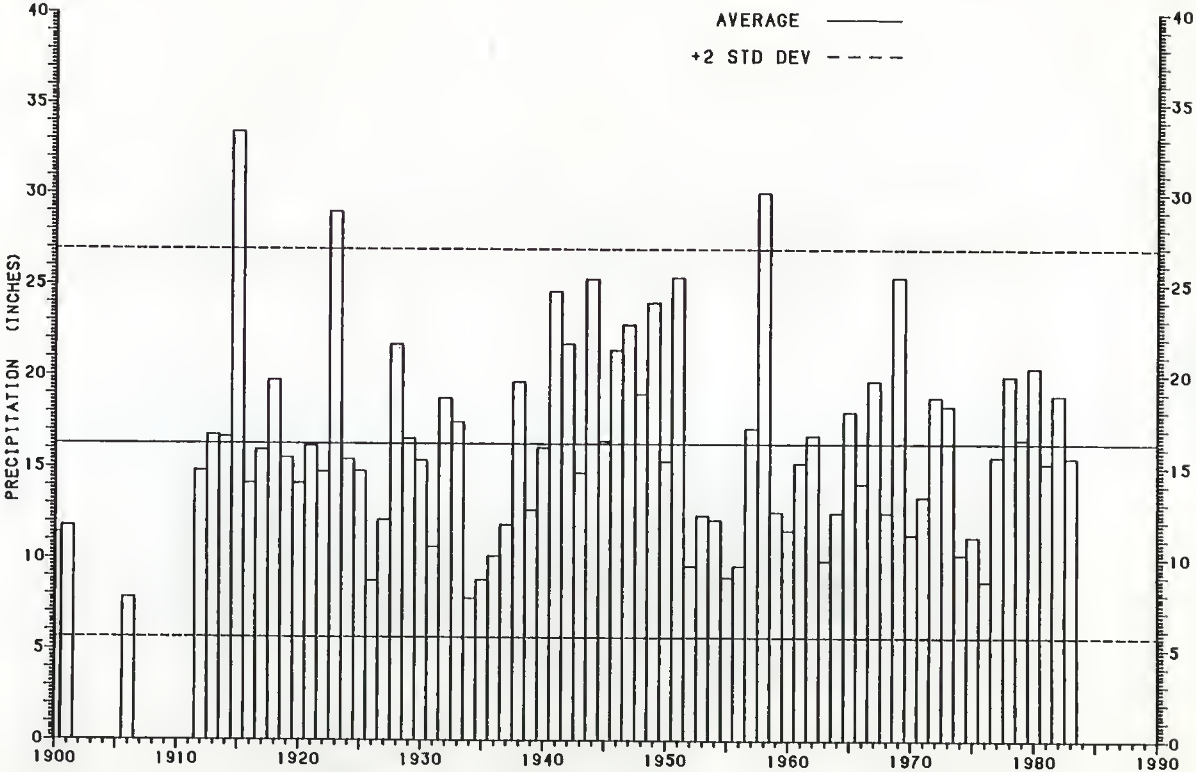

AVERAGE MONTHLY PRECIPITATION
Tribune, Kansas
PRECIPITAION, INCHES
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEP.
OCT.
NOV.
DEC.
MONTH

Figure 1.9

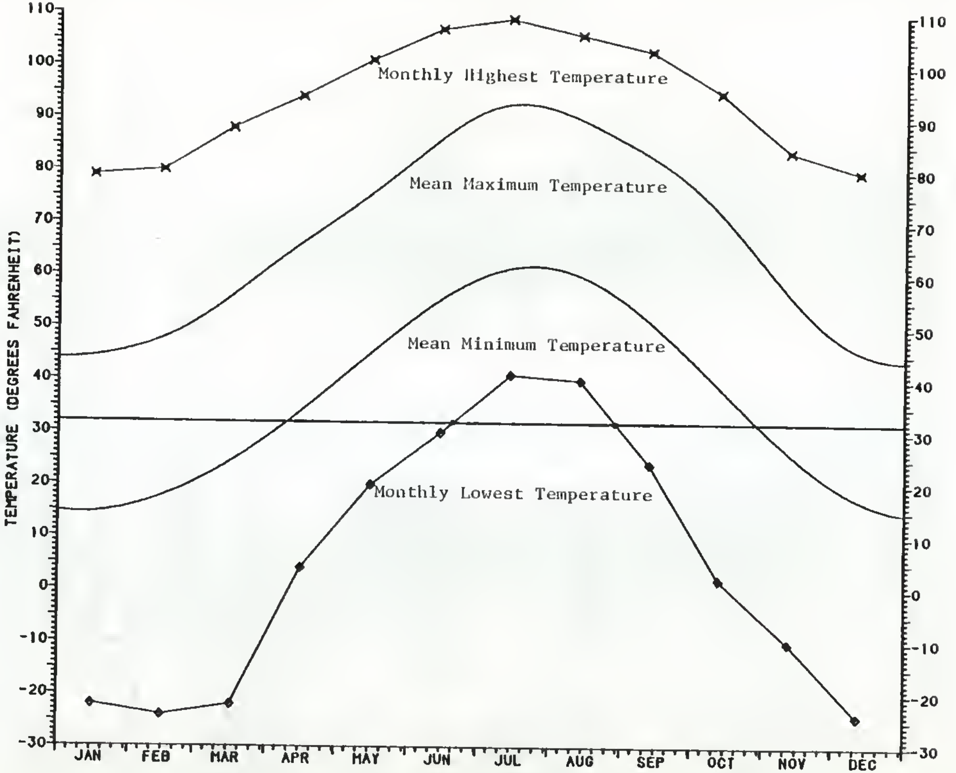


ANNUAL PRECIPITATION IN TRIBUNE

PRODUCED BY THE KANSAS AGRICULTURAL EXPERIMENT STATION WEATHER DATA LIBRARY, MANHATTAN, KANSAS actual rainfall been plus or minus an inch, of that amount. A total of 14 years had more than 3.75 inches; 27 received less than 1.75 inches. The greatest July total was 8.45 inches in 1958. The two smallest July totals were 0.11 inches in 1952 and only a trace in 1955. Dry periods of 30 consecutive days occur about once a year; these periods have no more than 0.25 inches of precipitation on any day from April through September.

A graph of the temperature, based on records of the U.S. Weather Bureau at Tribune, Kansas, is shown in Figure 1.10. It includes the mean maximum, mean minimum, and temperature extremes for each month. Also shown are the most probable periods in which temperatures of 100 degrees F., and freezing might be experienced. The freeze-free period usually extends from early May to early October providing a growing season of approximately 160 days. Greeley County has more crop damage from hail than any other type of storm. Hail storms occur largely during the period from April through July and are of short duration. This area also has moderate to occasionally strong winds, with an average hourly wind speed at 14 miles per hour.

Figure 1.10



GRAPHICAL WEATHER SUMMARY FOR TRIBUNE

PRODUCED WITH THE AID OF THE KANSAS AGRICULTURAL EXPERIMENT STATION WEATHER DATA LIBRARY

Chapter Two

REVIEW OF LITERATURE

A continuing problem in the Central Great Plains is the need for increased conservation of soil and water. Large sections of the Great Plains receive less than 20" of rainfall a year. However, heavy rains may fall in a short time period contributing to soil erosion. In the early 1900's moldboard plows buried virtually all crop residue, exposing the soil surface to wind and water erosion. Thus, the implement that originally made settlement possible in the Great Plains, contributed to the "dust bowl" that forced the outmigration of farmers from this area in the 1930's (Fenster et al., 1977). Those who remained on the land learned to leave some crop residue on the fields to protect the soil from erosion. Today there is still concern in the agricultural community about the impacts of erosion on the sustained productivity and economic viability of individual farm operators. In addition, society at large is expressing concerns associated with soil erosion as waterways become clogged with silt and water treatment costs increase (Christensen 1984).

Agronomic Principles of Tillage

Tillage is defined as the working of the soil to improve conditions for plant growth (Kipps, 1970). The primary objectives of tillage are to manage previous crop residue, prepare a suitable seedbed for germination, reduce competition from weeds, and improve soil conditions for plant growth (Martin and Loenard, 1967).

A desirable soil structure is one that has aggregates of a size that will not blow. If the stable aggregates are large enough, only the minimum amount of tillage needed to eradicate weeds and manage residues should be used. Too much tillage may produce harmful effects by breaking down the aggregates, compacting the soil, allowing the soil to crust over, or increasing the susceptibility of the soil to erosion by wind and rain. In practice, tillage and planting must be considered together, since the condition of the soil determines the type of planting necessary to obtain a good stand of the crop (Richey, et al., 1977). Certain crop rotations may partially substitute for tillage by loosening the soil, increasing soil organic matter, and increasing plant nutrient availability (Krause, 1983).

Cropping Systems

A cropping system consists of the kind and sequence of crops grown on a given area of cropland over a period of time (McBee et al., 1961). It may consist of a regular rotation of different crops grown in definite order, or only one crop grown on the same area year after year. Depending on the specific crops in the system and their sequence, a cropping system or a crop rotation may:

1. help control some weeds, insect pests, and diseases,
2. help maintain the supply of soil organic matter,
3. help maintain the supply of soil nitrogen,
4. improve soil structure and soil tilth,
5. regulate the use of plant nutrients from the soil, and
6. help control soil erosion
(Heady and Jensen, 1951; Kipps, 1970; Mannering and Griffith, 1981).

Phillips, et al., (1977) stated that "storing water in the soil during fallow to use for subsequent crop production is the major goal of any fallow system in the Great Plains." Other objectives that contribute to successful fallow and crop production include: (a) preserving crop residues to decrease wind and, to some extent, water erosion; (b) controlling unwanted vegetation during the fallow period; (c) establishing a satisfactory seedbed; (d) reducing herbicide residues (if herbicides are used) in the soil and harvested crops; and (e) producing yields and economic returns exceeding those from alternate methods.

Cropping systems may not always result in yield changes. Moreover, there usually are differences in the length of the systems. Some systems may increase/decrease the amount of pests. Also, fertilizers may be used to substitute for the nutrient benefits at a given system. Therefore, the decision to rotate crops or not depends on agronomic and economic relationships between systems.

History of Conservation Tillage in the Great Plains

The early Great Plains farmers moved in from the more humid midwest and southeastern U.S., where continuous cropping was a common practice. As these "sod busters" became more familiar with the semi-arid plains, they recognized that farming practices would have to be adapted to the soils and climate of the region. The challenge was how to make more water available for plant growth in this semi-arid region.

One solution to combat the erratic weather patterns was to crop the land every other year, storing spring and summer rains in the soil profile for the following crop. The first farmer on record to use this "summer fallow" procedure in the United States was near McDonald, Kansas in 1902 (Harris, 1962).

Summer fallow, as defined by John Bracker (1921), "is leaving part of the farm uncropped for a season and the soil managed so that a surplus supply of moisture is stored in the root zone."

Smika (1970) reports that summer fallow is part of the cropping system mainly in semiarid areas receiving under 20 inches of yearly precipitation, although many acres are fallowed in regions with up to 28 inches of rainfall annually. Because of higher evaporation rates in the Southern Plains, water storage under fallow conditions is less effective than in the northern regions. In the intermountain areas precipitation falls during the cooler fall and spring months, allowing more efficient soil-water storage than under hot summer conditions.

Summer fallow itself may or may not be considered a conservation tillage measure depending on the specific practices. Conservation tillage is defined by Mannering and Fenster (1983) as "any tillage system that reduces loss of soil or water relative to conventional tillage; often a form of noninversion tillage that retains protective amounts of residue mulch on the surface." Conventional tillage, on the other hand, is "the combined primary and secondary tillage operations performed in preparing a seedbed for a given crop growth in a given geographical area."

Fenster et al. (1977) defines four categories of cropping practices typical of the Central Great Plains:

1. bare fallow: use of a moldboard plow
2. stubble fallow: using a one-way offset or tanden disk
3. stubble mulch: using chisel and subsurface tillage implements
4. chemical fallow or ecofarming[2]: using chemicals to control weeds, replacing part or all of tillage operations.

In the "bare fallow" system all crop residues were buried with plows because no other suitable tillage implements were available. Farmers recognized that plowing killed weeds and initiated decomposition of stubble remaining after the crop was harvested. Also, the shallow disk planting

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2) Ecofarming is defined as a system of controlling weeds and managing crop residues throughout a crop rotation with minimum use of tillage so as to reduce soil erosion and production costs, while increasing weed control, water infiltration, moisture conservation, and crop yields (Burnside, et al, 1980).

equipment existing at that time would not seed through residue on the soil surface. Although bare fallow resulted in higher soil water contents and generally stabilized crop production, it left the soil surface vulnerable to erosion by wind and water.

Two pioneers of "stubble mulch tillage" were Dr. F.L. Duley and J.C. Russel. Their work started at Lincoln, Nebraska, in 1927 by the Nebraska Agricultural Experiment Station in Cooperation with the Resarch Division of the Soil Conservation Service, U.S. Department of Agriculture. Names proposed for this practice included "subsurface tillage", "noninversion tillage", and "subtillage" before settling on the current name. The main idea of stubble mulching was to deliberately leave crop residues on the soil surface.

Research progressed to the point where it was determined that different implements were needed that did not bury residue. Russel and Duley (1976) worked with the Chase Plow Company at Lincoln on a sweep-type noninversion plow, and in 1939 became aware of the first successful v-blade sweeps developed by Mr. C. S. Noble from Alberta, Canada. Later on, Oscar Miller of Stratton, NE added the "Miller Bar" rodweeder, which effectively killed summer weeds while leaving most of the stubble on the soil surface. However, one problem with this new stubble mulch system was cheat grass (downy brome). The plow buried much of the annual seed production, however with stubble mulching the seed was left on the soil surface, causing an increase in the numbers of these moisture robbing plants. Currently, early spring tillage, chemical control, and the use of rotations help keep the problem reasonably in check. From 1938 to 1953, Duley and Russel researched the benefits of mulch, and saw the use of this tillage practice expand in the U.S. Great Plains, Canada, Australia and Russia.

Tillage research also spread to other parts of the United States. Johnson and Unger (1976) summarized results from the Busland, Texas Experiment Station. Stubble mulch research began in 1941, with many test plots currently maintained. Average yields from 1943 to 1975 were 10.3 bu/acre for continuous wheat, 14.5 bu/acre for one-wayed and 16.5 bu/acre for subtilled. The stubble mulched plots averaged 14% better than the one-wayed plots. These higher yields were attributed to greater soil moisture content at seeding times.

Chepil and Wooodruff (1963) conducted tests in 1963 on winter wheat fields in the Nebraska panhandle, to determine soil erosion losses. They found that wind erosion losses averaged 10.7 tons/acre on bare fallow. However, stubble mulched fields with 2,600 lbs. average residue on the soil surface only lost 0.8 tons of soil per acre annually.

Bare fallow was compared with conservation stubble mulch fallow systems at research stations in the Central Great Plains from 1960-1970 by Smika (1976). Individuals who conducted the research include: B.W. Greb, Akron, CO; E.E. Banbury, Colby, KS; Dr. C.E. Norwood, Garden City, KS; C.R. Fenster, Alliance and Sidney, NE; and Dr. Clarence F. Becker, Archer, WY (see Table 2.1).

Results showed from .11 to 2.24 more inches of soil moisture stored under mulch than bare soil. The stubble reflects more radiation, reducing the rate of evaporation which can increase the summer fallow moisture storage efficiency. The average annual soil loss was 2.1 higher for bare soil than stubble mulched. Grain yields averaged 2.5 bu/acre higher in the mulched system with Akron, CO showing a 5.5 bu/acre increase. Researchers also reported that horse power requirements were slightly less for the mulched system. But, this system also had some negative points. There was lower soil nitrate level, which leads to slightly lower grain protein. Also, winter annuals were a problem in certain climatic areas. However, it was stated that proper management and fertilizer practices could overcome these shortcomings. Concern was expressed over the small plot size, and if the results could be representative of large fields. Researchers also noted that the use of herbicides to replace some or possibly all tillage operations offers tremendous potential in the area. Smika (1976) concluded the results with "I can see no reason why some form of the conservation mulch fallow system is not practiced on every acre of fallow land every year in the Central Great Plains."

Table 2.1

Grain yield at eight Central Great Plains locations with bare and conservation stubble mulch fallow systems.

Location	Fallow System Bare Soil (bu/acre)	Fallow System Mulch Soil (bu/acre)
Akron, CO (4)*	35.3	43.8
Colby, KS (4)	27.1	28.2
Garden City, KS (6)	19.8	23.6
Oakley, KS (4)	36.0	39.0
Alliance, NE (8)	21.9	21.6
N. Platte, NE (8)	40.0	43.0
Sidney, NE (6)	38.3	38.8
Archer, WY (2)	19.2	19.2
Avg. All Locations	29.7	32.2

*Denotes number of years of results.

As with stubble mulch tillage, a major goal of chemical fallow systems is to maintain crop residue on the surface for soil and water conservation. Fenster et al., (1977) found the most successful conservation tillage methods in the semiarid Great Plains combined the use of herbicides with mechanical tillage to control weeds.

As early as 1947, T.S. Aashemin, project leder for the Soil Conservation Service, observed the use of 2,4-D, and wondered if herbicides could be used to reduce the number of tillage operations in the fallow season. Using 2,4-D and other experimental compounds to control weeds was first studied at the Hays, KS Experiment Station in the early 1950's. Bill Phillips (1964) pioneered the use of Atrazine applied after wheat harvest, followed by planting grain sorghum into the standing residue on the spring. This system allowed two crops to be grown in three years. In the wheat fallow systems there are 14 months of fallow compared with eleven months in the wheat-sorghum fallow system. Combinations of conventional, reduced and no-till systems were compared. The conventional systems were tilled an average of 3.6 times yearly. but only 0.7 times in the least tillage system. While differences in the wheat yields were small, the reduced-till sorghum yeilds were 3,370 lbs/acre compared with 2870 lbs/acre on conventional plots over an 11 year period.

In 1956, Baker et al., reported the results of chemical fallow at Havre, Froid, and Moccasin, Montana. They obtained similar wheat yields on chemical and conventional fallow. Soil compaction on chemically fallowed plots made seeding difficult and in some cases, reduced stands. One tillage during the season was usually adequate to prepare a satisfactory seedbed. Chemical fallow effectively resisted soil erosion by wind and water.

Studies at Sidney, Montana on a loam soil over the periods 1956 to 1959, and 1960 to 1964 were reported by Black and Power (1965). They compared mechanical fallow, chemical plus mechanical fallow, and complete chemical fallow with respect to moisture conservation, spring wheat yields, and soil erodibility. In both studies, the stubble mulch method was superior moisture conservation and wheat yields. Maximum moisture storage was achieved when the fallow method included a late spring tillage operation. Complete chemical fallow provided significantly more surface residue and a higher percentage of nonerodible soil particles than conventional stubble mulch. They concluded that greater soil cloddiness, surface roughness, and residue maintenance resulting from complete chemical fallow in comparison with stubble mulch fallows may become increasingly important for wind erosion control on coarse textured soils, in low straw-production areas, and during periods of prolonged drought.

Chemical fallow studies were begun in 1955 at Bushland, Texas Experiment station. Wiese (1982) found that 2,4-D successfully controlled broadleaf weeds, but no herbicide was available at that time to adequately control grasses. Therefore, results were generally discouraging because weed and volunteer wheat control was poor, and additional soil moisture was not stored in the chemical fallow system. Consequently. grain yields of wheat and sorghum were not increased in wheat fallow, and wheat sorghum fallow systems.

Barnes et al. (1955) used Dalapon plus 2,4-D at Sheridan, Wyoming to control grassy weeds and broadleafs. This method of chemical fallow was compared with stubble mulch tillage and spring plowing plus subsurface tillage to study infiltration rates. They found that chemical fallow had a greater infiltration rate than the other methods of soil preparation.

A comprehensive summary of chemical fallow studies in Wyoming was prepared by Alley and Chamberlain (1962). Experiments were conducted at the Archer Agricultural Substation and the Sheridan Substation in cooperation with wheat growers in the region. The overall results of the study on Atrazine were summarized as follows:

1. Atrazine will control both grass and broadleaf weeds for a complete summer fallow period.

2. The residual effect of this compound is not completely understood when subjected to different soil and climatic conditions.

3. Yields of winter wheat have been equal or exceeded those from mechanically fallowed land.

4. Atrazine persists for a longer period at time in clay soils than in sandy soils.

Another research project on chemical fallow was conducted at the Nebraska Experiment Station from 1959-1962 (Fenster et al., 1965). This study was designed to test the feasibility of several herbicides for use in chemical fallow. Atrazine and Prometone at four pounds per acre controlled 100% of the weeds during the fallow period. However, these chemicals tended to persist in the soil for an extended period of time. As a result, the wheat plants frequently suffered serious injury the following growing season. The researchers concluded that more suitable herbicide combinations, and low cropping rotations must be devised before conservation reduced tillage systems could be feasible.

The effects of no-tillage and different types of stubble mulch tillage operations on moisture storage, nitrate accumulation, and wheat yields were studied at the Oregon Experiment Station from 1962-1965. Oveson and Appleby (1971) reported the no-till systems stored significantly less moisture in the top 15 centimeters than the conventional systems. However, at a depth of 1.8 meters the systems were comparable in moisture storage. Yields were similar in the conventional and chemical fallow plots. The researchers did imply the need for additional economic analysis in chemical fallow systems.

At North Platte, Nebraska, a study was initiated in 1963 to determine whether chemical fallow was feasible in the region. Wicks and Smika (1968) studied Atrazine, Amitrole and Paraquat over a five year period. The best weed control and yields were achieved with the chemical fallow system. Stubble mulch and plow systems yielded the poorest. Statistical analysis revealed that the yields from plots treated with Paraquat and Atrazine were greatest in comparison with other systems.

Greb (1974) reported on a study from 1967-1974 at Akron, Colorado. Complete chemical control was not attempted; the primary objective was to concentrate on fall weed control from harvest to fall dormancy. Double sweeping with v-blades and the use of Atrazine-Amitrole reduced weed growth by 64 and 72 percent, respectively. It was concluded that:

1. The ideal control system would include instant, complete killing of all unwanted vegetation shortly after wheat harvest, keeping the soil essentially sterile until midsummer the next year.

2. That the contact pre-emergence herbicides necessary to accomplish this objective would have to be economical and meet Environmental Protection Agency standards and guidelines.

Clean tillage, stubble mulch, combination stubble mulch and herbicides with no tillage were compared as systems in a wheat-fallow rotation by Davidson and Santlemann (1973) in Oklahoma. After four years, none of the systems had differently altered organic matter or soil bulk density in the top nine inches. Although differences in soil moisture were not always significant, reduced and no-tillage tended to store the most water. However, due to problems with wheat and poor wheat stand establishment the yields were lower in reduced and no-till plots. No-till plots also showed yellowish conditions from nitrogen deficiency.

Research in Kansas

Using herbicides to replace tillage during the fallow period of a wheat-fallow system was first studied at Hays, Kansas, in the late 1940's. Only 2,4-D and a few contact-type herbicides were available. Broadleaf weed control was easily accomplished with 2,4-D, but weedy grasses and volunteer wheat were difficult to kill with herbicides then available. The grasses are still difficult to control economically and without residual herbicide damage to the seeded wheat.

In the 1950's, Bill Phillips pioneered the use of Atrazine applied after wheat harvest and then planting sorghum the following spring. It was concluded that while research on the wheat-fallow system should continue, a wheat-sorghum-fallow system offered certain advantages in a reduced tillage program.

Five cropping systems for wheat and sorghum production in this 3-year wheat-sorghum-fallow rotation were established. The systems varied from conventional tillage, with little or no herbicidal use, to as near zero tillage as possible with then-available herbicides and planting equipment. By establishing three sets of plots, it was possible to have all phases of the rotation each year. Each plot series was carried through a minimum of three complete rotational sequences. From 1959 through 1971, the conventional systems were tilled an average of 3.6 times yearly compared with only 0.7 times for the least tillage system, excluding planting operations (Phillips, 1969).

While differences in wheat yields were small, sorghum yields on the conventionally tilled plots averaged 2870 lbs/acre compared to 3030 lbs/acre on "no till" plots. However, when one tillage operation was added before planting to the "no-till" system plots average yields increased to 3370 lbs/acre. Some of the reduced tillage plots became heavily infested with field sandbur (Cenchrus incertus), disrupting the system. While the problem was corrected, it was concluded that more satisfactory herbicides and planting equipment were needed for zero-tillage wheat production under area conditions.

Thompson (1985) summarizes a recent study at Hays which compares clean till (CTWW) with no till continous wheat-wheat (NTWW), continuous sorghum-sorghum (CTSS, NTSS), wheat-sorghum-fallow (NTWSF, CTWSF), wheat-fallow (NTWF, CTWF), and sorghum-fallow (NTSF, CTSF). The study found that wheat stands were thinner and more uneven on untilled areas, whereas sorghum was easier to establish. Recently, more improved planting equipment has helped stand establishment. Soil water differences were small, except near the surface. Only small yield differences (1-3 bushels) were found between clean tilled and no-till plots, except in sorghum yields with the no-till wheat-sorghum-fallow system. Here sorghum yields were 6.3 bu/acre better than the clean-till system.

Table 2.2

Yields from 1976-1984 for cropping systems at Hays, Kansas were:

CTWW	NTWW	CVWSF-W	NTWSF-W	CTWF	NTWF
20.0	21.17	29.28	30.10	28.40	32.17
Change	+1.17		+ .91		+3.77
CTSS	NTSS	CVWSF-S	NTWSF-S	CTSF	NTSF
38.57	38.26	59.88	66.18	57.23	55.13
Change	-.31		+6.3		-2.1

A separate study was started at Hays in 1972 on continuous "super thick" sorghum. Thompson (1982) reports that planting in narrower rows and increasing plant population from around 25,000 to 75,000 plants per acre has increased yields 13 bushels/acre.

Currently, the Colby Experiment Station has several studies of dryland cropping systems underway. A wheat chemical fallow, reduced-tillage study was initiated in 1978 (Lawless and Lamn, 1983). Fifteen different chemical combinations are being tested for results on weed control, available soil moisture at planting and yields. Another study began in 1980, and currently continues where researchers are studying the effect of various tillage and herbicide combinations on sorghum yields and fallow-efficiency in a wheat-sorghum-fallow rotation. Three levels of nitrogen are examined with six herbicides.

The Garden City Experiment Station began looking at reduced tillage in 1971 (Norwood, 1983, 1984). These studies have looked at the differences in reduced or no tillage systems compared to conventional (tillage only) systems and have considered the effects on weed control, residue retention, moisture conservation, and yield. Results for the 1979-1982 period indicate that most moisture is stored between wheat harvest and sorghum planting while little moisture is added if the plots are left fallow from June until September when wheat would be planted. The conclusion is that sufficient subsoil moisture is normally available to grow sorghum and that it is not advantageous from a soil moisture storage standpoint to leave the field fallow until wheat planting time (Norwood, 1983). In comparing cropping systems the wheat-sorghum-fallow rotation produced sorghum yields comparable to the sorghum-fallow yields two out of four years, while the wheat yields were comparable in two out of three years.

A long-term study was started in May, 1971 at the Tribune Research Station to compare various cropping sequences on dryland. These systems are continuous wheat (WW), continuous sorghum (SS), sorghum-fallow, (SF) wheat-fallow (WF) and wheat-sorghum-fallow (WSF). The WF and WSF are divided into conventional and minimum tillage using Atrazine, a long term residual herbicide. In addition, the effect of nitrogen has been studied. Conclusions based on ten years of data include increased yields under chemical fallow amounting to an average of 14 bu/acre for sorghum and 5 bu/acre for wheat in a WSF rotation and 7 bu/acre for wheat in a wheat-fallow rotation. (Chapter Four contains additional information.)

Conservation Tillage Outside the United States

Research in Western Canada (Molbert et al., 1967) between 1956 and 1961 indicated that three or four tillage operations provided the highest yields of grain when compared with chemical fallow. The herbicides then available did not control all of the weeds that were present. Different amounts of tillage had little effect on soil moisture conservation.

The screening of chemical herbicides for minimum tillage and zero-tillage began in 1966 by the Canadian Weed Committee (1976). Chipman chemicals worked with the weed committee and had good results from Gramoxone (paraquat). Studies with fall applied Atrazine have been underway at Swift current since 1972. Atrazine controlled most weed growth except foxtail weeds (*Sertaria sp.*). Yields were 26 bu/acre in chemical fallow systems, compared with 21 for the total tillage system.

Rowell et al (1977) reported the results as a seven year experiment dealing with reduced tillage on wheat yields in New South Wales, Australia. The study began in 1967 and was designed to study the value of bipyridilium herbicides as substitutes for mechanical weed control. The reduced tillage plots averaged slightly lower yields than conventional plots, with the difference not statistically significant. It was noted that grass weeds had a tendency to build up under minimum tillage techniques.

An economic evaluation of eight spring-wheat-fallow rotations was conducted by Zewntner and Lindwall (1982) in Southern Alberta, Canada. Two conventional tillage rotations; v-blade only. and one-way disk only were compared with six minimum tillage rotations including: fall blade/herbicides, fall blade/herbicides/fall balde, herbicides/fall balde, spring blade/herbicides, spring disk/herbicides, and herbicides only. The primary herbicide used was Paraquat. Yield data produced at the Lethbridge Agricultural Experiment Station from 1968-1976 was analyzed in a 600 hectare (1500 acre) farm-level simulation model to determine the differences in resource requirements, overhead costs, and break-even costs for herbicides under three labor and wheat price scenarios. Results revealed that minimum tillage treatments required from 4.1% to 14.2% less resources than the conventional systems, with main reductions in labor, fuel/oil, and machine repairs. The herbicide/fall-blade had the highest break-even costs for herbicides whereas the spring-blade/herbicides treatment had the lowest. The break-even costs were not affected greatly by changes in the price for labor because of the relatively small differences in labor requirements among most treatments. However, changes in the wheat price greatly affected the break-even costs for herbicides due to fairly large differences in grain yields among some treatments. The study concluded that it may not be practical to eliminate tillage completely. but the resource savings coupled with improved moisture conservation, grain yields, and erosion resistance make minimum tillage an attractive alternative to conventional practices.

Practices and Economics of Conservation Tillage in the Corn Belt

Some of the first efforts to reduce tillage in the corn belt were advanced by Edward Faulkner in the Plowman's Folly (1943). Faulkner, an Ohio farmer, and farmer agricultural extension agent felt the plow was unnatural and an impediment to plant growth. It was felt that higher economic returns could be achieved without the plow. This publication set the stage for continued economic and technical interest in the new techniques of conservation tillage.

Herbicides use as a substitute for cultivation in row-crop production started in 1954 with the work of Davidson and Barrors with the Dow Chemical Company. The invention of Atrazine in 1957 by the Ciba-Geigy Corporation made conservation tilled corn technically possible. Atrazine was ideal for this purpose because it controls most weeds but does not harm corn plants. The introduction of Paraquat by the Chevron Chemical Company in 1966, and its subsequent development for use in reduced and no-till cropping systems was an important addition to aid adoption of new conservation practices. Paraquat kills existing vegetation and then becomes inactive so that it does not harm the following crop. Monsanto added Roundup (glyphosphate) herbicide in 1969. This is a translocated herbicide which moves through the plant, thus controlling perennial weeds such as field bindweed, canada thistle, etc. Research is continuing on many other herbicides which should make conservation tillage more useful in a variety of crops, soils, and other complex factors.

Types of Tillage

This section reviews conventional and reduced tillage practices typical of the corn belt.

Conventional Tillage: The entire field is plowed with a moldboard plow. disked three to four times, and dragged or harrowed to smooth the surface before planting. Additional cultivations for the sake of weed control may add to the number of operations. Herbicides are often used in conjunction with this system of tillage.

Reduced Tillage: All reduced tillage ("minimum tillage," "conservation tillage") involves leaving some plant residues on the surface of the soil. thus decreasing wind and water erosion but necessitating the application of herbicides to control weeds and/or for seedbed preparations. Many intermediate situations exist between total reliance on plowing and total reliance on herbicides for weed control.

Plowing with Reduced Secondary Tillage: The soil is mixed by a moldboard plow. a chisel plow, or a large disk. This system leaves a rougher seedbed than conventional tillage because additional disking and harrowing is omitted. The rough seedbed encourages water infiltration and hence reduces erosion. Mulch, or surface residue left on the surface, helps prevent or reduce wind erosion as well.

Plowing with Secondary Tillage Only in the Row: Small rotary tillers of the wheels of the planter provide the secondary tillage in the immediate seedbed area. Wind erosion is decreased by this method.

Strip Tillage or Till-planting: Tillage is performed only on the row. Most of the surface residue remains on the surface, decreasing wind and water erosion and increasing water infiltration. Generally. a ridge is formed by cultivation the previous year to allow the soil to dry and to increase soil temperatures early in the planting season.

No-tillage: The only soil manipulation required is opening a slit or trench just wide and deep enough to receive the seed and then covering the seed with soil. No-tillage leaves almost all the previous crop residue on the surface, and reduces wind and water erosion to the minimum. This is the ultimate in reduced tillage systems and is the most heavily dependent on the use of herbicides.

Economic Analysis

Some of the first economic analysis, although rough in nature, was based on a study at the experimental fields in Scandia and Belleville, Kansas, and reported by Fairbanks, et al. (1963). The study compared costs between plow-surface plant, till-plant, and lister methods of growing corn. The till-plant system saved $7.42/acre and $2.53/acre over plow surface plant and lister methods, respectfully. Research also found significant increases in the inflation rate of water for the till-plant rotation.

D.H. Doster (1976) compared the Economics of alternative tillage systems in 1973. The "till plant", and "no-till coulter" saved $10/acre and $6.20/acre when compared with conventional plowing. The study found that yield response from the systems varied with soil type. On a Tracy silt loam soil, yields were 138 bu/acre on till plant, 125 bu/acre conventional. But with a Pewamo clay loam soil, the conventional methods were 12 and 31 bu/acre better than till-plant and no-till methods, respectfully. concerns about conservation tillage were lower soil temperatures at planting, increased insect and disease pest which thrive in crop residues left on the soil surface along with questions over the increased use of herbicides, insecticides and fungicides.

Environment Magazine (1980) summarizes some of the concerns raised by the increased use of chemicals with conservation and no-till practices:

> "Even if chemicals were adequate to control induced pests, the use of those chemicals might constitute a serious pollution problem. From the general public's point of view, the extra pesticides used would be an additional burden on our already heavily contained environment. From the farmer's point of view, the costs of the extra pesticides might be sufficient to tip the economic balance against further use of the no-till system."

More recently, a Missouri study found that most farmers recognized soil erosion as a serious problem, many perceive the expected benefits from conserving soil will not outweigh their expected costs. Reasons given for this were: (1) long-term data on the use of conservation systems is not available; (2) the technology associated with conservation tillage such as machinery, seed varieties, and chemicals is not in advanced sufficiently to meet all the needs of the systems. The study went on to compare three systems of corn production: conventional, minimum and no-till. Yields and prices were assumed constant. A comparison of returns to land and management revealed that minimum-till systems generated the highest returns. Results of the study were as follows: minimum-till systems; $43.39/acre, no-till system; $38.71/acre and conventional plow system; $34.98/acre. The study noted that the magnitude of the differences between systems was small considering the potential risk of adopting a new management system. However, a beginning operator would find minimum-till and no-till systems $3,500 and $47,500 lower, respectively in initial investment costs, resulting in smaller debt-repayment loads. Labor savings could be used to learn new technology and/or expand operation size. Young farmers with heavy land mortgages and conventional equipment may thus be at a disadvantage in adopting no-till technology.

Jose (1981) compared costs of five tillage systems used in row-crop production: a net present value framework with a 13% discount rate showed the moldboard plow system with the best cash outflow, followed by the no-till, chisel plow, disk, and till-plant systems. The study noted that long-term erosion control would add value to land, but that it was difficult to estimate exact benefits.

Jolly (1983) reported the economics of a corn-soybean tillage experiment from 1976-80 in central Iowa. Conventional plow, full width, chisel plant, strip-tillage, minimum till in row, and slot tillage (no-till) were compared. All conservation systems reduced soil loss by at least half versus the conventional methods on land with one to four percent shapes. Machinery-related costs were lower in conservation tillage because a lower number of field operators saved fuel, repair and labor expense, fewer and small machines reduced ownership costs, plus the possibility of increasing farm size, width, no reduction in timeliness help spread fixed costs over more acres. In the evaluation of returns from the different systems, risk was considered critically important; because most producers need an additional economic incentive to adopt new technology it is perceived as more risky than existing practices. Analysis of variance for return over operating costs failed to show a statistically significant effect between tillage systems. Therefore, the system with the least risk would be preferred. The measure of risk used was standard deviation of return to land and management. This was lowest for the full width (chisel plant) system, and greatest in conventional tillage. It was noted that the variance in the reduced tillage systems declined the last two years of the five year study, possibly reflecting better management skills. This tends to support comments by Rahm and Huffman (1982) who state that managerial expertise, as measured by years of education, is important in reducing errors associated with the adoption of reduced tillage systems. When crop insurance was considered it tended to reduce the importance of moisture conservation in the high residue systems during drought years. The study concluded that crop production practices are location specific, and it is not advisable to generalize too broadly on the basis of experiment results. However, it was felt that economic analysis gave an accurate picture of the risk and return trade offs among these production systems.

Klemme (1983) reported that adoption of reduced tillage systems has increased because of greater concern over soil erosion, and as a result of increased fuel prices. It was noted however, that declines in production costs due to lower fuel, repair and capital expenses, may be offset by increased fertilizer and chemical expense. Results showed that the production costs for conventional, till-plant and no-till corn are nearly equal if similar yield levels are produced in each system. The study went on to say that break-even costs of production are highly sensitive to yield levels, and their variability. Also, selection of reduced tillage systems was dependent on its performance over time.

Economics of Conservation Tillage in Semi-Arid Regions

Economic analysis of conservation tillage systems has also been conducted outside the corn belt region in areas which are more applicable to the great plains region.

Texas Research in the 1960's with a wheat-sorghum-fallow rotation found no difference in sorghum yields using chemical fallow or sweep tillage. At that time the cost of atrazine and 2,4-D exceeded the cost of the five v-blade sweep operations needed to control weeds during the fallow period. Consequently, there was little economic incentive for producers to use the new conservation systems (Wiese, 1966).

A major study was coordinated by the wheat industry resource committee (Retzlaff et. al., 1979) which compared conventional, ecofallow and total chemical fallow systems. Data from 1968-1978 collected at the High Plains Agricultural Laboratory, Sidney, NE were used in the study. Researchers found no significant differences in yield hetween systems. 1978-1979 commodity prices and custom rates were used as reported hy the NW crop reporting district of Nebraska. Ag Net Computer Program "CROP BUDGET" and "MACHINE" were used to determine tillage and equipment costs. Coefficients were used to determine repair, lahor and fuel costs. Cash inflows and outflows were analyzed in a net present value (NPV) framework at the 9 percent discount level. Chemical and Ecofallow systems had NPV's $34,938 and $21,708 hetter than the conventional rotation over the 10-year period.

Hinman et. al. (1980) headed an extension study on cost comparisons for alternative tillage practices in western Whitman County, Washington. A representative farm of 2000 acres (1000 crop, 1000 fallow) was used as the hasis of reserach. Wheat yields between conventional and conservation tillage were assumed equal with conservation tillage costs totaling $131.04/acre compared with $141.19 for the conventional practice. The main savings came from reduced tillage operations saving lahor, fuel and oil.

A survey of North Dakota farmers (Swenson, 1982) found that no-till spring wheat yields were similar to conventional county average yields, but no-till barley and winter wheat yields were 10.3 hu/acre and 12.8 bu/acre greater than conventional results. Production costs of raising spring wheat and barley under no-till and conventional tillage were compared in three rotations: continuous cropping, crop-crop-fallow, and crop-fallow.

It was assumed that the crop rotations would help prevent the buildup of foliar pathogens. The study found that costs of no-till in continuous cropping were slightly higher than conventional practices. There were reductions in machinery owned, but the high herbicide expenditures of complete chemical fallow make it economically uncompetitive with mechanical fallow.

Economics of three cropping systems: summer-fallow-wheat, summer-fallow-wheat-wheat and continuous wheat were compared in North Dakota (Johnson et. al., 1982). Wheat yields were based on a statistical model which determined yields on fallowed and continuous land. This study expanded on Knight's research in Kansas (1956) which found that wheat yields, prices and production costs influence the amount of fallow in given areas. Knight's research found that wheat-fallow was superior in western Finney County of Kansas, but wheat-wheat-wheat-fallow rotation provided the highest annual yields in Central Ellis County for the period 1947-54.

Johnson's research in North Dakota found that the use of nitrogen fertilizer and chemical weed control had increased the current yields of continuous cropping. Based on yield trend lines, research showed yields on fallowed land increasing only 1.54 bushels for every bushel increase on non-fallowed. If this trend continues in the region, the fallow system will become less economically desirable. With a wheat price of $4.17/bushel returns were equal in all systems, but the continuous yields had the greatest sensitivity to price changes. When nitrogen prices rose above .40 cents a pound, the higher returns would come from the fallow system (holding other prices constant). It was concluded there was substantial increases of economic uncertainty on yields when going from wheat-fallow to more intensive systems, and unless wheat prices increase considerably over current levels, only a gradual reduction in summer-fallow would be expected.

Epplin et. al. (1983) reported differences in costs of conservation tillage systems for continuous winter wheat production in Oklahoma. Rapid rises in fuel prices, introduction of new no-till drills and better herbicide combinations bad combined to generate considerable producer interest in alternative production systems. Eight base systems and 14 combinations were compared at one location. Tbe main systems were: two conventional (plow and chisel), a two-tillage system, 3 one-tillage systems (reduced) and two zero-tillage systems. The study showed labor savings from reductions tillage operations, and 3-5 gallons less fuel required in reduced tillage practices. The zero-till systems had lower machinery investments, which were offset by larger herbicide expenditures. Tbere was only $3.00/acre separating the total costs of all systems. Thus, reduced and no-till were competitive with conventional on a cost basis. But it was concluded that conservation tillage yields must be equal or better to obtain increased use of these systems.

Costs and returns of wheat-corn-ecofallow versus stubble-mulch wheat fallow are required by Johnson (1982) in Nebraska. If 65 bushel corn yields with 45 bushel wheat are obtained in the ecofallow system, and wheat maintains a dollar-bushel premium to corn then annual revenue would be $25.55/acre ecofallow compared with $21.00/acre for current conventional wheat-fallow rotations. Other advantages at the wheat-corn-fallow rotation are reductions in wind and water loss, plus benefits in the interruption of weed and insect cycles. Perry (1984) reports in the 1984 Nebraska ecofarming proceedings that "cash" costs may increase in ecofallow rotations from increases in chemical costs, but these costs are likely to be more than offset by savings in fuel, oil and labor. Yield variability may increase slightly during development of new farming systems which stems from the effect of improper management decisions.

Klein (1984) reports on one of the newer developments in ecofarming, referred to as "opportunity farming." Opportunity farming strategies take advantage of favorable soil moisture conditions during selected crop planting periods. An example would be to plant no-till sorghum after the three year fallow-wheat-corn rotation if three feet or more of moist soil were available at sorghum planting time. Per unit costs of production are estimated based on yields from the North Platte, Nebraska Agricultural Experiment Station.

		Price/Unit
Wheat:	Ecofallow	3.19
	Stubble-mulch	3.54
	Continuous	3.60
	Clean fallow	3.96
	Corn, ecofallow	2.13
Sorghum:	No-till	2.03
	Coventional	3.09

From the analysis given no-till continuous sorghum and wheat-corn-ecofallow systems provide the lowest cost of production per bushel.

<u>Research of National Interest</u>

Longer term impacts of tillage practices is also of interest, but little work has been actually conducted in this area. One such attempt was conducted by Williams et. al. (1983) to examine longer run soil productivity. This study uses a computer algorithum to assess the affects of erosion on soil nationwide. In this study, hydrologic, weather, nutrient, plant growth, soil temperature, tillage and economic data are used in analysis. The mathematical model EPIC (Erosion-Productivity Impact Calculator) was developed to help direct national policy decisions on soil and water use.

The need for more detailed economic information on soil conservation practices promoted the development of a computerized system which estimates and displays the short-run costs of alternative conservation practices on specific soils (Raitt, 1981). Annual conservation costs are based on continuous row cropping without conservation practices. Crop budgets from the budget generator of Oklahoma State are combined with the universal soil loss equation (USLE) to estimate erosion rates, costs per acre and costs per ton of soil erosion for a specific soil type and location. Information for this analysis can be used at the local farm level or the state and national level for program and policy direction.

Another computerized model is SOILEC (Soil Conservation Economics) from Bost and Lee et. al. (1980). This model may be run on microcomputers. SOILEC provides a guide for policy makers wishing to set subsidy levels in contracts with farmers to achieve given conservation targets. Second, the model helps farmers analyze the physical and economic trade-offs involved in management decisions to accomplish soil erosion control.

A limitation of these models is that there are designed for mainly row crop production which is not typical of the Great Plains. In addition, it is very difficult to get accurate estimates of longer term tillage and erosion consequenses due to the large number of interacting variables which must be estimated in analyzing these types of problems.

Chapter Three

CONCEPTUAL CONSIDERATIONS

Introduction

The overall conceptual approach is to incorporate the cropping practices used on the Tribune Experiment Station into an enterprise budget system of costs and returns. Budget figures are established from a 2000 acre representative farm validated by Kansas State Farm Management Association data (Parker. 1982,1983), plus extension information from agronomists, agricultural economists and agricultural engineers. The enterprise budgets analyze seven different cropping systems of wheat and/or sorghum. Annual net income per system is calculated as landlord income, and tennet income from rented and owned land. The major systems which provide the largest income are analyzed with the K-Farm Cash Flow System, recently developed at Kansas State University (Barnaby, 1984).

Economic Framework

At the heart of any economic problem is the determination of how to allocate limited or scarce resources to achieve a given goal. Scarcity of resources implies that the quantities of most resources have set limits within a given period of time. Because resources are limited, they have a value which is measured by a price. This price helps guide the allocation of these resources.

The allocation dilemma of scarce resources is a second characteristic of economic problems. Resources have many alternative uses and human wants always surpass what the resources can provide. Therefore, resources must be allocated among competing alternatives to obtain the "best" use of the fixed quantities of resources. Best depends upon some type of criteria, which is the third characteristic of economic problems. A criteria is an important standard against which alternative allocations of resources can be judged. Thus, economics provides a framework in which resource allocation problems can be studied to achieve maximal goal achievement. For these reasons, Doll and Orazem (1984) summarize economics as the science of choice making.

In traditional economic theory of the firm, the goal is assumed to be maximization of profit, which equals revenue from the sale of products less the cost of production. Production may be defined as the transformation of inputs used with land, labor and capital into a product which has value in the marketplace. The farm is assumed to behave as if all decisions are made by one person, often called the manager of the firm.

When making short-term decisions, the firm has fixed and variable inputs. Fixed inputs may include the use of land, buildings, and machinery, which are hard to change in short periods of time. When a production process has one or more fixed inputs, the marginal product from each variable input will eventually decline at some level of use. This event is called the "Law of Diminishing Returns" or the "Law of Variable Proportions," and causes marginal costs to rise as production or output increases.

Given a set of input and product prices, the manager chooses a production process with a corresponding level of output. In this study it is assumed that agronomists have selected input combinations which are close to the maximum economic yield or profit-maximizing level on the production function surface of the given cropping systems. It is also assumed that profit maximization is the major goal of the firm in the short and long run. Conservation of soil and water will depend upon how profitable it is to do so in the production practice.

In the long run, all inputs are assumed to be variable. The firm chooses an optimal scale of production by setting the long run marginal cost of production equal to the product price. (It is assumed that the manager knows what the long run average prices and marginal costs will be.) The scale of production to achieve this goal then determines the fixed costs used in short run decision making.

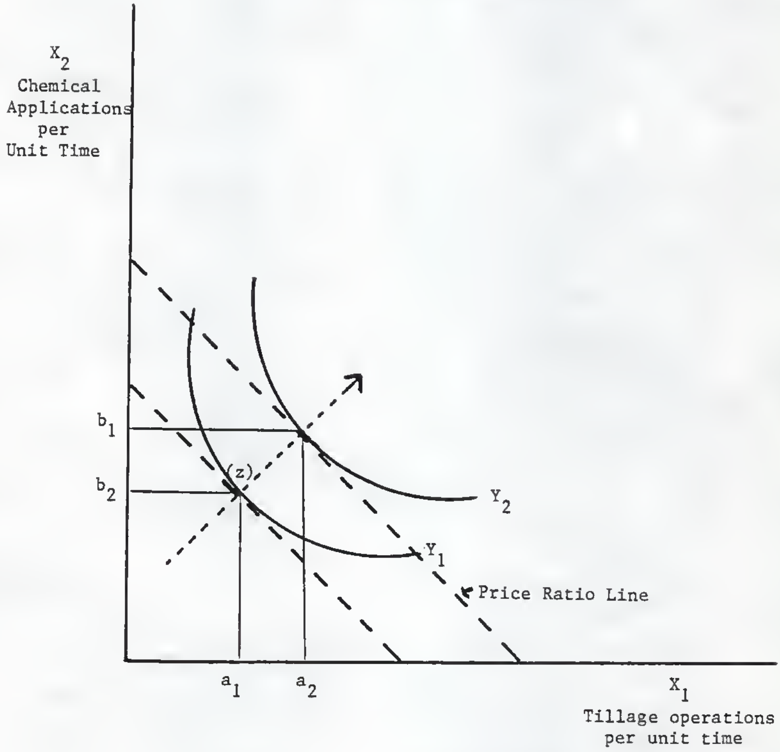
The question of reduced tillage versus conventional tillage wheat and sorghum production can be studied in this economic framework. This problem can be viewed as an allocation of scarce and costly resources, which include chemical herbicides, labor and equipment for farm tillage operations. Through a better allocation of these resources, farm managers may find a resource mix that increases net returns from their land, labor, and capital.

The Factor-Factor Model

Allocation problems of this type can be conceptualized by using a simple factor-factor production economics model. Figure 3.1 graphically depicts the economic relationships of a factor-factor model, with curves Y_1 and Y_2 representing two individual isoquants from an infinite family of isoquants. Each isoquant represents the set of all possible input combinations of X_1 and X_2 that yield a fixed quantity of output. For example, a_1 and b_2 quantities of resource X_1 and X_2 yield output Y_1. By moving along the curve Y_1, the quantities of X_1 and X_2 will change as one resource is substituted for the other. Although the level of production Y_1 does not change as movement is made along the isoquant, the total variable costs will change. Total variable costs are minimized for each isoquant at the

Figure 3.1

Factor-Factor Production Economics Model



combination of X_1 and X_2 where the marginal rate of substitution between the two resources is equal to the ratio of the resource prices (Leftwich, 1979). The set of all these least-cost combinations form a line called the expansion path. The least-cost combination to produce Y_1 in Figure 3.1 is the point of tangency between price ratio line and the Y_1 isoquant (point z).

This study does not solve for the location along the expansion path but assumes input levels used by experiment station agronomists are close to the correct position on the expansion path for each system. However, different combinations of inputs are studied by examining alternative combinations of tillage and chemical use in cropping systems of wheat and sorghum.

Application of the Factor-Factor Model

The factor-factor model is helpful to conceptualize the problem of reduced tillage versus conventional tillage crop production. Chemical herbicides and tillage operations can be viewed as two competitive resouces used to control weeds. Since both resources are factor of production and used to control weeds, a trade-off exists between the resources. One farmer may choose to produce wheat with the more traditional method of intense tillage, while another farmer may choose to apply more chemical herbicides and reduce the number of tillage operations. If both farmers produce equal amounts of grain, ceteris paribus, the two grain production systems represent two points on an isoquant. Because the two resources are substitutes, the isoquants have negative slopes as illustrated in Figure 3.1.

If researchers knew precisely the production function of all the cropping systems, this allocation problem could be quickly resolved. Based on the given production function, a multiple-factor model would indicate the number of tillage operations and the quantity of herbicides that should be used. Unfortunately. the real production function of cropping systems is a vastly more complex relationship. A large number of factors interact to produce each bushel of grain. Because of data limitations, it is not reasonable to estimate a mathematical function which accounts for all the factors and interactions. Without the production function, marginal physical products and marginal rates of substitution cannot be estimated. Therefore, a simple factor-factor model cannot be used to find a global profit maximum.

Enterprise Budgets

Enterprise budgets can be used to analyze factor-factor relationships of complex production functions. An enterprise budget is a statement of the expected outcome from a particular production practice (Jobes, 1978). The budget presents a statement of expected revenues from and the expenses incurred in the production of a given product. Each enterprise budget projects the total factor costs and total revenue for one point on the production surface. By formulating enterprise budgets with different resource combinations, many different production possibilities can be studied.

Enterprise budgets will be used to compare costs and returns of the alternative cropping systems. It should be noted that managers seldom have complete technical information pertaining to the production function for a particular commodity. Budgets generally are used to reflect future actions, and it is difficult to make accurate predictions regarding future prices and yields. Jobes (1978) stated that although farm managers lack information needed to make perfect decisions, Enterprise budgets provide a format to classify information in a manner such that the economics of alternative production systems can be consistently analyized.

Applications of Economic Theory with Resource Constraints

Crop farms have various resource constraints. These include: (1) time constraints; (2) availability of land and labor; and (3) the productive capacity of farm machinery per unit of time.

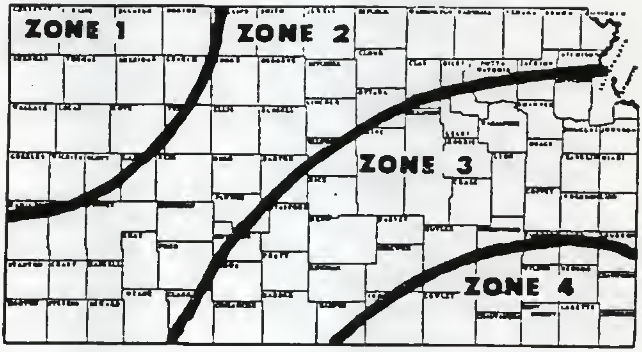
Time constraints are created by the seasonal nature of crop production. Given the average weather conditions in Western Kansas, optimal wheat production is obtained when wheat is planted between September 10 and 20 (Wilkins, 1978). Optimal sorghum yields are obtained when sorghum is planted between May 15 and June 5 (Peterson, 1981). Planting crops before or after the optimal periods generally will reduce crop yields. The amount of time suitable for fieldwork within the optimal periods is therefore an important resource constraint (Figure 3.2). Each production activity is constrained by the amount of time suitable for field work during its planting and harvesting periods.

The number of total crop acres, full-time laborers, and machinery compliments are generally not changed from one year to the next. In the theory of the firm. these items are fixed inputs in the short run. In addition, the productive capacities per unit of time for the tillage implements and seed equipment are usually fixed over short periods of time. Therefore, a complement of resources must exist which can complete the work on time in a reasonable number of years.

The economic objectives of cropping systems include planting crops in the optimal time periods. Thus, tillage not only must prepare a suitable seedbed, but should prepare it before the optimal planting periods. How-

Figure 3.2

Suggested Planting Dates.



Grain Sorghum:

Zone 1 May 15-June 5
Zone 2 May 10-June 20
Zone 3 May 5-June 20
Zone 4 May 1-May 15

Wheat:

Zone 1................September 10-20
Zone 2........September 10-October 20
Zone 3........September 25-October 20
Zone 4...................October 5-10

Source: Wheat Production Handbook, C-529, and Grain Sorghum Handbook C-494. Kansas State University.

ever, there is an economic tradeoff between the benefits of early planting and the annual cost of large machinery which could complete tillage and planting operations more quickly. Since a fine soil may crust over and reduce aeration and water infiltration, there can be an economic tradeoff between preparing an optimal seedbed, in which a fine seedbed is often desired, and improving soil conditions for plant growth. Since fine soils also are susceptible to erosion, there may be an economic tradeoff between preparing a fine seedbed and maintaining long term soil productivity.

Finally, weed management may affect the timeliness of other operations. Heavy weed infestations can greatly reduce grain yields and delay the completion of harvest. This study selects machinery complements so that enough machinery is available to meet constraints on planting and harvesting time (Krause, 1983). Refer to chapter 4 for additional details.

Chapter Four

PROCEDURE AND ASSUMPTIONS

Outline of Procedures

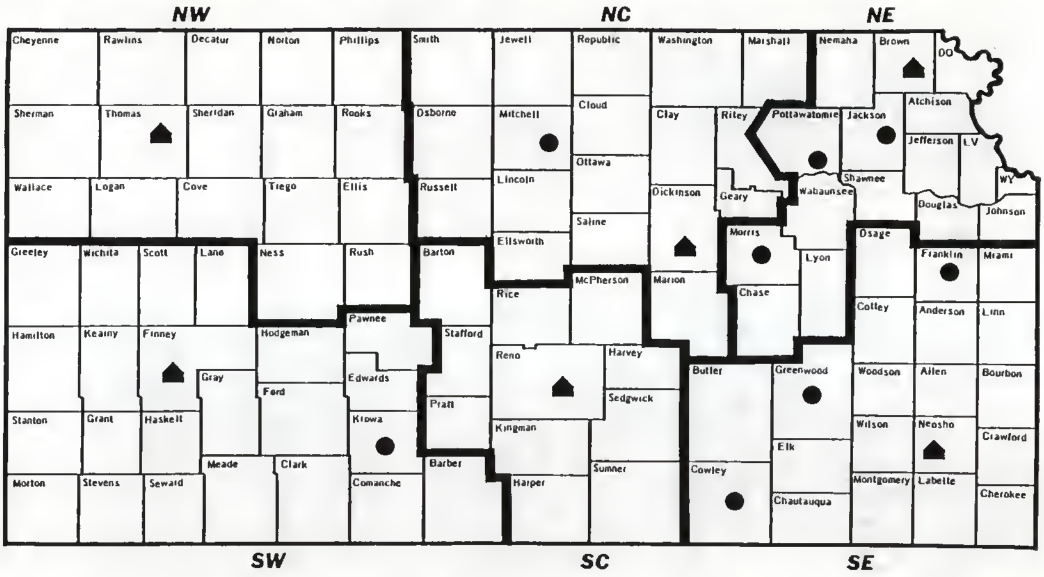
Enterprise budgets are used to analyze the costs and returns of each cropping system based on a representative 'case' farm. Details of the representative farm are based on information from 1982 and 1983 Southwest Kansas Farm Management Association data, Department of Agricultural Economics, Cooperative Extension Service, Kansas State University, Manhattan, KS (Figure 4.1). There are ninety-five predominately nonirrigated (dryland) farms in the group that compose the data base.

The term "cropping system" is defined in this study as a unique combination and timing of field operations and operating inputs used to produce a grain crop. Significant variations in the number, timing or quantity of operating inputs and field operations constitute a different cropping system. Seven cropping systems are being analyzed to determine which system provides the greatest net return per acre.

Enterprise Budgets are a means of economically evaluating various crop production systems; their formulation is an important part of procedures used in this study. To formulate these budgets, three steps are used. The first step is to identify a series of technically feasible wheat and/or sorghum cropping systems including operating inputs and typical tillage practices for each. The operating inputs include items with variable costs of production, such as seed, fertilizer, and herbicides. In addition to specifying the quantities and prices of these items, the timing of their application is also important for annual operating capital charges.

Figure 4.1

KANSAS FARM MANAGEMENT ASSOCIATIONS



▲ ASSOCIATION HEADQUARTERS ● SATELLITE OFFICE

The second step is to determine the tillage requirements. These must cnclude information about the timing and technical requirements of each field operation. Therefore, each system has a unique combination of operating inputs and tillage requirements. An important part of this step is to identify tractor-implement combinations. Tractors and implements must be selected for each field operation, based on the tillage requirements of the systems. The cost of a field operation depends on which tractor-implement combination is selected. An agricultural engineering work sheet (Schrock, 1976) was used to determine power take-off horsepower (PTO H.P.) for the tractors; with consideration to total farm size, planting and tillage constraints, and available field work days.

The third step is the actual formulation of the enterprise budgets. Costs for labor, fuel, oil, repair and ownership are calculated for each field operation in each of the cropping systems, using an electronic spreadsheet. The cost of these operating inputs are summed with the various fixed machinery and land costs to arrive at total costs in the enterprise budget. Also, yield and price variability are analyzed. Cash flow budgets wil be include to complete the study.

Previous studies have been criticized because the assumptions used in formulating cost estimates were not representative of actual farming units. Therefore, one of the goals of this research is to provide farmers and researchers information based on validated figures of existing farms, combining this with replicated yield data over an 11 year period.

Data from 95 farms in the Southwest (SW) Kansas Farm Management Association was used to establish the size and tenure of the case farm. The average farm in the SW Association was 1926 Acres. This figure was rounded to 2000 Acres for calculation ease. A benchmark conventional wheat-fallow system with 1000 Ac. Wheat, and 1000 Ac. fallow annually will be compared with six other cropping systems of wheat and/or grain sorghum.

Land that farmers own in the SW area is 31.9% of the total acres they operate. Therefore, the case farm will assume 33% owned (666 Ac.), and 66% rented (1333 Ac.), from landowners in the surrounding area of the farm headquarters. SW area farmers have long-term debt on 24% of their owned land. In this representative example it equals 158 Ac., just shy of a quarter-section. The standard quarter-section consists of 160 Ac., and is a common unit which is bought/sold in Western Kansas. The land being purchased is assumed to be acquired six years ago in 1978, when much land exchanged hands (Langemeier, 1985). This assumption is necessary when calculating the principle and interest from an amoritization schedule used in cash flow analysis (Figurski, 1982). The long-term debt is assumed to be amortized over 25 years at 12% interest (Pretzer, 1985). These assumptions will be used to formulate costs in enterprise budgets of each of the 7 cropping systems. The assumptions for constructing the enterprise budget are briefly outlined on the following page. Further detail can be found in the text.

CROPPING SYSTEMS

1. Conventional Tillage Wheat-Fallow ------- CVWF
2. Reduced Tillage Wheat-Fallow ------------ RTWF
3. Conventional Tillage Continuous Wheat --- CVWW
4. Conventional Tillage Continuous Sorghum - CVSS
5. Conventional Tillage Wheat-Sorghum-Fallow CVWSF
6. Reduced Tillage Wheat-Sorghum-Fallow ---- RTWSF
7. Conservation Tillage Sorghum-Fallow ----- CTSF

Assumptions of Representative Base Case Farm

1) Size of Farm: 2000 Acres--1000 wheat, 1000 fallow.

2) Tenure: 33% Owned--666 Acres, 67% Rented-1333 Acres. Long term debt @ 12% interest, on 24% of owned land.--158 Acres. (Parker, 1984)

3) Cropping Systems: Technical information on cropping practices and yield data was obtained from Roy Gwin, Head, Tribune Branch Experiment Station (1973-1983).

4) Machinery Complement: Based on recommendations from Ag Engineers (Pacey and Schrock, 1983)

5) Fuel Requirements from average of Kansas farmers, compiled by Schrock (1985).

6) Tractor-Implement complements analyzed on the MACHINE program of AGNET, University of Nebraska, Lincoln via Zenith microcomputer. Used field efficiencies, and repair costs.

7) Machinery Prices: Tractors--Average List Book Value, Machinery Hotline for John Deere, IH, Case, and Versatile (4WD). Implements--Average price for John Deere and/or Flex-King. Deprecation Value, List price x 85% x 1/2 dep. life.(15% Int.)

8) Input Prices: Suggested retail prices from chemical dealers. (Summarized by Thompson, 1984)

9) Crop Prices: Season average prices (73-83) from the West Central district of Kansas Crop and Livestock reporting service.

10) All fertilizer and herbicides custom applied @ $3.00/Acre. (Kansas Custom Rates, 1984)

11) Harvest: All custom combined and hauled at $13-$.13-$.13. ($13.00 per acre, 13 cents per bushel over 20 for wheat, 30 for sorghum, and 13 cents per bushel for truck hauling.)

12) One owner/operator, plus hired summer help. Labor = $6/hour.

13) Real Estate taxes = $0.50 per $100/acre value. (Krause and Langemeier, 1984)

14) Share rent to Landlord = (33.3% of yield * average price)

15) Cash Flow: Enterprise budgets will be used as input into the K-FARM cash flow program. Results include expenses, cash inflows, outflows, and interest on operating credit line. (Barnaby, 1984)

The Experiment Plots

In 1971 a research project was established at the Tribune Experiment Station in western Kansas to examine the validity of conservation tillage wheat and sorghum cropping systems. The experimental plots are 27 feet wide and 100 feet long; arranged in a randomized block design with four replications and fourteen treatments (Figure 4.2). Each crop of the sequence is planted in each replication yearly. The first full set of data was reported in 1973 with the experiments currently maintained.

Yields by replication are analyzed using the Statistical Analysis System (SAS) to obtain mean and variance information. The variance of yields along with price information is used to generate net incomes to examine risk. Stochastic dominance analysis could be used to examine risk also, but is beyond the scope of this study.

Table (4.1) is a listing of all tillage, herbicide, and fertilizer inputs for all seven cropping systems. Time periods by month are on either side of the flow sheet. Conventional wheat-fallow (CVWF) is the benchmark system which is practiced by the majority of farmers in western Kansas. The other systems compared in this study are : reduced till wheat-fallow (RTWF), continuous wheat-wheat (CVWW), conventional wheat-sorghum-fallow (CVWSF), reduced till wheat-sorghum-fallow (RTWSF), continuous sorghum (CVSS), and conservation sorghum-fallow (CTSF). The main differences between systems are the length of fallow period and the type of weed control. In the reduced-till systems mechanical weed control is partially or totally replaced with herbicide application for chemical weed control. The sorghum-fallow system has a 19 month fallow period between crops; wheat-fallow systems 15 months, wheat-sorghum fallow systems 11 months, and continuous sorghum 6 months, while the continuous wheat system has just over 2 months

Figure 4.2

Experiment Plots for Cropping Systems, Tribune Experiment Station, KS.

401	2		301	5
402	9		302	10
403	1		303	8
404	11		304	6
405	4		305	13
406	7		306	14
407	12		307	3
408	13		308	12
409	14		309	9
410	3		310	6
411	10		311	1
412	7		312	5
413	11		313	2
414	4		314	8
415	8		315	13
416	5		316	3
417	4		317	2
418	10		318	14
419	6		319	12
420	1		320	7
421	11		321	9
422	2		322	5
423	7		323	3
424	4		324	14
425	11		325	13
426	1		326	10
427	8		327	6
428	9		328	12

CROPPING SYSTEM

		1984	
1.	SS	S	CVSS
2.	WW	W	CVWW
3.	FWS	W	CVWSF-W
4.	FWS	S	CVWSF-S
5.	FWS	F	CVWS-F
6.	FW	W	CVFW-W
7.	FW	F	CVFW-F
8.	FS	S	CSSF-S
9.	FS	F	CSSF-F
10.	[FWS]	W	RTWSF-W
11.	[FWS]	S	RTWSF-S
12.	[FWS]	F	RTWSF
13.	[FW]	W	RTWF-W
14.	[FW]	F	RTWF-F

Table 4.1

TILLAGE SYSTEMS

Month Yr	CVWF Conventional Summer Fallow Wheat	RTWF Reduced-Till Summer Fallow Wheat	CVWW Conventional Continuous Wheat	CVSS Conventional Continuous Sorghum	CVWSF Conventional Wheat-Sorghum -Fallow	RTWSF Reduced-Till Wheat-Sorghum -Fallow	CSSF Conservation Summer Fallow Sorghum
				Plant Sorghum			Plant Sorghum
July 1	Harvest Wheat	Harvest Wheat	Harvest Wheat		Harvest Wheat	Harvest Wheat	Atriazine 1#
	V-Blade Sweep	Atriazine 3/4#	V-Blade Sweep	Cultivate	V-Blade Sweep	Atriazine 1.25#	Cultivate
		With V-Blade		2,4-D (100%) 0.5#		With V-Blade	2,4-D (33%) 0.5#
AUG				Cultivate			
			Disk	Parathion(25%) .5#			Parathion(33%) .5#
SEPT			RodWeed				
			Plant Wheat				
OCT	V-Blade Swp (75%)				V-Blade Swp (75%)		
				Harvest Sorghum			Harvest Sorghum
NOV							
DEC							
JAN							
FEB							
MARCH			Topdress Nitrogen				
			Ammonium Nitrate				
			Dry Form, 15#				
APRIL				Spread 15# N as	Spread 22.5# N	Spread 22.5# N	
				Dry Am. Nitrate	Dry Am. Nitrate	Dry Am. Nitrate	
				Disk	Disk		
MAY	Disk (50%)						V-Blade Sweep
				Disk	Disk		
JUNE						Plant Sorghum	
	V-Blade Sweep			Plant Sorghum	Plant Sorghum	Atriazine	Disk
		V-Blade Sweep		1.75# Seed			
July 2			Harvest Wheat				
	V-Blade Sweep		V-Blade Sweep	Cultivate	Cultivate	Cultivate	V-Blade Sweep
		V-Blade Sweep		2,4-D (100%) 0.5#	2,4-D (33%) 0.5#	2,4-D (33%) 0.5#	
AUG				Cultivate	Cultivate (50%)		
	RodWeed		Disk	Parathion(25%).5#	Parathion(33%).5#	Parathion(33%).5#	Rodweed
		RodWeed					
SEPT	RodWeed		Disk				
	Plant Wheat 40#	Plant Wheat	Plant Wheat				
OCT							
				Harvest Sorghum	Harvest Sorghum	Harvest Sorghum	
NOV							List Furrow (30'')
							(Beds)
DEC							

Table 4.1, Cont.

JAN							
FEB							
MARCH	Topdress 30# N (Amm. Nitrate)	Topdress 30# N (Amm. Nitrate)	Topdress 15# N (Amm. Nitrate)				
APRIL				Spread 15# N as Dry Amm. Nitrate Disk			
MAY					Disk (50%)		Lilliston
JUNE				Disk			Lilliston
				Plant Sorghum 1.75# Seed	V-Blade Sweep		Plant Sorghum 30# N
July 3	Harvest Wheat V-Blade Sweep	Harvest Wheat Atriazine 3/4# With V-Blade	Harvest Wheat V-Blade Sweep			V-Blade Sweep	Atriazine 1#
				Cultivate 2,4-D (33%) 0.5#	V-Blade Sweep		Cultivate
AUG			Disk	Cultivate		V-Blade Sweep	2,4-D (33%) 0.5#
				Parathion(33%).5#	RodWeed		Parathion(33%).5#
SEPT			Disk Plant Wheat 40#		RodWeed Plant Wheat 40#	RodWeed Plant Wheat	
OCT	V-Blade Swp (75%)			Harvest Sorghum			Harvest Sorghum
NOV							
DEC							
JAN							
FEB							
MARCH			Topdress N 15# as Ammonium Nitrate		Topdress 22.5# N Ammonium Nitrate	TopDress 22.5 # N Ammonium Nitrate	
APRIL				Spread 15# N as Dry Amm. Nitrate Disk			
MAY	Disk (75%)						Lilliston
JUNE				Disk			Lilliston
	V-Blade Sweep			Plant Sorghum 1.75# Seed			Plant Sorghum 30 # N
July 4		V-Blade Sweep	Harvest Wheat		Harvest Wheat	Harvest Wheat Atrazine 1.25# With V-Blade	Atriazine 1#
	V-Blade Sweep			Cultivate			Cultivate
AUG		V-Blade Sweep		2,4-D (33%) 0.5# Cultivate	V-Blade Sweep		2,4-D (33%) 0.5#
	RodWeed	RodWeed	Disk	Parathion(33%).5#			Parathion(33%).5#
SEPT	RodWeed Plant Wheat 40#	Plant Wheat	Disk Plant Wheat				
OCT				Harvest Sorghum	V-Blade Swp(75%)		Harvest Sorghum

Table 4.1, Cont.

NOV							
DEC							
JAN							
FEB							
MARCH	TopDress 30# N (Amm. Nitrate)	TopDress 30# N (Amm. Nitrate)	Topdress 15# N (Amm. Nitrate)				
APRIL				Spread 15# N as Dry Amm. Nitrate Disk	Spread 22.5# N Dry Amm. Nitrate Disk	Spread 22.5# N Dry Amm. Nitrate Disk	
MAY						Bladex 2# Lasso 1 Qt.	V-Blade Sweep
JUNE				Disk Plant Sorghum 1.75# Seed	Disk Plant Sorghum	Disk Plant Sorghum (Safend Seed)	Disk
July 5	Harvest Wheat V-Blade Sweep	Harvest Wheat Atriazine 3/4# With V-Blade	Harvest Wheat V-Blade Sweep	Cultivate	Cultivate	Cultivate (50%)	V-Blade Sweep
AUG			Disk	Cultivate			Rodweed
SEPT			RodWeed Plant Wheat 40#				
OCT	V-Blade Swp(75%)			Harvest Sorghum	Harvest Sorghum	Harvest Sorghum	
NOV							List Furrow (30" Beds)
DEC							
JAN							
FEB							
MARCH			Topdress N 15# as Ammonium Nitrate				
APRIL				Spread 15# N as Dry Amm. Nitrate Disk			
MAY	Disk (75%)				Disk (50%)		Lilliston
JUNE	V-Blade Sweep	V-Blade Sweep		Disk Plant Sorghum 1.75# Seed	V-Blade Sweep	V-Blade Sweep	Lilliston Plant Sorghum 30 # N Atriazine 1#
July 6	V-Blade Sweep	V-Blade Sweep	Harvest Wheat	Cultivate 2,4-D (33%) 0.5#		V-Blade Sweep	Cultivate 2,4-D (33%) 0.5#
AUG	RodWeed	RodWeed	Disk	Cultivate Parathion(33%).5#	RodWeed	RodWeed	Parathion(33%).5#
SEPT	RodWeed Plant Wheat 40#	Plant Wheat	Disk Plant Wheat		RodWeed Plant Wheat	Plant Wheat	
OCT				Harvest Sorghum			Harvest Sorghum

NOV							
DEC							
JAN							
FEB							
MARCH	Topdress 30# N Ammonium Nitrate	Topdress 30# N Ammonium Nitrate	Topdress 15# N Ammonium Nitrate		Topdress 22.5# N Ammonium Nitrate	TopDress 22.5 # N Ammonium Nitrate	
APRIL				Spread 15# N as Dry Amm. Nitrate			
MAY				Disk			Lilliston
JUNE				Disk Plant Sorghum 1.75# Seed			Lilliston Plant Sorghum 30 # N Atriazine
July 7	Harvest Wheat	Harvest Wheat	Harvest Wheat	Cultivate 2,4-D (33%) 0.5# Cultivate Parathion(33%).5#	Harvest Wheat	Harvest Wheat	Cultivate 2,4-D (33%) 0.5# Parathion(33%).5#
				Harvest Sorghum			Harvest Sorghum

fallow between wheat harvest and seeding the next wheat crop. The conventional tillage plots are tilled totally by mechanical implements. In the RTWF system. plots are undercut after harvest, with Atrazine also applied at that time for long-term weed control. V-blades and rodweeders are used to prepare a seedbed the following year. The RTWSF system follows the same procedure after wheat harvest. Sorghum is planted the folowing spring with additional chemical weed control being applied. After sorghum harvest, conventional tillage is used to prepare a seedbed for wheat planting the next fall.

Six years are needed to fully compare each cropping sequence with the others. The WW and SS produce annual crops; the WF and SF have crops on one-half the acreage, whereas the WSF includes one-third of the land in wheat and sorghum -- the remaining one third of the land being fallowed. Stated another way. the WW and SS have six annual crops. WSF provides four crops in six years (two wheat, two sorghum); but the WF and SF produce only three crops every six years. These experiment plots have all had nitrogen fertilizer applied at 15 lbs/acre yearly. This gives the wheat-fallow system 30 lbs. per crop which is an average rate in western Kansas (Gwin, 1985). Specific fertilizer. and herbicide input levels used on these test plots are assumed to be near the optimum profit maximizing levels.

Total "no-till" systems were not included in this study. but may provide additional stored soil moisture, which might increase yields and net income. However. the fertilizer and herbicide costs must not become too large for no-till to be competitive with other systems.

<u>Conventional</u> <u>Wheat-Fallow:</u> Conventional summer-fallow wheat begins with harvest around the first part of July (Table 4.2). The stubble is undercut with v-blade sweeps in mid-July to control weed growth, and mini-

Table 4.2

Field Operations Required in Cropping System: Conventional Wheat Fallow

FIELD OPERATION		DATE (In Cycle)	(App.)	YEAR	Amount	Field Efficiency	4WD Tractor	2WD Tractor	Annual Acres
Disk	1 (75%)	MAY	1	I	--	83.5%	27 FT		750
V-Blade	2	JUNE	5	I	--	80.0%	42 FT	30 FT	1000
V-Blade	3	JULY	15	I	--	80.0%	42 FT	30 FT	1000
RodWeed	4	AUG	12	I	--	80.0%	48 FT	36 FT	1000
RodWeed	5	SEPT	1	I	--	80.0%	48 FT		1000
Hoe Drill	6	SEPT	10	I	--	72.5%		40 FT	1000
Apply Nitrogen		MARCH	1	II	30 LBS	-	Custom Hired		1000
Harvest Wheat		JUNE	30	II	$13-13-13	-	Custom Hired		1000
V-Blade	7	JULY	10	II	--	80.0%	42 FT	30 FT	1000
V-Blade	8 (75%)	OCT	1	II	--	80.0%	42 FT		750
									9500

mize moisture loss from the soil. If additional weeds and volunteer wheat are present in the early fall. the stubble will be v-bladed again. Agronomists estimate this will occur 75 percent of the time (Gwin 1984). The wheat stubble lies untouched until the following spring. Seventy-five percent of the years the land will be tilled with a disk in early May, especially if there is heavy stubble. Then in early June and mid-July, the fallowed land will be v-bladed, then rodweeded in August and early September. The conventional wheat-fallow system averages 1.75 tillage operations between harvest and winter. The following spring and summer the land is tilled 4.75 times on the average, resulting in 6.5 tillage operations to produce a crop. Around 40 lbs/acre of wheat seed is drilled in early September. In March of the next crop year the growing wheat is fertilized with dry granulated ammonium nitrate fertilizer, to obtain 30 pounds of nitrogen per acre. This process is called "topdressing." The wheat matures in June and is harvested in June/July depending on weather conditions. Then the cycle is repeated for the next crop.

Reduced Till Wheat-Fallow: Reduced-till wheat-fallow is described in Table 4.3. After wheat harvest, stubble is treated with Atrazine and v-bladed. The Atrazine will control broadleaf and selected grasses until early summer in the next year. This saves or reduces the number of tillage operations needed compared to the conventional system, v-blade sweeps and rodweeding is used for seedbed preparation. Wheat is planted in September, and the system is identical to conventional wheat-fallow for the remainder of the crop sequence.

Table 4.3

Field Operations Required in Cropping System: Reduced Till Wheat Fallow

FIELD OPERATION		(In Cycle) DATE	(App.)	YEAR	Amount	Field Efficiency	4WD Tractor	2WD Tractor	Annual Acres
V-Blade	1	JUNE	5	I	--	80.0%	42 FT	30 FT	1000
V-Blade	2	JULY	20	I	--	80.0%	42 FT	30 FT	1000
RodWeed	3	AUG	20	I	--	80.0%	48 FT	36 FT	1000
Hoe Drill	4	SEPT	10	I	--	72.5%		40 FT	1000
Apply Nitrogen		MARCH	1	II	30 LBS	-	Custom Hired		1000
Harvest Wheat		JUNE	30	II	$13-13-13	-	Custom Hired		1000
Apply Atrazine		JULY	10	II	.75 LB	-	Custom Hired		1000
V-Blade	5	JULY	10	II	--	80.0%	42 FT	30 FT	1000
									8000

Conventional Continuous Wheat-Wheat: This system produces a wheat crop every year (Table 4.4). Following harvest the stubble is v-bladed, disked and rodweeded to manage residue and prepare a seedbed. The total acres covered by tillage operations in the CVWW systems is slightly larger than acres covered in the conventional wheat-fallow system. Wheat is planted in September just two and one half months following harvest. The crop is topdressed the following spring with 15 lbs. of nitrogen as ammonium nitrate. It should be noted that this nitrogen rate keeps the annual amount of fertilizer constant -- but the continuous wheat system might gain favorable yield response from higher levels of nitrogen (Davidson and Santleman, 1973, Johnson, 1982.)

Conventional Wheat-Sorghum-Fallow: The wheat-sorghum-fallow rotation is identical to the conventional wheat-fallow system through the fallow period, wheat planting and harvest. The major difference is that an additional sorghum crop is planted during the late spring, 11 months following wheat harvest (Table 4.5) The wheat stubble is disked twice to prepare the sorghum seedbed. Nitrogen (22.5 lbs.) is applied as ammonium nitrate before the second disking. Sorghum seed (1.75 lbs.) is planted in 30 inch rows during late May/early June. The sorghum is cultivated twice, requires 2,4-D 33% of the time for weed control, and needs Parathion for greenbug control in 33% of the years. The crop is harvested in October. The following spring the land is tilled using conventional wheat-fallow implements (disks, v-blades, rodweeders) to prepare for wheat planting 11 months later.

Reduced Till Wheat-Sorghum-Fallow: This system follows the same time period as conventional WSF, with one wheat and one sorghum crop produced in three years (Table 4.6). Following wheat harvest, Atrazine is custom

Table 4.4

Field Operations Required in Cropping System: Conventional Wheat-Wheat

FIELD OPERATION		(In Cycle) DATE (App.)		YEAR	Amount	Field Efficiency	4WD Tractor	4WD Tractor	2WD Tractor	Annual Acres
Apply Nitrogen		MARCH	1	I	15 LBS	-		Custom Hired		2000
Harvest Wheat		JUNE	30	I	$13-13-13	-		Custom Hired		2000
V-Blade	1	JULY	10	I	--	80.0%	42 FT	42 FT	30 FT	2000
Disk	2	AUG	5	I	--	83.5%	27 FT	27 FT	20 FT	2000
RodWeed	3	SEPT	1	I	--	80.0%	48 FT	48 FT	36 FT	2000
HoeDrill	4	SEPT	10	I	--	72.5%	50 FT		40 FT	2000
										12000

Table 4.5

Field Operations Required in Cropping System: Conventional Wheat-Sorghum-Fallow

FIELD OPERATION	DATE (In Cycle)	(App.)	YEAR	Amount	Field Efficiency	4WD Tractor	2WD Tractor	Annual Acres
Disk 1 (75%)	MAY	1	I	--	83.5%	27 FT		500
V-Blade 2	JUNE	5	I	--	80.0%	42 FT	30 FT	667
V-Blade 3	JULY	15	I	--	80.0%	42 FT	30 FT	667
RodWeed 4	AUG	12	I	--	80.0%	48 FT	36 FT	667
RodWeed 5	SEPT	1	I	--	80.0%	48 FT		667
Hoe Drill 6	SEPT	10	I	--	72.5%		40 FT	667
Apply Nitrogen	MARCH	1	II	22.5 LBS	-	Custom Hired		667
Harvest Wheat	JUNE	30	II	$13-13-13	-	Custom Hired		667
V-Blade 7	JULY	10	II	--	80.0%	42 FT	30 FT	667
V-Blade 8 (75%)	OCT	1	II	--	80.0%	42 FT		500
Apply Nitrogen	APRIL	25	III	22.5 LBS	-	Custom Hired		667
Disk 9	APRIL	29	III	--	83.5%	27 FT	20 FT	667
Disk 10	MAY	20	III	--	83.5%	27 FT	20 FT	667
Plant 11	JUNE	1	III	--	67.5%		30 FT	667
Cultivate 12	JULY	12	III	--	76.5%		30 FT	667
Spray 2,4-D (33%)	JULY	15	III	0.5 LB	-	Custom Hired		220
Cultivate 13 (50%)	JULY	30	III	--	76.5%		30 FT	333
Parathion (33%)	AUG	1	III	0.5 LB	-	Custom Hired		220
Harvest Sorghum	OCT	8	III	$13-13-13	-	Custom Hired		667
								11002

Table 4.6

Field Operations Required in Cropping System: Reduced Till Wheat-Sorghum-Fallow

FIELD OPERATION	DATE (In Cycle) (App.)		YEAR	Amount	Field Efficiency	4WD Tractor	2WD Tractor	Annual Acres
V-Blade 1	JUNE	5	I	--	80.0%	42 FT	30 FT	667
V-Blade 2	JULY	20	I	--	80.0%	42 FT	30 FT	667
RodWeed 3	AUG	20	I	--	80.0%	48 FT	36 FT	667
Hoe Drill 4	SEPT	10	I	--	72.5%		40 FT	667
Apply Nitrogen	MARCH	1	II	22.5 LBS	-	Custom Hired		667
Harvest Wheat	JUNE	30	II	$13-13-13	-	Custom Hired		667
Apply Atrazine	JULY	10	II	1.25 LBS	-	Custom Hired		667
V-Blade 5	JULY	10	II	--	80.0%	42 FT	30 FT	667
Apply Nitrogen	APRIL	25	III	22.5 LBS	-	Custom Hired		667
Disk 6	MAY	1	III	--	83.5%	27 FT	20 FT	667
Plant 7	JUNE	1	III	--	67.5%		30 FT	667
Cultivate 8	JULY	12	III	--	76.5%		30 FT	667
Spray 2,4-D (25%)	JULY	15	III	0.5 LB	-	Custom Hired		167
Parathion (33%)	AUG	1	III	0.5 LB	-	Custom Hired		222
Harvest Sorghum	OCT	8	III	$13-13-13	-	Custom Hired		667
								9060

applied, followed by tillage with v-blade sweeps. In April, 22.5 lbs. dry nitrogen is applied at seeding and planted in early June. The sorghum is cultivated once, requires 2,4-D 33% of the time for weed control, and needs Parathion for greenbug control in 33% of the years. Harvest occurs in October.

Conventional Sorghum-Sorghum: Table 4.7 lists the field operations required in the CVSS system. The land is disked twice in the spring to prepare a sorghum seedbed and incorporate 15 pounds nitrogen fertilizer. Just under two pounds sorghum seed is planted in early June, cultivated twice, with 2.4-D being used every year for weed control, greenbugs treated with Parathion 25% of the time, with the crop being harvested annually in October.

Conservation Sorghum-Fallow: The conservation tillage sorghum-fallow system is similar to a conventional sorghum-fallow system except for some additional conservation measures needed during the 20 month fallow period (Table 4.8). Planting occurs in early June. The sorghum is cultivated once, requires 2,4-D 33% of the time for weed control, and needs Parathion for greenbug control in 33% of the years. Harvest occurs in October. Following sorghum harvest, stalks are allowed to stand in the field to aid moisture conservation until the following spring. Beginning in May the soil is undercut with a V-blade. Disking, and rodweeding is done to control weeds through the summer fallow period. In the fall, 6-8 inch furrows are formed with a lister to reduce wind erosion. During the following spring, beds formed by the lister are reshaped with a rolling cultivator to prepare a seedbed for June planting.

Table 4.7

Field Operations Required in Cropping System: Conventional Sorghum-Sorghum

FIELD OPERATION	DATE (App.)		(In Cycle) YEAR	Amount	Field Efficiency	4WD Tractor	2WD Tractor	2WD Tractor	Annual Acres
Apply Nitrogen	APRIL	20	I	15 LBS	-		Custom Hired		2000
Disk 1	APRIL	25	I	--	83.5%	27 FT	20 FT	20 FT	2000
Disk 2	MAY	30	I	--	83.5%	27 FT	20 FT	20 FT	2000
Plant 3	JUNE	5	I	--	67.5%		30 FT	30 FT	2000
Cultivate 4	JULY	12	I	--	76.5%		30 FT	30 FT	2000
Spray 2,4-D	JULY	15	I	0.5 LB	-		Custom Hired		2000
Cultivate 5	JULY	30	I	--	76.5%		30 FT	30 FT	2000
Parathion (25%)	AUG	1	I	0.5 LB	-		Custom Hired		500
Harvest Sorghum	OCT	8	I	$13-13-13	-		Custom Hired		2000
									16500

Table 4.8

Field Operations Required in Cropping System: Conservation Sorghum-Fallow

FIELD OPERATION	DATE	(In Cycle) (App.)	YEAR	Amount	Field Efficiency	4WD Tractor	2WD Tractor	Annual Acres
V-Blade 1	MAY	1	I	--	80.0%	42 FT	30 FT	1000
Disk 2	JUNE	5	I	--	83.5%	27 FT	20 FT	1000
V-Blade 3	JULY	15	I	--	80.0%	42 FT	30 FT	1000
RodWeed 4	AUG	12	I	--	80.0%	48 FT	36 FT	1000
List'Beds' 5	OCT	20	I	--	76.5%		30 FT	1000
Lilliston 6	APRIL	20	II	--	76.5%		30 FT	1000
Apply Nitrogen	APRIL	25	II	30 LBS	-	Custom Hired		1000
Lilliston 7 (50%)	MAY	15	II	--	76.5%		30 FT	500
Plant 8	JUNE	1	II	--	67.5%		30 FT	1000
Apply Atrazine	JUNE	5	II	1 LB	-	Custom Hired		1000
Cultivate 9	JULY	12	II	--	76.5%		30 FT	1000
Sprsy 2,4-D (33%)	JULY	15	III	0.5 LB	-	Custom Hired		333
Parathion (33%)	AUG	1	III	0.5 LB	-	Custom Hired		333
Harvest Sorghum	OCT	8	III	$13-13-13	-	Custom Hired		1000
								11100

Machine Complement Selection

One difficulty in using enterprise budgets to evaluate different cropping systems is selecting a complement of tractor-implement combinations. Each tillage operation of any production system requires the use of one tractor and one implement. The difficulty arises in selecting which tractor size and implement width should be used for a given field operation.

Schrock provides a worksheet to determine tractor size and implement width needed. The worksheet has four steps: (1) identify the critical job; (2) estimate the time available to do the job; (3) size the machinery needed; and (4) estimate power requirements for tillage tools.

Identify the Critical Job: Farm equipment should have sufficient work capacity to complete field operations within a certain time period. The limiting factor for tractors are critical tillage and planting periods. Browers (1974) states that every field operation has a timeliness dimension. Timeliness is the completing of field operations at an optimum time in regard to crop quantity and quality. Since crop yields and/or quality may decline when field operations are not completed within a given time frame, recommendations from agronomists were used to establish the critical periods.

Optimum planting dates for crops used in the study were outlined in the Wheat Production Handbook (Wilkins, 1978) and Grain Sorghum Handbook (Peterson, 1981). Time constraints for tillage are based on input from Gwinn (1984). For example, tillage in the first week of June is important. Stopping weed growth before excessive moisture is used can have dramatic impacts on crop yields.

Estimate the Time Available to do the Job: To calculate time available to satisfactorily complete a field operation, the farm manager needs to have some estimate of how many days weather will allow field work. A major concern is the uncertainty of weather conditions. Weather plays an important role in determining the size, and therefore, the cost of a machinery complement. In general, as precipitation increases, the number of field days in a given time period decreases. Field days refer to days when the soil moisture content is satisfactory to perform field operations.

Buller et al., (1976) compiled the field work days available for different locations in Kansas based on their frequency of occurrence in a given year. The 85% level will be used in this study (Table 4.9). This timeliness level should lead to a slightly larger equipment complement which will satisfactorily complete operations in the majority of years.

Given the available field work days, an operator must decide how many hours per day he is willing to work. For the purpose of this study, ten hours per day will be used as the standard. Thus, the number of work days available and hours per day can be multiplied to determine the total running time to complete the job. This allows some flexibility for longer work days when inclement weather reduces the number of field work days more than the expected average.

Sizing the Machinery: The total acres which will be covered in any one field operation is divided by the total running time available to determine field capacity in acres per hour. Field capacity is represented by the following formula.

$$F.C. = \frac{S \times W \times E}{8.25}$$

F.C. = Field capacity in Acres/hour
S = Speed in miles per hour
W = Swath width in feet
E = Field efficiency (decimal)

Table 4.9

Minimum Number of Field Workdays Available on 85% of Years for 6 KANSAS Locations

		Southeast (Fall River)	Northeast (Sabetha)	East Central (Manhattan)	Central (Kanopolis)	West Central (Hays)	Western (Tribune)
April	1-15	3	3	5	7	9	11
	16-30	3	4	4	8	8	9
May	1-15	3	4	3	3	7	8
	16-31	1	2	2	5	7	7
June	1-15	1	1	1	4	3	6
	16-30	2	2	3	4	7	8
July	1-15	4	4	6	7	7	9
	16-31	2	5	5	5	8	9
Aug	1-15	6	7	7	8	7	8
	16-31	4	5	5	6	9	9
Sept	1-15	3	1	2	4	7	9
	16-31	1	0	2	3	5	10
Oct	1-15	4	1	2	6	6	-
	16-31	1	2	3	4	9	-

Source: Field Workdays in Kansas, Ag. Exp. Sta. Bulletin 596.

For our purposes, the same equation can be reversed so that we can determine the width needed to achieve a given field capacity.

$$W = \frac{F.C. \times 8.25}{S \times E}$$

Field efficiency figures were obtained from the MACHINE Program of AGNET, University of Nebraska, via microcomputer. Speeds were assigned on recommendations from agricultural engineers. Bowers (1977) recommends speeds in the range of 4.5 to 6 m.p.h. Research found that by pulling slightly smaller implements at faster speeds reduced wear on the tractor drive train, and allows operators the flexibility of gearing down when pulling through exceptionally "hard" areas of the field.

Estimate Power Requirements for Implements: For tillage and planting implements, the tractor size (H.P.) must match the width of implement selected. Therefore, the implement width -- determined by field capacity needed to meet field workday time constraints -- is multiplied by the H.P. required per foot at width. Appendix A contains the results of machine complements that were found to be limiting.

The following is a list of implements used in the cropping systems of this study and their tractor power take-off horsepower (H.P.) requirements per foot (Schrock, 1976).

Table 4.10 Equipment Complement for Representative 'Case' Farm.

Implement	H.P./Ft.	Max. Width for 234 H.P.(1)	Size in Study	Max. Width for 184 H.P.(2)	Size in Study
Disk	7.5	31.2	27	24.5	20
V-blade sweep	5.5	42.5	42	33.6	30
Rod weeder	4.5	52	48	40.8	36
Hoe drill	4.25	62.4	50	43	40
Row planter	4			49	30
Cultivator	4			49	30

1) Four Wheel Drive Tractor.
2) Two Wheel Drive Tractor.

Prices

Crop prices are the season average from the west central district of the Kansas crop and livestock reporting service. This was assumed to be representative of prices received by farmers, thus useful for comparative purposes. (See Appendix B).

Enterprise Budget Format and Assumptions

Enterprise budgets are used to summarize all the annual operating expenses and machinery costs for analysis purposes. The enterprise budget for the conventional wheat-fallow system is included here as an example of the budget format which is used in the study (Table 4.11). Further budget information is tabulated for each system, and can be found in Appendix E.

Enterprise Budget Example

The general outline of the enterprise budgets is as follows. Each budget has two major sections. The first section of the budget contains blocks of information by field operation. The first section of the budget contains blocks of information by field operation. The first block contains information on a disking operation which would start in May. The second major section contains a summary of all costs associated with field operation as well as additional field and variable costs that are not directly associated with individual field operations. This section of the budget has a traditional enterprise budget format. The last line on the budget contains estimated net farm income and net cash farm income to the farm manager and landlord. The following section contains additional detail about the estimates of the values used in the budgeting process.

The first section of the budget which lists each field operation individually contains 9 columns of information. In each subsection, there

Table 4.11-I

CROPPING SYSTEM

Tribune

WHEAT: Conventional Wheat-Fallow (CVWF)

YEAR I: Fallow, Plant Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	MAY 1	5.25	MPH.	(83.5%	Eff.)			
Disk (75% of time)		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.31	---- VC ----	
Fuel		0.855	GPA.	0.95	0.7500	0.61	2.08	0.066
Oil		15%	FUEL	COST	0.0000	0.09	---- FC ----	
Repair		4.1%	LIST	PRIC	1.4200	1.07	4.92	0.157
Ownshp Tractor		52.28	T.HR	48.18	0.0697	3.36	---- TC ----	
Ownshp Implemt		750	ACRS	22.45	0.0697	1.56	7.00	0.223
4WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	---- VC ----	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.86	0.027
Oil		15%	FUEL	COST	0.0000	0.06	---- FC ----	
Repair		3.3%	LIST	PRIC	0.3900	0.23	3.03	0.097
Ownshp Tractor		26.07	T.HR	48.18	0.0446	2.15	---- TC ----	
Ownshp Implemt		584	ACRS	19.59	0.0446	0.87	3.88	0.124
2WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	---- VC ----	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.024
Oil		15%	FUEL	COST	0.0000	0.04	---- FC ----	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.55	0.113
Ownshp Tractor		26.00	T.HR	36.61	0.0625	2.29	---- TC ----	
Ownshp Implemt		416	ACRS	20.24	0.0625	1.27	4.31	0.138
4WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	---- VC ----	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.86	0.027
Oil		15%	FUEL	COST	0.0000	0.06	---- FC ----	
Repair		3.3%	LIST	PRIC	0.3900	0.23	3.03	0.097
Ownshp Tractor		26.07	T.HR	48.18	0.0446	2.15	---- TC ----	
Ownshp Implemt		584	ACRS	19.59	0.0446	0.87	3.88	0.124
2WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	---- VC ----	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.024
Oil		15%	FUEL	COST	0.0000	0.04	---- FC ----	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.51	0.112
Ownshp Tractor		26.00	T.HR	36.61	0.0625	2.29	---- TC ----	
Ownshp Implemt		416	ACRS	19.59	0.0625	1.22	4.27	0.136

Table 4.11-II

CROPPING SYSTEM
Tribune
(Cont.)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	56%	48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.13	---- VC ----	
Fuel		0.481	GPA.	0.95	0.5600	0.26	0.71	0.023
Oil		15%	FUEL	COST	0.0000	0.04	---- FC ----	
Repair		6.0%	LIST	COST	0.5200	0.29	2.39	0.076
Ownshp Tractor		21.30	T.HR	48.18	0.0374	1.80	---- TC ----	
Ownshp Implemt		570	ACRS	15.70	0.0374	0.59	3.10	0.099
2WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	44%	36	FEET	(20.1	A/Hr)			
Labor		1	HOUR	6.00	0.0498	0.13	---- VC ----	
Fuel		0.481	GPA.	0.95	0.4400	0.20	0.89	0.028
Oil		15%	FUEL	COST	0.0000	0.03	---- FC ----	
Repair		6.0%	LIST	PRIC	1.2000	0.53	3.23	0.103
Ownshp Tractor		21.42	T.HR	36.61	0.0498	1.82	---- TC ----	
Ownshp Implemt		430	ACRS	28.27	0.0498	1.41	4.12	0.132
4WD	SEP 1	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	100%	48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.22	---- VC ----	
Fuel		0.481	GPA.	0.95	1.0000	0.46	1.27	0.041
Oil		15%	FUEL	COST	0.0000	0.07	---- FC ----	
Repair		6.0%	LIST	PRIC	0.5200	0.52	2.39	0.076
Ownshp Tractor		37.37	T.HR	48.18	0.0374	1.80	---- TC ----	
Ownshp Implemt		1000	ACRS	15.70	0.0374	0.59	3.66	0.117
2WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill	100%	40	FEET	(14.9	A/Hr)			
Labor		1	HOUR	6.00	0.0669	0.40	---- VC ----	
Fuel		0.406	GPA.	0.95	1.0000	0.39	2.15	0.068
Oil		15%	FUEL	COST	0.0000	0.06	---- FC ----	
Repair		3.7%	LIST	PRIC	1.3000	1.30	5.23	0.167
Ownshp Tractor		66.94	T.HR	36.61	0.0669	2.45	---- TC ----	
Ownshp Implemt		1000	ACRS	41.54	0.0669	2.78	7.38	0.235
Seed Wheat		40	LBS.	0.100	$6/Bu	4.00		0.128
Crop Insurance			LEVEL	I	2.50	4.41		0.141
Total Variable Costs for all Operations							10.42	0.333
Total Fixed Costs for all Operations							31.28	0.998

TOTAL TILLAGE COSTS YEAR 1 (Per Acre)							$41.70	1.331

Table 4.11-III

CROPPING SYSTEM
Tribune

WHEAT: Conventional Wheat Fallow (CVWF)
YEAR II: Harvest Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	30	LBS.	0.27		8.10		0.258
Custom App.		1	ACRE	3.00		3.00		0.096
(landlord)		33%	SPLT		11.10	-3.66	8.65	0.276
HARVEST	JUN 30							
Custom Combine		1	ACRE	13.00		13.00		0.415
Bushel Bonus >20		11	BSHL	0.13		1.47		0.047
Truck Hauling		31	BSHL	0.13		4.07		0.130
TOTAL HARVEST EXPENSE						18.55	18.55	0.592
Tillage to control weed growth after Harvest								
4WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	---- VC ----	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.86	0.027
Oil		15%	FUEL	COST	0.0000	0.06	---- FC ----	
Repair		3.3%	LIST	PRIC	0.3900	0.23	3.03	0.097
Ownshp Tractor		26.07	T.HR	48.18	0.0446	2.15	---- TC ----	
Ownshp Implemt		584	ACRS	19.59	0.0446	0.87	3.88	0.124
2WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	---- VC ----	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.024
Oil		15%	FUEL	COST	0.0000	0.04	---- FC ----	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.55	0.113
Ownshp Tractor		26.00	T.HR	36.61	0.0625	2.29	---- TC ----	
Ownshp Implemt		416	ACRS	20.24	0.0625	1.27	4.31	0.138
Tillage 75% of the time.								
4WD	OCT 1	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.20	---- VC ----	
Fuel		0.748	GPA.	0.95	0.7500	0.53	1.11	0.035
Oil		15%	FUEL	COST	0.0000	0.08	---- FC ----	
Repair		3.3%	LIST	PRIC	0.3900	0.29	3.03	0.097
Ownshp Tractor		33.48	T.HR	48.18	0.0446	2.15	---- TC ----	
Ownshp Implemt		750	ACRS	19.59	0.0446	0.87	4.13	0.132

Table 4.11-IV

ENTERPRISE BUDGET
Tribune

WHEAT: Conventional Wheat-Fallow (CVWF)
YEAR I: Fallow, Plant Wheat and YEAR II: Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.389 Hours	0.075	2.34	0.60	-----	-----
2. Seed	0.128	4.00	4.00	-----	-----
3. Herbicide	0.000	0.00	0.00	-----	-----
4. Insecticide	0.000	0.00	0.00	-----	-----
5. Fertilizer *	0.354	11.10	11.10	-----	-----
6. Fuel ($/Gallon)=$0.95	0.146	4.57	4.57	-----	-----
7. Oil	0.022	0.69	0.69	-----	-----
8. Equipment repair	0.174	5.46	5.46	-----	-----
9. Custom Hire (Harvest Exp)	0.592	18.55	18.55	-----	-----
10. Interest (1/2 VC @ 15%)	0.112	3.50	2.10	-----	-----
A. TOTAL VARIABLE COSTS (Own Land)	1.602	50.20	47.07	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *	1.485	46.54	43.41	-----	-----
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.255	8.00	8.00	-----	-----
12. Interest on Land	1.532	48.00	24.48	-----	-----
OR ($400/A x 2 x 6%)	(24% LT DEBT @ 12%i)			<160 AC>	
13. Share Rent (Returns x 33%)	1.096	34.34	34.34	-----	-----
14. Depreciation on Machinery	0.338	10.59	0.00	-----	-----
15. Interest on Machinery	0.394	12.34	4.07	-----	-----
16. Insurance, and Housing	0.053	1.65	1.65	-----	-----
B. TOTAL FIXED COSTS (Own Land)	2.571	80.58	38.20	-----	-----
TOTAL FIXED COSTS (Rent Land)	1.880	58.92	40.06	-----	-----
C. TOTAL COSTS PER ACRE OWNED	4.173	130.78	85.27	-----	-----
TOTAL COSTS PER ACRE RENTED	3.365	105.46	83.46	-----	-----
D. YIELD Per Acre			31.34	-----	
E. PRICE / Bushel			3.29	-----	
F. RETURNS PER ACRE			103.11	-----	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.77	55.36	59.70	-----	-----
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.88	-27.67	17.84	-----	-----
H. RETURNS OVER TOTAL COSTS (RENTED)	-0.07	-2.35	19.64	-----	-----
J. ANNUAL NET RETURNS PER AC. (AVE.)	-0.34	-10.70	19.05	-----	-----
K. NET RETURN TO MANAGEMENT		-10705	19048	-----	-----

* Assumes Landlord paying 1/3 of Fertilizer ($3.66), on rent land.

are also two rows of descriptive information about the operation. For example, the first operation in the conventional wheat-fallow cropping system occurs in the spring following wheat harvest of the previous year (See Rows 9 and 10 of Figure 4.10-I). This operation is a disking operation using a four wheel drive (4WD) tractor. Additional information listed in the first two rows indicates that this operation occurs in about 75% of the years and starts approximately May 1. It also indicates the tractor pulls a 27 foot wide disk and travels 5.75 miles per hour. It also assumes an 83.5% field efficiency so it can complete 14.3 acres per hour.

The number of acres the equipment complement (tractor and implement) can cover in one hour is a function of implement width, ground speed and field efficiency, which allows time for turning, lubrication, moves between field, etc. The following formula was used:

$$\frac{\text{speed x width x \% efficiency)}}{8.25} = \text{acres per hour}$$

Field efficiencies and acres/hour are listed in parenthesis for each operation.

For the rest of the information listed in each field operation section the column labels apply. The first column lists the inputs required for the field operation. For the disking operation this includes rows 11 through 16. Column two indicates the data where the operation begins. Columns three and four indicate the quantity of use and relevant unit of measure for the input. The fifth column lists the value ($) per unit of input. Column seven contains the input cost per acre to complete the operation. Generally, to obtain $/acre, the quantity of the input is multiplied times its corresponding unit price and multiplied by the coefficient in column number six. Column number six indicates the number of units/acre of the input that are required. For labor use and fixed costs associated with tractors and implements, these units are recorded in Hrs/acre. For the fuel calculation, this unit is the percentage indicated in the second row of each operation section. For the labor and fuel costs, the figure is first reduced by a percentage (indicated in row ten) of work the specific equipment complement covers. Further details of the disking operation are elaborated on here. <See Table 4.10-I.>

Labor cost (Row 11), is calculated with the use of equation (1).

Eq. (1) Labor cost/Acre = Hrs/Acre * $/Hr * unit/Acre * Acre %

$ 0.031 = 1 * $6.00 * 0.0697 * 0.75

Labor is valued at $6.00 per hour (Langemeir and Krause, 1984). In this example, it takes 0.0697 hours to complete a single acre and only 75% of the acres are covered annually by this operation.

Fuel cost (Row 12), is calculated with the use of equation (2).

Eq. (2) Fuel cost/Acre = Gal/Acre * $/Gal * Acre %

$0.61 = 0.855 * $0.95 * 0.75

Fuel consumption in gallons per acre was obtained from a survey of Kansas agricultural producers (Schrock, 1985). The fuel price used is the January 1984 average price in cents per gallon for No. 2 Diesel Fuel, excluding tax (Agricultural Prices, USDA). Oil and lubricant cost was assumed to be 15% of the fuel cost (Kletke, 1979).

Repair costs (Row 14), are estimated with the use of equation (3).

Eg (3) Repair costs/Acre = (List price * % Factor)/Acres * Acre %

$1.07 = $1.42 (from AGNET) * 0.75

Repair costs were obtained from the MACHINE Program of AGNET, University of Nebraska, Lincoln. (See Appendix C) Cost is figured as a percentage factor times the list price, divided by the number of acres the implement covers annually. This figure is again allocated to the amount of work the equipment complement does when machines are running simultaneously.

Labor, fuel, oil, and repair cost are considered variable costs of each operator. These costs are summed for the operation and displayed under VC (Variable Costs) in column eight. Column nine converts the information in column eight to a per bushel basis.

Fixed costs for the tractors and implements are calculated from an electronic spreadsheet designed to calculate depreciation, interest, and insurance costs and convert them to a per acre and per hour basis. (See Appendix D) For example, the four wheel drive tractor costs $48.15/Hour and the disk costs $22.45/Hour. Each takes 0.0697 hours to complete one acre an hour disking operation. Therefore fixed costs for the tractor and the implement are $3.36 and $1.56 per acre respectively. The fixed costs for the tractor and implement are summed to determine the field costs for each operation. Once this is done, the total cost which is the sum of the fixed and variable cost for each operation, is calculated per acre and per bushel. and displayed in column 8 and 9 of the operation section.

Tractor and implement costs were figured using the following assumptions. The original value for which depreciation estimates are based on is the purchased price. This purchase price is estimated as 85% of list price. Equipment age was assumed to be one-half of its depreciable life for equipment that would already exist in a conventional wheat-fallow cropping system. Any equipment that would have to be purchased for an alternative rotation was assumed to be new. Depreciable life was determined to be 10-years for tractors, 12 years for planters and 14 years for tillage implements. Because of this, tractors were assumed to be 5 years old, planters 6 years old, and tillage implements 7 years old (Hoag, 1984). To find the purchase price for each implement, the 1984 list price was discounted by a ratio of price indexes for tractors and implements for the appropriate year (Agriculture Outlook, 1978-1984). Salvage values are estimated to be a percentage of purchase price (Mohasci, et al, 1982).

Tractor and implement list prices (1984) are based on information received from area equipment dealers. The following equipment brands were used as a basis for the list price. List prices for each brand was averaged to obtain an overall average list price.

Depreciation is calculated using a straight line basis which is required for enterprise budget. Interest expense is based on the average value of the equipment over its life. The interest rate used for this calculation is 15%. Insurance and housing is estimated to be 1% of the depreciable base (purchase price). Once the annual fixed costs of the equipment are estimated, a per acre and per hour cost is also calculated. Per acre fixed costs for the equipment are calculated by dividing annual ownership cost by total acres. Total acres is used because it requires more than one acre of land to produce an acre of crop in the fallow systems. Therefore, crop acres is not the applicable base. Ownership costs per hour are calculated by dividing the annual ownership cost by the estimated total number of hours the machine is to be used during the year. The ownership costs per hour are then used to arrive at the ownership costs per acre for each operation.

Ownership costs per hour from the machinery cost calculator spreadsheet are transferred to the enterprise budget to determine the cost per acre for each operation that it is used in. The cost per hour is multiplied by the required time (hrs/acre) to complete the operation on one acre to arrive at the per acre cost of the tillage operation. In the example of the conventional wheat fallow system, 750 acres are disked at 14.3 acres per hour. This requires 52.28 total hours (Row 15). Ownership costs per hour from the machinery cost calculator spreadsheet for the tractor and disk are $448.18/hr and $22.45/hr respectively. These costs are based on 52.44 hours of use for the disk and 196 hours of use for the four-wheel-drive tractor (it is used for other tillage work as well as the disking operation). Once the per hour costs are figured the per acre costs are calculated by the number of hrs/acre required to complete the operation. In this case, $48.18/hr and $22.45/hr are multiplied by 0.0697 hrs/acre to arrive at tractor ownership costs of 3.36/acre and implement ownership costs per acre of $1.56 for the disking operation. Other tillage costs are calculated similarly.

Fixed and variable costs for the operation are added together to arrive at total cost for the operation. For the disking operation, those costs are $7.00/acre or $0.223/bushel. (Row 16, Columns 8 & 9)

The information in each field operation section is used in two ways. It is used to arrive at cost per operative to compare to custom rates for the operation. In addition the costs of labor, fuel, oil, and repairs are transferred from each operation to the summary enterprise budget. Ownership costs are most. Ownership costs used in the enterprise budget summary are taken from the machinery cost calculator spreadsheet summary directly. Total depreciable interest and insurance figures for all equipment for the respective tillage systems are summarized in the machinery cost calculator and those figures are used in the summary enterprise budgets.

Summary Enterprise Budgets

Details of the cropping systems are summarized in the second major section of the enterprise budgets, Details can be found in Table 4.10-IV, row 72, column 11 of the conventional wheat-fallow example. The summary is designed similarly to the Kansas State University Farm Management Guides. All items in the variable cost section of the summary are sum totals of the individual input requirements from the operation section of the enterprise budget. Items (1) Labor, (6) fuel,(7) oil, and (8) repair expenditures were discussed previously. The remaining items are examined here.

Seed expense (2) is calculated by determining the seeding rate (lbs/acre) and multiplying it by the appropriate cost per pound of seed. Wheat is planted at 40 lbs/acre and costs $0.10/lb.

Herbicide (3), insecticide (4), and fertilizer (5) costs are also calculated by multiplying the application rate per acre times the per unit cost of the chemical. Again, this is done in the operation section of the enterprise budget. (In figuring variable costs for rented land, one third of the fertilizer, herbicide, and insecticide costs are shared by the landlord.) Herbicide and fertilizer application rates are recommended by Tribune experiment station branch agronomist who conducted the actual studies. Additional fertilizer and herbicide are assumed to be custom applied at an average of $3.00/acre (Kansas custom rates, 1984).

Harvesting expenses (10) are based on hiring a custom harvestor to do all harvesting. Custom rates for harvest are assumed to be $13.00/acre and $0.13/bushel for each bushel above 20 bu/acre for wheat. The custom rate for hauling to storage is $0.13/bushel.

The one item which is not handfixed from the operations section of the enterprise budget is the interest expense (11) for the variable input.

Interest expense is calculated directly in the summary and is calculated as 15% interest on 1/2 of the sum of the variable cost items.

The cash column for the variable cost portion of the summary is the same as the total expenses except for labor and interest. It is assumed that the farm will be operated by one man with one summer help hired at $6.00 per hour. Therefore, cash for labor is only paid when hired labor is completing tillage operations. Actual cash interest expense is assumed to be 60% of the total interest expense (Langemeier and Krause, 1984). Letter A represents total variable costs for owned and rented land, which are the sum of items 1 through 11. In the conventional wheat-fallow example, the total variable costs per acre of wheat produced comes to $50.20 on own land, and 46.54 on rented land.

The second section of the summary enterprise budget lists the fixed cost associated with the cropping system. Real estate taxes (Item 11) are $0.50/acre for each $100.00 of land value. Land value is assumed to be $400.00/acre. Interest (12) on the land is calculated using a 6% interest rate. These assumptions are what are used in the KSU farm management guide for comparative budgeting. The actual cash payment for land in the cash column is the estimated land payment using a 12% interest rate for land financing.

Land payment (Item 13), is calculated with the use of equation 7.

Eq.(7) Land payment = Price/acre * LT debt * Amoritization figure * acres.

$$\$24.48 = 400/\text{acre} * 24\% * .1275 * 2$$

Share rent to the landlord (Item 14), is calculated in Equation 8.

Eq.(8) Share rent = Yield * Percent * Average Price

$$41.87 = 31.32 * 0.33 * 3.29$$

Machinery ownership costs depreciation, interest, and insurance/housing costs are listed in items 14. 15. and 16 respectively. The ownership costs are divided by the 2000 acres in the depreciation schedules. (See Appendix D) This figure is used in the continuous systems. However, it takes 2 years of land management to produce one full crop in the wheat-fallow and sorghum-fallow systems. Therefore, the ownership costs are doubled to properly allocate expenses on an annual basis. In the wheat-sorghum-fallow system, 3 years of land is manage to produce annual crops of wheat and sorghum, so the ownership expenses are tripled in this system.

Letter B shows the total fixed costs. For owned land, it is the sum of items 11, 12. 14. 15. and 16. Rented land combines items 13 through 16. Total costs (letter C) are simply total variables cost plus total fixed costs. Gross Returns (F) are calculated by multiplying yield (D) in bushels per acre times the average price (E). Net Returns over Variable Costs are in letter G, and are calculated by subtracting letter A from F. Net Returns over Total Costs for rented and owned land are calculated by subtracting letter C from F. Annual returns per acre is shown in letter J, and represents weighted returns over total costs, with 67% from rented land and 33% owned. Net Return To Management is calculated by multiplying line J by the number of crop acres. Returns must be compared on a total farm basis to reflect the differences in crop and fallow acres.

Chapter Five

ANALYSIS

This chapter summarizes net return to management for the seven cropping systems examined in the representative 'case' farm scenario. Using 1984 cost of production estimates from enterprise budgets with eleven-year average yields and prices, total net return is calculated. Also, cash return to the landlord is included from rented land. Input requirements for all systems are compared. Price and yield variability are reviewed, and the coeficient of variation with regard to expected income is used as a simple measure of risk. Cash flow analysis was conducted on the three most profitable systems, plus the benchmark conservation wheat system to determine differences in the amount of financing needed by month, the interest on operating line, and the resulting cash balance for the following year.

Annual Field Operations

Table 5.1 summarizes annual crop acres and the field operations required to complete each cropping system. In each cropping system the crop acres are custom fertilized with dry ammonimum nitrate and the crop is custom harvested at the end of each growing season. The major differences in the cropping systems are the tillage operations and chemical combinations. The reduced tillage wheat-fallow (RTWF) system saves 2.5 tillage operations but requires an additional herbicide application. Thus, the net result is 1500 fewer acres covered annually by field operations. Because of the additional sorghum crop, the wheat-sorghum-fallow (WSF) rotation requires substantially more field operations when compared with wheat-fallow (WF) systems. However. the actual farming units are 666.6 acres in the WSF system. compared to 1000 in the WF system. Thus, the resulting annual

Table 5.1

Annual Field Operations by Cropping System

OPERATION	CROPPING SYSTEM[1] RTWF	CVWF	RTWSF	CVWSF	CTSF	CVWW	CVSS
Annual Acrea							
Wheat	1000	1000	666.6	666.6	--	2000	2000
Sorghum	--	--	666.6	666.6	1000	--	--
Fallow	1000	1000	666.6	666.6	1000	--	--
CROP ACRES	1000	1000	1333.3	1333.3	1000	2000	2000
OPERATION							
Tillage							
Wheat	4	6.5	4	6.5	-	3	-
Sorghum	-	-	2	3.5	7.5	-	4
Planting							
Wheat	1	1	1	1	-	1	-
Sorghum	-	-	1	1	1	-	1
SUB-TOTAL	5	7.5	8	12	8.5	4	5
Fertilizer[2]							
Wheat	1	1	1	1	-	1	-
Sorghum	-	-	1	1	1	-	1
Chemical[2]							
Wheat	1	-	1	-	-	-	-
Sorghum	-	-	0.6	0.6	1.6	-	1.25
Harvest[2]							
Wheat	1	1	1	1	-	1	-
Sorghum	-	-	1	1	1	-	1
TOTAL	8	9.5	13.6	16.6	11.1	6.0	8.25
ACRES COVERED[3]	8000	9500	9060	11002	11100	12000	16500

1 RTWF: Reduced Tillage Wheat-Fallow
CVWF: Conventional Tillage Wheat-Fallow
RTWSF: Reduced Tillage Wheat-Sorghum-Fallow
CVWSF: Conventional Tillage Wheat-Sorghum-Fallow
CTSF: Conservation Tillage Sorghum-Fallow
CVSS: Conventional Tillage Sorghum-Sorghum
CVWW: Conventional Tillage Wheat-Wheat

2 Operations custom hired.

3 Refers to total number of acres covered with all field operations per year.

acres covered do not increase proportionally. The reduced till wheat-sorghum-fallow (RTWSF) involves 1.3 more annual herbicide applications, than conventional wheat-sorghum-fallow (CVWSF), but ends up covering 1942 less acres yearly. due to fewer tillage operations.

The conservation sorghum-fallow (CTSF) system requires more tillage operations because of the bedding operations needed to prevent wind and water erosion during the 20 month fallow period. This system covers 1600 more annual acres than the CVWF rotation.

The continuous wheat (CVWW), and sorghum (CVSS) systems put all land into production yearly. CVWW entails field operations on 12,000 acres annually. versus 8,000 in the CVWF system. CVSS requires annual herbicide application and insect control 25% of the time. While no chemical was assumed needed in the CVWW system, it should be noted that downy brome, <cheat>, (Bromus tectorum L.) and wild mustard (Brassica sp.) weeds may present a problem when producing continuous wheat in some areas. However, neither of these problems were encountered at the Tribune experiment plots over the past eleven years.

Empirical Results

Enterprise budgets from the seven cropping systems are contained in Tables 5.2 through 5.8. Net returns, and selected costs from enterprise budgets are summarized in Table 5.9. Eleven year average yields from the Tribune Branch Experiment Station, and season average prices from the West Central district of the Kansas Crop and Livestock reporting service are combined with 1984 cost of production estimates for comparative purposes. Specific yield and price data can be found in the risk analysis section later in the text.

Table 5.2

ENTERPRISE BUDGET
Tribune

WHEAT: Conventional Wheat-Fallow (CVWF)
YEAR I: Fallow, Plant Wheat and YEAR II: Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.389 Hours	0.075	2.34	0.60	-----	-----
2. Seed	0.128	4.00	4.00	-----	-----
3. Herbicide	0.000	0.00	0.00	-----	-----
4. Insecticide	0.000	0.00	0.00	-----	-----
5. Fertilizer *	0.354	11.10	11.10	-----	-----
6. Fuel ($/Gallon)=$0.95	0.146	4.57	4.57	-----	-----
7. Oil	0.022	0.69	0.69	-----	-----
8. Equipment repair	0.174	5.46	5.46	-----	-----
9. Custom Hire (Harvest Exp)	0.592	18.55	18.55	-----	-----
10. Interest (1/2 VC @ 15%)	0.112	3.50	2.10	-----	-----
A.TOTAL VARIABLE COSTS (Own Land)	1.602	50.20	47.07	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *	1.485	46.54	43.41	-----	-----
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.255	8.00	8.00	-----	-----
12. Interest on Land	1.532	48.00	24.48	-----	-----
OR ($400/A x 2 x 6%)	(24% LT DEBT @ 12%i)			<160 AC>	
13. Share Rent (Returns x 33%)	1.096	34.34	34.34	-----	-----
14. Depreciation on Machinery	0.338	10.59	0.00	-----	-----
15. Interest on Machinery	0.394	12.34	4.07	-----	-----
16. Insurance, and Housing	0.053	1.65	1.65	-----	-----
B.TOTAL FIXED COSTS (Own Land)	2.571	80.58	38.20	-----	-----
TOTAL FIXED COSTS (Rent Land)	1.880	58.92	40.06	-----	-----
C.TOTAL COSTS PER ACRE OWNED	4.173	130.78	85.27	-----	-----
TOTAL COSTS PER ACRE RENTED	3.365	105.46	83.46	-----	-----
D.YIELD Per Acre			31.34	-----	
E.PRICE / Bushel			3.29	-----	
F.RETURNS PER ACRE			103.11	-----	
G.RETURNS OVER VARIABLE COSTS (AVE.)	1.77	55.36	59.70	-----	-----
I.RETURNS OVER TOTAL COSTS (OWNED)	-0.88	-27.67	17.84	-----	-----
H.RETURNS OVER TOTAL COSTS (RENTED)	-0.07	-2.35	19.64	-----	-----
J.ANNUAL NET RETURNS PER AC. (AVE.)	-0.34	-10.70	19.05	-----	-----
K.NET RETURN TO MANAGEMENT		-10705	19048	-----	-----

* Assumes Landlord paying 1/3 of Fertilizer ($3.66), on rent land.

Table 5.3

ENTERPRISE BUDGET
Tribune

WHEAT: Reduced-Till Wheat-Fallow (RTWF)
YEAR I: Fallow, Plant Wheat and YEAR II: Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.266 Hours	0.042	1.60	0.45	-----	-----
2. Seed	0.105	4.00	4.00	-----	-----
3. Herbicide *	0.134	5.14	5.14	-----	-----
4. Insecticide	0.000	0.00	0.00	-----	-----
5. Fertilizer *	0.290	11.10	11.10	-----	-----
6. Fuel ($/Gallon)= $0.95	0.070	2.68	2.68	-----	-----
7. Oil	0.011	0.40	0.40	-----	-----
8. Equipment repair	0.108	4.14	4.14	-----	-----
9. Custom Hire (Harvest Exp)	0.532	20.34	20.34	-----	-----
10. Interest (1/2 VC @ 15%)	0.097	3.70	2.22	-----	-----
A.TOTAL VARIABLE COSTS (Own Land)	1.389	53.09	50.46	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *	1.249	47.73	45.10	-----	-----
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.209	8.00	8.00	-----	-----
12. Interest on Land	1.256	48.00	24.48	-----	-----
OR ($400/A x 2 x 6%)	(24% LT DEBT,		12%i)	<160 AC>	
13. Share Rent (Returns x 33%)	1.096	41.87	41.87	-----	-----
14. Depreciation on Machinery	0.277	10.59	0.00	-----	-----
15. Interest on Machinery	0.323	12.34	4.07	-----	-----
16. Insurance, and Housing	0.043	1.65	1.65	-----	-----
B.TOTAL FIXED COSTS (Rent Land)	1.739	66.45	47.59	-----	-----
TOTAL FIXED COSTS (Owned Land)	2.108	80.58	38.20	-----	-----
C.TOTAL COSTS PER ACRE RENTED	2.988	114.18	92.69	-----	-----
TOTAL COSTS PER ACRE OWNED	3.497	133.67	88.66	-----	-----
D.YIELD Per Acre			38.22	-----	
E.PRICE / Bushel			3.29	-----	
F.RETURNS PER ACRE			125.74	-----	
G.RETURNS OVER VARIABLE COSTS (AVE.)	1.99	76.25	75.29	-----	-----
H.RETURNS OVER TOTAL COSTS (RENTED)	0.30	11.56	33.05	-----	-----
I.RETURNS OVER TOTAL COSTS (OWNED)	-0.21	-7.92	37.09	-----	-----
J.ANNUAL NET RETURN PER AC. (AVE)	0.13	5.13	34.38	-----	-----
K.NET RETURN TO MANAGEMENT		5131	34382	-----	-----

* Assumes Landlord paying 1/3 of herbicide (1.70) and fertilizer (3.66)

Table 5.4

ENTERPRISE BUDGET

Tribune

WHEAT: Conventional Wheat-Wheat (CVWW)
YEAR I: Plant Wheat, and Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.225 Hours	0.086	1.35	0.83	-----	-----
2. Seed	0.253	4.00	4.00	-----	-----
3. Herbicide	0.000	0.00	0.00	-----	-----
4. Insecticide	0.000	0.00	0.00	-----	-----
5. Fertilizer *	0.446	7.05	7.05	-----	-----
6. Fuel ($/Gallon)= $0.95	0.146	2.31	2.31	-----	-----
7. Oil	0.022	0.35	0.35	-----	-----
8. Equipment repair	0.311	4.91	4.91	-----	-----
9. Custom Hire (Harvest Exp)	0.957	15.06	15.06	-----	-----
10. Interest (1/2 VC @ 15%)	0.166	2.63	1.58	-----	-----
A. TOTAL VARIABLE COSTS (Own Land)	2.382	37.65	36.08	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *	2.234	35.33	33.75	-----	-----
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.253	4.00	4.00	-----	-----
12. Interest on Land	1.518	24.00	12.24	-----	-----
OR ($400/A x 6%)	(24% LT DEBT, 12%i)				
13. Share Rent (Returns x 33%)	1.096	17.32	17.32	-----	-----
14. Depreciation on Machinery	0.589	9.31	0.00	-----	-----
15. Interest on Machinery	0.683	10.80	3.56	-----	-----
16. Insurance, and Housing	0.091	1.44	1.44	-----	-----
B. TOTAL FIXED COSTS (Rent Land)	2.459	38.87	22.32	-----	-----
TOTAL FIXED COSTS (Owned Land)	3.134	49.55	21.24	-----	-----
C. TOTAL COSTS PER ACRE RENTED	4.693	74.20	56.07	-----	-----
TOTAL COSTS PER ACRE OWNED	5.516	87.20	57.32	-----	-----
D. YIELD Per Acre			15.81	-----	
E. PRICE / Bushel			3.29	-----	
F. RETURNS PER ACRE			52.01	-----	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.01	15.92	15.94	-----	-----
H. RETURNS OVER TOTAL COSTS (RENTED)	-1.40	-22.18	-4.06	-----	-----
I. RETURNS OVER TOTAL COSTS (OWNED)	-2.23	-35.19	-5.30	-----	-----
J. ANNUAL NET RETURNS PER AC. (AVE.)	-1.67	-26.47	-4.47	-----	-----
K. NET RETURNS TO MANAGEMENT		-52946	-8941	-----	-----

* Assumes Landlord paying 1/3 of fertilizer (2.33) on rent land.

Table 5.5

ENTERPRISE BUDGET
Tribune

WHEAT: Conventional Wheat-Sorghum-Fallow (CVWSF)
YR. I: Fallow, Plt Wheat YR. II: Hrv Wheat YR. III: Plt & Hrv Sorghum

	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE				
1. Labor $6/Hr. x 0.748 Hour	4.49	1.63	-----	-----
2. Seed	6.19	6.19	-----	-----
3. Herbicide *	1.63	1.63	-----	-----
4. Insecticide *	1.29	1.29	-----	-----
5. Fertilizer *	18.15	18.15	-----	-----
6. Fuel ($/Gallon)= $0.95	7.99	7.99	-----	-----
7. Oil	1.20	1.20	-----	-----
8. Equip. repair	15.86	15.86	-----	-----
9. Custom Hire (Harvest Exp)	37.84	37.84	-----	-----
10. Interest (1/2 VC @ 15%)	7.10	4.26	-----	-----
TOTAL VARIABLE COSTS (Own Land)	101.72	96.03	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *	95.10	89.40	-----	-----
FIXED COSTS PER ACRE				
11. Real Estate Taxes (50c/$100 x 3)	12.00	12.00	-----	-----
12. Interest on Land	72.00	36.72	-----	-----
OR ($400/A x 3 x 6%)	(24% LT DEBT.12%i)			
13. Share Rt. WHT. (Returns x 33%)	33.27	33.27	-----	-----
Share Rt. SOR. (Returns x 33%)	30.61	30.61	-----	-----
14. Depreciation on Machinery	19.22	0.00	-----	-----
15. Interest on Machinery	21.94	7.24	-----	-----
16. Insurance, and Housing	2.96	2.96	-----	-----
TOTAL FIXED COSTS (Rent Land)	108.01	74.09	-----	-----
TOTAL FIXED COSTS (Owned Land)	128.12	58.92	-----	-----
TOTAL COSTS PER ACRE RENTED	203.10	163.49	-----	-----
TOTAL COSTS PER ACRE OWNED	229.84	154.95	-----	-----

	Wheat	Sorghum		Wht.	Sor.
YIELD Per Acre	30.37	40.16	(cwt.)	-----	-----
PRICE / Bushel	3.29	2.31	(4.12)	-----	-----
	-----	-----		-----	-----
RETURNS PER ACRE	99.92	92.77	192.69	-----	

	Total	Cash	(Your Farm) Total	(Your Farm) Cash
RETURNS OVER VARIABLE COSTS (AVE.)	95.40	101.10	-----	
RETURNS OVER TOTAL COSTS (RENTED)	-10.42	29.20	-----	
RETURNS OVER TOTAL COSTS (OWNED)	-37.16	37.74	-----	
ANNUAL NET RETURN PER ACRE (AVE.)	-19.24	32.01	-----	-----
NET RETURN TO MANAGEMENT	-12827	21343	-----	-----

Assumes Landlord paying 1/3 of herbicides (0.21), insecticides (0.43) and fertilizer (5.98) on rent land.

Table 5.6

ENTERPRISE BUDGET
Tribune

WHEAT & SORGHUM: Reduced-Till Wheat-Sorghum-Fallow (RTWSF)
YEAR I: Fallow/Plt. Wht. YEAR II: Harv. Wht. YEAR III: Plt./Harv. Sor

					(Your Farm)	
			Total	Cash	Total	Cash
VARIABLE COSTS PER ACRE						
1. Labor $6/Hr. x 0.531 Hours			3.19	0.69	-----	-----
2. Seed			6.19	6.19	-----	-----
3. Herbicide *			7.80	7.80	-----	-----
4. Insecticide *			1.29	1.29	-----	-----
5. Fertilizer *			18.15	18.15	-----	-----
6. Fuel ($/Gallon)= $0.95			4.76	4.76	-----	-----
7. Oil			0.67	0.67	-----	-----
8. Equipment Repair			14.38	14.38	-----	-----
9. Custom Hire (Harvest Exp)			42.87	42.87	-----	-----
10. Interest (1/2 VC @ 15%)			7.45	4.47	-----	-----
A.TOTAL VARIABLE COSTS (Own Land)			106.75	101.28	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *			97.76	92.29	-----	-----
FIXED COSTS PER ACRE						
11. R. Estate Taxes (50c/$100x3)			12.00	12.00	-----	-----
12. Interest on Land			72.00	36.72	-----	-----
OR ($400/A x 3 x 6%)			(24% LT DEBT,	24%i)		
13. Share Rt. WHT.(Ret. x 33%)			40.08	40.08	-----	-----
13. Share Rt. SOR.(Ret. x 33%)			40.39	40.39	-----	-----
14. Depreciation on Machinery			19.22	0.00	-----	-----
15. Interest on Machinery			21.94	7.24	-----	-----
16. Insurance, and Housing			2.96	2.96	-----	-----
B.TOTAL FIXED COSTS (Rent Land)			124.59	90.67	-----	-----
TOTAL FIXED COSTS (Owned Land)			128.12	58.92	-----	-----
C.TOTAL COSTS PER ACRE RENTED			222.35	182.96	-----	-----
TOTAL COSTS PER ACRE OWNED			234.87	160.20	-----	-----
D.YIELD Per Acre	Wheat		Sorghum		Wht.	Sor.
	36.92		52.98		-----	-----
E.PRICE / Bushel	3.29		2.31	4.12cwt	-----	-----
	-----		-----		-----	-----
F.RETURNS PER ACRE	121.47		122.38	243.85	-----	
G.RETURNS OVER VARIABLE COSTS (AVE.)			143.12	142.57	-----	-----
H.RETURNS OVER TOTAL COSTS (RENTED)			21.50	60.89	-----	-----
I.RETURNS OVER TOTAL COSTS (OWNED)			8.98	83.65	-----	-----
J.ANNUAL NET RETURNS PER ACRE (AVE.)			17.37	68.40	-----	-----
K.NET RETURNS TO MANAGEMENT			11580	45602	-----	-----

* Assumes Landlord paying 1/3 of herbicides (2.57), insecticides (0.43) and fertilizer (5.98), on rent land.

Table 5.7

ENTERPRISE BUDGET
Tribune

SORGHUM: Conventional Sorghum-Sorghum (CVSS)
Prepare Seedbed, Plant Sorhgum, Cultivate, Harvest Sorghum

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.424 Hours	0.066	2.54	1.46	-----	-----
2. Seed	0.056	2.19	2.19	-----	-----
3. Herbicide *	0.000	4.94	4.94	-----	-----
4. Insecticide *	0.000	1.29	1.29	-----	-----
5. Fertilizer *	0.182	7.05	7.05	-----	-----
6. Fuel ($/gallon)=$0.95	0.075	2.89	2.89	-----	-----
7. Oil	0.011	0.43	0.43	-----	-----
8. Equip. repair	0.098	3.79	3.79	-----	-----
9. Custom Hire (Harvest Exp)	0.495	19.18	19.18	-----	-----
10. Interest (1/2 VC @ 15%)	0.086	3.32	1.99	-----	-----
A. TOTAL VARIABLE COSTS (Own Land)	1.261	48.85	46.52		
TOTAL VARIABLE COSTS (Rent Land) *	1.147	44.46	42.14	-----	-----
FIXED COSTS PER ACRE					
12. Real Estate Taxes (50c/$100)	0.103	4.00	4.00	-----	-----
13. Interest on Land	0.619	24.00	12.24	-----	-----
OR ($400 x 6%)	(24% LT DEBT @ 12%i)				
14. Share Rent (Returns x 33%)	0.769	29.81	29.81	-----	-----
15. Depreciation on Machinery	0.206	7.99	0.00	-----	-----
16. Interest on Machinery	0.243	9.42	3.11	-----	-----
17. Insurance, and Housing	0.033	1.26	1.26	-----	-----
B. TOTAL FIXED COSTS (Rent Land)	1.251	48.48	34.18	-----	-----
TOTAL FIXED COSTS (Owned Land)	1.204	46.67	20.61	-----	-----
C. TOTAL COSTS PER ACRE RENTED	2.398	92.94	76.31	-----	-----
TOTAL COSTS PER ACRE OWNED	2.465	95.52	67.13	-----	-----
D. YIELD Per Acre			38.75	-----	
E. PRICE / Bushel	(cwt. 4.12)		$2.31	-----	
F. RETURNS PER ACRE			89.51	-----	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.16	43.60	47.38	-----	-----
H. RETURNS OVER TOTAL COSTS (RENTED)	-0.09	-3.43	13.20	-----	-----
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.15	-6.00	22.38	-----	-----
J. ANNUAL NET RETURNS PER AC. (AVE.)	-0.11	-4.28	16.23	-----	-----
K. NET RETURN TO MANAGEMENT		-8556	32461	-----	-----

* Assumes landlord paying 1/3 of herbicide (1.63), insecticide (0.43), and fertilizer (2.33) on rent land.

Table 5.8

ENTERPRISE BUDGET
Tribune

SORGHUM: Conservation Tillage Sorghum-Fallow (CTSF)
YEAR I: Fallow, YEAR II: Plant Sorghum and Harvest

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.599 Hours	0.056	3.60	1.11	-----	-----
2. Seed	0.034	2.19	2.19	-----	-----
3. Herbicide *	0.116	7.48	7.48	-----	-----
4. Insecticide *	0.020	1.29	1.29	-----	-----
5. Fertilizer *	0.172	11.10	11.10	-----	-----
6. Fuel ($/Gallon)=$0.95	0.066	4.29	4.29	-----	-----
7. Oil	0.010	0.64	0.64	-----	-----
8. Equipment repair	0.119	7.69	7.69	-----	-----
9. Custom Hire (Harvest Exp)	0.401	25.90	25.90	-----	-----
10. Interest (1/2 VC @ 15%)	0.072	4.63	2.78	-----	-----
A. TOTAL VARIABLE COSTS (Own Land)	1.065	68.80	64.47	-----	-----
TOTAL VARIABLE COSTS (Rent Land) *	0.968	62.57	58.24	-----	-----
FIXED COSTS PER ACRE					
11. Real Estate Taxes	0.124	8.00	8.00	-----	-----
12. Interest on Land	0.743	48.00	24.48	-----	-----
OR ($400/A x 2 x 6%)	(24% LT DEBT,		12%i)		
13. Share Rent (Returns x 33%)	0.769	49.70	49.70	-----	-----
14. Depreciation on Machinery	0.172	11.12	0.00	-----	-----
15. Interest on Machinery	0.201	13.00	4.29	-----	-----
16. Insurance, and Housing	0.027	1.77	1.77	-----	-----
B. TOTAL FIXED COSTS (Rent Land)	1.170	75.59	55.76	-----	-----
TOTAL FIXED COSTS (Owned Land)	1.267	81.89	38.54	-----	-----
C. TOTAL COSTS PER ACRE RENT LAND	2.138	138.16	114.00	-----	-----
TOTAL COSTS PER ACRE OWNED LAND	2.332	150.69	103.01	-----	-----
D. YIELD Per Acre			64.61	-----	
E. PRICE / Bushel	(cwt. 4.12)		$2.31	-----	
F. RETURNS PER ACRE			149.25	-----	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.31	84.62	91.01	-----	-----
H. RETURNS OVER TOTAL COSTS (RENTED)	0.17	11.09	35.25	-----	-----
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.02	-1.44	46.24	-----	-----
J. ANNUAL NET RETURN PER ACRE (AVE.)	0.11	6.96	38.88	-----	-----
K. NET RETURN TO MANAGEMENT		6956	38880	-----	-----

* Assumes Landlord paying 1/3 of herbicide (2.14), insecticide (0.43), and fertilizer (3.66) on rent land.

Table 5.9

Income, Returns, and Selected Costs by Cropping System.

INCOME & COSTS[2]	CROPPING SYSTEM[1]						
	RTWSF	CTSF	RTWF	CVSS	CVWSF	CVWF	CVWW
Gross Income	162565	149249	125744	179025	128457	103109	104030
Variable Costs	67150	64625	49498	91819	64855	47749	72186
Fixed Costs (Owned Land)	28471	27296	26860	31113	28471	26860	33033
Total Costs	150985	142293	120613	187581	141284	113814	156976
NET RETURNS	11580	6956	5131	-8556	-12827	-10705	-52946
Cash Income	45602	38880	34382	32461	21343	19048	-8941
Landlord Inc.[3] (Rented Land)	31770	28980	24343	33901	25449	20448	19993
Labor Cost	2125	3595	1597	5084	2991	2336	2704
Fuel/Oil Cost	3621	4932	3077	6656	6125	5260	5316
Fertilizer Cost	9425	8646	8646	10982	9425	8646	10982
Chemical Cost	4718	7587	4002	12458	1662	0	0
Repair Cost	9589	7690	4135	7572	10572	5457	9819
Depreciation	12813	11120	10590	15980	12813	10590	18620
Interest	14627	13000	12340	18840	14627	12340	21600

1 RTWSF: Reduced Tillage Wheat-Sorghum-Fallow
  CTSF: Conservation Tillage Sorghum-Fallow
  RTWF: Reduced Tillage Wheat-Fallow
  CVSS: Conventional Tillage Sorghum-Sorghum
  CVWSF: Conventionsl Tillage Whest-Sorghum-Fallow
  CVWF: Conventional Tillage Wheat-Fallow
  CVWW: Conventional Tillage Wheat-Wheat

2 Based on mean 11 year yields & prices with 1984 cost estimates

3 Based on Landlord receiving 1/3 of crop and paying 1/3 of yield increasing inputs. Represents gross income only.

Results by Cropping System

1) Reduced tillage wheat-sorghum-fallow (RTWSF) generated the highest average net return of $11,580. It produced the second highest gross and landlord income behind the CVSS system. RTWSF lowered labor and fuel costs by $3370, but had increased chemical costs of $3056 when compared with the CVWSF system. Depreciation and interest were the largest costs of all systems. The CVWSF system incurred $2223 more depreciation, and $2287 more interest than the benchmark CVWF system. The main reason for the higher income in reduced tillage systems is greater crop yields when compared to conventional systems.

2) Conservation sorghum-fallow (CTSF) generated the second highest net farm income of $6956, and the third best landlord income. The system has $931 more labor/fuel costs, $2233 more in repair costs than CVWF, because the sorghum planting, cultivating, and bedding equipment requires additional upkeep. In addition, CSSF requires $7587 more in chemicals than the CVWF system. Depreciation and interest are $1190 more than the CVWF system, but $3320 less than the CVWSF systems.

3) Reduced tillage wheat-fallow (RTWF) has the third largest net farm income of $5131, but only the fifth largest landlord income. The RTWF system has $2922 less fuel and labor costs, but required $4002 more chemicals than the CVWF system. Repair costs were also lower in the RTWF system. Depreciaton, interest, and fertilizer costs are the same in conventional and reduced tillage wheat-fallow ayatems. This occurs becauae the same equipment is used in producing these crops, and the nitrogen fertilizer rate is held constant.

4) The conventional sorghum-sorghum (CVSS) system produced the largest gross and landlord income, because of the fairly good yields occuring

on 2000 acres annually. However, this system also required the most total expenses resulting in an average return to management of -$8556. Reasons for this include large interest and depreciation on the additional 2WD machinery complement which is added to existing equipment in order to manage 2000 acres annually, along with high fuel, labor and chemical costs.

5) Conventional wheat-sorghum-fallow (CVWSF) produced an income of $-12827. Lower yields than the reduced tillage system are the reason for the low net income level, because total costs of CVWSF are $23706 less than RTWSF, mainly due to lower herbicide and share rent costs.

6) Conventional wheat-fallow (CVWF) is the predominant cropping system on the great plains, but did not produce very favorable results in this study with an average annual returns of -$10,705. This is $22,385 less than the leading RTWSF system.

7) The conventional wheat-wheat system resulted in the poorest net returna. Low annual yields combined with large depreciation and interest costs produce an average annual net farm income of -$52,946.

Cash income to the farm manager and landlord income is shown graphically in Figure 5.1. The cash returns generally follow net returns. Returns from highest to lowest are 1) RTWSF, 2) CTSF, 3) RTWF, 4) CVSS. 5) CVWSF, 6) CVWF, and 7) CVWW. This figure reveals the income potential for the farmer and landlord with the reduced tillage systems.

Total fixed costs for the owned land are shown in the first bar graph of each system in Figure 5.2. Only owned land costs are compared because with the rented land - part of the crop is shared with the landlord, and this amount charged to the cropping system as a fixed expense. Since this amount varies with yield it is misleading to compare rented land in this scenario. Fixed costs are reasonably close between systems, with continuous

Figure 5.1

Cash Farm Income and Landlord Income
by Cropping System

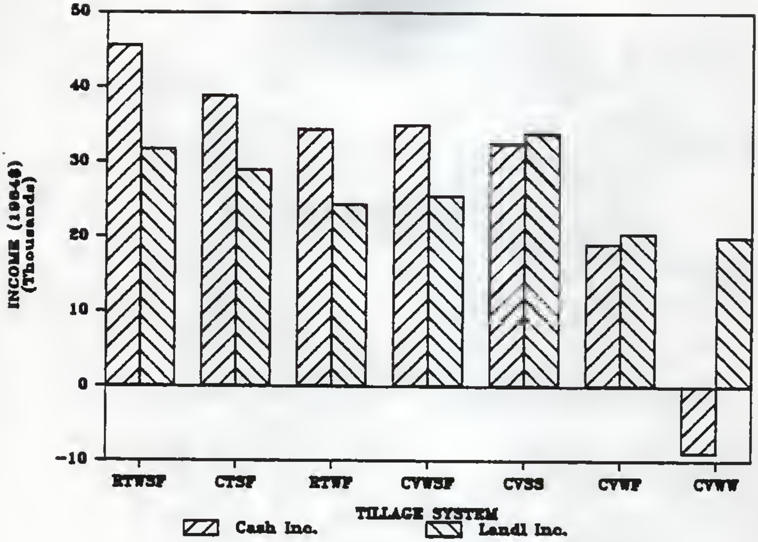
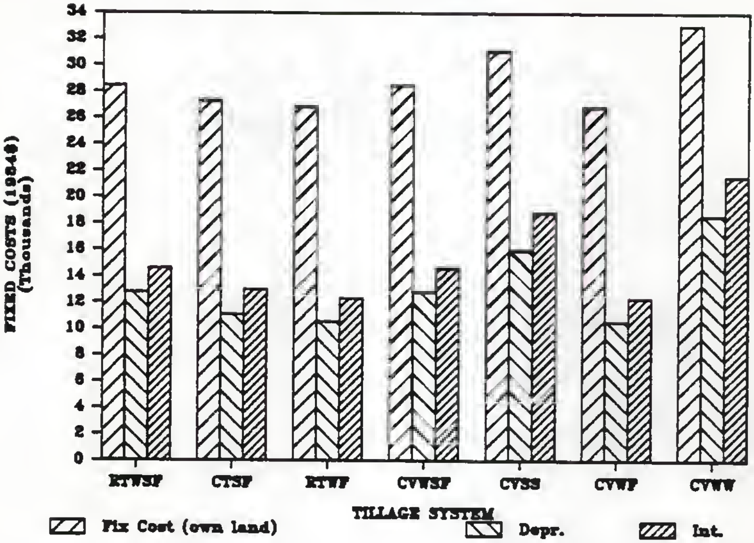


Figure 5.2

Fixed Costs, Depreciation, and Interest by Cropping System



wheat and sorghum systems having the largest costs mainly due to the additional equipment contained in these systems. The continuous systems are followed by the wheat-sorghum-fallow systems. The wheat-fallow system required the least fixed costs because less equipment was used when compaired to other systems. Interest and depreciation are represented in the second and third bar graphs of Figure 5.2. Interest was a larger total expense than depreciation, assumming a 15% interest rate, and straight line depreciation.

Total farm costs for selected inputs are compared in Figure 5.3. Total farm costs are shown in bar graphs for the inputs labor, fuel, fertilizer, chemicals, and repair. The CVSS and CVWW cropping systems required the most expense for fertilizer. Since the continuous systems cover all 2000 acres annually. they require large yearly inputs. In general, systems including sorghum required higher chemical expenditures than wheat systems only. The third largest expense of the cropping systems were repairs, followed by fuel and labor, which involve less than one-half of the other expenses in most systems. Labor requires the lowest expenditure because the large equipment complements cover the land in the cropping systems quickly to maintain the optimal requirements of the study.

Figure 5.4 contains a summary of returns and cost for the seven cropping systems. The first bar graph shows gross income. The next three bar graphs contain variable, fixed, and total costs. The last bar represents net returns to management. The CVSS has the highest gross income, but also contains the greatest total costs resulting in a negative net return. CVWF and CVWW had the lowest gross incomes generating negative returns to management. RTWSF, CTSF, and RTWF produced the largest gross

Figure 5.3

Total Farm Costs for Selected Inputs
by Cropping System

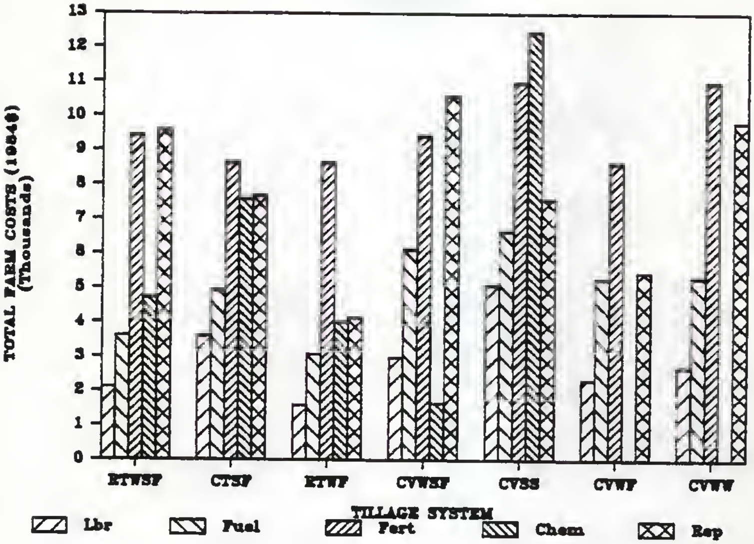
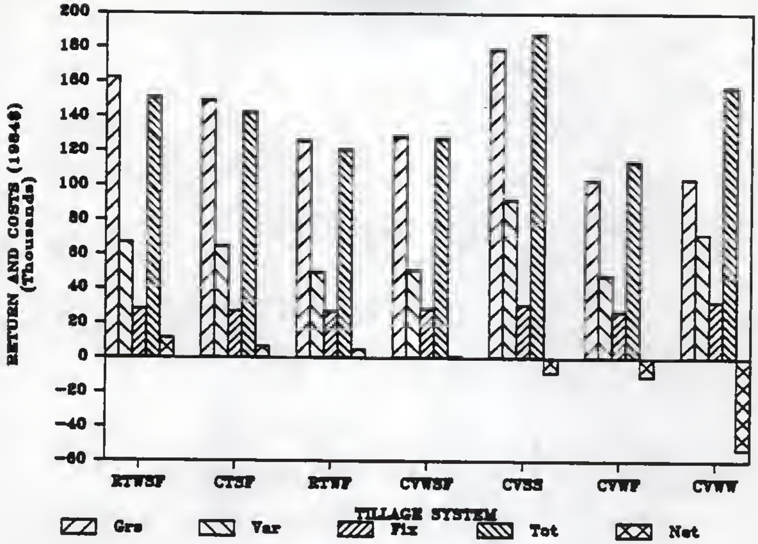


Figure 5.4

Returns and Costs
by Cropping System



returns, and the greatest net returns. However, it should be noted that the reduced tillage systems did not reduce total costs over conventional systems.

Risk Analysis

Webster defines risk as: 1) The possibility of loss, 2) something that creates or suggests a hazard or adverse chance. Knight (1921) formed two subclasses to describe lack-of-knowledge situations: risk and uncertainity. A farm manager was defined as facing risk in a production process when he was aware of all possible outcomes that could result from the process, and could attach a probability to each outcome. The manager was said to face uncertainty when he/she was unable to associate probabilities with the outcomes of the production process. In this study risk and uncertainty will be considered together. Roumasset (1977) divides risk into three types: 1) environmental risk (i.e. variable and irregular rainfall); 2) variance (i.e. variability of crop yields); and 3) the possibility that the dollar return from a decision will fall below a certain "disaster" point (i.e. the cost of innovation will not be covered).

This study is concerned with the possibilty of low net farm income. Risk originates largely from yield and price variability, which effects net returns. Yield variability may be due to weather cycles, insect and disease problems, etc. Price variability comes from economic supply and demand factors largely beyond the farm managers control.

This study will compare the yield, price, and net return variablilty for the seven cropping systems. Raw yield data by replication from the experiment plots at the Tribune Branch Experiment Station, and season average prices from the Kansas Crop and Livestock Reporting Service along with 1984 cost of production estimates were analyized to determine net return to management means, standard deviations, and coefficients of variation. (The coefficient of variation (C.V)., is calculated by dividing the standard deviation by the mean times 100).

Yield Variability Analysis

Table 5.10 contains the results of variability analysis. The RTWF system produced the highest average wheat yield of 38.22 bu/acre, 6.88 bu/acre more than the 31.34 average in the CVWF system. Wheat yields in the RTWSF system were 6.55 bushels per acre higher when compared to CVWSF. Grain sorghum production was also higher in the RTWSF system versus its conventional counterpart, with sorghum yields averaging 52.88 bu/acre in RTWSF and 40.16 in the CVWSF system. Sorghum has greater yield potential over wheat in reduced tillage systems, producing 12.82 more bushels per acre in this comparison. The CVSS system actually produced the highest annual yield per acre of all systems, averaging 38.75 bu/acre compared with 32.31 in the CTSF, and 19.11 in the RTWSF on an annual basis.

In addition to larger yields than conventional systems, the reduced tillage systems generally had lower variability of yields. The coefficient of variation (C.V.) will be used to compare wheat and sorghum yields, which have substantially different means. The RTWF system had the lowest C.V. of 30.60, compared with 39.80 for the CVWF system. However, the CVWW has the highest coefficient of variation of the wheat yields at 66.44. In systems including grain sorghum, conservation sorghum-fallow (CTSF) has the lowest C.V. of 43.07, followed by RTWSF with 47.08. CVWSF and CVSS had the highest coefficients of variation with 59.67, and 67.26, respectfully.

Table 5.10

Yield, Price, and Income Risk Analysis by Cropping System

	CROPPING SYSTEM[1]						
YIELDS[2]	CVWF	RTWF	CVWW	CVWSF	RTWSF	CTSF	CVSS
Wheat Mean	31.34	38.22	15.81	30.37	36.92	-	-
Std. Deviation	12.47	11.69	10.50	10.73	13.57	-	-
Coeff. Variation.	39.80	30.60	66.44	35.33	36.76	-	-
Sorghum Mean	-	-	-	40.16	52.98	64.61	38.75
Std. Deviation	-	-	-	27.01	24.94	27.82	23.12
Coeff. Variation.	-	-	-	67.26	47.08	43.07	59.67
PRICES[2]							
Wheat	3.29	3.29	3.29	3.29	3.29	-	-
Std. Deviation	.546	.546	.546	.546	.546	-	-
Coeff. Variation.	16.61	16.61	16.61	16.61	16.61	-	-
Sorghum	-	-	-	2.31	2.31	2.31	2.31
Std. Deviation	-	-	-	.414	.414	.414	.414
Coeff. Variation.	-	-	-	17.90	17.90	17.90	17.90
INCOME VARIABILITY ANALYSIS							
Mean Net Returns	-8786	6771	-49673	3638	11749	6885	-12726
Std. Dev. Returns	46134	43911	64765	53477	62683	72669	103265
Coeff. Variation[3] Per $ Exp. Income	-525	848 *****	-130	1469	533 ***	1055	-811

1 RTWSF: Reduced Tillage Wheat-Sorghum-Fallow
  RTWF: Reduced Tillage Wheat-Fallow
  CVSS: Conventional Tillage Sorghum-Sorghum
  CVWSF: Conventional Tillage Wheat-Sorghum-Fallow
  CTSF: Conservation Tillage Sorghum-Fallow
  CVWF: Conventional Tillage Wheat-Fallow
  CVWW: Conventional Tillage Wheat-Wheat

2 Based on 11 years yields and prices

3 Indicates a simple measure of risk. Lowest positive number indicates the least risk per dollar of expected income.

Price Variability Analysis

The sorghum systems generally yield more than wheat systems, but the grain produced is sold for less on the average. The mean price of wheat over the eleven year period 1973-1984. was $3.29 per bushel, with the sorghum price 98 cents lower at $2.31 /Bu. Comparing the sorghum price to wheat price reveals that the sorghum price has a slightly higher C.V. of 17.90 versus 16.61 for wheat.

Income Variability Analysis

Results show that the continuous sorghum system has the largest variability of income indicated by the standard deviation for 11 years of net income. CVSS is followed by the sorghum-fallow system, which generates the second highest net farm income. Reduced tillage wheat fallow has the lowest variability of income, and the third highest net farm income. Reduced tillage wheat-sorghum-fallow has the third largest variability of income, which is larger than RTWF, however RTWSF produces much greater net farm income.

An additional measure of risk used is the coefficient of variation. A decision maker might be willing to encounter slightly more risk if there is greater income potential. The coefficient of variation interpreted as risk per dollar of expected income is useful in comparing the results. The lowest positive number indicates the least risk per dollar of expected income. The analysis shows the RTWSF system with the lowest coefficient of variation at 533., followed by 848 for RTWF, 1055 for CSSF and 1469 in the CVWSF system. All other systems generated negative returns to management in this study.

Table 5.11 contains a listing of annual net returns by cropping system over the period 1973-1983. Results reveal that the reduced tillage

Table 5.11

Yearly Net Returns per Cropping System.

YEAR [2]	CROPPING SYSTEM [1]						
	RTWSF	CTSF	RTWF	CVWSF	CVSS	CVWF	CVWW
1973	24557	9362	2118	9362	-1764	839	11354
1974	621	-9579	32150	-9579	-84889	15917	-23826
1975	28408	18487	47488	18487	20846	6737	-67356
1976	-113190	-92043	-59438	-92043	-185724	-81017	-155496
1977	-61134	-55319	-52905	-55319	-55368	-46739	-91373
1978	43342	24126	14300	24126	64053	-29881	-72756
1979	1914	-44207	38815	-44207	-108299	10500	-57213
1980	-32291	29939	-47079	29939	164416	-61840	-50351
1981	97106	84708	26254	84708	126532	7693	-11337
1982	62762	-3370	-1657	-3370	-15817	-8961	-113284
1983	80975	77915	74443	77915	-63972	90106	85224
MEAN RETURN	11580	6956	5131	1178	-8556	-10705	-52946

1 RTWSF: Reduced Tillage Wheat-Sorghum-Fallow
  RTWF: Reduced Tillage Wheat-Fallow
  CVSS: Conventional Tillage Sorghum-Sorghum
  CVWSF: Conventional Tillage Wheat-Sorghum-Fallow
  CTSF: Conservation Tillage Sorghum-Fallow
  CVWF: Conventional Tillage Wheat-Fallow
  CVWW: Conventional Tillage Wheat-Wheat

2 Based on mean replication yields and season average prices with 1984 cost of production estimates.

systems produce fewer years of negative incomes when compared to their conventional systems. For example, the RTWSF system has negative incomes only 3 out of 11 years. The benchmark CVWF system has negative income 5 years, CVSS 7 years, and CVWW 9 out of the 11 years of data in this study.

Figure 5.5 provides a graphical overview of Table 5.11. The bar graphs show the results of each cropping system during the eleven year period. Cropping systems fron right to left in each year are 1) RTWSF, 2) RTWF, 3) CVWSF, 4) CTSF, 5) CVWF, 6) CVSS, and 7) CVWW. The RTWF system had the most consistent returns with less variation, as shown in 1976 and 1977 which were drier years than average. In these years this reduced tillage practice did not have as large of negative returns, when compared to CVWF. The CVSS system has the largest variability of returns. An example of this is shown in 1980 when the continuous sorghum system generated the greatest returns, but four years earlier it had the poorest results.

Cash Flow Requirements of Selected Systems

A computer program entitled Kansas Financial Analysis and Resource Management, <K-FARM>, was used in cash flow analysis (Barnaby, 1984). The assumptions used in the cash flow analysis are listed below.

1. Cash flow for all crop and fallow scenarios on a calendar year.

2. Annual payments on the 4WD and 2WD tractors occur in October. Equipment assumed financed over 5 years at 15% interest. Principle payment = $20,681. Interest = $15,512.

3. Includes land payment on 158 acres purchased in 1977 for $400 per acre. Payment is amortized over 25 years at 12% interest. Annual principle payment = $948, interest = $7212 in April.

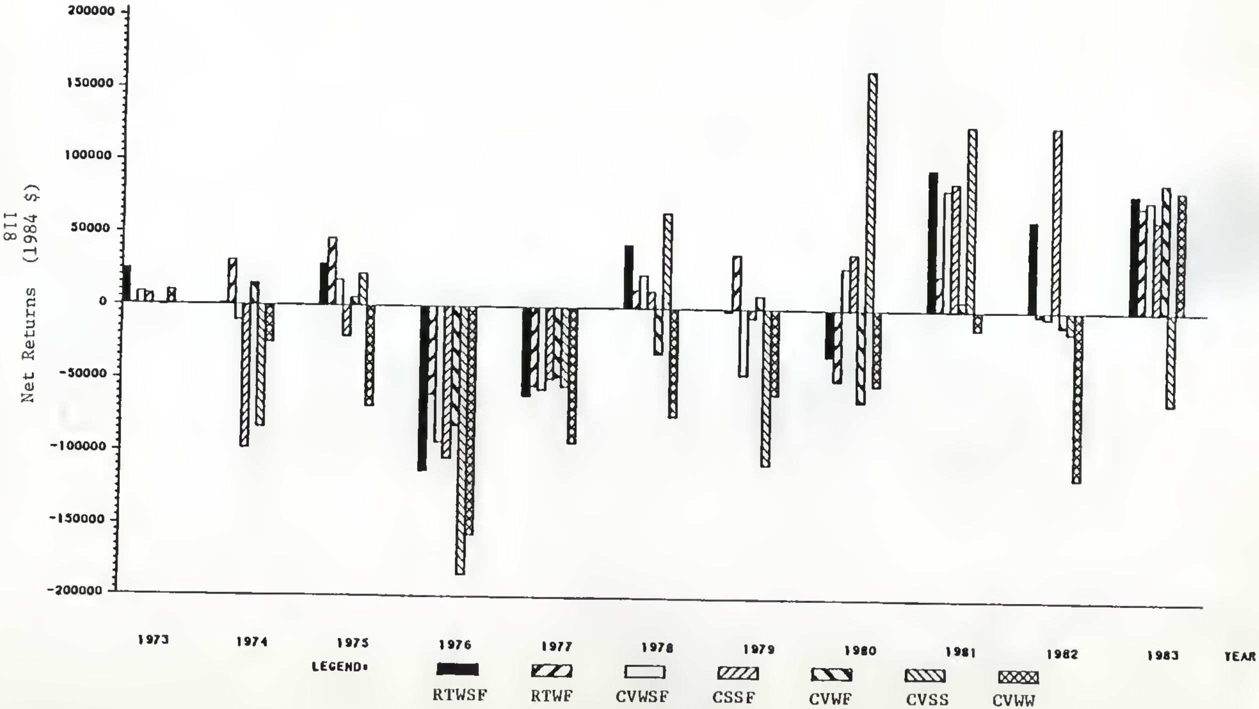
4. Annual real estate taxes ($2.00 /Ac) paid during June and Dec.

5. Sorghum planter is added to systems containing sorghum. Financed over 5 years, 15% annual payment = $5426, interest = $4070 in Nov.

6. Average family living expenses of $1500 per month added to operating line. (From SW Kansas Farm Management Data).

Figure 5.5

Annual Net Returns for 1973-1983, by Cropping System



Tables 5.12 and 5.13 contain the cash inflows, outflows, operating balance, and interest charges for RTWSF, CTSF, RTWF, and the benchmark CVWF systems. Cash inflows occur in July for the wheat crop, and October for grain sorghum. It was assumed that the case farm would receive the season average price. No marketing plan other than cash sales was used in this study. Each cropping system begins with a zero balance on January 1. The RTWSF received the largest cash inflow of the systems analyzed grossing $126,833, after share rent was paid to the landlord. This was followed by CSSF with $116,396, $98,065 for RTWF, and CVWF with $80,410. Conservation sorghum fallow required the largest cash outflow, because more tillage operations are required in this system in the fall of the second fallow period. In addition, sorghum equipment operation generally requires slightly more repair and labor than equipment in wheat systems. The reduced tillage systems saved labor, fuel, and repairs, but had higher chemical costs than their conventional counterparts. None of the systems met all the cash flow requirments when family living expenses were included. However. the reduced tillage wheat sorghum fallow covered the cash expense of the aditional sorghum planting equipment, and carried over the lowest operating balance of $11,950 to the following year. Interest on the operating note for the year was $1275, compared with $3443 in the CSSF system, but only $120 in the RTWF rotation. This system generates a positive cash flow following wheat harvest which reduces the total interest payment. The CVWF carries over the largest operating balance to the next year of almost $30,000.

The CSSF required the largest operating balance during the year of $56,070. This is due to the increased costs during the fallow period, and the delayed cash inflow from sorghum harvest, three months after all of the

Table 5.12

Cash Inflow, Outflow and Operating Line for RTWSF Versus CTSF

1. Reduced Tillage Wheat-Sorghum-Fallow (RTWSF)

CASN FLOW BUOGET	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL CASH INFLOW	0	0	0	0	0	0	63,177	0	0	63,656	0	0	126,833
TOTAL CASN OUTFLOW	1,500	1,500	6,220	14,371	3,416	21,358	10,666	3,943	5,768	18,734	47,200	2,832	137,508
NET CASNFLOW	-1,500	-1,500	-6,220	-14,371	-3,416	-21,358	52,511	-3,943	-5,768	44,922	-47,200	-2,832	-10,675
INTEREST ON OPER. LOAN	18	37	115	297	343	614	-34	14	87	-473	110	147	1,275
PROJ. LOAN&INTEREST	1,518	3,055	9,390	24,058	27,817	49,789	-2,756	1,201	7,056	-38,339	8,971	11,950	11,950

2. Conservation Tillage Sorghum-Fallow

CASN FLOW BUOGET	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL CASH INFLOW	0	0	0	0	0	0	0	0	0	116,396	0	0	116,396
TOTAL CASN OUTFLOW	1,500	1,500	10,156	11,221	5,127	12,579	5,363	4,401	1,500	30,090	44,000	2,832	130,269
NET CASHFLOW	-1,500	-1,500	-10,156	-11,221	-5,127	-12,579	-5,363	-4,401	-1,500	86,306	-44,000	-2,832	-13,873
INTEREST ON OPER. LOAN	18	37	165	307	375	537	611	673	700	-369	176	213	3,443
PROJ. LOAN&INTEREST	1,518	3,055	13,376	24,904	30,406	43,522	49,496	54,570	56,770	-29,905	14,271	17,316	17,316

Table 5.13

Cash Inflow, Outflow, and Operating Line for RTWF Versus CVWF.

3. Reduced Tillage Wheat-Fallow (RTWF)

CASH FLOW BUDGET	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL CASH INFLOW	0	0	0	0	0	0	98,065	0	0	0	0	0	98,065
TOTAL CASH OUTFLOW	1,500	1,500	10,156	9,651	1,500	24,717	8,601	3,495	7,250	3,140	37,700	2,832	112,042
NET CASHFLOW	-1,500	-1,500	-10,156	-9,651	-1,500	-24,717	89,464	-3,495	-7,250	-3,140	-37,700	-2,832	-13,977
INTEREST ON OPER. LOAN	18	37	165	287	310	623	-487	-449	-364	-330	136	174	120
PROJ. LOAN&INTEREST	1,518	3,055	13,376	23,314	25,124	50,464	-39,487	-36,441	-29,555	-26,745	11,091	14,097	14,097

4. Conventional Tillage Wheat-Fallow (CVWF)

CASH FLOW BUDGET	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL CASH INFLOW	0	0	0	0	0	0	80,410	0	0	0	0	0	80,410
TOTAL CASH OUTFLOW	1,500	1,500	10,156	9,651	3,270	22,837	4,413	2,975	8,300	4,040	37,700	2,832	109,174
NET CASHFLOW	-1,500	-1,500	-10,156	-9,651	-3,270	-22,837	75,997	-2,975	-8,300	-4,040	-37,700	-2,832	-28,764
INTEREST ON OPER. LOAN	18	37	165	287	332	621	-320	-287	-186	-138	330	370	1,229
PROJ. LOAN&INTEREST	1,518	3,055	13,376	23,314	26,916	50,374	-25,943	-23,255	-15,141	-11,239	26,791	29,993	29,993

other systems reduced the operating balance as a result of wheat harvest income. The remaining three systems required total operating balances within $666 of each other. RTWF required total credit of $49,841, CVWF used $49.753 and $49,175 was needed in the RTWSF system to cover financing needs. Therefore, these results show that there is no additional need for larger operating balances in the reduced tillage systems.

Chapter Six

SUMMARY AND CONCLUSIONS

Introduction

Nationwide there is a greal deal of interest in the conservation of soil and water resources. Practically every farm publication has an article on some facet of conservation tillage including reduced and no-till farming practices. A recent pamphlet published by the Chevron Chemical Company stated that "Conservation Tillage can be used to save Soil, Toil, and Oil in the 80s." While this study did not analyze soil erosion of the cropping systems, the reduced tillage systems will leave more residue on the soil surface, thus reducing soil loss from wind and water erosion, when compared with conventional cropping systems. It is very difficult to estimate the long term effects of lower erosion, but it is a definite "plus" for the reduced tillage systems.

It has been established that herbicide use can reduce the number of tillage operations in cropping systems. However, farm managers faced with declining net farm incomes, must be convinced that a specific cropping system has the potential to increase income, before widespread adoption will occur. Individuals will respond to economic incentives. Therefore, viable economic analysis that is applicable to existing farms is needed to aid in sound management decisions.

These conditions lead to the objective of this study, which is to analyze alternative conservation and reduced tillage systems, comparing their income potential and variability to a existing conventional wheat-fallow system. To pursue this objective, a representative 2000 acre "case" farm was established. The study assumed that farm managers could duplicate yields from cropping systems being studied at the Tribune, KS Experiment Station when similar input recommendations and management practices are followed. Input levels were identified by Agronomists, and Branch Experiment Station Personnel.

An equipment complement was selected to meet the optimal tillage and planting requirements of a benchmark conventional wheat-fallow system. When adopting an alternative cropping system, additional equipment is added to meet the requirements of that system.

From this scenario, variable and fixed costs were estimated in an enterprise budget format. Total costs were subtracted from yield and price data to obtain net farm income. Variability of yield, price, and income were analyzed in SAS, and the cash flow requirements of selected systems were analyzed on the K-FARM Program.

Results and Conclusions

Enterprise budget analysis reveals that reduced and conservation tillage systems increased yields over conventional systems, and generated higher net farm incomes, even though some of the reduced tillage systems had higher costs due to greater input requirements and additional machinery needs. Systems containing sorghum produced higher incomes, but also resulted in greater variability of income when compared to wheat only systems. This finding is not really new, since sorghum production is generally considered more 'risky' in Western Kansas, and other areas of the Great Plains. This fact is one of the prime reasons for using a measure of risk in the evaluation of alternative cropping systems.

When consideration was given to variability of income, the reduced tillage wheat-fallow had the lowest potential variability of income. Therefore, individuals who are risk adverse would prefer this system over others. However. when the coefficient of variation per dollar of expected income was considered, the reduced till wheat-sorghum-fallow system was the preferred system. followed by the reduced till wheat-fallow, and conservation sorghum-fallow systems. In comparision of RTWSF and RTWF, the higher expected net farm income of the RTWSF outweighs the increased income variability associated with it. The total operating balance needed for the RTWSF is slightly lower than the RTWF system, but higher in the CSSF system. The RTWF generates a positive cash flow following wheat harvest which lowers the interest paid on the operating line. However. this system carries over a larger balance to the following year. The RTWSF system has higher input and machinery expenses throughout the year which results a larger interest payment on the operating line. But this system generates enough additional income on the average to reduce the balance carried into the following year, versus the RTWF system. The conventional wheat-fallow system is forced to carry over twice the operating balance when compared to reduce tillage systems.

Limitations of Study

The heart of the analysis revolves around a representative "case" farm which actually does not exist. A limitation of using the case farm approach is that it relies heavily on assumptions about farm size, and its corresponding equipment complement. Obtaining realistic optimal tillage and planting constraints, which may change the equipment size and costs, is very difficult. In this study, slightly more horsepower was selected than may be required during many of the years. In addition, finding reliable equipment prices, allocating their fixed costs, and defining a repurchase plan could possibly be improved upon. Farmers that have better means of obtaining and maintaining equipmment may be able to lower costs in conservation tillage systems.

The results of the study are very sensitive to herbicide combinations, since specific herbicides recommendations will vary from location to location. Care must be taken in applying results from the "case" farm to actual farms.

Concern has been expressed that large fields may produce yields different from test plot results. Certainly, increased knowledge of herbicides and better management practices are needed when a farm manager adopts a totally different cropping system.

Future Research Needs

The results and limitations of this study point to several additional research needs. Better knowledge of optimal tillage and planting constraints might lead to more realistic equipment complements. Sensitivity analysis of labor rates, fuel prices, interest rate changes, along with yield and price changes would add valuable insight to the study. Risk analysis could be expanded upon by adding different crop insurance levels and observing their effect on income. Interaction with government commodity programs would aid farm managers in their decision process. Long-term erosion consequences and the corresponding value added to cropping systems would most likely aid in the adoption of conservation tillage practices.

APPENDICES

Appendix A

This appendix contains the results of the equipment complement selection spreadsheets (Schrock, 1976).

Critical time periods for the conventional wheat-fallow system in this study were June tillage operations, and September planting. A 221 power take-off horsepower (PTO H.P.) and 190 PTO H.P. tractor are needed to complete optimal field operations in 85% of the years, with ten hour days. However, if 11 hour days are worked during planting a 172 H.P. is selected. (Tables A.1, A.2). The continous wheat system requires two 230 H.P. tractors, and one 166 H.P. tractor. Therefore, for comparision ease the base case farm will have one 234 H.P. four wheel drive tractor and one 184 H.P. two wheel drive tractor with cooresponding tillage implements as the benchmark equipment complement. (Horsepower figures are the average of four available brands.) Slightly smaller tractors are capable of completing the sorghum planting operations, (Table A.6) but the larger tractors were used in the study to keep costs consistant when comparing one system to the other.

Table A.1

MACHINERY SELECTION
Work Sheet
(CVWF)

1. Identify the Critical Job

Description V-BLADE TILLAGE		4WD
Amount	600	Acres

2. Estimate the Time Available

Desired Period JUNE 1-7	7	DAYS
Percentage of Time Available for Work -	40%	
Available Working Daya	2.8	Days
Hours per Day	10	Hrs.

Total Running Time	28	Hra.

3. Size the Machinery to do the Job

Field Capacity Needed

600 Acrea / 28 Hra =	21.4	A/Hr
Speed	5.5	MPH
Field Efficiency	80.0	%

Required Width

$$\text{Width} = \frac{\text{Field Capacity} * 8.25}{\text{Speed} * \text{Field Eff.}}$$

$$W = \frac{21.4 * 8.25}{5.5 \quad 80} = 40.2 \text{ Feet}$$

4. Estimate Power Requirements

Required Width	40.2	Feet
Power Required (PTOHP/FT).	5.5	H/ft

Required Tractor Horsepower	221	HP

Table A.2

MACHINERY SELECTION
Work Sheet
(CVWF)

1. Identify the Critical Job
   Description PLANT WHEAT 2WD
   Amount . . . . 1000 Acres

2. Estimate the Time Available
   Desired Period SEPT 10-20 10 DAYS
   Percentage of Time Available for Work - 60%
   Available Working Days . . . . 6 Days
   Hours per Day . . . . 11 Hrs.

   Total Running Time . . . . 66 Hrs.

3. Size the Machinery to do the Job
   Field Capacity Needed
   1000 Acres / 66 Hrs = 15.2 A/Hr
   Speed . . . . 4.25 MPH
   Field Efficiency . . . . 72.5 %
   Required Width

$$\text{Width} = \frac{\text{Field Capacity} * 8.25}{\text{Speed} * \text{Field Eff.}}$$

$$W = \frac{15.2 * 8.25}{4.25 \quad 72.5} = 40.6 \text{ Feet}$$

4. Estimate Power Requirements
   Required Width . . . . 40.6 Feet

Table A.3

MACHINERY SELECTION
Work Sheet
(CVWF)

1. Identify the Critical Job
   Deacription   PLANT WHEAT   2WD
   Amount . . . . 1000 Acres

2. Estimate the Time Available
   Desired Period   SEPT 10-20   10 DAYS
   Percentage of Time Available for Work - 60%
   Available Working Days . . . .   6 Days
   Houra per Day . . . .   11 Hrs.

   Total Running Time . . . .   66 Hrs.

3. Size the Machinery to do the Job
   Field Capacity Needed
   1000 Acres / 66 Hrs = 15.2 A/Hr
   Speed . . . . 4.25 MPH
   Field Efficiency . . . . 72.5 %
   Required Width

$$\text{Width} = \frac{\text{Field Capacity} * 8.25}{\text{Speed} * \text{Field Eff.}}$$

$$W = \frac{15.2 * 8.25}{4.25 \quad 72.5} = 40.6 \text{ Feet}$$

4. Estimate Power Requirements
   Required Width . . . . 40.6 Feet
   Power Required (PTOHP/FT). . . . . 4.25 H/ft

   Required Tractor Horaepower . . . . 172 HP

Table A.4

MACHINERY SELECTION
Work Sheet
(CVWW)

1. Identify the Critical Job

Description	DISK TILLAGE		4WD
Amount		725	Acres

2. Estimate the Time Available

Desired Period	AUG 1-7	7	DAYS
Percentage of Time Available for Work -		53%	
Available Working Days		3.71	Days
Hours per Day		12	Hrs.

Total Running Time		44.5	Hrs.

3. Size the Machinery to do the Job

Field Capacity Needed

725 Acrea / 44.5 Hrs =	16.3	A/Hr
Speed	5.25	MPH
Field Efficiency	83.5	%

Required Width

$$\text{Width} = \frac{\text{Field Capacity} * 8.25}{\text{Speed} * \text{Field Eff.}}$$

$$W = \frac{16.3 * 8.25}{5.25 \quad 83.5} = 30.6 \text{ Feet}$$

4. Estimate Power Requirements

Required Width	30.6	Feet
Power Required (PTOHP/FT).	7.5	H/ft

Required Tractor Horsepower	230	HP

Table A.5

MACHINERY SELECTION
Work Sheet
(CVWW)

```
1.  Identify the Critical Job
        Description     DISK TILLAGE                4WD
        Amount . . . . . . . . . . . . . . . . 550  Acres

2.  Estimate the Time Available
        Desired Period     AUG 1-7                7  DAYS
        Percentage of Time Available for Work -   53%
        Available Working Days . . . . . . . 3.71  Days
        Hours per Day  . . . . . . . . . . .   11  Hrs.
                                              ---
        Total Running Time . . . . . . . . . 40.8  Hrs.

3. Size the Machinery to do the Job
        Field Capacity Needed
                  550  Acres  / 40.8 Hrs = 13.5  A/Hr
                 Speed . . . . . . . . . . . 5.25  MPH
                 Field Efficiency  . . . . . 83.5  %

        Required Width
                         Field Capacity * 8.25
                 Width = --------------------
                          Speed * Field Eff.

                               13.5 *8.25
                         W =   --------- =25.4  Feet
                               5.25  83.5

4. Estimate Power Requirements
        Required Width . . . . . . . . . . . 25.4  Feet
        Power Required (PTOHP/FT). . . . . .  7.5  H/ft
                                             -----
        Required Tractor Horsepower . . . . . 190   HP
```

Table A.6

MACHINERY SELECTION
Work Sheet
(CTSF)

1. Identify the Critical Job

Description	PLANT SORGHUM		2WD
Amount		1000	Acres

2. Estimate the Time Available

Desired Period	MAY 15-JUNE 5	20	DAYS
Percentage of Time Available for Work -			40%
Available Working Days		8	Days
Hours per Day		10	Hrs.

Total Running Time		80	Hrs.

3. Size the Machinery to do the Job

Field Capacity Needed

1000 Acres / 80 Hrs =	12.5	A/Hr
Speed	4.25	MPH
Field Efficiency	67.5	%

Required Width

$$\text{Width} = \frac{\text{Field Capacity} * 8.25}{\text{Speed} * \text{Field Eff.}}$$

$$W = \frac{12.5 * 8.25}{4.25 \quad 67.5} = 35.9 \text{ Feet}$$

4. Estimate Power Requirements

Required Width	35.9	Feet
Power Required (PTOHP/FT).	4.25	H/ft

Required Tractor Horsepower	153	HP

Appendix B

This appendix documents the prices used in the analysis. Tractor and implement list prices were obtained from area dealers, and equipment hotline (1984) for several major brands. Input prices were obatained from local suppliers (Thompson 1984). Crop prices are the season average for the west central district crop reporting district of Kansas (Johnson 1984).

Table B.1

Equipment Prices

1. 4WD Tractor, 234 H.P.	$99,600
2. 2WD Tractor, 184 H.P.	$64,100
3. Disk, 27 feet	$17,300
4. Disk, 21 feet	$12,200
5. V-Blade, 42 feet	$29.900
6. V-Blade, 30 feet	$23,400
7. Rodweeder, 48 feet	$13,500
8. Rodweeder, 36 feet	$8,800
9. Cultivator, 30 feet	$11,500
10. Rolling cultivator, 30 ft.	$13,800
11. Bedding cultivator, 30 ft.	$5,000
12. Planter, 30 feet	$25,600
13. Hoe drill. 40 feet	$35,200
14. Hoe drill. 50 feet	$52.700

Table B.2

Input Costs

Product	Average Cost	Cost/unit
1. Ammonium Nitrate	$150/ton	$0.27 /lb N
2. Atriazine	$11.50/gal.	$2.85 /lb
3. 2.4-D (6LVE)	$15.50/gal	$3.88 /lb
4. Parathion	$4.31/lb	$4.31 /lb

Table B.3

Crop Prices
(Dollars per Bushel)
Season Average, Kansas West Central Distrct

Year	Wheat	Sorghum
1973	$3.55	$2.19
1974	$3.99	$3.01
1975	$3.39	$2.27
1976	$2.56	$1.80
1977	$2.17	$1.73
1978	$2.80	$1.98
1979	$3.62	$2.13
1980	$3.67	$2.80
1981	$3.61	$2.24
1982	$3.46	$2.26
1983	$3.40	$2.67

Appendix C

This appendix contains a sample run of the AGNET MACHINE program for the 27 foot disk used in the conventional wheat-fallow cropping system. (Bitney. 1984)

AGNET MACHINE Program
(Sample Run)

This is the machinery cost estimation program used for determining field machine costs. This program can be used to estimate a custom rate, compare costs between machines that can do the same job, estimate a lease rate using fixed costs only, and estimate costs of different field operations.

General Assumptions of Machine Program
1-Field efficiency is the efficency of accomplishing the field operation. Would be less than 10% due to turning, overlap, adjustments of machine in the field, refilling seed boxes, etc.
2-Rate (acres/hour) is based on field efficiency (%), speed (mph), and size of machine (width in feet) calculated as follows:
rate = (size x speed x field efficiency) / 8.25
3-Labor factor is a factor to include the additional labor beyond the actual field operation. This would include preparing the machine for the season, travel time to and from the field, etc.
4-Labor & misc costs in all cases are summarized as a part of the implement operating cost.
5-Assumes straight line depriciation based on maximum wear out life.
6-Does not include investment credit or income tax savings.

Assumptions for Self-Propelled Operations
1-Fuel and oil costs become part of the implement operating cost.

Assumptions on Multi-Machine Operations
1-Multiple operations are those where two or more implements are pulled by a tractor, such as a tandum disc and a spike tooth harrow.
2-If different speeds are entered for different machines, the slowest speed is used for all calculations.
3-The same is true for field efficiency where the worst efficiency is used.

For reference see Nebguide G75-208 "Cost Estimation-Field Operations" by Robert E. Perry.

For questions or comments contact:

Larry Bitney, 223 Filley Hall, UNL, Lincoln, NE 68583 (402) 472-2047

```
 1 Machine No.                                    115.   TANDEM DISC
  2 Size (ft)                                      27.00
  3 Soeed (mph)                                     5.25
  4 Field Efficiency (%)                           83.50
  5 Machine List Price                          17300.00
  6 Machine Annual Use (acres)                    500.00
  7 Rate (acres/hr)                                14.35
  8 Labor ($/hr)                                    5.00
  9 Misc Costs ($/acre)                             0.0
 10 Tractor                                     234.HP 4WD-WFCV
 11 Tractor List Price                          99600.00
 12 Fuel Consumption (gals/hr)                     10.25
 13 Fuel Cost ($/gal)                               1.10
 14 Tractor Annual Use (hrs)                      196.00
 15 Machine Annual Ownership Costs (% of list)     12.85
 16 Tractor Annual Ownership Costs (% of list)     11.65
 17 Machine Annual Repair Costs (% of list)         4.10
 18 Tractor Annual Repair Costs (% of list)         4.50
 19 Oil Factor (% of fuel cost)                    10.00
 20 Labor Factor (overhead)                         1.20
 21 Interest Rate on Machinery Investment           7.50


LIST, CHANGE, RUN, RESTART, or STOP?
.                          FIXED COSTS                                      $/HR    $/AC

Ownership Cost/Hour
(includes depr., interest, taxes, insurance & housing)
 Implement:
  List Price $  17300. X 12.85% Cost Factor /   35. hrs/yr     63.79   4.45
 Tractor:
  List Price $  99600. X 11.65% Cost Factor /  196. hrs/yr     59.20   4.13
                                                               -----   -----
Total Fixed Costs                                             122.99   8.57

                          OPERATING COSTS

Repair Cost Hou
 Implement:
  List Price $ 17300. X  4.10% Cost Factor /   35. hrs/yr      20.35   1.42
 Tractor:
  List Price $ 99600. X  4.50% Cost Factor /  196. hrs/yr      22.87   1.59

Fuel Cost/hr: 10.25 gal/hr X 1.10 price $/gal                  11.27   0.79

Oil/hr: 11.27 Fuel Cost($/hr) X 10.00 % Oil Factor              1.13   0.08

Labor:  5.00 $/hr X  1.20 Labor Factor                          6.00   0.42

Misc Costs:   0.0  Misc Costs/ac X  14.35 ac/hr                 0.0    0.0
                                                               -----   -----
Total Operating Costs                                          61.62   4.30

                          COST SUMMARY
TANDEM DISC                 List $  17300.   500. Acres/Yr 14.35 Acres/Hr
4WD-WFCV                    List $  99600.   196. Hours/Yr
```

	* * * * *	$/HOUR	* * * * *		* * * * *	$/ACRE	* * * * *	
	LABOR	TRACTOR	IMPLEMENT	TOTAL	LABOR	TRACTOR	IMPLEMENT	TOTAL
FIXED	0.0	59.20	63.79	122.99	0.0	4.13	4.45	8.57
OPERATING	6.00	35.27	20.35	61.62	0.42	2.46	1.42	4.30
TOTAL	6.00	94.47	84.14	184.61	0.42	6.58	5.86	12.87

```
help
Do you want a list of machine codes?
.help
Do you want a list of machine codes?
.n

enter machine no., size (width in ft), speed in mph, list price,
total annual use in acres/year, and misc costs in dollars per acre.
Misc costs include supplies, twine, seed, etc.  When 0 for
speed is entered, the program will choose a value for you.

EXAMPLE:  115 18 0 3200 1680 0

Enter (1)Machine  (2)Size    (3)Speed  (4)List   (5)Annual    (6)Misc Cost
         Number      width/ft   (mph)     Price    Use(acres)   ($/acre)
.14400 42 5.5 29900 2500 0

Is this a SINGLE, MULTIPLE or SELF-PROPELLED operation?
.

For the tractor enter:
(1)Horse- (2)Fuel  (3)Fuel  (4)Fuel (5)Total  (6)Labor  (7)List (8)Model
   power     Use      Price    Type    Annual    Cost        Price   Name
             gal/hr   $/gal    code    Use (hr)  $/hr
.help

Enter the following information for each tractor that will be used

Horsepower - PTO horsepower rating
Fuel Use   - Gallons of fuel used per hour.  If you don't know,
             enter a zero and the program will calculate average fuel
             consumption for you.  Some suggested examples are:

                                           PTO HORSEPOWER
                                     50   70  100  130  160  200   250
             Gallons/Hour (gasoline): 3.0  4.2  6.0
             Gallons/Hour (diesel)  : 2.2  3.1  4.4  5.7  7.0  8.8  11.0

Fuel Price - Price of fuel in dollars/gallon
Fuel Type Code -  1=diesel, 2=gasoline
Total Annual Use (hr) - Engine hours of use yearly
             (for rented tractors, enter hours of use for this crop only)
Labor Cost - Dollars per hour
List Price - Cost of comparable new equipment (you may enter
             a zero for list price on rented tractors)
Model Name - Identification name or number (up to 12 characters)

EXAMPLE:  94 5.0 1.25 1 450 1 22000 JD4020

For the tractor enter:
(1)Horse- (2)Fuel  (3)Fuel  (4)Fuel (5)Total  (6)Labor  (7)List (8)model
   power     Use      Price    Type    Annual    Cost        Price   Name
             gal/hr   $/gal    code    Use (hr)  $/hr
.234 0 1.1 1 196 5 99600 4wd-wfcv

LIST, CHANGE, RUN, RESTART, or STOP?
.
```

Appendix D

This appendix contains the depreciation schedule for the conventional wheat-fallow system. The remaining six systems schedules were constructed in a simular manner.

Table D.1

DEPRECIATION SCHEDULE FOR CONVENTIONAL WHEAT- FALLOW (WF.CV)

184 HP 2WD Trsctor, Conventional Wheat-Fallow (WF.cv) 2690 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Descriptor	184 HP 2WD	Depreciable Value	$40491.58
List Price	$64100.00	Deprec. Coefficient	10
Discount	0.15		
Beg Index	136	Depreciation	$2636.00
End Index	183	Interest	$3036.87
Interest Rate	0.15	Insurance	$404.92
Life (Yrs)	10		-------
Life (Hrs)	6000	Total	$6077.79
Salvsge Value	$14131.56		
An. Hrs Used	166	Cost Per Hour	$36.61
Insurance %	0.01	Cost Per Acre	$2.26

234 HP 4WD Tractor, Conventional Wheat-Fallow (WF.cv) 4560 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Descriptor	234 HP 4WD	Deprecisble Value	$62916.72
List Price	$99600.00	Deprec. Coefficient	10
Discount	0.15		
Beg Index	136	Depreciation	$4095.88
End Index	183	Interest	$4718.75
Interest Rate	0.15	Insurance	$629.17
Life (Yrs)	10		-------
Life (Hrs)	6000	Totsl	$9443.80
Salvsge Vslue	$21957.94		
An. Hrs Used	196	Cost Per Hour	$48.18
Insurance %	0.01	Cost Per Acre	$2.07

Disk 27 feet--Conventional Wheat-Fallow (WF.cv) 500 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Descriptor	Disk 27'	Depreciable Value	$8079.67
List Price	$17300.00	Deprec. Coefficient	15
Discount	0.15		
Beg Index	100	Depreciation	$480.47
End Index	182	Interest	$605.98
Interest Rate	0.15	Insurance	$80.80
Life (Yrs)	15		-------
Life (Hrs)	6000	Totsl	$1167.24
Salvage Value	$872.60		
An. Hrs Used	52	Cost Per Hour	$22.45
Insursnce %	0.01	Cost Per Acre	$2.33

Table D.1, Cont.

V-Blade Sweep--42 feet, Conventional Wheat-Fallow (WF.cv) 2500 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Descriptor	V-Blade 42'	Depreciable Value	$13964.29
List Price	$29900.00	Deprec. Coefficient	15
Discount	0.15		
Beg Index	100	Depreciation	$830.41
End Index	182	Interest	$1047.32
Interest Rate	0.15	Insurance	$139.64
Life (Yrs)	15		-------
Life (Hrs)	6000	Total	$2017.37
Salvage Value	$1508.14		
An. Hrs Used	103	Cost Per Hour	$19.59
Insurance %	0.01	Cost Per Acre	$0.81

V-Blade Sweep--30 feet, Conventional Wheat-Fallow (WF.cv) 1250 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Descriptor	V-Blade 30'	Depreciable Value	$10928.57
List Price	$23400.00	Deprec. Coefficient	15
Discount	0.15		
Beg Index	100	Depreciation	$649.89
End Index	182	Interest	$819.64
Interest Rate	0.15	Insurance	$109.29
Life (Yrs)	15		-------
Life (Hrs)	6000	Total	$1578.81
Salvage Value	$1180.29		
An. Hrs Used	78	Cost Per Hour	$20.24
Insurance %	0.01	Cost Per Acre	$1.26

RodWeeder--48 feet, Conventional Wheat-Fallow (WF.cv) 1558 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Descriptor	RodWeed 48'	Depreciable Value	$6304.95
List Price	$13500.00	Deprec. Coefficient	15
Discount	0.15		
Beg Index	100	Depreciation	$374.93
End Index	182	Interest	$472.87
Interest Rate	0.15	Insurance	$63.05
Life (Yrs)	15		-------
Life (Hrs)	6000	Total	$910.85
Salvage Value	$680.93		
An. Hrs Used	58	Cost Per Hour	$15.70
Insurance %	0.01	Cost Per Acre	$0.58

Table D.1, Cont.

RodWeeder--36 feet. Conventional Wheat-Fallow (WF.cv) 441 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Deacriptor	RodWeed 36'	Depreciable Value	$4109.89
List Price	$8800.00	Deprec. Coefficient	15
Diacount	0.15		
Beg Index	100	Depreciation	$244.40
End Index	182	Intereat	$308.24
Interest Rate	0.15	Insurance	$41.10
Life (Yrs)	15		-------
Life (Hrs)	6000	Total	$593.74
Salvage Value	$443.87		
An. Hrs Used	21	Coat Per Hour	$28.27
Insurance %	0.01	Cost Per Acre	$1.35

Grain Drill--40 feet. Conventional Wheat-Fallow (WF.cv) 1000 AC

EQUIPMENT COST DATA		EQUIPMENT COST ESTIMATE	
Deacriptor	Hoe Drill 40'	Depreciable Value	$17754.73
Liat Price	$35200.00	Deprec. Coefficient	12
Diacount	0.15		
Beg Index	108	Depreciation	$1273.90
End Index	182	Intereat	$1331.60
Interest Rate	0.15	Insurance	$177.55
Life (Yrs)	12		-------
Life (Hrs)	6000	Total	$2783.05
Salvage Value	$2467.91		
An. Hrs Uaed	67	Coat Per Hour	$41.54
Insurance %	0.01	Coat Per Acre	$2.78

TOTALS

Depreciation	Interest	Insurance
$10585.88	$12341.28	$1645.50
Per Acre	Per Acre	Per Acre
$10.59	$12.34	$1.65

Appendix E

This appendix contains the detailed calculations of the cropping systems and the summary enterprise budgets.

Table E.1

CROPPING SYSTEM
Tribune
WHEAT: Conventional Wheat-Fallow (CVWF)
YEAR I: Fallow, Plant Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	MAY 1	5.25	MPH.	(83.5%	Eff.)			
Disk (75% of time)		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.31	—— VC ——	
Fuel		0.855	GPA.	0.95	0.7500	0.61	2.08	0.066
Oil		15%	FUEL	COST	0.0000	0.09	—— FC ——	
Repair		4.1%	LIST	PRIC	1.4200	1.07	4.92	0.157
Ownshp Tractor		52.28	T.HR	48.18	0.0697	3.36	—— TC ——	
Ownshp Implemt		750	ACRS	22.45	0.0697	1.56	7.00	0.223
4WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.86	0.027
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.3%	LIST	PRIC	0.3900	0.23	3.03	0.097
Ownshp Tractor		26.07	T.HR	48.18	0.0446	2.15	—— TC ——	
Ownshp Implemt		584	ACRS	19.59	0.0446	0.87	3.88	0.124
2WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.024
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.55	0.113
Ownshp Tractor		26.00	T.HR	36.61	0.0625	2.29	—— TC ——	
Ownshp Implemt		416	ACRS	20.24	0.0625	1.27	4.31	0.138
4WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.86	0.027
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.3%	LIST	PRIC	0.3900	0.23	3.03	0.097
Ownshp Tractor		26.07	T.HR	48.18	0.0446	2.15	—— TC ——	
Ownshp Implemt		584	ACRS	19.59	0.0446	0.87	3.88	0.124
2WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.024
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.51	0.112
Ownshp Tractor		26.00	T.HR	36.61	0.0625	2.29	—— TC ——	
Ownshp Implemt		416	ACRS	19.59	0.0625	1.22	4.27	0.136

CROPPING SYSTEM
Tribune
(Cont.)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 56%		48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.13	—— VC ——	
Fuel		0.481	GPA.	0.95	0.5600	0.26	0.71	0.023
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		6.0%	LIST	COST	0.5200	0.29	2.39	0.076
Ownshp Tractor		21.30	T.HR	48.18	0.0374	1.80	—— TC ——	
Ownshp Implemt		570	ACRS	15.70	0.0374	0.59	3.1$	0.099
2WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 44%		36	FEET	(20.1	A/Hr)			
Labor		1	HOUR	6.00	0.0498	0.13	—— VC ——	
Fuel		0.481	GPA.	0.95	0.4400	0.20	0.89	0.028
Oil		15%	FUEL	COST	0.0000	0.03	—— FC ——	
Repair		6.0%	LIST	PRIC	1.2000	0.53	3.23	0.103
Ownshp Tractor		21.42	T.HR	36.61	0.0498	1.82	—— TC ——	
Ownshp Implemt		430	ACRS	28.27	0.0498	1.41	4.12	0.132
4WD	SEP 1	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 100%		48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.22	—— VC ——	
Fuel		0.481	GPA.	0.95	1.0000	0.46	1.27	0.041
Oil		15%	FUEL	COST	0.0000	0.07	—— FC ——	
Repair		6.0%	LIST	PRIC	0.5200	0.52	2.39	0.076
Ownshp Tractor		37.37	T.HR	48.18	0.0374	1.80	—— TC ——	
Ownshp Implemt		1000	ACRS	15.70	0.0374	0.59	3.66	0.117
2WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill 100%		40	FEET	(14.9	A/Hr)			
Labor		1	HOUR	6.00	0.0669	0.40	—— VC ——	
Fuel		0.406	GPA.	0.95	1.0000	0.39	2.15	0.068
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.7%	LIST	PRIC	1.3000	1.30	5.23	0.167
Ownshp Tractor		66.94	T.HR	36.61	0.0669	2.45	—— TC ——	
Ownshp Implemt		1000	ACRS	41.54	0.0669	2.78	7.38	0.235
Seed Wheat		40	LBS.	0.100	$6/Bu	4.00		0.128
Crop Insurance			LEVEL	1	2.50	4.41		0.141
Total Variable Costs for all Operations							10.42	0.333
Total Fixed Costs for all Operations							31.28	0.998
TOTAL TILLAGE COSTS YEAR 1 (Per Acre)							$41.70	1.331

Table E.2

CROPPING SYSTEM
Tribune

WHEAT: Conventional Wheat Fallow (CVWF)
YEAR II: Harvest Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	30	LBS.	0.27		8.10		0.258
Custom App.		1	ACRE	3.00		3.00		0.096
(landlord)		33%	SPLT		11.10	-3.66	8.65	0.276
HARVEST	JUN 30							
Custom Combine		1	ACRE	13.00		13.00		0.415
Bushel Bonus)20		11	BSHL	0.13		1.47		0.047
Truck Hauling		31	BSHL	0.13		4.07		0.130
TOTAL HARVEST EXPENSE						18.55	18.53	0.592

Tillage to control weed growth after Harvest

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.5800	0.41	0.86	0.027
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.3%	LIST	PRIC	0.3900	0.23	3.03	0.097
Ownshp Tractor		26.07	T.HR	48.18	0.0446	2.15	— TC —	
Ownshp Implemt		584	ACRS	19.59	0.0446	0.87	3.88	0.124
2WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.4200	0.30	0.76	0.024
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.55	0.113
Ownshp Tractor		26.00	T.HR	36.61	0.0625	2.29	— TC —	
Ownshp Implemt		416	ACRS	20.24	0.0625	1.27	4.31	0.138

Tillage 75% of the time.

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	OCT 1	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.20	— VC —	
Fuel		0.740	GPA.	0.95	0.7500	0.53	1.11	0.035
Oil		15%	FUEL	COST	0.0000	0.08	— FC —	
Repair		3.3%	LIST	PRIC	0.3900	0.29	3.03	0.097
Ownshp Tractor		33.48	T.HR	48.18	0.0446	2.15	— TC —	
Ownshp Implemt		750	ACRS	19.59	0.0446	0.87	4.13	0.132

ENTERPRISE BUDGET
Tribune

WHEAT: Conventional Wheat-Fallow (CVWF)
YEAR I: Fallow, Plant Wheat and YEAR II: Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.389 Hours	0.075	2.34	0.60	—	—
2. Seed	0.128	4.00	4.00	—	—
3. Herbicide	0.000	0.00	0.00	—	—
4. Insecticide	0.000	0.00	0.00	—	—
5. Fertilizer *	0.354	11.10	11.10	—	—
6. Fuel ($/Gallon)=$0.95	0.146	4.57	4.57	—	—
7. Oil	0.022	0.69	0.69	—	—
8. Equipment repair	0.174	5.46	5.46	—	—
9. Custom Hire (Harvest Exp)	0.592	18.55	18.55	—	—
10. Interest (1/2 VC @ 15%)	0.112	3.50	2.10	—	—
A. TOTAL VARIABLE COSTS (Own Land)	1.602	50.20	47.07	—	—
TOTAL VARIABLE COSTS (Rent Land) *	1.485	46.54	43.41	—	—
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.255	8.00	8.00	—	—
12. Interest on Land	1.532	48.00	24.48	—	—
OR ($400/A x 2 x 6%)	(24% LT DEBT @ 12%i)			(160 AC)	
13. Share Rent (Returns x 33%)	1.096	34.34	34.34	—	—
14. Depreciation on Machinery	0.338	10.59	0.00	—	—
15. Interest on Machinery	0.394	12.34	4.07	—	—
16. Insurance, and Housing	0.053	1.65	1.65	—	—
B. TOTAL FIXED COSTS (Own Land)	2.571	80.58	38.20	—	—
TOTAL FIXED COSTS (Rent Land)	1.880	58.92	40.06	—	—
C. TOTAL COSTS PER ACRE OWNED	4.173	130.78	85.27	—	—
TOTAL COSTS PER ACRE RENTED	3.365	105.46	83.46	—	—
D. YIELD Per Acre			31.34	—	
E. PRICE / Bushel			3.29	—	
F. RETURNS PER ACRE			103.11	—	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.77	55.36	59.70	—	—
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.88	-27.67	17.84	—	—
H. RETURNS OVER TOTAL COSTS (RENTED)	-0.07	-2.35	19.64	—	—
J. ANNUAL NET RETURNS PER AC. (AVE.)	-0.34	-10.78	19.05	—	—
K. NET RETURN TO MANAGEMENT		-10705	19048	—	—

* Assumes Landlord paying 1/3 of Fertilizer ($3.66), on rent land.

LANDLORD NET INCOME / ACRE Wht. 38.67 T/YEAR 15.34

Table E.3

CROPPING SYSTEM
Tribune
WHEAT: Reduced-Till Wheat-Fallow (RTWF)
YEAR 1: Fallow, Plant Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.95	0.025
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.3%	LIST	PRIC	0.5600	0.32	5.41	0.142
Ownshp Tractor		26.07	T.HR	95.39	0.0446	4.26	—— TC ——	
Ownshp Implemt		584	ACRS	25.86	0.0446	1.15	6.37	0.167
2WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.020
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.54	0.093
Ownshp Tractor		26.00	T.HR	36.39	0.0625	2.27	—— TC ——	
Ownshp Implemt		416	ACRS	28.24	0.0625	1.27	4.30	0.113
4WD	JUL 20	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.95	0.025
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.3%	LIST	PRIC	0.5600	0.32	5.41	0.142
Ownshp Tractor		26.07	T.HR	95.39	0.0446	4.26	—— TC ——	
Ownshp Implemt		584	ACRS	25.86	0.0446	1.15	6.37	0.167
2WD	JUL 20	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.020
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.54	0.093
Ownshp Tractor		26.00	T.HR	36.39	0.0625	2.27	—— TC ——	
Ownshp Implemt		416	ACRS	28.24	0.0625	1.27	4.30	0.113

CROPPING SYSTEM
Tribune
(Cont)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	AUG 20	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 56%		48	FEET	(26.0	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.13	—— VC ——	
Fuel		0.481	GPA.	0.95	0.5600	0.26	1.23	0.032
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		6.0%	LIST	COST	1.4500	0.01	5.19	0.136
Ownshp Tractor		21.30	T.HR	95.39	0.0374	3.56	—— TC ——	
Ownshp Implemt		570	ACRS	43.37	0.0374	1.62	6.42	0.168
2WD	AUG 20	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 44%		36	FEET	(20.1	A/Hr)			
Labor		1	HOUR	6.00	0.0498	0.13	—— VC ——	
Fuel		0.481	GPA.	0.95	0.4400	0.20	0.89	0.023
Oil		15%	FUEL	COST	0.0000	0.03	—— FC ——	
Repair		6.0%	LIST	PRIC	1.2000	0.53	3.22	0.084
Ownshp Tractor		21.42	T.HR	36.39	0.0498	1.81	—— TC ——	
Ownshp Implemt		430	ACRS	28.27	0.0498	1.41	4.11	0.108
2WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill 100%		40	FEET	(14.9	A/Hr)			
Labor		1	HOUR	6.00	0.0669	0.40	—— VC ——	
Fuel		0.406	GPA.	0.95	1.0000	0.39	2.15	0.056
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.7%	LIST	PRIC	1.3000	1.30	5.22	0.136
Ownshp Tractor		66.94	T.HR	36.39	0.0669	2.44	—— TC ——	
Ownshp Implemt		1000	ACRS	41.54	0.0669	2.70	7.36	0.193
Seed Wheat		40	LBS.	0.100	$6/Bu	4.00		0.105
Crop Insurance			LEVEL	1	2.50	4.41		0.115
Total Variable Costs for all Operations							16.11	0.421
Total Fixed Costs for all Operations							31.53	0.825
							——	——
TOTAL TILLAGE COSTS FALLOW (Per Acre)							$47.64	1.246

Table E.4

CROPPING SYSTEM
Tribune

WHEAT: Reduced-Till Wheat-Fallow (RTWF)
YEAR 11: Harvest Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	30	LBS.	0.27		8.10		0.212
Custom App.		1	ACRE	3.00		3.00		0.078
(landlord)		33%	SPLT		11.10	-3.66	8.65	0.226
HARVEST	JUN 30							
Custom Combine		1	ACRE	13.00		13.00		0.340
Bushel Bonus)20		18	BSHL	0.13		2.37		0.062
Truck Hauling		38	BSHL	0.13		4.97		0.130
TOTAL HARVEST EXPENSE						20.34	20.34	0.532

Tillage with Atrazine for fall weed control.

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.95	0.025
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.3%	LIST	PRIC	0.5600	0.32	5.41	0.142
Ownshp Tractor		26.07	T.HR	95.39	0.0446	4.26	—— TC ——	
Ownshp Implemt		584	ACRS	25.86	0.0446	1.15	6.37	0.167
2WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.76	0.020
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	0.6200	0.26	3.54	0.093
Ownshp Tractor		26.00	T.HR	36.39	0.0625	2.27	—— TC ——	
Ownshp Implemt		416	ACRS	20.24	0.0625	1.27	4.30	0.113
ATRAZINE		0.75	LBS.	2.85		2.14		
Application		1	ACRE	3.00		3.00		
(landlord)		33%	SPLT		5.14	-1.70	3.44	0.09

ENTERPRISE BUDGET
Tribune

WHEAT: Reduced-Till Wheat-Fallow (RTWF)
YEAR 1: Fallow, Plant Wheat and YEAR 11: Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.266 Hours	0.042	1.60	0.45	——	——
2. Seed	0.105	4.00	4.00	——	——
3. Herbicide *	0.134	5.14	5.14	——	——
4. Insecticide	0.000	0.00	0.00	——	——
5. Fertilizer *	0.290	11.10	11.10	——	——
6. Fuel ($/Gallon)= $0.95	0.070	2.68	2.68	——	——
7. Oil	0.011	0.40	0.40	——	——
8. Equipment repair	0.108	4.14	4.14	——	——
9. Custom Hire (Harvest Exp)	0.532	20.34	20.34	——	——
10. Interest (1/2 VC @ 15%)	0.097	3.70	2.22	——	——
A. TOTAL VARIABLE COSTS (Own Land)	1.389	53.09	50.46	——	——
TOTAL VARIABLE COSTS (Rent Land) *	1.249	47.73	45.10	——	——
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.209	8.00	8.00	——	——
12. Interest on Land	1.256	48.00	24.48	——	——
OR ($400/A x 2 x 6%)	(24% LT DEBT,	12%i)		(160 AC)	
13. Share Rent (Returns x 33%)	1.096	41.87	41.87	——	——
14. Depreciation on Machinery	0.277	10.59	0.00	——	——
15. Interest on Machinery	0.323	12.34	4.07	——	——
16. Insurance, and Housing	0.043	1.65	1.65	——	——
B. TOTAL FIXED COSTS (Rent Land)	1.739	66.45	47.59	——	——
TOTAL FIXED COSTS (Owned Land)	2.108	80.58	38.20	——	——
C. TOTAL COSTS PER ACRE RENTED	2.988	114.18	92.69	——	——
TOTAL COSTS PER ACRE OWNED	3.497	133.67	88.66	——	——
D. YIELD Per Acre			38.22	——	
E. PRICE / Bushel			3.29	——	
F. RETURNS PER ACRE			125.74	——	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.99	76.25	75.29	——	——
H. RETURNS OVER TOTAL COSTS (RENTED)	0.30	11.56	33.05	——	——
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.21	-7.92	37.09	——	——
J. ANNUAL NET RETURN PER AC. (AVE)	0.13	5.13	34.38	——	——
K. NET RETURN TO MANAGEMENT		5131	34382	——	——

* Assumes Landlord paying 1/3 of herbicide (1.70) and fertilizer (3.66)

LANDLORD NET INCOME / ACRE Wht. 36.51 T/YEAR 18.26

Table E.5

CROPPING SYSTEM
Tribune
WHEAT: Conventional Wheat-Wheat (CVWW)
YEAR I: Harvest Wheat, Prepare Seedbed

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	15	LBS.	0.27		4.05		0.256
Custom App.		1	ACRE	3.00		3.00		0.190
(landlord)		33%	SPLT		7.05	-2.33	5.49	0.347
HARVEST	JUN 30							
Custom Combine		1	ACRE	13.00		13.00		0.822
Truck Hauling		16	BSHL	0.13		2.06		0.130
TOTAL HARVEST EXPENSE						15.06		0.952
4WD1	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 37%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.10	—— VC ——	
Fuel		0.748	GPA.	0.95	0.3700	0.26	0.90	0.057
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	1.3400	0.58	5.27	0.333
Ownshp Tractor		32.89	T.HR	56.89	0.0446	2.54	—— TC ——	
Ownshp Implemt		737	ACRS	61.13	0.0446	2.73	6.17	0.390
4WD2	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 37%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.10	—— VC ——	
Fuel		0.748	GPA.	0.95	0.3700	0.26	0.90	0.057
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	1.3400	0.50	6.49	0.411
Ownshp Tractor		32.90	T.HR	84.32	0.0446	3.76	—— TC ——	
Ownshp Implemt		737	ACRS	61.13	0.0446	2.73	7.39	0.467
2WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 26%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.10	—— VC ——	
Fuel		0.748	GPA.	0.95	0.2600	0.18	0.69	0.044
Oil		15%	FUEL	COST	0.0000	0.03	—— FC ——	
Repair		3.3%	LIST	PRIC	1.4700	0.38	5.28	0.334
Ownshp Tractor		32.89	T.HR	36.61	0.0625	2.29	—— TC ——	
Ownshp Implemt		526	ACRS	47.84	0.0625	2.99	5.97	0.378
4WD1	AUG 5	5.25	MPH.	(83.5%	Eff.)			
Disk 36.5%		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.15	—— VC ——	
Fuel		0.855	GPA.	0.95	0.3656	0.30	0.72	0.046
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		7.8%	LIST	PRIC	0.6300	0.23	5.56	0.352
Ownshp Tractor		50.86	T.HR	56.89	0.0697	3.97	—— TC ——	
Ownshp Implemt		730	ACRS	22.89	0.0697	1.60	6.28	0.398

CROPPING SYSTEM
Tribune
(Cont)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD2	AUG 5	5.25	MPH.	(83.5%	Eff.)			
Disk 36.5%		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.15	—— VC ——	
Fuel		0.855	GPA.	0.95	0.3650	0.30	0.85	0.054
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		4.1%	LIST	PRIC	0.9700	0.35	7.47	0.473
Ownshp Tractor		50.86	T.HR	84.32	0.0697	5.88	—— TC ——	
Ownshp Implemt		730	ACRS	22.89	0.0697	1.60	8.32	0.526
2WD	AUG 5	5.25	MPH.	(83.5%	Eff.)			
Disk 27%		20	FEET	(10.6	A/Hr)			
Labor		1.00	HOUR	6.00	0.0941	0.15	—— VC ——	
Fuel		0.855	GPA.	0.95	0.2700	0.22	0.66	0.041
Oil		15%	FUEL	COST	0.0000	0.03	—— FC ——	
Repair		9.1%	LIST	PRIC	0.9300	0.25	4.96	0.314
Ownshp Tractor		50.81	T.HR	36.61	0.0941	3.44	—— TC ——	
Ownshp Implemt		540	ACRS	16.14	0.0941	1.52	5.62	0.355
4WD1	SEP 1	5.75	MPH.	(80.0%	Eff.)			
RodWeed 36%		48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.08	—— VC ——	
Fuel		0.481	GPA.	0.95	0.3600	0.16	0.67	0.042
Oil		15%	FUEL	COST	0.0000	0.02	—— FC ——	
Repair		6.0%	LIST	PRIC	1.1100	0.40	3.34	0.211
Ownshp Tractor		27.17	T.HR	56.89	0.0374	2.13	—— TC ——	
Ownshp Implemt		727	ACRS	32.53	0.0374	1.22	4.01	0.254
4WD2	SEP 1	5.75	MPH.	(80.0%	Eff.)			
RodWeed 36%		48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.08	—— VC ——	
Fuel		0.481	GPA.	0.95	0.3600	0.16	0.67	0.042
Oil		15%	FUEL	COST	0.0000	0.02	—— FC ——	
Repair		6.0%	LIST	PRIC	1.1100	0.40	4.37	0.276
Ownshp Tractor		27.16	T.HR	84.32	0.0374	3.15	—— TC ——	
Ownshp Implemt		727	ACRS	32.53	0.0374	1.22	5.04	0.318
2WD	SEP 1	5.75	MPH.	(80.0%	Eff.)			
RodWeed 28%		36	FEET	(20.1	A/Hr)			
Labor		1	HOUR	6.00	0.0498	0.08	—— VC ——	
Fuel		0.481	GPA.	0.95	0.2800	0.13	0.50	0.032
Oil		15%	FUEL	COST	0.0000	0.02	—— FC ——	
Repair		6.0%	LIST	PRIC	0.9700	0.27	2.88	0.182
Ownshp Tractor		27.20	T.HR	36.61	0.0498	1.82	—— TC ——	
Ownshp Implemt		546	ACRS	21.21	0.0498	1.06	3.38	0.214

Table E.6

CROPPING SYSTEM
Tribune

WHEAT: Conventional Wheat-Wheat (CVWW)
YEAR 1: (CONT.) Plant Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill	56%	50	FEET	(18.7	A/Hr)			
Labor		1	HOUR	6.00	0.0535	0.19	— VC —	
Fuel		0.406	GPA.	0.95	0.6000	0.23	1.44	0.091
Oil		15%	FUEL	COST	0.0000	0.03	— FC —	
Repair		3.7%	LIST	PRIC	1.6300	0.98	7.18	0.454
Ownshp Tractor		59.98	T.HR	56.89	0.0535	3.05	— TC —	
Ownshp Implemt		1120	ACRS	77.16	0.0535	4.13	8.62	0.545
2WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill	44%	40	FEET	(14.9	A/Hr)			
Labor		1	HOUR	6.00	0.0669	0.16	— VC —	
Fuel		0.406	GPA.	0.95	0.4000	0.15	0.99	0.063
Oil		15%	FUEL	COST	0.0000	0.02	— FC —	
Repair		3.7%	LIST	PRIC	1.6300	0.65	5.90	0.373
Ownshp Tractor		58.90	T.HR	36.61	0.0669	2.45	— TC —	
Ownshp Implemt		880	ACRS	51.54	0.0669	3.45	6.89	0.436
Seed Wheat		40	LBS.	0.100	$6/Bu	4.00		0.253
Crop Insurance			LEVEL	I	2.50	4.41		0.279

ENTERPRISE BUDGET
Tribune

WHEAT: Conventional Wheat-Wheat (CVWW)
YEAR I: Plant Wheat, and Harvest Wheat

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.225 Hours	0.086	1.35	0.83	—	—
2. Seed	0.253	4.00	4.00	—	—
3. Herbicide	0.000	0.00	0.00	—	—
4. Insecticide	0.000	0.00	0.00	—	—
5. Fertilizer *	0.446	7.05	7.05	—	—
6. Fuel ($/Gallon)= $0.95	0.146	2.31	2.31	—	—
7. Oil	0.022	0.35	0.35	—	—
8. Equipment repair	0.311	4.91	4.91	—	—
9. Custom Hire (Harvest Exp)	0.952	15.06	15.06	—	—
10. Interest (1/2 VC @ 15%)	0.166	2.63	1.58	—	—
A. TOTAL VARIABLE COSTS (Own Land)	2.382	37.65	36.08	—	—
TOTAL VARIABLE COSTS (Rent Land) *	2.234	35.33	33.75	—	—
FIXED COSTS PER ACRE					
11. Real Estate Taxes (50c/$100)	0.253	4.00	4.00	—	—
12. Interest on Land	1.518	24.00	12.24	—	—
OR ($400/A x 6%)	(24% LT DEBT,		12%i)		
13. Share Rent (Returns x 33%)	1.096	17.32	17.32	—	—
14. Depreciation on Machinery	0.589	9.31	0.00	—	—
15. Interest on Machinery	0.683	10.80	3.56	—	—
16. Insurance, and Housing	0.091	1.44	1.44	—	—
B. TOTAL FIXED COSTS (Rent Land)	2.459	38.87	22.32	—	—
TOTAL FIXED COSTS (Owned Land)	3.134	49.55	21.24	—	—
C. TOTAL COSTS PER ACRE RENTED	4.693	74.20	56.07	—	—
TOTAL COSTS PER ACRE OWNED	5.516	87.20	57.32	—	—
D. YIELD Per Acre			15.81	—	
E. PRICE / Bushel			3.29	—	
F. RETURNS PER ACRE			52.81	—	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.01	15.92	15.94	—	—
H. RETURNS OVER TOTAL COSTS (RENTED)	-1.40	-22.18	-4.06	—	—
I. RETURNS OVER TOTAL COSTS (OWNED)	-2.23	-35.19	-5.30	—	—
J. ANNUAL NET RETURNS PER AC. (AVE.)	-1.67	-26.47	-4.47	—	—
K. NET RETURNS TO MANAGEMENT		-52946	-8941	—	—

* Assumes Landlord paying 1/3 of fertilizer (2.33) on rent land.

LANDLORD NET INCOME / ACRE Wht. 14.99 T/YEAR 14.99

Table E.7

CROPPING SYSTEM
Tribune
WHEAT: Conventional Wheat-Sorghum-Fallow (CVWSF)
YEAR 1: Fallow, Plant Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	MAY 1	5.25	MPH.	(83.5%	Eff.)			
Disk (75%)		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.21	— VC —	
Fuel		0.855	GPA.	0.95	0.7500	0.61	1.17	0.039
Oil		15%	FUEL	COST	0.0000	0.09	— FC —	
Repair		4.1%	LIST	PRIC	0.5200	0.26	3.88	0.128
Ownshp Tractor		34.82	T.HR	43.32	0.0697	3.02	— TC —	
Ownshp Implemt		500	ACRS	12.29	0.0697	0.86	5.05	0.166
4WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0440	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.5800	0.41	0.93	0.031
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.3%	LIST	PRIC	0.5200	0.30	3.01	0.099
Ownshp Tractor		17.23	T.HR	43.32	0.0446	1.93	— TC —	
Ownshp Implemt		386	ACRS	24.02	0.0446	1.07	3.94	0.130
2WD	JUN 5	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.4200	0.30	0.09	0.029
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		3.3%	LIST	PRIC	0.9200	0.39	3.45	0.114
Ownshp Tractor		17.50	T.HR	24.21	0.0625	1.51	— TC —	
Ownshp Implemt		280	ACRS	30.96	0.0625	1.94	4.34	0.143
4WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	— VC —	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.93	0.031
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.3%	LIST	PRIC	0.5200	0.30	3.01	0.099
Ownshp Tractor		17.09	T.HR	43.32	0.0446	1.93	— TC —	
Ownshp Implemt		383	ACRS	24.02	0.0446	1.07	3.94	0.130
2WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	— VC —	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.09	0.029
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		3.3%	LIST	PRIC	0.9200	0.39	3.45	0.114
Ownshp Tractor		17.33	T.HR	24.21	0.0625	1.51	— TC —	
Ownshp Implemt		277	ACRS	30.96	0.0625	1.94	4.34	0.143

CROPPING SYSTEM
Tribune
(Cont)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	56%	48	FEET	(26.0	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.13	— VC —	
Fuel		0.481	GPA.	0.95	0.5600	0.26	1.64	0.054
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		6.0%	LIST	COST	2.1700	1.22	2.49	0.082
Ownshp Tractor		14.20	T.HR	43.32	0.0374	1.62	— TC —	
Ownshp Implemt		380	ACRS	23.36	0.0374	0.87	4.13	0.136
2WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	44%	36	FEET	(21.2	A/Hr)			
Labor		1	HOUR	6.00	0.0472	0.12	— VC —	
Fuel		0.481	GPA.	0.95	0.4400	0.20	1.15	0.038
Oil		15%	FUEL	COST	0.0000	0.03	— FC —	
Repair		6.0%	LIST	PRIC	1.8000	0.79	3.14	0.104
Ownshp Tractor		13.50	T.HR	24.21	0.0472	1.14	— TC —	
Ownshp Implemt		286	ACRS	42.41	0.0472	2.00	4.29	0.141
4WD	SEP 1	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	100%	48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0373	0.22	— VC —	
Fuel		0.481	GPA.	0.95	1.0000	0.46	2.92	0.096
Oil		15%	FUEL	COST	0.0000	0.07	— FC —	
Repair		6.0%	LIST	PRIC	2.1700	2.17	2.49	0.082
Ownshp Tractor		24.05	T.HR	43.32	0.0373	1.62	— TC —	
Ownshp Implemt		666	ACRS	23.36	0.0373	0.87	5.41	0.170
2WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill	100%	40	FEET	(14.94	A/Hr)			
Labor		1	HOUR	6.00	0.0669	0.40	— VC —	
Fuel		0.406	GPA.	0.95	1.0000	0.39	2.01	0.092
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.7%	LIST	PRIC	0.0000	1.96	5.05	0.193
Ownshp Tractor		44.50	T.HR	24.21	0.0669	1.62	— TC —	
Ownshp Implemt		666	ACRS	63.25	0.0669	4.23	0.66	0.285
Seed Wheat		40	LBS.	0.100	$6/Bu	4.00		0.132
Crop Insurance			LEVEL	1	2.50	4.41		0.145
Total Variable Costs for all Operations							10.65	0.351
Total Fixed Costs for all Operations							15.61	0.514
TOTAL TILLAGE COSTS YEAR 1 (Per Acre)							26.27	0.865

Table E.8

CROPPING SYSTEM
Tribune

WHEAT: Conventional Wheat-Sorghum-Fallow (CVWSF)
YEAR 11: Harvest Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	22.5	LBS.	0.27		6.08		0.200
Custom App.		1	ACRE	3.00		3.00		0.099
(landlord)		33%	SPLT		9.08	-2.99	7.07	0.233
HARVEST	JUN 30							
Custom Combine		1	ACRE	13.00		13.00		0.428
Bushel Bonus)20		10	BSHL	0.13		1.35		0.044
Truck Hauling		30	BSHL	0.13		3.95		0.130
TOTAL HARVEST EXPENSE						18.30	18.2962	0.602
Tillage to control weed growth after Harvest								
4WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.93	0.031
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		3.3%	LIST	PRIC	0.5200	0.30	3.01	0.099
Ownshp Tractor		17.23	T.HR	43.32	0.0446	1.93	—— TC ——	
Ownshp Implemt		386	ACRS	24.02	0.0446	1.07	3.94	0.130
2WD	JUL 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	—— VC ——	
Fuel		0.748	GPA.	0.95	0.4200	0.30	0.09	0.029
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		3.3%	LIST	PRIC	0.9200	0.39	3.45	0.114
Ownshp Tractor		17.50	T.HR	24.21	0.0625	1.51	—— TC ——	
Ownshp Implemt		280	ACRS	30.96	0.0625	1.94	4.34	0.143
Tillage 75% of the time.								
4WD	OCT 1	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep		42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.20	—— VC ——	
Fuel		0.748	GPA.	0.95	0.7500	0.53	1.20	0.040
Oil		15%	FUEL	COST	0.0000	0.08	—— FC ——	
Repair		3.32%	LIST	PRIC	0.5200	0.39	3.01	0.099
Ownshp Tractor		22.32	T.HR	43.32	0.0446	1.93	—— TC ——	
Ownshp Implemt		500	ACRS	24.02	0.0446	1.07	4.21	0.139

CROPPING SYSTEM
Tribune

WHEAT: Conventional Wheat-Sorghum-Fallow (CVWSF)
YEAR 111: Plant Sorghum, Harvest Sorghum

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	22.50	LBS.	0.27		6.08		0.151
Custom App.		1.00	ACRE	3.00		3.00		0.075
(landlord)		33%	SPLT		9.08	-2.99	7.07	0.176
4WD	APR 25	5.25	MPH.	(83.5%	Eff.)			
Disk 100%		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.42	—— VC ——	
Fuel		0.855	GPA.	0.95	1.0000	0.81	1.07	0.047
Oil		15%	FUEL	COST	0.0000	0.12	—— FC ——	
Repair		4.1%	LIST	PRIC	0.5200	0.52	3.08	0.097
Ownshp Tractor		46.42	T.HR	43.32	0.0697	3.02	—— TC ——	
Ownshp Implemt		666	ACRS	12.29	0.0697	0.86	5.75	0.143
4WD	MAY 20	5.25	MPH.	(83.5%	Eff.)			
Disk 56%		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.23	—— VC ——	
Fuel		0.855	GPA.	0.95	0.5600	0.45	1.05	0.035
Oil		15%	FUEL	COST	0.0000	0.07	—— FC ——	
Repair		4.1%	LIST	PRIC	0.5200	0.29	3.08	0.120
Ownshp Tractor		26.70	T.HR	43.32	0.0697	3.02	—— TC ——	
Ownshp Implemt		383	ACRS	12.29	0.0697	0.86	4.92	0.162
2WD	MAY 20	5.25	MPH.	(83.5%	Eff.)			
Disk 44%		20	FEET	(11.7	A/Hr)			
Labor		1	HOUR	6.00	0.0855	0.23	—— VC ——	
Fuel		0.855	GPA.	0.95	0.4400	0.36	1.39	0.046
Oil		15%	FUEL	COST	0.0000	0.05	—— FC ——	
Repair		4.1%	LIST	PRIC	1.7100	0.75	4.70	0.157
Ownshp Tractor		17.69	T.HR	24.21	0.0855	2.07	—— TC ——	
Ownshp Implemt		283	ACRS	31.66	0.0855	2.71	6.16	0.203

Table E.9

CROPPING SYSTEM
Tribune

SORGHUM: Conventional Wheat-Sorghum-Fallow (CVWSF)
YEAR III: Plant Sorghum, Harvest Sorghum

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
2WD	JUN 5	4.25	MPH.	(67.5%	Eff.)			
Planter (12-row)		30	FEET	(10.4	A/Hr)			
Labor		1	HOUR	6.00	0.0959	0.58	—— VC ——	
Fuel		0.502	GPA.	0.95	1.0000	0.48	3.91	0.129
Oil		10%	FUEL	COST	0.0000	0.05	—— FC ——	
Repair		7.3%	LIST	PRIC	2.8100	2.81	7.77	0.256
Ownsho Tractor		41.63	T.HR	24.21	0.0959	2.32	—— TC ——	
Ownsho Implemt		666	ACRS	56.85	0.0959	5.45	11.68	0.385
Sorghum Seed		1.75	LBS.	1.25	$50/BG	2.19		
Insurance			LEVEL	I	1.75	5.00		
2WD	JUL 12	4.00	MPH.	(76.5%	Eff.)			
Cultivate (12-row)		30	FEET	(11.1	A/Hr)			
Labor		1	HOUR	6.00	0.0899	0.81	—— VC ——	
Fuel		0.417	GPA.	0.95	1.0000	0.59	2.33	0.077
Oil		10%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		9.1%	LIST	PRIC	0.0899	0.87	3.34	0.110
Ownsho Tractor		89.78	T.HR	24.21	0.0899	2.18	—— TC ——	
Ownsho Implemt		999	ACRS	12.93	0.0899	1.16	5.67	0.187
2,4-D	JUL 15	0.5	LBS.	3.88		0.64		
Application (33%)		1.00	ACRE	3.00		0.99		
(landlord)		33%	SPLT		1.63	-0.21	1.49	
PARATHION	AUG 1	1	LBS.	4.31		0.54		
Application (25%)		1	ACRE	3.00		0.75		
(landlord)		33%	SPLT		1.29	-0.43	1.80	
HARVEST	OCT 8							0.000
Custom Combine		1	ACRE	13.00		13.00		0.428
Bushel Bonus >30		10	BSHL	0.13		1.32		0.043
Truck Hauling		40	BSHL	0.13		5.22		0.172
TOTAL HARVEST EXPENSE						19.54	19.54	

ENTERPRISE BUDGET
Tribune

WHEAT: Conventional Wheat-Sorghum-Fallow (CVWSF)
YR. I: Fallow, Plt Wheat YR. II: Hrv Wheat YR. III: Plt & Hrv Sorghum

	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE				
1. Labor $6/Hr. x 0.748 Hour	4.49	1.63	——	——
2. Seed	6.19	6.19	——	——
3. Herbicide *	1.63	1.63	——	——
4. Insecticide *	1.29	1.29	——	——
5. Fertilizer *	18.15	18.15	——	——
6. Fuel ($/Gallon)= $0.95	7.99	7.99	——	——
7. Oil	1.20	1.20	——	——
8. Equip. repair	15.86	15.86	——	——
9. Custom Hire (Harvest Exp)	18.30	18.30	——	——
10. Interest (1/2 VC @ 15%)	5.63	3.38	——	——
A. TOTAL VARIABLE COSTS (Own Land)	80.72	75.61	——	——
TOTAL VARIABLE COSTS (Rent Land) *	74.09	68.98	——	——
FIXED COSTS PER ACRE				
11. Real Estate Taxes (50c/$100 x 3)	12.00	12.00	——	——
12. Interest on Land	72.00	36.72	——	——
OR ($400/A x 3 x 6%)	(24% LT DEBT,12%i)			
13. Share Rt. WHT. (Returns x 33%)	33.27	33.27	——	——
Share Rt. SOR. (Returns x 33%)	30.61	30.61	——	——
14. Depreciation on Machinery	19.22	0.00	——	——
15. Interest on Machinery	21.94	7.24	——	——
16. Insurance, and Housing	2.96	2.96	——	——
B. TOTAL FIXED COSTS (Rent Land)	108.01	74.09	——	——
TOTAL FIXED COSTS (Owned Land)	128.12	58.92	——	——
C. TOTAL COSTS PER ACRE RENTED	182.10	143.07	——	——
TOTAL COSTS PER ACRE OWNED	208.84	134.53	——	——

	Wheat	Sorghum		Wht.	Sor.
D. YIELD Per Acre	30.37	40.16	(cwt.)	——	——
E. PRICE / Bushel	3.29	2.31	(4.12)	——	——
F. RETURNS PER ACRE	99.92	92.77	192.69		——

	Total	Cash	(Your Farm) Total	(Your Farm) Cash
G. RETURNS OVER VARIABLE COSTS (AVE.)	116.41	121.52	——	
H. RETURNS OVER TOTAL COSTS (RENTED)	10.59	49.62	——	
I. RETURNS OVER TOTAL COSTS (OWNED)	-16.15	58.16	——	
J. ANNUAL NET RETURN PER ACRE (AVE.)	1.77	52.44	——	——
K. NET RETURN TO MANAGEMENT	1178	34957	——	——

* Assumes Landlord paying 1/3 of herbicides (0.21), insecticides (0.43) and fertilizer (5.98) on rent land.

K. LANDLORD NET INCOME / ACRE Wht. 30.28 Sor. 26.98 T/YEAR 19.09

Table E.10

CROPPING SYSTEM
Tribune

WHEAT: Reduced-Till Wheat-Sorghum-Fallow (RTWSF)
YEAR 1: Fallow, Plant Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	JUN 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep	58%	42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.5800	0.41	1.03	0.028
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.3%	LIST	PRIC	0.6900	0.40	5.46	0.148
Ownshp Tractor		17.25	T.HR	90.81	0.0446	4.05	— TC —	
Ownshp Implemt		386	ACRS	31.52	0.0446	1.41	6.49	0.176
2WD	JUN 10	5.50	MPH.	(80%	Eff.)			
V-Blade Sweep	42%	30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.4200	0.30	1.08	0.029
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		3.3%	LIST	PRIC	1.3800	0.58	4.74	0.128
Ownshp Tractor		17.40	T.HR	29.36	0.0625	1.84	— TC —	
Ownshp Implemt		280	ACRS	46.44	0.0625	2.90	5.82	0.158
4WD	JUL 20	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep	58%	42	FEET	(22.4	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.5800	0.41	1.03	0.028
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.3%	LIST	PRIC	0.6900	0.40	5.46	0.148
Ownshp Tractor		17.23	T.HR	90.81	0.0446	4.05	— TC —	
Ownshp Implemt		386	ACRS	31.52	0.0446	1.41	6.49	0.176
2WD	JUL 20	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep	42%	30	FEET	(16.0	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	— VC —	
Fuel		0.740	GPA.	0.95	0.4200	0.30	1.08	0.029
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		3.3%	LIST	PRIC	1.3800	0.58	4.74	0.128
Ownshp Tractor		17.50	T.HR	29.36	0.0625	1.84	— TC —	
Ownshp Implemt		280	ACRS	46.44	0.0625	2.90	5.82	0.158

CROPPING SYSTEM
Triboune
(Cont)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Busnel
4WD	AUG 20	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	56%	48	FEET	(26.8	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.13	— VC —	
Fuel		0.481	GPA.	0.95	0.5600	0.26	1.64	0.044
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		6.0%	LIST	COST	2.1700	1.22	5.82	0.158
Ownshp Tractor		14.20	T.HR	90.81	0.0374	3.39	— TC —	
Ownshp Implemt		380	ACRS	65.06	0.0374	2.43	7.46	0.202
2WD	AUG 20	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder	44%	36	FEET	(20.1	A/Hr)			
Labor		1	HOUR	6.00	0.0498	0.13	— VC —	
Fuel		0.481	GPA.	0.95	0.4400	0.20	1.15	0.031
Oil		15%	FUEL	COST	0.0000	0.03	— FC —	
Repair		6.0%	LIST	PRIC	1.0000	0.79	3.58	0.097
Ownshp Tractor		14.25	T.HR	29.36	0.0498	1.46	— TC —	
Ownshp Implemt		286	ACRS	42.41	0.0498	2.11	4.73	0.128
2WD	SEP 10	4.25	MPH.	(72.5%	Eff.)			
Hoe Drill	100%	40	FEET	(14.9	A/Hr)			
Labor		1	HOUR	6.00	0.0669	0.40	— VC —	
Fuel		0.406	GPA.	0.95	1.0000	0.39	2.81	0.076
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.7%	LIST	PRIC	1.9600	1.96	6.11	0.165
Ownshp Tractor		44.58	T.HR	29.36	0.0669	1.97	— TC —	
Ownshp Implemt		666	ACRS	61.85	0.0669	4.14	8.91	0.241
Seed Wheat		40	LBS.	0.100	$6/Bu	4.00		0.108
Crop Insurance			LEVEL	I	2.50	4.41		0.119
Total Variable Costs for all Operations							18.22	0.494
Total Fixed Costs for all Operations							35.90	0.972
TOTAL TILLAGE COSTS-FALLOW (Per Acre)							$54.13	1.466

Table E.11

CROPPING SYSTEM
Tribune

WHEAT: Reduced-Till Wheat-Sorghum-Fallow (RTWSF)
YEAR II: Harvest Wheat

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	MAR 1	22.5	LBS.	0.27		6.08		0.165
Custom App.		1	ACRE	3.00		3.00		0.081
(landlord)		33%	SPLT		9.08	-2.99	7.07	0.191
HARVEST	JUNE 30							
Custom Combine		1	ACRE	13.00		13.00		0.352
Bushel Bonus)20		17	BSHL	0.13		2.20		0.060
Truck Hauling		37	BSHL	0.13		4.80		0.130
TOTAL HARVEST EXPENSE						20.00	20.00	0.542
Tillage with Atrazine for fall weed control.								
4WD	JULY 10	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 100%		42	FEET	(19.6	A/Hr)			
Labor		1	HOUR	6.00	0.0510	0.31	— VC —	
Fuel		0.740	GPA.	0.95	1.0000	0.82	1.90	0.051
Oil		10%	FUEL	COST	0.0000	0.08	— FC —	
Repair		3.3%	LIST	PRIC	0.6900	0.69	6.15	0.166
Ownshp Tractor		33.67	T.HR	90.81	0.0510	4.63	— TC —	
Ownshp Implemt		660	ACRS	29.65	0.0510	1.51	8.04	0.218
ATRAZINE		1.25	LBS.	2.85		3.56		
Application		1	ACRE	3.00		3.00		
(landlord)		33%	SPLT		6.56	-2.17	5.11	0.138

CROPPING SYSTEM
Tribune

SORGHUM: Reduced-Till Wheat-Sorghum-Fallow (RTWSF)
YEAR III: Prepare Seedbed with Weed Control.

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
TOPDRESS N	APR 29	22.5	LBS.	0.27		6.08		0.115
Custom App.		1	ACRE	3.00		3.00		0.057
(landlord)		33%	SPLT		9.08	-2.99	7.07	0.133
4WD	MAY 1	5.25	MPH.	(83.5%	Eff.)			
Disk (56%)		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.23	— VC —	
Fuel		0.855	GPA.	0.95	0.5600	0.45	1.82	0.034
Oil		15%	FUEL	COST	0.0000	0.07	— FC —	
Repair		4.1%	LIST	PRIC	1.9000	1.06	9.46	0.179
Ownshp Tractor		26.70	T.HR	90.81	0.0697	6.33	— TC —	
Ownshp Implemt		383	ACRS	44.89	0.0697	3.13	11.28	0.213
2WD	MAY 1	5.25	MPH.	(83.5%	Eff.)			
Disk (44%)		20	FEET	(10.6	A/Hr)			
Labor		1	HOUR	6.00	0.0941	0.25	— VC —	
Fuel		0.855	GPA.	0.95	0.4400	0.36	1.41	0.027
Oil		15%	FUEL	COST	0.0000	0.05	— FC —	
Repair		4.1%	LIST	PRIC	1.7100	0.75	5.74	0.108
Ownshp Tractor		26.63	T.HR	29.36	0.0941	2.76	— TC —	
Ownshp Implemt		283	ACRS	31.66	0.0941	2.90	7.15	0.135

Table E.12

CROPPING SYSTEM
Tribune

WHEAT: Reduced Till Wheat-Sorghum-Fallow (RTWSF)
YEAR III: CONT. Plant Sorghum, Harvest Sorghum

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
2WD	JUN 1	4.25	MPH.	(67.5%	Eff.)			
Planter (12-row)		30	FEET	(10.43	A/Hr)			
Labor		1	HOUR	6.00	0.0959	0.58	—— VC ——	
Fuel		0.502	GPA.	0.95	1.0000	0.48	1.56	0.030
Oil		15%	FUEL	COST	0.0000	0.07	—— FC ——	
Repair		7.3%	LIST	PRIC	2.8100	2.81	1.76	0.033
Ownshp Tractor		63.04	T.HR	29.36	0.0959	2.81	—— TC ——	
Ownshp Implemt		666	ACRS	56.85	0.0959	5.45	3.32	0.063
Sorghum Seed		1.75	LBS.	1.25	$50/BG	2.19		
Insurance			LEVEL	1	1.75	5.00		
2WD	JUL 12	4.00	MPH.	(76.5%	Eff.)			
Cultivate (12-row)		30	FEET	(11.13	A/Hr)			
Labor		1	HOUR	6.00	0.0899	0.54	—— VC ——	
Fuel		0.406	GPA.	0.95	1.0000	0.39	1.56	0.030
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		9.1%	LIST	PRIC	3.1400	3.14	1.76	0.033
Ownshp Tractor		59.85	T.HR	29.36	0.0899	2.64	—— TC ——	
Ownshp Implemt		666	ACRS	27.71	0.0899	2.49	3.32	0.063
2,4-D	JUL 15	0.5	LBS.	3.88	0.25	0.49		
Application (25%)		1	ACRE	3.00	0.25	0.75		
(landlord)		33%	SPLT		1.24	-0.41	0.96	0.018
Parathion	AUG 1	0.5	LB.	4.31	0.25	0.54		
Application (25%)		1	ACRE	3.00	0.25	0.75		
(landlord)		33%	SPLT		1.29	-0.43	1.00	0.019
HARVEST	OCT 8							
Custom Combine		1	ACRE	13.00		13.00		
Bushel Bonus)30		23	BSHL	0.13		2.99		
Truck Hauling		53	BSHL	0.13		6.89		
TOTAL HARVEST EXPENSE						22.87	22.87	0.432

ENTERPRISE BUDGET
Tribune

WHEAT & SORGHUM: Reduced-Till Wheat-Sorghum-Fallow (RTWSF)
YEAR I: Fallow/Plt. Wht. YEAR II: Harv. Wht. YEAR III: Plt./Harv. Sor

	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE				
1. Labor $6/Hr. x 0.531 Hours	3.19	0.69	——	——
2. Seed	6.19	6.19	——	——
3. Herbicide *	7.80	7.80	——	——
4. Insecticide *	1.29	1.29	——	——
5. Fertilizer a	18.15	18.15	——	——
6. Fuel ($/Gallon)= $0.95	4.76	4.76	——	——
7. Oil	0.67	0.67	——	——
8. Equipment Repair	14.38	14.38	——	——
9. Custom Hire (Harvest Exp)	42.87	42.87	——	——
10. Interest (1/2 VC @ 15%)	7.45	4.47	——	——
A. TOTAL VARIABLE COSTS (Own Land)	106.75	101.28	——	——
TOTAL VARIABLE COSTS (Rent Land) *	97.76	92.29	——	——
FIXED COSTS PER ACRE				
11. R. Estate Taxes (50c/$100x3)	12.00	12.00	——	——
12. Interest on Land	72.00	36.72	——	——
OR ($400/A x 3 x 6%)	(24% LT DEBT,	24%i)		
13. Share Rt. WHT. (Ret. x 33%)	40.08	40.08	——	——
13. Share Rt. SOR. (Ret. x 33%)	40.39	40.39	——	——
14. Depreciation on Machinery	19.22	0.00	——	——
15. Interest on Machinery	21.94	7.24	——	——
16. Insurance, and Housing	2.96	2.96	——	——
B. TOTAL FIXED COSTS (Rent Land)	124.59	90.67	——	——
TOTAL FIXED COSTS (Owned Land)	128.12	58.92	——	——
C. TOTAL COSTS PER ACRE RENTED	222.35	182.96	——	——
TOTAL COSTS PER ACRE OWNED	234.87	160.28	——	——

	Wheat	Sorghum		Wht.	Sor.
D. YIELD Per Acre	36.92	52.90		——	——
E. PRICE / Bushel	3.29	2.31	4.12cwt	——	——
F. RETURNS PER ACRE	121.47	122.38	243.85	——	

	Total	Cash	(Your Farm) Total	(Your Farm) Cash
G. RETURNS OVER VARIABLE COSTS (AVE.)	143.12	142.57	——	——
H. RETURNS OVER TOTAL COSTS (RENTED)	21.50	60.89	——	——
I. RETURNS OVER TOTAL COSTS (OWNED)	8.98	83.65	——	——
J. ANNUAL NET RETURNS PER ACRE (AVE.)	17.37	68.40	——	——
K. NET RETURNS TO MANAGEMENT	11580	45602	——	——

* Assumes Landlord paying 1/3 of herbicides (2.57), insecticides (0.43) and fertilizer (5.98), on rent land.

LANDLORD NET INCOME Wht. 34.92 Sor. 36.56 T/YEAR 23.83

Table E.13

CROPPING SYSTEM
Tribune
SORGHUM: Conventional Sorghum-Sorghum (CVSS)
Prepare Seedbed, Plant Sorhgum, Cultivate, Harvest Sorghum

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
NITROGEN	APR 20	15.00	LBS.	0.27		4.05		0.105
Custom App.		1.00	ACRE	3.00		3.00		0.077
(landlord)		33%	SPLT		7.05	-2.33	5.49	0.142
4WD	APR 25	5.25	MPH.	(83.5%	Eff.)			
Disk 40%		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.17	—— VC ——	
Fuel		0.855	GPA.	0.95	0.4000	0.32	0.72	0.019
Oil		15%	FUEL	COST	0.0000	0.05	—— FC ——	
Repair		4.1%	LIST	PRIC	0.4400	0.10	7.46	0.193
Ownshp Tractor		55.76	T.HR	85.85	0.0697	5.98	—— TC ——	
Ownshp Implemt		800	ACRS	21.22	0.0697	1.48	8.10	0.211
2WD1	APR 25	5.25	MPH.	(83.5%	Eff.)			
Disk 30%		20	FEET	(10.6	A/Hr)			
Labor		1	HOUR	6.00	0.0941	0.17	—— VC ——	
Fuel		0.855	GPA.	0.95	0.3000	0.24	0.58	0.015
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		4.1%	LIST	PRIC	0.4200	0.13	2.98	0.077
Ownshp Tractor		56.46	T.HR	17.27	0.0941	1.63	—— TC ——	
Ownshp Implemt		600	ACRS	14.38	0.0941	1.35	3.55	0.092
2WD2	APR 25	5.25	MPH.	(83.5%	Eff.)			
Disk 30%		20	FEET	(10.6	A/Hr)			
Labor		1	HOUR	6.00	0.0941	0.17	—— VC ——	
Fuel		0.855	GPA.	0.95	0.3000	0.24	0.58	0.015
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		4.1%	LIST	PRIC	0.4200	0.13	3.03	0.078
Ownshp Tractor		56.46	T.HR	17.27	0.0941	1.63	—— TC ——	
Ownshp Implemt		600	ACRS	14.97	0.0941	1.41	3.61	0.093
4WD	MAY 30	5.25	MPH.	(83.5%	Eff.)			
Disk 40%		27	FEET	(14.3	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.17	—— VC ——	
Fuel		0.855	GPH.	0.95	0.4000	0.32	0.72	0.019
Oil		15%	FUEL	COST	0.0000	0.05	—— FC ——	
Repair		4.1%	LIST	PRIC	0.4400	0.10	7.46	0.193
Ownshp Tractor		55.76	T.HR	85.85	0.0697	5.98	—— TC ——	
Ownshp Implemt		800	ACRS	21.22	0.0697	1.48	8.10	0.211

CROPPING SYSTEM
Tribune
(Cont)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
2WD1	MAY 30	5.25	MPH.	(83.5%	Eff.)			
Disk 30%		20	FEET	(10.6	A/Hr)			
Labor		1	HOUR	6.00	0.0941	0.17	—— VC ——	
Fuel		0.855	GPA.	0.95	0.3000	0.24	0.58	0.015
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		4.1%	LIST	PRIC	0.4200	0.13	3.03	0.078
Ownshp Tractor		56.46	T.HR	17.27	0.0941	1.63	—— TC ——	
Ownshp Implemt		600	ACRS	14.97	0.0941	1.41	3.61	0.093
2WD2	MAY 30	5.25	MPH.	(83.5%	Eff.)			
Disk 30%		20	FEET	(10.6	A/Hr)			
Labor		1	HOUR	6.00	0.0941	0.17	—— VC ——	
Fuel		0.855	GPA.	0.95	0.3000	0.24	0.58	0.015
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		4.1%	LIST	PRIC	0.4200	0.13	3.03	0.078
Ownshp Tractor		56.46	T.HR	17.27	0.0941	1.63	—— TC ——	
Ownshp Implemt		600	ACRS	14.97	0.0941	1.41	3.61	0.093
2WD	JUN 5	4.50	MPH.	(67.5%	Eff.)			
Planter1	(12 row)	30	FEET	(11.0	A/Hr)			
Labor	(50%)	1	HOUR	6.00	0.0905	0.27	—— VC ——	
Fuel		0.502	GPA.	0.95	0.5000	0.24	0.96	0.025
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		7.3%	LIST	PRIC	0.8300	0.42	3.20	0.083
Ownshp Tractor		90.53	T.HR	17.27	0.0905	1.56	—— TC ——	
Ownshp Implemt		1000	ACRS	18.12	0.0905	1.64	4.16	0.107
2WD	JUN 5	4.50	MPH.	(67.5%	Eff.)			
Planter2	(12 row)	30	FEET	(11.0	A/Hr)			
Labor	(50%)	1	HOUR	6.00	0.0905	0.27	—— VC ——	
Fuel		0.502	GPA.	0.95	0.5000	0.24	0.96	0.025
Oil		15%	FUEL	COST	0.0000	0.04	—— FC ——	
Repair		7.3%	LIST	PRIC	0.8300	0.42	5.47	0.141
Ownshp Tractor		90.53	T.HR	17.27	0.0905	1.56	—— TC ——	
Ownshp Implemt		1000	ACRS	43.10	0.0905	3.91	6.43	0.166
Sorghum Seed		1.75	LBS.	1.25	$50/BG	2.19		0.056
Crop Insurance			LEVEL	I	1.75	5.00		0.129

Table E.14

CROPPING SYSTEM
Tribune

SORGHUM: Conventional Sorghum-Sorghum (CVSS)
(CONT.) Cultivate, Harvest

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
2WD1	JUL 12	4.25	MPH.	(76.5%	Eff.)			
Cultivate	100%	38	FEET	(11.0	A/Hr)			
Labor		1	HOUR	6.00	0.0846	0.51	—— VC ——	
Fuel		0.42	GPA.	0.95	1.0000	0.40	2.01	0.052
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		9.1%	LIST	PRIC	1.0500	1.05	2.24	0.058
Ownshp Tractor		169.17	T.HR	17.27	0.0846	1.46	—— TC ——	
Ownshp Implemt		2000	ACRS	9.24	0.0846	0.78	4.26	0.110
2WD2	JUL 30	4.50	MPH.	(76.5%	Eff.)			
Cultivate	100%	38	FEET	(12.5	A/Hr) -			
Labor		1	HOUR	6.00	0.0799	0.48	—— VC ——	
Fuel		0.417	GPA.	0.95	1.0000	0.40	1.98	0.051
Oil		15%	FUEL	COST	0.0000	0.06	—— FC ——	
Repair		9.1%	LIST	PRIC	1.0500	1.05	2.16	0.056
Ownshp Tractor		159.77	T.HR	17.27	0.0799	1.38	—— TC ——	
Ownshp Implemt		2000	ACRS	9.82	0.0799	0.78	4.15	0.107
2,4-D	JUL 15	0.5	LBS.	3.88		1.94		
Application (100%)		1	ACRE	3.00		3.00		
(landlord)		33%	SPLT		4.94	-1.63	3.85	0.099
PARATHION	AUG 1	0.5	LBS.	4.31		0.54		
Application (25%)		1	ACRE	3.00		0.75		
(landlord)		33%	SPLT		1.29	-0.43	1.00	0.026
HARVEST	OCT 8							
Custom Combine		1	ACRE	13.00		13.00		
Bushel Bonus)38		8.8	BSHL	0.13		1.14		
Truck Hauling		39	BSHL	0.13		5.04		
TOTAL HARVEST EXPENSE						19.18	19.18	0.495

CROPPING SYSTEM
Tribune

SORGHUM: Conventional Sorghum-Sorghum (CVSS)
Prepare Seedbed, Plant Sorghum, Cultivate, Harvest Sorghum

	T$/ Bushel	Total	Cash	(Your Farm) Total	(Your Farm) Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.424 Hours	0.066	2.54	1.46	——	——
2. Seed	0.056	2.19	2.19	——	——
3. Herbicide *	0.000	4.94	4.94	——	——
4. Insecticide *	0.000	1.29	1.29	——	——
5. Fertilizer *	0.182	7.05	7.05	——	——
6. Fuel ($/gallon)=$0.95	0.075	2.89	2.89	——	——
7. Oil	0.011	0.43	0.43	——	——
8. Equip. repair	0.098	3.79	3.79	——	——
9. Custom Hire (Harvest Exp)	0.495	19.18	19.18	——	——
10. Interest (1/2 VC @ 15%)	0.086	3.32	1.99	——	——
A. TOTAL VARIABLE COSTS (Own Land)	1.261	48.85	46.52		
TOTAL VARIABLE COSTS (Rent Land) *	1.147	44.46	42.14	——	——
FIXED COSTS PER ACRE					
12. Real Estate Taxes (50c/$100)	0.103	4.00	4.00	——	——
13. Interest on Land	0.619	24.00	12.24	——	——
OR ($400 x 6%)	(24% LT DEBT @ 12%)				
14. Share Rent (Returns x 33%)	0.769	29.81	29.81	——	——
15. Depreciation on Machinery	0.206	7.99	0.00	——	——
16. Interest on Machinery	0.243	9.42	3.11	——	——
17. Insurance, and Housing	0.033	1.26	1.26	——	——
B. TOTAL FIXED COSTS (Rent Land)	1.251	48.48	34.18	——	——
TOTAL FIXED COSTS (Owned Land)	1.204	46.67	20.61	——	——
C. TOTAL COSTS PER ACRE RENTED	2.398	92.94	76.31	——	——
TOTAL COSTS PER ACRE OWNED	2.465	95.52	67.13	——	——
D. YIELD Per Acre			38.75	——	
E. PRICE / Bushel		(cwt. 4.12)	$2.31	——	
F. RETURNS PER ACRE			89.51	——	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.16	43.60	47.38	——	——
H. RETURNS OVER TOTAL COSTS (RENTED)	-0.09	-3.43	13.20	——	——
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.15	-6.00	22.38	——	——
J. ANNUAL NET RETURNS PER AC. (AVE.)	-0.11	-4.28	16.23	——	——
K. NET RETURN TO MANAGEMENT		-8556	32461	——	——

* Assumes landlord paying 1/3 of herbicide (1.63), insecticide (0.43), and fertilizer (2.33) on rent land.

Table E.15

CROPPING SYSTEM
Tribune
SORGHUM: Conservation Sorghum-Fallow (CTSF)
YEAR 1: Fallow

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	MAY 1	5.50	MPH.	(80.0%	Eff.)			
V-Blade Swp 100%		42	FEET	(22.40	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.27	— VC —	
Fuel		0.748	GPA.	0.95	1.0000	0.71	1.71	0.026
Oil		15%	FUEL	COST	0.0000	0.11	— FC —	
Repair		3.3%	LIST	PRIC	0.6200	0.62	4.50	0.070
Ownshp Tractor		44.04	T.HR	71.5	0.0446	3.19	— TC —	
Ownshp Implemt		1000	ACRS	29.2	0.0446	1.30	6.20	0.096
4WD	JUN 5	5.25	MPH.	(83.5%	Eff.)			
Disk 57%		27	FEET	(14.35	A/Hr)			
Labor		1	HOUR	6.00	0.0697	0.23	— VC —	
Fuel		0.855	GPA.	0.95	0.5600	0.45	1.47	0.023
Oil		15%	FUEL	COST	0.0000	0.07	— FC —	
Repair		4.1%	LIST	PRIC	1.2700	0.71	7.02	0.109
Ownshp Tractor		40.01	T.HR	71.54	0.0697	4.99	— TC —	
Ownshp Implemt		574	ACRS	29.18	0.0697	2.03	8.49	0.131
2WD	JUN 5	5.25	MPH.	(83.5%	Eff.)			
Disk 43%		20	FEET	(10.63	A/Hr)			
Labor		1	HOUR	6.00	0.0941	0.25	— VC —	
Fuel		0.855	GPA.	0.95	0.4400	0.36	1.16	0.018
Oil		15%	FUEL	COST	0.0000	0.05	— FC —	
Repair		4.1%	LIST	PRIC	1.1400	0.50	3.15	0.049
Ownshp Tractor		40.09	T.HR	12.85	0.0941	1.21	— TC —	
Ownshp Implemt		426	ACRS	20.58	0.0941	1.94	4.31	0.067
4WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 58%		42	FEET	(22.40	A/Hr)			
Labor		1	HOUR	6.00	0.0446	0.16	— VC —	
Fuel		0.748	GPA.	0.95	0.5800	0.41	0.99	0.015
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		3.3%	LIST	PRIC	0.6200	0.36	4.46	0.069
Ownshp Tractor		26.07	T.HR	71.54	0.0446	3.19	— TC —	
Ownshp Implemt		584	ACRS	28.41	0.0446	1.27	5.45	0.084
2WD	JUL 15	5.50	MPH.	(80.0%	Eff.)			
V-Blade Sweep 42%		30	FEET	(16.00	A/Hr)			
Labor		1	HOUR	6.00	0.0625	0.16	— VC —	
Fuel		0.748	GPA.	0.95	0.4200	0.30	1.28	0.020
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		3.3%	LIST	PRIC	1.8600	0.78	4.60	0.071
Ownshp Tractor		26.00	T.HR	12.85	0.0625	0.80	— TC —	
Ownshp Implemt		416	ACRS	60.72	0.0625	3.80	5.88	0.091

CROPPING SYSTEM
Tribune
(Cont)

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit/ Acre	$/ Acre	$/ Operation	$/ Bushel
4WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 56%		48	FEET	(26.76	A/Hr)			
Labor		1	HOUR	6.00	0.0374	0.13	— VC —	
Fuel		0.481	GPA.	0.95	0.5600	0.26	1.23	0.019
Oil		15%	FUEL	COST	0.0000	0.04	— FC —	
Repair		6.0%	LIST	PRIC	1.4500	0.81	4.29	0.066
Ownshp Tractor		21.30	T.HR	71.54	0.0374	2.67	— TC —	
Ownshp Implemt		570	ACRS	43.37	0.0374	1.62	5.53	0.086
2WD	AUG 12	5.75	MPH.	(80.0%	Eff.)			
Rod Weeder 44%		36	FEET	(20.07	A/Hr)			
Labor		1	HOUR	6.00	0.0498	0.13	— VC —	
Fuel		0.481	GPA.	0.95	0.4400	0.20	0.89	0.014
Oil		15%	FUEL	COST	0.0000	0.03	— FC —	
Repair		6.0%	LIST	PRIC	1.2000	0.53	2.05	0.032
Ownshp Tractor		21.42	T.HR	12.85	0.0498	0.64	— TC —	
Ownshp Implemt		430	ACRS	28.27	0.0498	1.41	2.94	0.045
2WD	OCT 20	4.50	MPH.	(76.5%	Eff.)			
List 'Beds' 100%		30	FEET	(12.52	A/Hr)			
Labor		1	HOUR	6.00	0.0799	0.48	— VC —	
Fuel		0.417	GPA.	0.95	1.0000	0.40	1.30	0.021
Oil		15%	FUEL	COST	0.0000	0.06	— FC —	
Repair		8.5%	LIST	PRIC	0.4500	0.45	1.39	0.022
Ownshp Tractor		79.88	T.HR	12.85	0.0799	1.03	— TC —	
Ownshp Implemt		1000	ACRS	4.61	0.0799	0.37	2.78	0.043
Total Variable Costs for all Operations							9.82	0.152
Total Fixed Costs for all Operations							31.46	0.487
TOTAL TILLAGE COSTS YEAR 1 (Per Acre)							$41.28	0.639

2WD	APR 20	5.00	MPH.	(76.5%	Eff.)			
Lilliston 150%		30	FEET	(13.91	A/Hr)			
Labor		1	HOUR	6.00	0.0719	0.65	— VC —	
Fuel		0.417	GPA.	0.95	1.0000	0.59	2.22	0.030
Oil		15%	FUEL	COST	0.0000	0.09	— FC —	
Repair		8.5%	LIST	PRIC	0.5900	0.89	1.26	0.046
Ownshp Tractor		107.04	T.HR	12.85	0.0719	0.92	— TC —	
Ownshp Implemt		1500	ACRS	4.61	0.0719	0.33	3.47	0.076

Table E.16

CROPPING SYSTEM
Tribune

SORGHUM: Conservation Sorghum-Fallow (CTSF)
YEAR II: Plant Sorghum in Beds, Harvest Sorghum

INPUT	(Date)	Quantity	Unit	$/ Unit	Unit Acre	$/ Acre	$/ Operation	$/ Bushel
NITROGEN	MAY 1	30	LBS.	0.27		8.10		
Application		1	ACRE	3.00		3.00		
(landlord)		33%	SPLT		11.10	-3.66	8.65	
2WD	JUN 5	4.25	MPH.	(67.5%	Eff.)			
Planter (12-row)		30	FEET	(10.43	A/Hr)			
Labor		1	HOUR	6.00	0.0959	0.58	—— VC ——	
Fuel		0.502	GPA.	0.95	1.0000	0.48	2.99	0.03
Oil		15%	FUEL	COST	0.0000	0.07	—— FC ——	
Repair		7.3%	LIST	PRIC	1.8700	1.87	2.97	0.034
Ownshp Tractor		95.86	T.HR	12.85	0.0959	1.23	—— TC ——	
Ownshp Implemt		1000	ACRS	18.12	0.0959	1.74	5.96	0.064
ATRAZINE	JUN 10	1	LBS.	2.85		2.85		
Application		1	ACRE	3.00		3.00		
(landlord)		33%	SPLT		5.85	-1.93	4.56	0.081
Sorghum Seed		1.75	LBS.	1.25	$50/BG	2.19		
Insurance			LEVEL	I	1.75	5.00		
2WD	JUL 12	4.25	MPH.	(76.5%	Eff.)			
Cultivate (12-row)		30	FEET	(11.82	A/Hr)			
Labor		1	HOUR	6.00	0.0846	0.17	—— VC ——	
Fuel		0.417	GPA.	0.95	0.3300	0.13	0.49	0.03
Oil		15%	FUEL	COST	0.0000	0.02	—— FC ——	
Repair		9.1%	LIST	PRIC	0.5200	0.17	1.07	0.034
Ownshp Tractor		28.17	T.HR	12.85	0.0846	1.09	—— TC ——	
Ownshp Implemt		333	ACRS	9.24	0.0846	0.78	2.36	0.064
2,4-D	JUL 15	0.5	LBS.	3.88		0.64		
Application (33%)		1	ACRE	3.00		0.99		
(landlord)		33%	SPLT		1.63	-0.21	1.49	0.023
PARATHION	AUG 1	0.5	LBS.	4.31		0.54		
Application (25%)		1	ACRE	3.00		0.75		
(landlord)		33%	SPLT		1.29	-0.43	1.00	0.016
HARVEST	OCT 8							
Custom Combine		1	ACRE	13.00		13.00		
Bushel Bonus)30		35	BSHL	0.13		4.50		
Truck Hauling		65	BSHL	0.13		8.40		
TOTAL HARVEST EXPENSE						25.90	25.90	0.435

ENTERPRISE BUDGET
Tribune

SORGHUM: Conservation Tillage Sorghum-Fallow (CTSF)
YEAR I: Fallow, YEAR II: Plant Sorghum and Harvest

	T$/ Bushel	Total	Cash	(Your Farm) Total	Cash
VARIABLE COSTS PER ACRE					
1. Labor $6/Hr. x 0.599 Hours	0.056	3.60	1.11	——	——
2. Seed	0.034	2.19	2.19	——	——
3. Herbicide *	0.116	7.48	7.48	——	——
4. Insecticide *	0.020	1.29	1.29	——	——
5. Fertilizer *	0.172	11.10	11.10	——	——
6. Fuel ($/Gallon)=$0.95	0.066	4.29	4.29	——	——
7. Oil	0.010	0.64	0.64	——	——
8. Equipment repair	0.119	7.69	7.69	——	——
9. Custom Hire (Harvest Exp)	0.401	25.90	25.90	——	——
10. Interest (1/2 VC @ 15%)	0.072	4.63	2.78	——	——
A. TOTAL VARIABLE COSTS (Own Land)	1.065	68.80	64.47	——	——
TOTAL VARIABLE COSTS (Rent Land) *	0.968	62.57	58.24	——	——
FIXED COSTS PER ACRE					
11. Real Estate Taxes	0.124	8.00	8.00	——	——
12. Interest on Land	0.743	48.00	24.48	——	——
OR ($400/A x 2 x 6%)	(24% LT DEBT,		12%i)		
13. Share Rent (Returns x 33%)	0.769	49.70	49.70	——	——
14. Depreciation on Machinery	0.172	11.12	0.00	——	——
15. Interest on Machinery	0.201	13.00	4.29	——	——
16. Insurance, and Housing	0.027	1.77	1.77	——	——
B. TOTAL FIXED COSTS (Rent Land)	1.170	75.59	55.76	——	——
TOTAL FIXED COSTS (Owned Land)	1.267	81.89	38.54	——	——
C. TOTAL COSTS PER ACRE RENT LAND	2.138	138.16	114.00	——	——
TOTAL COSTS PER ACRE OWNED LAND	2.332	150.69	103.01	——	——
D. YIELD Per Acre			64.61	——	
E. PRICE / Bushel		(cwt. 4.12)	$2.31	——	
F. RETURNS PER ACRE			149.25	——	
G. RETURNS OVER VARIABLE COSTS (AVE.)	1.31	84.62	91.01	——	——
H. RETURNS OVER TOTAL COSTS (RENTED)	0.17	11.09	35.25	——	——
I. RETURNS OVER TOTAL COSTS (OWNED)	-0.02	-1.44	46.24	——	——
J. ANNUAL NET RETURN PER ACRE (AVE.)	0.11	6.96	38.88	——	——
K. NET RETURN TO MANAGEMENT		6956	38880	——	——

* Assumes Landlord paying 1/3 of herbicide (2.14), insecticide (0.43), and fertilizer (3.66) on rent land.

LANDLORD NET INCOME / ACRE Sor. 43.47 T/YEAR 21.73

Appendix F

This appendix contains the summary page of the K-FARM cash flow program.

Table F.1

K-FARM Cash Flow Summary
for Reduced Tillage Wheat-Sorghum-Fallow

CASH FLOW BUDGET

RTWSF

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
LABOR	0	0	0	0	156	295	463	83	0	0	0	0	997
REPAIRS	0	0	0	0	1,207	2,526	3,207	1,338	1,305	0	0	0	9,583
INTEREST	0	0	0	7,206	0	0	0	0	0	0	19,600	0	26,806
CASH RENT	0	0	0	0	0	0	0	0	0	0	0	0	0
FEED PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
SEED	0	0	0	0	0	1,459	0	0	2,664	0	0	0	4,123
HERBICIDES/INSECTICIDE	0	0	0	0	0	0	4,057	670	0	0	0	0	4,727
FERTILIZER&LIME	0	0	4,720	4,720	0	0	0	0	0	0	0	0	9,440
CUSTOM HIRE	0	0	0	0	0	13,340	0	0	0	15,254	0	0	28,594
SUPPLIES & MISC.	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVESTOCK EXPENSES	0	0	0	0	0	0	0	0	0	0	0	0	0
FUEL	0	0	0	0	553	906	1,439	352	299	0	0	0	3,549
TAXES	0	0	0	0	0	1,332	0	0	0	0	0	1,332	2,664
ALL INSURANCE	0	0	0	0	0	0	0	0	0	1,980	0	0	1,980
UTILITIES	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSERVATION	0	0	0	0	0	0	0	0	0	0	0	0	0
AUTO	0	0	0	0	0	0	0	0	0	0	0	0	0
FEES AND DUES	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT OPERATING EXPENSES	0	0	4,720	11,926	1,916	19,858	9,166	2,443	4,268	17,234	19,600	1,332	92,463
LIVESTOCK PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
MACHINE PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
BUILDING PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
LOAN PRIN. PAYMENTS	0	0	0	945	0	0	0	0	0	0	26,100	0	27,045
LAND PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT CASH OUTFLOW	0	0	4,720	12,871	1,916	19,858	9,166	2,443	4,268	17,234	45,700	1,332	119,508
FAMILY LIVING EXPENSES	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	18,000
STATE INCOME TAXES	0	0	0	0	0	0	0	0	0	0	0	0	0
FICA&FED INCOME TAX	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-FARM CASH OUTFLOW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL CASH OUTFLOW	1,500	1,500	6,220	14,371	3,416	21,358	10,666	3,943	5,768	18,734	47,200	2,832	112,042
NET CASHFLOW	-1,500	-1,500	-6,220	-14,371	-3,416	-21,358	52,511	-3,943	-5,768	44,922	-47,200	-2,832	-10,675
BEGINING LOAN BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0
PROJECTED LOAN BALANCE	1,500	3,018	9,275	23,761	27,474	49,175	-2,722	1,187	6,969	-37,866	8,861	11,803	11,950
INTEREST ON OPER. LOAN	18	37	115	297	343	614	-34	14	87	-473	110	147	1,275
PROJ. LOAN&INTEREST	1,518	3,055	9,390	24,058	27,817	49,789	-2,756	1,201	7,056	-38,339	8,971	11,950	11,950

Table F.2

K-FARM Cash Flow Summary for
Conservation Tillage Sorghum-Fallow

CASH FLOW BUDGET CTSF	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
LABOR	0	0	0	0	0	525	322	125	0	0	0	0	972
REPAIRS	0	0	0	890	620	3,180	1,310	1,240	0	450	0	0	7,690
INTEREST	0	0	0	7,206	0	0	0	0	0	0	18,220	0	25,426
CASH RENT	0	0	0	0	0	0	0	0	0	0	0	0	0
FEED PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
SEED	0	0	0	0	2,187	0	0	0	0	0	0	0	2,187
HERBICIDES/INSECTICIDE	0	0	0	0	0	4,562	1,271	1,006	0	0	0	0	6,839
FERTILIZER&LIME	0	0	8,656	0	0	0	0	0	0	0	0	0	8,656
CUSTOM HIRE	0	0	0	0	0	0	0	0	0	25,900	0	0	25,900
SUPPLIES & MISC.	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVESTOCK EXPENSES	0	0	0	0	0	0	0	0	0	0	0	0	0
FUEL	0	0	0	680	820	1,480	960	530	0	460	0	0	4,930
TAXES	0	0	0	0	0	1,332	0	0	0	0	0	1,332	2,664
ALL INSURANCE	0	0	0	0	0	0	0	0	0	1,780	0	0	1,780
UTILITIES	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSERVATION	0	0	0	0	0	0	0	0	0	0	0	0	0
AUTO	0	0	0	0	0	0	0	0	0	0	0	0	0
FEES AND DUES	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT OPERATING EXPENSES	0	0	8,656	8,776	3,627	11,079	3,863	2,901	0	28,590	18,220	1,332	87,044
LIVESTOCK PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
MACHINE PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
BUILDING PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
LOAN PRIN. PAYMENTS	0	0	0	945	0	0	0	0	0	0	24,280	0	25,225
LAND PURCHASED	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT CASH OUTFLOW	0	0	8,656	9,721	3,627	11,079	3,863	2,901	0	28,590	42,500	1,332	112,269
FAMILY LIVING EXPENSES	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	18,000
STATE INCOME TAXES	0	0	0	0	0	0	0	0	0	0	0	0	0
FICA&FED INCOME TAX	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-FARM CASH OUTFLOW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL CASH OUTFLOW	1,500	1,500	10,156	11,221	5,127	12,579	5,363	4,401	1,500	30,090	44,000	2,832	137,508
NET CASHFLOW	-1,500	-1,500	-10,156	-11,221	-5,127	-12,579	-5,363	-4,401	-1,500	86,306	-44,000	-2,832	-13,873
BEGINING LOAN BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0
PROJECTED LOAN BALANCE	1,500	3,018	13,211	24,597	30,031	42,985	48,885	53,897	56,070	-29,536	14,095	17,103	17,316
INTEREST ON OPER. LOAN	18	37	165	307	375	537	611	673	700	-369	176	213	3,443
PROJ. LOAN&INTEREST	1,518	3,055	13,376	24,904	30,406	43,522	49,496	64,570	56,770	-29,905	14,271	17,316	17,316

Table F.3

K-FARM Cash Flow Summary for
Reduced Tillage Wheat-Fallow

CASN FLOW BUDGET

RTWF	JAN	FEB	NAR	APR	NAY	JUN	JUL	AUG	SEP	OCT	NOV	OEC	TOTAL
LABOR	0	0	0	0	0	155	313	125	0	0	0	0	593
REPAIRS	0	0	0	0	0	580	1,160	1,340	1,300	0	0	0	4,380
INTEREST	0	0	0	7,206	0	0	0	0	0	0	15,520	0	22,726
CASN RENT	0	0	0	0	0	0	0	0	0	0	0	0	0
FEED PURCHASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
SEED	0	0	0	0	0	0	0	0	4,000	0	0	0	4,000
HER8ICIDES/INSECTICIDE	0	0	0	0	0	0	4,008	0	0	0	0	0	4,008
FERTILIZER&LINE	0	0	8,656	0	0	0	0	0	0	0	0	0	8,656
CUSTON NIRE	0	0	0	0	0	20,340	0	0	0	0	0	0	20,340
SUPPLIES & NISC.	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVESTOCK EXPENSES	0	0	0	0	0	0	0	0	0	0	0	0	0
FUEL	0	0	0	0	0	810	1,620	530	450	0	0	0	3,410
TAXES	0	0	0	0	0	1,332	0	0	0	0	0	1,332	2,664
ALL INSURANCE	0	0	0	0	0	0	0	0	0	1,640	0	0	1,640
UTILITIES	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSERVATION	0	0	0	0	0	0	0	0	0	0	0	0	0
AUTO	0	0	0	0	0	0	0	0	0	0	0	0	0
FEES ANO OUES	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT OPERATING EXPENSES	0	0	8,656	7,206	0	23,217	7,101	1,995	5,750	1.640	15,520	1,332	72,417
LIVESTOCK PURCNASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
NACNINE PURCHASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
8UILDING PURCHASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
LOAN PRIN. PAYNEMTS	0	0	0	945	0	0	0	0	0	0	20.680	0	21,625
LAND PURCHASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT CASN OUTFLOW	0	0	8,656	8,161	0	23,217	7,101	1,995	6,750	1,640	36,200	1,332	94,042
FANILY LIVING EXPENSES	1,600	1,500	1,500	1,500	1,600	1,600	1,600	1,500	1,500	1,500	1,500	1,500	18,000
STATE INCONE TAXES	0	0	0	0	0	0	0	0	0	0	0	0	0
FICA&FEO INCONE TAX	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-FARN CASN OUTFLOW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL CASH OUTFLOW	1,500	1,500	10,156	9,651	1,500	24,717	8,601	3,495	7,250	3,140	37,700	2,832	109,174
NET CASHFLOW	-1,500	-1,500	-10,156	-9.651	-1,500	-24,717	89,464	-3,495	-7,250	-3,140	-37.700	-2,832	-13,977
BEGINING LOAN BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0
PROJECTEO LOAN BALANCE	1,500	3,018	13,211	23,027	24,814	49,841	-39,000	-35,992	-29,191	-26,415	10,955	13,923	14,097
INTEREST ON OPER. LOAN	18	37	165	287	310	623	-487	-449	-364	-330	136	174	120
PROJ. LOAN&INTEREST	1,518	3,055	13,376	23,314	25,124	50,464	-39,487	-36,441	-29,555	-26,745	11,091	14,097	14,097

Table F.4

K-FARM Cash Flow Summary for
Conventional Tillage Wheat-Fallow

CASN FLOW BUOGET

CVWF	JAN	FEB	NAR	APR	NAY	JUN	JUL	AUG	SEP	OCT	NOV	OEC	TOTAL
LABOR	0	0	0	0	0	155	313	125	0	0	0	0	593
REPAIRS	0	0	0	0	1,070	490	980	820	1,820	290	0	0	5,470
INTEREST	0	0	0	7,206	0	0	0	0	0	0	15,520	0	22,726
CASN RENT	0	0	0	0	0	0	0	0	0	0	0	0	0
FEEO PURCNASED	0	0	0	0	0	0	0	0	0	0	0	0	0
SEEO	0	0	0	0	0	0	0	0	4,000	0	0	0	4,000
NERBICIOES/INSECTICIDE	0	0	0	0	0	0	0	0	0	0	0	0	0
FERTILIZER&LINE	0	0	8,656	0	0	0	0	0	0	0	0	0	8,656
CUSTON NIRE	0	0	0	0	0	18,550	0	0	0	0	0	0	18,550
SUPPLIES & NISC.	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVESTOCK EXPENSES	0	0	0	0	0	0	0	0	0	0	0	0	0
FUEL	0	0	0	0	700	810	1,620	530	980	610	0	0	5,250
TAXES	0	0	0	0	0	1,332	0	0	0	0	0	1,332	2,664
ALL INSURANCE	0	0	0	0	0	0	0	0	0	1,640	0	0	1,640
UTILITIES	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSERVATION	0	0	0	0	0	0	0	0	0	0	0	0	0
AUTO	0	0	0	0	0	0	0	0	0	0	0	0	0
FEES ANO DUES	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT OPERATING EXPENSES	0	0	8,656	7,206	1,770	21,337	2,913	1,475	6,800	2,540	15,520	1,332	69,549
LIVESTOCK PURCNASED	0	0	0	0	0	0	0	0	0	0	0	0	0
NACNINE PURCNASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
BUILDING PURCNASED	0	0	0	0	0	0	0	0	0	0	0	0	0
LOAN PRIN. PAYNENTS	0	0	0	945	0	0	0	0	0	0	20,680	0	21,625
LANO PURCNASEO	0	0	0	0	0	0	0	0	0	0	0	0	0
TOT CASN OUTFLOW	0	0	8,656	8,151	1,770	21,337	2,913	1,475	6,800	2,540	36,200	1,332	91,174
FANILY LIVING EXPENSES	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	18,000
STATE INCONE TAXES	0	0	0	0	0	0	0	0	0	0	0	0	0
FICA&FED INCOME TAX	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-FARN CASN OUTFLOW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL CASN OUTFLOW	1,500	1,500	10,156	9,651	3,270	22,837	4,413	2,975	8,300	4,040	37,700	2,832	130,269
NET CASNFLOW	-1,500	-1,500	-10,156	-9,651	-3,270	-22,837	75,997	-2,975	-8,300	-4,040	-37,700	-2,832	-28,764
BEGINING LOAN BALANCE	0	0	0	0	0	0	0	0	0	0	0	0	0
PROJECTED LOAN BALANCE	1,500	3,018	13,211	23,027	26,584	49,753	-25,623	-22,968	-14,955	-11,101	26,461	29,623	29,993
INTEREST ON OPER. LOAN	18	37	165	287	332	621	-320	-287	-186	-138	330	370	1,229
PROJ. LOAN&INTEREST	1,518	3,055	13,376	23,314	26,916	50,374	-25,943	-23,255	-15,141	-11,239	26,791	29,993	29,993

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ECONOMIC ANALYSIS OF REDUCED TILLAGE WHEAT
AND GRAIN SORGHUM ROTATIONS IN WESTERN KANSAS

By

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1985

The purpose of this study is to evaluate the economic potential and associated risks of conventional and conservation (reduced) tillage systems for wheat and sorghum in Western Kansas. Reduced tillage systems for wheat and sorghum were compared with conventional wheat and sorghum cropping systems typical of Western Kansas and the Central Great Plains. Experiment Station yield and price data from 1973-1983 were used with 1984 cost of production estimates to determine expected returns to a case farm.

The representative base case farm was established from data of 95 actual farming units in the Southwest Farm Management Association, Kansas State University. A 2000 acre dryland cash grain farm was used as the basis for this study. Of the 2000 acres, 1340 acres are rented, with one-third of the crop going to the landlord. Owned acres total 660, with long term debt against 158 acres.

Tillage requirements, and input requirements for cropping systems were established with the help of Agronomists, and Experiment Station Personnel. Cropping systems included in this study are: 1) conventional tillage wheat-fallow, 2) reduced tillage wheat-fallow, 3) conventional tillage wheat-wheat, 4) conventional tillage wheat-sorghum-fallow, 5) reduced tillage wheat-sorghum-fallow, 6) conventional tillage sorghum-sorghum, and 7) conservation tillage sorghum-fallow.

An equipment complement capable of completing optimal tillage and planting requirements in 85% of the years for the benchmark conventional wheat-fallow system was established using Agricultural Engineering worksheets. This set of equipment consists of one 230 horsepower tractor, one 180 horsepower tractor, disks, v-blades, and rodweeders for tillage operations. A hoedrill is used to plant wheat. In the continuous systems, a third equipment complement is added to the previously described complement. Sorghum planting and cultivation equipment is added to systems containing grain sorghum to maintain optimal requirements in all systems. Harvest and chemical applications are assumed custom hired.

Enterprise budgets are used to analyze the costs and returns of each cropping system. Labor, fuel, oil, and repair costs are estimated for each tillage operation in the cropping systems. These costs are summed with seed, fertilizer, insecticide, fertilizer, and harvest expenses to calculate the variable costs per system. The fixed costs are calculated based on the format of extension enterprise budgets at Kansas State. Cash flow budgets complete the analysis.

Results of the study show that reduced and conservation tillage systems tend to produce greater yields, and increase net farm income when compared to other systems. Reduced till systems, which use mainly Atrazine for weed control, required fewer tillage operations, using less fuel and labor, but had greater expenditures for chemicals when compared to conventional tillage systems. The reduced till wheat-sorghum-fallow system generated the greatest average annual returns to management of $11,580 over the eleven year period studied. Conservation sorghum-fallow had average returns of $6956, followed by reduced till wheat-fallow with $5131. All of the remaining systems had negative returns, with the conventional wheat-fallow system losing $10,705 on the average.

Risk analysis revealed that yields of reduced tillage systems were generally less variable than their conventional counterparts. Systems containing sorghum tended to generate higher incomes with more variability than systems with only wheat. When consideration was given to variability of income, the reduced tillage wheat-fallow had the lowest potential variability. Therefore, individuals who are risk adverse would prefer this system over others. The coefficient of variation of income is interpreted as a measure of risk per dollar of expected income. Results from this measure show farmers who were risk adverse would likely prefer the reduced tillage wheat-sorghum-fallow cropping system.

Cash flow requirements were the largest for the conservation sorghum-fallow system, due to increased tillage operations required for erosion control and the absence of any cash inflow until October each year. Whereas the other systems considered in cash flow analysis received income in July following the wheat harvest. The reduced till wheat-fallow, and wheat-sorghum-fallow systems did not require larger cash flow requirements than the conventional wheat-fallow system. The total operating lines of credit required for these three systems were within a 1.5% differential of each other.

ECONOMIC ANALYSIS OF REDUCED TILLAGE WHEAT AND GRAIN SORGHUM ROTATIONS IN WESTERN KANSAS

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