AN ECONOMIC EVALUATION OF ALTERNATIVE TILLAGE SYSTEMS AND PLANTING DATES FOR CONTINUOUS WINTER WHEAT PRODUCTION IN OKLAHOMA

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CHAPTER I

INTRODUCTION

General Problem

Recent conditions have jeopardized the financial existence of some American grain producers. Increasingly competitive agricultural export markets have forced many Oklahoma wheat producers to consider alternative means of raising receipts and/or reducing the costs of production.

The production system employed by a wheat grower plays a key role in his economic struggle for survival. Handke defines a wheat production system as ". . . .a unique combination and timing of field operations and operating inputs used to produce wheat. Any variation in the number, timing or quantity of operating inputs and field operations constitutes a different wheat production system." (Handke, 1982). Therefore, each system's financial viability is due to the unique multitude of field operations, inputs, and resource combinations that consolidate at specific times to produce a wheat forage and grain yield. A system's inputs are not only composed of such items as seed, fertilizers, herbicides, insecticides, and fuel, but also include machinery and equipment services, operating capital, labor, machinery repairs, and other substantial investments. Therefore, the substitution of one production system for another can create contrasting costs and receipts for a wheat farmer.

Alternative wheat production systems have been implemented in Oklahoma and other parts of the United States for a number of years. Aspects of these systems which have previously been examined include wheat forage and grain yields (Heer, 1985), machinery requirements (Epplin, Tice, Baquet, and Handke, 1982), risk analysis (Williams, Johnson, and Gwin, 1987), sensitivity analysis (Handke, 1982), soil water availability (Heer, 1985), multiple crop production systems (Shrestha, Debertin, Hall, and Anschel, 1988), as well as variable and fixed input costs (Handke, 1982). However, many key aspects of these systems have remained uninvestigated because the data necessary to draw verifiable conclusions have not been available.

Specific Problem

Wheat farmers have been searching for viable means of increasing their receipts or cutting their costs. The implementation of alternative wheat production systems offers one possible solution to this dilemma. However, many aspects of these alternative production systems need to be thoroughly researched before a farmer can be expected to make crucial, long-term decisions about such systems.

Purpose of the Study

The overall objective of this study is to determine the net returns associated with alternative wheat production systems available to Oklahoma wheat producers. Specific objectives are:

1. To define alternative wheat production systems in this study.
2. To determine the necessary field operations, operating inputs, and machinery requirements for each wheat production system.
3. To determine the operating input costs for alternative production systems.

4. To determine the economic impact of varying forage and grain yields among alternative production systems.
5. To determine the variability of net returns associated with alternative production systems.

Study Area

The study area employed in this research is identical to the one used by Handke. It consists of a hypothetical 1,280 acre farm in Garfield County, Oklahoma. One thousand two hundred forty acres of this farm are in continuous winter wheat production, and the remaining 40 acres consist of waterways, improvements, and waste (Handke, 1982). The soil type consists of a clay-loam soil. One type of clay-loam soil common to the area is the Renfrow-Vernon-Kirkland Association, which constitutes approximately 34 percent of this county's soil. Garfield County has an average annual precipitation rate of 29.15 inches, and it exhibits a continental, temperate, subhumid climate (United States Department of Agriculture, 1967). These attributes are part of the reason that Garfield County is Oklahoma's leading wheat producing county as shown in Figure 1 (Oklahoma Agricultural Statistics Service, 1986).

This particular study area is utilized for various reasons. First, since Garfield County is Oklahoma's leading wheat producing county, it is a natural candidate for the study of an "ideal" Oklahoma wheat farm location. Second, a wheat farm of this size would be considered "typical" for this highly wheat-intensive part of the state. Third, this area is geographically close to areas where alternative production system tests have been conducted by the Oklahoma State University Agronomy Department. Fourth, the timing of field operations, the types and quantities of inputs, and the field workdays available

ALL WHEAT PRODUCTION, OKLAHOMA, 1986

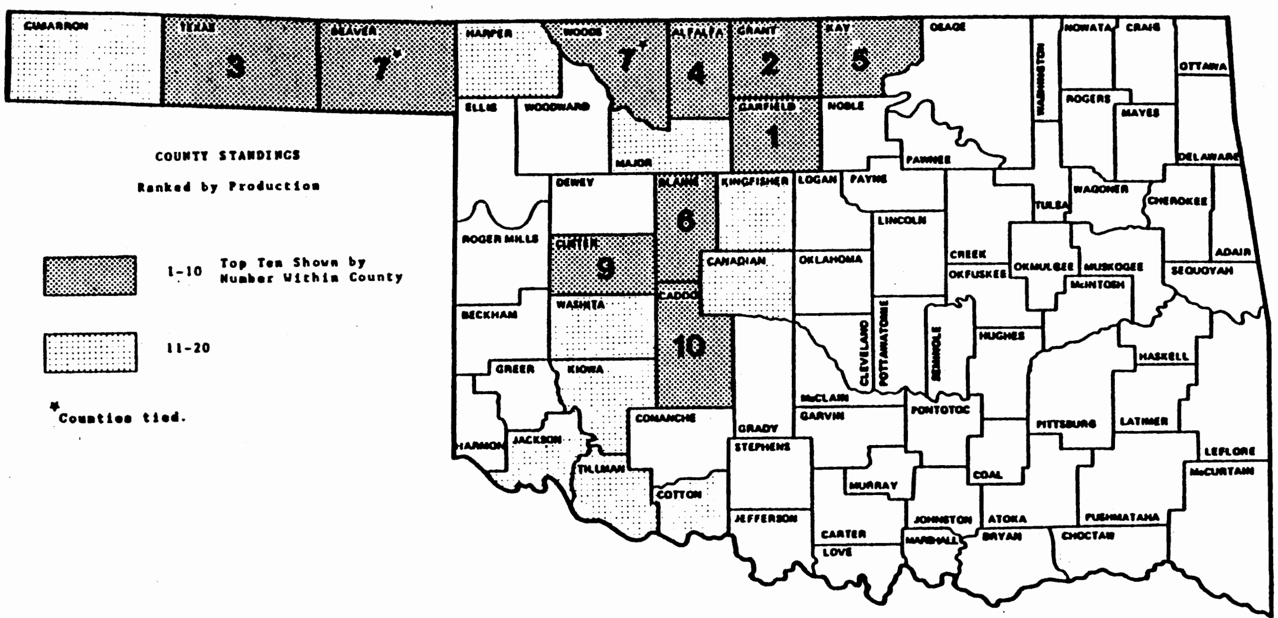

Figure 1. Leading Wheat Producing Counties in Oklahoma.

for performing such operations were estimated for the area.

Summary of Procedures

To determine various net returns, the first step is to define the set of alternative wheat production systems to be examined. Each system's required field operations must be established. Such a task involves listing the required field operations, as well as the proper sequence and timing of these operations. The next step entails recording the requisite operating inputs for each system, as well as the quantities and prices of these inputs.

The subsequent step consists of developing a machinery complement for each of the production systems to be studied. According to Handke, a machinery complement is an inventory of the machinery capable of performing the required field operations in the available field workdays (Handke, 1982). The formulation of a machinery complement is a very involved process, and it utilizes many components. The major components of a machinery complement include the required field operations for each system, the field workdays available to perform field operations, and a list and ranking of available machinery.

The required field operations for each of the production systems will be developed in this study, and therefore need no explanation at this time. The field workdays available to perform the required field operations must also be developed. This study employs available field workday estimates developed by Handke (Handke, 1982). The procedures and data used to develop these estimates will be discussed in the text.

The list and ranking of available power units (tractors) and implements capable of performing the required field operations is the final component to be developed. This component of the machinery complement is itself comprised of many elements. These elements include a list of the actual tractors and implements capable of being used in each system, the initial list and purchase prices of these machines, the widths of the implements, the horsepower for each tractor, the operating speeds and field efficiencies of all machinery, the repair cost values and remaining farm values for all machinery, the hours of life for all machinery, the number of hours that each piece of machinery is used on an annual basis, the number of years that each piece of machinery is owned, and the fuel multipliers for all tractors. These elements are all necessary in the development of a list and ranking of available machinery, which will be discussed later in this study.

Once the machinery complements are formed, they are incorporated with such information as the timing and sequence of required field operations, the prices and quantities of requisite operating inputs, wheat forage and grain yields, and the value of products yielded to develop an enterprise budget for each production system. Each of these budgets is calculated on a per acre basis and contains all of the information necessary to estimate total receipts, total operating costs, total fixed costs, and various net returns for each production system in that specific production period.

CHAPTER II

THE STUDY

Introduction

Three alternative continuous monoculture dryland winter wheat (Triticum aestivum L.) production systems are examined in this study. The first system is called the conventional tillage system. This system utilizes numerous tillage operations to control weeds and prepare a seed bed for planting. Of the three production systems discussed in this study, the conventional tillage system is currently the most widely implemented by Oklahoma wheat farmers. The second system is called the one tillage system. This system is a reduced tillage system that requires one tillage operation and various herbicide applications. The third system is called the zero tillage system and depends solely upon herbicide applications to control or suppress weed growth. Each system's required field operations will be discussed in detail.

At this point, it is necessary to distinguish between the terms "tillage operation" and "field operation." Foth maintains that a tillage operation has three main purposes: 1) to mechanically change the structure of the soil's top layer, 2) to disrupt weed germination and growth, and 3) to manage crop residues in the soil's top layer (Foth, 1978). Examples of a tillage operation include tandem disking, sweep plowing, moldboard plowing, and field cultivating.

A field operation is considered to be any mechanical procedure involved in the preparation, growth, or harvesting of a wheat crop in a field of production. Therefore, all tillage operations are considered to be field operations since they prepare the soil for a wheat crop. However, not all field operations are tillage operations. For example, the application of dry fertilizer (18-46-0) by a spreader does not disrupt weed germination or growth, manage crop residues, or substantially alter the soil's structure. Two other examples of a field operation that are not a tillage operation include the planting of wheat and the application of anhydrous ammonia (82-0-0). Although, both of these operations may disrupt weed development and slightly alter the soil's structure, they do not manage crop residues. Other field operations include the aerial application of insecticides and/or herbicides and the ground spray application of herbicides.

Three Alternative Tillage Systems

The conventional, one, and zero tillage systems will each be developed and examined in this study. Each of these systems is composed of a multitude of constituents. Among the constituents that will be reviewed for each system include the required field operations and the operating inputs.

Required Field Operations

The required field operations for each of the alternative tillage systems are contained in Table 1. The conventional tillage system is composed of four tillage operations and five additional field operations.

The conventional tillage system's first postharvest operation involves the tandem disk. The main purpose of this tillage practice is to mechanically kill existing weeds, to conserve soil moisture, to break up and incorporate crop

Table 1. Field Operations for Three Alternative Winter Wheat Tillage Systems in Oklahoma

Field Operations	Month
Conventional Tillage System	
Tandem Disk	June
Moldboard Plow	June
Fertilize (18-46-0)	August
Tandem Disk	August
Fertilize (82-0-0)	August
Field Cultivator	September
Conventional Drill (seed)	September
Aerial Spray (parathion & Glean, biannually)	February
Harvest	June
One Tillage System	
Sweep Plow and Mulch Treader	June
Ground Spray (Bladex & Aatrex)	June
Fertilize (82-0-0)	August
Ground Spray (Roundup)	September
Stubble Drill (seed & 18-46-0)	September
Ground Spray (Lexone or Sencor)	November
Aerial Spray (parathion, biannually)	February
Harvest	June
Zero Tillage System	
Ground Spray (Bladex, Aatrex, & Landmaster)	June
Fertilize (82-0-0)	August
Ground Spray (Roundup)	September
Stubble Drill (seed & 18-46-0)	September
Ground Spray (Lexone or Sencor)	November
Harvest	June

residues into the soil, and to prepare the ground for further tillage.

The next step employed in this system involves the moldboard plow. Moldboard plowing is usually performed in June, but timing may vary depending upon rainfall and weed growth. Since plowing completely overturns the soil and buries all crop residues, it is the traditional way to "clean-till" the ground and is the major tillage operation of the conventional tillage system. Additionally, cheat (Bromus spp.) infestations have been less severe when a moldboard plow operation is employed. Consequently, the conventional system does not require a herbicide application for cheat control as does the one and zero tillage systems (Epplin, Krenzer, and Beck, 1988).

The plowing operation is followed by an August application of dry fertilizer (18-46-0). This fertilizer is broadcast onto the soil by a rented fertilizer spreader. Use of a rented fertilizer spreader to apply the 18-46-0 has two advantages. First, this method of application is relatively fast, thereby allowing fertilizer to be applied at a rate of up to 25 acres per hour. Second, since the phosphate portion of this fertilizer must be incorporated into the soil, the surface broadcast application can be closely followed by a tillage operation (Handke, 1982).

After the fertilizer application, the soil is once again tilled with the tandem disk to incorporate the dry fertilizer (18-46-0) into the soil, to eliminate existing vegetation, and to breakup clods or moldboard ridges. Such a tillage operation typically occurs in August, but timing may vary depending upon soil conditions and vegetation density.

The subsequent field operation involves the application of anhydrous ammonia (82-0-0) in August. This fertilizer application increases the soil's available nitrogen level. A field cultivator is utilized prior to planting to prepare the soil for water intake, to kill unwanted plants, and to prepare a seedbed conducive to seed germination and emergence.

In the conventional tillage system, the wheat is planted with a conventional seed drill during a period from the last of August to the first of November, depending upon climatic conditions and the quantity of available soil moisture. The planting period in Table 1 has been indicated as September, although alternative planting dates were carried out on agronomy wheat test plots in August, September, October, and November (Heer, 1985). Since the fertilizer requirements are satisfied by previous applications, additional fertilizer is not supplied at planting time for the conventional tillage system.

In February, an aerial spray procedure occurs. In this field operation, a combination of parathion and Glean (chlorsulfuron) are applied to the crop by airplane. Parathion is an insecticide commonly used to control greenbug infestations. Glean (chlorsulfuron) is a translocated, soil-applied herbicide which is applied after the crop has emerged. Because Glean (chlorsulfuron) demonstrates residual effects, it affects both unemerged and actively growing annual broadleaf weed species during its active life period (Table 2). This aerial spray application is generally performed on a biannual basis by a hired aerial sprayer in this system. The application rate and cost of this field operation are discussed later.

The final field operation of the conventional tillage system is the harvesting procedure. Wheat grain is typically harvested during June in north central Oklahoma. In this study, the grain harvesting and hauling operations are assumed to be carried out by hired custom harvesters and haulers.

The one tillage system is composed of a single tillage operation and seven additional field operations (Table 1). The lone tillage operation in this system involves the use of a sweep plow in combination with a mulch treader in June, immediately after harvest. This sweep operation breaks up the soil structure,

Table 2. Description of Herbicides Used in Alternative Tillage Systems[a]

	Herbicides					
Common Name	chlor-sulfuron	cyan-azine	atra-zine	gly-phosate + 2,4-D	gly-phosate	metri-buzin
Trade Name	Glean 80W	Bladex	Aatrex 80W	Land-master	Roundup	Lexone/ Sencor
Major Producer	DuPont	Shell	Ciba-Geigy	Mon-santo	Mon-santo	DuPont/ Mobay
WHEAT PRODUCTION						
Systems that use this herbicide[b]	C	O,Z	O,Z	Z	O,Z	O,Z
TYPE OF HERBICIDE						
Contact						
Translocated	T			T	T	T
Soil-applied	S	S	S			S
STAGE OF CROP GROWTH WHEN APPLIED						
Preplant		Pt	Pt	Pt	Pt	
Preemerge						
Postemerge	Po					Po
WEEDS CONTROLLED OR SUPPRESSED						
Ann. Broadleaves	B	B	B	B		B
Ann. Grasses		G	G	G	G	G
Perennials				P	P	
WEEDS AFFECTED BY HERBICIDE APPLICATION						
Unemerged	U	U	U			
Actively growing	A			A	A	A
GRAZING RESTRICTIONS		R	R	R	R	R
ACTIVATION NEEDED	A	A	A			A

[a] Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Oklahoma Agricultural Experiment Station is implied. Pesticide users are responsible for determining that the intended use is not inconsistent with the pesticide label as well as federal and state regulations.

[b] C = conventional tillage, O = one tillage, and Z = zero tillage.

and it also cuts the roots of the wheat stubble and weeds that remain after harvest. The mulch treader, which is attached to the rear of the sweep plow, performs three functions. First, it displaces the upper part of any weed plant, which has just been disconnected from its roots by the sweep, thereby eliminating existing weed growth. Second, it shatters the wheat stubble at the soil's surface and helps incorporate the crop residue into the soil. Third, it aids in breaking up and conditioning the soil's structure.

A ground spray field operation closely follows the sweep tillage operation in June. In this procedure, a tank mix of Bladex (cyanazine) and Aatrex (atrazine) is sprayed onto the soil before seed planting occurs (Table 2). These two herbicides control or suppress many annual broadleaf and grass weed species which emerge during the summer fallow period. These herbicides do not effectively control or suppress weeds which are well established at the time that they are applied. However, due to the sweep plow-mulch treader operation which precedes this spraying operation, very few weeds will be established at application time.

In August, anhydrous ammonia (82-0-0) is applied to the soil with a modified anhydrous applicator. This field operation is then followed by a ground spray procedure in September before planting. Roundup (glyphosate) is the herbicide used in this spray operation. It is a translocated herbicide which controls or suppresses a variety of weed species (Table 2). This herbicide is applied before the crop is planted to kill any actively growing weeds which might hinder wheat planting or emergence.

Later in September, the wheat seed will be planted with a stubble drill. A stubble drill is constructed to be heavier than the conventional drill used in the conventional tillage system. Also, the stubble drill has a coulter and a double disk opener besides the press wheel, whereas the conventional drill only has a single disk opener and a press wheel. The purpose of the coulter and the double disk opener on the stubble drill is to cut through the heavier wheat stubble and crop residues that exist in the reduced tillage systems so that the wheat can be planted in the soil at a typical depth of one to two inches (Solie, 1987). Figure 2 demonstrates the arrangement of the stubble drill coulter, double disk opener, and press wheel as seen from a side view (Stiegler, Johnston, Greer, Gerling, Downs, Bloome, Williams, Coppock, Jobes, Fain, Pitts, and Donavan, 1982). Dry fertilizer (18-46-0) is also deposited into the ground alongside the seed wheat by the stubble drill. This fertilizer is applied in such a manner since a tillage operation, which is normally used to incorporate this fertilizer into the soil, will not be available in this tillage system.

Another ground spray herbicide application for the one tillage system occurs in November. Lexone or Sencor (metribuzin) is sprayed upon the emerged crop to destroy or inhibit various actively growing weed species. One of the targeted plants is cheat (Bromus spp.) which is a major problem in some wheat producing areas. A February aerial spray application of parathion occurs next. This operation will be needed approximately every other year for the control of greenbugs.

The one tillage system's wheat grain crop will then be harvested. This field operation occurs when the grain is ripe and exhibits an acceptable moisture content, typically in June.

The zero tillage system employs many of the same field operations that the one tillage system employs (Table 1). Only two field operations differ between the systems. The first difference involves the initial postharvest herbicide application. The zero tillage system uses a ground spray application of Bladex (cyanazine), Aatrex (atrazine), and Landmaster (glyphosate +2,4-D), whereas

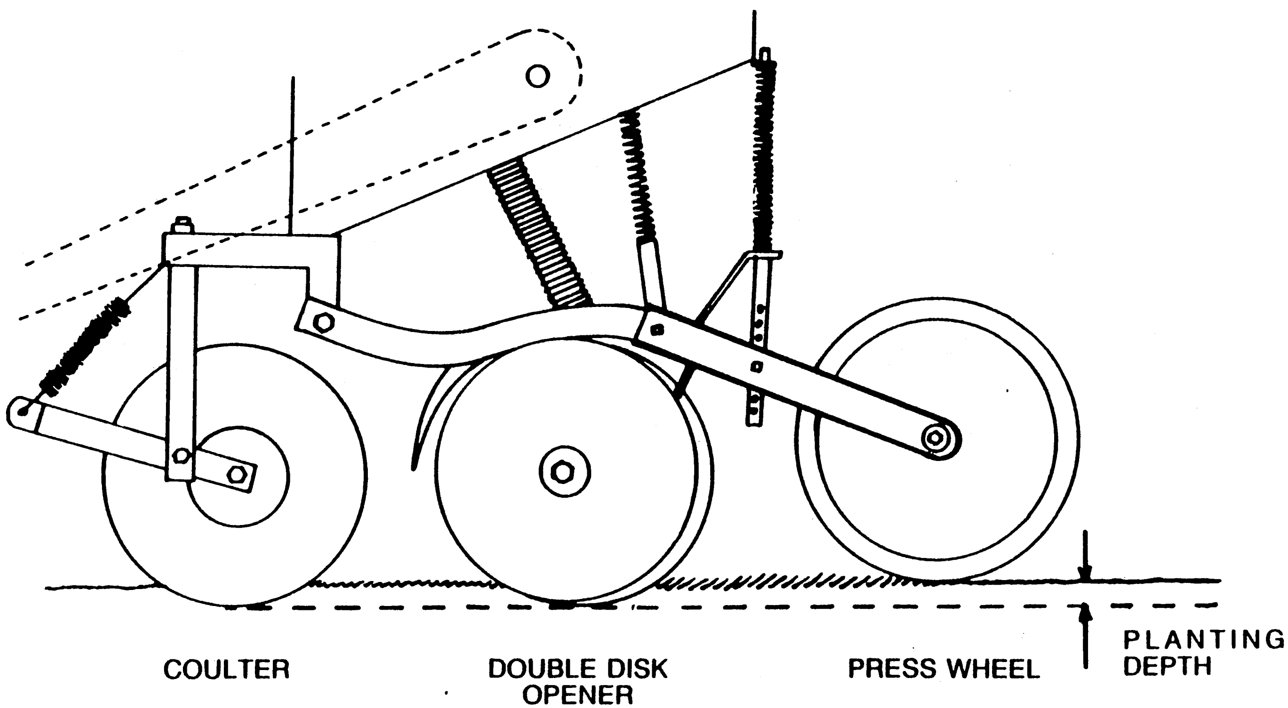

Figure 2. Diagram of the Stubble Drill.

the initial spray operation for the one tillage system only utilizes the first two, respectively. The purpose of the Landmaster (glyphosate +2,4-D) application in he zero tillage system is to destroy or inhibit any existing weed species at application time. Since a sweep tillage operation is not performed in this system and Bladex (cyanazine) and Aatrex (atrazine) don't effectively control established weeds, something has to be done to reduce existing weed numbers. If these existing weeds are not suppressed or controlled, they can deplete moisture from the soil and cause problems at planting time. Therefore, Landmaster (glyphosate + 2,4-D) is added to the Bladex (cyanazine) and Aatrex (atrazine) tank mix and applied as a substitute for the sweep plow's tillage operation.

The other difference between these systems involves the fact that the zero tillage system does not employ a February aerial spray application of parathion. Such an application appears to be unnecessary on the zero tillage system. Burton and Krenzer report that greenbug infestations tend to be greatly reduced on wheat crops planted in the previous year's crop residue. The reduction of greenbug numbers on the zero tillage system has not been attributed to any specific factor(s) to date (Burton and Krenzer, 1985). However, the mere fact that greenbug populations tend to be reduced in the zero tillage system has to be considered an advantage for this particular system.

The other field operations in the zero tillage system are the same and occur at the same times as those of the one tillage system.

Operating Inputs

Selected operating inputs for each of the alternative tillage systems are denoted in Table 3. Additionally, the unit of measurement and the price per unit

Table 3. Selected Inputs for Alternative Wheat Tillage Systems

Operating Inputs	Units	Price Per Unit (Dol.)	Number of Units Applied per Acre: Conventional Tillage	One Tillage	Zero Tillage
Bladex	lb.	4.00		2.0	2.0
Aatrex	lb.	2.00		0.5	0.5
Landmaster	oz.	0.156			54.0
18-46-0 Fertilizer	cwt.	10.00	0.88	0.88	0.88
Dry Fertilizer Spreader Rental	cwt.	0.125	0.88		
82-0-0 Fertilizer	lb.	0.088	103.00	103.00	140.00
Roundup	pt.	12.50		1.0	1.0
Seed Treatment/Bushel Seed	bu.	1.00		1.0	1.0
Seed	bu.	4.00	1.0	1.0	1.0
Lexone or Sencor	pt.	19.00		0.75	0.75
Parathion	oz.	0.172	10.0[a]	10.0[a]	
Glean	oz.	16.00	0.167[a]		
Aerial Spray Application	ac.	3.34	1.0[a]	1.0[a]	

[a] Applied biannually.

for each input are presented.

The first two operating inputs listed for the conventional tillage system are 18-46-0 fertilizer and dry fertilizer spreader rental. These two inputs are utilized at the same time. The fertilizer spreader is needed to apply the 18-46-0 to the field, and it is usually obtained from the fertilizer dealer. The fertilizer dealer typically allows the farmer to use the spreader at no charge, or for a very minimal rental fee, since the farmer has purchased the fertilizer from his dealership. Since 88 pounds of 18-46-0 fertilizer are applied per acre, approximately 15.84 pounds of actual nitrogen and 40.48 pounds of actual phosphate will be available for use on each acre of soil. Additionally, 103 pounds of anhydrous ammonia (82-0-0) are applied per acre at a later date. This 82-0-0 application places an additional 84.46 pounds of available nitrogen into the soil. Therefore, a total of approximately 100 pounds of available nitrogen and 40.48 pounds of available phosphate per acre are delivered to the soil in the conventional tillage system.

The next input used in the conventional tillage system is seed wheat. A seeding rate of one bushel (60 pounds) of seed per acre was used in this tillage system, as well as the one and zero tillage systems. This seeding rate is typical for wheat grown in the study area which is to be used for forage and grain production.

An aerial spray application of parathion and Glean (chlorsulfuron) occurs subsequently. The purpose of parathion as an insecticide and Glean (chlorsulfuron) as a herbicide has been previously discussed. Parathion is applied at a rate of 10.0 ounces of active ingredient per acre, and Glean (chlorsulfuron) is applied at 0.167 (one-sixth) of an ounce of active ingredient per acre. This aerial application is typically necessary on a biannual basis. Therefore, the application rates could be divided by two and considered an average annual application rate of 5.0 ounces and 0.088 ounces of active ingredient, respectively. The aerial spray application rate is calculated on a per acre basis.

The first two inputs listed for the one tillage system are Bladex (cyanazine) and Aatrex (atrazine) which are applied simultaneously. As stated previously, the purpose of these two herbicides is to control or suppress weed growth during the summer fallow period. The application rate for Bladex (cyanazine) is two pounds of active ingredient per acre and for Aatrex (atrazine) is one-half pound of active ingredient per acre. As with the conventional tillage system, the one tillage system uses 88 pounds of dry fertilizer (18-46-0) and 103 pounds of anhydrous ammonia (82-0-0) per acre to supply 100 pounds of available nitrogen and 40.48 pounds of available phosphate to the soil (Table 3). Unlike the conventional tillage system, 18-46-0 is applied through the stubble drill as the seed is being planted rather than broadcast.

One pint of Roundup (glyphosate) per acre is applied in this system. Roundup controls or suppresses a number of weed species (Table 2). Its purpose in this system is to control or suppress any of the species which are actively growing before the planting period. If such weeds are not controlled or suppressed, they can seriously hamper seed planting, germination, and growth.

The next two inputs in the one tillage system are the seed treatment and the seed. This system uses one bushel (60 pounds) of seed per acre, as does the conventional tillage system. However, the seed in the one tillage system has been treated with a fungicide called Vitavex 200 (carboxin-thiram). This fungicidal seed treatment protects the seed against fungi which tend to dwell in the wheat crop residue (Williams, 1988).

After the wheat crop has been planted and established, 0.75 of a pint of active Lexone or Sencor (metribuzin) is applied per acre. This herbicide's specific purpose is to control or suppress volunteer cheat which directly competes with the wheat crop for soil moisture and nutrients. This herbicide also controls or suppresses other weed species as well, and therefore eliminates the need for a Glean (chlorsulfuron) application which is used in the conventional tillage system.

Parathion is aerially sprayed onto the crop at an application rate of 10 ounces of active ingredient per acre. This insecticide application controls greenbug infestations, although it may also eliminate any beneficial insects. This application generally occurs on a biannual basis, so the application rate could therefore be considered as five ounces per acre annually.

The zero tillage system employs two pounds of active Bladex (cyanazine) and one-half pound of active Aatrex (atrazine) per acre as presented in Table 2. These application rates are identical to those of the one tillage system. However, an additional herbicide is utilized in the zero tillage system that is not employed in the one tillage system. Landmaster (glyphosate + 2,4-D) is applied at a rate of 54 ounces of active ingredient per acre at the same time that Bladex (cyanazine) and Aatrex (atrazine) are sprayed. This Landmaster application substitutes for the sweep operation of the one tillage system and the moldboard operation of the conventional tillage system, since it effectively controls most actively growing weed species.

As with the other systems, the zero tillage system utilizes 88 pounds of dry fertilizer (18-46-0) per acre. This fertilizer is applied through the stubble drill as in the one tillage system. Unlike either of the other two systems, however, the zero tillage system requires 140 pounds of anhydrous ammonia (82-0-0) per acre (Krenzer, 1987). Therefore, a total of approximately 130 pounds of available nitrogen and 40.48 pounds of available phosphate are introduced into the soil in the zero tillage system. According to Tisdale and Nelson, this additional nitrogen usage prevents an untimely reduction of nitrogen in the soil by heterotrophic soil microorganisms. These microorganisms are necessary for the decomposition of organic matter in the soil. However, if a large amount of carbonaceous material (crop residue) is present on the soil surface, these microorganisms will utilize all nitrogen present in the soil for this decomposition process. As a result, available nitrogen is not present for the development of the new wheat crop, which has been planted among the crop residue, until the microorganisms die at a later date and release the available nitrogen. This additional nitrogen usage is therefore quite important since it ultimately supplies more nitrogen than these microorganisms need in the decomposition process. As a result, there is no deficiency of soil nitrogen available to the developing wheat crop (Tisdale and Nelson, 1969).

The zero tillage system utilizes application rates identical to those in the one tillage system for Roundup (glyphosate), seed treatment, seed, and Lexone or Sencor (metribuzin).

The quantities of all inputs in Table 3, except the dry fertilizer spreader rental, the seed treatment, and the aerial spray application, were obtained from the Oklahoma State University Agronomy Department (Krenzer, 1987). However, the quantity of the last three inputs listed was dependent upon the amounts of other inputs that were used in the systems. For example, the amount of dry fertilizer spreader rental per acre (88 pounds per acre) is determined by the dry fertilizer (18-46-0) application rate (88 pounds per acre). Additionally, the quantities of seed treatment and aerial spray application were dependent upon the rates of seed applied per acre and the number of required aerial herbicide applications per acre, respectively.

The prices of the herbicides and the insecticide were also obtained from the Oklahoma State University Agronomy Department (Krenzer, 1987). The prices for anhydrous ammonia (82-0-0) and dry fertilizer (18-46-0) were gathered from Agricultural Prices-1986 Summary (United States Department of Agriculture, 1986). The aerial spray application cost was obtained from Oklahoma Farm and Ranch Custom Rates, 1986-87, Oklahoma State University Extension Facts No. 140 (Nelson and Kletke, 1987). The price for dry fertilizer spreader rental was gathered from previously existing enterprise budgets. The fungicidal seed treatment cost was obtained from the Oklahoma State University Plant Pathology Department (Williams, 1988). The cost of seed wheat was obtained from certified seed producer prices in Oklahoma (Purvine, 1987).

Machinery Complements

Substantial information is required to formulate a machinery complement for a specific farming system. For example, information such as the required field operations for each system, the field workdays available to perform the required field operations, and a list and ranking of available machinery capable of performing the required field operations in the time available is necessary. Each of these components will be discussed and reviewed in subsequent sections.

The selected machinery complements for each tillage system are given in Table 4. It is quite evident from this table that the conventional tillage system requires a great deal more machinery than does the one and zero tillage systems. All three systems require an 85 and 182 horsepower tractor. However, a 95 horsepower tractor is also required by the conventional tillage system. In addition, the conventional tillage system requires three moldboard plows, one tandem disk, two field cultivators, a conventional drill, and a rented

Table 4. Selected Machinery Complements for the Alternative Tillage Systems

Machines		System: Conventional Tillage (feet)	One Tillage (feet)	Zero Tillage (feet)
Tractor 1[a]		85	85	85
Tractor 2		95	182	182
Tractor 3		182		
Moldboard Plow 1	(3-16")	4		
Moldboard Plow 2	(4-14")	4.7		
Moldboard Plow 3	(6-18")	9		
Tandem Disk		20.9		
Sweep Plow[b]			30	
Field Cultivator 1		12.5		
Field Cultivator 2		13.5		
Anhydrous Applicator[c]		30	30	30
Stubble Drill w/Fertilizer			30	30
Drill w/Fertilizer		42		
Dry Fertilizer Spreader[d]		60		
Sprayer			42	42
Machinery Investment[e]		$133,769	$97,270	$87,619

[a] For tractors the unit is horsepower rather than feet.
[b] This sweep plow is equipped with a mulch treader attachment.
[c] Systems 2 and 3 use a modified anhydrous applicator.
[d] Rented by farmer, all other machinery is purchased.
[e] Expressed in dollars, for entire farming operations.

dry fertilizer spreader that is not necessary for the one and zero tillage systems.

All three systems require a 30 foot anhydrous applicator, although the one and zero tillage system applicator must be modified. This modification allows the applicator to cut through the heavy crop residues that are present in the reduced tillage systems and place anhydrous ammonia (82-0-0) into the soil. However, this modification also makes this type of applicator more expensive.

Both the one and zero tillage systems require a stubble drill, which is unnecessary in the conventional system. The differences between the conventional drill, which is used in the conventional tillage system, and the stubble drill have previously been discussed. Because it is heavier and has additional components, the stubble drill is more expensive per foot than is the conventional drill.

Additionally, the one and zero tillage systems require a sprayer since they both utilize a great number of herbicide ground spray operations. The one tillage system also requires a sweep plow, which is not necessary in the other two tillage systems.

Handke developed optimal machinery complements for 22 tillage systems. He utilized the Optimal Machinery Complement Selection System (OMCSS) developed by Griffin (Griffin, 1980). The objective of OMCSS is to select the minimum cost machinery complement which can perform the necessary field operations in the amount of field work days available. The program uses the IBM Mathematical Programming Systems Extended - Mixed Integer Programming optimization routine (Handke, 1982).

Some aspects of the selected machinery complements for the three tillage systems in this study were derived directly from Handke's study (Handke, 1982). Other aspects of these complements required updating and revising portions of Handke's work in this area. This updating and revising procedure was performed to specifically make these three machinery complements as up-to-date and relevant to this study's three tillage systems as possible. The components of these three selected machinery complements will now be discussed.

Required Field Operations. The required field operations for each tillage system must be developed before machinery complements can be formed. The required field operations for the three tillage systems involved in this study have previously been established and reviewed as the tillage systems were being defined. These field operations, as well as their timing and sequence, were determined by trials conducted at Oklahoma Agricultural Experiment Station test plots over a four year production period.

Many of the required field operations for the three tillage systems in this study are similar to those established by Handke in three of his 22 tillage systems (Handke, 1982). Adjustments were made for any differences that existed in the field operations of this study's actual wheat test plots.

Available Field Workdays. Using information provided by Reinschmiedt (1971) and Bonnett (1973), Handke estimated the number of available field workdays for the Garfield County area. The estimates developed by Handke are utilized in this study, and they are presented in Table 5 (Handke, 1982).

A timeliness level indicates the probability that a specified number of field workdays will be available to perform field operations in a given time period. As the number of available field workdays increases, the timeliness level decreases and smaller machinery is necessary to complete the required field operations. The reverse of this is also true (Handke, 1982).

In addition, the available field work hours must be determined. Such a figure is obtained by multiplying the number of hours that a machinery operator works per day by the number of available field workdays in that period. By working more hours per day, a farmer can increase the number of available field work hours in a specific time period with weather suitable for field work. Therefore, he can either reduce the size of machinery necessary or make up for days lost due to unfavorable weather (Handke, 1982).

Handke selected a timeliness level of 80 percent with 10 hour workdays. To illustrate what these figures mean, an example will be given from Table 5. Since a tandem disk operation occurs in June for the conventional tillage system, the June 16-30 period at an 80 percent timeliness level will be examined. There are 10.50 available field workdays for this specific period and timeliness level. Therefore, these 10.50 field workdays should be available to complete the necessary field operations on an average of eight out of ten years, assuming that the farmer works 10 hours a day (Handke, 1982).

The available field workdays listed in Table 5 are used in developing the machinery complements for each of the tillage systems in this study.

List and Ranking of Available Machinery. Table 6 is a condensate of the list of available machinery capable of performing the required field operations in this study's three tillage systems in the time allowed to meet 80 percent timeliness. This table simply supplies the name, size, and initial list price of each piece of available machinery. Many other aspects of these machinery pieces were utilized in determining the proper machinery complements for this study. These aspects have been mentioned earlier in machinery complement discussion, but are excluded from this table due to space limitations.

Table 5. Available Field Workdays for the Enid Area

Time Periods	Maximum Number of Days Available	Timeliness Level 50% (Days)	80% (Days)	90% (Days)	98% (Days)
January 1-16	16	15.25	14.25	13.00	10.75
January 17-31	15	15.00	13.25	12.50	8.75
February 1-14	14	13.25	12.75	11.00	8.75
February 15-28	14	13.25	12.25	11.75	10.00
March 1-16	16	14.75	13.00	11.25	7.50
March 17-31	15	14.00	11.75	9.50	7.50
April 1-15	15	13.00	10.75	8.75	7.75
April 16-30	15	12.75	10.00	8.75	5.75
May 1-16	16	13.00	10.25	8.25	6.00
May 17-31	15	12.00	8.50	6.25	3.50
June 1-15	15	12.50	9.75	7.50	4.75
June 16-30	15	13.25	10.50	9.50	7.50
July 1-16	16	14.25	11.75	10.50	8.25
July 17-31	15	13.75	12.25	10.75	7.50
August 1-16	16	14.75	12.25	11.00	8.25
August 17-31	15	13.75	11.75	10.00	6.75
September 1-15	15	13.50	10.50	8.75	5.50
September 16-30	15	13.25	9.25	6.75	4.00
October 1-16	16	14.00	12.25	11.00	8.00

Table 6. Machinery Available for Field Operations

Name of Machine	Width[a] (feet)	Initial[b] List Price (Dol.)	Name of Machine	Width (feet)	Initial[b] List Price (Dol.)
Tractor 72	72	33,104	Sweep Plow	15	5,969
Tractor 85	85	29,150	Sweep Plow	20	9,431
Tractor 95	95	45,193	Sweep Plow	25	10,620
Tractor 115	115	50,146	Sweep Plow	30	13,470
Tractor 131	131	56,443	Sweep Plow	35	15,640
Tractor 162	162	71,334	Sweep Plow & F	15	6,089
Tractor 182	182	76,293	Sweep Plow & F	20	9,591
Tractor 245	245	110,054	Sweep Plow & F	25	10,820
Moldboard Plow 314	3.5	2,893	Sweep Plow & F	30	13,710
Moldboard Plow 316	4	2,918	Sweep Plow & F	35	15,910
Moldboard Plow 414	4.7	5,801	Field Cultivator	9.5	2,550
Moldboard Plow 416	5.3	7,350	Field Cultivator	12.5	3,050
Moldboard Plow 516	6.7	8,712	Field Cultivator	13.5	3,210
Moldboard Plow 616	8	11,586	Field Cultivator	16.5	4,135
Moldboard Plow 618	9.2	11,967	Field Cultivator	19.5	5,190
Moldboard Plow 818	12	12,567	Field Cultivator	24	9,353
Chisel Plow	10	3,688	Field Cultivator	27.3	10,472
Chisel Plow	12	3,865	Field Cultivator	37	14,594
Chisel Plow	14	4,130	Mod. Anhyd. App.	14	5,500
Chisel Plow	16	6,381	Anhydrous Appli.	24	3,026
Chisel Plow	20	7,229	Anhydrous Appli.	27	3,104
Off-Set Disk	10.6	7,671	Anhydrous Appli.	30	3,182
Off-Set Disk	12.3	8,494	Stubble Drills w/F	8	8,300
Off-Set Disk	13.8	8,918	Stubble Drill w/F	15	16,547
Off-Set Disk	16	10,813	Stubble Drill w/F	30	36,627
Off-Set Disk	21	12,609	Drill w/Fert.	21.3	16,550

Table 6. (continued)

Off-Set Disk	27.5	19,486	Drill w/Fert	30	23,912
Tandem Disk	12.3	5,867	Drill w/Fert	42	35,844
Tandem Disk	13.8	6,199	Dry Fert. Spread	60	0[c]
Tandem Disk	16.2	7,267	Lqd. Fert. Spread	40	0[c]
Tandem Disk	20.9	14,413	Sprayer	21	1,958[d]
Tandem Disk	22.4	14,729	Sprayer	28	2,633[d]
Tandem Disk	27.5	19,486	Sprayer	35	2,917[d]
Tandem Disk	30.8	20,814	Sprayer	42	3,373[d]
Tandem Disk	41	29,507	Mulch Treader	1	125[e]

[a] For tractors the unit is horsepower rather than feet.

[b] Prices include freight charges.

[c] These items are rented rather than purchased.

[d] Sprayers include PTO centrifugal pumps, tanks, and no-drip nozzles.

[e] Mulch treader attachments cost $125 per foot above implement costs.

Although a number of items in Table 6 are similar to those in Handke's available machinery list, changes were made to Handke's list. These changes updated the list, while basically maintaining the tractor and implement possibilities that Handke used in his study to develop his machinery complements. While each of these machinery pieces is listed only once in Table 6, it is possible to use any of these pieces more than once in any machinery complement developed for a tillage system (Handke, 1982).

The names, sizes, and initial list prices for the tractors and most of the implements were obtained from a J. I. Case - International Harvester dealership. Additional information includes anhydrous applicator data from Wako Incorporated, ground sprayer data from Kyco Equipment Company, as well as some stubble drill and moldboard plow data from a John Deere dealership. These specific machinery lines were chosen due to readily available data, and no endorsement of a particular machinery line was intended.

It is evident from Table 6 that a wide number of machines, as well as machinery sizes, were made available for selection in developing the machinery complements. However, there were a few implements which had only one width available for use in these systems. The prices for each piece of machinery ascended as the machinery size increased, except for one case. The 72 horsepower tractor has an initial list price of $33,104, whereas the 85 horsepower tractor has an initial list price of $29,150. This situation occurs because the 72 horsepower tractor is the largest model of small series tractors that this company produces. This small series of tractors is basically designed for home and garden use, and it is much more expensive per unit of horsepower than are the larger series which are designed for farm use. Therefore, the largest model from the home and garden tractor series is more expensive than the smallest model from the farm tractor series.

Additionally, the 245 horsepower tractor is much more expensive than is the 182 horsepower tractor. This is due to the fact that the 182 horsepower tractor is the largest of the two-wheel drive tractors, while the 245 horsepower tractor is the smallest of the four-wheel drive tractors. Likewise, the 20.9-foot tandem disk is much more expensive than the 16.2-foot tandem disk. This is attributable to the fact that the 16.2-foot model is the largest "rigid", single-framed tandem disk produced, while the 20.9-foot model is the smallest "flex", hinge-framed tandem disk produced. Many of the larger model implements require additional support or bracing and are therefore more expensive.

It is important to note the cost of the modified anhydrous applicator as compared to those of the typical anhydrous applicators. The 14-foot modified anhydrous applicator has an initial list price of $5,500. The 24-foot common anhydrous applicator has an initial list price of $3,026, while the 27-and 30-foot models list at $3,104 and $3,182, respectively. The modifications included on the 14-foot model are necessary due to the increased crop residues on the soil's surface in the one and zero tillage systems. However, these modifications greatly increase the initial list price of this applicator as compared to those of the common anhydrous applicators.

Additionally, the comparison between stubble drills and conventional drills is noteworthy. In this list, both the stubble drills and the conventional drills are equipped with fertilizer attachments. These fertilizer attachments are used on the stubble drills selected for use in the one and zero tillage systems. The fertilizer attachments on the conventional drills are not utilized in the conventional system, but they are included in this list for two reasons. First, if the field operations for the conventional system would need to be changed for some reason, these fertilizer attachments would quite possibly be necessary. Second, many grain producers now have fertilizer attachments on their conventional drills. The initial list prices in this list should therefore reflect what it would cost a producer to replace his machinery with new machinery of equal size and operational capabilities.

The initial list prices of the stubble drills are substantially greater than those of the conventional drills. The stubble drills cost from $1,038 per foot for the eight-foot model to $1,221 per foot for the 30-foot model. Comparatively, the conventional drills cost from $777 per foot for the 21.3-foot model to $853 per foot for the 42-foot model. However, it is necessary to use the stubble drills with the one and zero tillage systems due to the amounts of crop residue at the soil's surface in these systems.

This list of available machinery must be ranked. According to Handke, "Ranking refers to the matching of implement widths to tractor sizes. The tractor must be large enough to pull the implement at a desirable speed and depth". (Handke, 1982). Using research by Jones and Bowers (1977), as well as Bowers (1970), Handke estimated the maximum width of each implement that can be pulled by specific tractors (Handke, 1982). These estimates were used as guidelines in ranking various tractors and implements for each of the three tillage systems in this study.

Once the required field operations, the available field workdays, and the list and ranking of available machinery are estimated, the selected machinery complements, as previously discussed, can be developed for the alternative tillage systems. The next process involves incorporating all of the available information into an enterprise budget for each of the three tillage systems.

Enterprise Budgets

Handke utilized Oklahoma State University's Enterprise Budget Generator (EBG) to develop enterprise budgets for each of his 22 tillage systems. Handke also details some of the operations and advantages of the Enterprise Budget Generator in his study (Handke, 1982). Three of Handke's enterprise budgets were modified to accommodate the three tillage systems in this study.

A great magnitude of information must be amassed before enterprise budgets for the various tillage systems can be formed. Some of the necessary information previously reviewed in this study includes the required field operations, the timing and sequence of these field operations, the requisite operating inputs, the prices and quantities of these operating inputs, and the selected machinery complement for each system. In addition, the development of these machinery complements has required that the available field workdays and the listing and ranking of available machinery be developed.

Additional information necessary for the formation of enterprise budgets includes such items as wheat grain and forage yields, the value of products yielded, and the interest rate on capital. Once such items have been gathered and incorporated with the aforementioned information, enterprise budgets can be formed.

Wheat Grain and Forage Yield Data. Wheat grain yield data were collected at Lahoma and Stillwater experiment station test plots for production years 1982-83 through 1985-86. The findings for grain production are presented in Table 7 (Heer, 1985). Wheat grain yields were available for the conventional and zero tillage systems, but not for the one tillage system. Therefore, the one tillage system's grain yield is assumed to be the average of

Table 7. Test Plot Wheat Yield Data

	Stillwater Grain Yields				Lahoma Grain Yields		
Planting Dates	Conventional Tillage System bu/ac	One Tillage System bu/ac	Zero Tillage System bu/ac	Planting Dates	Conventional Tillage System bu/ac	One Tillage System bu/ac	Zero Tillage System bu/ac
1982-83				1982-83			
Aug 27[a]	-----	-----[b]	-----	Aug. 23	46.9	45.9	44.9
Sept. 13	38.4	42.4	46.3	Sept. 14	48.8	49.4	50.0
Sept. 24[a]	54.3	50.5[b]	46.7	Oct. 19	39.2	39.7	40.2
Oct. 15	52.0	51.8	51.5	Nov. 16	35.9	39.1	42.3
Nov. 17	45.6	46.2	46.7				
1983-84				1983-84			
Aug. 17[c]	-----	63.1	58.4	Aug. 16	44.8	43.7	42.5
Sept. 24	75.5	72.2	68.9	Sept. 23	54.1	47.8	41.5
Oct. 14[c]	67.7	-----	-----	Nov. 2[d]	37.0	39.7	42.3
Oct. 24	72.8	70.7	68.6	Nov. 15	33.1	32.6	32.1
Nov. 16	60.2	50.0	39.7				
1984-85				1984-85			
Aug. 15	51.9	46.0	40.0	Aug. 16	40.5	41.1	41.7
Sept. 19	55.4	46.9	38.4	Sept. 18	40.6	39.9	39.2
Oct. 15	58.6	52.7	46.7	Oct. 15	50.0	49.3	48.5
Nov. 14	34.8	23.8	12.9	Nov. 15	25.2	30.0	34.8
1985-86				1985-86			
Aug. 16	21.2	17.0	12.8	Aug. 29	27.1	25.7	24.2
Sept. 17	19.4	18.3	17.1	Sept. 16	30.3	27.0	23.7
Oct. 27	22.7	19.2	15.6	Oct. 26	26.5	18.9	11.3

Table 7. (continued)

Dec. 11[e]	9.8	8.8	6.9	Nov.[f]	-----	-----	-----
OVERALL MEAN	46.3	42.5	38.6	OVERALL MEAN	38.7	38.0	37.3
SEPTEMBER MEAN	47.2	45.0	42.7	SEPTEMBER MEAN	43.5	41.0	38.6

[a] August 27 conventional and zero tillage Stillwater plantings failed to germinate and were replanted on September 24.

[b] The one tillage grain yields are assumed to be the mean of the conventional and zero tillage grain yields; if the zero tillage system plantings were delayed, replanted, or failed to produce data, then the one tillage plantings are assumed to have followed the zero tillage system's lead.

[c] August 17 conventional Stillwater planting failed to germinate and was replanted on October 14.

[d] October conventional and zero tillage plantings were delayed until November 2.

[e] November conventional and zero tillage plantings were delayed until December 11.

[f] Grain yields for November planting date are not available.

the conventional and zero tillage system's yields for each particular year and planting date.

Grain yields in Table 7 are arranged according to experiment station location, tillage system, and planting date. Since grain yield data for Lahoma's November 1985-86 planting date are not available, the completed Stillwater data set is used throughout this study. However, both the Lahoma and Stillwater grain yield data are used to project estimated enterprise budget returns presented and discussed in Chapter III. Since many of Oklahoma's wheat producers use the winter wheat forage for livestock production, as well as the grain, this study employs the September mean grain yields for each tillage system's initial enterprise budget. Although the October plantings tended to produce the greatest mean yield for grain in the Stillwater tillage systems, these plantings failed to produce the wheat forage yields desired by Oklahoma farmers for beef production, while the September plantings produced ample forage yields.

Several interesting features are evident in Table 7. First, several of the plantings either failed to germinate and had to be replanted or were postponed due to weather and soil conditions. Second, 1983-84 was an exceptionally high grain producing season at Stillwater. Many of that year's yields were in the high 60 to low 70 bushel per acre range. In contrast, 1985-86 was an exceptionally poor grain producing season at Stillwater, with all yields falling below 25 bushel per acre. Third, the overall mean yield for Stillwater's conventional tillage system is noticeably higher than that of the one or zero tillage system. The same is true for the September mean yield, although to a lesser degree.

Forage yield data were also collected from these test plots (Heer, 1985). Specific forage yields expressed in pounds per acre will not be examined in this study. Instead, this study determines whether the forage yields for each system's planting dates will satisfy a 0.4 stocking density for a 437 pound stocker steer. Such a stocking density indicates that there will be 0.4 stocker beef animals per acre of land or 1.0 stocker beef animals per 2.5 acres of land. This stocking density is typical for Oklahoma wheat and stocker production (Walker, Bernardo, Trapp, and Rodriguez, 1988). According to Heer's study (Heer, 1985), the August and September plantings for all three tillage systems would typically produce enough forage to maintain this 0.4 stocking density, while the October and November plantings would be unable to support such a stocking density.

Value of Products Yielded. June wheat prices are used for wheat in the enterprise budgets. June is typically the harvest month for wheat, and a substantial proportion of farmers in Oklahoma either sell all or part of their wheat crop at that time. These prices were obtained from Agricultural Prices - 1983 Summary through Agricultural Prices - 1987 Summary by the United States Department of Agriculture, the National Agricultural Statistics Service, and the Agricultural Statistics Board.

Since a stocking density is utilized as the unit of measure for forage in this study, a price(s) must be obtained for the stocking density establish the value of forage production. An enterprise budget for stocker steers on winter wheat pasture was employed in this process (Walker, Lusby, McMurphy, 1987), and is included in Appendix A.

The first step in this process is to find the value of the beef animal at sale time. This step is accomplished by multiplying the selling price for that particular time period and size of animal by the quantity of animal to be sold. All buying and selling prices of stocker steers at Oklahoma City during specific time periods were obtained from a publication produced by the United States Department of Agriculture, the Agricultural Marketing Service, and the Oklahoma Livestock and Seed Division. The second step consists of determining the total operating costs for producing this animal. To determine this step, the animal's purchase value, the annual operating capital requirements, and all other operating costs must be established.

Next, the total operating costs can be subtracted from the selling value of the animal. The remaining value represents the returns above total operating costs per head for stocker steers, and it is considered to be the price for the stocking density in this study. This figure is then multiplied by the stocking density, which was established as 0.4, to determine the value of forage production per acre for that exclusive time period.

Interest on Operating Capital. Interest rates are vital in determining the cost of capital necessary in an enterprise budget. All interest rates used in this study are average interest rates on operating loans at Tenth District Agricultural Banks as reported by the Financial Letter: Federal Reserve Bank of Kansas City and the Agricultural Finance Databook.

CHAPTER III

STUDY RESULTS

Introduction

The results of the enterprise budget analysis for the three alternative tillage systems are presented in this chapter. In the first section, hours of machinery usage for each system are reviewed. Although the tractor-implement combinations have previously been estimated, care must be taken to insure that the hours of implement and tractor usage are compatible and that they comply with the available field workdays for each time period.

The second section contains summaries of each tillage system's enterprise budgets. Two alternative summaries are presented. One summary details each system's enterprise budget without forage production data. The other summary details each system's enterprise budget with forage production data.

In the third section, results of the enterprise budgets from section two are examined. Various aspects of the enterprise budgets are compared among the alternative tillage systems.

The fourth section presents estimated enterprise budgets for each tillage system over a four year production period. This production period is the one in which wheat grain yield and forage yield data were collected from Stillwater and Lahoma. Some of the estimated enterprise budgets include forage production data, while others do not examine this information and solely review the grain yield aspect.

The final section of this chapter presents all of the estimated returns from section four. These estimated returns are analyzed and compared among the alternative tillage systems.

Machinery Hours

Table 8 presents the hours of usage for implements and tractors as determined by each tillage system's enterprise budget. Tractor-implement combinations were previously determined to form the enterprise budgets. Table 8 contains a list of the hours of usage for individual implements and tractors. Therefore, it is possible to determine if the hours of usage per acre for each implement are compatible with the hours of tractor usage per acre.

There will inevitably be more hours of tractor usage per acre and total tractor usage than hours of implement usage per acre and total implement usage. This is attributable to such factors as the tractor operator raising the implement out of the ground on field corners, transporting the implement from one part of the field to another, raising the implement out of the ground to avoid fences or waterways, or allowing the tractor to idle in a stationary position while still attached to the implement. The budget generator computes tractor hours by multiplying the number of implement hours by 1.1. The total hours of implement and tractor usage represent the time required to perform the necessary field operations for the entire 1,240 acres of cropland. These total hours of tractor and implement usage must comply with the number of available field work hours and available field workdays. All of the hours of tractor and implement usage required for the specified field operations in Table 8 were examined and found to be in complete compliance with the available field work hours and the available field workdays previously determined.

Table 8. Machinery Hours Table for Alternative Tillage Systems

	Implement Hours per Acre	Tractor Hours per Acre	Tractor Used	Total Implement Hours	Total Tractor Hours
CONVENTIONAL TILLAGE:					
Tandem Disks[a]	0.192	0.2112	182	238.08	
Anhydrous Applicator	0.075	0.0825	95	93.	
Dry Fertilizer Spreader	0.038	0.0418	85	47.12	
Field Cultivator	0.077	0.0847	85	95.48	
Drill w/Fertilizer	0.062	0.0682	182	76.88	
Field Cultivator	0.077	0.0847	95	95.48	
Moldboard Plow 316	0.16	0.176	85	198.40	
Moldboard Plow 618	0.081	0.0891	182	100.44	
Moldboard Plow 414	0.179	0.1969	95	221.96	
Tractor 85					375.10
Tractor 95					451.48
Tractor 182					456.94
			TOTAL HOURS	1166.84	1283.52
ONE TILLAGE:					
Modified Anhydrous Applicator	0.075	0.0825	182	93.	
Sprayers	0.18	0.198	85	223.2	
Stubble Drill w/Fertilizer.	0.094	0.1034	182	116.56	
Sweep Plow[b]	0.067	0.0737	182	83.08	
Tractor 85					245.52
Tractor 182					321.90
			TOTAL HOURS	515.84	567.42

Table 8. (continued)

ZERO TILLAGE:					
Sprayers	0.18	0.198	85	223.2	
Modified Anhydrous Applicator	0.075	0.0825	182	93.	
Stubble Drill w/Fertilizer	0.094	0.1034	182	116.56	
Tractor 85					245.52
Tractor 182					230.52
			TOTAL HOURS	432.76	476.04

[a] The hours of implement and tractor usage listed for implements referred to in a plural tense are the cumulative sum for that tillage system.

[b] The sweep plow for the one tillage system is equipped with mulch treader attachments.

One final detail should be explained. When any of the implements in Table 8 are referred to in a plural tense, such as tandem disks or sprayers, this does not imply that more than one of these particular implements is required. This form of reference is used to indicate that the same field operation is budgeted more than once with the same implement and tractor. Therefore, the hours of implement and tractor usage listed for those implements are the cumulative sum for that tillage system.

Summary of Enterprise Budgets

The cost and return portions of each tillage system's enterprise budget are examined in Tables 9 and 10. The operating inputs, fixed inputs, and production from each system are also included. Table 9 contains grain yields in the production section, while Table 10 contains both grain and forage yields in the production system.

The operating inputs portion of Table 9 is divided into sections such as fertilizer, insecticide, herbicide, seed, seed treatment, fuel, annual operating capital, and other. The unit of measure, the price or cost per unit, the quantity of input per acre, and the total value per acre is listed for each of these operating inputs. The unit of measure and the price or cost per unit for each operating input is the same across all three tillage systems. However, the quantity used per acre and the total value per acre for each operating input may vary across tillage systems.

Many of the differences in input requirements for each tillage system have already been discussed. By viewing the values per acre in Table 9, it is evident that major differences exist between systems in herbicides, fuel, annual operating capital, and labor charges. Additionally, the total operating costs for

Table 9. Summary of Winter Wheat Enterprise Budgets for Three Alternative Tillage Systems Considering Grain Production

	Unit	Price or Cost per Unit (dol.)	Conventional Tillage Quan. per Acre	Conventional Tillage Value per Acre (dol.)	One Tillage Quan. per Acre	One Tillage Value per Acre (dol.)	Zero Tillage Quan. per Acre	Zero Tillage Value per Acre (dol.)
OPERATING INPUTS:[a]								
Fertilizer								
82-0-0	lb.	0.088	103.000	9.06	103.000	9.06	140.000	12.32
18-46-0	cwt.	10.000	0.880	8.80	0.880	8.80	0.880	8.80
Fertilizer spreader	cwt.	0.125	0.880	0.11				
Insecticide								
Parathion[b]	oz.	0.172	5.000	0.86	5.000	0.86		
Herbicide								
Glean[b]	oz.	16.000	0.083	1.33				
Bladex	lb.	4.000			2.000	8.00	2.000	8.00
Aatrex	lbs.	2.000			0.500	1.00	0.500	1.00
Landmaster	oz.	0.156					54.000	8.42
Roundup	pt.	12.500			1.000	12.50	1.000	12.50
Lexone or Sencor	pt.	19.000			0.750	14.25	0.750	14.25
Seed	bu.	4.000	1.000	4.00	1.000	4.00	1.000	4.00
Seed Treatment	bu.	1.000			1.000	1.00	1.000	1.00
Fuel	gal.	1.00	6.11	6.11	3.06	3.06	2.42	2.42

Table 9. (continued)

Annual Operating Capital	dol.	0.115	23.97	2.76	41.69	4.79	42.42	4.88
Other								
Machinery								
Lube + Repairs	dol.			5.83		4.65		3.99
Custom Harvest								
Base Charge	ac.	12.000	1.000	12.00	1.000	12.00	1.000	12.00
Excess for > 20 bu.	bu.	0.120	27.200	3.26	25.000	3.00	22.700	2.72
Custom Haul	bu.	0.120	47.200	5.66	45.000	5.40	42.700	5.12
Aerial Spray App[b]	ac.	3.340	0.500	1.67	0.500	1.67		
Labor Charges	hr.	4.630	1.137	5.26	0.501	2.32	0.420	1.94
TOTAL OPERATING COSTS				66.71		96.36		103.36
TOTAL OPERATING COSTS/BUSHEL				1.41		2.14		2.42
FIXED INPUTS:								
Machinery								
Interest at 11.5%	dol.			12.40		9.02		8.12
Depreciation, Taxes, Insur.	dol.			14.01		10.39		9.15
Land								
Interest at 0%	dol.			___		___		___
TOTAL FIXED COSTS				26.41		19.41		17.27
TOTAL FIXED COSTS/ BUSHEL				0.56		0.43		0.40

Table 9. (continued)

TOTAL OPERATING AND FIXED COSTS				93.12		115.77		120.63
TOTAL OPERATING AND FIXED COSTS /BUSHEL				1.97		2.57		2.83
PRODUCTION:								
Wheat Grain[c]	bu.	2.300	47.200	108.56	45.000[d]	103.50	42.700	98.21
Small Grain[e] Pasture	stocking rate							
TOTAL RECEIPTS				108.56		103.50		98.21
RETURNS ABOVE TOTAL OPERATING COSTS				41.85		7.14		-5.15
RETURNS ABOVE TOTAL OPERATING AND FIXED COSTS				15.44		-12.27		-22.42

[a] Does not include additional expenses for years in which crops were replanted.

[b] Average annual application rate.

[c] Wheat grain yields for the conventional and zero tillage systems are from tillage test plots (September plantings) at Stillwater for years 1982-83 through 1985-86.

[d] Wheat grain yields for the one tillage system are the mean of the conventional and zero tillage system grain yields.

[e] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

Table 10. Summary of Winter Wheat Enterprise Budgets for Three Alternative Tillage Systems Considering Grain and Forage Production

	Unit	Price or Cost per Unit (dol.)	Conventional Tillage Quan. per Acre	Conventional Tillage Value per Acre (dol.)	One Tillage Quan. per Acre	One Tillage Value per Acre (dol.)	Zero Tillage Quan. per Acre	Zero Tillage Value per Acre (dol.)
OPERATING INPUTS:[a]								
Fertilizer								
82-0-0	lb.	0.088	103.000	9.06	103.000	9.06	140.000	12.32
18-46-0	cwt.	10.000	0.880	8.80	0.880	8.80	0.880	8.80
Fertilizer spreader	cwt.	0.125	0.880	0.11				
Insecticide								
Parathion[b]	oz.	0.172	5.000	0.86	5.000	0.86		
Herbicide								
Glean[b]	oz.	16.000	0.083	1.33				
Bladex	lbs.	4.000			2.000	8.00	2.000	8.00
Aatrex	lbs.	2.000			0.500	1.00	0.500	1.00
Landmaster	oz.	0.156					54.000	8.42
Roundup	pt.	12.500			1.000	12.50	1.000	12.50
Lexone or Sencor	pt.	19.000			0.750	14.25	0.750	14.25
Seed	bu.	4.000	1.000	4.00	1.000	4.00	1.000	4.00
Seed Treatment	bu.	1.000			1.000	1.00	1.000	1.00

Table 10. (continued)

Fuel	gal.	1.00	6.11	6.11	3.06	3.06	2.42	2.42
Annual Operating Capital	dol.	0.115	23.97	2.76	41.69	4.79	42.42	4.88
Other								
Machinery								
Lube + Repairs	dol.			5.83		4.65		3.99
Custom Harvest								
Base Charge	ac.	12.000	1.000	12.00	1.000	12.00	1.000	12.00
Excess for > 20 bu.	bu.	0.120	27.200	3.26	25.000	3.00	22.700	2.72
Custom Haul	bu.	0.120	47.200	5.66	45.000	5.40	42.700	5.12
Aerial Spray App[b]	ac.	3.340	0.500	1.67	0.500	1.67		
Labor Charges	hr.	4.630	1.137	5.26	0.501	2.32	0.420	1.94
TOTAL OPERATING COSTS				66.71		96.36		103.36
TOTAL OPERATING COSTS/BUSHEL.				1.41		2.14		2.42
FIXED INPUTS:[c]								
Machinery								
Interest at 11.5%	dol.			13.43		10.05		9.15
Depreciation, Taxes, Insur.	dol.			15.64		12.02		10.78
Livestock Equipment								
Interest at 11.5%	dol.			0.85		0.85		0.85
Depreciation, Taxes, Insur	dol.			0.89		0.89		0.89
Land								
Interest at 0%	dol.							
Taxes	dol.			______		______		______

Table 10. (continued)

TOTAL FIXED COSTS				30.81		23.81		21.67
TOTAL FIXED COSTS/ BUSHEL				0.65		0.53		0.51
TOTAL OPERATING AND FIXED COSTS				97.52		120.17		125.03
TOTAL OPERATING AND FIXED COSTS /BUSHEL				2.07		2.67		2.93
PRODUCTION:								
Wheat Grain[d]	bu.	2.300	47.200	108.56	45.000[e]	103.50	42.700	98.21
Small Grain Pasture[f]	stocking rate	77.89	0.40	31.16	0.40	31.16	0.40	31.16
TOTAL RECEIPTS				139.72		134.66		129.37
RETURNS ABOVE TOTAL OPERATING COSTS				73.01		38.30		26.01
RETURNS ABOVE TOTAL OPERATING AND FIXED COSTS				42.20		14.49		4.34

[a] Does not include additional expenses for years in which crops were replanted.

[b] Average annual application rate.

[c] Stocker steer enterprise budget fixed costs are included here.

[d] Wheat grain yields for the conventional and zero tillage systems are from tillage test plots (September plantings) at Stillwater for years 1982-83 through 1985-86.

[e] Wheat grain yields for the one tillage system are the mean of the conventional and zero tillage system grain yields.

[f] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

the conventional tillage system are different from those of the one and zero tillage system. These computed operating input figures do not take into consideration the possibility that one or more of these alternative tillage systems may require additional inputs if a crop has to be replanted. The Stillwater conventional tillage system August plantings for 1982-83 and 1983-84 were replanted. Likewise, the Stillwater zero tillage system August planting for 1982-83 was replanted. The additional inputs required for these replanting operations are taken into consideration in subsequent estimated enterprise budgets.

Since parathion and Glean are usually applied by aerial spray application on a biannual basis in this study, the annual quantity per acre figure for these inputs is determined to be one-half the biannual application rate. In other words, this figure is the average annual application rate for these specific inputs.

The custom harvest and custom hauling input costs are based upon a constant 12-12-12 rate throughout all tillage systems. The first twelve indicates that an initial $12 per acre harvesting fee will be charged by the custom harvesters. The second twelve indicates that an additional charge of $0.12 per bushel will be applied to every bushel of wheat harvested above a 20 bushels per acre yield. For example, the conventional tillage system exhibits a wheat yield of 47.2 bushels per acre. Since there is a difference of 27.2 between 47.2 and 20, 27.2 is multiplied by $0.12 to determine the additional harvesting charge on a per acre basis. In this system, the additional charge is $3.26. The third twelve indicates that $0.12 will be charged for every bushel of wheat hauled by the custom haulers. For the conventional tillage system, a cost of $5.66 per acre is assessed for hauling 47.2 bushels of wheat at $0.12 per bushel. In this study, it is assumed that all wheat cutting and hauling is performed by custom harvesters and haulers.

The fixed inputs portion of Table 9 is divided into machinery and land sections. However, since the quantity and quality of land is assumed to be the same for all systems, land costs are ignored. Therefore, any differences in fixed costs among systems are attributable to diversities in the machinery section. The conventional tillage system requires more machinery fixed inputs than do either of the other two tillage systems. However, differences in machinery fixed costs between systems are not nearly as substantial as the differences in total operating costs between systems. The total operating and machinery fixed costs of the one and zero tillage systems are greater than those of the conventional tillage system.

The total operating costs, machinery fixed costs, and total operating and machinery fixed costs are calculated on a per bushel basis as well as a per acre basis. This is accomplished by dividing the respective costs for each system by the wheat yield per acre for that particular system. The total operating costs for the conventional tillage system are $66.71 (Table 9). Therefore, this $66.71 is divided by the wheat yield for this system, 47.2 bushels per acre, to obtain a value of $1.41 which is the estimate of total operating costs per bushel. The same procedure is used to obtain all other costs per bushel throughout these tables.

The production portion of Table 9 includes the value of the wheat grain yield for each tillage system. As previously stated, the wheat grain yields for the conventional and zero tillage systems are the September planted, mean grain yields from Stillwater test plots for production years 1982-83 to 1985-86. The one tillage system's wheat grain yield is the mean of the conventional and zero tillage system yields since no yield data were available for that system. The total receipts for the conventional tillage system are highest, followed by those of the one and zero tillage systems, respectively.

If the total operating costs are subtracted from the total receipts, the returns above total operating costs can then be obtained (Table 9). The returns above total operating costs for the conventional tillage system exceed those of the other two systems. The returns above total operating costs for the zero tillage system are negative.

If the machinery fixed costs are subtracted from the returns above total operating costs, the returns above total operating and machinery fixed costs can then be obtained. The conventional tillage system is the only system which projects positive returns. Under the conditions described in these tillage system's enterprise budgets, the conventional tillage system would be the only system to generate a positive return to the land, labor, overhead, and risk management inputs.

Table 10 includes the same aspects of each system's enterprise budget that are included in Table 9. However, Table 10 also includes an estimated price for forage production under these circumstances. The price for forage production was obtained by using an enterprise budget for stocker steers developed by Walker, Guiterrez, and Lusby. The stocker budget reflects the estimated costs and returns for a stocker steer with an initial weight of 437 pounds. The stocking period begins in November, and the budget reflects the sale of a 665 pound animal in March.

A stocking density of 0.4 was assumed for all August and September plantings for all tillage systems. Thus, the estimated returns from one stocker steer with an initial weight of 437 pounds are allocated over 2.5 acres. This stocking density and the rate of stocker growth were assumed constant for two reasons. First, pre- and post-winter dormancy clipping data were not available in all years. Second, estimates of stocker performance under the variable weather conditions associated with the years of the study were not available. However, from the Heer's research (Heer, 1985), it was estimated that the August and September plantings would yield enough forage to support and maintain the 0.4 stocking density. As a result, the stocker weight gain is assigned a price. That price is used as a proxy for the value of forage production in this study, and it takes into consideration all of the operating input costs for stocker steer production. Since the operating input costs of stocker steer production are included in the forage, or small grain pasture, price in Table 10, the fixed costs of stocker steer production should also be included at some point. These fixed costs are included in Table 10.

The fixed inputs in Table 10 not only include the machinery fixed costs of grain production, but they also include the fixed costs of stocker steer production. These stocker steer costs must be included as an estimate of the fixed costs of forage production in this section since the price of stocker steer weight gain is used as the price of wheat forage, or small grain pasture, production in this budget. By including these costs, both the total operating costs and the total fixed costs can be estimated for wheat grain and forage production.

The operating inputs included in Table 10 are identical to those in Table 9. The fixed inputs section of Table 10 includes the same machinery fixed costs as Table 9, but it also includes additional machinery and equipment costs that Table 9 does not contain. These additional fixed costs are attributable to the inclusion of stocker production in this enterprise budget. In Table 10, the conventional tillage system's total fixed costs are the greatest, followed by those of the one tillage system and the zero tillage system. When the total operating and the total fixed costs are summed, the zero tillage system exhibits the greatest costs, followed in order by the one and conventional systems.

As previously stated, the production section of Table 10 includes both grain and forage yield data. The forage data are listed as small grain pasture in the table. The values for grain production in Table 10 match those in Table 9 since the quantities and price are the same. However, the added value of stocker production in Table 10 make this table's total receipts substantially higher. The conventional tillage system exhibits the greatest total receipts followed in order by those of the one and zero tillage systems.

The returns above total operating costs for Table 10 vary greatly, with those of the conventional tillage system vastly superior to those of the other two systems. Likewise, the returns above total operating and fixed costs are much greater for the conventional tillage system than for either of the other two systems.

Comparison of Expected Yields, Selected Input Requirements, and Production Costs

This section includes additional analysis of the information contained in the enterprise budgets just examined. All of the information presented in Tables 11 and 12 was derived from data in Tables 9 and 10, respectively.

Table 11 includes the expected yields, the selected input requirements, and the production costs for the three tillage system enterprise budgets which consider grain production only. Table 12 includes the expected yields, the selected input requirements, and the production costs for the three tillage system enterprise budgets which consider both grain and forage production.

Table 11. Estimates of Expected Yields, Selected Input Requirements, and Production Costs for Alternative Tillage Systems Considering Grain Production

	Conventional Tillage	One Tillage	Change from Conv.	Zero Tillage	Change from Conv.
Wheat Grain Yield (bu/acre)[a]	47.20	45.00[b]	-5%	42.70	-10%
Total Wheat Receipts ($/acre)	108.56	103.50	-5%	98.21	-10%
Machinery Labor (hours/acre)	1.14	0.50	-56%	0.42	-63%
Tractor Fuel (gal/acre)	6.11	3.06	-50%	2.42	-60%
Herbicide Costs ($/acre)	1.33	35.75	2588%	44.17	3221%
Operating Capital ($/acre)	23.97	41.69	74%	42.42	77%
Average Machinery Investment ($/acre)	107.88	78.44	-27%	70.66	-34%
Total Operating & Machinery Capital ($/acre)	131.85	120.13	-9%	113.08	-14%
Production Costs ($/acre)[c]					
Fertilizer					
82-0-0	9.06	9.06	0%	12.32	36%
18-46-0	8.80	8.80	0%	8.80	0%
Insecticide					
Parathion	0.86	0.86	0%		
Fungicide					
Vitavex 200		1.00		1.00	
Herbicide					
Glean	1.33				
Bladex		8.00		8.00	
Aatrex		1.00		1.00	
Landmaster		0.00		8.42	
Roundup		12.50		12.50	
Lexone or Sencor		14.25		14.25	

Table 11. (continued)

Machinery fuel, lube, repairs[c]	11.94	7.71	-35%	6.41	-46%
Interest cost of operating capital	2.76	4.79	74%	4.88	77%
Other operating costs[c]	31.96	28.39	-11%	25.78	-19%
Total Operating Costs ($/acre)	66.71	96.36	44%	103.36	55%
Total Operating Costs ($/bu.)	1.41	2.14	52%	2.42	72%
Total Fixed Costs ($/acre)	26.41	19.41	-27%	17.27	-35%
Total Fixed Costs ($/bu.)	0.56	0.43	-23%	0.40	-29%
Total Operating & Fixed Costs ($/acre)	93.12	115.77	24%	120.43	30%
Total Operating & Fixed Costs ($/bu.)	1.97	2.57	30%	2.83	44%
Returns above Total Operating Costs ($/acre)	41.85	7.14	-83%	-5.15	-112%
Returns above Total Operating & Fixed Costs ($/acre)	15.44	-12.27	-179%	-22.42	-245%

[a] Wheat grain yields for the conventional and zero tillage systems are means from the tillage test plots (September plantings) at Stillwater for years 1982-83 through 1985-86.

[b] Wheat grain yield for the one tillage system is the mean of the conventional and zero tillage grain yields.

[c] Does not include additional expenses for years in which crops were replanted.

Table 12. Estimates of Expected Yields, Selected Input Requirements, and Production Costs for Alternative Tillage Systems Considering Grain and Forage Production

	Conventional Tillage	One Tillage	Change from Conv.	Zero Tillage	Change from Conv.
Wheat Grain Yield (bu/acre)[a]	47.20	45.00[b]	-5%	42.70	-10%
Wheat Grain Receipts ($/acre)	108.56	103.50	-5%	98.21	-10%
Wheat Forage Receipts ($/acre)[c]	31.16	31.16	0%	31.16	0%
Total Wheat Receipts ($/acre)	139.72	134.66	-4%	129.37	-7%
Machinery Labor (hours/acre)	1.14	0.50	-56%	0.42	-63%
Tractor Fuel (gal/acre)	6.11	3.06	-50%	2.42	-60%
Herbicide Costs ($/acre)	1.33	35.75	2588%	44.17	3221%
Operating Capital ($/acre)	23.97	41.69	74%	42.42	77%
Average Machinery Investment ($/acre)	116.78	87.39	-25%	79.57	-32%
Average Equipment Investment ($/acre)	7.39	7.39	0%	7.39	0%
Total Operating Machinery & Equipment Capital ($/acre)	148.14	136.47	-8%	129.38	-13%
Production Costs ($/acre)[d]					
Fertilizer					
82-0-0	9.06	9.06	0%	12.32	36%
18-46-0	8.80	8.80	0%	8.80	0%
Insecticide					
Parathion	0.86	0.86	0%		
Fungicide					
Vitavex 200		1.00		1.00	
Herbicide					

Table 12. (continued)

Glean	1.33				
Bladex		8.00		8.00	
Aatrex		1.00		1.00	
Landmaster				8.42	
Roundup		12.50		12.50	
Lexone or Sencor		14.25		14.25	
Machinery Fuel, Lube, Repairs	11.94	7.71	-35%	6.41	-46%
Interest Cost of Operating Capital	2.76	4.79	74%	4.88	77%
Other operating costs	31.96	28.39	-11%	25.78	-19%
Total Operating Costs ($/acre)	66.71	96.36	44%	103.36	55%
Total Operating Costs ($/bu.)	1.41	2.14	52%	2.42	72%
Total Fixed Costs ($/acre)	30.81	23.81	-23%	21.67	-30%
Total Fixed Costs ($/bu.)	0.65	0.53	-19%	0.51	-22%
Total Operating & Fixed Costs ($/acre)	97.52	120.17	23%	125.03	28%
Total Operating & Fixed Costs ($/bu.)	2.07	2.67	29%	2.93	42%
Returns above Total Operating Costs ($/acre)	73.01	38.30	-48%	26.01	-64%
Returns above Total Operating & Fixed Costs ($/acre)	42.20	14.49	-66%	4.34	-90%

[a] Wheat grain yields for the conventional and zero tillage systems are means from the tillage test plots (September plantings) at Stillwater for years 1982-83 through 1985-86.

[b] Wheat grain yield for the one tillage system is the mean of the conventional and zero tillage grain yields.

[c] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

[d] Does not include expenses for years in which crops were replanted.

Table 11 includes a comparison of selected aspects in the production, operating input, and fixed input sections of Table 9 among the alternative tillage systems. In the production section, the wheat grain yield and total wheat receipts will be examined. In the operating inputs section, the herbicide, fuel, capital, and labor requirements will be of special interest. In the fixed inputs section, the machinery requirements will be examined.

In Table 12, many of the same type of relevant items from Table 10 will be examined, in addition to two others. The small grain pasture production and the equipment requirements of the fixed inputs section are included.

Tables 11 and 12 basically compare the differences in production, operating inputs, and fixed costs among systems from Tables 9 and 10. In general, the conventional tillage system seems to produce higher yields, incur less operating costs, and require more fixed inputs than do the one and zero tillage systems. Tables 11 and 12 fuse these differences among the systems into two tables, and use this information to project "bottom-line" return figures for each tillage system. The differences among tillage systems are presented in Tables 11 and 12 and will now be discussed.

The estimated wheat grain yield of the one tillage system in Table 11 is 45.0 bushels per acre, which is a five percent decrease when compared to the expected yield of 47.20 bushels per acre for the conventional tillage system. The zero tillage system's yield is 42.70 bushel per acre, down ten percent from that of the conventional system. Additionally, the total grain receipts of $103.50 and $98.21 for the one and zero tillage systems also represent a five and ten percent decrease in receipts as compared to the $108.56 grain receipts for the conventional tillage system.

The hours of machinery labor per acre are 1.14 for the conventional system. The figure is 0.50 hours per acre for the one tillage system, which represents a 56 percent decrease from the conventional system. The figure for the zero tillage system is 0.42 hours per acre, which is a 63 percent reduction in comparison to the conventional system's 1.14 figure. The conventional system requires 6.11 gallons of diesel per acre. This amount is approximately two times more than the 3.06 gallons required for the one tillage system, and it is greater than two times more than the 2.42 gallons required by the zero tillage system. The increased machinery labor and tractor fuel requirements for the conventional tillage system are due to the large number of field operations that must be performed. Although these particular operating input requirements are higher for the conventional tillage system, they are more than offset by the high herbicide requirements of the one and zero tillage systems.

The differences in herbicide costs per acre for the three tillage systems are greater than the differences in any other required input costs for these systems. The conventional tillage system requires annual herbicide costs of only $1.33 per acre. In contrast, the one tillage system incurs herbicide costs of $35.75 per acre, which represents a 2,588 percent increase over the conventional system. Likewise, the zero tillage system incurs herbicide costs of $44.17 per acre, which represents a 3,221 percent increase over the conventional system. These huge contrasts in herbicide costs across the tillage systems play a major role in the determination and selection of the most economically feasible tillage system.

The operating capital requirements for the one tillage system are $41.69 in Table 11. This figure represents a 74 percent increase over the $23.97 required by the conventional tillage system. The zero tillage system's operating capital requirements of $42.42 per acre represent a 77 percent increase over the conventional tillage system's estimate. These differences in operating capital requirements are also reflected in the amount of interest charged on operating capital in the production costs section of Table 11. The conventional tillage system has an interest cost of $2.76 per acre. The one tillage system has an interest cost of $4.79, or a 74 percent increase, while the zero tillage system has an interest cost of $4.88, or a 77 percent increase. These differences in operating capital requirements and interest costs are basically attributable to the high herbicide requirements of the one and zero tillage systems.

The average machinery investment estimates in Table 11 are derived from the fixed inputs section of Table 9. These average machinery investment estimates were obtained by dividing the value per acre figure for machinery interest by the 11.5 percent interest rate. For example, Table 9 shows a fixed input, machinery interest value of $12.40 per acre for the conventional tillage system. If this figure of $12.40 is divided by the interest rate of 11.5 percent, the average machinery investment of $107.88 per acre is obtained for the conventional tillage system in Table 11. The same procedure is used to obtain all of the average machinery investment figures for the alternative tillage systems. The conventional tillage system's $107.88 average machinery investment is 27 percent greater than the one tillage system's $78.44 investment or 34 percent greater than the zero tillage system's $70.66 investment. The conventional tillage system requires a larger machinery investment than do the other two tillage systems since it consists of a large number of field operations, and therefore necessitates more machinery.

Average machinery investment is computed by the budget generator. The budget generator computes an estimated salvage value for each machine. Average investment over the life of the machine on the farm is assumed to be the mean of the sum of the machine's purchase price and salvage value. These investment estimates are not directly presented on the enterprise budgets. However, the machinery interest cost is computed by multiplying the average machinery investment per acre by the interest rate. Hence, the investment can be determined by dividing the interest costs by the interest rate.

If the operating capital and average machinery investment are summed, the total operating and machinery capital requirements can be obtained. The conventional tillage system has total capital requirements of $131.85, which is the highest capital requirement figure among the three tillage systems. However, this figure is only 9 percent higher than the one tillage system's $120.13 figure and 14 percent higher than the zero tillage system's $113.08 figure.

The production costs for fertilizer are the same across all systems with one exception. For reasons previously explained, the zero tillage system requires 36 percent more anhydrous ammonia (82-0-0) than does the conventional or one tillage system.

The production costs for insecticides, fungicides, and herbicides become difficult to compare across tillage systems since the same inputs tend not to be used for all three systems. For instance, the conventional and one tillage systems require the same amount of parathion, but the zero tillage system requires none. On the other hand, many inputs are budgeted for use by the one and zero tillage systems which are not required for the conventional tillage system. Examples of this include Vitavex 200, Bladex, Aatrex, Roundup, and Lexone or Sencor. Other inputs are used exclusively by a single tillage system such as Glean for the conventional tillage system and Landmaster for the zero tillage system.

The machinery fuel, lube, and repair costs range from $11.94 for the conventional tillage system to $7.71, a 35 percent decrease, for the one tillage system to $6.41, a 46 percent decrease, for the zero tillage system. Other operating costs vary from $31.96, to $28.39, to $25.78 for the conventional, one, and zero tillage systems, respectively. These other operating costs include inputs such as seed wheat, custom harvesting and hauling, dry fertilizer spreader rental, aerial spray application, and labor.

When the various production costs are summed in Table 11, the total operating costs can be estimated. The conventional tillage system's total operating costs are $66.71 per acre. The one tillage system's costs accumulate to a total of $96.36, which is an additional $29.65 or 44 percent above the costs of the conventional tillage system. The zero tillage system's costs sum to a figure of $103.36, which is $36.65 or 55 percent greater than the operating costs of the conventional tillage system. The total operating costs for all three tillage systems would be relatively close if not for the herbicides used in the one and zero tillage systems. Because these herbicides are a necessary part of these two tillage systems, however, the conventional tillage system's total operating costs are substantially lower than those of the one and zero tillage systems.

Unlike the total operating costs, the total fixed costs, which were obtained from Table 9, tend to be greater for the conventional tillage system than for the one or zero tillage systems. These increased fixed costs are incurred since the conventional tillage system involves a large number of field operations, which in turn necessitates greater machinery and/or equipment requirements. However, the conventional tillage system's $26.41 total fixed costs are only $7.00 or 27 percent greater than those of the one tillage system and only $9.14 or 35 percent greater than those of the zero tillage system on a per acre basis.

The conventional tillage system's total operating and fixed costs equal $93.12 (Table 11). The one tillage system's costs are considerably higher at $115.77. Likewise, the total estimated costs for the zero tillage system are also much higher than those for the conventional tillage system. These costs are estimated to be $120.43 per acre.

The estimated returns above total operating costs are substantially larger for the conventional tillage system than for the other two systems. The estimated returns for the conventional tillage system are $41.85. In contrast, the one tillage system's returns are estimated to be $7.14 or 83 percent below those of the conventional tillage system. Furthermore, the zero tillage system's returns are estimated to be -$5.15 or 112 percent below those of the conventional tillage system.

Likewise, the estimated returns above total operating and fixed costs are decisively larger for the conventional tillage system whose returns are $15.44. The one tillage system exhibits returns of -$12.27, which is a decrease of 179 percent. Additionally, the zero tillage system produces returns of -$22.42, which is a 245 percent decrease as compared to the conventional system. Although the conventional tillage system incurred higher total fixed costs, the reduced production receipts and the higher operating input costs of the one and zero tillage systems caused these two system's returns to be much less desirable than those of the conventional tillage system.

Table 12 includes information derived from data obtained in Table 10, and considers both grain and stocker production in its results. Table 11 and Table 12 have many values which are identical for all three tillage systems. Among the common values are those for wheat grain yield, machinery labor, tractor fuel, operating capital, all of the production costs, and the total operating costs per acre and per bushel.

The value of beef gain derived from forage production is included in Table 12. Total wheat receipts for all three tillage systems are higher in Table 12 than they are in Table 11. This is due to the $31.16 of stocker production receipts that are included in Table 12. These additional receipts bring the total receipts to $139.72 for the conventional tillage system, $134.66 for the one tillage system, and $129.37 for the zero tillage system. The $134.66 is a four percent reduction from the $139.72 figure, and the $129.37 is a seven percent reduction from the $139.72 figure.

Other differences in Table 12 include the average machinery and equipment investment figures. These figures were derived from numbers in the fixed inputs section of Table 10. The conventional tillage system has an average machinery investment of $116.78 per acre. This figure is 25 percent greater than the one tillage system's $87.39 figure, and it is 32 percent greater than the zero tillage systems $79.57 figure. The average livestock equipment investment per acre is $7.39 for all three systems.

When the operating capital, the average machinery investment, and the average equipment investment figures are summed for each system, the total operating, machinery, and equipment capital is obtained. The total capital required for the conventional tillage system is $148.14. This amount is approximately $16.35 more than is required for the conventional tillage system in Table 11. The one tillage system requires $136.47, which is eight percent or $11.67 less than the conventional tillage system's requirements and approximately $16.35 greater than the requirements for the one tillage system in Table 11. The zero tillage system requires $129.38, which is 13 percent or $18.76 less than the conventional tillage system's requirements and approximately $16.35 more than the requirements of the zero tillage system in Table 11.

The total fixed costs for the conventional tillage system are $30.81 per acre (Table 12). The one tillage system's total fixed costs are $23.81. The total fixed costs of the zero tillage system are $21.67.

The total operating and fixed costs per acre are $97.52, $120.17, and $125.03 for the conventional, one, and zero tillage systems, respectively. The total costs for the one and zero tillage systems are respectively 23 and 28 percent greater than the costs of the conventional tillage system.

The returns above total operating costs per acre are $73.01, $38.30, and $26.01, for the conventional, one, and zero tillage systems, respectively. Likewise, the returns above total operating and fixed costs per acre are much higher for the conventional tillage system than for the other two systems. The returns for the conventional tillage system equal $42.20, which are 66 and 90 percent greater than the one and zero tillage system's returns of $14.49 and $4.34, respectively.

Estimated Enterprise Budgets for Alternative Tillage Systems Over a Four Year Period

Enterprise budgets were estimated for the four year period for which Heer collected wheat grain and forage yield data at Stillwater and Lahoma (Heer, 1985). This period included the production years of 1982-83 through 1985-86. Stillwater and Lahoma grain yield data as presented in Table 7 were used in these enterprise budget estimates. The projected returns obtained from these enterprise budgets for both Stillwater and Lahoma are presented in subsequent tables. However, only Stillwater's projected enterprise budgets are presented in this study due to space limitations and to avoid repetitiveness. A separate enterprise budget is estimated for each Stillwater planting period. Therefore, there is an enterprise budget for each tillage system in August 1982-83, September 1982-83, October 1982-83, etc. Since there are four planting periods during each year and four production years, 16 enterprise budgets were estimated for each tillage system. These 16 enterprise budgets include wheat grain yields, but they do not account for the value of forage production. Therefore, additional enterprise budgets were estimated for August and September plantings in each year for all tillage systems to account for this forage production. Since enterprise budgets were estimated for two more planting periods in each of four years, each tillage system has an additional eight enterprise budget estimates. So, the total number of enterprise budgets estimated for each of the three tillage systems equals 24.

These enterprise budget estimates are grouped according to tillage system, planting period, and production estimates (whether the production section accounted solely for grain yields, or for both grain and stocker production) in Tables 13 through 30 which are in Appendix A.

Tables 13 through 18 contain enterprise budget estimates for the conventional tillage system, Tables 19 through 24 contain enterprise budget estimates for the one tillage system, while Tables 25 through 30 contain enterprise budget estimates for the zero tillage system. Additionally, each of these tables contains enterprise budgets which were planted in a specific month. Furthermore, each of these tables also accounts for either grain production or for both grain and forage production. For example, Table 13 presents enterprise budget estimates for the conventional tillage system's August plantings, which take into account only wheat grain production. Table 14 presents enterprise budget estimates for the conventional tillage system's September plantings, which take into account only wheat grain production. Table 17 presents enterprise budget estimates for the conventional tillage system's August plantings, which in this case account for both wheat grain and forage production. Table 19 presents enterprise budget estimates for the one tillage system's August plantings, which take into account only wheat grain production. The rest of the enterprise budget estimates are presented similarly.

Many of the prices obtained for these enterprise budget estimates are actual prices for that specific item in the time period being examined. Most of these actual prices were obtained from publications by the United States Department of Agriculture, the National Agricultural Statistics Service, the Agricultural Statistics Board, the Federal Reserve Bank of Kansas City, the Agricultural Marketing Service, and the Oklahoma Livestock and Seed Division. When actual prices were not available for specific inputs in specific years, indexes for the inputs in question were used to estimate prices for the time period being examined.

The conventional tillage system's August 1982-83 and 1983-84 estimated enterprise budgets in Table 13, and the one and zero tillage system's August 1982-83 estimated enterprise budgets in Tables 19 and 25, include the additional inputs used when the wheat crop was replanted. These additional inputs included such items as seed, fuel, labor, and machinery lube and repair. Therefore, additional costs were included for all of these inputs except labor. The quantity of labor is exhibited in each enterprise budget, but a price and value are not assigned to this input. Therefore, the costs for the labor input are not counted in the operating inputs section. Thus, the estimated returns are returns to the unpaid resources including land, labor, management, overhead, and risk.

The annual operating capital requirements are determined in the same manner for each of the estimated enterprise budgets in Table 13 through Table 30. The quantity of annual operating capital used per acre per year is estimated by summing the values of all operating inputs from fertilizer to fuel, and then multiplying that sum by the proportion of a year in which the operating capital will be employed. For instance, if the operating input values from fertilizer to fuel summed to $50.00 and this operating capital was used for six months, the quantity of annual operating capital required for each acre per year would be $25.00. This figure is obtained by multiplying the $50.00 by 0.50. This 0.50 figure is obtained by dividing the six months of capital usage by the twelve months in a complete year.

Furthermore, the value of the annual operating capital can be determined by multiplying the quantity of annual operating capital required for that particular year by the price per unit. The price per unit in this instance represents the annual interest rate expressed in a decimal form. For this example, $25.00 would then be multiplied by an annual interest rate expressed in decimal form, such as 0.15. The result, $3.75, would represent the value or cost of the annual operating capital for that period.

The total operating costs, the total receipts, and the returns to land, labor, management, machinery fixed costs, overhead, and risk are emphasized in each of these tables. The total operating costs and total receipts are not reviewed per se, but the returns to the inputs listed above are compiled in a table and presented in the following section.

Summary of Estimated Enterprise Budget Returns for the Alternative Tillage Systems

The enterprise budget returns for Stillwater and Lahoma are contained in Tables 31 and 32. The returns are presented according to location, tillage system, planting period, and production estimates. The production estimates indicate whether the enterprise budget includes income resulting solely from

Table 31. Summary of What Returns for Alternative Tillage Systems in Dollars Per Acre at Stillwater

	Conventional Tillage System	One Tillage System	Zero Tillage System		Mean	Standard Deviation
1982-83				Conventional		
August	101.96	56.80	37.01	August	80.94	64.20
September	61.39	40.88	44.28	September	80.32	78.12
October	102.60	69.36	60.05	October	92.35	71.73
November	83.21	52.40	45.51	November	54.91	68.66
1983-84				One		
August	144.77	105.02	81.44	August	36.88	64.59
September	177.12	133.32	114.10	September	41.27	73.59
October	168.71	128.66	113.17	October	51.61	72.03
November	129.54	64.27	23.30	November	6.30	62.73
1984-85				Zero		
August	84.62	35.26	10.39	August	15.59	62.07
September	94.03	37.68	6.08	September	26.79	71.72
October	102.65	53.29	28.42	October	35.28	72.81
November	38.61	-24.49	-63.36	November	-18.40	61.97
1985-86						
August	-7.58	-49.57	-66.48			
September	-11.28	-46.81	-57.31			
October	-4.56	-44.88	-60.51			
November	-31.73	-67.00	-79.04			

Table 31. (continued)

	Conventional Tillage System plus Grazing	One Tillage System plus Grazing	Zero Tillage System plus Grazing		Mean	Standard Deviation
1982-83				Conventional + Gr.		
August	148.32	103.16	83.37	August	107.96	76.33
September	107.75	87.24	90.64	September	107.33	85.53
1983-84				One + Gr.		
August	169.85	130.10	106.52	August	63.89	76.27
September	202.20	158.40	139.18	September	68.28	82.37
1984-85				Zero + Gr.		
August	115.11	65.75	40.88	August	42.61	73.82
September	124.52	68.17	36.57	September	53.80	81.58
1985-86						
August	-1.45	-43.45	-60.35			
September	-5.15	-40.68	-51.18			

Table 32. Summary of Returns for Alternative Tillage Systems in Dollars Per Acre at Lahoma

	Conventional Tillage System	One Tillage System	Zero Tillage System		Mean	Standard Deviation
1982-83				Conventional		
August	87.14	51.48	40.04	August	56.76	37.88
September	92.90	62.09	55.50	September	67.10	44.35
October	63.82	32.71	25.81	October	50.95	33.24
November	53.81	30.89	32.16	November	37.29	21.63
1983-84				One		
August	81.65	44.69	32.00	August	21.63	37.72
September	110.57	57.42	28.89	September	27.31	42.32
October	57.38	32.25	31.37	October	15.89	41.31
November	45.26	10.16	-0.34	November	11.09	19.35
1984-85				Zero		
August	53.96	22.08	14.97	August	11.08	37.34
September	54.23	18.85	8.25	September	12.24	42.00
October	79.51	44.13	33.26	October	5.19	50.01
November	12.81	-7.78	-3.61	November	9.40	19.78
1985-86						
August	4.28	-31.72	-42.69			
September	10.70	-29.12	-43.69			
October	3.07	-45.53	-69.67			
November						

Table 32. (continued)

	Conventional Tillage System plus Grazing	One Tillage System plus Grazing	Zero Tillage System plus Grazing		Mean	Standard Deviation
1982-83				Conventional + Gr.		
August	133.50	97.84	86.40	August	83.77	52.86
September	139.26	108.45	101.86	September	94.12	57.23
1983-84				One + Gr.		
August	106.73	69.77	57.08	August	48.65	52.89
September	135.65	82.50	53.97	September	54.33	56.94
1984-85				Zero + Gr.		
August	84.44	52.57	45.46	August	38.10	52.67
September	84.72	49.34	38.74	September	39.25	57.84
1985-86						
August	10.41	-25.59	-36.56			
September	16.83	-22.99	-37.56			

grain yields or income from both grain and winter grazing. The means and standard deviations of the estimated returns are also included.

The estimated returns of the conventional tillage system for both the Stillwater and Lahoma locations are superior to those of the one and zero tillage systems.

Such a substantial difference in returns is attributable to several factors. First, the grain yields in Table 7 generally favor the conventional tillage system. Second, although the conventional tillage system incurs more fixed costs than does the one or zero tillage systems, the one and zero tillage systems require the relatively expensive stubble drill, thereby off-setting part of the conventional tillage system's higher fixed costs. Third, although the conventional tillage system requires higher labor, fuel, and machinery operating inputs than do the other two tillage systems, the one and zero tillage systems incur herbicide costs which are relatively high as compared to those of the conventional tillage system.

To determine which set of returns, and therefore, which tillage system and planting period is most desirable for a grain producer, the returns for both locations were analyzed using stochastic dominance. The results of the analysis are presented in Table 33.

A personal computer, stochastic dominance program developed by Cochran and Raskin was used to determine which tillage system(s) and planting period(s) exhibited first and second degree stochastic dominance. According to Boehlje and Eidman, production systems which exhibit first degree stochastic dominance would be preferred by decision makers who prefer more to less. Second degree stochastic dominance assumes that a decision-maker is risk averse once the first degree stochastically efficient set has been determined (Boehlje and Eidman, 1984).

Table 33. Stochastically Dominant Return Sets

Grain Production:

	Lahoma	Stillwater
First Degree Stochastic Dominant Set	Con Sept[a] and Con Oct	Con Sept and Con Oct
Second Degree Stochastic Dominant Set	Con Sept	Con Oct

Grain and Forage (Small Grain Pasture) Production:

	Lahoma	Stillwater
First Degree Stochastic Dominant Set	Con Gr Sept	Con Gr Aug and Con Gr Sept
Second Degree Stochastic Dominant Set	Con Gr Sept	Con Gr Aug

[a] Con = Conventional Tillage System.
One = One Tillage System.
Zero = Zero Tillage System.

Gr = with Grazing.

Aug = August Plantings.
Sept = September Plantings.
Oct = October Plantings.
Nov = November Plantings.

Table 33 presents the alternative return sets which exhibit first and second degree stochastic dominance. First, the enterprise budget returns which considered only grain production were examined. It was determined that two production strategies dominated all other production strategies by first degree stochastic dominance for both the Lahoma and Stillwater locations. For the Lahoma site, it was determined that the conventional tillage system's September and October return sets were first degree stochastically dominant, while for the Stillwater site, it was determined that the conventional tillage system's September and October strategies were first degree stochastically dominant. Therefore, if a grain producer is solely looking for grain production and prefers more returns to less, the preferred strategy is to use the conventional tillage system and plant in either September or October at both the Lahoma and Stillwater locations.

Next, second degree stochastic dominance analysis was performed. For the Lahoma location, it was determined that the conventional tillage system's September return set dominated all others by second degree stochastic dominance. At the Stillwater location, it was determined that the conventional tillage system's October return set dominated all others by second degree stochastic dominance. Therefore, the preferred strategy for a risk averse Lahoma grain producer who only desires grain production is to employ the conventional tillage system and plant in September, since the conventional tillage system's September return set is first degree stochastically dominant. Furthermore, a Stillwater grain producer who is risk averse should employ the conventional tillage system and plant his crop in October.

The bottom section of Table 33 presents the first and second degree stochastically dominant return sets for the enterprise budgets which consider both grain and forage production. It was determined that one first degree stochastically dominant and one second degree stochastically dominant strategy exists for the Lahoma location. In this case, the September planted, conventional tillage system with grazing serves as both the first and second degree stochastically dominant strategy.

Therefore, a Lahoma farmer who wishes to have grain and stocker production should use the conventional tillage system and plant in September.

For the Stillwater location, it was determined that two first degree stochastically dominant and one second degree stochastically dominant strategy exists. The August and September planted, conventional tillage systems with grazing exhibited first degree stochastic dominance over all of the other systems. A Stillwater farmer who prefers more income to less and who wishes to have both grain and stocker production should employ the conventional tillage system and plant in August or September. Furthermore, it was determined that the August planted conventional tillage system with grazing exhibited second degree stochastic dominance. Hence, a Stillwater farmer who is risk averse and prefers more returns to less would use the conventional tillage system with grazing, small grain pasture, and plant his crop in August, even though he might have to replant the wheat crop at a later date.

The stochastically dominant return sets in Table 33 all have one thing in common. They all employ the conventional tillage system as opposed to the one and zero tillage systems. Indeed, differences do exist in regard to planting dates. Despite these differences, the conventional tillage system still emerges as the dominating tillage system whether one looks at grain production or grain and stocker production.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Introduction

Many Oklahoma wheat producers are desperately trying to maintain control of their farming operations. It is therefore imperative for them to find means of raising receipts and/or reducing costs to retain economic control of their operations. To accomplish such goals, these grain producers must have access to all of the pertinent production data available. Without access to such data, these wheat producers can not accurately make the decisive management decisions which are critical to their operation's well-being.

The objective of this study is to present and compare various aspects of three alternative wheat production systems. First, each production system must be organized and developed. The three alternative wheat production systems in this study are the conventional tillage system, the one tillage system, and the zero tillage system. The development of each tillage system is complex. The first step entails the listing of required field operations and their timing. The second step involves detailing the operating inputs, as well as their quantities, prices, and usage schedule. The third step calls for the formation of a machinery complement and all of its required components. The fourth step requires the consolidation of all data in the aforementioned steps, plus grain and forage yields, input and output prices, and interest rate information, to develop enterprise budgets. These enterprise budgets are computed to provide estimates of the total operating costs, total fixed costs, total receipts, and net returns to land, labor, management, overhead, and risk. These return estimates, as well as other selected components of each system, are compared across the three alternative tillage systems. Finally, first and second degree stochastic dominance is used to identify strategies which would be preferred by farmers who prefer more income to less and are risk averse.

Results and Conclusions

The selection of the "best" wheat tillage system from an economic standpoint is dependent upon three aspects of this study. First, the wheat grain and forage yields are responsible for the total wheat receipts. Second, the variable operating inputs determine the total operating costs. Third, the fixed inputs produce the total fixed costs. These three aspects are combined to form return estimates. Although these return estimates are the most valuable data produced by this study, other aspects are also quite significant.

Table 11 contains enterprise budget figures for the three alternative tillage systems at Stillwater. In this case, only grain production is considered. The total wheat receipts of $108.56 for the conventional tillage system are five and ten percent higher than those of the one and zero tillage systems. Although these receipt figures are noteworthy and do bear an influence upon the final return estimates, they do not solely determine the "best" wheat tillage system. Likewise, the total fixed costs do play a noteworthy role in the final return estimates, but they are not the deciding factor when determining the "best" tillage system.

The conventional tillage system's total fixed costs of $26.41 are 27 and 35 percent greater than those of the one and zero tillage system. However, the total fixed costs do not vary more than $9.14 among the three tillage systems. The differences in total wheat receipts and total fixed costs among tillage systems basically cancel out each other when summed. For although the conventional tillage system incurs $7.00 and $9.14 more total fixed costs than the one and zero tillage systems, it offsets these costs by producing total grain receipts which are $5.06 and $10.35 greater than those of the one and zero tillage systems at the Stillwater location. Therefore, the total operating costs must play a substantial role in the selection of the "best" tillage system.

The total operating costs indeed bear a substantial role in the determination of the return estimates. The total operating costs of the conventional tillage system accumulate to $66.71, while the total operating costs of the one and zero tillage systems accumulate to $96.36 and $103.36. These two sums respectively represent a 44 and a 55 percent increase over the conventional tillage system's total operating costs. These excessive operating costs for the one and zero tillage systems, in addition to the superior grain production receipts for the conventional tillage system, more than offset the conventional tillage system's higher fixed costs when the returns above total operating and fixed costs are estimated. These returns for the conventional tillage system equal $15.44, while the same returns for the one and zero tillage systems equal -$12.27 and -$22.42, respectively.

The total operating costs of the one and zero tillage systems are substantially greater than those of the conventional tillage system for one major reason. The herbicides used in the one and zero tillage system are quite expensive as demonstrated in Table 11. The conventional tillage system's herbicide costs sum to a mere $1.33, while the herbicide costs of the one and zero tillage systems accumulate to $35.75 and $44.17, respectively. These herbicide costs represent a 2,588 and a 3,221 percent increase in usage as compared to the conventional tillage system.

In Table 12, which includes both grain and forage production, the herbicide costs are the same as in Table 11. Likewise, the total operating costs for all three tillage systems are the same. The total fixed costs and the total wheat receipts are different due to the use of the winter forage for stocker production. The total fixed costs for the three tillage systems are $30.81, $23.81, and $21.67. The wheat grain and stocker receipts equal $139.72, $134.66, and $129.37. However, neither the fixed costs nor the wheat receipts differ more than $10.35 between the systems. In fact, the conventional tillage system's higher total fixed costs are once again counterbalanced by its favorable total wheat receipts. Therefore, it is still the vast difference in herbicide costs which impacts the returns above total operating and fixed costs and ultimately distinguishes the conventional tillage system as the system with the highest returns. The conventional tillage system's returns above total operating and fixed costs equal $42.20, while those of the one and zero tillage systems equal $14.49 and $4.34, respectively.

Enterprise budgets were also estimated for the four year period from which Heer collected wheat grain and forage data (Heer, 1985). These enterprise budgets for the Stillwater location are presented in Tables 13 through 30. They are grouped according to tillage system, planting period, and production estimates (whether the production section accounts solely for grain production or for both grain and forage, small grain pasture, production). Historic price data were obtained for most of the inputs. In instances where production prices were not available for specific inputs or products, indexes were used to estimate prices for the time period being examined. These budgets include any added costs which were incurred when crops had to be replanted due to unfavorable weather or germination conditions.

The enterprise budget returns for each tillage system at the Stillwater and Lahoma locations are contained in Tables 31 and 32. These enterprise budget returns represent returns to the unpaid resources of land, labor, management, overhead, and risk. In each case, the conventional tillage system's estimated returns were greater, or less negative, than those of the one and zero tillage systems. This holds true whether one examines differences in specific planting periods or in the entire four year production period.

Table 33 presents the results of stochastic dominance analysis. All strategies included in the first and second degree stochastic dominant sets at both locations utilized the conventional tillage system. Differences with regard to planting dates do exist. However, the conventional tillage system clearly dominates as the superior tillage system whether a farmer desires only wheat production or both wheat and forage, small grain pasture, production.

Limitations of the Study

A number of limitations accompanying this study due to the organizational procedures, as well as the sheer complexity, involved in the development of such a project. Extreme care was taken to avoid or eliminate as many of the study's restrictions as possible. However, due to time factors and data scarcity, the development of study limitations was unavoidable.

First, the development of a hypothetical farm with assumed characteristics must be carried out to establish the conditions for the study. However, the hypothetical farm's assumed characteristics automatically discriminate against farms in different locations, of various sizes, with alternative soils, or with varied weather conditions (Handke, 1982). Therefore, the acquired results pertain to the type of conditions set forth in this particular study.

Second, the development of alternative tillage systems with specific characteristics must also be carried out. By forming such detailed tillage systems however, other "intermediate" tillage systems are excluded. Additionally, the three tillage systems developed in this study are dependent upon explicit geographical location, weather pattern, and machinery selection choices.

Third, machinery models and prices, operating input prices, product prices, and many other factors used in this study are dynamic. Much of the data used in this project will be out-of-date by the time this study is completed and published. In addition, Handke details some of the limitations evolving from the machinery selection process (Handke, 1982).

Fourth, the study's estimated wheat receipts come from wheat grain and stocker steer production. The production figures were obtained from relatively small test plots at experiment station locations. Additionally, these production figures were obtained in a four year time period. It is therefore unknown whether the same yield levels would be obtainable on a large scale basis over an indefinite period of time.

Fifth, strategies included in the first and second degree stochastic dominant sets are assumed to be appropriate for producers who prefer more to less and are risk averse. However, no attempt was made to elicit utility functions from farmers in the region. Hence, it is not known if they are risk averse. A farmer may not necessarily be risk averse. He may try to obtain the highest possible returns every year, which typically brings about increased risks. So, although the majority of producers may prefer more to less and may be risk averse, attitudes regarding risk were not determined.

Finally, the return distributions were obtained from only four data points. Therefore, the stochastic dominance analysis used to analyze these returns is dependent upon these four observations which are assumed to be equally likely. No attempt was made to determine if the four years are typical.

Future Research Needs

There are many aspects of this study which could provide valuable data for future research projects. Some of these aspects have been discussed in the manuscript, while others will now be examined.

First, it is essential to know if the grain and forage yields observed in this study can be reproduced for each tillage system in typical farming conditions. It would be of equal importance to know if these yields could be higher than expected, lower than expected, or maintained over a period of time. What is the relationship between grain production and forage production in each of these tillage systems? Does stocker grazing diminish wheat grain production in any of these tillage systems? Only future research can determine the answers to such questions.

Second, a more precise and accurate method of valuing wheat forage production would be tremendously beneficial. Such a method would allow return estimates to be projected with more certainty and less error. It is surprising that a logical, clearly defined, and uniformly acceptable method of valuing wheat forage production has not been developed thus far.

Third, soil conservation aspects of this study were basically overlooked. Conservation work among alternative tillage systems has previously been carried out by other researchers. However, additional work in this area should shed significant light upon the economic impact and outlook of soil conservation among alternative tillage systems for continuous winter wheat production.

Fourth, the long-term effects of pesticide usage upon wheat land and the environment are uncertain. Many producers and consumers are concerned about pesticide intensive production systems. Although pesticide intensive production systems may possess soil conservation benefits, such systems may also create problems in wildlife, soil, and water safety. It would therefore be beneficial to conduct additional research on the extended usage of pesticides for wheat grain and forage production.

Finally, the effect of government policy upon wheat production deserves examination. Government initiated wheat programs and tax incentives designed to benefit farmers could have a substantial influence upon which tillage system a farmer should employ. It would also be beneficial to determine if a farmer would use the same tillage system if such programs and exemptions were not provided by government.

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APPENDICES

APPENDIX A

STOCKER STEERS ON WINTER WHEAT PASTURE — 13120001
COST/RETURNS PER HEAD, 100 OR MORE HEAD — 11/01/86
SPRING CALVES HEAD 135 DAYS — STATE

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
STR CALVES(4-500	CWT.	71.040	4.370	310.44	________
NON-LEGUME HAY	LBS.	0.030	386.000	11.58	________
SALT & MIN.	LBS.	0.090	7.460	0.67	________
MKTG CHRG	CWT.	1.720	6.790	11.68	________
VET & MED.	HD.	9.000	1.000	9.00	________
VET-MED-LS SUPP	HD.	2.080	1.000	2.08	________
CUSTOM HAULING	CWT.	0.350	11.160	3.91	________
ANNUAL OPERATING CAPITAL	DOL.	0.115	111.106	12.78	________
MACHINERY LABOR	HR.	4.000	1.260	5.04	________
EQUIPMENT LABOR	HR.	4.000	0.080	0.32	________
LIVESTOCK LABOR	HR.	4.000	1.610	6.44	________
MACHINERY FUEL, LUBE, REPAIRS	DOL.			7.76	________
EQUIPMENT FUEL, LUBE, REPAIRS	DOL.			0.85	________
TOTAL OPERATING COST				382.55	________

FIXED COSTS	AMOUNT	VALUE		YOUR VALUE
MACHINERY				
INTEREST AT 11.50%	22.36	2.57		________
DEPR., TAXES INSURANCE		4.08		________
EQUIPMENT				
INTEREST AT 11.50%	18.56	2.13		________
DEPR., TAXES INSURANCE		2.22		________
LAND				
WHEAT PASTURE 2.53 AUMS		0.00		________
INTEREST AT 0.00%	0.00	0.00		________
TAXES		0.00		________
TOTAL FIXED COST			11.01	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
STEERS (6-700#)	CWT.	68.598	6.654	456.46	________

RETURNS ABOVE TOTAL OPERATING COSTS	73.91	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK, AND MANAGEMENT	62.91	________

AV NET GAIN 1.79/DAY. 2% DEATH LOSS. 3% SHRINK OFF CATTLE WTS. STEERS CONDITIONED AND FED HAY 1ST 15 DAYS
ASSUMES 2# HAY/DAY FOR 120 DAYS

WALKER, GUTIERREZ, LUSBY
11/13/86

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

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BUDGET IDENTIFICATION NUMBER  131200010110111          ANNUAL CAPITAL MONTH  3            BUDGET RECORD NUMBER 131
                                                                                                  BUDGET FILE   2

STOCKER STEERS ON WINTER WHEAT PASTURE                                            13120001
COST,RETURNS PER HEAD, 100 OR MORE HEAD                                           11/21/86
SPRING CALVES HEAD 135 DAYS                                                          STATE

                          1     2     3     4     5     6     7     8     9    10    11    12     13     14    15   16   17   18
                         JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC  PRICE  WEIGHT UNIT ITEM TYPE CONT
LINE                                                                                                      CODE CODE
PRODUCTION                                        NUMBER OF UNITS
  1 STEERS (6-700#)     0.00  0.00  0.98  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00 -7.000   6.790  16   11   7    0

OPERATING INPUTS                                  RATE/UNIT                                      PRICE  NUMBER UNIT ITEM TYPE CONT
                                                                                                        UNITS CODE CODE
 11 STR CALVES(4-500    0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  1.00  0.00 -2.000   4.370  16    7   3    0
 12 WHEAT PASTURE       0.64  0.72  0.38  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.24  0.55  0.000   1.000  10  151   3    0
 13 NON-LEGUME HAY     64.00 66.00 33.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00161.00 62.00  0.030   1.000  12  111   3    0
 14 SALT & MIN.         1.86  2.20  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.75  1.65 -1.000   1.000  12  103   3    0
 15 MKTG CHRG           0.00  0.00  6.79  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  1.720   1.000  16  485   3    0
 16 VET & MED.          0.10  0.10  0.05  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.70  0.05  9.000   1.000   1  416   3    0
 17 VET-MED-LS SUPP     0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  1.00  2.380   1.000   1  419   3    0
 18 CUSTOM HAULING      0.00  0.00  6.79  0.00  0.00  0.00  0.00  0.00  0.00  0.00  4.37  0.00  0.350   1.000  16  484   3    0

MACHINERY REQUIREMENTS                            HOURS                                          XXXXX  XXXXX POWER MACH TYPE CONT
                                                                                                              UNIT CODE
 26 PICKUP  75 TON      0.15  0.15  0.15  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.20  0.15  0.000   0.000   0   11   4    0
 27 STOCK TRAILER       0.05  0.05  0.05  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.05  0.05  0.000   0.000  11   99   4    0

EQUIPMENT REQUIREMENTS                                                                          NUMBER PROPORT XXX EQUIP TYPE XXXX
                                                                                                 UNITS OF COST      CODE
 37 LVST. HNDLING                                                                                1.000  0.002   0     6    5    0
 38 FEEDING EQUIP                                                                                1.000  0.002   0     7    5    0


 40 LIVESTOCK LABOR     0.28  0.28  0.28  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.49  0.28

-------------------------------------------------------------------------------------------------------------------------------
                                 MONTHLY SUMMARY OF RECEIPTS AND EXPENDITURES
  CATEGORY          YEAR UNIT     JAN     FEB    MAR     APR     MAY     JUN     JUL     AUG     SEP     OCT     NOV     DEC        TOTAL
TOTAL RECEIPTS         1 DOL.     0.00    0.00 456.46    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00       456.46
TOTAL VARIABLE COST    1 DOL.     4.64    4.73  17.24    0.00    0.00    0.00    0.00    0.00    0.00    0.00  325.17    6.19       357.97
-------------------------------------------------------------------------------------------------------------------------------
ANNUAL CAPITAL         1 DOL.    28.00   28.39   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00   27.10   27.61       111.11
-------------------------------------------------------------------------------------------------------------------------------
                                 LABOR REQUIREMENTS
MACHINERY LABOR        1 HOUR     0.24    0.24   0.24    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.30    0.24         1.26
LIVESTOCK LABOR        1 HOUR     0.28    0.28   0.28    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.49    0.28         1.61
EQUIPMENT LABOR        1 HOUR     0.02    0.02   0.02    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.02    0.02         0.08
   TOTAL LABOR         1 HOUR     0.54    0.54   0.54    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.81    0.54         2.95
-------------------------------------------------------------------------------------------------------------------------------
                                 MACHINERY REQUIREMENTS BY MONTH
PICKUP  75 TON           HOUR     0.20    0.20   0.20    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.25    0.20         1.05
STOCK TRAILER    ( 0.2)HOUR       0.05    0.05   0.05    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.05    0.05         0.25
-------------------------------------------------------------------------------------------------------------------------------
                     NO.         MONTHLY EQUIPMENT REQUIREMENTS AS A PROPORTION OF THE ITEMS WHOLE FARM USE
LVST. HNDLING       1.0 1 HD.   0.0005 0.0005 0.0005 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0005 0.0005        0.0025
FEEDING EQUIP       1.0 1 HD.   0.0005 0.0005 0.0005 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0005 0.0005        0.0025
        THE FINAL ENTRY IN EACH ROW REPRESENTS THE PROPORTION OF THE ITEMS TIME ALLOCATED TO THE BUDGET UNIT
-------------------------------------------------------------------------------------------------------------------------------
                                MACHINERY FIXED AND VARIABLE COST PER HOUR                         TOTAL
  MACHINE           CODE     DEPR      INSUR.      TAX    TOTAL FIXED  REPAIR    FUEL      LUB    VARIABLE     INT      HR/TIME
PICKUP  75 TON       11      2.15      0.07       0.17       2.39       2.70     3.74      0.56     7.00       1.32      1.00
STOCK TRAILER        99      5.38      0.25       0.68       6.30       1.66     0.00      0.00     1.66       4.73      1.00
-------------------------------------------------------------------------------------------------------------------------------
                                ANNUAL COST SUMMARY FOR EQUIPMENT AND LIVESTOCK
LINE                                    LIST   DEPREC-             INSUR-                        FUEL     HOURS TOT OWN- TOT OPER-
NO.      ITEM          SIZE  UNIT      PRICE   IATION  INTEREST     ANCE     TAXES  REPAIRS AND LUBE     LABOR ERSHIP/YR ATING/YR
  6 LVST. HNDLING      1.00 HD.      9900.00   445.50   626.18     32.67     54.45    198.00     0.00     16.00   532.62    198.00
  7 FEEDING EQUIP      1.00 HD.      3600.00   324.00   227.70    .11.88     19.80    144.00     0.00     16.00   355.68    144.00
-------------------------------------------------------------------------------------------------------------------------------
                                ANNUAL CHARGES MADE IN THIS BUDGET FOR EQUIPMENT AND LIVESTOCK
LINE                                 NUMBER  PROPOR  OWNERSHP OPERATING INTERST LABOR HOURS
NO.      ITEM          SIZE  UNIT     ITEMS  CHARGED  CHARGES  CHARGES  CHARGES  CHARGED
  6 LVST. HNDLING      1.00 HD.       1.00    0.00     1.33     0.49     1.57     0.04
  7 FEEDING EQUIP      1.00 HD.       1.00    0.00     0.89     0.36     0.57     0.04
-------------------------------------------------------------------------------------------------------------------------------
      COLUMN          1     2      3       4      5     6      7         8      9      10     11     12      13     14    15    16    17
NAME OF MACHINE     CODE  WIDTH INITIAL  SPEED  FIELD  RC1    RC2       RC3   HOURS  YEARS  RFV1   RFV2  PURCHASE FUEL HOURS  HP   FUEL
                          (FEET) LIST    (MPH)  EFFIC-                         USED  OWNED                 PRICE  TYPE  OF        MULT
                                 PRICE          ENCY                         ANNUALLY                                 LIFE
PICKUP  75 TON       11    0.8  13500.   20.0  0.68   0.80 0.001585  1.40   400.    5.0  0.670  0.885   13500    1    4000  140  0.03
STOCK TRAILER        99.  21.0   3400.   20.0  0.80   0.60 0.002510  1.30    50.   10.0  0.635  0.895    3400    0    1000    0  0.00
-------------------------------------------------------------------------------------------------------------------------------
    COLUMN---        1      2    3    4     5          6         7       8      9     10     11
                                                                      SALVAGE REPAIR FUEL & ANNUAL
                                         LIST   PURCHASE  YEARS  PROP OF  PROP  LUB AS HOURS
ITEM NAME          CODE   SIZE UNIT TYPE  PRICE     PRICE   LIFE    LIST OF LIST PROP   LABOR
LVST. HNDLING       6.    1.00   1  2.00 9900.00  9900.00  20.00   0.100  0.400  0.000  16.00
FEEDING EQUIP       7.    1.00   1. 2.00 3600.00  3600.00  10.00   0.100  0.400  0.000  16.00
-------------------------------------------------------------------------------------------------------------------------------
        AV NET GAIN 1.79/DAY 2% DEATH LOSS. 3% SHRINK OFF CATTLE  WALKER,GUTIERREZ,LUSBY      MACHINERY COMPLEMENT   11
        WTS  STEERS CONDITIONED AND FED HAY 1ST 15 DAYS                                       EQUIPMENT COMPLEMENT   11
        ASSUMES 2# HAY/DAY FOR 120 DAYS                        11/13/86                             PRICE VECTOR    2
                          LINE CHANGE               LINE CHANGE             LINE CHANGE               LINE CHANGE           LINE CHANGE
GENERAL NAME CHANGE-->111  NON-LEGUME HAY           416  VET-MED-LS SUPP    485  MKTG CHRG            484  CUSTOM HAULING   417  LIVESTOCK SUPP
                      150  SUMMER PASTURE           157  WINTER DRY PAST    120  MIXED FEED           151  WHEAT PASTURE
MACHNRY NAME CHANGE--> 99  STOCK TRAILER             98  STOCK TRAILER
EQUIP NAME CHANGE---->  6  LVST  HNDLING              7  FEEDING EQUIP

                   RW CL      VALUE      RW CL      VALUE      RW CL      VALUE      RW CL      VALUE      RW CL      VALUE      RW CL     VALUE
MACH COMP CHGS-->99  2.    21.000000   99  3.  3400.000000   99  4    20.000000   99  5.    0.300000   98  6     0.60000099  7     0.002510
                 99  8      1.000000   99  9     50.000000   99 10.   10.000000   99 11     0.635000   99 12     0.89500099 13.  3400.000000
                 99 14.     0.000000   99 15.  1000.000000   99 16.    0.000000   11  3. 13500.000000   11 13 13500.00000098  2.    21.000000
                 98. 3.  3400.000000   98  4     20.000000   98  5     0.900000   98  6     0.500000   98  7     0.00251098  8      1.000000
                 98  9     50.000000   98 10.    10.000000   98 11     0.635000   98 12.    0.895000   98 13  3400.00000098 14     0.000000
                 98 15.  1000.000000
EQUP COMP CHGS--> 6  2.     1.000000    6  3      1.000000    6  4     2.000000    6  5  9900.000000    6  6  9900.000000 6  7    20.000000
                  6  8.     0.100000    6  9      0.400000    6 10.    0.000000    6 11.   16.000000    7  2     1.000000 7  3.     1.000000
                  7  4      2.000000    7  5   3600.000000    7  6  3600.000000    7  7    10.000000    7  8     0.100000 7  9     0.400000
                  7 10.     0.000000    7 11.    16.000000

BUDGET 131200010110111 HAS BEEN STORED IN CASH FLOW SUMMARY FILE LOCATION NUMBER  131 FILE NUMBER   2
```

APPENDIX B

Table 13. Estimated Enterprise Budget for the August Conventional Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.110	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.200	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.00	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.	0.083	15.748	1.31	16.126	1.34	16.126	1.34	16.00	1.33
Bladex	lb.		3.937		4.031		4.031		4.00	
Aatrex	lb.		1.969		2.016		2.016		2.00	
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.		12.303		12.598		12.598		12.50	
Lexone or Sencor	pt.		18.701		19.150		19.150		19.00	
Seed	bu.	1.00	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
(replant)[a]	bu.	1.00	3.80	3.80	4.20	4.20				
Fuel	gal.	6.11	1.01	6.17	1.01	6.17	0.99	6.05	1.00	6.11
(replant)[a]	gal.	1.33	1.01	1.34	1.01	1.34				
Labor	hr.	0.137								
(replant)[a]	hr.	0.26								

Table 13. (continued)

Annual	dol.	30.56	0.139	4.25						
Operating		32.47			0.146	4.74				
Capital[b]		26.60					0.134	3.56		
		23.80							0.123	2.93
Other	dol.									
Custom Harvest[c]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				4.12		5.72		3.83		0.14
Custom Haul[c]				6.52		8.12		6.23		2.54
Rent Fertilizer Spreader				0.12		0.12		0.11		0.11
Aerial Spray Application				1.75		1.79		1.74		1.67
Machinery Lube + Repair				6.35		6.60		6.38		5.83
(replant)[a]				1.89		1.92		——		——
TOTAL OPERATING COSTS	dol.			75.60		82.03		67.45		55.28
PRODUCTION:										
Wheat Grain[d]	bu.	54.3	3.27	177.56						
		67.7			3.35	226.80				
		51.9					2.93	152.07		
		21.2							2.25	47.70
TOTAL RECEIPTS	dol.			177.56		226.80		152.07		47.70

Table 13. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	101.96	144.77	84.62	- 7.58

[a] The 1982-83 and 1983-84 August plantings were replanted and thus have two sets of expenses for some items.

[b] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[c] Custom harvest and custom hauling based upon a 12-12-12 constant harvest rate.

[d] Wheat grain yields for each year are from conventional tillage test plots (August plantings) at Stillwater.

Table 14. Estimated Enterprise Budget for the September Conventional Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.110	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.200	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.00	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.	0.083	15.748	1.31	16.126	1.34	16.126	1.34	16.00	1.33
Bladex	lb.		3.937		4.031		4.031		4.00	
Aatrex	lb.		1.969		2.016		2.016		2.00	
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.		12.303		12.598		12.598		12.50	
Lexone or Sencor	pt.		18.701		19.150		19.150		19.00	
Seed	bu.	1.00	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	6.11	1.01	6.17	1.01	6.17	0.99	6.05	1.00	6.11
Labor	hr.	1.137								

Table 14. (continued)

Annual Operating Capital[a]	dol.	26.49	0.139	3.68						
		28.09			0.146	4.10				
		26.60					0.134	3.56		
		23.80							0.123	2.93
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				2.21		6.66		4.25		
Custom Haul[b]				4.61		9.06		6.65		2.33
Rent Fertilizer Spreader				0.12		0.12		0.11		0.11
Aerial Spray Application				1.75		1.79		1.74		1.67
Mach. Lube + Repairs				6.35		6.60		6.38		5.83
TOTAL OPERATING COSTS	dol.			64.18		75.81		68.29		54.93
PRODUCTION:										
Wheat Grain[c]	bu.	38.4	3.27	125.57						
		75.5			3.35	252.93				
		55.4					2.93	162.32		
		19.4							2.25	43.65
TOTAL RECEIPTS	dol.			125.57		252.93		162.32		43.65

Table 14. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	61.39	177.12	94.03	-11.28

[a] The price for annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant harvest rate.

[c] Wheat grain yields for each year are from conventional tillage test plots (September plantings) at Stillwater.

Table 15. Estimated Enterprise Budget for the October Conventional Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.110	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.200	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.00	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.	0.083	15.748	1.31	16.126	1.34	16.126	1.34	16.00	1.33
Bladex	lb.		3.937		4.031		4.031		4.00	
Aatrex	lb.		1.969		2.016		2.016		2.00	
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.		12.303		12.598		12.598		12.50	
Lexone or Sencor	pt.		18.701		19.150		19.150		19.00	
Seed	bu.	1.00	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	6.11	1.01	6.17	1.01	6.17	0.99	6.05	1.00	6.11
Labor	hr.	1.137								

Table 15. (continued)

Annual Operating Capital[a]	dol.	26.49	0.139	3.68						
		28.09			0.146	4.10				
		26.60					0.134	3.56		
		23.80							0.123	2.93
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.			3.84		6.34		4.63		0.32	
Custom Haul[b]				6.24		8.74		7.03		2.72
Rent Fertilizer Spreader				0.12		0.12		0.11		0.11
Aerial Spray Application.				1.75		1.79		1.74		1.67
Mach. Lube + Repairs				6.35		6.60		6.38		5.83
TOTAL OPERATING COSTS	dol.			67.44		75.17		69.05		55.64
PRODUCTION:										
Wheat Grain[c]	bu.	52.0	3.27	170.04						
		72.8			3.35	243.88				
		58.6					2.93	171.70		
		22.7							2.25	51.08
TOTAL RECEIPTS	dol.			170.04		243.88		171.70		51.08

Table 15. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	102.60	168.71	102.65	-4.56

[a] The price for annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant harvest rate.

[c] Wheat grain yields for each year are from conventional tillage test plots (October plantings) at Stillwater.

Table 16. Estimated Enterprise Budget for the November Conventional Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.110	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.200	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.00	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.	0.083	15.748	1.31	16.126	1.34	16.126	1.34	16.00	1.33
Bladex	lb.		3.937		4.031		4.031		4.00	
Aatrex	lb.		1.969		2.016		2.016		2.00	
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.		12.303		12.598		12.598		12.50	
Lexone or Sencor	pt.		18.701		19.150		19.150		19.00	
Seed	bu.	1.00	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	6.11	1.01	6.17	1.01	6.17	0.99	6.05	1.00	6.11
Labor	hr.	1.137								

Table 16. (continued)

Annual Operating Capital[a]	dol.	26.49	0.139	3.68						
		28.09			0.146	4.10				
		26.60					0.134	3.56		
		23.80							0.123	2.93
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.07		4.82		1.78		0.00
Custom Haul[b]				5.47		7.22		4.18		1.18
Rent Fertilizer Spreader				0.12		0.12		0.11		0.11
Aerial Spray Application.				1.75		1.79		1.74		1.67
Mach. Lube + Repairs				6.35		6.60		6.38		5.83
TOTAL OPERATING COSTS	dol.			65.90		72.13		63.35		53.78
PRODUCTION:										
Wheat Grain[c]	bu.	45.6	3.27	149.11						
		60.2			3.35	201.67				
		34.8					2.93	101.96		
		9.8							2.25	22.05
TOTAL RECEIPTS	dol.			149.11		201.67		101.96		22.05

Table 16. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	83.21	129.54	38.61	-31.73

[a] The price for annual operating capital is the annual interest rate expressed in decimal form.
[b] Custom harvest and custom hauling based upon a 12-12-12 constant harvest rate.
[c] Wheat grain yields for each year are from conventional tillage test plots (November plantings) at Stillwater.

Table 17. Estimated Enterprise Budget for the August Conventional Tillage System Considering Grain and Forage Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.110	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.200	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.00	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.	0.083	15.748	1.31	16.126	1.34	16.126	1.34	16.00	1.33
Bladex	lb.		3.937		4.031		4.031		4.00	
Aatrex	lb.		1.969		2.016		2.016		2.00	
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.		12.303		12.598		12.598		12.50	
Lexone or Sencor	pt.		18.701		19.150		19.150		19.00	
Seed	bu.	1.00	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
(replant)[a]	bu.	1.00	3.80	3.80	4.20	4.20				
Fuel	gal.	6.11	1.01	6.17	1.01	6.17	0.99	6.05	1.00	6.11
(replant)[a]	gal.	1.33	1.01	1.34	1.01	1.34				
Labor	hr.	1.137								

Table 17. (continued)

(replant)[a]	hr.	0.26								
Annual	dol.	30.56	0.139	4.25						
Operating	32.47			0.146	4.74					
Capital[b]		26.60					0.134	3.56		
		23.80							0.123	2.93
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				4.12		5.72		3.83		0.14
Custom Haul[c]				6.52		8.12		6.23		2.54
Rent Fertilizer Spreader				0.12		0.12		0.11		0.11
Aerial Spray Application.				1.75		1.79		1.74		1.67
Mach. Lube + Repairs				6.35		6.60		6.38		5.83
(replant)[a]				1.89		1.92		——		——
TOTAL OPERATING COSTS	dol.			75.60		82.03		67.45		55.28
PRODUCTION:										
Wheat Grain[d]	bu.	54.3	3.27	177.56						
		67.7			3.35	226.80				
		51.9					2.93	152.07		
		21.2							2.25	47.70
Wheat Forage[e]	stocking	0.4	115.91	46.36						
	rate	0.4			62.69	25.08				
		0.4					76.23	30.49		

Table 17. (continued)

		0.4				15.33	6.13
TOTAL RECEIPTS	dol.		223.92	251.88	182.56		53.83
RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY AND EQUIPMENT FIXED COSTS, OVERHEAD, & RISK	dol.		148.32	169.85	115.11		-1.45

[a] The 1982-83 and 1983-84 August plantings were replanted and thus have two sets of expenses for some items.

[b] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[c] Custom harvest and custom hauling based upon a 12-12-12 constant harvest rate.

[d] Wheat grain yields for each year are from conventional tillage test plots (August plantings) at Stillwater.

[e] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

Table 18. Estimated Enterprise Budget for the September Conventional Tillage System Considering Grain and Forage Production

			1982-83		1983-84		1984-85		1985-86	
	Unit	Quantity per Acre per Year	Price per Unit	Value (dol.)	Price per Unit	Value (dol.)	Price per Unit	Value (dol.)	Price per Unit	Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.110	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.200	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.00	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.	0.083	15.748	1.31	16.126	1.34	16.126	1.34	16.00	1.33
Bladex	lb.		3.937		4.031		4.031		4.00	
Aatrex	lb.		1.969		2.016		2.016		2.00	
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.		12.303		12.598		12.598		12.50	
Lexone or Sencor	pt.		18.701		19.150		19.150		19.00	
Seed	bu.	1.00	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	6.11	1.01	6.17	1.01	6.17	0.99	6.05	1.00	6.11
Labor	hr.	1.137								

Table 18. (continued)

Annual	dol.	26.49	0.139	3.68						
Operating		28.09			0.146	4.10				
Capital[a]		26.60					0.134	3.56		
		23.80							0.123	2.93
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				2.21		6.66		4.25		0.00
Custom Haul[b]				4.61		9.06		6.65		2.33
Rent Fertilizer Spreader				0.12		0.12		0.11		0.11
Aerial Spray Application.				1.75		1.79		1.74		1.67
Mach. Lube + Repairs				6.35		6.60		6.38		5.83
TOTAL OPERATING COSTS	dol.			64.18		75.81		68.29		54.93
PRODUCTION:										
Wheat Grain[c]	bu.	38.4	3.27	125.57						
		75.5			3.35	252.93				
		55.4					2.93	162.32		
		19.4							2.25	43.65
Wheat Forage[d]	stocking rate	0.4	115.91	46.36						
		0.4			62.69	25.08				
		0.4					76.23	30.49		
		0.4							15.33	6.13
TOTAL RECEIPTS	dol.			171.93		278.01		192.81		49.78

Table 18. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY AND EQUIPMENT FIXED COSTS, OVERHEAD, & RISK	dol.	107.75	202.20	124.52	-5.15

[a] The price for annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant harvest rate.

[c] Wheat grain yields fo reach year are from conventional tillage test plots (September plantings) at Stillwater.

[d] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter wheat pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

Table 19. Estimated Enterprise Budget for the August One Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.11	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.0	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	0.0	0.154		0.157		0.157		0.156	
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.150	14.36	19.150	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
(replant)[a]	bu.	1.0	3.80	3.80						
Fuel	gal.	3.06	1.01	3.09	1.01	3.09	0.99	3.03	1.00	3.06
(replant)[a]	gal.	0.903	1.01	0.91						
Labor	hr.	0.501								
(replant)[a]	hr.	0.114								

Table 19. (continued)

Annual	dol.	45.97	0.139	6.39						
Operating		44.73			0.146	6.53				
Capital[b]		43.51					0.134	5.83		
		40.95							0.123	5.04
Other	dol.									
Custom Harvest[c]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.66		5.17		3.12		
Custom Hauling[c]				6.06		7.57		5.52		2.04
Aerial Spray Application.				1.75		1.79		1.74		1.67
Seed Treatment				1.05		1.07		1.04		1.00
(replant)[a]				1.05						
Machinery Lube + Repairs				4.99		5.15		5.00		4.65
(replant)[a]				2.43		—		—		—
TOTAL OPERATING COSTS	dol.			108.34		106.37		99.52		87.82
PRODUCTION:										
Wheat Grain[d]	bu.	50.5	3.27	165.14						
		63.1			3.35	211.39				
		46.0					2.93	134.78		
		17.0		—		—		—	2.25	38.25
TOTAL RECEIPTS	dol.			165.14		211.39		134.78		38.25

Table 19. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	56.80	105.02	35.26	-49.57

[a] The 1982-83 August planting was replanted and thus has two sets of expenses for some items.

[b] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[c] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[d] Wheat grain yields are estimates based upon yield data from conventional and zero tillage test plots (August plantings) at Stillwater between 1982-83 through 1985-86.

Table 20. Estimated Enterprise Budget for the September One Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.11	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.0	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.150	14.36	19.150	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	3.06	1.01	3.09	1.01	3.09	0.99	3.03	1.00	3.06
Labor	hr.	0.501								
Annual	dol.	42.83	0.139	5.95						
Operating		44.73			0.146	6.53				
Capital[a]		43.51					0.134	5.83		
		40.95							0.123	5.04

Table 20. (continued)

Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				2.69		6.26		3.23		
Custom Hauling[b]				5.09		8.66		5.63		2.20
Aerial Spray Application				1.75		1.79		1.74		1.67
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repairs				4.99		5.15		5.00		4.65
TOTAL OPERATING COSTS	dol.			97.77		108.55		99.74		87.99
PRODUCTION:										
Wheat Grain[c]	bu.	42.4	3.27	138.65						
		72.2			3.35	241.87				
		46.9					2.93	137.42		
		18.3							2.25	41.18
TOTAL RECEIPTS	dol.			138.65		241.87		137.42		41.18

Table 20. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	40.88	133.32	37.68	-46.81

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat yields are estimates based upon yield data from conventional and zero tillage test plots (September plantings) at Stillwater between 1982-83 between through 1985-86.

Table 21. Estimated Enterprise Budget for the October One Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.11	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.0	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.150	14.36	19.150	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	3.06	1.01	3.09	1.01	3.09	0.99	3.03	1.00	3.06
Labor	hr.	0.501								
Annual	dol.	42.83	0.139	5.95						
Operating		44.73			0.146	6.53				
Capital[a]		43.51					0.134	5.83		

Table 21. (continued)

		40.95							0.123	5.04
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.82		6.08		3.92		
Custom Hauling[b]				6.22		8.48		6.32		2.30
Aerial Spray Application				1.75		1.79		1.74		1.67
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repairs				4.99		5.15		5.00		4.65
TOTAL OPERATING COSTS	dol.			100.03		108.19		101.12		88.09
PRODUCTION:										
Wheat Grain[c]	bu.	51.8	3.27	169.39						
		70.7			3.35	236.85				
		52.7					2.93	154.41		
		19.2							2.25	43.21
TOTAL RECEIPTS	dol.			169.39		236.85		154.41		43.21
RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.			69.36		128.66		53.29		-44.88

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat yields are estimates based upon yield data from conventional and zero tillage test plots (October plantings) at Stillwater between 1982-83 through 1985-86.

Table 22. Estimated Enterprise Budget for the November One Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.11	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.0	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.150	14.36	19.150	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	3.06	1.01	3.09	1.01	3.09	0.99	3.03	1.00	3.06
Labor	hr.	0.501								

Table 22. (continued)

Annual	dol.	42.83	0.139	5.95						
Operating		44.73			0.146	6.53				
Capital[a]		43.51					0.134	5.83		
		40.95							0.123	5.04
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.14		3.60		0.47		
Custom Hauling[b]				5.54		6.00		2.87		1.01
Aerial Spray Application				1.75		1.79		1.74		1.67
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repairs				4.99		5.15		5.00		4.65
TOTAL OPERATING COSTS	dol.			98.67		103.23		94.22		86.80
PRODUCTION:										
Wheat Grain[c]	bu.	46.2	3.27	151.07						
		50.0			3.35	167.50				
		23.8					2.93	69.73		
		8.8							2.25	19.80
TOTAL RECEIPTS	dol.			151.07		167.50		69.73		19.80

Table 22. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	52.40	64.27	-24.49	-67.00

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat yields are estimates based upon yield data from conventional and zero tillage test plots (November plantings) at Stillwater between 1982-83 through 1985-86.

Table 23. Estimated Enterprise Budget for the August One Tillage System Considering Grain and Forage Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.11	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.0	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.150	14.36	19.150	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
(replant)[a]	bu.	1.0	3.80	3.80						
Fuel	gal.	3.06	1.01	3.09	1.01	3.09	0.99	3.03	1.00	3.06
(replant)[a]	gal.	0.903	1.01	0.91						
Labor	hr.	0.501								
(replant)[a]	hr.	0.114								

Table 23. (continued)

Annual	dol.	45.97	0.139	6.39						
Operating		44.73			0.146	6.53				
Capital[b]		43.51					0.134	5.83		
		40.95							0.123	5.04
Other	dol.									
Custom Harvest[c]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.66		5.17		3.12		
Custom Hauling[c]				6.06		7.57		5.52		2.04
Aerial Spray Application				1.75		1.79		1.74		1.67
Seed Treatment				1.05		1.07		1.04		1.00
(replant)[a]				1.05						
Machinery Lube + Repairs				4.99		5.15		5.00		4.65
(replant)[a]				2.43		—		—		—
TOTAL OPERATING COSTS	dol.			108.34		106.37		99.52		87.83
PRODUCTION:										
Wheat Grain[d]	bu.	50.5	3.27	165.14						
		63.1			3.35	211.39				
		46.0					2.93	134.78		
		17.0							2.25	38.25
Wheat Forage[e]	stocking rate	0.4	115.91	46.36						
		0.4			62.69	25.08				
		0.4					76.23	30.49		
		0.4							15.33	6.13
TOTAL RECEIPTS	dol.			211.50		236.47		165.27		44.38

Table 23. (continued)

RETURNS TO dol. LAND, LABOR, MANAGEMENT, MACHINERY & EQUIPMENT FIXED COSTS, OVERHEAD, & RISK	103.16	130.10	65.75	-43.45

[a] The 1982-83 August planting was replanted and thus has two sets of expenses for some items.

[b] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[c] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[d] Wheat yields are estimates based upon yield data from conventional and zero tillage test plots (August plantings) at Stillwater between 1982-83 through 1985-86.

[e] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter wheat pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

Table 24. Estimated Enterprise Budget for the September One Tillage System Considering Grain and Forage Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	103	0.106	10.92	0.118	12.15	0.11	11.33	0.088	9.06
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.	5.0	0.169	0.85	0.173	0.87	0.173	0.87	0.172	0.86
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.		0.154		0.157		0.157		0.156	
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.150	14.36	19.150	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	3.06	1.01	3.09	1.01	3.09	0.99	3.03	1.00	3.06
Labor	hr.	0.501								
Annual Operating Capital[a]	dol.	42.83	0.139	5.95						
		44.73			0.146	6.53				
		43.51					0.134	5.83		
		40.95							0.123	5.04

Table 24. (continued)

Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				2.69		6.26		3.23		
Custom Hauling[b]				5.09		8.66		5.63		2.20
Aerial Spray Application.				1.75		1.79		1.74		1.67
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repairs				4.99		5.15		5.00		4.65
TOTAL OPERATING COSTS	dol.			97.77		108.55		99.74		87.99
PRODUCTION:										
Wheat Grain[c]	bu.	42.4	3.27	138.65						
		72.2			3.35	241.87				
		46.9					2.93	137.42		
		18.3							2.25	41.18
Wheat Forage[d]	stocking rate	0.4	115.91	46.36						
		0.4			62.69	25.08				
		0.4					76.23	30.49		
		0.4							15.33	6.13
TOTAL RECEIPTS	dol.			185.01		266.95		167.91		47.31

Table 24. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY & EQUIPMENT FIXED COSTS, OVERHEAD, & RISK	dol.	87.24	158.40	68.17	-40.68

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat yields are estimates based upon yield data from conventional and zero tillage test plots (September plantings) at Stillwater between 1982-83 through 1985-86.

[d] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter wheat pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

Table 25. Estimated Enterprise Budget for the August Zero Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS										
Fertilizer										
82-0-0	lb.	140	0.106	14.84	0.118	16.52	0.11	15.40	0.088	12.32
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.		0.169		0.173		0.173		0.172	
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	54	0.154	8.32	0.157	8.48	0.157	8.48	0.156	8.42
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.15	14.36	19.15	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
(replant)[a]	bu.	1.0	3.80	3.80						
Fuel	gal.	2.42	1.01	2.44	1.01	2.44	0.99	2.40	1.00	2.42
(replant)[a]	gal.	0.90	1.01	0.91						
Labor	hr.	0.42								
(replant)[a]	hr.	0.114								

Table 25. (continued)

Annual .	dol.	46.49	0.139	6.46						
Operating		45.75			0.146	6.68				
Capital[b]		44.52					0.134	5.97		
		41.77							0.123	5.14
Other	dol.									
Custom Harvest[c]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.20		4.61		2.40		
Custom Haul[c]				5.60		7.01		4.80		1.54
Seed Treatment				1.05		1.07		1.04		1.00
(replant)[a]				1.05						
Machinery Lube + Repair				4.28		4.41		4.28		3.99
(replant)[a]				2.36		——		——		——
TOTAL OPERATING COSTS	dol.			115.70		114.20		106.81		95.28
PRODUCTION:										
Wheat Grain[d]	bu.	46.7	3.27	152.71						
		58.4			3.35	195.64				
		40.0					2.93	117.20		
		12.8							2.25	28.80
TOTAL RECEIPTS	dol.			152.71		195.64		117.20		28.80

Table 25. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	37.01	81.44	10.39	-66.48

[a] The 1982-83 August planting was replanted and thus has two sets of expenses for some items.

[b] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[c] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[d] Wheat grain yields for each year are from zero tillage test plots (August plantings) at Stillwater.

Table 26. Estimated Enterprise Budget for the September Zero Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	140	0.106	14.84	0.118	16.52	0.11	15.40	0.088	12.32
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.		0.169		0.173		0.173		0.172	
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	54	0.154	8.32	0.157	8.48	0.157	8.48	0.156	8.42
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.15	14.36	19.15	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	2.42	1.01	2.44	1.01	2.44	0.99	2.40	1.00	2.42
Labor	hr.	0.42								
Annual	dol.	43.74	0.139	6.08						
Operating	dol.	45.75			0.146	6.68				
Capital[a]		44.52					0.134	5.97		

Table 26. (continued)

		41.77							0.123	5.14
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.16		5.87		2.21		
Custom Haul[b]				5.56		8.27		4.61		2.05
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repair				4.28		4.41		4.28		3.99
TOTAL OPERATING COSTS	dol.			107.12		116.72		106.43		95.79
PRODUCTION:										
Wheat Grain[c]	bu.	46.3	3.27	151.40						
		68.9			3.35	230.82				
		38.4					2.93	112.51		
		17.1							2.25	38.48
TOTAL RECEIPTS	dol.			151.40		230.82		112.51		38.48
RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.			44.28		114.10		6.08		-57.31

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat yields for each year are from zero tillage test plots (September plantings) at Stillwater.

Table 27. Estimated Enterprise Budget for the October Zero Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS										
Fertilizer										
82-0-0	lb.	140	0.106	14.84	0.118	16.52	0.11	15.40	0.088	12.32
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.		0.169		0.173		0.173		0.172	
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	54	0.154	8.32	0.157	8.48	0.157	8.48	0.156	8.42
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.15	14.36	19.15	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	2.42	1.01	2.44	1.01	2.44	0.99	2.40	1.00	2.42
Labor	hr.	0.42								
Annual	dol.	43.74	0.139	6.08						
Operating	45.75			0.146	6.68					
Capital[a]		44.52					0.134	5.97		

Table 27. (continued)

		41.77							0.123	5.14
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.78		5.83		3.20		
Custom Haul[b]				6.18		8.23		5.60		1.87
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repair				4.28		4.41		4.28		3.99
TOTAL OPERATING COSTS	dol.			108.36		116.64		108.41		95.61
PRODUCTION:										
Wheat Grain[c]	bu.	51.5	3.27	168.41						
		68.6			3.35	229.81				
		46.7					2.93	136.83		
		15.6							2.25	35.10
TOTAL RECEIPTS	dol.			168.41		229.81		136.83		35.10
RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.			60.05		113.17		28.42		-60.51

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat grain yields for each year are from zero tillage test plots (October plantings) at Stillwater.

Table 28. Estimated Enterprise Budget for the November One Tillage System Considering Grain Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS:										
Fertilizer										
82-0-0	lb.	140	0.106	14.84	0.118	16.52	0.11	15.40	0.088	12.32
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.		0.169		0.173		0.173		0.172	
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	54	0.154	8.32	0.157	8.48	0.157	8.48	0.156	8.42
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.15	14.36	19.15	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	2.42	1.01	2.44	1.01	2.44	0.99	2.40	1.00	2.42
Labor	hr.	0.42								

Table 28. (continued)

Annual Operating Capital[a]	dol.	43.74	0.139	6.08						
		45.75			0.146	6.68				
		44.52					0.134	5.97		
		41.77							0.123	5.14
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.20		2.36				
Custom Haul[b]				5.60		4.76		1.55		0.83
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repair				4.28		4.41		4.28		3.99
TOTAL OPERATING COSTS	dol.			107.20		109.70		101.16		94.57
PRODUCTION:										
Wheat Grain[c]	bu.	46.7	3.27	152.71						
		39.7			3.35	133.00				
		12.9					2.93	37.80		
		6.9							2.25	15.53
TOTAL RECEIPTS	dol.			152.71		133.00		37.80		15.53

Table 28. (continued)

RETURNS TO LAND, LABOR, MANAGEMENT, MACHINERY FIXED COSTS, OVERHEAD, & RISK	dol.	45.51	23.30	-63.36	-79.04

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat grain yields for each year are from zero tillage test plots (November plantings) at Stillwater.

Table 29. Estimated Enterprise Budget for the August Zero Tillage System Considering Grain and Forage Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS										
Fertilizer										
82-0-0	lb.	140	0.106	14.84	0.118	16.52	0.11	15.40	0.088	12.32
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.		0.169		0.173		0.173		0.172	
Herbicide										
Glean	oz.		15.748		16.126		16.126	0.00	16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	54	0.154	8.32	0.157	8.48	0.157	8.48	0.156	8.42
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.15	14.36	19.15	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
(replant)[a]	bu.	1.0	3.80	3.80						
Fuel	gal.	2.42	1.01	2.44	1.01	2.44	0.99	2.40	1.00	2.42
(replant)[a]	gal.	0.90	1.01	0.91						
Labor	hr.	0.42								
(replant)[a]	hr.	0.114								

Table 29. (continued)

Annual Operating Capital[b]	dol.	46.49	0.139	6.46						
		45.75			0.146	6.68				
		44.52					0.134	5.97		
		41.77							0.123	5.14
Other	dol.									
Custom Harvest[c]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.20		4.61		2.40		
Custom Haul[c]				5.60		7.01		4.80		1.54
Seed Treatment				1.05		1.07		1.04		1.00
(replant)[a]				1.05						
Machinery Lube + Repair				4.28		4.41		4.28		3.99
(replant)[a]				2.36		—		—		—
TOTAL OPERATING COSTS	dol.			115.70		114.20		106.81		95.28
PRODUCTION:										
Wheat Grain[d]	bu.	46.7	3.27	152.71						
		58.4			3.35	195.64				
		40.0					2.93	117.20		
		12.8							2.25	28.80
Wheat Forage[e]	stocking rate	0.4	115.91	46.36						
		0.4			62.69	25.08				
		0.4					76.23	30.49		
		0.4							15.33	6.13
TOTAL RECEIPTS	dol.			199.07		220.72		147.69		34.93

Table 29. (continued)

RETURNS TO dol. LAND, LABOR, MANAGEMENT, MACHINERY & EQUIPMENT FIXED COSTS, OVERHEAD, & RISK	83.37	106.52	40.88	-60.35

[a] The 1982-83 August planting was replanted and thus has two sets of expenses for some items.

[b] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[c] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[d] Wheat grain yields for each year are from zero tillage test plots (August plantings) at Stillwater.

[e] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter wheat pasture from November to March, and it accounts for all stocker steer enterprise budget operating costs.

Table 30. Estimated Enterprise Budget for the September Zero Tillage System Considering Grain and Forage Production

	Unit	Quantity per Acre per Year	1982-83 Price per Unit	1982-83 Value (dol.)	1983-84 Price per Unit	1983-84 Value (dol.)	1984-85 Price per Unit	1984-85 Value (dol.)	1985-86 Price per Unit	1985-86 Value (dol.)
OPERATING INPUTS										
Fertilizer										
82-0-0	lb.	140	0.106	14.84	0.118	16.52	0.11	15.40	0.088	12.32
18-46-0	cwt.	0.88	11.825	10.41	12.213	10.75	11.20	9.86	10.00	8.80
Insecticide										
Parathion	oz.		0.169		0.173		0.173		0.172	
Herbicide										
Glean	oz.		15.748		16.126		16.126		16.00	
Bladex	lb.	2.0	3.937	7.87	4.031	8.06	4.031	8.06	4.00	8.00
Aatrex	lb.	0.5	1.969	0.98	2.016	1.01	2.016	1.01	2.00	1.00
Landmaster	oz.	54	0.154	8.32	0.157	8.48	0.157	8.48	0.156	8.42
Roundup	pt.	1.0	12.303	12.30	12.598	12.60	12.598	12.60	12.50	12.50
Lexone or Sencor	pt.	0.75	18.701	14.03	19.15	14.36	19.15	14.36	19.00	14.25
Seed	bu.	1.0	3.80	3.80	4.20	4.20	4.15	4.15	3.90	3.90
Fuel	gal.	2.42	1.01	2.44	1.01	2.44	0.99	2.40	1.00	2.42
Labor	hr.	0.42								

Table 30. (continued)

Annual	dol.	43.74	0.139	6.08						
Operating		45.75			0.146	6.68				
Capital[a]		44.52					0.134	5.97		
		41.77							0.123	5.14
Other	dol.									
Custom Harvest[b]										
Base charge				12.00		12.00		12.00		12.00
Excess for > 20 bu.				3.16		5.87		2.21		
Custom Haul[c]				5.56		8.27		4.61		2.05
Seed Treatment				1.05		1.07		1.04		1.00
Machinery Lube + Repair				4.28		4.41		4.28		3.99
TOTAL OPERATING COSTS	dol.			107.12		116.72		106.43		95.79
PRODUCTION:										
Wheat Grain[c]	bu.	46.3	3.27	151.40						
		68.9			3.35	230.82				
		38.4					2.93	112.51		
		17.1							2.25	38.48
Wheat Forage[e]	stocking rate	0.4	115.91	46.36						
		0.4			62.69	25.08				
		0.4					76.23	30.49		
		0.4							15.33	6.13
TOTAL RECEIPTS	dol.			197.76		255.90		143.00		44.61

Table 30. (continued)

RETURNS TO dol. LAND, LABOR, MANAGEMENT, MACHINERY & EQUIPMENT FIXED COSTS, OVERHEAD, & RISK	90.64	139.18	36.57	-51.18

[a] The price for the annual operating capital is the annual interest rate expressed in decimal form.

[b] Custom harvest and custom hauling based upon a 12-12-12 constant rate.

[c] Wheat yields for each year are from zero tillage test plots (September plantings) at Stillwater.

[d] The wheat forage price is based upon the gain (value in dollars) of stocker steers on winter wheat pasture from November to March, and it accounts for stocker steer enterprise budget operating costs.

2

VITA

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Candidate for the Degree of

Master of Science

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