

A DECISION AID TOOL FOR SELECTING FARM
EQUIPMENT AND ESTIMATING COSTS OF
MACHINERY COMPLEMENTS

By

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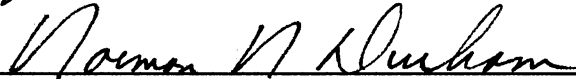
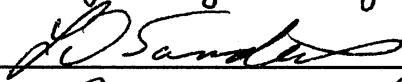
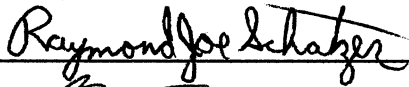
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CHAPTER I

INTRODUCTION

Agriculture and Farm Machinery

The development and adoption of farm machine technology in United States agriculture during the past 50 years has had a significant impact on the structure of production and has brought on a substantial change in farming. Expanding farm size, increasing capitalization, and growing reliance on non-farm inputs characterize today's modern farm, which is now so dramatically different from the small, self-sufficient unit of years past. The net effect of these changes is that farming and farm management have been transformed from a vocation and a way of life to a commercial business requiring the discipline and tools of modern business management.

Farmers are constantly called upon to make capital investment decisions. Next to land, machinery purchases require the greatest volume of capital. In addition to financial considerations, farm managers selecting machinery must consider the number of acres farmed, crops grown, labor availability, and timeliness of field operations. Farmers must balance their selection of machinery between the risk of loss from not completing field work in crucial time periods and the cost of having large machinery idle for long time periods.

The Problem

Many farmers have difficulty finding the appropriate machinery combination that will provide the necessary level of machinery services. Agricultural lenders attribute mismanagement in farm machinery procurement as a major culprit in farm business delinquency. Also, machinery related expenses, such as fuel, hired labor, and repairs, may constitute as much as 35% to 50% of an individual farm's operating expenses. Therefore, it seems that substantial savings and increased productivity can be secured with improved selection and allocation of machinery complements by farmers.

The farm manager must make decisions not only in regard to current machinery requirements, but also according to expected future machinery needs. Between the years of 1970 and 1988, Oklahoma farm numbers declined 25.5% (12). During the same period, the number of farms having cash receipts of more than \$40,000 increased 295%. These larger commercial farms in 1987 represented 29.3% of the total number of farms and received 90.2% of total farm proceeds, compared to only 7.4% of the farms and 59.3% of farm receipts in 1970.

On the other hand, farms with less than \$5,000 in sales represented 57.5% of all farms in 1970 and dwindled to 34.2% of all farms in 1988. This change represents an exit from the farming industry of 752 thousand farms in only 18 years. The typical farm size in the United States has increased from 242 acres in 1954 to 462 acres in 1987. Oklahoma's average farm size was 300 acres per farm in 1954, and had expanded to 449 acres per farm in 1987.

As farming's industrial structure has evolved from a large number of small farms to a much smaller number of relatively large farms, the combination of inputs used per unit of output has also changed greatly. Farm equipment is

replacing labor in the input mix, allowing farmers to spread their labor over more acres and activities. The availability of larger farm machines and the substantial economies of scale resulting from their use has allowed many family owned farms to increase in size.

The tractor is the most important item in a farm machinery complement, both in terms of the dollar investment it represents and by the chief role it plays in determining the size and composition of the complement. Generally, a shift to larger farm equipment must be preceded by an increase in tractor horsepower. Since most agricultural production requiring field machinery is seasonal, equipment will have high and low use periods and will likely stand idle much of the time.

The trade-off between labor intensive operations and machinery intensive operations is also difficult for the farmer to analyze, yet it plays a very important role in a farmer's choice of machinery. Agricultural labor is scarce. Traditional farm wage rates are relatively low when compared to other segments of the economy. In addition, most farmers need only seasonal help while most laborers prefer year round employment.

Increasing the machinery capacity presents a form of insurance, enabling adequate performance over a wider span of weather conditions. But the problem confronting many farm operators is two dimensional. Operators want the least cost combination of machinery but they also may want adequate excess capacity in their complement to guarantee completion of timely field operations in years of adverse weather conditions.

Decision Making Environment

Farmers make their machinery decisions on the basis of a variety of information sources. One primary source of information may be the local machinery dealer. Although machinery dealers are well informed, they may have only partial knowledge of the equipment, and may have a conflict of interest. Another source may be a neighbor who recently purchased the equipment the farmer would like to learn about. Farm industry publications and agricultural extension fact sheets are other information sources. All of these sources provide a variety of data from which a farmer must try to generate a machinery complement practical to his unique needs.

In addition to timeliness considerations in selecting machinery complements, personal preferences are also important. If a farmer buys a tractor larger than needed, fixed costs will be high. Although the added fixed costs from owning a larger tractor may or may not approach the expected savings in labor, the timeliness benefits may be substantial.

The Oklahoma farmer does not have directly available to him an economically sound machinery selection model to update, advise, and guide him in machinery selection decisions. Machinery selection is the first of a chain of machinery management decisions which can lead to profit or loss from all or part of the farm operation. A computerized model for assisting decision makers, capable of identifying feasible machinery complements, would be of significant economic assistance to the owner-operator. Furthermore, information on machinery and labor tradeoffs will be a valuable aid to the farmer planning machinery purchases.

Purpose of the Study

The primary purpose of this study is to develop a computer spreadsheet model, which Oklahoma producers can use for selecting machinery complements. More specifically, the machinery selection model can be used for determining if available labor hours are adequate for completing timely field operations. Also, the model can be used to select the allocation of labor and capital held in the owners resource pool.

For the purpose of demonstrating the model, eight Typical Farm Regions will be used. The eight regions are the Panhandle, West-Northwest, Southwest, North Central, South Central, Northeast, East-Northeast and Southeast areas. Because of the differing typography of these areas, each region contains three typical size farms (small, medium and large). The complement for each state area will be determined so different cropping methods, farm sizes, and farming practices can be compared. These comparisons will lead to some general conclusions concerning expected machine costs for each region of Oklahoma.

Objectives

1. Assemble data describing a set of machinery which can be used to estimate machine working rates, match machines to tractor size, and estimate costs of owning and operating farm machinery.
2. Develop a model for aggregating farm machinery information into a farm complement which can be used to determine farm machinery use, machinery cost, and labor use. The model can also be used for comparing alternative machinery complements with regards to machines chosen and complement cost.

3. Identify viable farm machinery complements for areas of Oklahoma given average farm size and average crop mixes.
4. Compare the composition and costs of machinery complements for areas of Oklahoma.

Data Requirements and Procedures

The following data are necessary to select the most economically feasible machinery complement:

1. The hours available for completing field work in each critical time period throughout the year.
2. The acres covered by each field operation in each time period.
3. The cost and capabilities of the machines from which the most economically feasible complements will be chosen.

The above data will be used for determining feasible machinery complements. The hours available must be specified by the producer. There are important considerations. First, because of weather patterns, how many hours will be available for field work? Second, what part of the producers time will other farm enterprises and farm management require? After answering these questions, the manager must select the number of hours available in each time period.

Information on average farm sizes and crops grown is taken from Oklahoma Typical Farm Regions data (9). This information is used to determine crop acreage, crop mix and farm size for the various farms considered in the study.

Once the crop mix is determined for each study area, the implements needed to perform each field operation are specified. The Oklahoma State

University Crop Budgets (12) are the principal source of field operation requirements.

Tractor and implement matching is accomplished using equations formulated by Bowers (2). When purchasing equipment, like other input items, size increases occur in fixed proportions. For instance, a 140 horsepower tractor may most correctly match a 19 foot tandem disk. However, the closest substitute available on the market may have a width of 18 foot 6 inches. In this study, implement prices reflect the prices of the most comparable sized equipment available on the market. The prices for all different tractors and implement sizes are compiled from dealer provided information. Once all data describing the basic machinery set and the farm are collected the model is executed. The model is discussed in detail in Chapter II.

Viable machinery solutions are then found for a number of situations. Each situation analyzed will include a unique combination of the tractor sizes, farm size, crop mix, and/or labor availability.

Literature Review

Substantial research has been completed in the area of farm machinery costs and performance. A multitude of studies have examined machinery costs, cost coefficients, and parameters. Hunt (7), Bowers (2), Grevis - James (4), and others have isolated these cost components and estimated the appropriate procedures for finding them. Many universities, state experiment stations, and state extension services (Arizona, Iowa, North Dakota, Oklahoma State University and others) report current machinery costs for these states. Since these figures are widely available, a detailed analysis will not be given. The

reader is directed to the bibliography and particularly to the Agricultural Engineer's Yearbook for these facts (1).

Mclsaac and Lovering (11) in Canada developed a computer program in 1977 for calculating least cost implement sizes for tilling and seeding cereals. The information needed for input into the program included machinery prices, equipment use, hours of equipment life, implement draft requirements, repair rates, and operating efficiencies. Also needed were acres to be covered and field operations to be performed. The program included a penalty cost for the value of crop losses due to late seeding. The program predicted the set of machinery which would perform the given field work for the lowest total cost. Total cost was the sum of tractor, implement, labor, and penalty costs. The program did not take into account the suitability of the tractor selected for other farm needs during the year. The program also did not consider the scheduling of operations between two tractors.

Osborn and Barrick (14) developed a model for selecting equipment for Texas High Plain farms. They determined least-cost equipment combinations for three typical farm sizes and evaluated the effects of alternative wage rates on the least-cost systems. Required input data included equipment prices, tractor and implement operating characteristics, and the field operations to be performed. Their model selected equipment combinations based on technical feasibility, time requirements and annual costs, both fixed and variable. Osborn and Barrick found that equipment size had a meager effect on annual cost. That is, it was difficult to reduce annual costs by moving toward a more capital intensive operation. Osborn and Barrick also concluded that the relative availability of short-term versus long-term capital was important in selecting a machinery complement. If the use of short-term capital is restricted relative to long-term capital, long-term capital should be invested in larger equipment.

Conversely, if long-term capital is more limiting, smaller equipment should be purchased and more labor employed.

Hunt (7) added a more precise and dynamic mathematical model for tractor performance by furnishing an optimal travel speed for each operation, as well as the appropriate machine size. Unfortunately, the tractor and implement sizes selected by the program did not adapt to typical equipment found on surveyed farms. Hunt's program did however, serve as the stepping stone for coming machinery selection models.

Reinschmiedt (17) developed a methodology for working with rainfall uncertainty. His procedure uses historical rainfall data for a particular area to prepare distributions of work time available in each time period during the year. The user picks a timeliness level for each period using his preferences about the percent of time he wants to complete field operations within a designated time frame. Reinschmiedt's work proved to be beneficial for future research.

Hininger (6) implemented a mixed integer programming model emphasizing the timeliness of field operations to determine least-cost farm machinery complements. With the use of the model, Hininger determined that by relaxing the time constraints for performing necessary field operations, machinery complement costs decreased due to using fewer machines and/or smaller equipment. He further concluded annual average machinery cost per acre decreased as the wage rate decreased. As wage rates were lowered smaller implements were used to execute necessary field operations. This model considered the inability to perform field operations because of wet weather conditions, but did not consider climatic conditions such as dryness or extreme cold.

Griffin (5) programmed an optimum machinery complement selection model permitting tillage requirements for a particular farm enterprise mix to be

separated or combined into a maximum of 24 mutually exclusive time periods. Requirements for a particular implement type can appear in a number of these time slots, possibly competing in each time slot with one or more other required field operations.

Using Reinschmiedt's study, along with a rainfall simulation model Griffin develop distributions of numbers of field work days. Alternative timeliness levels were calculated from the frequency distributions. These field time values were then used as time constraints in a mixed integer programming model.

A study by Kletke and Griffin (8) at Oklahoma State University looked at the effect of alternative wage rates on optimal machinery complements. A mixed integer linear programming model was developed to determine optimum machinery complements for North central Oklahoma wheat farms. Data required for the model include the hours available for field work in each critical time period, the acres to be covered by each field operation in each time period, the cost and computational parameters for all machines from which the optimal machinery complements were chosen.

The farm situations examined were relatively elementary ones. Kletke and Griffin found that as labor costs increased relative to machinery cost, farmers should substitute larger implements and tractors for hired labor.

Review of Subsequent Chapters

There are four subsequent chapters. The first part of Chapter II contains some of the theoretical concepts upon which this study is based. In addition, the technical, mathematical and economic relationships required for data preparation are presented. The machinery selection model used in this study is also discussed at length, including a discussion of the formulas used for

determining machinery operating and ownership costs. Chapter III presents a discussion of the model operation. Chapter III also gives some insight into the operation of the model and how user data is incorporated into the program. Finally, a typical farm example is presented to better familiarize the user with the program. Chapter IV presents the results. Economically feasible machinery complements are presented for numerous Oklahoma Typical Farm Regions. An attempt is also made to draw implications from the results. Chapter V summarizes the results and implications of the study. In addition, Chapter V outlines expected weaknesses in the model and makes suggestions for further research.

CHAPTER II

THE DEVELOPMENT OF A DECISION MODEL

The purpose of this chapter is to introduce and develop a quantitative decision model for determining feasible, cost effective farm machinery complements. The model will be developed by discussing the relevant economic theory, outlining the model structure, discussing the input, and presenting the output.

Machinery Cost Components

In agricultural production, a producer employs inputs according to the level of output he plans to attain. For example, additional fertilizer application or the use of herbicides may enhance yields. This is not only true for basic inputs, such as fertilizers and herbicides, but also in the use of farm machinery where larger sized equipment may improve timeliness and increase labor productivity. Machinery costs, unlike basic production input costs can be divided into two distinct types. These types are fixed costs and variable costs.

Some machinery costs are a direct result of ownership (fixed costs), while other costs can be directly associated with the level of usage of a particular item in a given time period (variable costs). Ownership or fixed costs include depreciation, interest, insurance, property taxes, and machinery storage. These costs are a result of ownership. Variable or operating costs include fuel, oil, lubrication, repair, and labor.

Farm Manager Goals

Agricultural producers operate with multiple goals. Possible goals include:

1. Maximizing profit
2. Providing an adequate machinery complement to insure timeliness
3. Expanding farm size
4. Having more time for family and leisure

Like most competitive firms, the primary goal is maximizing profit. Profit is defined as the level of output multiplied by the relevant price of the output less the costs of production. In an agricultural situation, output is determined by the level of inputs employed. Since output possibilities are specified by the inputs used, producers may strive to minimize the costs of inputs for producing an output to yield an adequate profit margin. However, some producers may employ higher cost, larger machinery complements to insure timely completion of field operations. Therefore, an adequately sized machinery complement may be considered a management goal. In addition, producers may purchase larger equipment to allow for expansion within the operation. A producer's goal of desiring more time for family and leisure activities may lead to choosing larger equipment.

Problem Identification

Agricultural production is a biological process requiring a period of time between applying inputs and receiving outputs. The timely application of inputs such as rainfall, fertilizer, herbicides, insecticides, seeding and ground preparation are all important. Unfortunately, some agricultural inputs are available only in discrete units. For instance, different fertilizer elements may be needed to bring soils to an adequate production level. However, the possibility

of obtaining the proper combination of fertilizers may not exist, or it may be necessary to purchase a blend of the fertilizers containing one or more unneeded elements. This problem also exists with farm machinery. It is not possible to purchase part of a large tractor, the alternatives may be a large tractor or a small tractor. The decision maker must evaluate the discrete alternatives and select the tractor size that best achieves the goals of the manager.

Labor and capital are often thought of as close yet not perfect substitutes in agricultural production. A particular farming operation may be labor intensive, capital intensive, or have a balance in its use of capital and labor to accomplish necessary field work. The capacity of a machine is its rate of accomplishment per unit of time. Acres per hour is the most common measure of machine performance. The substitution of capital for labor occurs when larger machinery, that has the capability to complete a given field operation in a shorter time span, replaces smaller machinery that requires more time to complete the same field practices. Producers may reduce crop losses by using machinery with greater than necessary capacity to complete field operations within the "best" time periods. Excess capacity benefits the producer in years when weather patterns dictate that more than normal field operations must be performed. Also, excess capacity is desirable when rainfall may be so plentiful that the days number of days available to complete vital field work are reduced. Nevertheless, since the farmer manager is making the decision, he may prefer to substitute labor for capital by hiring additional labor to complete the field operations. As long as field operations can be completed in the required time period, output will remain the same despite the amount of labor employed or the size of equipment required to accomplish the field work.

Modern farming operations usually involve several different crops, with each one having its own tilling, planting, and harvesting requirements. In a diversified agricultural operation, there will be an extensive machinery inventory. But, each machine purchased causes the farm to incur more overhead or fixed costs. By carefully analyzing the work to be done in the available time, tractors can be selected to work with correctly sized equipment for completing important field operations on time. In the production process, the timeliness factor makes proper machine size selection important.

Since producers have the responsibility of allocating their capital and labor, it is appropriate that a machinery selection model be designed to enhance the decision making process and not arbitrarily decide what the distribution of inputs should be. Each farming operation requires a distinct machinery complement. Therefore, the model should also allow production decisions to be made according to the relevant cropping activities. Acreage specification of the crops grown and the timeliness of field operations is important in compiling a good, working machinery complement. Consequently, the model should allow for specifying acreage according to the amount of each crop grown.

Since no two farming operations are exactly alike, good judgement by the farm manager will be needed to select a machinery complement. A machinery selection system, such as the one developed in this study, will provide useful machine capacity and cost information to make the decision makers job a little easier. Because the system is designed to assist in machinery selection for diversified farm organizations, the model should allow the user to input data concerning labor availability, tractor sizes available, and cropping practices employed.

Data Requirements

Four types of data are needed for the model; machinery costs and capacity, the number of acres of each crop produced, field operations performed, and the labor hours available. For this study, it is assumed that there is no existing machinery complement and that the crop production plan will be repeated year after year. If the cropping pattern were to be varied from year to year, the model could be applied to each alternative farm plan, with the decision maker then selecting the most feasible machinery complement capable of performing the work required for each alternative plan.

The Machinery Selection Model

The machinery selection model is designed with two specific uses in mind. First, the model allows the user to determine if a complement can complete the necessary field operations with a specified amount of labor. The user can specify the monthly amount of producer labor available for cropping practices. Also, the user specifies the maximum hours each tractor can be used each month. If the producer labor is not adequate, labor is hired up to the limit each tractor can be used. Conceptually, the amount of labor available might vary between eight and twenty-four hours per day. Second, the model can be used for comparing the economic feasibility of alternative tractor sizes. A procedure can be developed to evaluate complements providing various levels of capital and labor substitution.

Unlike many machinery selection models, which require mainframe computer capacity to obtain solutions, this model uses a Lotus 1-2-3 spreadsheet.

Typical Oklahoma farms range in crop mix and farm size according to the location or area in question. Consequently, the model selection must allow for a wide variation in the size of tractors that may be used.

Estimating Machine Capacity

The following equation is used for estimating the effective working width of implements (Bowers):

$$\text{TECHNICAL WIDTH} = \text{PTO(HP)} * (.86) * (375) / (\text{SPEED} * \text{DRAFT})$$

Where: PTO (HP) is the maximum power take off horsepower produced at the shaft when tested consecutively on the dynamometer,

.86 is a conversion factor that alters PTO horsepower into drawbar HP,

375 serves as a constant.

SPEED is the operational ground speed in miles per hour of the specific piece of machinery.

DRAFT is the force of the soil resistance placed against the drawbar in pounds per foot depending on soil depth, soil type and soil moisture content.

Acres covered per hour is a function of width, speed, and efficiency. The following equation is for estimating acres per hour:

$$\text{ACRES/HOUR} = [(\text{WIDTH}) * (\text{SPEED}) * (\text{EFFICIENCY}) * (5280)] / 43560$$

Where: WIDTH is the actual working width of the machine in feet,

SPEED is the rate in miles per hour the implement is being operated,

EFFICIENCY is the actual field capacity over the theoretical field capacity.

5,280 is the number of feet in one mile,

43,560 is the number of square feet in one acre.

The field efficiency coefficient within the acres per hour equation helps take into account time lost in turning, filling grain boxes, adjustments, and other operations reducing the effective field capacity.

Since this model is only concerned with the acres covered per hour by each specific machine in seven horsepower ranges, a summary table in the model provides acres covered per hour for each machine for each tractor size. Each tractor size serves as a column heading and the rows consist of the various implements available to the model. The results of the calculations are presented in the relevant cells and are the acres covered per hour for each machine.

Field Operations Required By Crop

Unlike many machinery selection models, the user can specify the acreage of each crop he chooses to produce. The model allows eight different cropping activities. Options include crops generally grown in the Oklahoma area. Table I presents the crop activities and the number of times per month a given machine must be used for each crop. The times over for each crop are found in representative Oklahoma State University Enterprise Budgets (12). used.

Multiplying the times over for each crop by the number of acres produced gives the number of acres that must be worked each month to produce that crop. Aggregating the acres covered for each crop over all crops gives the total acres that must be covered by each machine in each month throughout the year.

TABLE I
CROP BUDGETS TIMES OVER BY MACHINE

<u>WHEAT</u>													TIMES
MACHINE	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	OVER
OFFSET	0	0	0	0	0	1	0	0	0	0	0	0	1
CHISEL	0	0	0	0	0	0	0.34	0	0	0	0	0	0.34
SWEEP													
PLOW	0	0	0	0	0	0	0.33	0	0	0	0	0	0.33
M.B. PLOW	0	0	0	0	0	0	0.33	0	0	0	0	0	0.33
SWEEP													
COND.	0	0	0	0	0	0	0	1	0	0	0	0	1
TANDEM													
DISK	0	0	0	0	0	0	1	0	0	0	0	0	1
SPRING-TOOTH	0	0	0	0	0	0	0	1	1	0	0	0	2
DRILL	0	0	0	0	0	0	0	0	1	0	0	0	1
<u>ALFALFA</u>													
OFFSET	0	0	0	0	0	0	0.4	0.2	0	0	0	0	0.6
CHISEL	0	0	0	0	0	0.2	0	0	0	0	0	0	0.2
LANDPLANE	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2
SWEEP													
COND.	0	0	0	0	0	0	0	0	0.2	0	0	0	0.2
CULTI-PACKER	0	0	0	0	0	0	0	0	0.4	0	0	0	0.4
SPRING-TOOTH	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2
S.HARROW	0	0	0	0	0	0	0	0	0.2	0	0	0	0.2
DRILL	0	0	0	0	0	0	0	0	0.2	0	0	0	0.2
WIND-ROWER	0	0	0	0	1	1	0	1	1	0	0	0	4
BALER	0	0	0	0	1	1	0	1	1	0	0	0	4
<u>GRAIN SORGHUM</u>													
M.B. PLOW	0	1	0	0	0	0	0	0	0	0	0	0	1
TANDEM													
DISK	0	0	1	0	1	0	0	0	0	0	0	0	2
SPRING-TOOTH	0	0	0	0	1	0	0	0	0	0	0	0	1
PLANTER	0	0	0	0	1	0	0	0	0	0	0	0	1
CULTIVATOR	0	0	0	0	0	1	1	0	0	0	0	0	2

TABLE I (Continued)

<u>SUDAN</u>													TIMES
<u>MACHINE</u>	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APRIL</u>	<u>MAY</u>	<u>JUNE</u>	<u>JULY</u>	<u>AUG</u>	<u>SEPT</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>	<u>OVER</u>
M.B.													
PLOW	0	1	0	0	0	0	0	0	0	0	0	0	1
TANDEM													
DISK	0	0	1	0	1	0	0	0	0	0	0	0	2
SPRING-													
TOOTH	0	0	0	0	1	0	0	0	0	0	0	0	1
DRILL	0	0	0	0	1	0	0	0	0	0	0	0	1
WIND													
ROWER	0	0	0	0	0	1	0	1	0	0	0	0	2
BALER	0	0	0	0	0	1	0	1	0	0	0	0	2

Tractor-Machine-Labor Relationships

The model allows for one, two, or three tractor complements. Implement work can be allocated to any tractor or combination of tractors as specified by the user. The allocation is made by specifying the percent of work to be done by each tractor and its complement. It is assumed that each tractor will be used only with implements that match that tractor. The process used for matching a machine and tractor is discussed in the next chapter.

Tractor hours of operation are determined by multiplying machine hours by the arbitrary constant 1.1. Allocating additional time to motorized equipment, such as tractors, allows for tractor warmup, fueling and lubrication, and the transportation of equipment from one location to another. Labor hours are determined by multiplying tractor hours by 1.1. This allows for time to drive to and from the field and management associated with machinery. The model is used to allocate labor hours as calculated using the above relationships.

and from the field and management associated with machinery. The model is used to allocate labor hours as calculated using the above relationships.

After a set of machinery is first selected for a farm, the complement evaluation process is begun. The objective of using the model is to select the complement best meeting the manager's multiple goals. The complement should be evaluated by examining the hours of labor (operator and hired) used. Also important is the monthly hours of use and the annual hours of tractor use as well as total complement cost. If too much or too little labor is being used, the complement can be revised to make it "better". Available for revision are the number of tractors, the horsepower size of tractors, and the mix of field operations required of each tractor. After one or more complement revisions, the manager may decide that he has designed a complement that best meets his objectives.

Estimating Machinery Costs

One of the most important costs influencing farm profit is the cost of owning and operating machinery. Machinery costs are one of the few costs that good management can minimize and learning how to accurately estimate machinery costs will aid in cutting costs. Accurate cost estimates play an important role in every machinery management decision. The major component of the model estimates the fixed and variable costs of machine operation. Ownership or fixed costs are those associated with physical possession of an item. Ownership costs include charges for depreciation, interest on investment, taxes, insurance, and shelter. Operating or variable costs are those associated with operating the machinery complement in performing field operations. These costs include charges for fuel, lubrication, repairs, and labor.

Ownership Costs

Depreciation is typically the largest cost associated with ownership. It is the loss of value resulting from normal machine wear and obsolescence. Machines depreciate or have a loss in value because of age, wear, and obsolescence (16).

The loss of value associated with typical use is termed as normal wear. The more a machine is used, the greater wear on nonreplaceable parts. As a result, the ability of the machine to operate like new may be reduced or numerous breakdowns may cause substantial loss of usable time.

Obsolescence occurs when major model changes have taken place or the machine no longer has enough capacity, even though the machine still has some useful life, its value may be greatly reduced. New machinery concepts or technological advances may also be introduced which can make existing similar machines obsolete. A manufacturer's change in design can cause a decrease in value of existing machines. This obsolescence can result even though there is no loss in functional capability of the old machine.

There are several methods generally acceptable for computing depreciation. The declining-balance depreciation method better reflects the actual value of a machine at any age. With the declining-balance method, a machine depreciates a different amount for each year, but the annual percentage of depreciation is the same. For planning purposes, depreciation should reflect the actual decline in value incurred by the operator. Bowers uses a modified double declining balance method to represent this relationship. The major modification is the addition of a factor which yields a very high first year depreciation. Salvage value for determining depreciation costs is obtained with the following equation:

$$\text{SALVAGE VALUE} = \text{RFV1} * \text{LIST PRICE} * (\text{RFV2}^{\text{Years}})$$

Where: LIST PRICE is the suggested manufacturers selling price.

RFV1 is the first year correction factor,

RFV2 is a component of the standard declining balance equation.

RFV1 and RFV2 are two variables which describe the declining balance depreciation equation for machines.

YEARS represents the number of years the operator expects to own the machine.

Using the computation for salvage value, depreciation costs of operation can be determined using the following equation:

$$\text{DEPRECIATION COSTS} =$$

$$\frac{(\text{PURCHASE PRICE} - \text{SALVAGE VALUE})}{(\text{YEARS OWNED})}$$

Where: PURCHASE PRICE is the actual dollar amount paid for the machine.

A large expense item for agricultural machinery is interest. It is a direct expense item on borrowed capital. Even if cash is paid for purchased machinery, money is tied up that might be available for use elsewhere in the business. Therefore interest is always a cost since the money may be used for other productive purposes. Interest rates vary considerably but usually are between 9 and 14 percent. Interest cost is computed using the following equation:

$$\text{INTEREST COST} =$$

$$\frac{(\text{PURCHASE PRICE} + \text{SALVAGE VALUE})}{2} * \text{INTEREST RATE}$$

The model allows the user to specify the current interest rate as a data parameter.

Taxes are paid on machinery in the same manner as on other property. Tax costs vary from one place to another but are generally a function of purchase price. The annual charge for taxes would be from one to two percent of the value of the machine. In some cases, a sales tax is also assessed when the machine is purchased. The tax cost is based on the purchase price of the machine. Tax costs are computed using the following formula:

$$\text{TAX COST} = \text{PURCHASE PRICE} * \text{TAX RATE}$$

The program allows the user to specify the tax rate as a model parameter.

Insurance policies are usually carried on more expensive machines while the risk of loss is usually assumed by the farmer on the simpler, less expensive machines. Many insurance companies offer blanket policies which allow farmers to insure complete machinery inventories in one policy. Whether the farmer or an insurance company carries the risk, a charge for possible loss should be made. In most cases, an annual charge for insurance or risk represents about 0.25 to 0.50 percent of the remaining value of the machine. The computed insurance cost is based on the average amount of capital invested. The formula for insurance cost is as follows:

$$\text{INSURANCE COST} = \frac{(\text{PURCHASE PRICE} + \text{SALVAGE VALUE})}{2} * \text{INSURANCE RATE}$$

The program allows the operator to enter the insurance rate as a model parameter.

Total ownership cost is the sum of depreciation, insurance, tax, and interest. Fixed costs vary inversely with the hours of annual use. Total costs are

not greatly affected by the amount of use. Therefore, the more equipment is used, the lower the average fixed cost per unit of work.

Operating Costs

The variable or operating machinery costs vary directly with usage. If a machine is not used, variable costs will not be incurred. Fuel and lubrication costs are true operating costs. This is because the hourly consumption of fuel and lubricants stay nearly constant from year to year. Repairs are also variable because they will not occur if the machine is not used.

The most accurate method for estimating fuel costs is accurate records on similar machines and operations. However, in cases where actual records are not available, fuel costs can be estimated because the amount of fuel consumed is directly related to the amount of energy exerted. Traditionally, there are three different kinds of fuel used to power farm tractor engines. These fuel types are diesel, gas, and L.P. gas. However, in more recent years, diesel engines have become the standard in tractors due to their fuel efficiency.

Fuel consumption is estimated using the following equation:

$$\text{FUEL COST} = \text{PTO HORSEPOWER} * \text{FUEL CONSUMPTION MULTIPLIER} * \text{FUEL PRICE PER GALLON} * \text{ANNUAL HOURS USED}$$

Where: The FUEL CONSUMPTION MULTIPLIER is an estimate of fuel consumed per hour per horsepower, the appropriate multiplier for diesel engines is .048.

The diesel fuel price is a parameter which the user can specify.

Modern tractors use a wide variety of lubricants-engine oil, transmission oil, hydraulic fluid, and grease. Total tractor lubrication costs are generally estimated to be 15 percent of total fuel costs. Once the fuel cost is estimated, the cost of lubrication can be calculated simply by multiplying the fuel cost by .15. The following equation is used to calculate lubrication costs:

$$\text{LUBRICATION COSTS} = \text{ANNUAL FUEL COST} * .15$$

The cost of fuel and lubricants is computed only for machines with motors. Lubrication costs for machines without motors are included in repair costs.

Repair costs, usually considered an operating cost, are another important part of machinery costs. Repairs required to maintain reliability will increase as annual use and length of life are increased. With any type of machine there are four main types of repair. These types are:

- <1> Routine wear
- <2> Accidental breakage or damage
- <3> Repairs due to operator neglect
- <4> Routine overhauls.

Typical examples of routine wear would include disk blades, chisel points, cultivator sweeps, fan belts, and tires. Even with the best of care, replacement of these items will be necessary sooner or later.

Accidents causing damage to machinery can happen even with the best of operators. But carelessness or rushing a job is far more likely to cause costly accidents. Unfortunately, these types of accidents often involve a frame, axle, housing, or some other part that is hard to replace. Often these types of parts

are not stocked by a dealer and/or the total damage is so severe that repair is not advisable. With good management, few of these repairs will be needed.

If time is not taken to perform needed maintenance or minor repairs, more serious problems may result. Also, putting off scheduled servicing can result in more extensive repair costs.

Machine overload and poor maintenance can be associated with accelerated machine repairs and a shorter machine life. Even if machinery is used in a responsible manner, routine overhauls are needed to replace worn or defective parts and restore original performance.

Studies of machinery repair costs indicate a wide variation in costs according to the kind of machine and the way it is used. While it is difficult to estimate repair costs for a particular machine accurately, an equation has been developed which can serve as a guideline to estimate repair costs. This model uses the following equation to compute machinery repair costs:

REPAIR COST =

$$\frac{\text{LIST PRICE} * \text{RC1} * \text{RC2} * [(\text{PERCENT LIFE})^{\text{RC3}}]}{\text{YEARS OWNED}}$$

Where percent life =

$$\frac{(\text{YEARS OWNED} * \text{HOURS USED ANNUALLY})}{(\text{HOURS OF LIFE})} * 100$$

Where: RC1 is the ratio of total accumulated repairs to initial list price for the entire life of the machine.

RC2 and RC3 are two repair cost constants that go together to determine the shape of the repair rate curve.

HOURS OF LIFE is the total number of hours during the machine's expected mechanical life.

The labor cost involved in farm machinery may or may not be a direct cost to the producer. For owner-operators, the hourly labor charge may be estimated by examining alternative opportunities for the owner's time, whether they be off-farm employment or other on-farm enterprises. For hired operators, a constant hourly rate might be more appropriate.

The total operating cost is the sum of the fuel cost, lubrication cost, and repair cost. Labor cost is considered separately in this model because it may represent the operators contribution to the operation. However, if the amount of owner-operator labor hours are not sufficient to complete necessary practices, hired labor will be required. Total operating costs vary according to the number of machine hours. Consequently, if unplanned field operations are required, profits will decline by the variable cost of the operation.

The model provides a summary of fixed and variable costs. Users can use the summaries to determine the feasibility and desirability of alternative machinery complements. The program also aids the operator in making comparisons between large equipment (less labor) and small equipment (more labor). The model permits the user to decide how he wishes to allocate resources. It provides information so that decision making is made with full knowledge of what to expect.

CHAPTER III

DATA SPECIFICATION

Statewide Machinery Complements

Selecting machinery complements occurs in an environment of uncertainty. There are tradeoffs between the amounts of capital and labor employed to complete timely field operations. The inability of a machinery complement to complete field operations within the optimum time period can be considered an expense. Therefore, the machine size and labor availability should balance the low ownership cost advantage of small capacity machinery with the timely-operation advantages of larger capacity machinery.

A representative set of tractors and implements comprising the machinery complement is selected considering all possible field operations needed for the Oklahoma study area. For the purpose of this study, seven tractor sizes ranging from 95 to 200 power take off (PTO) horsepower are used. The tractor sizes are 95, 105, 125, 140, 155, 175 and 200 PTO horsepower.

Assumptions About Machine Size Availability

In developing a complement for each tractor several assumptions were made. First, 6-row row-crop equipment is used with tractors up to 140 PTO horsepower and 12-row equipment is used with tractors greater than 140 PTO horsepower. In addition, the size of the land plane, or more commonly called land leveler, is restricted to sixteen feet in width. Even though a sixteen foot

land plane does not use some tractors to their full capability, larger land planes are not generally available.

The model also assumes a fixed size for hay equipment. This assumption was made because there are many different sizes of equipment. For example, farm equipment manufacturer's currently offer five round balers capable of producing round bales with varying dimensions. A 5-foot by 6-foot (5*6) round baler is use for the sake of simplicity. Because of tractor PTO limitations, 540 PTO driven machinery, i.e.; balers, windrowers and rotary mowers, must be used with tractors not exceeding 140 PTO horsepower. No haying equipment can be pulled with tractors greater than 140 PTO horsepower.

Each tractor less than or equal to 140 PTO horsepower can be matched with up to 19 machines. These machines include primary and secondary tillage tools, drilling and row crop equipment and forage production equipment. Tractors greater than 140 PTO horsepower are matched with 16 machines. This includes all machines matched with the smaller tractors except forage production equipment. Table II lists the possible machines for the two horsepower ranges.

Matching Tractors To Implements

The machine matched with each tractor, is determined using Bowers formula for determining proper implement width and hourly acre coverage. Table III through IX reveal the specific tractor - equipment complements. Included are the working width, travel speed, efficiency criteria, and the acre coverage per hour for the respective machines.

TABLE II
TRACTOR SIZE AND EQUIPMENT POSSIBILITIES

95 - 140 Horsepower	155 - 200 Horsepower
Offset Disk	Offset Disk
Chisel Plow	Chisel Plow
Land plane	Land plane
Sweep Plow	Sweep Plow
Moldboard Plow	Moldboard Plow
Sweep Conditioner	Sweep Conditioner
Cultipacker	Cultipacker
Tandem Disk	Tandem Disk
Springtooth	Springtooth
Spike Harrow	Spike Harrow
Grain Drill	Grain Drill
Row Planter	Row Planter
Row Cultivator	Row Cultivator
Rotary Hoe	Rotary Hoe
Sprayer	Sprayer
Stalk Shredder	Stalk Shredder
Rotary Mower	
Windrower	
Round Baler	

TABLE III
95 HORSEPOWER TRACTOR TYPICAL
FARM MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	10.21	10	4.8	625	0.81	4.81
CHISEL	9.64	10	4.1	775	0.79	3.79
LAND PLANE	12.00	12	3.5	350	0.42	2.14
SWEEP PLOW	15.47	15	5.5	360	0.75	7.74
M.B. PLOW	5.98	6	4.1	1,250	0.80	2.38
SWEEP COND.	15.92	16	5.5	350	0.75	7.96
CULTIPACKER	13.62	14	6.0	375	0.79	7.82
TANDEM DISK	13.11	13	5.5	425	0.81	7.08
SPRINGTOOTH	18.57	19	5.5	300	0.70	8.67
S.HARROW	MSW	37	6.0	100	0.70	18.84
DRILL	MSW	21	6.0	225	0.72	11.17
PLANTER	MSW	15	5.0	200	0.75	6.82
CULTIVATOR	MSW	15	5.5	320	0.65	6.50
ROTARY HOE	MSW	18	5.0	230	0.75	8.18
SPRAYER	MSW	40	5.5	200	0.60	16.00
S.SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT.MOWER	MSW	15	4.5	200	0.76	6.22
WINDROWER	MSW	14	5.4	150	0.76	6.96
BALER	MSW	14	3.0	200	0.67	3.41

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

TABLE IV
105 HORSEPOWER TRACTOR TYPICAL FARM
MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	11.29	11	4.8	625	0.81	5.32
CHISEL	10.66	11	4.1	775	0.79	4.18
LAND PLANE	12.00	12	3.5	350	0.42	2.14
SWEEP PLOW	17.10	17	5.5	360	0.75	8.55
M.B. PLOW	6.61	7	4.1	1250	0.80	2.63
SWEEP COND.	17.59	18	5.5	350	0.75	8.80
CULTIPACKER	15.05	15	6.0	375	0.79	8.65
TANDEM DISK	14.49	14	5.5	425	0.81	7.82
SPRINGTOOTH	20.52	21	5.5	300	0.70	9.58
S.HARROW	MSW	37	6.0	100	0.70	18.84
DRILL	MSW	21	6.0	225	0.72	11.17
PLANTER	MSW	15	5.0	200	0.75	6.82
CULTIVATOR	MSW	15	5.5	320	0.65	6.50
ROTARY HOE	MSW	18	5.0	230	0.75	8.18
SPRAYER	MSW	40	5.5	200	0.60	16.00
S.SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT.MOWER	MSW	15	4.5	200	0.76	6.22
WINDROWER	MSW	14	5.4	150	0.76	6.96
BALER	MSW	14	3.0	200	0.67	3.41

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

TABLE V

125 HORSEPOWER TRACTOR TYPICAL
FARM MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	13.44	13	4.8	625	0.81	6.33
CHISEL	12.69	13	4.1	775	0.79	4.98
LAND PLANE	16.00	16	3.5	350	0.42	2.85
SWEEP PLOW	20.36	20	5.5	360	0.75	10.18
PLOW	7.87	8	4.1	1,250	0.80	3.13
SWEEP COND.	20.94	21	5.5	350	0.75	10.47
CULTIPACKER	17.92	18	6.0	375	0.79	10.29
TANDEM DISK	17.25	17	5.5	425	0.81	9.31
SPRINGTOOTH	24.43	24	5.5	300	0.70	11.40
S.HARROW	MSW	53	6.0	100	0.70	26.98
DRILL	MSW	27	6.0	225	0.72	13.96
PLANTER	MSW	15	5.0	200	0.75	6.82
CULTIVATOR	MSW	15	5.5	320	0.65	6.50
ROTARY HOE	MSW	18	5.0	230	0.75	3.82
SPRAYER	MSW	40	5.5	200	0.60	16.00
S.SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT.MOWER	MSW	15	4.5	200	0.76	6.22
WINDROWER	MSW	14	5.4	150	0.76	6.96
BALER	MSW	14	3.0	200	0.67	3.41

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

TABLE VI
140 HORSEPOWER TRACTOR TYPICAL
FARM MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	15.05	15	4.8	625	0.81	7.09
CHISEL	14.21	14	4.1	775	0.79	5.58
LAND PLANE	16.00	16	3.5	350	0.42	2.85
SWEEP PLOW	22.80	23	5.5	360	0.75	11.40
PLOW	8.81	9	4.1	1,250	0.80	3.50
SWEEP COND.	23.45	23	5.5	350	0.75	11.73
CULTIPACKER	20.07	20	6.0	375	0.79	11.53
TANDEM DISK	19.32	19	5.5	425	0.81	10.43
SPRINGTOOTH	27.36	27	5.5	300	0.70	12.77
S.HARROW	MSW	53	6.0	100	0.70	26.98
DRILL	MSW	27	6.0	225	0.72	13.96
PLANTER	MSW	15	5.0	200	0.75	6.82
CULTIVATOR	MSW	15	5.5	320	0.65	6.50
ROTARY HOE	MSW	18	5.0	230	0.75	8.18
SPRAYER	MSW	40	5.5	200	0.60	16.00
S.SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT.MOWER	MSW	15	4.5	200	0.76	6.22
WINDROWER	MSW	14	5.4	150	0.76	6.96
BALER	MSW	14	3.0	200	0.67	3.41

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

TABLE VII

155 HORSEPOWER TRACTOR TYPICAL
FARM MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	16.66	17	4.8	625	0.81	7.85
CHISEL	15.73	16	4.1	775	0.79	6.18
LAND PLANE	16.00	16	3.5	350	0.42	2.85
SWEEP PLOW	25.25	25	5.5	360	0.75	12.62
PLOW	9.75	10	4.1	1,250	0.80	3.88
SWEEP COND.	25.97	26	5.5	350	0.75	12.98
CULTIPACKER	22.22	22	6.0	375	0.79	12.76
TANDEM DISK	21.39	21	5.5	425	0.81	11.55
SPRINGTOOTH	30.30	30	5.5	300	0.70	14.14
S.HARROW	MSW	67	6.0	100	0.70	34.11
DRILL	MSW	36	6.0	225	0.72	18.85
PLANTER	MSW	30	5.0	200	0.75	13.64
CULTIVATOR	MSW	30	5.5	320	0.65	13.00
ROTARY HOE	MSW	30	5.0	230	0.75	13.64
SPRAYER	MSW	60	5.5	200	0.60	24.00
S. SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT. MOWER	NA	NA	4.5	200	0.76	NA
WINDROWER	NA	NA	5.4	150	0.76	NA
BALER	NA	NA	3.0	200	0.67	NA

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

NA represents a machine not available to this specific B Tractor size.

TABLE VIII

175 HORSEPOWER TRACTOR TYPICAL
FARM MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	18.81	19	4.8	625	0.81	8.87
CHISEL	17.76	18	4.1	775	0.79	6.97
LAND PLANE	16.00	16	3.5	350	0.42	2.85
SWEEP PLOW	28.50	29	5.5	360	0.75	14.25
PLOW	11.01	11	4.1	1,250	0.80	4.38
SWEEP COND.	29.32	29	5.5	350	0.75	14.66
CULTIPACKER	25.08	25	6.0	375	0.79	14.41
TANDEM DISK	24.14	24	5.5	425	0.81	13.04
SPRINGTOOTH	34.20	34	5.5	300	0.70	15.96
S.HARROW	MSW	67	6.0	100	0.70	34.11
DRILL	MSW	36	6.0	225	0.72	18.85
PLANTER	MSW	30	5.0	200	0.75	13.64
CULTIVATOR	MSW	30	5.5	320	0.65	13.00
ROTARY HOE	MSW	30	5.0	230	0.75	13.64
SPRAYER	MSW	60	5.5	200	0.60	24.00
S. SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT. MOWER	NA	NA	4.5	200	0.76	NA
WINDROWER	NA	NA	5.4	150	0.76	NA
BALER	NA	NA	3.0	200	0.67	NA

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

NA represents a machine not available to this specific tractor size.

TABLE IX

200 HORSEPOWER TRACTOR TYPICAL
FARM MACHINERY COMPLEMENT

Name of Machine	Technical Width	Working Width	Speed (mph)	Draft (lbs)	Field Efficiency	Acres/ Hour
OFFSET	21.50	22	4.8	625	0.81	10.13
CHISEL	20.30	20	4.1	775	0.79	7.97
LAND PLANE	16.00	16	3.5	350	0.42	2.85
SWEEP PLOW	32.58	33	5.5	360	0.75	16.29
PLOW	12.59	13	4.1	1,250	0.80	5.00
SWEEP COND.	33.51	34	5.5	350	0.75	16.75
CULTIPACKER	28.67	29	6.0	375	0.79	16.47
TANDEM DISK	27.59	28	5.5	425	0.81	14.90
SPRINGTOOTH	39.09	39	5.5	300	0.70	18.24
S.HARROW	NA	NA	6.0	100	0.70	NA
DRILL	MSW	36	6.0	225	0.72	18.85
PLANTER	MSW	30	5.0	200	0.75	13.64
CULTIVATOR	MSW	30	5.5	320	0.65	13.00
ROTARY HOE	MSW	30	5.0	230	0.75	13.64
SPRAYER	MSW	60	5.5	200	0.60	24.00
S. SHREDDER	MSW	15	4.8	550	0.80	6.98
ROT. MOWER	NA	NA	4.5	200	0.76	NA
WINDROWER	NA	NA	5.4	150	0.76	NA
BALER	NA	NA	3.0	200	0.67	NA

NOTE: MSW is the manufacturers suggested width.

TECHNICAL WIDTH is the computed width based horsepower and draft.

WORKING WIDTH is standard implement size closest to technical width available in the market.

ACRES/HOUR is computed using speed, width, and efficiency.

NA represents a machine not available to this specific tractor size.

The farm sizes and crop mixes considered for each of the eight regions of Oklahoma are based on a previous study, Typical Oklahoma Farms (9). This study used the 1982 Oklahoma Agricultural Census to divide farms into three typical sizes (small, medium and large) for each region of the state. Typical Oklahoma crops include small grains, alfalfa, grain sorghum, corn, peanuts, soybeans, cotton, and sudan hay. The crop mixes and farm sizes will vary according to the region. The technical coefficients and factor prices will remain constant. Table X lists the technical coefficients and factor prices used in this model. The parameters are based on current price values. The technical coefficients are used by the Oklahoma State University Enterprise Budget to convert machine hours into tractor hours and labor hours, respectively.

Using The Machinery Selection Model

The model requires user information for proper operation. Two types of information are required. Figure 1 explains the model flow and the information required. The first is basic data that most users will not revise. Included are the machinery complements (previously discussed) and the times over for each machine for each crop by month (also previously discussed). Second is the data input users will continually modify. Included are operator labor, tractor size, tractor capacity, and crop acreage. This section deals with data describing individual farm and resource situations.

TABLE X
 TECHNICAL COEFFICIENTS USED IN THE MACHINERY
 SELECTION MODEL

Parameter Description	Value
PRICE PER GALLON OF DIESEL	\$0.80
INTEREST RATE PER DOLLAR OF INVESTMENT	0.09
MACHINERY INSURANCE RATE	0.006
MACHINERY TAX RATE	0.01
PRICE OF MACHINERY LABOR PER HOUR	5.00
MAXIMUM NUMBER OF TRACTORS ALLOWED IN COMPLEMENT	3
FACTOR BY WHICH MACHINE HOURS ARE MULTIPLIED TO OBTAIN TRACTOR HOURS	1.1
FACTOR BY WHICH TRACTOR HOURS ARE MULTIPLIED TO OBTAIN MACHINERY LABOR REQUIREMENTS	1.1

Data required for operation of the model is as follows:

1. Operator labor available by month,
2. Size of tractor or tractors,
3. Maximum tractor hours available by month,
4. Field operation allocation,
5. Crop acreages,
6. Technical and cost coefficients.

Theses data requirements will be discussed in order.

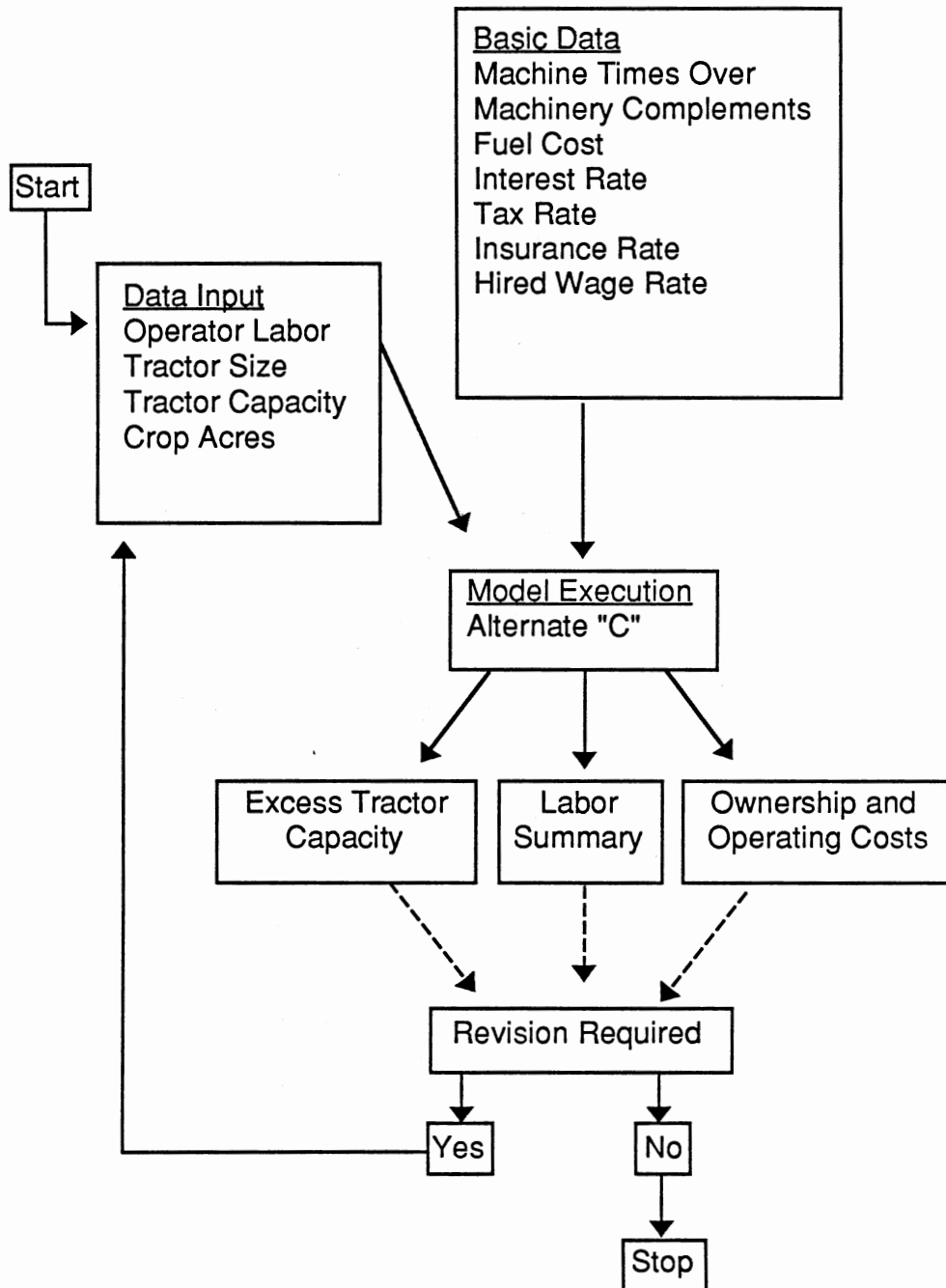


Figure 1. Complete Model Flowchart.

Operator Labor Available By Month

The time available for performing various operations is limited by operator labor availability. The amount of labor an operator devotes to crop production activities varies from location to location. In central and eastern Oklahoma, labor hours available are often hampered because of weather conditions. One of the requirements of this model is that the user specify monthly labor available. The labor available should consider the need for timely field operations. A major factor restricting the labor which can be applied to field work is wet fields. Following is a discussion of the days available for field work across areas of the state.

Time Available For Fieldwork. The estimated days available for field operations within each time period were prepared from tables developed by Reinschmiedt (17) for southwestern Oklahoma. Reinschmiedt determined from a survey of producers the amounts of field time lost as a result of alternative amounts of rainfall, given soil type and soil moisture conditions prior to the rain. Rain and wet field conditions are the primary impediments to field operations in Oklahoma.

There is a tradeoff between the specified number of suitable days available during a specific time period and the percentage of time one could expect to have at least the specified number of working days occur. The number of days available for each time period is displayed in Table XI and Table XII. Table XI represents a 95 percent timeliness level and Table XII represents an 85 percent timeliness level. The regions of study are numbered one through eight and represent the Panhandle, West-Northwest, Southwest, North Central, South Central, Northeast, East, and Southeast, respectively. For

this analysis, a 95 percent timeliness level was chosen indicating a relatively high preference for successfully being able to accomplish scheduled tasks in the time periods provided. The 95 percent timeliness level dictates that work completed within the number of days specified will be possible 19 out of 20 years.

The number of operator hours devoted to machinery operations can vary considerable from time period to time period. These hours can vary due to seasonality, working conditions, other seasonal demands, and operator preferences. The total hours available per operator according to the specific time period is a product of the number of daily hours the producer will devote to field practices and the days available for completing field work.

TABLE XI
THE DAYS AVAILABLE FOR FIELD WORK IN EACH TIME
PERIOD FOR EIGHT TYPICAL FARM REGIONS

95 PERCENT TIMELINESS LEVEL

REGION	1	2	3	4	5	6	7 and 8
PERIOD							
JANUARY	28.50	24.25	20.00	20.00	18.92	18.50	16.75
FEBRUARY	24.50	21.13	17.75	19.75	16.83	17.00	13.00
MARCH	15.50	17.50	19.50	20.25	18.08	16.00	14.50
APRIL	21.50	18.63	15.75	14.75	13.83	13.00	11.00
MAY	18.00	14.63	11.25	11.25	10.92	10.75	10.25
JUNE	17.50	15.38	13.25	14.00	12.83	12.50	11.25
JULY	18.50	18.75	19.00	17.00	18.25	18.00	18.75
AUGUST	18.50	18.50	18.50	20.50	19.00	19.25	18.00
SEPTEMBER	19.00	16.75	14.50	16.75	14.67	14.75	12.75
OCTOBER	22.75	18.25	13.75	17.00	15.08	15.75	14.50
NOVEMBER	24.00	21.00	18.00	18.75	17.25	16.75	15.00
DECEMBER	26.50	23.63	20.75	19.50	18.17	16.50	14.25

TABLE XII
THE DAYS AVAILABLE FOR FIELD WORK IN EACH TIME
PERIOD FOR EIGHT TYPICAL FARM REGIONS

85 PERCENT TIMELINESS LEVEL

REGION	1	2	3	4	5	6	7 and 8
PERIOD							
JANUARY	29.50	25.10	20.70	23.75	19.58	23.00	22.25
FEBRUARY	26.50	22.85	19.20	23.00	18.20	20.50	18.00
MARCH	27.50	24.36	21.86	24.00	23.58	21.63	19.25
APRIL	25.25	21.88	18.50	19.25	16.24	16.88	14.50
MAY	22.00	17.88	13.75	17.50	13.35	16.50	15.50
JUNE	22.25	19.55	16.85	20.25	16.31	18.25	16.25
JULY	22.75	22.45	22.15	23.25	22.44	23.25	23.25
AUGUST	23.50	23.50	23.50	21.00	22.88	21.25	21.50
SEPTEMBER	23.50	20.72	17.93	20.75	18.14	19.13	17.50
OCTOBER	25.75	20.66	15.56	22.50	17.07	21.25	20.00
NOVEMBER	28.00	24.50	21.00	23.65	20.13	22.33	21.00
DECEMBER	28.25	25.19	22.12	19.50	19.37	19.13	18.75

Owner Labor Availability. The first step in using this program, is to enter the number of labor hours available for the operation for each month (cells C44 through N44). Cell numbers are provided to aid users in data entry.

Size of Tractor or Tractors

The second step in using this program is entering the tractor or tractors the user plans to incorporate into the model. A list of the tractors is presented in the data entry section. The model ranks the tractors according to PTO horsepower. Available in the model are tractors ranging from 95 to 200 horsepower. Users

identify the tractors horsepower (cells B15, C15, and D15). It is possible to use 1, 2, or 3 tractors. The tractors need not be listed in any specific order.

Maximum Tractor Hours Available By Month

A crucial input for this analysis is the maximum tractor time available for each specific period. Tractor hours can be limited by weather conditions and are thus restricted to the number of days available shown in Tables XI and XII. Weather constraints include both dry and wet weather patterns. Timeliness of field operations can be hampered substantially by not having adequate tractor power to complete needed field work. The number of hours necessary in peak usage periods, such as June, July, and August, may be constrained by labor availability or weather conditions. Farm managers need to take into account the maximum number of hours a tractor can be used when selecting tractor horsepower. The maximum available tractor hours for each time period are entered (cells C47 through N47).

Field Operation Allocation

Farm implements do not accomplish tillage tasks alone, but must be provided power and locomotion by suitably powerful tractors. This model allows the user to allocate each field operation to at least one or a combination of tractors. The specification is based on a percentage of the particular field operation the user wishes to complete with a certain tractor. For example, the user may choose to employ a two tractor complement where both tractors are allocated to completing the offset disking requirements. This is a column of data, (cells B20 through B38) where the user specifies the machines which will be employed by Tractor #1. Entries should be the percent of work which will be

completed by Tractor 1. There is also a column of data for Tractor #2 (cells C20 through C38) and Tractor #3 (D20 through D38). The user must be certain that all (100%) of each field operation is performed.

Crop Acreage

Crop selection and acreage specification are two important features of this model. As previously stated, this model allows the user to select crops according to current operating practices and to specify the number of acres associated with each crop (cells C5 through C12). For example, if the farming operation consists of 800 wheat acres, 800 will be entered (cell C5). Each cell in this range must have a number. If a crop in this model's crop mix is not produced, enter a zero.

Technical and Cost Coefficients

Table X contains a list of the technical and cost coefficients used in the model. Following is a list of the data entry location for these coefficients.

Price per gallon of Diesel Fuel	(117)
Interest Rate per Dollar of Investment	(118)
Machinery Tax Rate	(119)
Insurance and/or Risk Rate	(120)
Wage Rate for Hired Labor	(121)

The labor needs are satisfied by operator labor and/or the purchasing of hired labor. Unlike the other operating inputs, the need for hired labor varies according to the size of operation, owner labor availability, and the size of farm equipment. If labor is hired, charges are included in operating or variable costs.

In this program, hired labor will only be used if operator hours are not sufficient to complete necessary field operations in designated time periods.

Calculating The Model

Complete Calculation

After all data has been inserted, calculation is accomplished with the computer command Alternate C (Alt-C). Alternate C completes the entire execution of the program. This includes not only calculating the labor requirements, tractor requirements and summaries; it also estimates the machinery costs for the complement given the specific farm organization.

Pressing Alt and C simultaneously executes a Lotus macro. Depending on computer speed, up to five minutes may be required for calculation.

Partial Calculation

The F9 computer function key partially recalculates the model. This function allows the user to compare required labor hours for alternative tractor sizes and tractor-equipment specification without timely macro execution. By using F9 to execute the model recalculation, the program user can determine the association of tractor hours and operator labor or hired labor needed to complete field operations. Using the F9 function key only recalculates the time feature of the model, it will not update ownership and operating costs. If cost comparisons are desired Alt C must be used.

Program Results

This model is constructed with two intended uses. First, it provides a tool for determining the sufficiency of tractor hours and operator labor hours given a

specific complement. Second, it permits producers to compare the costs of alternative machinery complements. These costs include fixed costs, variable costs, and hired labor charges.

Tractor Capacity

The first results deal with tractor hours of operation. The tractor horsepower appears first (cell B58 for Tractor #1) followed by the hours of tractor operation in each month (cells C58 through N58 for Tractor #1) and finally, the total annual hours of uses (cell O58).

Following the tractor use summary is a computation of excess capacity for each tractor. The hours each tractor is used each month is subtracted from the user specified maximum tractor hours available. The results are listed in the Tractor Excess Capacity Summary. The Excess Capacity table allows the user to determine if field operations can be satisfactorily completed by the specified complement. A number greater than 0 (cells C74,75,76 through N74,75,76) implies there is excess capacity and that the tractor could perform additional work if necessary. Negative numbers indicate the tractor is being used a greater number of hours than the user specified was available. User judgement is required to increase or decrease tractor size or to reallocate work between tractors. By making appropriate changes, a "better" complement can be found.

Operator Labor Summary

Many farms rely solely on owner/operator labor to complete field operations. To determine if operator labor hours are sufficient monthly machine labor hours required (cells C84 through N84) are subtracted from monthly operator labor hours available (cells C83 through N83). If the results (cells C87

through N87) are zeros the operator can personally complete all field practices. However, if the result is a number greater than zero for any specific time period, the producer must either allocate more personal labor to the time period, hire labor, or select larger equipment. The cost of hired labor (cells C88 through N88) is the product of the additional hours of labor needed and the wage rate. This calculation will only be relevant if operator labor is not sufficient to complete timely field practices. Hired labor is a variable cost of operation.

Costs Associated With Production

This model combines fixed costs, variable costs, and charges for hired labor to determine the total annual cost associated with field operations. A cost table (cells B92 through J94) summarizes the expenses (1 line for each tractor) associated with the whole farm machinery complement. Fixed and variable costs are computed for each tractor and the equipment associated with that tractor. Depreciation, taxes, insurance, and interest are the fixed costs. Repair, fuel and lubrication are the variable costs.

From these calculations total complement operation and ownership costs can be computed. Total cost (cell G98) is the sum of ownership costs (cell F96) and operation costs (cell J96).

The tractor capacity, operator labor, and complement cost estimates provide information for model users to compare alternative complements. The information provided is sufficient to insure complement feasibility and determine which complements among those feasible have the lowest cost.

Sample Farm Initial Specification

Following is an example to illustrate model operation. The large west-northwest farm is taken from an earlier study, Typical Oklahoma Farms. The daily operator labor available consists of 5 hours in January, February, November and December; 7 hours in March, April, September and October; and 9 hours in May, June, July and August. With the aid of Reinschmiedt's study (see Table XIII) the number of operator labor hours for each time period are computed. Based on the user's knowledge, a two tractor complement is selected (one 155 horsepower tractor and one 95 horsepower tractor). The maximum number of tractor hours either tractor will be used are arbitrarily constrained to 200 hours each time period. All primary and secondary tillage operations will be completed with the larger tractor while planting and haying operations will be completed with the smaller tractor. The crop activities and acreages for the large west-northwest farm are 820 wheat acres, 23 sorghum acres and 73 sudan hay acres. The parameter values associated with the model are the price of diesel fuel at .80 dollars per gallon, an interest rate of 9 percent, a tax rate of 1 percent, an insurance rate of .6 percent and a hired labor wage rate of five dollars per hour. Figure 2 shows the location of all model data specified by the user. All cell locations for input are in the upper left corner of the spreadsheet template.

After all data is entered the Alt and C keys are pressed simultaneously to execute the macro and evaluate the complement.

TABLE XIII
 OPERATOR LABOR HOURS BY TIME PERIOD
 WEST NORTHWEST AREA OF OKLAHOMA

TIME PERIOD	DAYS AVAILABLE PER PERIOD	OPERATOR HOURS PER DAY	TOTAL OPERATOR HOURS AVAILABLE
JANUARY	24.25	5	121
FEBRUARY	21.13	5	106
MARCH	17.5	7	123
APRIL	18.63	7	130
MAY	14.63	9	132
JUNE	15.38	9	138
JULY	18.75	9	169
AUGUST	18.5	9	167
SEPTEMBER	16.75	7	117
OCTOBER	18.85	7	128
NOVEMBER	21	5	105
DECEMBER	23.6	5	118

Sample Farm (Initial Results)

The output results for this typical sample farm are presented in Figure 3. The first table summarizes the monthly tractor use. Tractor #1 (155 Hp.) is used 593 hours per year and Tractor #2 (95 Hp.) is used 170 hours per year.

The second table in Figure 3 shows the excess capacity for each tractor in each month. Tractor #1 will not meet the requirements to complete timely field operations in the July time period. This is determined by using the excess capacity summary. Tractor #1 needs an additional 28 hours to complete July field practices.

<u>CROP ACTIVITIES</u>		<u>ACRES</u>			<u>TRACTOR SIZES</u> <u>(IN PTO HP)</u>	
WHEAT		820			95	
ALFALFA		0			105	
GRAIN SORGHUM		23			125	
CORN		0			140	
PEANUTS		0			155	
SOYBEANS		0			175	
COTTON		0			200	
SUDAN HAY		73				

<u>TRACTOR HP</u>	<u># 1</u>	<u># 2</u>	<u># 3</u>	<u>COST DATA ENTRY</u>	
	155	95		CURRENT FUEL COST	0.80
<u>MACHINE OPERATION</u>	<u>SPECIFIED TRACTOR USAGE</u>			INTEREST RATE	0.090
OFFSET	100%	0%	0%	CURRENT TAX RATE	0.010
CHISEL	100%	0%	0%	INSURANCE RATE	0.006
LAND PLANE	100%	0%	0%	HIRED WAGE RATE	5.00
SWEEP PLOW	100%	0%	0%		
M.B. PLOW	100%	0%	0%		
SWEEP COND.	100%	0%	0%		
CULTIPACKER	100%	0%	0%		
TANDEM DISK	100%	0%	0%		
SPRINGTOOTH	100%	0%	0%		
S.HARROW	100%	0%	0%		
DRILL	0%	100%	0%		
PLANTER	0%	100%	0%		
CULTIVATOR	0%	100%	0%		
ROTARY HOE	0%	100%	0%		
SPRAYER	0%	100%	0%		
S.SHREDDER	100%	0%	0%		
ROT.MOWER	0%	100%	0%		
WINDROWER	0%	100%	0%		
BALER	0%	100%	0%		

<u>OWNER-OPERATOR MONTHLY LABOR</u>													
	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUNE</u>	<u>JULY</u>	<u>AUG</u>	<u>SEPT</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>	<u>TOTAL</u>
<u>HRS AVAIL-</u>	121	106	123	130	132	138	169	167	117	128	105	118	1,436
<u>MAXIMUM TRACTOR HOURS PER TIME PERIOD</u>	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 2. Tractor Horsepower Selection.

A third table indicates that operator labor is sufficient to complete field operations in January, February, March, April, May, October, November and December. Hired labor will be required in June, July, August, and September.

At this point, the program user must analyze the problem and attempt to make adjustments. The initial analysis indicates Tractor #1 is not adequate to perform the July operations in a timely fashion.

Sample Farm (A Second Iteration)

Because the initial situation is not feasible, the machinery complement must be revised to make the complement viable. Several alternatives are available; tractor size(s) could be increased, hours available could be increased, or a reallocation of fieldwork between tractors could be made. For this problem, a shift of fieldwork from Tractor #1 to Tractor #2 was made.

Figure 4 illustrates the changes made. Moldboard Plow work is shifted from 100 percent done by Tractor #1 to 75 percent done by Tractor #1 and 25 percent done by Tractor #2. Also, tandem disk fieldwork is split 50-50 between the two tractors. The model is then recalculated using the Alt-c command.

Figure 5 presents the second iteration output. Changes resulting from the second iteration are a shift in tractor hours to 519 for Tractor #1 and 291 for Tractor #2. Because the output shows excess capacity for each time period, this tractor-farm equipment complement satisfies the criteria of completing the field practices in a timely manner. The machines used with Tractor #1 include the offset disk, chisel, sweep plow, moldboard plow, sweep conditioner, tandem disk and springtooth. The total fixed costs incurred for Tractor #1 and its equipment are \$18,288.62. Total variable costs for Tractor #1 excluding hired labor are \$6691.48. The total fixed costs incurred for Tractor #2 and its

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
<hr/>															
TRACTOR #1															
155	0.00	27	9	0.00	17	115	228	133	64	0.00	0.00	0.00		593	
TRACTOR #2															
95	0.00	0.00	0.00	0.00	10.90	39	4	35	81	0.00	0.00	0.00		170	
TRACTOR #3															
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	
<hr/>															
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
<hr/>															
TRACTOR HOUR															
REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
<hr/>															
MAXIMUM TRACTOR															
HOURS PER															
MONTH (HP)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
<hr/>															
EXCESS CAPACITY															
TRACTOR#1															
155	200	173	191	200	183	85	-28	67	136	200	200	200	200	200	
TRACTOR #2															
95	200	200	200	200	189	161	196	165	119	200	200	200	200	200	
TRACTOR #3															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<hr/>															
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY															
ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
<hr/>															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
<hr/>															
OWNER LABOR															
PROVIDED	121	106	123	130	132	138	169	167	117	128	105	118	1,436		
TOTAL HOURS															
REQUIRED	0.00	30	10	0.00	30	169	255	185	159	0.00	0.00	0.00	839		
<hr/>															
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	31	86	18	42	0.00	0.00	0.00	178		
<hr/>															
COST OF HIRED															
LABOR	0.00	0.00	0.00	0.00	0.00	156	431	91	210	0.00	0.00	0.00	888		
<hr/>															
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C	T.O.C./TRACTOR					
<hr/>															
TRACTOR #1															
	9,108	7,356	490	1,335	18,289	3,930	529	3,530	7,989				26,278		
TRACTOR #2															
	7,012	5,667	378	1,048	14,104	969	151	1,00	2,12	9			16,234		
TRACTOR #3															
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
<hr/>															
TOTAL FIXED COSTS							32,393.10	TOTAL VARIABLE COSTS					10,118.29		
TOTAL OPERATING COST INCLUDING HIRED LABOR							43,399.40	COST PER ACRE					47.38		

Figure 3. Machinery Complement Selection Results.

<u>CROP ACTIVITIES</u>	<u>ACRES</u>			<u>TRACTOR SIZES (IN PTO HP)</u>	
WHEAT	820			95	
ALFALFA	0			105	
GRAIN SORGHUM	23			125	
CORN	0			140	
PEANUTS	0			155	
SOYBEANS	0			175	
COTTON	0			200	
SUDAN HAY	73				

	<u># 1</u>	<u># 2</u>	<u># 3</u>	<u>COST DATA ENTRY</u>	
TRACTOR HP	155	95		CURRENT FUEL COST	0.80
MACHINE SPECIFIED				INTEREST RATE	0.090
OPERATION	<u>TRACTOR USAGE</u>			CURRENT TAX RATE	0.010
OFFSET	100%	0%	0%	INSURANCE RATE	0.006
CHISEL	100%	0%	0%	HIRED WAGE RATE	5.00
LAND PLANE	100%	0%	0%		
SWEEP PLOW	100%	0%	0%		
M.B. PLOW	75%	25%	0%		
SWEEP COND.	100%	0%	0%		
CULTIPACKER	100%	0%	0%		
TANDEM DISK	50%	50%	0%		
SPRINGTOOTH	100%	0%	0%		
S.HARROW	100%	0%	0%		
DRILL	0%	100%	0%		
PLANTER	0%	100%	0%		
CULTIVATOR	0%	100%	0%		
ROTARY HOE	0%	100%	0%		
SPRAYER	0%	100%	0%		
S.SHREDDER	100%	0%	0%		
ROT.MOWER	0%	100%	0%		
WINDROWER	0%	100%	0%		
BALER	0%	100%	0%		

<u>OWNER- OPERATOR MONTHLY</u>													
<u>LABOR HOURS</u>	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUNE</u>	<u>JULY</u>	<u>AUG</u>	<u>SEPT</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>	<u>TOTAL</u>
AVAILABLE	121	106	123	130	132	138	169	167	117	128	105	118	1,436
MAXIMUM TRACTOR HOURS PER TIME PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 4. Tractor Horsepower Selection.

TOTAL																
TRACTOR																
HOURS HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL			
TRACTOR #1																
155	0.00	20	5	0.00	12	115	170	133	64	0.00	0.00	0.00	0.00	519		
TRACTOR #2																
95	0.00	11	7	0.00	18	39	99	35	81	0.00	0.00	0.00	0.00	291		
TRACTOR #3																
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW. CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT. TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER. IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.																
TRACTOR HOUR REQUIREMENT																
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC				
MAXIMUM TRACTOR HOURS PER MONTH (HP)																
200	200	200	200	200	200	200	200	200	200	200	200	200	200	200		
EXCESS CAPACITY																
TRACTOR #1																
155	200	180	195	200	188	85	30	67	136	200	200	200	200	200		
TRACTOR #2																
95	200	189	193	200	182	161	101	165	119	200	200	200	200	200		
TRACTOR #3																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.																
LABOR																
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL			
OWNER LABOR																
PROVIDED	121	106	123	130	132	138	169	167	117	128	105	118	1,436			
TOTAL HOURS REQUIRED	0.00	35	13	0.00	33	169	296	185	159	0.00	0.00	0.00	890			
HIRED LABOR																
HOURS																
REQUIRED	0.00	0.00	0.00	0.00	0.00	31	127	18	42	0.00	0.00	0.00	218			
COST OF HIRED LABOR																
LABOR	0.00	0.00	0.00	0.00	0.00	156	633	91	210	0.00	0.00	0.00	1,090			
COST RESULTS																
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB	FUEL	T.V.C.	T.O.C./TRACTOR						
TRACTOR #1																
	9,108	7,356	490	1,335	18,289	3,140	463	3,088	6,691				24,980			
TRACTOR #2																
	8,037	6,398	427	1,190	16,052	1,442	259	1,730	3,432				19,484			
TRACTOR #3																
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
TOTAL FIXED COSTS						34,340.64	TOTAL VARIABLE COSTS					10,123.08				
TOTAL OPERATING COST INCLUDING HIRED LABOR							45,554.05	COST PER ACRE					49.73			

Figure 5. Machinery Complement Selection Results.

associated equipment are \$16,052.01. Total variable costs for Tractor #2 excluding hired labor are \$3431.61. Tractor #2's machinery consists of a moldboard plow, tandem disk, planter, cultivator, windrower, baler and two grain drills. The total operating cost including hired labor for this typical farm is \$45,554.05. The total operating cost is \$49.73 per acre.

Sample Farm (A Third Iteration)

The second iteration complement is feasible; but it may be possible to lower the costs by changing the complement. In the second iteration complement, Tractor #2 could be used more hours. Thus it may be possible to lower the complement cost by using a smaller Tractor #1 and shift more of the fieldwork to Tractor #2.

Figure 6 shows the input data changes for this iteration. A 140 horsepower tractor replaces the 155 horsepower tractor and an additional portion of the moldboard plowing (25 percent) is shifted to Tractor #2. This is an acceptable strategy if the hours of tractor use do not exceed user specified limits.

Figure 7 presents the results of the revised data. Annual tractor hours are 546 and 333 for Tractor #1 and Tractor #2, respectively. Neither tractor is used more than 200 hours per month and no additional tractor hours are needed by either Tractor #1 or #2 to complete field operations. Thus, this tractor-farm equipment complement is able to complete field practices in a timely manner. The complement shift from iteration two to iteration three reduces fixed costs from \$34341 to 32634; variable costs excluding hired labor increase from \$10,123 to \$10,182; hired labor charges increase from \$1,090 to \$1,430. The total cost per acre is \$48.30. Reducing the size of Tractor #1 and shifting some

<u>CROP ACTIVITIES</u>		<u>ACRES</u>			<u>TRACTOR SIZES</u> <u>(IN PTO HP)</u>	
WHEAT		820			95	
ALFALFA		0			105	
GRAIN SORGHUM		23			125	
CORN		0			140	
PEANUTS		0			155	
SOYBEANS		0			175	
COTTON		0			200	
SUDAN HA		73				

	# 1	# 2	# 3	<u>COST DATA ENTRY</u>	
TRACTOR HP	140	95		CURRENT FUEL COST	0.80
MACHINE OPERATION	SPECIFIED TRACTOR USAGE			INTEREST RATE	0.090
OFFSET	100%	0%	0%	CURRENT TAX RATE	0.010
CHISEL	100%	0%	0%	INSURANCE RATE	0.006
LAND PLANE	100%	0%	0%	HIRED WAGE RATE	5.00
SWEEP PLOW	100%	0%	0%		
M.B. PLOW	50%	50%	0%		
SWEEP COND.	100%	0%	0%		
CULTIPACKER	100%	0%	0%		
TANDEM DISK	50%	50%	0%		
SPRINGTOOTH	100%	0%	0%		
S.HARROW	100%	0%	0%		
DRILL	0%	100%	0%		
PLANTER	0%	100%	0%		
CULTIVATOR	0%	100%	0%		
ROTARY HOE	0%	100%	0%		
SPRAYER	0%	100%	0%		
S.SHREDDER	100%	0%	0%		
ROT.MOWER	0%	100%	0%		
WINDROWER	0%	100%	0%		
BALER	0%	100%	0%		

OWNER-OPERATOR MONTHLY													
LABOR HOURS AVAILABLE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
	121	106	123	130	132	138	169	167	117	128	105	118	1,436
MAXIMUM TRACTOR HOURS PER TIME PERIOD													
	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 6. Tractor Horsepower Selection.

TOTAL TRACTOR													
HOURS HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1													
140	0.00	15	5	0.00	13	127	167	148	71	0.00	0.00	0.00	546
TRACTOR #2													
95	0.00	22	7	0.00	18	39	130	35	81	0.00	0.00	0.00	333
TRACTOR #3													
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT SUMMARY													
JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
140	200	185	195	200	187	73	33	52	129	200	200	200	200
TRACTOR #2													
95	200	178	193	200	182	161	70	165	119	200	200	200	200
TRACTOR #3													
0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR SUMMARY														
JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR PROVIDED														
121	106	123	130	132	138	169	167	117	128	105	118	1,436		
TOTAL HOURS REQUIRED														
0.00	41	14	0.00	35	183	327	201	167	0.00	0.00	0.00	967		
HIRED LABOR HOURS REQUIRED														
0.00	0.00	0.00	0.00	0.00	45	158	34	50	0.00	0.00	0.00	286		
COST OF HIRED LABOR														
0.00	0.00	0.00	0.00	0.00	224	789	169	248	0.00	0.00	0.00	1,430		
COST RESULTS														
DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1														
8,301	6,639	443	1,199	16,581	3,066	440	2,933	6,439				23,020		
TRACTOR #2														
8,037	6,398	427	1,190	16,052	1,684	266	1,791	3,743				19,795		
TRACTOR #3														
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
TOTAL FIXED COSTS					32,633.50				TOTAL VARIABLE COSTS				10,182.24	
TOTAL OPERATING COST INCLUDING HIRED LABOR						44,245.34				COST PER ACRE				48.30

Figure 7. Machinery Complement Selection Results.

of the fieldwork will result in a savings of \$1.43 per acre. Although \$1.43 per acre seems a small amount, the annual savings for a 916 acre farm are \$1,308.71.

Summary

In this chapter, the statewide machinery complements were introduced. The farm machinery selection model was presented as a complete computer software package that can provide farm managers a tool to aid in machinery selection and management problems. The program flow as a system was also presented and explained. The discussion of input requirements and output interpretation can serve as a user's guide. Input for a sample farm was presented and results reviewed. The machinery complement for the sample farm was revised in sequential steps, demonstrating the process for using the program.

CHAPTER IV

RESULTS

Machinery selection is based on a number of factors including the number of acres farmed, the crops grown, the amount of operator labor and the time available to complete field operations. Oklahoma has a wide variety of climatic conditions, soil types, and cropping systems. This dictates a wide range for feasible machinery complements.

Complements for 24 different typical farm situations are analyzed in this chapter. Each situation is in one of the eight regions of Oklahoma. The analysis looks at different size farms according to regional location.

The Average Farm Enterprise Mix

There has always been considerable difficulty in identifying an average farm for study. Statistical averages hide the enterprise specialization found among individual farms of a given size. Also, representative or typical farm organizations generally change as farm size increases. Measuring economies of scale from farms of varying size may be biased since some of the economies may be derived from changes in enterprise mix. This study selects complements for farms of three sizes in each region. However, broad statements about economies of scale are inappropriate, since an exhaustive set of machine sizes for the small farm were not available.

Regions Of The State

Information concerning crops grown and farm size is obtained from an earlier study, Typical Oklahoma Farms. In this study, Oklahoma was divided into eight regions based on soils, crops grown and crop acreage as reported in the 1982 Agricultural Census (19), and Oklahoma Agricultural Statistics (13) published annually. County data was aggregated into region summaries. From the data, "average" small, medium and large farm sizes were specified for each state area. The allocation was made so that somewhere between 5 and 10 percent of the regional farmland was in small farms. The remaining 90 to 95 percent was divided as equally as possible between medium and large farms.

Farm Descriptions For Each Area

To better comprehend the typical farms concept, region by region descriptions give some insight about the crop practices and the level of diversification in each area. Figure 8 shows the specific state areas which make up each region. Table XIV presents the average number of acres of each crop grown in each region. The average columns are four-year averages of data taken from Oklahoma Agricultural Statistics. The average can be used for comparing highly specialized areas, such as north central Oklahoma, to more diversified farming operations such as northeastern Oklahoma. Since this data is an average of all similar sized operations in the regions, there is a high probability that no such farm of this nature exists.

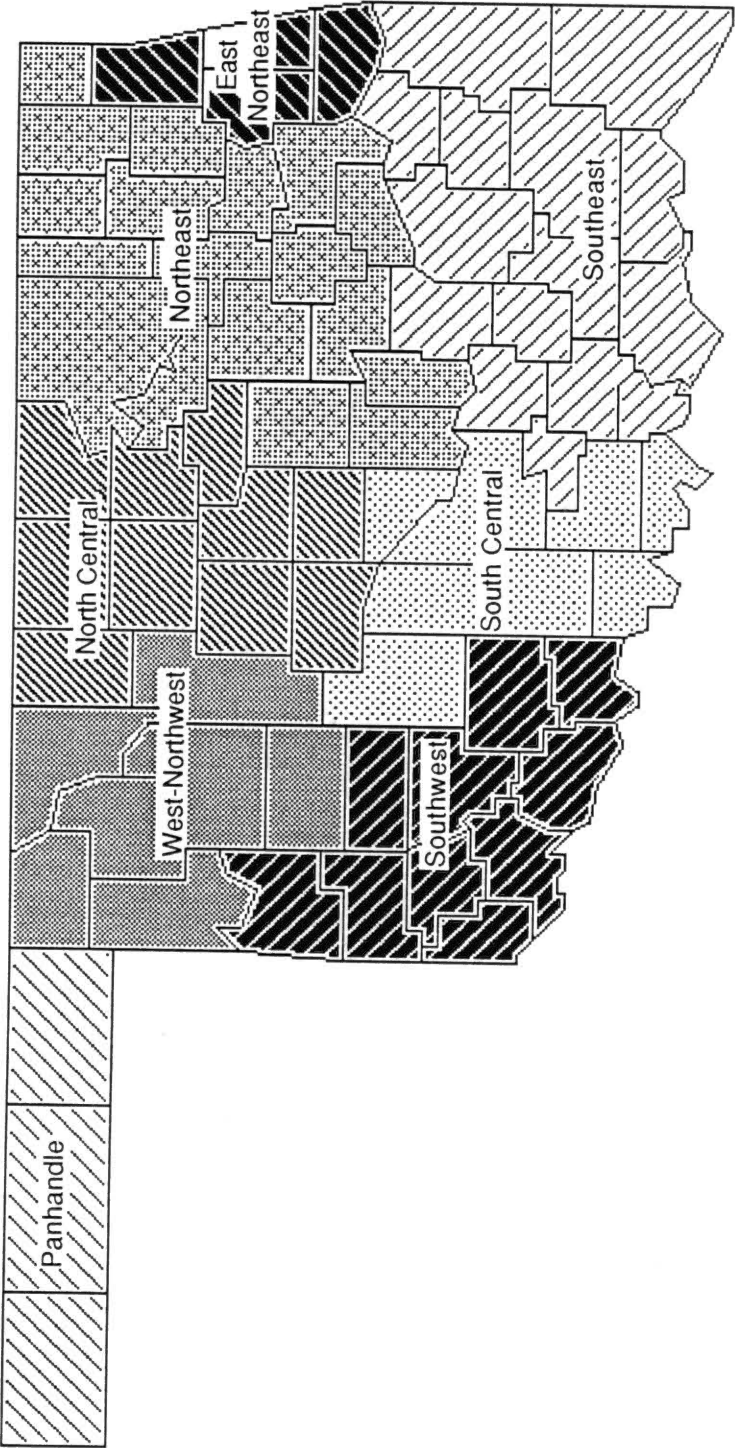


Figure 8. Regions of the State

TABLE XIV
CROP SUMMARY FOR OKLAHOMA TYPICAL FARMS

Crop	Farm Size in Acres					
	Small		Medium		Large	
	Average	Typical	Average	Typical	Average	Typical
WHEAT	97	100	337	346	1545	1585
SORGHUM	28	28	98	98	450	450
ALFALFA	0	0	0	0	0	0
SUDAN HAY	3	3	12	12	53	53
COTTON	0	0	0	0	0	0
PEANUTS	0	0	0	0	0	0
CORN	0	0	0	0	0	0
SOYBEANS	0	0	0	0	0	0
OATS	1	0	3	0	13	0
BARLEY	2	0	6	0	27	0
TOTAL ACREAGE	131	131	456	456	2088	2088

Location: West-Northwest--Region 2						
Crop	Small		Medium		Large	
	Average	Typical	Average	Typical	Average	Typical
WHEAT	62	65	208	219	801	820
SORGHUM	2	0	5	0	19	23
ALFALFA	0	0	2	0	6	0
SUDAN HAY	5	5	17	19	67	73
COTTON	0	0	1	0	4	0
PEANUTS	0	0	0	0	0	0
CORN	0	0	0	0	0	0
SOYBEANS	0	0	0	0	0	0
OATS	1	0	4	0	14	0
BARLEY	0	0	1	0	5	0
TOTAL ACREAGE	70	70	238	238	916	916

TABLE XIV (continued)

Crop	Farm Size in Acres					
	Small		Medium		Large	
	Average	Typical	Average	Typical	Average	Typical
WHEAT	61	62	224	230	827	848
SORGHUM	2	3	7	8	28	28
ALFALFA	2	2	8	8	31	31
SUDAN HAY	5	5	18	18	66	66
COTTON	11	10	39	38	141.7	142
PEANUTS	0	0	0	0	0.4	0
CORN	0	0	0	0	0.1	0
SOYBEANS	0	0	0	0	0	0
OATS	1	0	5	0	17.2	0
BARLEY	0	0	1	0	3.5	0
TOTAL ACREAGE	82	82	302	302	1114.9	1115

Location: North Central--Region 4

WHEAT	71	73	280	286	964	984
SORGHUM	1	2	6	6	20	24
ALFALFA	3	2	11	11	34	34
SUDAN HAY	5	5	20	20	69	69
COTTON	0	0	0	0	1.2	0
PEANUTS	0	0	0	0	0.1	0
CORN	0	0	0	0	1.4	0
SOYBEANS	0	0	0	0	1.2	0
OATS	1	0	3	0	10.5	0
BARLEY	1	0	3	0	9.6	0
TOTAL ACREAGE	82	82	323	323	1,111	1,111

TABLE XIV (continued)

Location: South Central--Region 5

Crop	Farm Size in Acres					
	Small		Medium		Large	
	Average	Typical	Average	Typical	Average	Typical
WHEAT	10	12	90	95	376	398
SORGHUM	0	0	3	3	12	12
ALFALFA	2	2	14	14	59	59
SUDAN HAY	4	4	34	34	143	143
COTTON	1	0	5	5	18.3	18
PEANUTS	0	0	1	1	4.6	6
CORN	0	0	0	0	0	0
SOYBEANS	0	0	1	1	6.3	6
OATS	1	0	5	0	21.4	0
BARLEY	0	0	0	0	1.4	0
TOTAL ACREAGE	18	18	153	153	642	642

Location: Northeast--Region 6

WHEAT	7	8	27	29	199	217
SORGHUM	4	4	14	14	104	104
ALFALFA	1	2	5	5	33	33
SUDAN HAY	10	9	36	36	256	256
COTTON	0	0	0	0	0.1	0
PEANUTS	0	0	0	0	2.9	3
CORN	0	0	0	0	0	0
SOYBEANS	3	3	11	11	84.4	85
OATS	1	0	2	0	17.3	0
BARLEY	0	0	0	0	1.3	0
TOTAL ACREAGE	26	26	95	95	698	698

TABLE XIV (continued)

Location: East--Region 7						
Crop	Farm Size in Acres					
	Small		Medium		Large	
	Average	Typical	Average	Typical	Average	Typical
WHEAT	4	4	7	8	34	37
SORGHUM	0	0	1	1	7	7
ALFALFA	0	0	1	1	7	7
SUDAN HAY	12	12	37	37	185	185
COTTON	0	0	0	0	0	0
PEANUTS	0	0	0	0	0	0
CORN	0	0	0	0	1.9	0
SOYBEANS	2	2	6	6	28.4	30
OATS	0	0	1	0	2.7	0
BARLEY	0	0	0	0	0	0
TOTAL ACREAGE	18	18	53	53	266	266

Location: Southeast--Region 8						
WHEAT	4	4	12	13	88	97
SORGHUM	0	0	1	1	10	10
ALFALFA	1	1	3	3	18	18
SUDAN HAY	10	10	32	32	234	234
COTTON	0	0	0	0	1	0
PEANUTS	0	0	2	2	11	12
CORN	0	0	1	1	5.9	6
SOYBEANS	2	2	5	5	38.3	38
OATS	0	0	1	0	8.7	0
BARLEY	0	0	0	0	0.1	0
TOTAL ACREAGE	17	17	57	57	415	415

Typical farms are modifications of average situations to develop realistic farm organizations. This is accomplished by grouping many of the smaller crop acreages with similar, larger acreage crops to form logical or typical farms for this study. In Table XIV, the average column represents mean crop acreages for the three respective farms while the typical column presents the adjusted crop acreage used in this study.

Generation Of The Models

The machinery selection program was used to identify feasible solutions for the three farms in each region. All model runs are presented in Appendix A.

Results From Model Runs

The types of machinery needed to complete regional field operations vary according to crops grown in each area. Table XV presents the tractor size and related farm equipment for each typical farm. Region by region analysis shows the need for only one tractor on all small and medium size farms. However, as many as three tractors are needed for some large farms. It is important to emphasize this program deals strictly with crop production. The model does not take into consideration tractor use for livestock and other common farmstead practices. If livestock is a major activity on the farm some of the fixed costs associated with tractor ownership can be allocated to livestock operations. This would reduce the fixed costs allocated to land and lower machinery costs per acre. It is assumed that all costs are allocated to the crop activities.

TABLE XV
MACHINERY COMPLEMENTS FOR TYPICAL
FARM REGIONS

Region: Panhandle	Farm Size				
	Small 95	Medium 95	155	Large 155	125
<u>EQUIPMENT</u>					
OFFSET	x	x	x	x	
CHISEL	x	x	x	x	
LANDPLANE					
SWEEP PLOW	x	x	x	x	
MOLDBOARD PLOW	x	x	x	x	x
SWEEP CONDITIONER	x	x	x	x	
CULTIPACKER					
TANDEM DISK	x	x	x	x	x
SPRINGTOOTH	x	x	x	x	
SPIKE HARROW					
GRAIN DRILL	x	x			x
ROW PLANTER	x	x			x
ROW CULTIVATOR	x	x			x
ROTARY HOE					
SPRAYER					
STALK SHREDDER					
ROTARY MOWER					
WINDROWER	x	x			x
BALER	x	x			x

TABLE XV (Continued)

Region: West-Northwest				
Tractor Size (HP)	Farm Size			
	Small 95	Medium 95	Large 140	95
EQUIPMENT				
OFFSET	x	x	x	
CHISEL	x	x	x	
LAND PLANE				
SWEEP PLOW	x	x	x	
MOLDBOARD PLOW	x	x	x	x
SWEEP CONDITIONER	x	x	x	
CULTIPACKER				
TANDEM DISK	x	x	x	x
SPRINGTOOTH	x	x	x	
SPIKE HARROW				
GRAIN DRILL	x	x	x	
ROW PLANTER				x
ROW CULTIVATOR				x
ROTARY HOE				
SPRAYER				
STALK SHREDDER				
ROTARY MOWER				
WINDROWER	x	x		x
BALER	x	x		x

TABLE XV (Continued)

Region: Southwest				
Tractor Size (HP)	Farm Size			
	Small 95	Medium 95	Large 125	95
EQUIPMENT				
OFFSET	x	x	x	
CHISEL	x	x	x	
LAND PLANE	x	x	x	
SWEEP PLOW	x	x	x	
MOLDBOARD PLOW	x	x	x	x
SWEEP CONDITIONER	x	x	x	
CULTIPACKER	x	x	x	
TANDEM DISK	x	x	x	x
SPRINGTOOTH	x	x	x	
SPIKE HARROW	x	x	x	
GRAIN DRILL	x	x		x
ROW PLANTER	x	x		x
ROW CULTIVATOR	x	x		x
ROTARY HOE				
SPRAYER	x	x		x
STALK SHREDDER				
ROTARY MOWER				
WINDROWER	x	x		x
BALER	x	x		x

TABLE XV (Continued)

Region: North Central				
Tractor Size (HP)	Farm Size			
	Small 95	Medium 95	140	Large 105
<u>EQUIPMENT</u>				
OFFSET	x	x	x	
CHISEL	x	x	x	x
LAND PLANE	x	x	x	
SWEEP PLOW	x	x	x	
MOLDBOARD PLOW	x	x	x	x
SWEEP CONDITIONER	x	x	x	
CULTIPACKER	x	x	x	
TANDEM DISK	x	x	x	x
SPRINGTOOTH	x	x	x	
SPIKE HARROW	x	x		
GRAIN DRILL	x	x		x
ROW PLANTER	x	x		x
ROW CULTIVATOR	x	x		x
ROTARY HOE				
SPRAYER				
STALK SHREDDER				
ROTARY MOWER				
WINDROWER	x	x		x
BALER	x	x		x

TABLE XV (Continued)

Region: South Central			
Tractor Size (HP)	Farm Size		
	Small 95	Medium 95	Large 125
<u>EQUIPMENT</u>			
OFFSET	x	x	x
CHISEL	x	x	x
LAND PLANE	x	x	x
SWEEP PLOW	x	x	x
MOLDBOARD PLOW	x	x	x
SWEEP CONDITIONER	x	x	x
CULTIPACKER	x	x	x
TANDEM DISK	x	x	x
SPRINGTOOTH	x	x	x
SPIKE HARROW	x	x	x
GRAIN DRILL	x	x	x
ROW PLANTER		x	x
ROW CULTIVATOR		x	x
ROTARY HOE		x	x
SPRAYER		x	x
STALK SHREDDER			
ROTARY MOWER			
WINDROWER	x	x	x
BALER	x	x	x

TABLE XV (Continued)

Region: Northeast				
Tractor Size (HP)	Farm Size			
	Small 95	Medium 95	Large 95	95
EQUIPMENT				
OFFSET	x	x	x	
CHISEL	x	x		x
LAND PLANE	x	x	x	
SWEEP PLOW	x	x	x	
MOLDBOARD PLOW	x	x	x	x
SWEEP CONDITIONER	x	x	x	
CULTIPACKER	x	x	x	
TANDEM DISK	x	x	x	x
SPRINGTOOTH	x	x	x	
SPIKE HARROW	x	x	x	
GRAIN DRILL	x	x		x
ROW PLANTER	x	x		x
ROW CULTIVATOR	x	x		x
ROTARY HOE			x	
SPRAYER				
STALK SHREDDER				
ROTARY MOWER				
WINDROWER	x	x		x
BALER	x	x	x	

TABLE XV (Continued)

Region: East			
Tractor Size (HP)	Farm Size		
	Small 95	Medium 95	Large 95
<u>EQUIPMENT</u>			
OFFSET	x	x	x
CHISEL	x	x	x
LANDPLANE	x	x	x
SWEEP PLOW	x	x	x
MOLDBOARD PLOW	x	x	x
SWEEP CONDITIONER	x	x	x
CULTIPACKER		x	x
TANDEM DISK	x	x	x
SPRINGTOOTH	x	x	x
SPIKE HARROW		x	x
GRAIN DRILL	x	x	x
ROW PLANTER	x	x	x
ROW CULTIVATOR	x	x	x
ROTARY HOE			
SPRAYER			
STALK SHREDDER			
ROTARY MOWER			
WINDROWER	x	x	x
BALER	x	x	x

TABLE XV (Continued)

Region: Southeast			
Tractor Size (HP)	Farm Size		
	Small 95	Medium 95	Large 95
<u>EQUIPMENT</u>			
OFFSET	x	x	x
CHISEL	x	x	x
LAND PLANE	x	x	x
SWEEP PLOW	x	x	x
MOLDBOARD PLOW	x	x	x
SWEEP CONDITIONER	x	x	x
CULTIPACKER	x	x	x
TANDEM DISK	x	x	x
SPRINGTOOTH	x	x	x
SPIKE HARROW	x	x	x
GRAIN DRILL	x	x	x
ROW PLANTER	x	x	x
ROW CULTIVATOR	x	x	x
ROTARY HOE			
SPRAYER			
STALK SHREDDER		x	x
ROTARY MOWER			
WINDROWER	x	x	x
BALER	x	x	x

Economies Of Scale In Farm Machinery Use

Economies of scale in farm machinery use result from several sources. Preeminent, are economies related to spreading the relatively high fixed costs over a greater number of acres. Maintaining satisfactory timeliness may limit economies of scale at some point. Another source of scale economies is the labor-saving and consequently cost-saving aspect of operating larger, higher capacity equipment. And finally, there are possible economies of size in purchasing farm machinery per unit of capacity. The cost per horsepower for large tractors is generally less than for small tractors. The existence of economies of scale can definitely be demonstrated by comparing the small, medium, and large typical farms in this study. Table XVI presents a comparison of the fixed and variable costs for each size farm in each region. As farm sizes increase from small to large in each respective region, fixed costs per acre

TABLE XVI
OKLAHOMA TYPICAL FARMS FIXED AND
VARIABLE COST COMPARISONS

Region	TYPICAL FARM SIZE PER ACRE COSTS					
	SMALL		MEDIUM		LARGE	
	Fixed	Variable	Fixed	Variable	Fixed	Variable
1	152.07	7.69	43.69	10.63	26.32	13.61
2	250.38	6.95	73.64	8.82	35.62	12.68
3	274.82	8.09	74.62	10.67	30.74	16.38
4	267.50	7.36	67.91	9.95	32.60	14.40
5	1085.58	8.22	150.43	11.29	43.23	17.47
6	843.66	9.25	230.90	11.19	42.45	18.56
7	1106.74	10.14	413.87	12.46	82.46	18.85
8	1290.30	10.20	406.22	11.97	55.79	20.75

decrease and variable costs per acre increase. Increases in per acre variable costs can be explained by the growing need for hired labor as farm size increases. These results are exaggerated because a 95 horsepower tractor is the smallest permitted. If smaller tractors were incorporated into the machinery complements the fixed cost per hour would decline relative to the medium and large farms, but the economies of scale would still be obvious. Table XVII presents the farm size, tractors used, excess tractor capacity, and per acre total operating costs associated with the large farms in each region. If farm managers are considering expansion, tractor excess capacity is a crucial factor. If additional land were added to an existing farm, the manager must determine if existing machinery has the needed capacity. Tractor excess capacity is the smallest remaining hour number in any critical time period. The only farm with "too much" excess capacity is the Northeast farm where 112 hours is available in the "most restrictive" time period. This could imply that the machinery complement could handle considerably more than 698 acres and not be over used. All of the other complements have limited excess capacity. If the farm size were increased, a larger machinery complement could be needed.

Implications Of Diversification And Specialization

This section discusses the differences between a diversified farm in southwest Oklahoma and a specialized farm in north central Oklahoma. Although the farm sizes are comparable and each farm has two tractors, the diversified farm uses a 95 and 125 horsepower tractor and the specialized farm uses a 105 and 140 horsepower tractor. This indicates that farm organization has a substantial effect on the machinery complements. Diversified farms can

TABLE XVII
 COMPARING SELECTED TRACTORS FOR
 LARGE TYPICAL FARMS

Region	Tractor (HP)	Tractor Hour Use	Tractor Excess Capacity (Hours)	Total Cost Per Acre
Panhandle 2088 Acres	95	555	38	39.93
	155	582	25	
	155	606	9	
West-Northwest 916 Acres	95	333	45	48.30
	140	546	8	
Southwest 1115 Acres	95	537	17	47.12
	125	752	5	
North Central 1111 Acres	105	463	15	47.00
	140	623	19	
South Central 642 Acres	125	797	15	60.70
Northeast 698 Acres	95	467	112	61.02
	95	608	44	
East 266 Acres	95	464	93	101.32
Southeast 415 Acres	95	701	46	76.54

often get by with smaller machinery used in many time periods whereas specialized farms need larger machinery to get all work done in a relatively few periods. Note that the costs per acre for these two complements are both about the same \$47.00 and \$47.12 per acre, even though the complements are quite different. The specialized farm has larger tractors but relatively few implements. The diversified farm has smaller tractors but, requires more implements. In this case the costs per acre are about the same.

Chapter Summary

An attempt was made in this chapter to estimate the costs for typical farms in all regions of Oklahoma. With the aid of typical farm examples, the program user can better comprehend the factors which are important in constructing a machinery complement. Perhaps the most important fact demonstrated in this chapter is that machinery costs vary widely. It is not appropriate to build enterprise budgets which do not take into account farm size or crop mix for the farm being examined.

CHAPTER V

SUMMARY AND CONCLUSIONS OF THE STUDY

Summary

The management conditions faced by farmers today are distinguished by uncertainty and change. A farmer can not regulate the price of inputs which are purchased or the weather which may govern his daily decisions. However, when choosing and operating farm machinery, he has wide range of choices permitting the substitution of capital for labor, and thereby controlling, in some respects, his vulnerability to unfavorable weather.

The primary objective of this study was to find and apply an appropriate analytical solution procedure and to incorporate that procedure into a convenient computerized system for determining feasible machinery complements using a micro computer. The objective was accomplished using Lotus 1-2-3. This spreadsheet template can be used to input, retrieve, modify, and store relevant machinery cost and performance information. With this program, a user can easily select a machinery complement within the constraints of the subject farm's unique management characteristics, determine if the machinery and labor combination can complete timely field operations, and compute the machinery cost associated with production activities.

This program does not select an optimal solution. It simply serves as a planning tool to aid producers in selecting farm equipment. The model can be

used in an iterative fashion to select lower cost complements. However, the lowest cost complement possible cannot be assured. Using the model's feasibility and cost estimating capability, this model can help production managers, Extension personnel, and others extend their knowledge of farm machinery complements and their costs.

Suggestions For Further Research

This machinery selection model is a practical, understandable and easy to use decision aid for assisting agricultural producers in their machinery selection decisions. Further research is needed for expanding the model. For example, the data in the current model does not allow for tractor sizes smaller than 95 horsepower. This proved to be a critical factor in machinery for small, conventional farming operations where the need for larger tractors and related equipment does not exist. Second, the budgets containing field operations used in this study were selected from a distribution of crop activities for one area of Oklahoma. For example, many field operations conducted in northwest Oklahoma are not performed elsewhere (e.g. using diversified primary tillage such as moldboard plowing, sweep plowing, and chisel plowing all in the same year), but the wheat budget for northwest Oklahoma was used for the whole state. It would improve the model if the field operations were regionalized. Third, adding machinery information for additional crops would make the model more useful to farmers with a wider range of crop enterprises. Finally, if livestock operations were included in the model, costs associated with tractor ownership could be more appropriately allocated.

A study of the impacts of changes in interest rates, wage rates, and labor availability could be undertaken. For a selected farm or farms, the "best"

complement associated with alternative interest rates, wage rates, and labor hours could be determined. These results may prove helpful for estimating expected future machinery costs. A similar study would examine changes in timeliness requirements. This would really be a study of the costs of requiring field work to be completed in fewer hours each month. Such a study could be combined with a study of the costs of not getting field work done in a timely fashion.

If the model is adopted as a useful piece of software, it could be made easier to use by installing additional macros for data entry and locating desired output. also, more machinery complements with more alternative machines would be desirable to permit farmers with special demands to use the model.

Conclusion Of The Study

Commercial farms are larger and more highly capitalized than ever. Operating margins will continue to decline, while the cost of hired, skilled labor will continue to escalate. Agricultural producers need good tools to make crucial, effective management decisions. Innovative production decisions are needed to enhance net farm returns. This machinery selection model allows producers to examine alternative sets of farm machinery with a minimum of time effort and then choose a complement that is most efficient for their operation.

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APPENDIX

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	1,585
ALFALFA	0
GRAIN SORGHUM	450
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	53

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	155	155	125

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE SPECIFIED
OPERATION TRACTOR USAGE

OFFSET	50%	50%	0%
CHISEL	50%	50%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	50%	50%	0%
M.B. PLOW	40%	40%	20%
SWEEP COND.	50%	50%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	40%	30%	30%
SPRINGTOOTH	50%	50%	0%
S.HARROW	0%	100%	0%
DRILL	0%	0%	100%
PLANTER	0%	0%	100%
CULTIVATOR	0%	0%	100%
ROTARY HOE	0%	0%	100%
SPRAYER	0%	0%	100%
S.SHREADER	100%	0%	0%
ROT.MOWER	0%	0%	100%
WINDROWER	0%	0%	100%
BALER	0%	0%	100%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS													
AVAILABLE	143	123	109	151	162	15	167	167	133	159	120	133	1,592
MAXIMUM TRACTOR HOURS													
PER TIME													
PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 9. Machinery Complement Selection Results for Large Panhandle.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	155	0.00	57	19	0.00	39	111	191	129	62	0.00	0.00	0.00	607
TRACTOR #2														
	155	0.00	57	14	0.00	34	111	175	129	62	0.00	0.00	0.00	582
TRACTOR #3														
	125	0.00	29	18	0.00	95	102	162	25	125	0.00	0.00	0.00	555
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.														
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.														
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.														
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.														
TRACTOR HOUR REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
155	200	143	181	200	161	89	9	71	138	200	200	200	200	200
TRACTOR #2														
155	200	143	186	200	166	89	25	71	138	200	200	200	200	200
TRACTOR #3														
125	200	171	182	200	105	98	38	175	75	200	200	200	200	200
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.														
LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	143	123	109	151	162	158	167	167	133	159	120	133	1,592	
TOTAL HOURS														
REQUIRED	0.00	157	57	0.00	184	356	581	311	273	0.00	0.00	0.00	1,919	
HIRED LABOR														
HOURS														
REQUIRED	0.00	34	0.00	0.00	22	198	414	144	140	0.00	0.00	0.00	952	
COST OF HIRED LABOR														
LABOR	0.00	170	0.00	0.00	110	990	2,069	722	700	0.00	0.00	0.00	4,760	
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	9,108	7,356	490	1,335	18,289	4,108	542	3,613	8,263				26,552	
TRACTOR #2	9,108	7,356	490	1,335	18,289	3,834	520	3,466	7,819				26,108	
TRACTOR #3	9,196	7,335	489	1,357	18,377	3,769	495	3,303	7,567				25,945	
TOTAL FIXED COSTS 54,954.70														
TOTAL VARIABLE COSTS 23,649.61														
TOTAL OPERATING COST INCLUDING HIRED LABOR 83,364.61														
COST PER ACRE 39.93														

Figure 9. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	820
ALFALFA	0
GRAIN SORGHUM	23
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	73

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	140	95	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE SPECIFIED
OPERATION TRACTOR USAGE

MACHINE OPERATION	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	50%	50%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	50%	50%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	0%	100%	0%
PLANTER	0%	100%	0%
CULTIVATOR	0%	100%	0%
ROTARY HOE	0%	100%	0%
SPRAYER	0%	100%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	0%	100%	0%
WINDROWER	0%	100%	0%
BALER	0%	100%	0%

OWNER-OPERATOR

MONTHLY

LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
-------	-----	-----	-----	-----	-----	------	------	-----	------	-----	-----	-----	-------

HOURS

AVAILABLE	121	106	123	130	132	138	169	167	117	128	105	118	1,436
-----------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Figure 10. Machinery Complement Selection Results for Large Northwest.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	140	0.00	15	5	0.00	133	127	167	148	71	0.00	0.00	0.00	546
TRACTOR #2														
	95	0.00	22	7	0.00	18	39	130	35	81	0.00	0.00	0.00	333
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.

CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.

TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.

IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
	140	200	185	195	200	187	73	33	52	129	200	200	200	200
TRACTOR #2														
	95	200	178	193	200	182	161	70	165	119	200	200	200	200
TRACTOR #3														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	121	106	123	130	132	138	169	167	117	128	105	118	1,436		
TOTAL HOURS															
REQUIRED	0.00	41	14	0.00	35	183	327	201	167	0.00	0.00	0.00	967		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	45	158	34	50	0.00	0.00	0.00	286		
COST OF HIRED LABOR															
	0.00	0.00	0.00	0.00	0.00	224	789	169	248	0.00	0.00	0.00	1,430		
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	8,301	6,639	443	1,199	16,581	3,066	440	2,933	6,439				23,020		
TRACTOR #2	8,037	6,398	427	1,190	16,052	1,684	269	1,791	3,743				19,795		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TOTAL FIXED COSTS							32,633.50	TOTAL VARIABLE COSTS				10,182.24			
TOTAL OPERATING COST INCLUDING HIRED LABOR							44,245.34	COST PER ACRE				48.30			

Figure 10. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	848
ALFALFA	31
GRAIN SORGHUM	28
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	142
SUDAN HAY	66

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	125	95	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	50%	50%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	50%	50%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	0%	100%	0%
PLANTER	0%	100%	0%
CULTIVATOR	0%	100%	0%
ROTARY HOE	0%	100%	0%
SPRAYER	0%	100%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	0%	100%	0%
WINDROWER	0%	100%	0%
BALER	0%	100%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
---------------	-----	-----	-----	-----	-----	------	------	-----	------	-----	-----	-----	-------

HOURS AVAILABLE	100	89	137	110	101	119	171	167	102	96	90	104	1,282
-----------------	-----	----	-----	-----	-----	-----	-----	-----	-----	----	----	-----	-------

MAXIMUM TRACTOR HOURS

PERIOD	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
PER TIME	200	200	200	200	200	200	200	200	200	200	200	200

Figure 11. Machinery Complement Selection Results for Large Southwest.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	125	25	17	6	0.00	78	149	195	174	84	0.00	0.00	25	752
TRACTOR #2														
	95	0.00	22	72	0.00	70	75	183	47	99	0.00	0.00	33	537
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.
 CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.
 TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.
 IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT													
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
	125	175	183	194	200	122	51	5	25	116	200	200	175
TRACTOR #2													
	95	200	178	193	200	130	125	17	153	101	200	200	167
TRACTOR #3													
	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	100	89	137	110	101	119	171	167	102	96	90	104	1,282	
TOTAL HOURS														
REQUIRED	27	42	14	0.00	163	246	417	416	244	201	0.00	64	1,418	
HIRED LABOR														
HOURS														
REQUIRED	0.00	0.00	0.00	0.00	62	127	246	77	99	0.00	0.00	0.00	611	
COST OF HIRED														
LABOR	0.00	0.00	0.00	0.00	310	637	1,228	384	497	0.00	0.00	0.00	3,056	
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C	T.O.C./TRACTOR				
TRACTOR #1	8,974	6,914	461	1,276	17,625	4,951	542	3,612	9,104				26,729	
TRACTOR #2	8,301	6,662	444	1,246	16,652	3,138	387	2,577	6,101				22,753	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS							34,277.59	TOTAL VARIABLE COSTS				15,204.80		
TOTAL OPERATING COST INCLUDING HIRED LABOR							52,538.25	COST PER ACRE				47.12		

Figure 11. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	984
ALFALFA	34
GRAIN SORGHUM	24
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	69

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	140	105	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	50%	50%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	50%	50%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	50%	50%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	0%	100%	0%
PLANTER	0%	100%	0%
CULTIVATOR	0%	100%	0%
ROTARY HOE	0%	100%	0%
SPRAYER	0%	100%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	0%	100%	0%
WINDROWER	0%	100%	0%
BALER	0%	100%	0%

OWNER-OPERATOR

MONTHLY LABOR HOURS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
AVAILABLE	100	99	142	103	101	126	153	185	117	119	94	98	1,339

MAXIMUM TRACTOR

HOURS PER TIME PERIOD	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
	200	200	200	200	200	200	200	200	200	200	200	200

Figure 12. Machinery Complement Selection Results for Large North Central.

TOTAL													
TRACTOR													
HOURS HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1													
140	0.00	15	5	0.00	13	153	169	181	87	0.00	0.00	0.00	623
TRACTOR #2													
105	0.00	19	7	0.00	34	54	185	49	114	0.00	0.00	0.00	463
TRACTOR #3													
0	0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		0.00											

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT													
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
200	20	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
140	200	185	195	200	187	47	31	19	113	200	200	200	200
TRACTOR #2													
105	200	181	193	200	166	146	15	151	86	200	200	200	200
TRACTOR #3													
0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	100	99	142	103	101	126	153	185	117	119	94	98	1,339	
TOTAL HOURS														
REQUIRED	0.00	37	13	0.00	51	228	390	254	221	0.00	0.00	0.00	1,194	
HIRED LABOR														
HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	102	237	69	104	0.00	0.00	0.00	512	
COST OF HIRED LABOR														
LABOR	0.00	0.00	0.00	0.00	0.00	512	1,185	3445	20	0.00	0.00	0.00	2,562	
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	9,488	7,721	515	1,423	19,146	3,914	503	3,351	7,767				2,6913	
TRACTOR #2	8,570	6,788	453	1,261	17,071	2,815	373	2,487	5,675				22,746	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS						36,217.40	TOTAL VARIABLE COSTS				13,442.10			
TOTAL OPERATING COST INCLUDING HIRED LABOR							52,221.11	COST PER ACRE				47.00		

Figure 12. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES ACRES

WHEAT	398
ALFALFA	59
GRAIN SORGHUM	12
CORN	0
PEANUTS	6
SOYBEANS	6
COTTON	18
SUDAN HAY	143

TRACTOR SIZES

(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	125	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE	95	84	127	97	98	115	164	171	103	106	86	91	1,246
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MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 13. Machinery Complement Selection Results for Large South Central.

TOTAL																
TRACTOR																
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
TRACTOR #1																
	125	3	55	18	4	94	176	153	185	103	0.00	0.00	6	797		
TRACTOR #2																
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
TRACTOR #3																
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW																
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.																
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.																
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.																
TRACTOR HOUR REQUIREMENT																
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC				
MAXIMUM TRACTOR HOURS PER MONTH (HP)																
	200	200	200	200	200	200	200	200	200	200	200	200	200	200		
EXCESS CAPACITY																
TRACTOR #1																
	125	197	145	182	196	106	24	47	15	97	200	200	194			
TRACTOR #2																
	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
TRACTOR #3																
	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.																
LABOR																
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL			
OWNER LABOR																
PROVIDED	95	84	127	97	98	115	164	171	103	106	86	91	1,246			
TOTAL HOURS																
REQUIRED	3	60	20	5	104	193	168	204	114	0.00	0.00	7	877			
HIRED LABOR																
HOURS																
REQUIRED	0.00	0.00	0.00	0.00	6	78	4	33	11	0.00	0.00	0.00	131			
COST OF HIRED LABOR																
LABOR	0.00	0.00	0.00	0.00	28	392	19	163	53	0.00	0.00	0.00	655			
COST RESULTS																
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.FUEL	T.V.C.	T.O.C./TRACTOR							
TRACTOR #1	14,123	10,848	3,723	2,062	27,756	6,163	3,825	574	10,561						38,317	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00	
TOTAL FIXED COSTS							27,756.40	TOTAL VARIABLE COSTS				10,561.05				
TOTAL OPERATING COST INCLUDING HIRED LABOR							38,972.07	COST PER ACRE				60.70				

Figure 13. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	217
ALFALFA	33
GRAIN SORGHUM	104
CORN	0
PEANUTS	3
SOYBEANS	85
COTTON	0
SUDAN HAY	256

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	95	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	0%	100%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	50%	50%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	50%	50%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	0%	100%	0%
PLANTER	0%	100%	0%
CULTIVATOR	0%	100%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	0%	100%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE	93	85	112	91	97	113	162	173	103	110	84	83	1,223
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MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 14. Machinery Complement Selection Results for Large Northeast.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
95	0.00	83	28	0.69	109	143	47	156	41	0.00	0.00	0.00	0.00	608
TRACTOR #2														
95	0.00	83	28	26	90	79	88	46	27	0.00	0.00	0.00	0.00	0.00467
TRACTOR #3														
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILIABLE) IS RELAYED IN THE RESULTS ROW.

CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.

TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.

IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT													
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
95	200	117	172	199	91	57	153	44	159	200	200	200	200
TRACTOR #2													
95	200	117	172	174	110	121	112	154	173	200	200	200	200
TRACTOR #3													
0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	93	85	112	91	97	113	162	173	103	110	84	83	1,223		
TOTAL HOURS															
REQUIRED	0.00	183	62	29	219	244	148	222	75	0.00	0.00	0.00	1,183		
HIRED LABOR HOURS															
REQUIRED	0.00	98	0.00	0.00	122	131	0.00	49	0.00	0.00	0.00	0.00	401		
COST OF HIRED LABOR															
LABOR	0.00	491	0.00	0.00	609	657	0.00	247	0.00	0.00	0.00	0.00	2,004		
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	7,337	6,117	408	1,140	15,002	4,045	333	2,219	6,597				21,599		
TRACTOR #2	7,482	5,725	382	1,042	14,631	2,398	255	1,703	4,356				18,987		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
TOTAL FIXED COSTS							29,632.79	TOTAL VARIABLE COSTS				10,952.87			
TOTAL OPERATING COST INCLUDING HIRED LABOR							42589.62	COST PER ACRE				61.02			

Figure 14. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	37
ALFALFA	7
GRAIN SORGHUM	7
CORN	0
PEANUTS	0
SOYBEANS	30
COTTON	0
SUDAN HAY	185

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE SPECIFIED OPERATION TRACTOR USAGE

MACHINE OPERATION	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE	84	65	102	77	92	101	169	162	89	102	75	71	1,118
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MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 15. Machinery Complement Selection Results for Large East.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	0.00	89	30	9	90	107	24	103	13	0.00	0.00	0.00	464
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.

CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.

TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.

IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT													
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
	95	200	111	170	191	110	93	176	97	187	200	200	200
TRACTOR #2													
	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3													
	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	84	65	102	77	92	101	169	162	89	102	75	71	1,118	
TOTAL HOURS														
REQUIRED	0.00	98	33	10	99	118	26	114	14	0.00	0.00	0.00	511	
HIRED LABOR														
HOURS														
REQUIRED	0.00	33	0.00	0.00	7	17	0.00	0.00	0.00	0.00	0.00	0.00	57	
COST OF HIRED LABOR														
LABOR	0.00	164	0.00	0.00	35	84	0.00	0.00	0.00	0.00	0.00	0.00	283	
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	11,126	8,616	574	1,619	21,935	2,785	254	1,693	4,732	26,667				
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
TOTAL FIXED COSTS							21,935.10	TOTAL VARIABLE COSTS			4,731.76			
TOTAL OPERATING COST INCLUDING HIRED LABOR							26,950.16	COST PER ACRE			101.32			

Figure 15. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	97
ALFALFA	18
GRAIN SORGHUM	10
CORN	6
PEANUTS	12
SOYBEANS	38
COTTON	0
SUDAN HAY	234

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	84	65	102	77	92	101	169	162	89	102	75	71	1,118

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 16. Machinery Complement Selection Results for Large Southeast.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
	95	0.00	117	41	19	129	154	58	150	33	0.00	0.00	0.00	701	
TRACTOR #2															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR HOURS PER MONTH (HP)															
	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
	95	200	83	159	181	71	46	142	50	167	200	200	200	200	
TRACTOR #2															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	84	65	102	77	92	101	169	162	89	102	75	71	1,118		
TOTAL HOURS															
REQUIRED	0.00	129	45	21	142	170	63	165	36	0.00	0.00	0.00	771		
HIRED LABOR															
HOURS															
REQUIRED	0.00	64	0.00	0.00	50	69	0.00	3	0.00	0.00	0.00	0.00	185		
COST OF HIRED LABOR															
LABOR	0.00	318	0.00	0.00	251	343	0.00	15	0.00	0.00	0.00	0.00	927		
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,663	9,150	610	1,732	23,154	4,745	383	2,256	7,684				30,838		
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TOTAL FIXED COSTS							23,154.27	TOTAL VARIABLE COSTS				7,683.89			
TOTAL OPERATING COST INCLUDING HIRED LABOR							31,765.41	COST PER ACRE				76.54			

Figure 16. (Continued).

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	346
ALFALFA	0
GRAIN SORGHUM	98
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	12

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	143	123	109	151	162	158	167	167	133	159	120	133	1,592

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 17. Machinery Complement Selection Results for Medium Panhandle.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	0.00	51	17	0.00	48	101	174	98	78	0.00	0.00	0.00	567
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT. TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER. IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.														
TRACTOR HOUR REQUIREMEN														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
95	200	149	183	200	152	99	26	102	122	200	200	200	200	200
TRACTOR #2														
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3														
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.														
LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	143	123	109	151	162	158	167	167	133	159	120	133	1,592	
TOTAL HOURS														
REQUIRED	0.00	56	19	0.00	53	112	191	107	86	0.00	0.00	0.00	623	
HIRED LABOR														
HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	24	0.00	0.00	0.00	0.00	0.00	24	
COST OF HIRED LABOR														
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	120	0.00	0.00	0.00	0.00	0.00	120	
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	10,047	7,873	525	1,476	19,921	2,350	310	2,067	4,727				24,648	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS										19,921.39	TOTAL VARIABLE COSTS		4,726.96	
TOTAL OPERATING COST INCLUDING HIRED LABOR										24,768.27	COST PER ACRE		54.32	

Figure 17. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES ACRES

WHEAT	219
ALFALFA	0
GRAIN SORGHUM	0
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	19

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE	121	106	123	130	132	138	169	167	117	128	105	118	1,436
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MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	
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Figure 18. Machinery Complement Selection Results for Medium Northwest.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	0.00	9	3	0.00	7	59	99	67	49	0.00	0.00	0.00	294
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.														
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.														
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.														
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.														
TRACTOR HOUR REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
	95	200	191	197	200	193	141	101	133	151	200	200	200	200
TRACTOR #2														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOTE: IF NEGATIVE NUMBERS APPEAR, IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.														
LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	121	106	123	130	132	138	169	167	117	128	105	118	1,436	
TOTAL HOURS														
REQUIRED	0.00	10	3	0.00	8	65	109	74	54	0.00	0.00	0.00	324	
HIRED LABOR														
HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST OF HIRED LABOR														
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	8,763	6,991	466	1,306	17,527	866	161	1,073	2,100					19,627
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00
TOTAL FIXED COSTS							17,526.71	TOTAL VARIABLE COSTS				2,099.79		
TOTAL OPERATING COST INCLUDING HIRED LABOR							19,626.51	COST PER ACRE				82.46		

Figure 18. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	230
ALFALFA	8
GRAIN SORGHUM	8
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	38
SUDAN HAY	18

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	100	89	137	110	101	119	171	167	102	96	90	104	1,282

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 19. Machinery Complement Selection Results for Medium Southwest.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
	95	9	12	4	0.00	46	73	119	75	57	0.00	0.00	18	413	
TRACTOR #2															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR															
REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR															
HOURS PER															
MONTH (HP)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
	95	191	188	196	200	154	127	81	125	143	200	200	182		
TRACTOR #2															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	100	89	137	110	101	119	171	167	102	96	90	104	1,282		
TOTAL HOURS															
REQUIRED	10	13	4	0.00	51	81	131	82	62	0.00	0.00	19	454		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,390	8,879	592	1,674	22,535	1,480	226	1,506	3,212				25,748		
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
TOTAL FIXED COSTS						22,535.44	TOTAL VARIABLE COSTS				3,212.33				
TOTAL OPERATING COST INCLUDING HIRED LABOR							25,747.77	COST PER ACRE				85.26			

Figure 19. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	286
ALFALFA	11
GRAIN SORGHUM	6
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	20

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	100	99	142	103	101	126	153	185	117	119	94	98	1,339

MAXIMUM TRACTOR

HOURS PER TIME PERIOD	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
	200	200	200	200	200	200	200	200	200	200	200	200

Figure 20. Machinery Complement Selection Results for Medium North Central.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	0.00	12	4	0.00	16	82	132	93	71	0.00	0.00	0.00	409
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.
 CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.
 TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.
 IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR														
EQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR														
HOURS PER														
MONTH (HP)	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
	95	200	188	196	200	184	118	68	107	129	200	200	200	200
TRACTOR #2														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	100	99	142	103	101	126	153	185	117	119	94	98	1,339		
TOTAL HOURS															
REQUIRED	0.00	13	4	0.00	17	90	145	102	78	0.00	0.00	0.00	450		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
COST OF HIRED															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,126	8,616	574	1,619	21,935	1,498	224	1,492	3,214				25,149		
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TOTAL FIXED COSTS							21,935.10	TOTAL VARIABLE COSTS				3,214.14			
TOTAL OPERATING COST INCLUDING HIRED LABOR							25,149.24	COST PER ACRE				77.86			

Figure 20. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	95
ALFALFA	14
GRAIN SORGHUM	3
CORN	0
PEANUTS	1
SOYBEANS	1
COTTON	5
SUDAN HAY	34

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
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HOURS

AVAILABLE	95	84	127	97	98	115	164	171	103	106	86	91	1,246
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MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 21. Machinery Complement Selection Results for Medium South Central.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
95		1	17	6	0.81	26	47	47	51	30	0.00	0.00	2	228
TRACTOR #2														
0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.

CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.

TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.

IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
95	199	183	194	19	174	153	153	149	170	200	200	198		
TRACTOR #2														
0	0	0	0	0	0	0	0	0	0	0	0	0		
TRACTOR #3														
0	0	0	0	0	0	0	0	0	0	0	0	0		

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	95	84	127	97	98	115	164	171	103	106	86	91	1,246		
TOTAL HOURS															
REQUIRED	1	19	6	0.89	29	52	52	56	33	0.00	0.00	3	251		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,601	9,090	606	1,719	23,017	770	125	833	1,728				24,745		
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00		
TOTAL FIXED COSTS						23,016.54	TOTAL VARIABLE COSTS				1,728.08				
TOTAL OPERATING COST INCLUDING HIRED LABOR							24,744.63	COST PER ACRE				161.73			

Figure 21. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	29
ALFALFA	5
GRAIN SORGHUM	14
CORN	0
PEANUTS	0
SOYBEANS	11
COTTON	0
SUDAN HAY	36

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	93	85	112	91	97	113	162	173	103	110	84	83	1,223

MAXIMUM TRACTOR

HOURS PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200
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Figure 22. Machinery Complement Selection Results for Medium Northeast.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
95	0.00	23		8	3	27	31	18	28	10	0.00	0.00	0.00	148
TRACTOR #2														
0	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
0	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.

CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.

TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.

IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
95	200	177	192	197	173	169	182	172	190	200	200	200	200	200
TRACTOR #2														
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3														
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	93	85	112	91	97	113	162	173	103	110	84	83	1,223		
TOTAL HOURS REQUIRED	0.00	25	9	4	30	34	20	31	10	0.00	0.00	0.00	162		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.T.O.C./TRACTOR						
TRACTOR #1	11,126	8,616	574	1,619	21,935	444	81	539	1,063	22,998					
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
TOTAL FIXED COSTS						21,935.10	TOTAL VARIABLE COSTS				1,062.90				
TOTAL OPERATING COST INCLUDING HIRED LABOR							22,998.01	COST PER ACRE				242.08			

Figure 22. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	8
ALFALFA	1
GRAIN SORGHUM	1
CORN	0
PEANUTS	0
SOYBEANS	6
COTTON	0
SUDAN HAY	37

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

OWNER-OPERATOR

MONTHLY LABOR HOURS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
AVAILABLE	84	65	102	77	92	101	169	162	89	102	75	71	1,118

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200

Figure 23. Machinery Complement Selection Results for Medium East.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
	95	0.00	18	6	2	18	21	5	21	2	0.00	0.00	0.00	92	
TRACTOR #2															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR HOURS PER MONTH (HP)															
	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
	95	200	182	194	198	182	179	195	179	198	200	200	200	200	
TRACTOR #2															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	84	65	102	77	92	101	169	162	89	102	75	71	1,118		
TOTAL HOURS REQUIRED	0.00	19	7	2	19	23	5	23	3	0.00	0.00	0.00	101		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,126	8,616	574	1,619	21,935	276	50	336	661					22,596	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	
TOTAL FIXED COSTS						21,935.10	TOTAL VARIABLE COSTS					660.64			
TOTAL OPERATING COST INCLUDING HIRED LABOR							22,595.74	COST PER ACRE					426.33		

Figure 23. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	13
ALFALFA	3
GRAIN SORGHUM	1
CORN	1
PEANUTS	2
SOYBEANS	5
COTTON	0
SUDAN HAY	32

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION SPECIFIED TRACTOR USAGE

OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE	84	65	102	77	92	101	169	162	89	102	75	71	1,118
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MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	200
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Figure 24. Machinery Complement Selection Results for Medium Southeast.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
95	0.00	16	6	3	18	21	8	21	5	0.00	0.00	0.00	0.00	97	
TRACTOR #2															
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILIABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR															
REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR															
HOURS PER															
MONTH (HP)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
95	200	184	194	197	182	179	192	179	195	200	200	200	200	200	
TRACTOR #2															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	84	65	102	77	92	101	169	162	89	102	75	71	1,118		
TOTAL HOURS															
REQUIRED	0.00	18	6	3	20	23	9	23	5	0.00	0.00	0.00	107		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.T.O.C./TRACTOR							
TRACTOR #1	11,663	9,150	610	1,732	23,154	275	53	354	682					23,836	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	
TOTAL FIXED COSTS							23,154.27	TOTAL VARIABLE COSTS					682.09		
TOTAL OPERATING COST INCLUDING HIRED LABOR							23,836.35	COST PER ACRE					418.18		

Figure 24. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	100
ALFALFA	0
GRAIN SORGHUM	28
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	3

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	143	123	109	151	162	158	167	167	133	159	120	133	1,592
MAXIMUM TRACTOR HOURS PER TIME PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 25. Machinery Complement Selection Results for Small Panhandle.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	0.00	14	5	0.00	14	29	50	28	23	0.00	0.00	0.00	162
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.
 CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.
 TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.
 IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR HOURS PER MONTH (HP)														
	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
	95	200	186	195	200	186	171	150	172	177	200	200	200	
TRACTOR #2														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	143	123	109	151	162	158	167	167	133	159	120	133	1,592	
TOTAL HOURS REQUIRED	0.00	16	5	0.00	15	32	55	31	25	0.00	0.00	0.00	179	
HIRED LABOR HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST OF HIRED LABOR														
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	10,047	7,873	525	1,476	19,921	326	89	592	1,007				20,929	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS							19,921.39	TOTAL VARIABLE COSTS				1,007.21		
TOTAL OPERATING COST INCLUDING HIRED LABOR							20,928.60	COST PER ACRE				159.76		

Figure 25. (Continued).

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	65
ALFALFA	0
GRAIN SORGHUM	0
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	5

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE.	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR HOURS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
AVAILABLE	121	106	123	130	132	138	169	167	117	128	105	118	1,436
MAXIMUM TRACTOR HOURS PER TIME PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 26. Machinery Complement Selection Results for Small Northwest.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	0.00	2	0.78	0.00	1.90	17	30	20	15	0.00	0.00	0.00	86
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.														
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.														
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.														
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.														
TRACTOR HOUR														
REQUIREMENT														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
MAXIMUM TRACTOR														
HOURS PER														
MONTH (HP)	200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY														
TRACTOR #1														
	95	200	198	199	200	198	183	170	180	185	200	200	200	200
TRACTOR #2														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3														
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.														
LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR:														
PROVIDED	121	106	123	130	132	138	169	167	117	128	105	118	1,436	
TOTAL HOURS														
REQUIRED	0.00	3	0.85	0.00	2	19	32	22	16	0.00	0.00	0.00	95	
HIRED LABOR														
HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST OF HIRED														
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	8,763	6,991	466	1,306	17,527	125	47	314	486	18,013				
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
TOTAL FIXED COSTS							17,526.71	TOTAL VARIABLE COSTS				486.38		
TOTAL OPERATING COST INCLUDING HIRED LABOR							18,013.09	COST PER ACRE				257.33		

Figure 26. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	62
ALFALFA	2
GRAIN SORGHUM	3
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	10
SUDAN HAY	5

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

OWNER-OPERATOR

MONTHLY LABOR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HOURS AVAILABLE	100	89	137	110	101	119	171	167	102	96	90	104	1,282
MAXIMUM TRACTOR HOURS PER TIME PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	

Figure 27. Machinery Complement Selection Results for Small Southwest.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
	95	3	4	1.24	0.00	13	20	32	20	16	0.00	0.00	5	112
TRACTOR #2														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRACTOR #3														
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.
 CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.
 TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.
 IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT													
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
	95	198	196	199	200	187	180	168	180	185	200	200	195
TRACTOR #2													
	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3													
	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	100	89	137	110	101	119	171	167	102	96	90	104	1,282	
TOTAL HOURS														
REQUIRED	3	4	1.37	0.00	14	22	35	22	17	0.00	0.00	5	123	
HIRED LABOR HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST OF HIRED LABOR														
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COST RESULTS														
	DEPREC.INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,390	8,879	592	1,674	22,535	194	61	408	664				23,199	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS						22,535.44	TOTAL VARIABLE COSTS				663.71			
TOTAL OPERATING COST INCLUDING HIRED LABOR							23,199.14	COST PER ACRE				282.92		

Figure 27. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	73
ALFALFA	2
GRAIN SORGHUM	2
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	5

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION

SPECIFIED TRACTOR USAGE

OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S. HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S. SHREADER	100%	0%	0%
ROT. MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE 100 99 142 103 101 126 153 185 117 119 94 98 1,339

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD 200 200 200 200 200 200 200 200 200 200 200 200

Figure 28. Machinery Complement Selection Results for Small North Central.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
	95	0.00	3	1	0.00	4	21	34	23	18	0.00	0.00	0.00	103	
TRACTOR #2															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR HOURS PER MONTH (HP)															
	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
	95	200	197	199	200	196	179	166	177	182	200	200	200	200	
TRACTOR #2															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	100	99	142	103	101	126	153	185	117	119	94	98	1,339		
TOTAL HOURS															
REQUIRED	0.00	4	1	0.00	4	23	37	25	19	0.00	0.00	0.00	113		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
TRACTOR #1	11,126	8,616	574	1,619	21,935	172	56	376	604					22,539	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS						21,935.10	TOTAL VARIABLE COSTS				604.10				
TOTAL OPERATING COST INCLUDING HIRED LABOR							22,539.21	COST PER ACRE				274.87			

Figure 28. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	12
ALFALFA	2
GRAIN SORGHUM	0
CORN	0
PEANUTS	0
SOYBEANS	0
COTTON	0
SUDAN HAY	4

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE 95 84 127 97 98 115 164 171 103 106 86 91 1,246

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD 200 200 200 200 200 200 200 200 200 200 200 200

Figure 29. Machinery Complement Selection Results for Small South Central.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
	95	0.00	2	0.62	0.00	2	6	6	6	4	0.00	0.00	0.00	27	
TRACTOR #2															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR HOURS PER MONTH (HP)															
	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
	95	200	198	199	200	198	194	194	194	196	200	200	200	200	
TRACTOR #2															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR															
PROVIDED	95	84	127	97	98	115	164	171	103	106	86	91	1,246		
TOTAL HOURS															
REQUIRED	0.00	2	0.68	0.00	3	6	6	7	4	0.00	0.00	0.00	29		
HIRED LABOR															
HOURS															
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR															
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
	DEPREC.INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR						
TRACTOR #1	9,842	7,734	516	1,449	19,540	36	15	97	148	19,688					
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
TOTAL FIXED COSTS						19,540.43	TOTAL VARIABLE COSTS						147.95		
TOTAL OPERATING COST INCLUDING HIRED LABOR							19,688.38	COST PER ACRE						1,093.80	

Figure 29. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	8
ALFALFA	2
GRAIN SORGHUM	4
CORN	0
PEANUTS	0
SOYBEANS	3
COTTON	0
SUDAN HAY	9

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE SPECIFIED OPERATION TRACTOR USAGE

MACHINE OPERATION	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE	93	85	112	91	97	113	162	173	103	110	84	83	1,223
-----------	----	----	-----	----	----	-----	-----	-----	-----	-----	----	----	-------

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD	200	200	200	200	200	200	200	200	200	200	200	200	200
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Figure 30. Machinery Complement Selection Results for Small Northeast.

TOTAL																
TRACTOR																
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
TRACTOR #1																
95	0.00	6	2	0.87	7	8	5	8	3	0.00	0.00	0.00	0.00	41		
TRACTOR #2																
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
TRACTOR #3																
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.																
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.																
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.																
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.																
TRACTOR HOUR																
REQUIREMENT																
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC				
MAXIMUM TRACTOR																
HOURS PER																
MONTH (HP)	200	200	200	200	200	200	200	200	200	200	200	200	200	200		
EXCESS CAPACITY																
TRACTOR #1																
95	200	194	198	199	193	192	195	192	197	200	200	200	200	200		
TRACTOR #2																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
TRACTOR #3																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.																
LABOR																
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL			
OWNER LABOR																
PROVIDED	93	85	112	91	97	113	162	173	103	110	84	83	1,223			
TOTAL HOURS																
REQUIRED	0.00	7	2	0.96	8	9	6	9	3	0.00	0.00	0.00	45			
HIRED LABOR																
HOURS																
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
COST OF HIRED																
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
COST RESULTS																
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR						
TRACTOR #1	11,126	8,616	574	1,618	21,935	70	22	148	240					22,175		
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00		
TOTAL FIXED COSTS						21,935.10	TOTAL VARIABLE COSTS					240.36				
TOTAL OPERATING COST INCLUDING HIRED LABOR							22,175.47	COST PER ACRE					852.90			

Figure 30. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	4
ALFALFA	0
GRAIN SORGHUM	0
CORN	0
PEANUTS	0
SOYBEANS	2
COTTON	0
SUDAN HAY	12

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

MACHINE OPERATION	SPECIFIED TRACTOR USAGE		
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S.HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S.SHREADER	100%	0%	0%
ROT.MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE 84 65 102 77 92 101 169 162 89 102 75 71 1,118

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD 200 200 200 200 200 200 200 200 200 200 200 200

Figure 31. Machinery Complement Selection Results for Small East.

TOTAL															
TRACTOR															
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
TRACTOR #1															
95		0.00	6	2	0.58	5	7	2	7	0.90	0.00	0.00	0.00	30	
TRACTOR #2															
0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3															
0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.															
CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.															
TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.															
IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.															
TRACTOR HOUR REQUIREMENT															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
MAXIMUM TRACTOR HOURS PER MONTH (HP)															
200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
EXCESS CAPACITY															
TRACTOR #1															
95	200	194	198	199	195	193	198	193	199	200	200	200	200	200	
TRACTOR #2															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRACTOR #3															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.															
LABOR															
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
OWNER LABOR PROVIDED															
84	65	102	77	92	101	169	162	89	102	75	71	1,118			
TOTAL HOURS REQUIRED															
0.00	6	2	0.64	6	8	2	8	0.99	0.00	0.00	0.00	33			
HIRED LABOR HOURS REQUIRED															
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR															
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS															
TRACTOR #1	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR					
10,047	7,873	525	1,476	19,921	55	17	111	183						20,104	
TRACTOR #2															
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TRACTOR #3															
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS						19,921.39	TOTAL VARIABLE COSTS						182.51		
TOTAL OPERATING COST INCLUDING HIRED LABOR							20,103.90	COST PER ACRE							1,116.88

Figure 31. (Continued)

TRACTOR HORSEPOWER SELECTION

CROP ACTIVITIES	ACRES
WHEAT	4
ALFALFA	1
GRAIN SORGHUM	0
CORN	0
PEANUTS	0
SOYBEANS	2
COTTON	0
SUDAN HAY	10

TRACTOR SIZES
(IN PTO HP)

95
105
125
140
155
175
200

	#1	#2	#3
TRACTOR HP	95	0	

COST DATA ENTRY

CURRENT FUEL COST	0.80
INTEREST RATE	0.090
CURRENT TAX RATE	0.010
INSURANCE RATE	0.006
HIRED WAGE RATE	5.00

MACHINE OPERATION

	#1	#2	#3
OFFSET	100%	0%	0%
CHISEL	100%	0%	0%
LAND PLANE	100%	0%	0%
SWEEP PLOW	100%	0%	0%
M.B. PLOW	100%	0%	0%
SWEEP COND.	100%	0%	0%
CULTIPACKER	100%	0%	0%
TANDEM DISK	100%	0%	0%
SPRINGTOOTH	100%	0%	0%
S. HARROW	100%	0%	0%
DRILL	100%	0%	0%
PLANTER	100%	0%	0%
CULTIVATOR	100%	0%	0%
ROTARY HOE	100%	0%	0%
SPRAYER	100%	0%	0%
S. SHREADER	100%	0%	0%
ROT. MOWER	100%	0%	0%
WINDROWER	100%	0%	0%
BALER	100%	0%	0%

OWNER-OPERATOR

MONTHLY LABOR JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC TOTAL

HOURS

AVAILABLE 84 65 102 77 92 101 169 162 89 102 75 71 1,118

MAXIMUM TRACTOR HOURS

PER TIME

PERIOD 200 200 200 200 200 200 200 200 200 200 200 200 200

Figure 32. Machinery Complement Selection Results for Small Southeast.

TOTAL														
TRACTOR														
HOURS	HP	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
TRACTOR #1														
95	0.00	5	2	0.58	5	7	2	7	2	0.00	0.00	0.00	29	
TRACTOR #2														
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRACTOR #3														
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NOTE: IF NA (NOT AVAILABLE) IS RELAYED IN THE RESULTS ROW.

CHECK HORSEPOWER REQUIREMENTS FOR PTO DRIVEN EQUIPMENT.

TRACTORS USED WITH 540 PTO EQUIPMENT CANNOT EXCEED 140 HORSEPOWER.

IN ADDITION, S.HARROW IS NOT OFFERED FOR TRACTORS EXCEEDING 155 HP.

TRACTOR HOUR REQUIREMENT													
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
MAXIMUM TRACTOR HOURS PER MONTH (HP)													
200	200	200	200	200	200	200	200	200	200	200	200	200	200
EXCESS CAPACITY													
TRACTOR #1													
95	200	195	198	199	195	193	198	193	199	200	200	200	
TRACTOR #2													
0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRACTOR #3													
0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: IF NEGATIVE NUMBERS APPEAR IN THE TRACTOR HOUR REQUIREMENT SUMMARY ADJUSTMENTS MAY BE NEEDED TO COMPLETE FIELD OPERATIONS.

LABOR														
SUMMARY	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	
OWNER LABOR														
PROVIDED	84	65	102	77	92	101	169	162	89	102	75	71	1,118	
TOTAL HOURS														
REQUIRED	0.00	5	2	0.64	6	7	2	7	2	0.00	0.00	0.00	32	
HIRED LABOR														
HOURS														
REQUIRED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST OF HIRED LABOR														
LABOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COST RESULTS														
	DEPREC.	INT.	INS.	TAXES	T.F.C.	REPAIR	LUB.	FUEL	T.V.C.	T.O.C./TRACTOR				
TRACTOR #1	11,126	8,616	574	1,619	21,935	53	16	105	173				22,108	
TRACTOR #2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TRACTOR #3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00	
TOTAL FIXED COSTS						21,935.10	TOTAL VARIABLE COSTS				173.34			
TOTAL OPERATING COST INCLUDING HIRED LABOR							22,108.44	COST PER ACRE				1,300.50		

Figure 32. (Continued)

VITA

Ross Ernest Sestak

Candidate for the Degree of

Master Of Science

Thesis: A DECISION AID FOR SELECTING FARM EQUIPMENT AND ESTIMATING COSTS OF MACHINERY COMPLEMENTS

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