FEASIBILITY OF MACHINERY

COOPERATIVES IN

OKLAHOMA

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Background

The fixed and operating costs associated with agricultural machinery represent a major expense category for agricultural producers. Machinery costs can represent anywhere for twenty to forty percent of total non-land production expenses (MachineryLink (2006), Weness (2001)). The increasing number of farms with a size of 2,000 acres or more is a result of the necessity for producers to spread equipment costs over increased acreage and achieve the scale economies of larger equipment (2002 Census of Agriculture). Increasingly efficient and technologically advanced equipment is more expensive than machinery of the past, making improvements in efficiency very costly to producers. A consequence of these trends is that producers with smaller amounts of acreage relative to the larger equipment they purchase do not reach the maximum efficiency of their machinery and machinery costs. Are there ways for these small producers to achieve the efficiencies of this equipment?

Informal equipment sharing agreements among farmers have existed throughout the history of agriculture, but these arrangements face problems concerning cost sharing, use and time allocation, and a structure for how the arrangement may be terminated. For example, which producer is responsible for the cot of repair or the condition in which the equipment is used? Formal structures for sharing machinery offer a solution to many of the problems associated with joint machinery ownership. Having a contract specifying how the equipment is to be used and specific guidelines for how costs will be shared eliminate some of these problems. One such formal structure for which a legal structure is in place is machinery cooperatives.

Research has been done in northern regions, including Canada, to show the benefits of machinery cooperatives. Harris and Fulton (Saskatchewan, 2000) found machinery cooperatives in Saskatchewan typically consist of small grain producers and have five or fewer members. The smaller number of farmers helps with some of the scheduling and timeliness problems associated with machinery cooperatives (Harris and Fulton, CUMA, 2000). The research reported an average expected per acre machinery cost savings of 35% greater for a small grain farm in Saskatchewan that jointly owned a piece of equipment with at least two other farms rather than individual ownership (Harris and Fulton, CUMA, 2000).

While the farming practices used by producers in Oklahoma and Saskatchewan differ, the potential for savings that may be available to Oklahoma producers through machinery cooperatives has yet to be investigated by researchers. Oklahoma farmers may benefit not only through cost savings, but also by gaining access to and creating “greater annual use of large ticket machines,” like combines and no-till equipment (Edwards, 2004). The reduction in the investment cost of these more expensive machinery items frees up capital which can in turn be used elsewhere.

This research will attempt to analyze how machinery cooperative can be used to help producers reduce their machinery costs. Through examining changes in the number of members, acres per member and the average distance between the members the results of this research will answer the question; can machinery cooperatives be a financially and logistically feasible means for producers to reduce machinery costs?

Objectives

The general objective of this research is to determine the potential cost savings to Oklahoma producers through the formation of machinery cooperatives.

1) Examine the types of equipment or production operations which are most appropriate for cooperative ownership.
2) Examine cooperative structure of a machinery cooperative considering the acres per member, number of members, required workdays and transportation.

Conceptual Framework

The underlying problem for the feasibility of some action depends on the benefits outweighing the costs. This is true for the machinery cooperative problem discussed in this paper. What is being done by creating a machinery cooperative is spreading the cost of a machinery complement over a larger acreage. The machinery cooperative, therefore, minimizes the per acre machinery costs of the producers (Pfeiffer and Peterson, 1980). Pfeiffer and Peterson (1980) show that the costs per unit (e.g. horsepower and feet) of machinery decrease as the units increase by achieving greater efficiency. Under a cooperative or sharing structure, the purchase of larger equipment for use on greater acreage would reduce per acre cost. Additional costs of transportation and the ability of the machinery cooperative to schedule machinery use to complete operations at critical times, however, arise under cooperative ownership which impact the minimum achievable machinery cost.

A machinery cooperative does not simply increase the number of acres for which the machinery is used. The addition of other producers increased the acreage and spreads the equity costs over a greater number of individuals. This implies that the machinery will need to be transferred from member to member as its use is required by the individual members. Not only can one see the scheduling problems that may arise from simultaneous need for a piece of machinery at a critical period in the production process, but there is also an increase in time required for making the actual machinery transfer (Edwards, 2001, 2004). The additional time required for transportation is based on two main criteria, number of members and the distance between members. Each addition member will require another transfer and the time to move the equipment to that member. With the total number of acres and the time required for transportation, an optimal set of equipment can be found based on the required number of working field days to complete the cooperatives operations in a specific area.

Based on the concepts previously described and the objectives of this research three hypotheses are developed. The main hypothesis is that machinery cooperatives will achieve lower per acre costs than individual ownership. A second hypothesis is that high cost low use equipment and intensive production practices will have the most potential for a machinery cooperative. The final hypothesis is that as geographic dispersion and number of members increase the required field days will increase to a time period greater than available field days. To test these hypotheses a machinery cost comparison template was developed and used to compare the machinery costs for individual and cooperative machinery ownership.

CHAPTER II

REVIEW OF LITERATURE

This section will examine the literature available in three areas of concern involved with the machinery cooperative problem. First the various methods for the calculation of machinery depreciation and machinery cost is reviewed. Second, literature which examines the various forms in which machinery cooperatives may be structured is reviewed. Finally, literature which examines past production methods for which machinery cooperatives have shown high possibilities for success is discussed.

Machinery Cost Calculations

There is much literature available on the topic of farm machinery depreciation methods. The available literature discusses many functional forms that have been used to estimate farm machinery depreciation. Farm equipment depreciation is a large part of the costs reported by farms annually, and is important in farm decision making. Many different methods and functional forms for calculating depreciation have been used. A study by Cross and Perry (1995), which is frequently cited in other papers, found that the adaptability of the Box-Cox functional form allowed for the greatest accuracy in predicting farm equipment depreciation. This study found that the rates of depreciation among different types of farm equipment take different functional forms. The flexibility of the Box-Cox functional form allowed different rates of depreciation among farm equipment to be accounted for. This was important because the study offered a simpler form which could be used by applied economists.

The Cross and Perry approach has faced further examination (Dumler, et al. (2003), Wu and Perry (2004)). Dumler, Burton and Kastens examine six alternative depreciation methods including the Cross and Perry (CP) method (2003). Other methods examined included the “old” method used by the American Society of Agricultural Biological Engineers (ASABE), the North American Equipment Dealers Association method, the method used by the Kansas Farm Management Association, and two accelerated depreciation methods used in tax calculation. The CP method was found to be the best method over all of the categories of equipment, having the lowest mean percentage error.

One other study reinforces the results of Cross and Perry (Wu and Perry, 2004). Wu and Perry use historical list prices from the North American Power Equipment Dealers’ Association, the *Farm Equipment Guide* and other non published sources. This study updated some of the price data used and also examined twelve additional functional forms for calculating depreciation of farm equipment as well as the CP method. Once again, this study found that the CP method is the most appropriate method for calculating farm equipment depreciation. It is also important to point out that the methods used by Cross and Perry in 1995 have been simplified and adopted by the American Society of Agricultural and Biological Engineers in 1997 as a part of the ASABE Standards (Wu and Perry, 2004).

There is limited literature on the topic of other machinery cost calculation methods; however, there are some very reliable sources covering available methods. The

ASABE has developed standards for machinery cost calculations which are used by Agricultural Engineers and Agricultural Economists (ASAE EP496.3). In order to simplify the calculations established by the standards of the ASABE, Tim Cross put together a paper containing equations for machinery cost calculation. This is a collection of machinery cost calculation methods for fixed and variable costs associated with machinery ownership and use. These equations tie costs to specific implements. The equations Cross lists and explains in this paper are similar to ASABE Standards, but for calculation purposes may be some what varied. As mentioned above, Cross has worked on the development of many cost calculation methods, and his work is important to research in this area. These calculation methods will be a valuable standard when estimating machinery cost for both an individual and machinery cooperative.

The ASABE formulas are often more technical than necessary and often requires more information than is available when the method is applied to ad hoc evaluations. Simpler equations have been developed which distribute costs based on calculated factors (Edwards 2005). The accuracy of these estimates is questionable because the costs are not directly applied to the use of specific types or sizes of implements. These costs are generally some percentage of a more available amount, such percent of purchase price or a factor of the number of hours accrued. A combination of these percentage equations and the ASABE equations will be used in this research.

Machinery Cooperative Structure

Producers face many options when making the decision on how they are going to acquire the use of machinery (Edwards and Meyer, 2001). Some of these options include ownership, custom hire, rental or leasing. All of these options have their individual costs as well as benefits. Ownership involves large capital investment, but allows the owner full control of the equipment. Leasing involves less capital investment, but may limit the number of hours a machine can be used without facing high penalties. Renting and custom hire are the least capital intensive, but may cause some problems with the availability of the equipment at the optimal time. Edwards and Meyer provide excellent explanations of the all of the cost and benefits involved in the decision process of how to acquire the use of machinery. Under the option for ownership, Edwards and Meyer offer an alternative for of ownership which requires less capital investment. This option is joint ownership and is discussed further in another paper by Edwards (2001).

Joint ownership is a method of ownership which allows farmers to reduce their machinery costs (Edwards, 2001). This form of ownership may also be known as a machinery cooperative depending on its structure. An "advantage to the formation of a machinery cooperative is the reduction in capital invested by individual farmers in machinery" (Ford and Cropp, 2002). Ford and Cropp's study focused specifically on small sized dairy farms of around 500 acres of cropland because of their greater potential to benefit from the economies of scale offered through membership in a machinery cooperative. These benefits are due to the lower amount of individual capital needed for investing in more efficient machinery.

Edwards (2001) discusses "the key to successful joint ownership is for the partners to agree on when and how to use each piece of equipment." This involves many circumstances, including "weather and crop conditions," as well as "minimizing the time spent transporting machinery." According to Edwards, this should be written in an agreement prior to engaging in joint ownership with another individual.

"Costs of jointly owned machinery should be shared equitably" (Edwards, 2001). Edwards points out, that ownership does not have to be divided equally. Per acre costs can be calculated based on the total use and then charged to each owner based on their potion of that total. Other examples of how costs may be distributed among members are presented by Harris and Fulton (Idea, 2000). This study examined the structure and savings of machinery cooperative members in Saskatchewan. "Farm machinery co-operatives in Saskatchewan operate almost exclusively in the grain sector and tend to have five or fewer members" (Harris and Fulton, Saskatchewan, 2000). The smaller number of farmers helps with some of the scheduling problems associated with machinery cooperatives. This study found that small grain farms saved 35% on machinery costs by sharing equipment with other farms (Harris and Fulton Saskatchewan, 2000)

When comparing different ownership options, it is important to consider the complements of machinery. Harris and Fulton make this comparison (Idea Worth Sharing). This is the cost of the machinery that complements the increase in size of the power unit used due to the increase in number of acres farmed in a machinery cooperative.

One structure for machinery cooperatives is described by Harris and Fulton (CUMA, 2000). This structure is known in Canada as CUMA which loosely translates to the "Cumulative Utilization of Agricultural Machinery". Under this structure, not all of the machinery owned by the cooperative is used by every member, but is instead shared by smaller groups of members in the cooperative (Harris and Fulton, CUMA, 2000). This structure also benefits producer because it limits their liability from the activities of the cooperative. Members are only liable up to their portion of the capital. The scheduling is done by the cooperative based on predetermined criteria of the individual CUMA.

Machinery Cooperative Successes

Harris and Fulton have studied the applicability of machinery cooperatives for small grain farms in Canada. This study compares to costs faced individual producers with those faced by members of machinery cooperatives. These studies are important to farmers in the US because of the basic production similarities. While the farming practices in the two countries are different, the implications for cost savings through machinery cooperatives still remain. More specifically, Oklahoma wheat farmers may benefit because they would be able to create “greater annual use of large ticket machines,” like combines and no-till equipment (Edwards, 2004).

Toro and Hansson (2004) compare actual cost data from machinery cooperatives to other operation in Sweden. The results show that producers are able to realize greater cost savings in a machinery cooperative. The study examined the cost of performing crucial activities at less than optimal times for machinery cooperatives in Sweden where the different regions face extremely variable weather conditions. Even with the high variability of timeliness costs, Sweden farmers that were members of a machinery cooperative realized cost savings in excess of 15%. That examination of timeliness is important because it shows that cost savings from machinery cooperatives can still be obtained in a region that experiences extreme variability in its climate from season to season as well as year to year. Toro and Hansson’s findings on timeliness will be a valuable contribution to the discussion of available and required working days and their impact on timeliness.

CHAPTER III

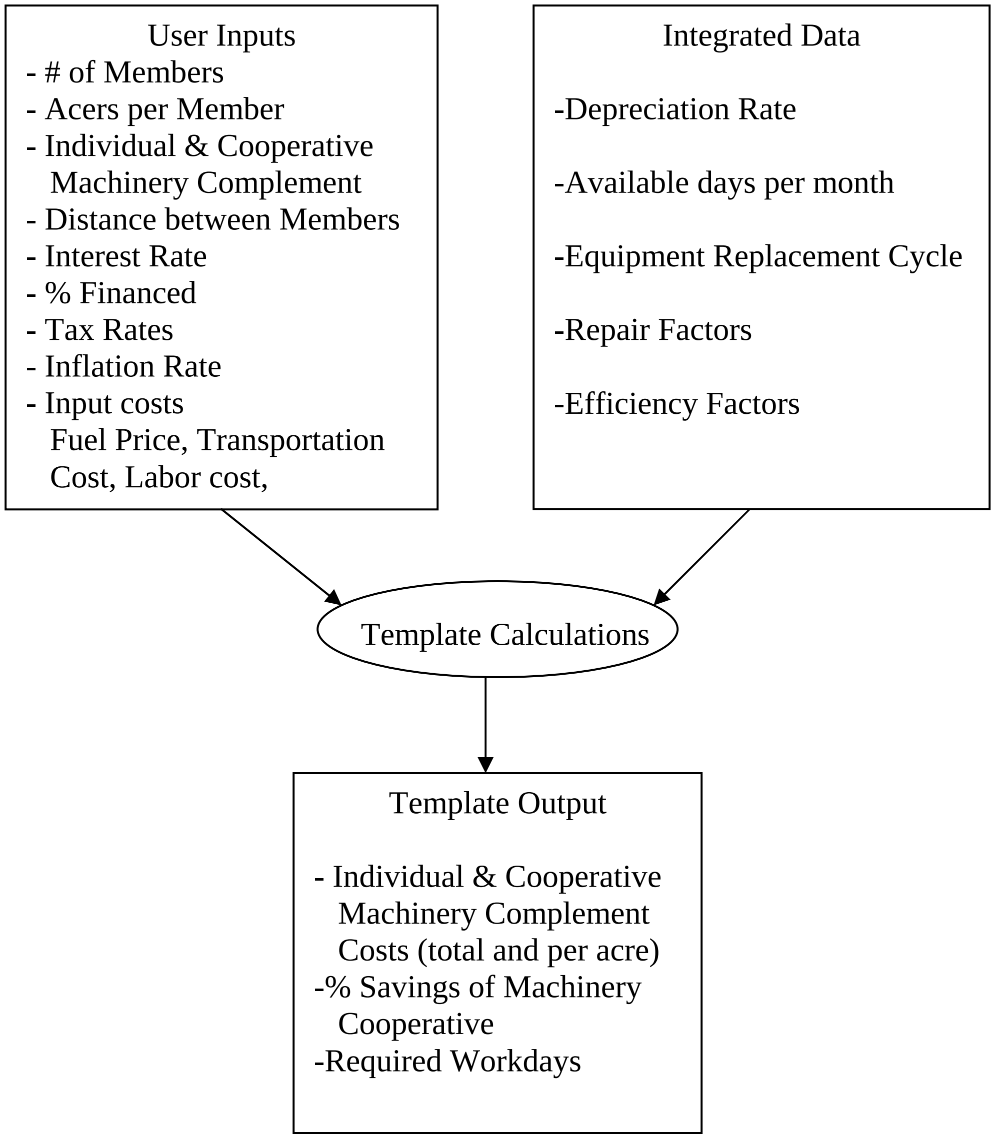
METHODOLOGY

This research will compare the machinery costs of individual ownership to cooperative ownership. This section discusses the methods used to calculate per acre machinery cost, and describes how these costs are compared for individual and cooperative ownership. Additionally, there is discussion of the methods used for determining the sets of equipment needed to meet the requirements of the different machinery cooperatives presented. Required field days are an important variable concerning the feasibility of the machinery cooperative and the method used to determine this is discussed as well. All of these costs are calculated using a spreadsheet template that was developed for this project.

Machinery Cooperative Feasibility Template

The machinery cooperative feasibility template uses a combination of user provided input information along with imbedded data and cost equations to calculate machinery costs for both individual producers and a machinery cooperative. Figure 1 outlines the flow of information used in the machinery cooperative feasibility template.

Figure 1. Machinery Cooperative Feasibility Template Outline



The feasibility template used the user inputs shown in the top left had box of Figure 1. These inputs are passed on the producers own cost information and should resemble as closely as possible the actual costs faced by the decision maker. The integrated data also show in Figure 1 are data that are set parameters imbedded in the machinery cooperative feasibility template. These values may be changed at the user's discretion but they offer a valuable starting point for the decision maker. It should be pointed out that this is a decision aid tool and will only provide estimates for the machinery costs and should be considered carefully by the user. The most accurate information is a decision maker has is his own historical costs. The feasibility template uses imbedded cost calculation and field day calculations to come up with an output that is used for analysis of the feasibility of the machinery cooperative.

Cost Calculations

Many of the calculation methods in the machinery cooperative template used to determine per acre fixed and variable costs of machinery are from the ASABE Standards (2003) and Cross (Machinery Cost). Other equations were adapted to fit the use of the machinery cooperative template and the potential needs of the users of the template.

Field capacity is used to determine the acres per hour for a piece of machinery given that it is unable to be used at 100% efficiency due to factors such as cleaning time, idle time, adjustments, etc. (Cross). The inverse of field capacity is used in the cost calculations that follow to find the per acre costs. Field capacity which is integrated into the cost calculations in the machinery cooperative feasibility template is calculated as:

$$F = \frac{s \cdot w \cdot \left(\frac{EF}{100} \right)}{8.25}$$

Where F is field capacity in acres per hour, s is speed in miles per hour, w is width of machinery in feet, and EF is the efficiency factor. This value is used also to calculate the required use of an individual piece of machinery. This use is described later in this section.

Variable costs are costs which depend on the use of the machine in a given time period. Variable cost is calculated as:

$$VC = CF + CO + CR + CL$$

Where *VC* is the per acre variable cost of machinery, *CF* is the fuel cost, *CO* is the oil and filter cost, *CR* is the repairs and maintenance cost, and *CL* is the labor cost. The components of variable cost are calculated as follows:

$$CF = \{P_f \cdot 0.73(0.06 \cdot hp)\}\left(\frac{1}{F}\right)$$

$$CO = 0.15 \cdot CF$$

Where P_f is the price per gallon of fuel and *hp* is horsepower of the machine.

$$CR = \frac{\left(P_m \cdot RF_1\left(\frac{h+u}{1{,}000}\right)^{RF_2}\right) - \left(P_m \cdot RF_1\left(\frac{h}{1{,}000}\right)^{RF_2}\right)}{u}\left(\frac{1}{F}\right)$$

Where P_m is the price of the machine, RF_1 is the repair factor 1 from Table 1, RF_2 is the repair factor 2 from Table 1, *u* is the hours of use of the machine in year *n*, and *h* is the accumulated hours of the machine at the beginning of year *n*.

$$CL = \{P_l \cdot 1.25\}\left(\frac{1}{F}\right)$$

Where P_l is the price of labor per hour.

Fixed costs are costs that are not related to the use in a given year. Fixed costs are calculated using the following equation:

$$FC = CD + CI + CN$$

Where *FC* is the per acre fixed cost, *CD* is the cost of depreciation, *CI* is the interest cost, *CH* is the cost of housing machinery, and *CN* is the cost of insurance and housing. The equations for the components of fixed cost are:

$$CD = \frac{P_m * d}{a}$$

Where *d* is the deprecation rate and *a* is the total acres. Interest cost is calculated using:

$$CI = \frac{L * r}{a}$$

Where *r* is the interest rate as a percent and *L* is the outstanding amount of the loan. Cost of housing and insurance machinery is calculated as:

$$CN = P_m * h$$

Where *h* is the insurance and housing rate as a percentage of property value. To calculate the total cost of machinery, variable and fixed costs are combined as:

$$TC = VC + FC$$

Where *TC* is the total cost per acre of the machinery.

The above calculations are used to calculate the cost of the machinery complement for both individual and cooperative ownership. The percentage reduction in these costs from individual to cooperative owner ship is calculated as:

$$\%Cost\,\mathrm{Re}\,duction = (1 - TC_c /(TC_I * \%ACREAGE)) * 100$$

Where %*CostReduction* is percent reduction of machinery cost from individual to cooperative owner ship, TC_I is the total cost per acre of the individual, TC_C is the total cost per acre of an individual in the machinery cooperative, and *%ACREAGE* is the producer's share of the total acres in the machinery cooperative.

Field Days

It is assumed that as the number of members in the machinery cooperative increased, the required time for transportation and additional setup time will also increase. The larger equipment used by the machinery cooperative is able to reduce the required days in the field, but at some point, diseconomies of scale occur.

An available workdays for a 95% expected completion probability is used for the individual farmer and the machinery cooperatives in all of the scenarios (Reinschmiedt, 1973). The available working days are compared to the required field days with the additional transportation. The results of this comparison of available versus required field days illustrates whether the machinery cooperative will be able to complete the operations in the different regions with a given set of equipment. A shortage in field days would result in that activity limiting the feasibility to the machinery cooperative.

Required field days are calculated as:

$$w = \frac{u + tr}{l}$$

Where w is the workdays required, u is the use in hours, tr is the time required for transportation in hours of the machinery cooperative and l is the average hours in a single workday. The use is calculated by:

$$u = \frac{T * a}{F}$$

Where T is the total number of times the acreage is covered. The transportation time is calculated as:

$$tr = \frac{d * (1 + n) * T}{MPH}$$

Where *d* is the distance in miles between members, *n* in the number of members and *MPH* is the miles per hour transportation speed.

Machinery Cooperative Descriptions

For this research, several possible examples of machinery cooperatives are developed for comparison of the effects which different variables have on the equipment costs of the cooperative machinery complement. To ease calculations, within each example individual producers are all assumed to have identical acreages, identical needs of equipment use, and share costs equally. Each example consists of different production operations. The machinery cooperatives chosen are for three different farming operations are for wheat production, cotton production and hay production. In addition to the three machinery cooperative examples there is also a specific case study for the feasibility of a hay machinery cooperative for a group of Oklahoma hay producers.

In each machinery cooperative example, a machinery complement is chosen for the individuals that will allow for the completion of all to the activities required by each of the production operations. The complement chosen for the individual meets the requirements to complete the production activities of that individual. The individual's complement of equipment is assigned so that the individual has a 95% confidence of completion level given the available number of working days (Reinschmiedt, 1973). The 95% confidence of completion level is chosen based on findings that producers generally possess equipment that exceeds their actual requirements (Pfeiffer and Peterson, 1980).

A separate complement of equipment is chosen for the machinery cooperative which should account for the increase in acreage of the cooperative. The equipment set for the machinery cooperative is chosen for each scenario considering the fact that a larger complement of equipment would be needed to accommodate a greater number of acres. The equipment complements are chosen to fulfill the requirements of a base farm size of the machinery cooperative without considering transportation days. This allows for marginal changes to be made on the size or geographical dispersion of the members for a complement of equipment which remains constant. The machinery complement is held constant to compare the effects of increasing acreage on per acre savings and timeliness of completion for the machinery cooperative relative to the individual.

In the hay cooperative case study, the machinery complements for both the individuals and the machinery cooperative were chosen by the producers that would make up the cooperative.

Wheat Machinery Cooperative

This example is an attempt to examine the feasibility of a three member no-till wheat machinery cooperative located in the panhandle region of Oklahoma. In order to accomplish this objective, a base farm size as well as an initial complement of equipment is used to calculate and compare the cost of machinery ownership for each of the three members both individually as well as under cooperative ownership. For this example the starting individual farm size for each of the three producers is 500 acres making the total acreage in the wheat machinery cooperative 1,500 acres.

The equipment complements for both individual and cooperative ownership are shown in Table 1. An identical machinery complement is used by all producers in this example under individual ownership. All the specifications of horsepower (HP) and operating width of the equipment, as well as the total current value of each producers set of equipment have identical values. Setting the machinery complements equal will allow the comparison to be generalized over all of the producers and the machinery cooperative. This will also help when examining how changing a member's share in the total acreage of the machinery cooperative and increasing total acreage impacts the feasibility of the machinery cooperative.

Table 1. Individual and Wheat Machinery Cooperative Equipment Complement

	Individual Ownership	Wheat Machinery Cooperative
Tractor, 2WD	95HP	200HP
Combine	20'	30'
Combine		30'
Drill	15'	30'
Boom Sprayer	30'	60'
Current Value	$320,600	$820,800

There are many differences in the two machinery complements shown in Table 1. The size of the machinery cooperative equipment complement is more than twice that of a single producers machinery complement. The critical piece of equipment which is added to the machinery cooperative is an additional combine. Two combines are used in the machinery cooperative to help reduce scheduling problems during the critical time of harvest.

As mentioned above, this wheat machinery cooperative example is located in the panhandle region of Oklahoma. The operating activities associated with wheat production in this example are planting, spraying/fertilizing, and harvest. Planting occurs in October; the acreage is sprayed or fertilized in February, July, September, and

November; and finally, the wheat is harvested in June. The available working days for these time periods are shown in Table 2.

Table 2. Available Workdays for 95% Confidence of Completion in the Oklahoma Panhandle

Month	Feb	Jun	Jul	Sep	Oct	Nov
Available Workdays	24.50	17.50	17.00	19.00	22.75	24.00

Cotton Machinery Cooperative

This example is an attempt to examine the feasibility of a cotton production machinery cooperative located in Southwest Oklahoma. In order to accomplish this objective, a base farm size as well as an initial complement of equipment is used to calculate and compare the cost of machinery ownership for each of the cooperative members individually as well as under cooperative ownership. The acreage in production for each producer begins at 200 acres making the total acres in production for this three member cotton machinery cooperative 600 acres. As in the wheat cooperative example, all of the producers are considered to have identical operations.

Listed in Table 3 the complements of equipment that would be used by each producer if the producers were to own their own complements of equipment and the complement of equipment that would be purchased under cooperative ownership. The individual producers' complements are all identical for sake of comparison.

Table 3. Individual and Cotton Machinery Cooperative Equipment Complements

Implement	Individual Ownership	Machinery Cooperative
Tractor, 2WD	95HP	200HP
Cotton Stripper	6 row	6 row
Cotton Stripper		6 row
Planter	8 row	16 row
Boom Sprayer	30’	60’
Current Value	$255,600	$520,800

A separate complement is used by the machinery cooperative with larger specifications for horsepower, width and total current value of that machinery. The complement of equipment for the machinery cooperative contains two cotton strippers as a means of reducing scheduling problems that arise during the harvest period.

The available working days for this example of cotton production in Southwest Oklahoma are shown in Table 4. In this scenario, the entire acreage is sprayed/fertilized a total of six times, once in May, June, August and October, and twice in July. The cotton is planted in May and harvested in November. The operations under the two ownership options are considered to be identical in this example.

Table 4. Available Workdays for 95% Confidence of Completion in Southwest Oklahoma

Month	May	Jun	Jul	Aug	Oct	Nov
Available Workdays	13	16.75	21	19.75	16.25	20.5

Hay Machinery Cooperative

This example is an attempt to examine the feasibility of a hay machinery cooperative located in the central region of Oklahoma. In order to accomplish this objective, a base farm size as well as an initial complement of equipment is developed to calculate and compare the cost of machinery ownership for each of the members both individually as well as under cooperative ownership. The acreage of hay in production for each producer and the total for the machinery cooperative are 100 and 300 acres respectively. As in the first two cooperative examples, all of the producers are assumed to have identical operations.

The complements of equipment that would be used under both individual and cooperative ownership are described in Table 5. The hay machinery cooperative equipment complement is larger in size, horsepower and total current value than the individual equipment complements complement. This complement of equipment contains two tractors as a means of reducing scheduling problems that may arise while sharing machinery. For example, two tasks can be completed during the same time period; after producer 1 mows, then producer 1 can rake while producer 2 mows.

Table 5. Individual and Hay Machinery Cooperative Equipment Complement

Implements	Individual Ownership	Machinery Cooperative
Tractor, 2WD	85HP	95HP
Tractor, 2WD		95HP
Mower, Rotary	10’	20’
Rake, Folding	20’	30’
Round Baler	4’	5’
Current Value	$82,000	$170,000

Under this acreage structure, it is assumed that the producers get two cuttings of hay per year, once in March and once in June. The available workdays in the central region of Oklahoma for these operations are 20.25 and 14 day for March and June respectively.

Assumptions and Variations

This section will outline the variables that remain constant in all three of the cooperative examples. Also, there is a description of the acreage and distance variations used to calculate cost and availability of working days of the machinery cooperative.

Table 6 lists all of the variables used in the calculation of the machinery cost of the cooperative that are the left unchanged in all of the examples above.

Table 6. Additional Machinery Cost Calculation Variables

Variable	Amount
Percent Financed	50%
Long Term Interest Rate	6%
Loan Term (years)	5
Equipment Replacement Cycle (years)	5
Hired Labor Rate/Hour	$10.00
Fuel Price $/gallon of diesel	$2.50
Transportation Cost $/mile	$2.00
Insurance Rate % of Property Value	2%
Property Tax as % of Property Value	1%
Inflation Rate	1%
Average Miles Between Members	10
Average Workday Length (hours)	10
Additional Setup Time (% Total Hours)	5%

To identify the impact of each member's share in the cooperative on individual cost savings a scenario of unequal acreage shares is done for each cooperative example. The acreage share percentage and number of acres is for each member in the three cooperative examples is shown in Table 7. In addition to these three pre selected acreage shares, an approximation of the breakeven share is found and shown in the results section. The total acres in these unequal share situations are equal to the total acres for the respective machinery cooperative example.

Table 7. Unequal Acreage Shares for Cooperative Examples

	Producer 1	Producer 2	Producer 3
Percent Share in Cooperative	50%	17%	33%
Wheat Cooperative	750	250	500
Cotton Cooperative	300	100	200
Hay Cooperative	150	50	100

In addition to the examination of unequal acreage shares, there is a need to identify the impact of an increase in acreage on the feasibility of the machinery cooperatives. For each machinery cooperative example, different acreage scenarios are examined by increasing the total acreage of the cooperative by 25, 50, 75 and 100%. Two other scenarios are examined for each machinery cooperative example by increasing the acreage through the addition of cooperative members. For each cooperative example, the number members are increased from three, four and five members. These additional members are assumed to have identical operations as the other producers in that machinery cooperative example.

One aspect of the machinery cooperative that is not found under individual ownership is the additional time required for transportation. The increase in the distance between members increases the number of required workdays. The question that needs to be answered is whether that increase impacts the ability of the machinery cooperative to complete all of the activities of the cooperative operations. The average distance between the machinery cooperative members used in all of the base scenarios is 10 miles. To see the impact this additional time requirement has the distance is increased to 25, 50, 75 and 100 miles. The assumption that the machinery is transported at a speed of 25 miles per hour is used in the calculations.

Hay Machinery Cooperative Case Study

Individual Ownership

The four producers considering a joint machinery venture had independently engaged in custom baling in previous years. They had now all four downsized their operations to encompass their owned land. Producers 1, 3 and 4 had approximately 100 acres hay and producer 2 had around 200 acres. From these acres the producers harvested two cuttings of hay in a typical year, once in March and once in June.

All of the participants had a compliment of relatively new (3-5 year old) hay equipment. Because of their previous custom baling activities, all of the producers had an equipment compliment with excess capacity for their current operation. However, after operating newer equipment none of the individuals was interested in trading down to older machinery. The machinery compliments and estimated value are summarized in Table 8.

Table 8. Individual Hay Machinery Complement for Hay Case Study

	Producer 1	Producer2	Producer 3	Producer 4
Tractor, 2WD	95HP	85HP	85HP	85HP
Mower, Rotary	10’	10’	14’	10’
Rake, Folding	20’	20’	20’	20’
Round Baler	5’	5’	4’	4’
Current Value	$87,000	$82,000	$82,000	$82,000

Cooperative Ownership

The machinery sharing venture analyzed was organized as a closed cooperative. A compliment of hay equipment which was capable of completing hay operations on the total hay acreage of the members was identified. The hay equipment identified consisted of the complement of equipment shown in Table 9.

Table 9. Hay Cooperative Case Study Machinery Complement

	Machinery Cooperative
Tractor, 2WD	95HP
Tractor, 2WD	95HP
Mower, Rotary	14’
Rake, Folding	30’
Round Baler	5’
Current Value	$170,000

The structure of two 95 HP tractors was recommended by the producers. The two tractor compliment was anticipated to enhance labor sharing by allowing one member to manage all of the mowing operations without having to coordinate for equipment. The producers also felt the two tractor compliment would enhance their ability to expand the cooperative into other machinery functions.

The equipment had an estimated cost of $170,000. It was assumed that the cooperative would have an initial capital structure of 50% equity and 50% debt. Under a typical structure for a closed machinery cooperative the members would be expected to sign usage agreement for their projected acreage and to make an initial equity investment in proportion to their share of the cooperative’s total project acreage.

CHAPTER IV

RESULTS

This chapter will review the findings for the three machinery cooperative examples and the case study described in Chapter III. Each scenario's results will be discussed in separate sections with the sections containing the results of the starting farm size, unequal share in cooperative, the percentage increases in acreage and increase in distance between members.

Wheat Machinery Cooperative

The current value of the wheat machinery cooperative equipment set is over two and a half times the value of an individual's equipment set. This is offset to the machinery cooperative members because these costs are shared equitably among the three machinery cooperative members. Table 10 shows that $136,800 would be required equity investment for a producer in this cooperative. This in turn results in a reduction of each producer's equity investment from individual ownership by 15%. This is an initial investment in machinery $23,500 less per producer than individual ownership. Because the structure of this cooperative is such that each producer is identical, producers share equally in the savings from reduced equity investment.

Table 10. Individual and Wheat Machinery Cooperative Equity Investment

	Individual Ownership	Machinery Cooperative
Total Equity Investment	$160,300	$136800
Equity Investment per acre	$321	$274

The results in Table 11 show how the fixed and variable operating costs change for the producers under individual and cooperative ownership. The values in Table 11 are the estimated per acre operating costs for the given fixed and variable costs associated with machinery ownership. The total fixed costs are reduced by $14 per acre for the machinery cooperative. In this example both total fixed and variable costs per acre are reduced. The increase in repairs and maintenance due to increased use and the addition of transportation cost do not exceed the reduction in fuel cost. The net effect on variable cost is a reduction of 11 cents.

Table 11. Individual and Machinery Cooperative Ownership Cost per Acre

	Individual Ownership	Machinery Cooperative
Fuel & Lube	11.32	10.64
Repair & Maintenance	2.41	2.68
Transportation		0.31
Total Variable Costs	13.73	13.62
Insurance & Housing	13.42	11.45
Interest	12.36	10.75
Property Tax	3.35	2.86
Depreciation	67.75	57.82
Total Fixed Costs	96.88	82.89
Total Cost	110.61	96.51

The total cost per acre cost of the machinery cooperative is $96.51 compared to the $110.61 total per acre cost of individual ownership. Each producer would have a 13% reduction in their machinery operating cost in the machinery cooperative.

All of the producers have an equal share in the wheat machinery cooperative in this scenario. Because of this, they all experience the same overall savings. To demonstrate the impact of a cooperative structure when there is an unequal share in the cooperative Table 12 shows the impact on initial investment and reduction in operating cost of four different acreage share possibilities.

Table 12. Comparison of Increasing Producer Acreage Share in Wheat Machinery Cooperative

	Producer Acreage Share			
	17%	33%	39%	50%
Acres	250	500	585	750
Initial investment	$68,400	$136,800	$160,056	$205,200
Operating Cost Reduction	53%	13%	0%	-22%

With these unequal acreage shares the producers' experience greater cost reduction with a lower share of the machinery cooperative's acreage. A producer with a 50% share of the total acreage would actually se an increase in machinery operating cost as well as initial equity investment. On the other end of the spectrum is the small share producer that would see substantially greater savings under cooperative ownership. It is at around 39% of the machinery cooperative acreage share that a producer would have approximately the same costs under individual and cooperative ownership. The large share producer is achieving more efficiency of the individual equipment complement thus accounting for the lack of savings in the machinery cooperative. It may not be concluded however that the producer would be unwilling to join the machinery cooperative because other factors could influence his decision making. In all of these acreage share comparisons the total acres of the cooperative remained at 1500 acres. The reduction in machinery operating cost in the machinery will also change as the total acres in production increase from the original acreage. The savings for increased acreage in production is show in Table 13.

Table 13. Machinery Operating Cost Reduction of Wheat Machinery Cooperative for Increased Acres

	Acres/ Member	Total Acreage	Cost Reduction
Base Acreage	500	1500	13%
Increase 25%	625	1875	12%
Increase 50%	750	2250	12%
Increase 75%	875	2625	11%
Increase 100%	1000	3000	11%

As the total acres of wheat in production increase the savings from the reduction in machinery operating cost decreases. Two factors are responsible for this decrease. One is due to the increase in use of the machinery causing a greater increase in variable cost relative to the reduction of fixed cost. The second is due to the individual machinery complements becoming more efficient as they cover more acreage.

Increasing the individual’s acreage reduces the difference in the per acre machinery cost of the individual and the machinery cooperative. Economies of scale are occurring under both types of ownership, but the wheat machinery cooperative is still achieving a reduction in machinery cost of 11%. Whether or not the operating activities are still able to be completed is a question Table 14 attempts to answer. This table shows the surplus or shortage of workdays for the completion of al activities for the wheat machinery cooperative.

Table 14. Workday Surplus or Shortage for Increasing Acreages in 3 Member Wheat Machinery Cooperative

Month	Base Acreage	Cooperative percent increase 25%	50%	75%	100%
Feb	18.79	17.40	16.01	14.62	13.23
Jun	9.69	7.75	5.82	3.88	1.95
Jul	11.29	9.90	8.51	7.12	5.73
Sep	13.29	11.90	10.51	9.12	7.73
Oct	10.22	7.12	4.03	0.93	-2.16
Nov	18.29	16.90	15.51	14.12	12.73

In this wheat cooperative example the ability of the cooperative to complete all of the activities in the available time period is not an issue up to a 75% increase. At that level the surplus of workdays drops below one day. When the wheat cooperative acreage is increased by 100% the sowing activity in October actually exceeds the available workdays. In the scenario with the 75% increase in acreage there are still surplus workdays available and around 11% cost reduction over individual ownership. The above scenarios for the wheat machinery cooperative found increased saving with a lower acreage share and a decrease in savings as individual acreage increased. The following wheat cooperative scenarios in Table 15 illustrate the impact of additional cooperative members on reduction in cost by adding acreage to the cooperative and reducing each member’s share in the wheat machinery cooperative.

Table 15. Comparison of 3, 4 and 5 Member Wheat Machinery Cooperative

	3 Member	4 Member	5 Member
Coop Acreage	1500	2000	2500
Initial Investment	$136,800	$ 102,600	$ 82,080
Operating Cost/Acre	96.51	76.62	65.05
Cost Reduction	13%	31%	41%

Increasing the initial three member wheat machinery cooperative structure to 4 and 5 members increases the total acres of cooperative wheat production to 2000 and 2500 acres respectively. The share of the total cooperative acreage for each member is reduced and the machinery operating cost reduction of the cooperative increased to 31% and 41% for the respective 4 and 5 member machinery cooperative structure. The increase in members and total acres not only increases the required time in the field, but also increases the time required for transportation of equipment between members. Table 16 shows that under these three wheat cooperative sizes, completion of all production activities is not hindered when there are 5 members. The surplus of workdays in October is however less than two and should be considered carefully. Once again it is the sowing activity in October that is of concern.

Table 16. Workday Shortage or Surplus for 3, 4 and 5 Member Wheat Machinery Cooperative

Month	3 Member	4 Member	5 Member
February	18.79	16.90	15.01
June	9.69	7.09	4.49
July	11.29	9.40	7.51
September	13.29	11.40	9.51
October	10.22	6.05	1.89
November	18.29	16.40	14.51

In all of the above wheat cooperative scenarios the average distance between the members of the cooperative has been held constant at 10 miles. The issue of transportation time is assumed to be an additional risk under cooperative ownership. Increasing this distance between the cooperative members requires additional transportation time which is added to the required field days. The surplus and shortage days are show in Table 17 for the increased distances between the wheat cooperative members.

Table 17. Workday Shortage or Surplus as Distance between Members Increases for 3 Member Wheat Machinery Cooperative

	Average Distance Between Wheat Cooperative Members			
Month	25 Miles	50 Miles	75 Miles	100 Miles
February	18.55	18.15	17.75	17.35
June	9.57	9.37	9.17	8.97
July	11.05	10.65	10.25	9.85
September	13.05	12.65	12.25	11.85
October	9.98	9.58	9.18	8.78
November	18.05	17.65	17.25	16.85

The workday shortage and surplus results in Table 17 are for the base wheat cooperative size. At no point does the increase in distance raise the required field days above the available workdays. Even the sowing activity that has been the limiting activity is able to be completed within the given time.

Cotton Machinery Cooperative

The complement of equipment for the cotton machinery cooperative has a total current value just over twice that of the individual cotton machinery complement. However, the total equity invest of each producer is offset in the machinery cooperative by sharing the cost with the other cooperative members. This in turn results in a reduction of each producer's required initial equity investment in machinery by around 32%. Table 18 shows the total dollar amount of equity investment as well as the per acre equity investment in machinery that would be required under individual and cooperative ownership for each producer.

Table 18. Individual and Cotton Machinery Cooperative Equity Investment

	Individual Ownership	Machinery Cooperative
Total Equity Investment	$ 127,800	$ 86,800
Equity Investment per acre	$ 639	$ 434

As indicated in Table 18, the initial investment is greatly reduced under cooperative ownership. The results in Table 19 show how the fixed and variable machinery operating costs change for the producers under individual and cooperative ownership. The results listed in Table 19 under each producer are the estimated per acre operating costs for the given fixed and variable costs associated with machinery ownership.

Table 19. Cotton Machinery Cooperative vs. Individual Ownership Cost per Acre

	Individual Ownership	Machinery Cooperative
Fuel & Lube	$ 11.62	$ 12.10
Repair & Maintenance	$ 2.45	$ 2.47
Transportation		$ 1.19
Total Variable Costs	$ 14.08	$ 15.75
Insurance & Housing	$ 26.74	$ 18.16
Interest	$ 24.63	$ 17.06
Property Tax	$ 6.69	$ 4.54
Depreciation	$ 135.04	$ 91.72
Total Fixed Costs	$ 193.10	$ 131.48
Total Cost	$ 207.18	$ 147.09

Just as with equity investment, per acre fixed costs are greatly reduced for the machinery cooperative. This is expected since the fixed costs are distributed over a greater number of acres and shared with other producers. In this example, the total variable costs of the machinery cooperative increase by $1.67 per acre over individual ownership due to the increase in the use of the equipment as well as the addition of transportation cost. The total cost per acre cost of the machinery cooperative is $147.09 or 29% less than the average per acre machinery operating cost of the producers individual ownership cost.

Because all of the producers have identical acreages and individual machinery complements their savings are equal. Each producer accounts for 33% of the base acreage for the cotton machinery cooperative. To demonstrate the impact of a cooperative structure when there is an unequal share in the cooperative acreage other acreage share variations are shown in Table 20.

Table 20. Comparison of Increasing Producer Acreage Share in Cotton Machinery Cooperative

	Producer Acreage Share			
	17%	33%	48%	50%
Acres	100	200	290	300
Initial investment	$43,400	$86,800	$125,860	$130,200
Operating Cost Reduction	63%	29%	1%	-2%

In these unequal acreage share scenarios the producers' initial investment increases and their reduction in machinery operating cost decrease. With a 17% share in the cooperative acreage a producer would reduce his machinery operating costs by 63%. A producer with 50% of the cooperative acreage would experience an increase in both initial investment and machinery operating cost. At just over 48% of the cooperative acreage a producer would have about the same costs as an individual and under cooperative ownership. In these acreage share comparisons the total acres of the cooperative remained at 600 acres.

The percent savings of the machinery cooperative will also change as the total acres in production change. The savings for increased acreage in production of the cotton machinery cooperative is show in Table 21.

Table 21. Machinery Operating Cost Reduction of Cotton Machinery Cooperative for Increased Acres

	Acres/ Member	Total Acreage	Cost Reduction
Base Acreage	200	600	29%
Increase 25%	250	750	28%
Increase 50%	300	900	28%
Increase 75%	350	1050	27%
Increase 100%	400	1200	26%

As the total acres of cotton in production increase the savings from the reduction in machinery operating cost decreases. Two factors are responsible for this decrease. One is due to the increase in use of the machinery causing a greater increase in variable cost relative to the reduction of fixed cost. The second is due to the individual machinery complements becoming more efficient as they cover more acreage.

Increasing the individual's acreage reduces the difference in the per acre machinery cost of the individual and the machinery cooperative. Economies of scale are occurring under both types of ownership, but the cotton machinery cooperative is still achieving a reduction in machinery cost of 26%. Whether or not the operating activities are still able to be completed is a question Table 22 attempts to answer. This table shows the surplus or shortage of workdays for the completion of al activities for the cotton machinery cooperative.

Table 22. Workday Shortage or Surplus as Distance between Members Increases for 3 Member Cotton Machinery Cooperative

	Base	Percent Increase in Cooperative Acreage			
Month	Acreage	25%	50%	75%	100%
May	7.36	6.03	4.70	3.37	2.04
June	14.37	13.81	13.26	12.703	12.15
July	18.62	18.06	17.51	16.95	16.40
August	14.99	13.88	12.77	11.66	10.55
October	13.87	13.31	12.76	12.20	11.65
November	13.28	11.50	9.71	7.93	6.14

In this cotton cooperative example the ability of the cooperative to complete all of the activities in the available time period as the acreage increases does not appear to be an issue. When the cotton cooperative acreage is increased by 100% the combination of planting and spraying activities in May bring the workday surplus down to its lowest amount of 2 days. While the surplus of workdays for May time period is somewhat slim in the 50 and 75% acreage increase as well on can assume that, given the 95% confidence of completion workday levels, to activities would be completed.

The above scenarios for the cotton machinery cooperative found increased savings with a lower acreage share and a decrease in savings as individual acreage increased. The following cotton cooperative scenarios in Table 23 illustrate the impact additional cooperative members will have on initial invest men and reduction in machinery operating cost.

Table 23. Comparison of 3, 4 and 5 Member Cotton Machinery Cooperative

	3 Member	4 Member	5 Member
Coop Acreage	600	800	1000
Initial Investment	$86,800	$65100	$52080
Operating Cost/Acre	147.23	114.75	95.52
Operating Cost Reduction	29%	45%	54%

Increasing the initial three member cotton machinery cooperative structure to 4 and 5 members increases the total acres of cooperative hay production to 800 and 1000 acres respectively. The share of the total cooperative acreage for each member is reduced and the percent savings of the cooperative members increases to 45% and 54% for the 4 and 5 member cooperative structure. The increase in members and total acres not only increases the required time in the field, but also increases the time required for transportation of equipment between members. Table 24 shows that under these three cotton cooperative sizes, completion of all production activities are not hindered even when 5 members are added to the machinery cooperative. Once again it is the planting and spraying activities in May that come closest to reaching the available workdays.

Table 24. Workday Surplus or Shortage for 3, 4 and 5 Member Cotton Machinery Cooperative

Month	3 Member	4 Member	5 Member
May	7.36	5.51	3.65
June	14.37	13.59	12.81
July	18.62	17.84	17.06
August	14.99	13.43	11.87
October	13.87	13.09	12.31
November	13.28	10.88	8.48

In all of the above cotton cooperative scenarios the average distance between the members of the cooperative has been held constant at 10 miles. The issue of transportation time is assumed to be an additional risk under cooperative ownership. Increasing this distance between the cooperative members requires additional transportation time which is added to the required field days. The surplus and shortage of workdays are show in Table 25 for the increased distances between the cotton cooperative members.

Table 25. Workday Surplus for Increased Distance Between 3 Cotton Machinery Cooperative Members

	Distance Between Cotton Machinery Cooperative Members			
Month	25 Miles	50 Miles	75 Miles	100 Miles
May	6.88	6.08	5.28	4.48
June	14.13	13.73	13.33	12.93
July	18.38	17.98	17.58	17.18
August	14.51	13.71	12.91	12.11
October	13.63	13.23	12.83	12.43
November	13.16	12.96	12.76	12.56

The workday results in Table 25 are for the base cotton cooperative size. Even at the farthest distance of 100 miles between members it is not a problem for the cotton machinery cooperative to complete all of its operations within the available workdays.

Hay Machinery Cooperative

The complement of equipment for the machinery cooperative has a current value around twice that of any producer owning equipment individually. However, this increase in total equity invest is offset in the machinery cooperative through sharing costs with multiple producers. This in turn results in a reduction of each producer’s initial equity investment by over 30%. Table 26 compares the total dollar amount of equity investment required for individual and cooperative ownership as well as the per acre investment that would be required.

Table 26. Producer Individual and Hay Machinery Cooperative Equity Investment

	Individual Ownership	Machinery Cooperative
Total Equity Investment	$ 41,000	$ 28,333
Equity Investment per acre	$ 410	$ 283

As indicated in Table 26, the initial investment is greatly reduced under cooperative ownership. The results in Table 27 show the fixed and variable costs for the producers under individual and cooperative ownership. The values in Table 27 are the estimated per acre costs for the given fixed and variable costs associated with machinery ownership. Just as with equity investment, per acre fixed costs are greatly reduced for the hay machinery cooperative. This is expected since the fixed costs are distributed over a greater number of acres. In this example, the variable costs of the machinery cooperative increase due to the increased use of the equipment. The net impact of the changes in fixed and variable cost are found in the change in total cost shown at the bottom of Table 27.

Table 27. Individual vs. Hay Machinery Cooperative Ownership Cost per Acre

	Individual Ownership	Machinery Cooperative
Fuel & Lube	$ 7.43	$ 10.60
Repair & Maintenance	$ 1.04	$ 2.26
Transportation		$ 1.67
Total Variable Costs	$ 8.46	$ 14.53
Insurance & Housing	$ 17.16	$ 11.86
Interest	$ 15.80	$ 11.14
Property Tax	$ 4.29	$ 2.96
Depreciation	$ 86.65	$ 59.88
Total Fixed Costs	$ 123.90	$ 85.84
Total Cost	$ 132.36	$ 100.36

The total cost per acre cost of the machinery cooperative is $100.36 or 24% less than the average of the per acre cost of the individual ownership. Because all of the producers are identical they all experience the same 24% reduction in machinery operating costs. The machinery cooperative contains an additional cost of transportation which would not be generated under individual ownership. This specific variable cost category is discussed further in a later subsection of this machinery cooperative example.

In this cooperative example all of the producers have an equal share in the hay machinery cooperative. Because of this, they all experience the same overall savings in the above scenario. To demonstrate the impact of a cooperative structure when there is an unequal share in the cooperative four acreage shares shown in Table 28 illustrating the impact on initial investment ant reduction in machinery operating cost.

Table 28. Comparison of Increasing Producer Acreage Share in Hay Machinery Cooperative

	Producer Acreage Share			
	17%	33%	45%	50%
Acres	50	100	135	150
Initial investment	$14,167	$28,333	$38,250	$42,500
Operating Cost Reduction	61%	24%	0%	-10%

In these unequal acreage share scenarios for the hay machinery cooperative the producer with the lowest share of the acreage achieves the greatest reduction in machinery operating costs over individual ownership. The producer with a 17% share of the total acreage had a 61% reduction in machinery operating cost as opposed to a producer with a 50% share having a 10% increase in machinery operating cost. The bread even acreage share amount for this hay machinery cooperative example is close to a 45% share. At this acreage share the producer would see approximately the same machinery cost under individual and cooperative ownership. In the acreage share comparisons the total acres of the cooperative remained at 300 acres. The percent savings of the machinery cooperative also change as the total acres in production change. The savings for increased acreage in production is shown in Table 29.

Table 29. Hay Machinery Cooperative Savings with Increased Acres

	Acres/ Member	Total Acreage	Cost Reduction
Base Acreage	100	300	24%
Increase 25%	125	375	23%
Increase 50%	150	450	21%
Increase 75%	175	525	20%
Increase 100%	200	600	18%

As the total acres of hay in production increase the percent savings decreases. This decrease is the result of two factors which reduce the difference in the individual and machinery cooperative total cost. The first factor causing this change is the increase in use of the equipment in the machinery cooperative increases the variable costs more than the fixed costs are reduced. The second factor is the increased efficiency of the individual's own equipment because of the increase in acreage. Although there is a decrease in percent saving of the machinery cooperative as the total acres increase, there is still a potential for producers to decrease their machinery cost. Whether or not the operating activities are still able to be completed is a question Table 30 attempts to answer.

Table 30. Workday Shortage or Surplus as Distance Between Members Increases for 3 Member Hay Machinery Cooperative

	Base	Cooperative percent Increase			
Month	Acreage	25%	50%	75%	100%
Tractor 1					
March	15.11	13.88	12.66	11.43	10.21
June	8.86	7.63	6.41	5.18	3.96
Tractor 2					
March	15.79	14.74	13.68	12.63	11.58
June	9.54	8.49	7.43	6.38	5.33

In this hay cooperative example the ability of the cooperative to complete all of the activities in the available time period is never in jeopardy. Even in the scenario with the maximum increase in acreage there are still surplus workdays available and nearly 18% machinery cost reduction.

The above scenarios for the hay machinery cooperative found increased saving with a lower acreage share and a decrease in savings as individual acreage increased. The following hay cooperative scenarios in Table 31 illustrate the impact of additional cooperative members on percent savings by adding acreage to the cooperative and reducing each member's share in the hay machinery cooperative.

Table 31. Comparison of 3, 4 and 5 Member Hay Machinery Cooperative

	3 Member	4 Member	5 Member
Coop Acreage	300	400	500
Initial Investment	$ 28,333	$ 21250	$ 17000
Cost/Acre	$ 100.36	$ 79.43	$ 67.09
% Savings	23.56%	39.99%	49.31%

The addition of one and two more producers to the initial three member cooperative structure increases the total acres of cooperative hay production to 400 and 500 acres respectively. The share of the total cooperative acreage for each member is reduced and the percent savings of the cooperative members increases as the number of members increases. The increase in members and total acres not only increases the required time in the field, but also increases the time required for transportation. Table 32 shows that under this structure of hay cooperative, completion of all production activities is not effected by the increase in members in the cooperative.

Table 32. Workday Surplus or Shortage for 3, 4 and 5 Member Hay Machinery Cooperative

Month	3 Member	4 Member	5 Member
Tractor 1			
March	15.11	13.42	11.72
June	8.86	7.17	5.47
Tractor 2			
March	15.79	14.33	12.86
June	9.54	8.08	6.61

In all of the above hay cooperative scenarios the average distance between the members of the cooperative has been held constant at 10 miles. The issue of transportation time is assumed to be an additional risk under cooperative ownership. Increasing this distance requires additional time which is added to the required field days. The results for increased distances are show in Table 33 for the surplus of workdays.

Table 33. Workday Surplus for Increased Distance between 3 Hay Machinery Cooperative Members

	Distance Between Hay Cooperative Members			
	25 Miles	50 Miles	75 Miles	100 Miles
Tractor 1				
March	14.75	14.15	13.55	12.95
June	8.50	7.90	7.30	6.70
Tractor 2				
March	15.43	14.83	14.23	13.63
June	9.18	8.58	7.98	7.38

The workday results in Table 33 are for the base hay cooperative size. At no point over the increase in distance is there a shortage of workdays for the hay machinery cooperative.

Hay Machinery Cooperative Case Study

The complement of equipment for the case study machinery cooperative has a current value around twice that of any producer owning equipment individually. However, this increase in total equity investment is offset by the increase in total acres and number of producers sharing the cost as a result of cooperative ownership. This in turn results in a reduction of each producer's equity investment by around 60% for producers 1, 3 and 4 and about 17% for producer 2. Table 34 shows the total dollar amount for this investment as well as the per acre investment that would be required. Because producer 1 has the highest current value of machinery, he has the highest equity investment per acre as an individual, but then realizes the greatest savings under the cooperative structure. Conversely, producer two has more acreage than the other producers and thus his equity investment is reduced much less than the other members.

Table 34. Producer Individual and Case Study Cooperative Equity Investment

	Producer 1	Producer 2	Producer 3	Producer 4
Current Equity Investment Individually	$43,500	41,000	41,000	41,000
Current Equity Investment/Acre	435	205	410	410
Required Investment in Cooperative	17,000	34,000	17,000	17,000
Required Coop Investment/acre	170	170	170	170

As indicated in Table 34 the initial investment is greatly reduced under cooperative ownership. The results in Table 35, however, show how the fixed and variable operating costs change for the producers under individual and cooperative ownership. The dollar amounts listed in Table 35 under each producer are the estimated per acre operating costs for the given fixed and variable costs associated with machinery ownership. Just as with equity investment, per acre fixed costs are greatly reduced for the machinery cooperative. This is expected since the fixed costs are distributed over a greater number of acres. In this example, the variable costs of the machinery cooperative increase due to the increase in the use of the equipment. What is also of interest, are the impacts these changes in fixed and variable costs have on the total cost shown at the bottom of Table 35.

Table 35. Case Study Cooperative vs. Individual Ownership Cost per Acre

	Machinery Cooperative	Producer 1	Producer 2	Producer 3	Producer 4
Fuel & Lube	10.60	8.30	7.43	6.48	7.43
Repair & Maintenance	3.49	1.55	2.78	1.33	1.54
Transportation	1.26				
Total Variable Costs	15.34	9.85	10.21	7.82	8.96
Insurance & Housing	7.11	18.20	8.58	17.16	17.16
Interest	6.68	16.77	7.90	15.80	16.80
Property Tax	1.78	4.55	2.14	4.29	4.29
Depreciation	35.93	91.93	43.32	86.65	86.65
Total Fixed Costs	51.50	131.45	61.95	124.05	124.10
Total Cost	66.84	141.31	72.16	131.72	132.86

The total cost per acre cost of the case study hay machinery cooperative is $66.84 or 39% less than the average of the per acre operating cost of the machinery cooperative members cost of individual ownership. The machinery cooperative contains an additional cost of transportation which would not be generated under individual ownership. Table 36 illustrates the differences in the machinery operating cost reduction for the producers of the hay machinery cooperative in this case study. The individual variations are due to the differences in individual equipment complements and the different number of acres in production.

Table 36. Case Study Cooperative Machinery Operating Cost Reduction

	Machinery Cooperative	Producer 1	Producer 2	Producer 3	Producer 4
Cost Reduction	39%	53%	7%	49%	50%

Producer 2 would receive the least benefit from joining the cooperative because he has twice as many acres as the other producers. His acreage accounts for 40% of the total acres in the machinery cooperative. Producer 1 has the most expensive individual equipment complement and sees the greatest reduction in machinery operating cost at 53%. From this examination it is clear that the amount of acres a producer has in production will greatly impact the cost reduction of the members of the machinery cooperative. The ability of the producers to complete the operating activities is of great importance concerning the feasibility of the machinery cooperative. Table 37 has the available and required working days for this hay machinery cooperative case study.

Table 37. Available vs. Required Days for Case Study Individual and Hay Cooperative

Month	Available Workdays	Individual Ownership Producer 1	Producer 2	Producer 3	Producer 4	Cooperative Ownership
Tractor 1						
Mar	20.25	3.50	6.50	3.00	3.50	8.47
Jun	14.00	3.50	6.50	3.00	3.50	8.47
Tractor 2						
Mar	20.25					7.33
Jun	14.00					7.33

With the given equipment complement chosen by the producers in this case study, all of the hay productions activities would be able to be completed within the given time periods. The total time required is less than 5 days greater than producer 2’s required days as an individual. Cooperative machinery ownership would reduce the time required for each producer even with the addition of transportation.

CHAPTER V

SUMMARY AND CONCLUSION

Summary

As machinery costs continue to increase and greater emphasis is placed on technology and conservation in production agriculture, the need for producers to find ways to reduce costs will increase. This research was an attempt to answer some of the problems agricultural producers face with rising machinery costs. Machinery cooperatives were analyzed as a possible solution to reducing producers' machinery costs. Three possible machinery cooperatives were examined for wheat, cotton and hay production as well as a case study for a group of Oklahoma hay producers. In these examples considerations were made for the equipment complements, debt and equity, transportation and available working days to name a few.

Through analyzing these different machinery cooperative examples three objectives were kept in mind. 1) Identify the potential for machinery cost savings through the formation of machinery cooperative. 2) Examine the types of equipment production operations that would work best under cooperative ownership. 3) Examine the structure of the cooperative that would achieve the best results for the producers.

To accomplish these objectives a machinery cooperative feasibility template was developed to calculate machinery cost and working days. Machinery cost calculations were integrated into the spreadsheet to compute the cost of individual and cooperative machinery complements for one to five producers with various acreage amounts. Calculations for required working days were also used in the template to determine how the increase in acreage, members and distance between members would impact the feasibility of a machinery cooperative.

Conclusions

The results of this research found that there is a potential for Oklahoma producers to reduce their machinery costs through the formation of machinery cooperatives. The range in the reduction of machinery operating cost for all of the machinery cooperatives was -22% to 63%. The times where the producers had an increase in machinery operating cost came when there was an unequal share in the total machinery cooperative acreage. In the case the three cooperative examples when a producer had 50% of the total acreage share of the machinery cooperative the producers machinery operating costs rose above those of individual ownership. This does not mean that a producer would be unwilling to participate in the machinery cooperative. There may still be other incentives the producer would perceive as beneficial. The individual workdays required by the producers was reduced in many cases. Producers with off farm income may value this ability to use their time elsewhere more than the additional cost.

As the number of members in the cooperatives increased the producers in the three examples saw more reduction in their machinery operating cost as well as in their required initial investment in machinery. The range in operating cost reduction of these three examples over the different number of members was 12% to 53%. The machinery cooperatives were able to complete all of the required activities in all 3, 4 and 5 member machinery cooperatives. The initial investment requirements for the 3, 4 and 5 member machinery cooperatives are shown in Table 38. This reduction in equity investment would free up capital for other farm or non-farm investment. This would also help a producer that would be unable to acquire an entire equipment complement individually. This frees up some of a producers debt or helps to reach the amount a producer can borrow.

Table 38. Initial Investment for Three Production Examples

Producers Sharing Cost	Production Type		
	Wheat	Cotton	Hay
Individual	$ 160,300	$ 127,800	$ 41,000
3 Member	$ 136,800	$ 86,800	$ 28,333
4 Member	$ 102,600	$ 65,100	$ 21,250
5 Member	$ 82,080	$ 52,080	$ 17,000

The only case in which the ability of any of the machinery cooperative examples was unable to complete all of the required activities for production was when the acres in wheat production were doubled. The activity that was limited was for this scenario was the sowing activity. While none of the other machinery cooperative examples exceeded the available workdays the seeding activities in the cotton and wheat machinery cooperative came very close to the maximum available workdays. Because a 95% confidence of completion was used in all of these examples this may not be as much of a concern as hypothesized. It should be pointed out that these results are for a selected equipment complement and would vary under a different machinery complement.

The cotton production activity is very intensive in the fact that chemicals must be applied throughout the process. This may have helped to increase the savings because the sprayer would be utilized with great frequency in the machinery cooperative. The hay machinery cooperative and the hay machinery cooperative case study utilize basically the same equipment complements under individual and cooperative ownership. This machinery is well under its capacity when owned individually so the benefit of the machinery cooperative is the increased capacity and therefore the reduction in machinery operating cost.

The wheat and cotton machinery complements utilized economies of scale by adding an additional wheat combine and cotton picker to their respective machinery complements. In the case of the wheat cooperative the two combine were also larger than the one in the individual machinery complement. This is perhaps the reason the harvest time does not face a shortage of workdays. Also in these two machinery cooperative examples, the combines and cotton pickers require the highest equity investment in their respective machinery complement.

In much the same way as the wheat and cotton cooperatives added harvesting equipment, the hay cooperative added an additional tractor to the machinery complement. While the number of hay harvesting implements remained the same, the ability to simultaneously use more than one piece of equipment came from the addition of another tractor. Just as with the harvest equipment in the wheat and cotton examples the tractor added to the hay cooperative’s machinery complement has the highest value of the entire set of equipment.

The cooperative structure requires additional time for transportation. This is one factor producers must consider over the savings of the cooperative. In these three examples and in the case study this did not present any problems with the completion of the operating activities. While these examples did not present any problems it should still be considered in decision making. Also, this may add some value to future discussion on machinery cooperative that operate over multiple regions.

Limitations & Future Study

The largest obstacle for the future of machinery cooperatives is the underlying interest of the farmers. While the machinery cooperative may reduce the farmer's initial investment, per acre cost and time requirement, many farmers may be unwilling to give up some of their individual control. Producers face many uncertainties like commodity prices, input prices and annual weather variations. Having that individual control allows greater flexibility to adapt to these variations. Producers must analyze their own preferences to see if a machinery cooperative would be able to improve his personal utility.

This is perhaps an area where machinery cooperatives should be researched further. Identifying the characteristics producers' value and applying that information to the machinery cooperative would allow researchers to identify the utility producers would gain under different machinery cooperative structures. Additional research concerning the structure for machinery cooperatives is needed to help producers understand all of the options available as well as potentially identifying a structure that would help to further achieve their objectives.

This research analyzed producers located in the same region but further study should include methods that examine the possible gains from members being located in separate regions. This could possibly result in an increase of working days available due to the differences in optimal planting and harvesting periods. One method of improving this area of the research would be to update the available workday data for Oklahoma. This could be done for more specific time periods other than the month increments used in this study. The regional descriptions could also be more descriptive so that producers would be able to select a more specific region of their production. Another means of improving future study of machinery cooperatives would be to add other expenses and producer revenues. This would help to give a better over estimate of savings and producer profits.

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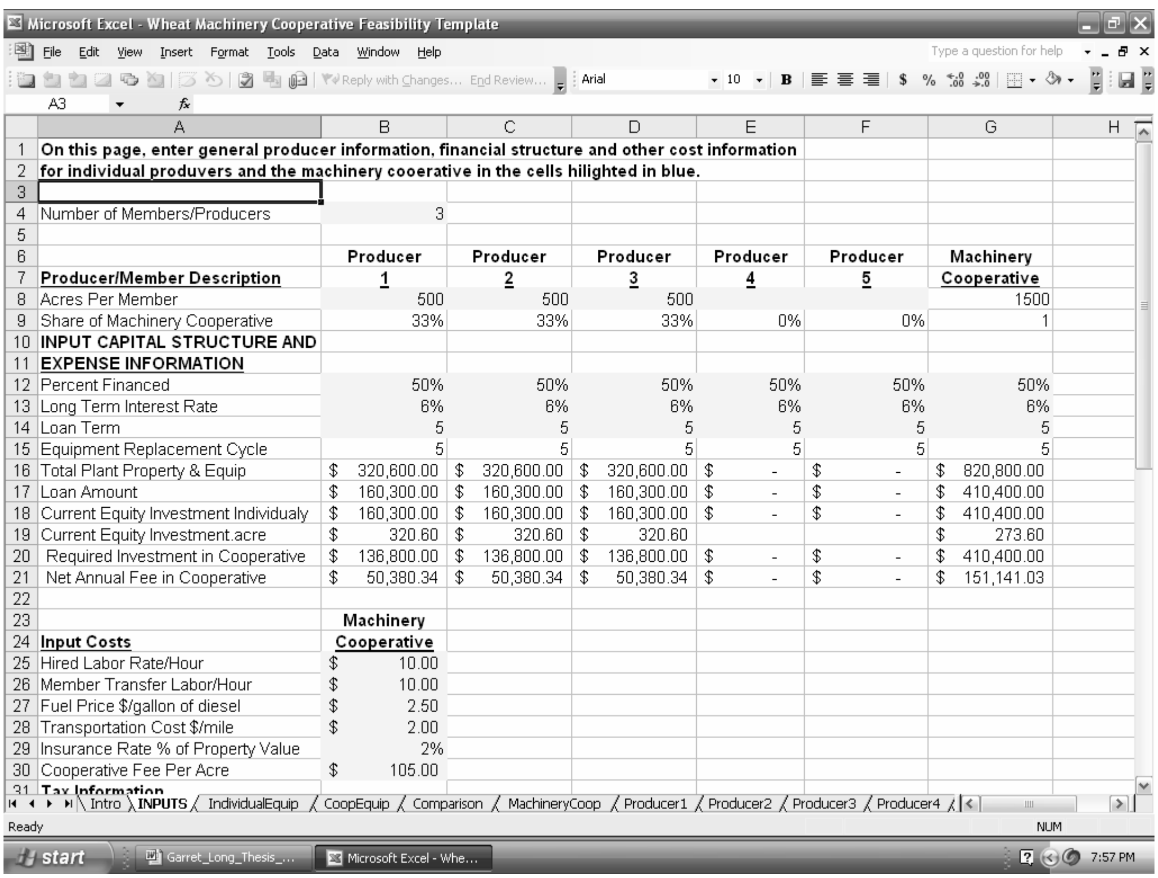
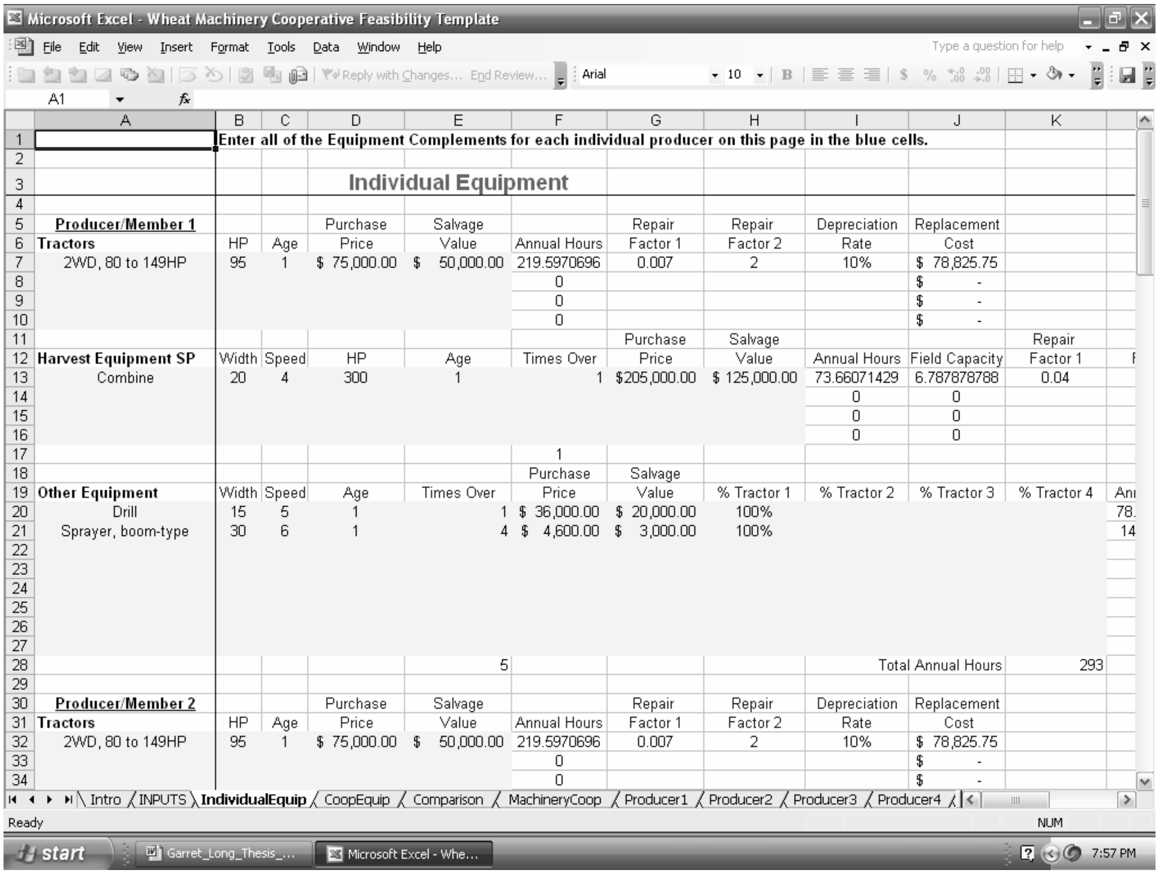
APPENDIX

MACHINERY COOPERATIVE FEASIBILITY TEMPLATE

This appendix shows three screen views of the Machinery Cooperative Feasibility Template used in this paper. These are the three input pages where users input their information for costs and individual and machinery equipment complements.

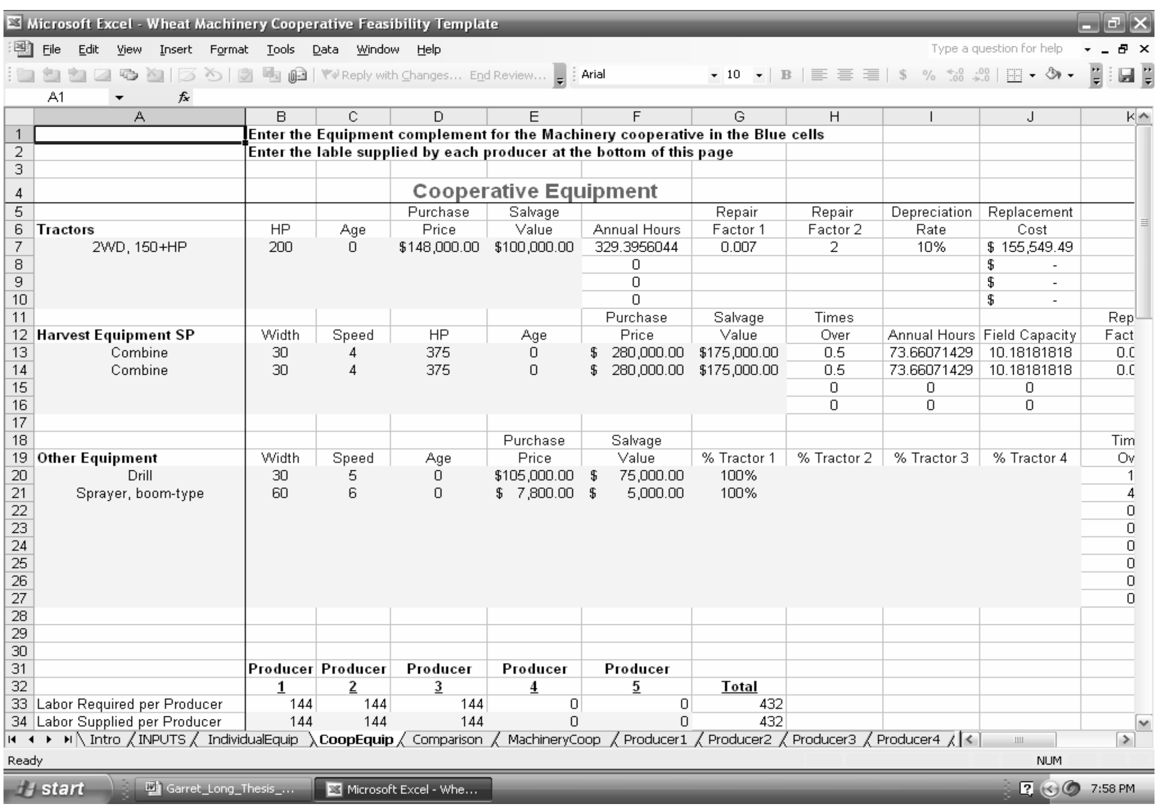


	A	B	C	D	E	F	G	H
1	**On this page, enter general producer information, financial structure and other cost information**							
2	**for individual produvers and the machinery cooerative in the cells hilighted in blue.**							
3								
4	Number of Members/Producers	3						
5								
6		**Producer**	**Producer**	**Producer**	**Producer**	**Producer**	**Machinery**	
7	**Producer/Member Description**	**1**	**2**	**3**	**4**	**5**	**Cooperative**	
8	Acres Per Member	500	500	500			1500	
9	Share of Machinery Cooperative	33%	33%	33%	0%	0%	1	
10	**INPUT CAPITAL STRUCTURE AND**							
11	**EXPENSE INFORMATION**							
12	Percent Financed	50%	50%	50%	50%	50%	50%	
13	Long Term Interest Rate	6%	6%	6%	6%	6%	6%	
14	Loan Term	5	5	5	5	5	5	
15	Equipment Replacement Cycle	5	5	5	5	5	5	
16	Total Plant Property & Equip	$ 320,600.00	$ 320,600.00	$ 320,600.00	$ -	$ -	$ 820,800.00	
17	Loan Amount	$ 160,300.00	$ 160,300.00	$ 160,300.00	$ -	$ -	$ 410,400.00	
18	Current Equity Investment Individualy	$ 160,300.00	$ 160,300.00	$ 160,300.00	$ -	$ -	$ 410,400.00	
19	Current Equity Investment.acre	$ 320.60	$ 320.60	$ 320.60			$ 273.60	
20	Required Investment in Cooperative	$ 136,800.00	$ 136,800.00	$ 136,800.00	$ -	$ -	$ 410,400.00	
21	Net Annual Fee in Cooperative	$ 50,380.34	$ 50,380.34	$ 50,380.34	$ -	$ -	$ 151,141.03	
22								
23		**Machinery**						
24	**Input Costs**	**Cooperative**						
25	Hired Labor Rate/Hour	$ 10.00						
26	Member Transfer Labor/Hour	$ 10.00						
27	Fuel Price $/gallon of diesel	$ 2.50						
28	Transportation Cost $/mile	$ 2.00						
29	Insurance Rate % of Property Value	2%						
30	Cooperative Fee Per Acre	$ 105.00						
31	**Tax Information**							


Microsoft Excel - Wheat Machinery Cooperative Feasibility Template

	A	B	C	D	E	F	G	H	I	J	K	L
1		Enter all of the Equipment Complements for each individual producer on this page in the blue cells.										
2												
3				Individual Equipment								
4												
5	**Producer/Member 1**			Purchase	Salvage		Repair	Repair	Depreciation	Replacement		
6	**Tractors**	HP	Age	Price	Value	Annual Hours	Factor 1	Factor 2	Rate	Cost		
7	2WD, 80 to 149HP	95	1	$ 75,000.00	$ 50,000.00	219.5970696	0.007	2	10%	$ 78,825.75		
8						0				$ -		
9						0				$ -		
10						0				$ -		
11							Purchase	Salvage			Repair	
12	**Harvest Equipment SP**	Width	Speed	HP	Age	Times Over	Price	Value	Annual Hours	Field Capacity	Factor 1	F
13	Combine	20	4	300	1	1	$205,000.00	$ 125,000.00	73.66071429	6.787878788	0.04	
14									0	0		
15									0	0		
16									0	0		
17						1						
18						Purchase	Salvage					
19	**Other Equipment**	Width	Speed	Age	Times Over	Price	Value	% Tractor 1	% Tractor 2	% Tractor 3	% Tractor 4	Ann
20	Drill	15	5	1	1	$ 36,000.00	$ 20,000.00	100%				78.
21	Sprayer, boom-type	30	6	1	4	$ 4,600.00	$ 3,000.00	100%				14
22												
23												
24												
25												
26												
27												
28					5				Total Annual Hours		293	
29												
30	**Producer/Member 2**			Purchase	Salvage		Repair	Repair	Depreciation	Replacement		
31	**Tractors**	HP	Age	Price	Value	Annual Hours	Factor 1	Factor 2	Rate	Cost		
32	2WD, 80 to 149HP	95	1	$ 75,000.00	$ 50,000.00	219.5970696	0.007	2	10%	$ 78,825.75		
33						0				$ -		
34						0				$ -		

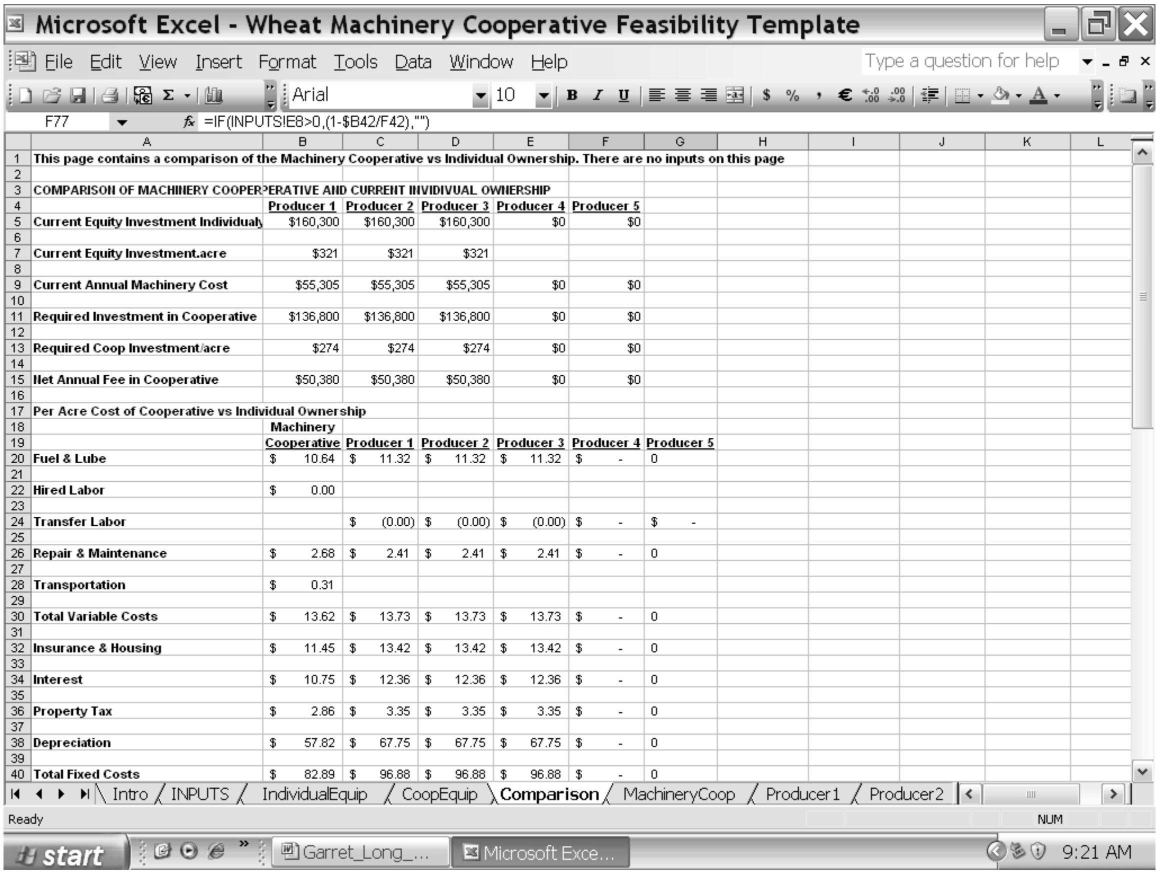
Intro / INPUTS / IndividualEquip / CoopEquip / Comparison / MachineryCoop / Producer1 / Producer2 / Producer3 / Producer4


Microsoft Excel - Wheat Machinery Cooperative Feasibility Template

	A	B	C	D	E	F	G	H	I	J	K
1		Enter the Equipment complement for the Machinery cooperative in the Blue cells									
2		Enter the lable supplied by each producer at the bottom of this page									
3											
4					Cooperative Equipment						
5				Purchase	Salvage		Repair	Repair	Depreciation	Replacement	
6	**Tractors**	HP	Age	Price	Value	Annual Hours	Factor 1	Factor 2	Rate	Cost	
7	2WD, 150+HP	200	0	$148,000.00	$100,000.00	329.3956044	0.007	2	10%	$ 155,549.49	
8						0				$ -	
9						0				$ -	
10						0				$ -	
11						Purchase	Salvage	Times			Rep
12	**Harvest Equipment SP**	Width	Speed	HP	Age	Price	Value	Over	Annual Hours	Field Capacity	Fact
13	Combine	30	4	375	0	$ 280,000.00	$175,000.00	0.5	73.66071429	10.18181818	0.0
14	Combine	30	4	375	0	$ 280,000.00	$175,000.00	0.5	73.66071429	10.18181818	0.0
15								0	0	0	
16								0	0	0	
17											
18					Purchase	Salvage					Tim
19	**Other Equipment**	Width	Speed	Age	Price	Value	% Tractor 1	% Tractor 2	% Tractor 3	% Tractor 4	Ov
20	Drill	30	5	0	$105,000.00	$ 75,000.00	100%				1
21	Sprayer, boom-type	60	6	0	$ 7,800.00	$ 5,000.00	100%				4
22											0
23											0
24											0
25											0
26											0
27											0
28											
29											
30											
31		**Producer**	**Producer**	**Producer**	**Producer**	**Producer**					
32		**1**	**2**	**3**	**4**	**5**	**Total**				
33	Labor Required per Producer	144	144	144	0	0	432				
34	Labor Supplied per Producer	144	144	144	0	0	432				

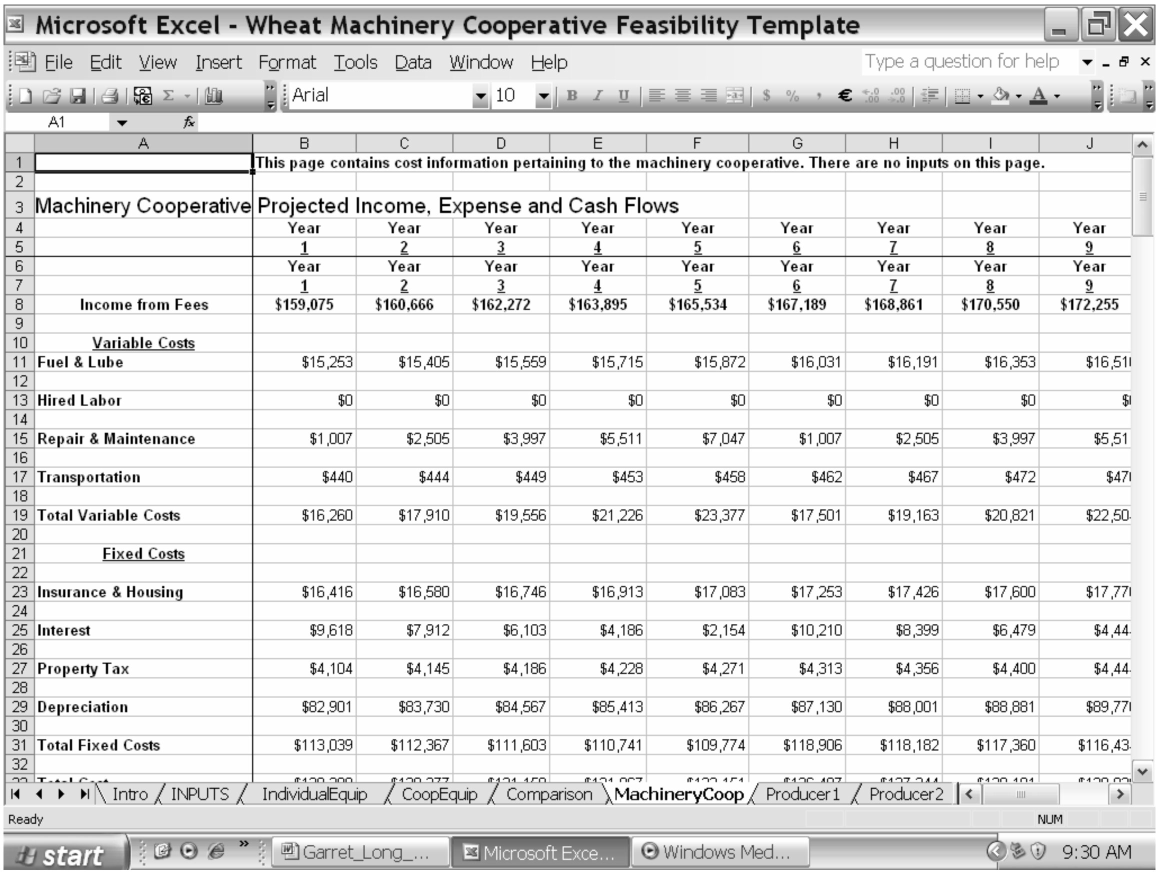
Intro / INPUTS / IndividualEquip / CoopEquip / Comparison / MachineryCoop / Producer1 / Producer2 / Producer3 / Producer4

The following images show the outputs for the machinery cooperative feasibility template. The comparison page shows the side by side costs of equity investment and machinery operating cost of individual and cooperative ownership.



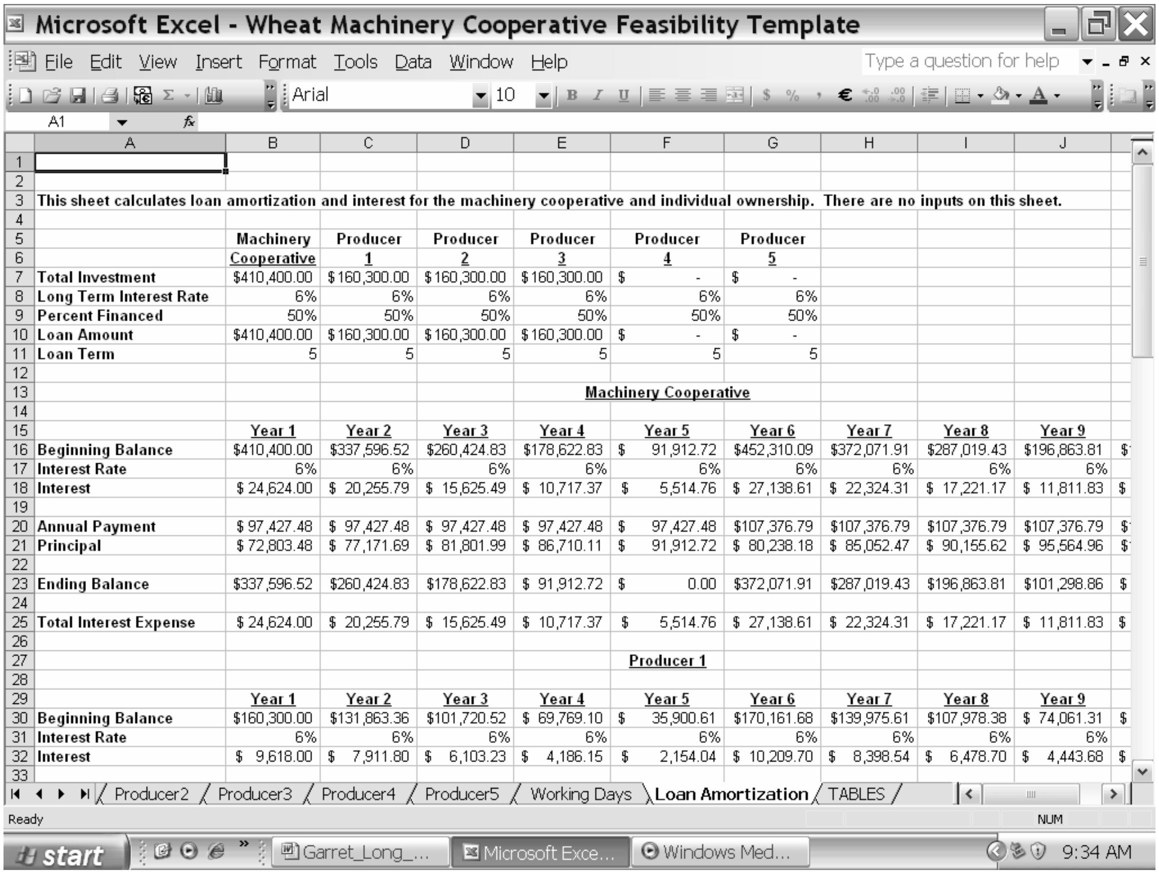
	A	B	C	D	E	F	G
1	This page contains a comparison of the Machinery Cooperative vs Individual Ownership. There are no inputs on this page						
2							
3	COMPARISON OF MACHINERY COOPER?ERATIVE AND CURRENT INVIDIVUAL OWNERSHIP						
4		Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	
5	Current Equity Investment Individualy	$160,300	$160,300	$160,300	$0	$0	
6							
7	Current Equity Investment.acre	$321	$321	$321			
8							
9	Current Annual Machinery Cost	$55,305	$55,305	$55,305	$0	$0	
10							
11	Required Investment in Cooperative	$136,800	$136,800	$136,800	$0	$0	
12							
13	Required Coop Investment/acre	$274	$274	$274	$0	$0	
14							
15	Net Annual Fee in Cooperative	$50,380	$50,380	$50,380	$0	$0	
16							
17	Per Acre Cost of Cooperative vs Individual Ownership						
18		Machinery					
19		Cooperative	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5
20	Fuel & Lube	$ 10.64	$ 11.32	$ 11.32	$ 11.32	$ -	0
21							
22	Hired Labor	$ 0.00					
23							
24	Transfer Labor		$ (0.00)	$ (0.00)	$ (0.00)	$ -	$ -
25							
26	Repair & Maintenance	$ 2.68	$ 2.41	$ 2.41	$ 2.41	$ -	0
27							
28	Transportation	$ 0.31					
29							
30	Total Variable Costs	$ 13.62	$ 13.73	$ 13.73	$ 13.73	$ -	0
31							
32	Insurance & Housing	$ 11.45	$ 13.42	$ 13.42	$ 13.42	$ -	0
33							
34	Interest	$ 10.75	$ 12.36	$ 12.36	$ 12.36	$ -	0
35							
36	Property Tax	$ 2.86	$ 3.35	$ 3.35	$ 3.35	$ -	0
37							
38	Depreciation	$ 57.82	$ 67.75	$ 67.75	$ 67.75	$ -	0
39							
40	Total Fixed Costs	$ 82.89	$ 96.88	$ 96.88	$ 96.88	$ -	0

This image shows the annual machinery costs for the machinery cooperative. Similar pages for the producers exist showing the annual machinery cost for the individual machinery complements.



Machinery Cooperative Projected Income, Expense and Cash Flows	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Income from Fees	**$159,075**	**$160,666**	**$162,272**	**$163,895**	**$165,534**	**$167,189**	**$168,861**	**$170,550**	**$172,255**
Variable Costs									
Fuel & Lube	$15,253	$15,405	$15,559	$15,715	$15,872	$16,031	$16,191	$16,353	$16,51
Hired Labor	$0	$0	$0	$0	$0	$0	$0	$0	$
Repair & Maintenance	$1,007	$2,505	$3,997	$5,511	$7,047	$1,007	$2,505	$3,997	$5,51
Transportation	$440	$444	$449	$453	$458	$462	$467	$472	$47
Total Variable Costs	$16,260	$17,910	$19,556	$21,226	$23,377	$17,501	$19,163	$20,821	$22,50
Fixed Costs									
Insurance & Housing	$16,416	$16,580	$16,746	$16,913	$17,083	$17,253	$17,426	$17,600	$17,77
Interest	$9,618	$7,912	$6,103	$4,186	$2,154	$10,210	$8,399	$6,479	$4,44
Property Tax	$4,104	$4,145	$4,186	$4,228	$4,271	$4,313	$4,356	$4,400	$4,44
Depreciation	$82,901	$83,730	$84,567	$85,413	$86,267	$87,130	$88,001	$88,881	$89,77
Total Fixed Costs	$113,039	$112,367	$111,603	$110,741	$109,774	$118,906	$118,182	$117,360	$116,43
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

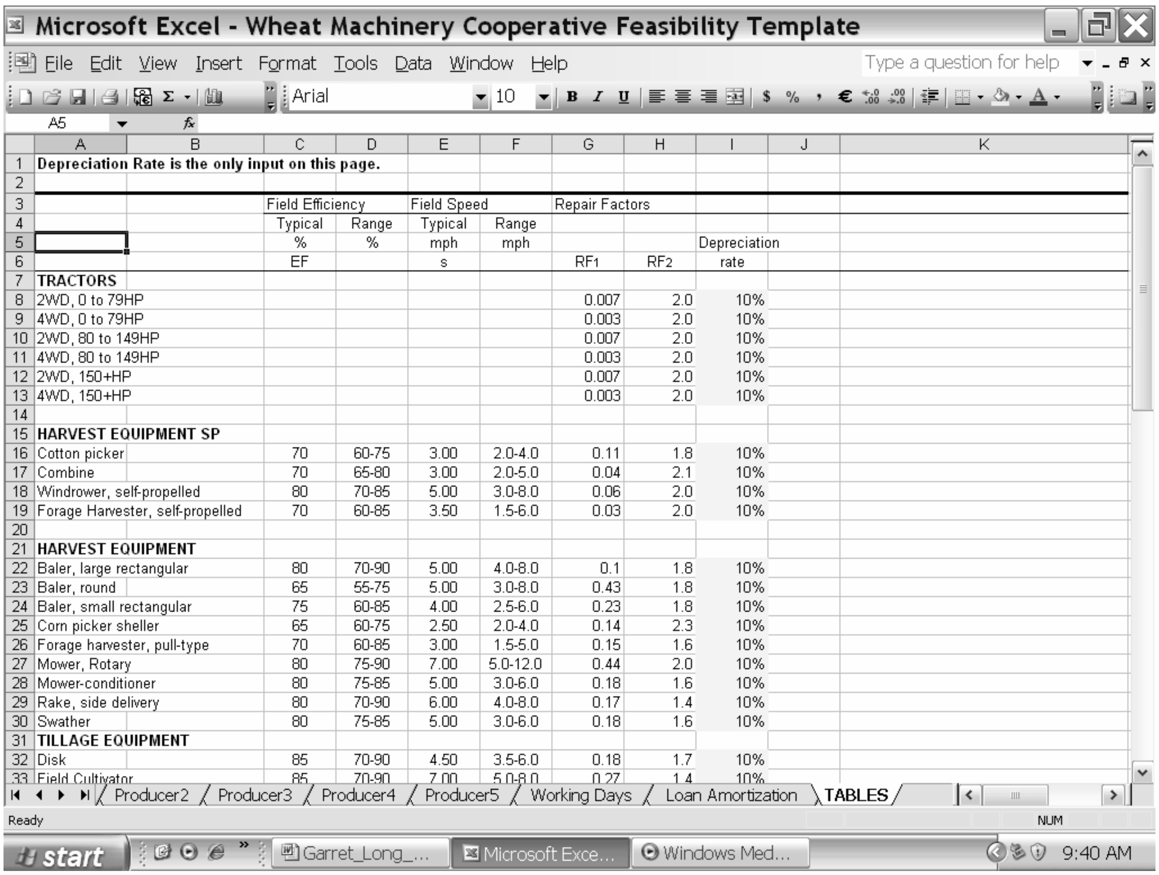
The next image shows the calculation for loan amortization for the machinery cooperative with the producers' individual loan amortization further down the sheet.


Microsoft Excel - Wheat Machinery Cooperative Feasibility Template

	A	B	C	D	E	F	G	H	I	J	
1											
2											
3	**This sheet calculates loan amortization and interest for the machinery cooperative and individual ownership. There are no inputs on this sheet.**										
4											
5		**Machinery**	**Producer**	**Producer**	**Producer**	**Producer**	**Producer**				
6		**Cooperative**	**1**	**2**	**3**	**4**	**5**				
7	**Total Investment**	$410,400.00	$160,300.00	$160,300.00	$160,300.00	$ -	$ -				
8	**Long Term Interest Rate**	6%	6%	6%	6%	6%	6%				
9	**Percent Financed**	50%	50%	50%	50%	50%	50%				
10	**Loan Amount**	$410,400.00	$160,300.00	$160,300.00	$160,300.00	$ -	$ -				
11	**Loan Term**	5	5	5	5	5	5				
12											
13						**Machinery Cooperative**					
14											
15		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	
16	**Beginning Balance**	$410,400.00	$337,596.52	$260,424.83	$178,622.83	$ 91,912.72	$452,310.09	$372,071.91	$287,019.43	$196,863.81	$
17	**Interest Rate**	6%	6%	6%	6%	6%	6%	6%	6%	6%	
18	**Interest**	$ 24,624.00	$ 20,255.79	$ 15,625.49	$ 10,717.37	$ 5,514.76	$ 27,138.61	$ 22,324.31	$ 17,221.17	$ 11,811.83	$
19											
20	**Annual Payment**	$ 97,427.48	$ 97,427.48	$ 97,427.48	$ 97,427.48	$ 97,427.48	$107,376.79	$107,376.79	$107,376.79	$107,376.79	$
21	**Principal**	$ 72,803.48	$ 77,171.69	$ 81,801.99	$ 86,710.11	$ 91,912.72	$ 80,238.18	$ 85,052.47	$ 90,155.62	$ 95,564.96	$
22											
23	**Ending Balance**	$337,596.52	$260,424.83	$178,622.83	$ 91,912.72	$ 0.00	$372,071.91	$287,019.43	$196,863.81	$101,298.86	$
24											
25	**Total Interest Expense**	$ 24,624.00	$ 20,255.79	$ 15,625.49	$ 10,717.37	$ 5,514.76	$ 27,138.61	$ 22,324.31	$ 17,221.17	$ 11,811.83	$
26											
27						**Producer 1**					
28											
29		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	
30	**Beginning Balance**	$160,300.00	$131,863.36	$101,720.52	$ 69,769.10	$ 35,900.61	$170,161.68	$139,975.61	$107,978.38	$ 74,061.31	$
31	**Interest Rate**	6%	6%	6%	6%	6%	6%	6%	6%	6%	
32	**Interest**	$ 9,618.00	$ 7,911.80	$ 6,103.23	$ 4,186.15	$ 2,154.04	$ 10,209.70	$ 8,398.54	$ 6,478.70	$ 4,443.68	$
33											

Producer2 / Producer3 / Producer4 / Producer5 / Working Days / Loan Amortization / TABLES

The page containing the field efficiency values along with the depreciation percentages used in the calculations of the feasibility template is shown in the image below.



	A	C	D	E	F	G	H	I
1	**Depreciation Rate is the only input on this page.**							
2								
3		Field Efficiency		Field Speed		Repair Factors		
4		Typical	Range	Typical	Range			
5		%	%	mph	mph			Depreciation
6		EF		s		RF1	RF2	rate
7	**TRACTORS**							
8	2WD, 0 to 79HP					0.007	2.0	10%
9	4WD, 0 to 79HP					0.003	2.0	10%
10	2WD, 80 to 149HP					0.007	2.0	10%
11	4WD, 80 to 149HP					0.003	2.0	10%
12	2WD, 150+HP					0.007	2.0	10%
13	4WD, 150+HP					0.003	2.0	10%
14								
15	**HARVEST EQUIPMENT SP**							
16	Cotton picker	70	60-75	3.00	2.0-4.0	0.11	1.8	10%
17	Combine	70	65-80	3.00	2.0-5.0	0.04	2.1	10%
18	Windrower, self-propelled	80	70-85	5.00	3.0-8.0	0.06	2.0	10%
19	Forage Harvester, self-propelled	70	60-85	3.50	1.5-6.0	0.03	2.0	10%
20								
21	**HARVEST EQUIPMENT**							
22	Baler, large rectangular	80	70-90	5.00	4.0-8.0	0.1	1.8	10%
23	Baler, round	65	55-75	5.00	3.0-8.0	0.43	1.8	10%
24	Baler, small rectangular	75	60-85	4.00	2.5-6.0	0.23	1.8	10%
25	Corn picker sheller	65	60-75	2.50	2.0-4.0	0.14	2.3	10%
26	Forage harvester, pull-type	70	60-85	3.00	1.5-5.0	0.15	1.6	10%
27	Mower, Rotary	80	75-90	7.00	5.0-12.0	0.44	2.0	10%
28	Mower-conditioner	80	75-85	5.00	3.0-6.0	0.18	1.6	10%
29	Rake, side delivery	80	70-90	6.00	4.0-8.0	0.17	1.4	10%
30	Swather	80	75-85	5.00	3.0-6.0	0.18	1.6	10%
31	**TILLAGE EQUIPMENT**							
32	Disk	85	70-90	4.50	3.5-6.0	0.18	1.7	10%
33	Field Cultivator	85	70-90	7.00	5.0-8.0	0.27	1.4	10%

VITA

Garret Lee Long

Candidate for the Degree of

Master of Science

Thesis: FEASIBILITY OF MACHINERY COOPERATIVES IN OKLAHOMA

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Porterville, California, March 30, 1983, the son of Mrs. Barbara Coe.

Education: Received Bachelor of Science degree from Oklahoma State University, Stillwater, Oklahoma in December, 2005, with a major in Agricultural Economics and Accounting; Completed the requirements for the Master of Science or Arts in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in December, 2007.

Experience: Employed as a Graduate Research Assistant in the Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma, 2006-2007.

Name: Garret Lee Long Date of Degree: December, 2007

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: FEASIBILITY OF MACHINERY COOPERATIVES IN OKLAHOMA

Pages in Study: 64 Candidate for the Degree of Master of Science

Major Field: Agricultural Economics

Scope and Method of Study: This study used a feasibility template which calculates and compares the cost of individual and cooperative machinery ownership. Specifically the study focused on the potential for savings to Oklahoma agricultural producer through the formation of machinery cooperatives. Three machinery cooperatives representative of Oklahoman wheat, cotton and hay production were analyzed. A case study of was also examined for a group of Oklahoma hay producers.

Findings and Conclusions: The research in this study found that there is a potential for Oklahoma producers to benefit from machinery cooperatives. The machinery cooperative examples used in this study showed that producers could greatly reduce their required equity investment and machinery operating costs. Machinery operating cost was typically reduced by 12 to 29% in the base scenarios. The cotton machinery cooperative example achieved the largest reduction in machinery cost at 29% as a result of the high intensity of this production. Various sizes of machinery cooperatives were examined and savings increased as the number of members increased. The initial investment required by the producers was reduced by 16 to 60% as the numbers of members in the machinery cooperative increased form 3 to 5 members. An examination of unequal acreage between members found that the producer with the greatest acreage share saw the least savings in the machinery cooperative. Even with the addition of transportation and setup time in the machinery cooperative completion of the production activities was not an issue for these machinery cooperative examples. Machinery cooperatives allow producer the ability to achieve greater efficiency of their machinery by using more of its capacity in a machinery cooperative. Producers could also reduce their individual required field days because of the larger equipment used in a machinery cooperative.

ADVISER'S APPROVAL: Dr. Phil Kenkel