EVALUATING FARM MANAGEMENT STRATEGY USING SENSITIVITY AND STOCHASTIC ANALYSIS

by

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ABSTRACT

The dramatic changes that have taken place in the production agriculture industry in the last decade have the Long Family Partnership wanting to reassess their farm land management strategy. As land owners, they feel as though they might be missing out on profit opportunity by continuing their current lease agreements as status quo. The objective of this research is to determine the optimal land management strategy for the Partnership farm that maximizes net returns for crop production, but also taking into account input costs and risk. Three scenarios were built: (1) a Base Case of the current share-crop and cash lease

Agreements; (2) the possibility of farming their own irrigated farm land and continuing to cash lease land used to produce dryland wheat; and (3) deciding to farm all the irrigated and dry land farm acreage themselves. In order to do this, a whole-farm budget spreadsheet model was generated to assess alternative land management scenarios. The difference in net returns between alternative land rental scenarios were then compared and followed by a sensitivity analysis and stochastic analysis using @RISK software . The findings concluded that there was greater potential to increase net farm income while still conservatively managing risk by investing into their own farm land, as not only owners but also as operators. The stochastic and sensitivity analysis confirmed that farming their own land was more sensitive to changes in yields, prices and input expenses. However, even in consideration of the additional risk, the probability of increasing net farm income was greater for the scenarios in which they farmed their own land.

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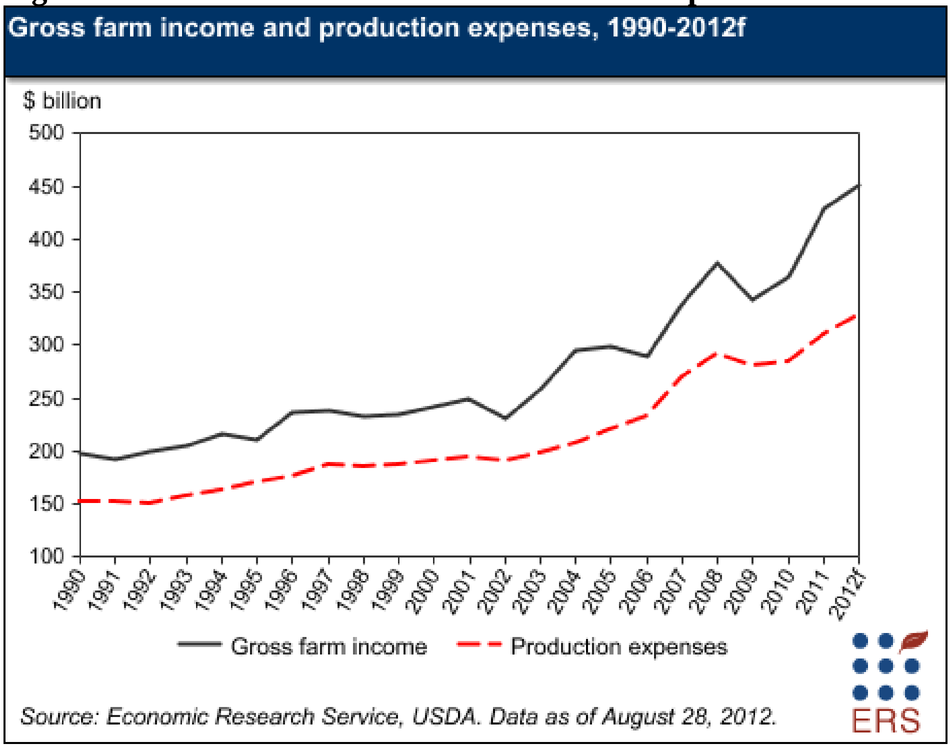
CHAPTER I: INTRODUCTION

1.1 The Problem

In the last decade, there have been dramatic changes in the dynamics of American agriculture. Grain prices have reached record highs and farm revenue is up. However, increasing input expenses continue to pose a threat to marginal profits. The cost of land and inputs has driven farmers either out of business or to operate on larger economies of scale. Small operators cannot afford the technology and equipment that has increased efficiency, but those that can manage their expenses by operating on a larger scale have significantly benefited from historically high commodity prices. The issue is then: how does the Long Family Partnership manage their own farmland to maximize their return in this current agricultural climate?

Long Family Partnership owns 8,960 acres of in the Oklahoma/Texas Panhandle. They have both dry and irrigated farmland that has been used to grow wheat, cotton and corn, as well as grass land that has been leased to graze cattle. Historically, they have either cash-leased or share-cropped their land to various farmers. They would like to consider the future option of farming their own land. Figure 1.1 represents the increase in gross farm income for farming in general in the U.S. in recent years and their primary motivation to reassess their farmland management strategy. However, this restructuring would require a significant increase in input expenses, as well as additional risk.

Figure 1.1: Gross Farm Income and Production Expenses 1990-2012



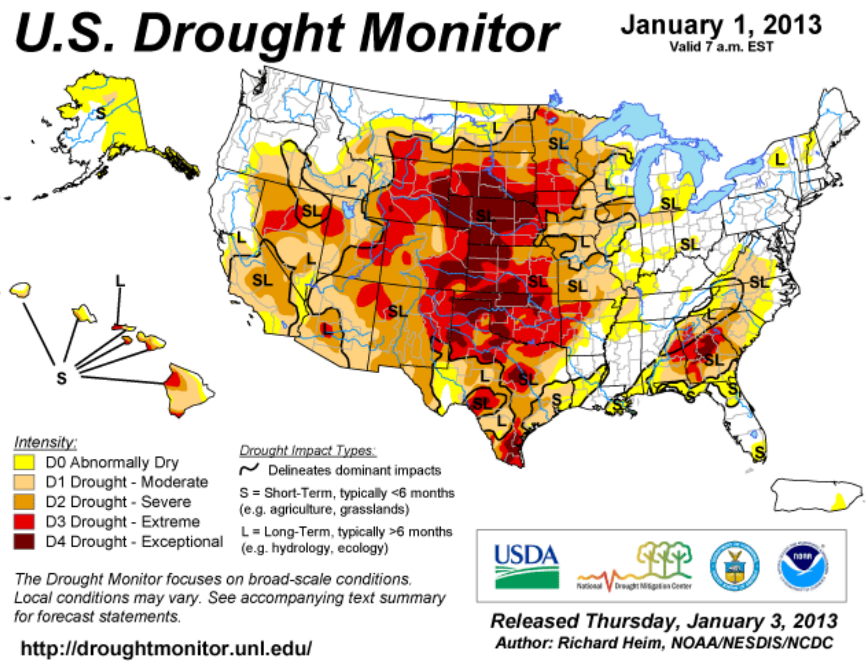
Long Family Partnership's previous farm management strategy has allowed them to avoid significant risk. Farmers face several factors that are out of their direct control and increase risk, such as weather, disease and price fluctuations. Even the best producers and management strategies are not immune from the potential impact of these factors on their operations. A primary example is the drought experienced in 2012. Figure 1.2 provides a visual representation of the impact of the drought, where more than half of the counties in the United States were designated disaster areas due to drought (Ariosto and Abbey 2012). This drought not only displays farming's susceptibility to weather patterns, but also the dramatic fluctuations that can occur in price. According, to an article published by the USDA about the impacts of the 2012 drought:

> *"The tighter-then-expected supplies, prices for many of the crops affected by the drought reached record or near-record levels. Marketing-year average prices for*

> *2012/13 (September 2012 through August 2013) were forecast in the November 9 WASDE report to fall within a range of $6.95-$8.25 per bushel for corn, with soybeans forecast at $13.90-$15.90 per bushel. Marketing-year average prices in these ranges would be record highs in nominal terms."* (United States Department of Agriculture 2012, under Crop Sectors).

The 2012 drought conditions and the resulting high commodity prices exemplify the relationship between weather, prices and risk involved in production agriculture.

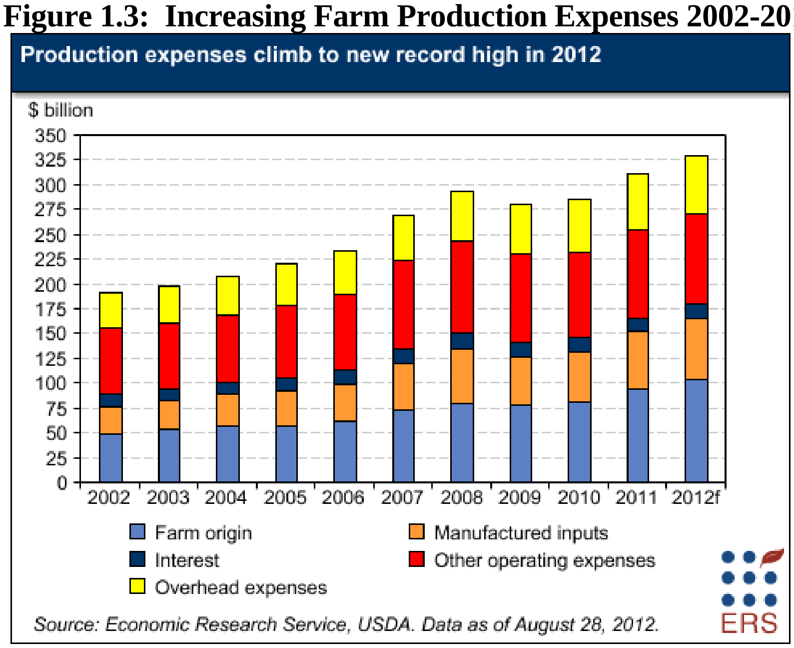
Figure 1.2: U.S. Drought Monitor 2012



According to USDA Agricultural Projections for 2021, it is predicted that, "long-term growth in global demand for agricultural products, in combination with the continued presence of U.S. ethanol demand for corn and EU biodiesel demand for vegetable oils, holds prices for corn, oilseeds, and many other crops at historically high levels" (Interagency Agricultural Projections Committee 2012, 11). It is not only due to current high prices, but the expectation that they will continue to stay high that motivates Long Family Partnership to reassess their current farm management strategy options.

An important variable in this research will be the rising cost of inputs and consequently the effects on operating expenses. Rising farm revenue has also been coupled with rising input expenses in farming. According to an Iowa State study, the estimated cost of producing an acre of corn and soybeans has risen more than 40% since 2006 (2012 Farm Sector Income Forecast 2012). Both Figures 1.1 and 1.3 offer graphical representations of the increasing farm expenses that operators have been facing. This is a driving force behind the changing dynamics of farmland and why we are seeing fewer operators' farm greater acreage. A farmer can reduce his average cost per unit by operating on a larger economy of scale. So although farm revenue is increasing due to higher commodity prices, the extent to which operating expenses fluctuate and are managed, will play a significant role in this study, as well.

Figure 1.3: Increasing Farm Production Expenses 2002-2012



1.2 Purpose and Objectives

The purpose of this research is to determine the optimal land management strategy for the Long Family Partnership farm that maximizes net returns for crop production taking into account input costs and risk. More specifically, the objectives are to:

1. Generate a whole farm budget spreadsheet model to assess alternative land management strategies;

2. Examine the difference in net returns between alternative land rental scenarios; and

3. Use sensitivity and stochastic analysis to examine the impact of the variability of input cost and revenue streams for alternative land rental scenarios.

CHAPTER II: LITERATURE REVIEW

The purpose of this chapter is to highlight previous models and research that are relevant to the Long Family Partnership's situation and the objective of this research. This would include the use of static spreadsheet models for farm planning and comparing rental agreements, as well as stochastic analysis models pertaining to optimizing general returns to land.

2.1 Use of Static Spreadsheet Models for Farm Planning and Rental Arrangements

There is significant previous research relevant to optimizing returns from farmland for owners; however it is fairly limited when comparing crop share agreements and cash rent lease agreements. Farmland is generally rented in three combinations: 1) cash rent 2) crop share or 3) cash rent/crop share combination. Several spreadsheets have been developed that allow landowners to compare these options by submitting certain data. Miller and Dobbins at Purdue University developed a spreadsheet that compared expected landowner and operator returns for crop share versus cash rent (Miller and Dobbins 2008). The spreadsheet was designed as a tool for landowners to optimize the return on their land, and was interactive in the sense that the operator or landowner had to enter specific data pertaining to their operation and situation. The purpose of the article was to explain the information that would be needed in the spreadsheet and then the spreadsheet was formulated to calculate and compare various returns. The data needed for the spreadsheet model was extensive and required information in the following six areas: 1) crops, acreage, yield, prices, and direct government payments; 2) production and storage variable costs; 3) fixed costs; 4) division of revenues and expenses for crop-share leases; 5) crop- share lease cash payments; and 6) cash rent lease. The spreadsheet calculated the estimated returns for tenant and landowner under each lease type, as well as a summary table comparing net returns from the crop-share and cash rent alternatives.

Valentin, Miller and Dobbins later extended their original spreadsheet by adding a flex-rent calculator (Valentin, Miller and Dobbins 2008). The flex rent option guarantees a base price to the landlord and a bonus is then calculated based on total revenue. The objective of this model was to allow landowners and operators to compare the net return based on different price and yield assumptions between cash leases, share-crops and flex rents. This model was also developed to help landowners optimize return to their land while examining certain scenarios and managing their risk. However, it failed to consider the option of the land owners farming their own land.

Doye et al. at Oklahoma State University developed an enterprise budget to estimate the profitability for agriculture enterprises, while taking into account the practices, resources and technology specific to each farm (Doye, Kletke, et al. 2012). The spreadsheet breaks down the production, operating receipts and fixed costs associated with an enterprise. Each line of the budget has a link to a separate tab that allows an operator to specify information that influences the variables in the budget, thus providing a more accurate breakdown of the inputs and expenses. Their spreadsheet is based upon their research and information published by the USDA using Ag Census 2012 Data (Doye, Kletke, et al. 2012). Their spreadsheet also provides default figures specific to the designated region/county, and is reported on a per acre basis.

The following table offers a brief explanation to other static spreadsheet models available and their purpose and features:

Table 2.1: Farm Management Spreadsheets Available

Source	Title	Purpose	Unique Features
(Raymond 2006)	Farm Lease Calculator	Makes revenues, inputs, operations, contributions, ect. of crop production easy to assemble and analyze so that landowners and tenants can form fair lease agreements	Contains a sensitivity tab that allow for the tenant to see the returns under various price and yield outcomes without having to enter and reenter all the different prices and yields
(Dhuyvetter and Kastens, FlexRent 2012)	Determining Flexible Cash Rents Using the *FlexRent* Spreadsheet	Calculates flexible rent for the year given crop revenue	Rents are allowed to flex based only on price, yield or revenue
(Dhuyvetter and Kastens, KSU- Lease 2012)	Determining Equitable Crop Share or Cash Rental Agreements	Intended to serve as a tool for landowners and their tenants as they negotiate terms of share or cash rental agreements	Income is shared in the same proportion expenses is shared
(Edwards 2012)	Computing a Cropland Cash Rental Rate	Compares different methods of computing Cropland Cash Rent	Discusses and compares establishing cash rent, based on the following options: share of gross income, tenant’s residual income, expected yield, corn suitability rating index, percent of land value

Although these spreadsheets and calculators may provide a basic budgeting tool for producers, they are limited in their ability and accuracy due to their static nature and sensitivity analysis. They allow for some manipulation of data, but they require manually adjusting the value of variables in order to see the effects on the budget. Furthermore, they require fixed-point estimates of various variables. As previously mentioned, the issue with fixed-point variables is that it is unrealistic in the current agricultural environment. Agriculture is unpredictable in nature and constantly fluctuating, so it would be extremely difficult to accurately estimate future conditions and variable values. As Lien explains, "To overcome these problems an alternative approach is stochastic budgeting which accounts for some of the main uncertainties in the evaluation and then gives an indication of the distribution of outcomes" (Lien 2003, 6). Upon this logic, our research takes the whole-farm budget further by adding a stochastic analysis to provide probability distributions of the various variables actually occurring.

2.2 Stochastic Budgeting Models

There have been several studies about optimizing general returns to land using stochastic budgeting. For instance, Grove, et al. used stochastic budgeting analysis to assess the feasibility of three alternative scenarios to convert from beef-cattle farming to game ranching (Grové, Taljaard and Cloete 2007). They constructed enterprise budgets for 16 alternative game species and beef cattle production scenarios. The enterprise and capital budgets were then fed into a stochastic net present value model to evaluate the profitability and financial feasibility of alternative strategies. They defined profitability as the investments in which the present value of the after-tax income will be greater than the initial investment, and financial feasibility was determined by whether the cash flows from the investment could annually cover the payments associated with the borrowed capital. They modeled their profitability and financial feasibility theory on the work of Boehlke and Eidman (Boehlje and Eidman 1984). They then used a risk simulation model to estimate the cumulative probability distributions of the net present value of the alternative scenarios. Furthermore, their research mentions the findings of Selley and Wilson that discovered decision-makers prefer information on the probabilities of success or failure of specific strategies for decision making-purposes, there in providing more evidence towards the effectiveness of the stochastic budgeting method in this research (Selley and Wilson 1997). Grove, Taljaard and Cloete's study concluded that it was not feasible to convert from beef-cattle farming to game ranching. Although game ranching was more profitable, when comparing cash flows, landowners may end up performing worse with game than with beef cattle, and the variability of annual cash flows was also expected to increase when converting to game ranching.

Dhoubhadel and Stockton at the University of Nebrask-Lincoln also published an article and Microsoft Excel workbook that provided an example of stochastic partial budgeting for the decision on whether to buy replacement heifers or raise them. In their spreadsheet, when a dollar value is specified, it is specified as a range rather than a single measure.

> *"The range of values is then used to create a probability density function which is used in combination with other variables and their density functions, to then determine the range and probabilities of the final outcomes. The resultant outcomes with their associated probabilities are then graphed by their occurrence from randomly drawn values. This graph is known in statistics as the Cumulative Distribution Function (CDF)"* (Dhoubhadel and Stockton n.d., 5).

The CDF is a graphical representation of the probability to a specific outcome value. Their example provided in their Excel workbook is hypothetical, but it takes a basic approach to explaining how a stochastic budgeting method can be used to capture the possibility of many outcomes.

Another stochastic stimulation project examined the costs and benefits of certain technology investments in the dairy business. Bewley, et al. (2010) looked at the impact of input and output prices on the cost of culling, days open, and disease in order to assess the benefits of “Precision Dairy Farming” (PDF) technologies and their relationship with disease incidence, disease impact and reproductive performance. Precision Dairy Farming is an information system that collects data on individual farm animals such as daily milk yield recording, milk component monitoring, pedometers, automatic temperature recording devices, milk conductivity indicators, automatic estrus detection monitors, and daily body weight measurements. The perceived benefits are increased efficiency, improved quality, minimized detrimental environmental impacts, increased fertility, ameliorated disease effects and general improved animal health and well-being (J. Bewley 2010). They chose to model their variables scholastically to account for variability in the prices paid for inputs and the prices received for outputs.

> *“In reality, every dairy producer recognizes that the profitability of any investment or decision will vary considerably depending on what combination of prices eventually occur. Although prices can never be predicted perfectly, through multiple iterations of simulation models, the variation in prices can be accounted for to provide an indication of how combinations of events will affect the probability of obtaining a desirable financial result”* (Bewley, et al. 2010, 17)

They then used net present value as the primary metric to determine profitability of the various technology investments. They found that costs of culling, days open, and diseases were highly variable when prices and deterministic inputs were stochastic.

Gudbrand Lien (2003) used stochastic budgeting to evaluate the financial feasibility of different investment and management strategies on a Norwegian dairy farm. In his case study, the farmer was evaluating between five investment and management strategies. The stochastic variables included in his model were fixed costs, activity gross margins, interest rates, labour requirement for activities, and milk quota price. An important thing that Lien points out was the issue of stochastic dependency between variables.

> *"The distribution of performance variables may be seriously compromised if important stochastic dependencies are ignored. For example, if yield and price are positively correlated, an analysis that assumes zero correlation will under-estimate variance of revenue, and will over-estimate it if they are negativity correlated"* (Lien 2003, 7).

In order to avoid stochastic dependence between variables he used the 'hierarchy of variables approach' developed by Hardaker, Huirine and Anderson .This approach requires a selection of a macro-level variables to which all types of fixed costs can be connected and correlated so that they avoid directly determining the relationship between each pair of correlated variables (Hardaker, Huirine and Anderson 1997). In this case they used the macro-level variable of the price index of agricultural means of production and production services. In his closing comments, Lien makes a couple of suggestions for similar work: 1) models should be kept as simple as reasonable; 2) the intention of budgeting models is not to give exact answers but to highlight relative consequences of different strategies; and 3) it is important to identify and measure stochastic dependencies (Lien 2003).

CHAPTER III: THEORY AND METHODS

The following chapter explains the theory and methods used to construct an empirical model to analyze the Long Family Partnership's options. This includes a description of the various land-owner options available to them as well as an explanation of the three different scenarios compared in this research. Furthermore, it expounds upon the stochastic analysis @Risk tool and how it was used to compare as well as evaluate risk and sensitivity within the various scenarios looking at different stochastic inputs.

3.1 Whole-Farm Budgeting Spreadsheet Model

This research focuses on the principals of accounting and budgeting theory. Accounting theory provides an overview of financial performance of a company through their balance and income statements. Budgeting theory then uses accounting theory to project and compare future revenue and expenses under a certain set of conditions. Farm managers use budgets as planning tools and as a means of assessing different management options for the farm (Ludena, et al. 2003). In this research, the budget model modified by Dr. Jeff Williams at Kansas State University is used to produce financial statements that assess the potential profitability of various farm management scenarios (Williams 2013) .

Doye, et al. 2012 at Oklahoma State University created the original budget that included multiple tabs in a somewhat complicated format. Williams then adjusted the original work to simplify the spreadsheet. The spreadsheet is broke down into the left and right side. The left side contains a net worth statement (Appendix A), cash flow statement (Appendix B), income statement (Appendix C), loan summary (Appendix D), financial analysis (Appendix E), loan information (Appendix F) and supplemental cash flow (Appendix G).

The right side of the spreadsheet contains information on the various enterprise budgets. The enterprise budgets breakdown the separate enterprises within the farm and then breakdown operating receipts (Appendix H) and operating expenses (Appendix I) to calculate a net operating receipt. The net operating receipt is then used to generate a cash flow statement which then helps generate a net farm income for each scenario.

3.2 Rental Arrangement Scenarios

This section explains the rental arrangement options and the three farm management scenarios constructed for those options.

Cash rent involves establishing a rental agreement with the operator and receiving an annual cash payment. The operator has no share in any of the expenses, but also does not benefit from any additional gains from market prices. This is by far the lowest-risk option for a landowner.

Share Crop lease agreements entail the owner and operator sharing certain expenses and splitting revenues on a proportional basis. The Long Family Partnership bases their share crop agreement on a one-third/two-third basis. The landowner provides the land and is responsible for anything permanently attached to the land such as pipes and irrigation motor. In addition they also pay one-third of the fertilizer and irrigation motor fuel expense, and receive one-third of the land's revenue. The operator receives two-thirds of the revenue but is responsible for everything not attached permanently to the land such as the equipment and sprinkler, and they have to pay two-thirds of the fertilizer and irrigation motor fuel expense. Other breakdowns of the shared expenses and revenue shares are possible, as well.

"Farm" indicates the option of the landowner farming their own land.

The potential rental arrangement scenarios that the Long Family Partnership is considering are listed in the table below:

Table 3.1: Farm Management Scenarios for Long Family Partnership

	Irrigated Farmland	Dry Land Farmland
Base Case	Share Crop	Cash Rent
Scenario 2	Farm	Cash Rent
Scenario 3	Farm	Farm

Certain scenarios were excluded from the work because of lack of feasibility or logic. For instance, the scenario of cash renting irrigated farmland and farming dry land was not considered an option, because it would be less profitable to cash rent the more productive irrigated farmland and then farm the less productive land. All options of cash renting the irrigated farmland were excluded from this research due to the Long Family Partnership's desire to capitalize in some form on rising grain prices. Furthermore, the option of share cropping dry land wheat was also excluded. Dry land wheat yields are low and rather risky in this area, so this is not a popular option for land owners or farmers.

3.3 Sensitivity and Stochastic Analysis

Traditional budgeting using fixed-point estimates is often inaccurate due to the fluctuating events and conditions in agriculture production. In order to account for these fluctuations and the risk involved in farming, a sensitivity and stochastic analysis was conducted to see the effect of certain conditions on net farm income.

The sensitivity analysis consisted of changing prices, yields and rental rates by a certain percentage and comparing how that percent change affected the net farm income across the three scenarios. First, corn and wheat prices were decreased by 10%, 20%, and 30% to examine the effect on net farm income for each scenario. Rental rates do not fluctuate as dramatically as crop prices and yields, so the percent decreases in rental rates considered were more conservative at 5%, 10% and 15%. Corn yields were decreased by 10%, 20% and 30%, as well. Due to the high risk involved with dry land farming in this area and yields, dry land wheat yields were decreased by 10%, 20%, 30%, 40%, and 50%.

Stochastic analysis was chosen as an additional objective because it accounts for some of the uncertainties within the budget by attaching probabilities of occurrence to the possible values of certain key variables, thereby generating the probability distribution of possible budget outcomes (Dillon 1993, 169-172). This framework allows uncertain variables to be expressed in stochastic terms in which many combinations of variable values can be analyzed to provide a full range of expected outcomes (Lien 2003). In this research, the three variables used in the @Risk stimulation were price, yield and fertilizer expense.

The probability distributions provided by @RISK allow the specification of nearly any type of uncertainty in decision variables or cell values in a spreadsheet model (Palisade Corporation 2010). It was assumed that prices, yields and fertilizer parameters in the spreadsheet model were normally distributed when conducting risk simulations. This means that @RISK would return values during a stimulation drawn from a normal distribution and based upon a given mean and standard deviation. Table 3.2 below provides a summary of the mean and standard deviations used for the yields and prices for corn and wheat, as well as for fertilizer expense. Furthermore, the distributions were assumed to be truncated. All @RISK distributions may be truncated to allow only samples within a specified range between minimum and maximum values within the distribution function. These values are shown in Figure 3.1 under column AT and listed under maximum and minimum values for each parameter. The maximum and minimum values listed were based off an interview with a local farmer and his historical and present experience and knowledge of prices, yield and fertilizer expenses (Hyer 2013).

Table 3.2: Means and Standard Deviations used in @Risk Normal Distribution Analysis

	Mean	Standard Deviation	Minimum	Maximum	Effective Mean
Wheat Yield	30	26.5	20	70	41
Corn Yield	200	52	175	275	218
Wheat Price	$7.06	$3.00	$4.00	$10.00	$7.02
Corn Price	$5.60	$3.81	$3.00	$10.50	$6.43
Fertilizer Expense	$115	$26.58	$85.00	$138.00	$112.51

An @Risk Input Section was added to the budget spreadsheet to run the various simulations. To run a certain variable for the stimulation, either a 1(yes) or 0 (no) were entered as an activation switch to allow a given parameter to be stochastic. Figure 3.1 is an example of how the stimulation for the price variable was set-up. After the stimulations were run, detailed summary statistics and cumulative distribution functions of the spreadsheet model output (e.g. net farm income) for each scenario was calculated and graphed

Figure 3.1: @Risk Input Section

AS	AT	AU	AV	AW	AX	AY
@RISK Input Section						Use
					Truncated	Distributions
				Standard Deviations	Normal Distributions	Yes = 1 No= 0
Wheat Yield	Bu/acre					
Maximum	70					
Expected	30	Wheat Yield		26.5	41	0
Minimum	20					
Corn Yield	Bu/acre					
Maximum	275					
Expected	200	Corn Yield		52.0	218	0
Minimum	175					
Wheat Price	$/bu					
Maximum	$10.00					
Expected	$7.06	Wheat Price		$3.00	$7.02	1
Minimum	$4.00					
Corn Price	$/bu					
Maximum	$10.50					
Expected	$5.60	Corn Price		$3.81	$6.43	1
Minimum	$3.00					
Corn NH3	$/acre	$/lb	Lbs/acre			
Highest	$138.00	$0.552	250			
Expected	$115.00	$0.460	250	$26.58	$112.51	0
Lowest	$85.00	$0.340	250			
Corn DAP	$/acre	$/lb	Lbs/acre			

CHAPTER IV: DATA

This chapter describes the data used to build the enterprise budgets for the three scenarios and explains how that data was obtained.

4.1 Farmland Description

The present farmland rental arrangement and description by field for the Long Family Partnership are summarized in the table below. Due to the pumping capacity of current irrigation wells, crops do not change and are not rotated. Each lease and cash rent agreement for the dry land wheat is re-negotiated on an annual basis. The CRP program on Section 90 pays $38 an acre.

Table 4.1: Farmland in Long Family Partnership

	Acreage	Irrigate or Dry Land	Crop	Current Lease Agreement
Section 25-1-14	645	Irrigated	Corn	Share Crop
Section 24-2-14	125	Irrigated	Corn	Share Crop
Section 88	520	Irrigated	Corn	Share Crop
Section 90	640	Dry Land	Wheat	CRP Program
Section 60	130	Irrigated	Corn	Share Crop
Section 29	320	Dry Land	Wheat	Cash Rent $45/acre
Section 6	640	Dry Land	Wheat	Cash Rent $40/acre

4.2 Enterprise Budgets

For each scenario described in Table 3.1 a budget must be created and then used to generate the whole-farm net revenue. The whole-farm net revenue was calculated by breaking down each farm into separate enterprises and then creating cash flow statements from the various enterprises. This required collecting data on the operating receipts and expenses per acre for each enterprise and then recording them in the month they were incurred. A combination of interviews with local farmers, Long Family Partnership records and the Oklahoma State University budget enterprise model was used to find the per acre operating receipts and expenses. The following breaks down the specifics of how data was collected for the various scenarios.

4.2.1. Share Cropping Irrigated Land

This data was relevant to Scenario 1. The information needed to calculate cash operating receipts:

- Number of acres
- Average yield per bushel/acre
- Selling Price per bushel
- Operators share %

Number of acres refers to the irrigated acreage under the sprinkler and can be found in Table 4.1.

Average yield per bu. /acre is 200 bushels an acre (Hyer 2013). Corn is harvested in October.

Average selling price /bu. is $5.60/ bu. based upon the projected 2013 future corn prices as of February 26, 2013 (ADM 2013).

Operators share was 33.3% because the family was share-cropping on a one-third/two-third agreement.

The information needed to calculate cash operating expenses:

- Fertilizer
- Fuel, oil and lubricants

According to the Long Family Partnership records from 2011 expenses, the average *fertilizer* expense was approximately $60.34/acre. *Fuel, oil and lubricants* expense averaged $53.33/acre. Both expenses were incurred during the months that irrigation is required March to September.

4.2.2. Cash Leasing for Dryland Wheat

This information was relevant to Scenarios 1 and 2. The cash receipts are based off of the rental arrangements. Section 29 would be leased for $45/acre and Section 6 for $40/acre. These numbers are based on the partnerships 2012 rental fees. Rental rate fees are primarily based on the specific quality of the land, wheat prices and the current CRP rates. Consistently higher wheat prices justify landowners raising rental prices. For instance, in 2011 and 2012, the Long Family Partnership increased their rental rates $5 due to the sustained increase in wheat prices. One year of high prices will not cause most landowners to raise their prices, but a consistent couple of years of climbing prices justify an increase in rental rates. Furthermore, a farmer must outbid the CRP rates; otherwise a landowner would prefer to just put their land in CRP. CRP rates are based off of the Environmental Benefit Index and in this area average $38/acre. Cash rent payments occur quarterly in January, April, July and November. With a cash lease agreement there would be no operating expenses.

4.2.3. Farming Irrigated Land

The data in this section refers to the option of the family deciding to farm their own irrigated land and use custom crews to strip-till, plant and harvest the corn. This data was relevant for Scenarios 2 and 3. The information and data used to calculate cash operating receipts:

- Number of acres
- Average yield per bushel/acre
- Selling Price per bushel
- Operators share %

Number of acres, *average yield per bu. /acre*, *average selling price /bu.* would be the same as the share cropping arrangement detailed in 4.2.1.

Operators share was 100% because the family was deciding to farm it themselves.

The information needed to calculate cash operating expenses:

- Hired labor
- Repairs
- Seeds
- Fertilizer
- Custom Hire
- Fuel, oil and lubricants
- Insurance

If it was left as a zero on the spreadsheet and not listed above, then it had no specific relevance to this individual enterprise or study. For instance since cattle were not included, there was a zero for vet medicine and breeding fees.

Hired labor is $4.75/acre. This was based on an average hired labor per acre expense of $9.50/acre and the assumption that irrigation required 50% of labor per acre (Doye, Kletke, et al. 2012). Hired labor expenses were only recorded in the months in which the sprinklers were turned on, March to September, since the only labor expenses would be in regards to irrigation maintenance. There would be no machine labor involved in this budget because of the decision to custom hire.

Repairs is $63.73/acre. According to the OSU enterprise budget, an approximate irrigation repair expense is 40% of the fuel, oil and lube irrigation expenses (Doye, Kletke, et al. 2012). Irrigation repairs would only occur during the months when the sprinklers are on, March thru September, and on majority of repairs would occur when the highest level of irrigation is required, June to September.

Fuel, oil, and lubricants is on average $159.33/acre. This is based upon the OSU budget assumptions that corn requires 33 inches of rain, but the Oklahoma Panhandle generally only receives about 5 inches of rain during corn growing months. Irrigation is then responsible for 28 additional inches of water. On average, the sprinklers are 75% efficient, meaning that 37.33 inches of irrigation are required for a corn crop. With a cost per acre inch of water being $4.25, the irrigation fuel, oil and lubricants bill is approximately $158.67/ acre (Doye, Kletke, et al. 2012). This number is further validated by the Long Family Partnership's historical records that show they spent $159.99 for irrigation per acre on average. An average of the expenses calculated by the OSU budget and the Long Family Partnership record was used to come up with a fuel, oil and lubricants expense of $159.33. Fuel, oil and lubricants would only occur during the months when the sprinklers are on, March thru September, and the majority of repairs would occur when the highest level of irrigation is required, June to September

Seed is $104/acre. The average bag of seed costs $260 and 1 bag can cover 2.5/acres. By dividing 260 by 2.5, the average seed cost is $104/acre (Hyer 2013). Corn is generally purchased in March to plant in April.

Fertilizer, lime and chemical is $181.21/acre. According to an interview with local farmer, Neil Hyer, the soil in this area requires 250 lbs. per acre of anhydrous ammonia and 50 lbs. of ammonium polyphosphate (Hyer 2013). Anhydrous ammonia costs $760/ton, however only 82% of the product contains nitrogen that is required to fertilize the soil, so of the 2000 pounds, only 1640 pounds actually fertilize. In order to get the price per pound, $760 is divided by 1640 which gives a cost per pound of $.463/lb. By multiplying the per pound cost by the 250 lbs. required per acre, the total cost of anhydrous ammonia per acre comes to $115/acre. In order to fertilize the ground with the necessary phosphate, an ammonium polyphosphate product known as 10-34-0 is used. Only 34% of the product is phosphate, so only 680 lbs. per ton contain the necessary phosphate needed for the soil. This product is priced at $580 per ton, and when $580 is divided by 680 lbs., the per lb. cost of the product is equal to $0.85. By multiplying the $0.85/pound by the 50 lbs. required per acre, the total per acreage cost of ammonium polyphosphate comes to $42.50. When fertilizing with these two products, the total fertilizing cost comes to $157.50. The pesticide expense includes

Dual II Magnum and Aim and costs \$ 23.71/acre, bringing the total for fertilizer, lime and chemical to *\$*181.21/acre (Hyer 2013) . Fertilizer is purchased and put on the ground at the first of the year in January.

Custom hire is \$146 per acre and includes the costs associated with hiring a custom crew to fertilize/spray, plant and harvest. Based upon the Oklahoma Farm and Ranch Custom Rates 2011-2012, to fertilize/spray was \$54/acre and planting rates were \$22/acre (Doye and Sahs, Oklahoma Farm and Ranch Custom Rates 2012). Harvest rates were based on a \$0.35/bu average (hauling included), averaging about \$70/acre (Hyer 2013). In this research, we used the high end of the custom rates in an effort to include the fixed costs of machines and equipment that are associated with owning your own equipment. Fertilizing occurs in January, planting occurs in April and crop harvest occurs in October.

Insurance is \$7.88/acre. Insurance rates were based on a 65% yield and price coverage policy from the local crop insurance agency, Linda Hill Crop Insurance (Hill 2013). Insurance payments are due August 1st.

Farmers in this area generally agree that corn operating expenses average \$600 an acre and according to the research and data, operating expenses average about \$595.03, which provides additional evidence validating the data collected. Furthermore, Southwest Kansas Farm Management Association published an Enterprise Report for irrigated corn based on a 5-year average and 2011, with total variable cost equally \$530.18. This supports the accuracy of the data collected and suggests that it may actually be overstating expenses.

4.2.4. Farming Dry Land

The data in this section refers to the option of the family deciding to farm their own dry land and hire custom crews to fertilize, spray, plant and harvest the wheat. This data was relevant for Scenarios 3. The information and data used to calculate cash operating receipts

- Number of acres
- Average yield per bushel/acre
- Selling Price per bushel
- Operators share

Number of acres refers to the dry land and can be found in Table 4.1.

Average yield per bu. /acre is 30 bushels an acre (Hyer 2013). Wheat is harvested in June.

Average selling price /bu. is $7.06/ bu based on the projected 2013 future wheat prices as of February 26, 2013 (ADM 2013). Because it was designated that no bushels were stored, the wheat was then sold in June.

Operators share was 100% because the family was deciding to farm it themselves.

The information needed to calculate cash operating expenses was:

- Seeds
- Fertilizer
- Custom Hire
- Insurance

Because this is dry land wheat and the decision to custom farm, several expense variables associated with irrigation (fuel, hired labor, ect.) have been eliminated from the budget.

Seed is $15/acre which is based upon a seed cost of $15/bushel; and 1 bushel is planted to 1 acre (Doye, Kletke, et al. 2012). Wheat is planted in September the year prior to the year it is harvested. For instance, wheat is planted in September 2010 and harvested June 2011.

Fertilizer, lime and chemicals are $54.83/acre. According to an interview with local farmer, Neil Hyer, the soil in this area requires 35 lbs. per acre of anhydrous ammonia and 15 lbs. of ammonium polyphosphate. Anhydrous ammonia costs $760/ton, however only 82% is of the product contains nitrogen that is required to fertilize the soil, so of the 2000 pounds, only 1640 pounds actually fertilize. In order to get the price per pound, $760 is divided by 1640 which gives a cost per pound of $.463. By multiplying the per pound cost by the 35 lbs. required per acre, the total cost of anhydrous ammonia per acre comes to $16.21. In order to fertilize the ground with the necessary phosphate, an ammonium polyphosphate product known as 10-34-0 is used. Only 34% of the product is phosphate, so only 680 lbs. per ton contain the necessary phosphate needed for the soil. This product is priced at $580 per ton, and when $580 is divided by 680 lbs. the per lb. cost of the product is equal to $0.85. By multiplying the $0.85/pound by the 15 lbs. required per acre, the total per acreage cost of ammonium polyphosphate comes to $12.75. When fertilizing with these two products the total fertilizing cost comes to $28.96. Pesticide is generally $25.87/acre which includes 16.40 ounces of Arial XL per acre, 1.50 pints of 2, 4-D, and 0 .75 pints of Dimethoate (Hyer 2013) . Wheat is fertilized in January and sprayed in April.

Custom hire is $90/acre. Based upon the Oklahoma Farm and Ranch Custom Rates 2011-2012, applying dry bulk fertilizer is $15/acre and occurs in January. Fungicide and pesticide and spraying for weeds is done in April and is $25/acre. No-till planting occurs in September the year prior and is $20/acre and harvesting is $30/acre, which occurs in June (Doye and Sahs, Oklahoma Farm and Ranch Custom Rates 2012). Again, the high ends of the custom rates were used to incorporate the potential maintenance cost associated if the equipment was owned by the partnership.

Insurance is $19.30/acre. Insurance rates were based on a 65% yield and price coverage policy from a local crop insurance agency, Linda Hill Crop Insurance (Hill 2013). Insurance payments are due August 1st. Higher insurance premiums are due to the risky nature of dry land wheat in the area.

CHAPTER V: RESULTS

This chapter describes the results from building the budgets as well as the sensitivity and stochastic analyses.

5.1 Budget Results

Table 5.1 summarizes the results of the spreadsheet model results for the Base Case, Scenario 2, and Scenario 3.

Table 5.1: Spreadsheet Model Results

		BASE CASE (BC)	Scenario 2	% CHANGE)	Scenario 3	% CHANGE
1.	Net Farm Income	375,312	639,064	70%	629,457	68%
2.	Gross Receipts	593,923	1,654,720	179%	1,818,048	206%
3.	Cash Expense	177,880	974,925	448%	1,147,860	545%
4.	Cash Interest Expense	12,744	27,823	118%	28,798	126%
5.	Assets (Ending)	1,889,851	2,153,603	14%	2,143,996	13%
6.	Liabilities (Ending)	252,430	252,430	-	252,430	-
7.	Net Worth (Ending)	1,637,420	1,901,172	16%	1,891,565	16%
8.	Accrued Interest (Ending) (I.S. - D.2. or N.W. - 31, 32, 33)	10,163	10,163	-	10,163	-
9.	Change in Above Beginning to Ending (I.S. – D2)	(1,051)	(1,051)	-	(1,051)	-
10.	Notes Payable + Interest Due (N.W. - 30,31)	0	0	-	0	-
11.	New Borrowing -- Operating Loan (Total Col) (C.F. 56)	101,662	883,627	769%	1,005,460	889%
12.	Outstanding Operating Debt (Ending-Dec.) (C.F. 63)	0	0	-	0	-
13.	Inflow - Outflow (Total Col) Notice interest is not (C.F. 54 Last Column)	216,925	495,756	129%	487,124	125%
14.	Cash Balance (Ending) (C.F. 62 or N.W. 1)	344,494	608,246	77%	598,639	74%

15.	Net Cash Income	416,043	679,795	63%	670,188	61%
16.	Operating Loan Interest (C.F. 60 last column)	1,530	16,609	986%	17,584	1049%

As can be seen from the above chart, net farm income increased significantly in Scenarios 2 and 3. Gross receipts increased 179% for Scenario 2 and 206% for Scenario 3. According to the Base Case share-crop agreement, the Long Family Partnership only receives one-third of gross receipts, so it would be expected that if they did their own farming that gross receipts would nearly triple, which is rather consistent with the above figures. Furthermore, cash expenses increased 448% for Scenario 2 and 545% for Scenario 3. Compared to the Base Case in which the share-crop agreement only mandates the sharing of one-third of the fertilizer and irrigation motor fuel expense, farming the land themselves would entail tripling their fertilizer and irrigation motor fuel expense as well as taking on many additional expenses. In other words, this dramatic increase in cash expenses for farming the land themselves would be expected. Also, the greater percentage increase of cash expenses for Scenario 3 compared to Scenario 2, explains why net farm income for Scenario 2 is greater than Scenario 3. The additional profit from farming their own dry land wheat was not greater than the income from cash rent provided because of the expenses associated with dry land farming.

The significant net farm income between the Base Case and Scenario 2 and Scenario 3 might be explained by the following. First, a landowner takes on significant additional risk to operate their own land, and in doing so must expect to be compensated for taking on additional risk with the promise of greater return. This is based off the fundamental theory of risk and return in which the potential return rises with increased risk. Secondly, as explained in the introduction chapter, this has been a decade of dramatic changes in agriculture particularly in regards to rising commodity prices and steady increase of gross farm income over the past few years. In other words, had this analysis been conducted 10 years ago, there would probably be less of a difference in the Base Case with Scenarios 2 and 3.

The results of the budget show that under the specific static conditions outlined in the budget, the Long Family Partnership could increase net farm income and net worth the most in Scenario 2 by choosing to farm their own irrigated corn land and cash rent their dry land. However, there is a risk and return tradeoff that needs to be assessed. Farming is a risky endeavor due to the variability and fluctuations that can occur with expenses, yields and prices. The following sections review the results of the sensitivity and stochastic analysis that were used to evaluate the effect of certain risks on the net farm income.

5.2 Sensitivity Results

This section examines how percentage decreases in prices, yield and rental rates affected net farm income for the various scenarios. Price increases were not included in this analysis because we did not foresee prices going much higher than what they have been in recent years. Furthermore, an increase in rental rates was not included because Long Family Partnership is already one of the highest paid landowners for dry land farm ground. Also, due to the annual rainfall and potential for drought in this area, there is considerable risk of low yields, so farmers are not willing to spend a considerable amount on dry land leases.

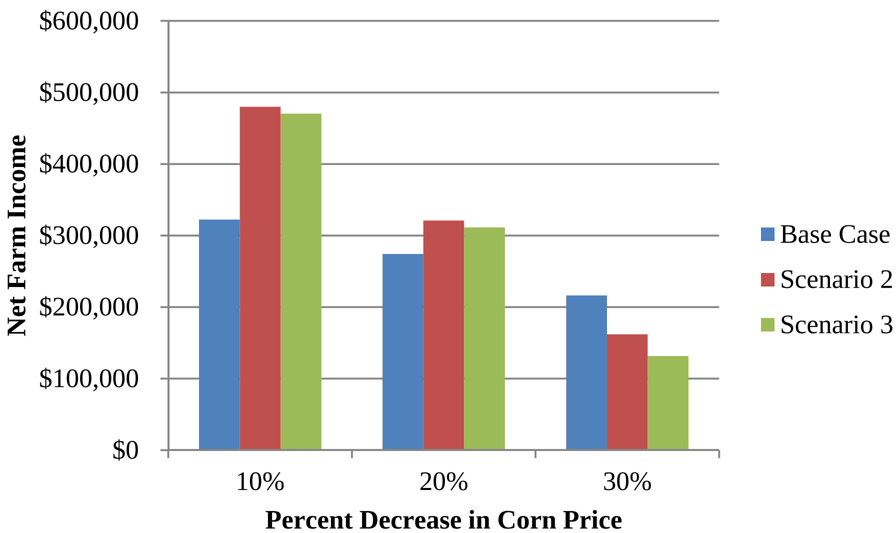
Table 5.2 and Figure 5.1 summarize how net farm income is affected when corn prices decrease from an expected $5.60 to $5.04 (10%), $4.48 (20%), and $3.92 (30%). Table 5.2 shows both the net farm income with the decreased corn price and the percent change in net farm income when the price is decreased, and Figure 5.2 offers a graphing of these figures.

Table 5.2: Decreasing Corn Prices Effect on Net Farm Income without Rental Rate Change in Base

Scenario	$5.60/bushel	$5.04/bushel (10% decrease)	% Change	$4.48/bushel (20% decrease)	% Change	$3.92/bushel (30% decrease)	% Change
Base Case	375,312	$322,352	-14.1%	$274,240	-26.9%	$216,431	-42.3%
Scenario 2	639,064	$480,024	-24.9%	$320,984	-49.8%	$161,944	-74.7%
Scenario 3	629,457	$470,417	-25.3	$311,377	-50.5%	$131, 562	-79.1%

*Base case refers to share cropping irrigated land and cash leasing dryland, Scenario 2 involves farming the irrigated themselves and cash leasing dryland, and Scenario 2 involved farming all the land themselves.

Figure 5.1: Decreasing Corn Prices Effect on Net Farm Income



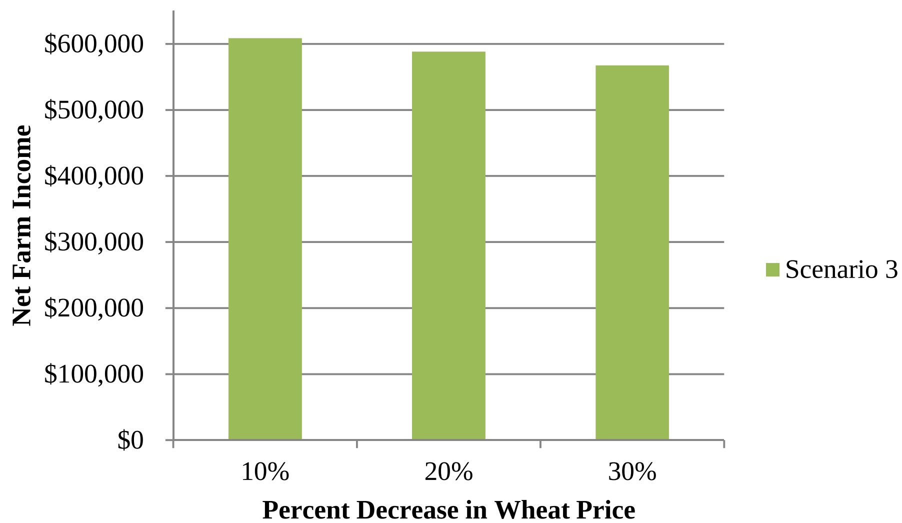
As can be seen by the above chart and graph, Scenarios 2 and 3 were far more sensitive to decreases in corn prices than the base case. A 20% decrease in price would lead to a greater than 50% decrease in net farm income for Scenarios 2 and 3. Furthermore, it is important to note that if prices dropped more than 30%, then the Base Case had a greater net farm income. This provides evidence that farming the land themselves, the Long Family Partnership would be subjected to greater risk associated with the possibility of decreasing commodity prices.

Table 5.3 and Figure 5.2 summarize how net farm income is affected when wheat prices decrease from an expected $7.06 to $6.35 (10%), $5.65 (20%), and $4.94 (30%). Table 5.3 shows both the net farm income with the decreased wheat price and the percent change on net farm income for Scenario 3 when the price is decreased and Figure 5.3 offers a graphing of these figures. The base case and Scenario 2 are not included in this analysis because the net farm income would not be affected by a decrease in wheat price due to the cash rental agreement.

Table 5.3: Decreasing Wheat Prices Effect on Net Farm Income

Scenario	$7.06/bushel	$6.35/bushel (10% decrease)	% Change	$5.65/bushel (20% decrease)	% Change	$4.94/bushel (30% decrease)	% Change
Scenario 3	629,457	$608,703	-3.30%	$588,240	-6.55%	$567,485	-9.85%

Figure 5.2: Decreasing Wheat Prices Effect on Net Farm Income



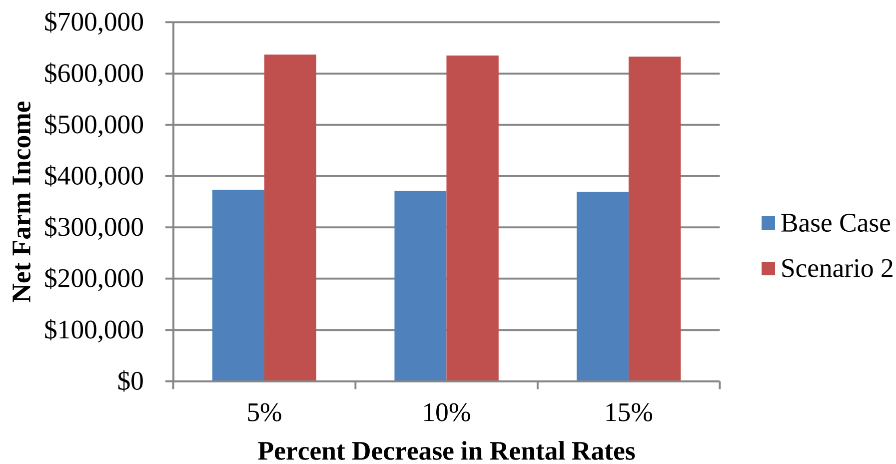
A decrease in wheat price does not have as a dramatic effect on net farm income as a decrease in corn price. This could be due to the fact that there are less acres of wheat involved in this farm scenario, considering there are only 960 acres of dry land wheat and 1760 acres of irrigated corn. Furthermore, the wheat contributes less gross revenue to the overall net farm income than does corn.

In the case of significant and constant decreases in wheat prices, rental rates would also need to be reduced. Table 5.4 and Figure 5.3 summarize how net farm income is affected when rental rates decrease 5%, 10%, and 15 %. Table 5.4 shows both the net farm income with the decreased rental rates and the percent change on net farm income for when the rental rate is decreased and Figure 5.4 offers a graphing of these figures. Scenario 3 is not included in this analysis because it does not include a cash rental agreement in the budget.

Table 5.4: Decreasing Rental Rates Effect on Net Farm Income

Scenario	Regular Rental Rates ($40 and $45/acre)	5% decrease	% Change	10% decrease	% Change	15% decrease	% Change
Base Case	$375,312	$373,284	-.5%	$371,256	-1.1%	$369,228	-1.6%
Scenario 2	$639,064	$637,030	-.3%	$634,997	-.6%	$632,963	-1%

Figure 5.3: Decreasing Rental Rates Effect on Net Farm Income



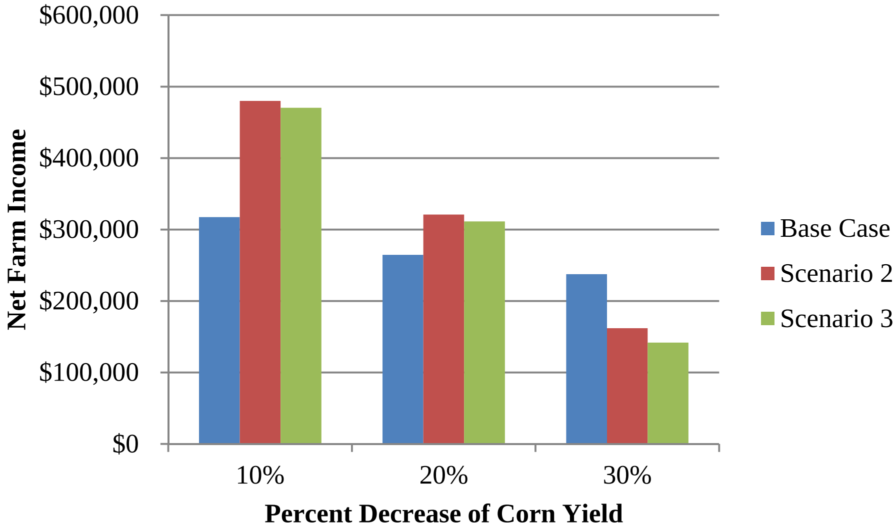
A decrease in rental rates had a minimal impact on the net farm income for both the Base Case and Scenario 2. This justifies the very reason that land owners often chose to enter into cash rental agreements, because they are very low in risk. Rates remain relatively constant through the years and provide a rather consistent form of income, and the farmers take on the risk of fluctuating prices and yields.

Table 5.5 and Figure 5.4 summarize how net farm income is affected when corn yields decrease from an expected 200 bu./acre to 180 bu./acre (10%), 160 bu./acre (20%), and 140 bu./acre (30%). Table 5.5 shows both the net farm income with the decreased corn yield and the percent change on net farm income when the yield is decreased, and Figure 5.5 offers a graphing of these figures.

Table 5.5: Decreasing Corn Yields Effect on Net Farm Income

Scenario	200 bu./acre	180 bu./acre (10% decrease)	% Change	160 bu./acre (20% decrease)	% Change	140 bu./acre (30% decrease)	% Change
Base Case	375,312	$317,503	-15.4%	$264,543	-29.5%	$237,510	-36.7%
Scenario 2	639,064	$480,024	-24.8%	$320,984	-50%	$161,944	-75%
Scenario 3	629,457	$470,417	-25.3%	$311,377	-50.5%	$141,948	-77.4%

Figure 5.4: Decreasing Corn Yields Effect on Net Farm Income



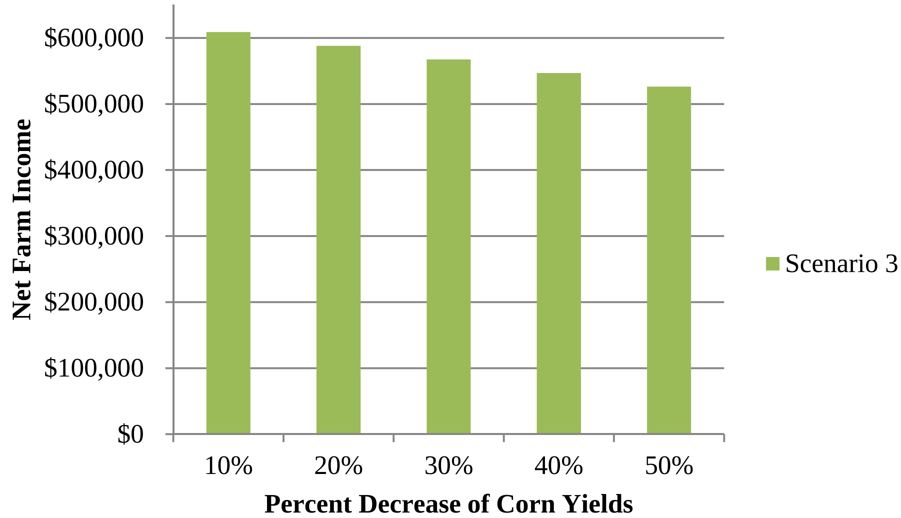
The chart and graph above provide significant evidence to the risk involved in farming the Long Family Partnership farming the land themselves. Scenarios 2 and 3 are far more sensitive to changes in yield than the base case. For example, with a 30% decrease in yields, there would be a greater than 75% loss in net farm income for Scenarios 2 and 3. Weather plays a primary role in the yields produced, and yet is very unpredictable. In other words, the potential of yields dropping below 30% of expected levels is a very legitimate threat.

Table 5.6 and Figure 5.5 summarize how net farm income is affected when wheat yields decrease from an expected 30 bu./acre to 27 bu./acre (10%), 24 bu./acre (20%), 21 bu./acre (30%), 18 bu./acre (40%), and 15 bu./acre (50%). Table 5.6 shows both the net farm income with the decreased wheat yields and the percent change on net farm income for Scenario 3 when the yield is decreased. Figure 5.6 offers a graphing of these figures. The base case and Scenario 2 are not included in this analysis because the net farm income would not be affected by a decrease in wheat yields due to the cash rental agreement.

Table 5.6: Decreasing Wheat Yields Effect on Net Farm Income

Scenario	30 bu./acre	27 bu./acre (10% decrease)	% Change	24 bu./acre (20% decrease)	% Change	21 bu./acre (30% decrease)	% Change	18 bu./acre (40% decrease)	% Change	15 bu./acre (50% decrease)	%Change
Scenario 3	629,457	$608,820	-3.3%	$588,182	-6.6%	$567,544	-9.8%	$546,906	-13.1%	$526,268	-16.4%

Figure 5.5: Decreasing Wheat Yields Effect on Net Farm Income



As previously mentioned, dry land wheat yields were decreased by 10%, 20%, 30%, 40%, and 50%, because without the support of irrigation, it is possible to experience greater yield losses to dry land wheat. Net farm income decreased with lower wheat yields; however net farm income was far less sensitive to decreases in wheat yields than corn yields. Corn is the greatest contributor to overall net farm income, so changes in the yield and revenue of dry land wheat were not as significant as they were for corn.

5.2 Stochastic Analysis Results

For each price, yield and fertilizer variables were considered to be stochastic and stimulations were run to see the impact on the various scenarios. Then for each stimulation, detailed summary statistics were produced and cumulative distribution function of net farm income for each scenario were graphed. Figure 5.6 shows the probability distribution function and Figure 5.7 shows the detailed summary statistics that @Risk provides of a fertilizer expense stimulation for the Base Case.

Figure 5.6: Probability Distribution Function for Fertilizer, Base Case

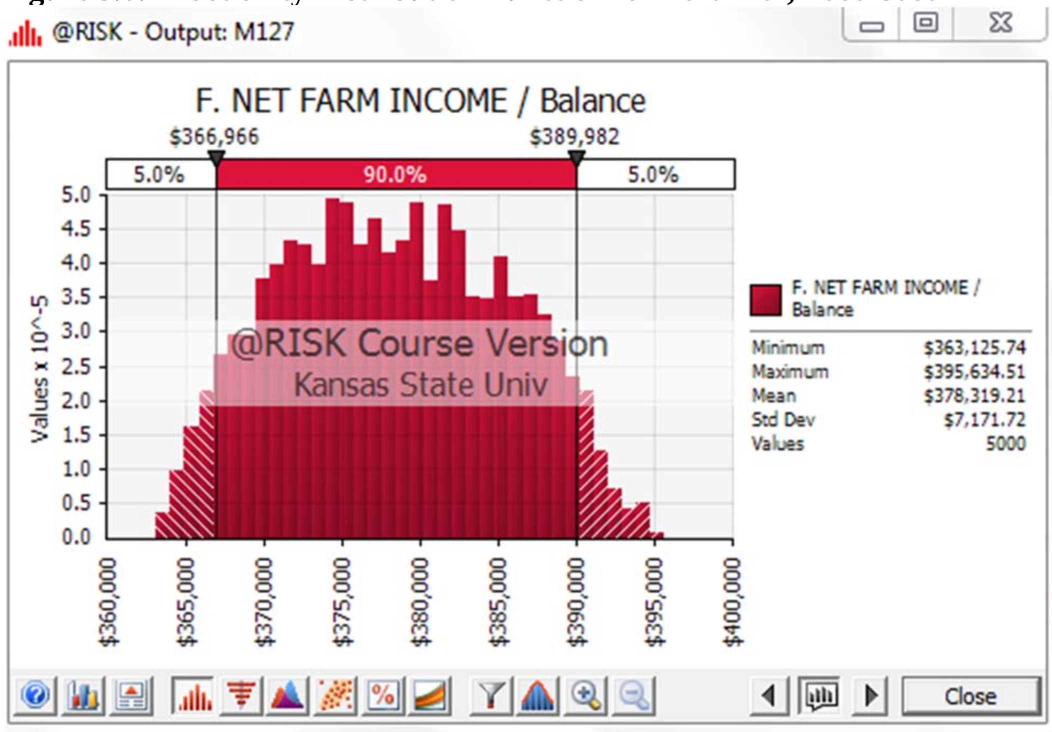


Figure 5.7: Detailed Statistics Summary including PDF Values

@RISK - Detailed Statistics

Name	F. NET FARM INC..
Description	Output
Cell	Sally Long!M127
Minimum	363125.8
Maximum	395634.5
Mean	378319.2
Std Deviation	7171.715
Variance	5.14335E+07
Skewness	6.295792E-02
Kurtosis	2.093819
Errors	0
Mode	375605.2
5% Perc	366965.9
10% Perc	368659.5
15% Perc	370098.4
20% Perc	371391
25% Perc	372572
30% Perc	373843.5
35% Perc	374850
40% Perc	375922.6
45% Perc	377054.6
50% Perc	378129.3
55% Perc	379341.9
60% Perc	380345.8
65% Perc	381551.4
70% Perc	382642.8
75% Perc	384003.1
80% Perc	385285
85% Perc	386695.9
90% Perc	388246.3
95% Perc	389981.9

These results generate a probability distribution of possible net farm incomes given the normal distribution assumption of the for the fertilizer expense parameter. For example, the above results indicate that there is a 5% probability that net income will be $366,966 or less or greater than $389,981.90.

The following sections break down each stochastic analysis for the price, yield and fertilizer variable on net farm income for each of the three scenarios:

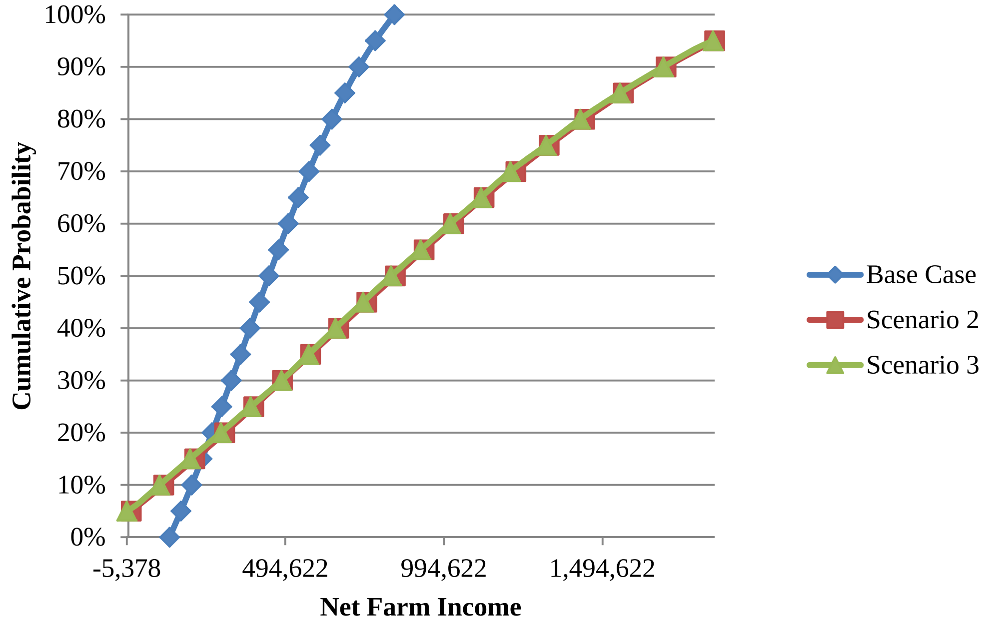
5.3.1. Corn and Wheat Price Variable

This section looks at the results on net farm income for when price is assumed to be normally distributed and is expressed as a stochastic term in the spreadsheet model. Table 5.7 provides summary statistics and Figure 5.8 provides the CDF's of net farm income for each scenario.

Table 5.7: Probability of Earning a Given Net Farm Income Assuming Corn Prices are Normally Distributed

Cumulative Probability of Occurence	Base Case	Scenario 2	Scenario 3
0%	$129,443	$-99,424	$-195,164
5%	$165,365	$8,592	-$5,378
10%	$199,400	$110,799	$97,899
15%	$232,026	$208,774	$193,986
20%	$263,457	$303,164	$291,320
25%	$294,062	$395,068	$385,430
30%	$324,040	$485,093	$482,745
35%	$353,673	$574,083	$567,903
40%	$383,229	$662,839	$652,516
45%	$412,788	$751,606	$739,566
50%	$442,538	$840,943	$828,076
55%	$472,861	$932,004	$921,491
60%	$503,828	$1,024,997	$1,014,655
65%	$535,792	$1,120,985	$1,111,649
70%	$569,215	$1,221,354	$1,203,941
75%	$604,158	$1,326,288	$1,316,725
80%	$641,583	$1,438,676	$1,424,608
85%	$682,042	$1,560,175	$1,549,493
90%	$726,899	$1,694,880	$1,686,743
95%	$777,909	$1,848,063	$1,842,924
100%	$838,447	$2,029,859	$2,090,697

Figure 5.8: CDF Results for Price Stochastic Analysis



This analysis shows that there is a greater potential for profit but also a greater opportunity for loss for Scenarios 2 and 3. According to the results, there is a greater than 5% chance that there could be a net farm income loss for Scenario 3. However it suggests, there is less than a 15% probability that the Base Case would generate a greater net farm income than Scenario 2 and 3.

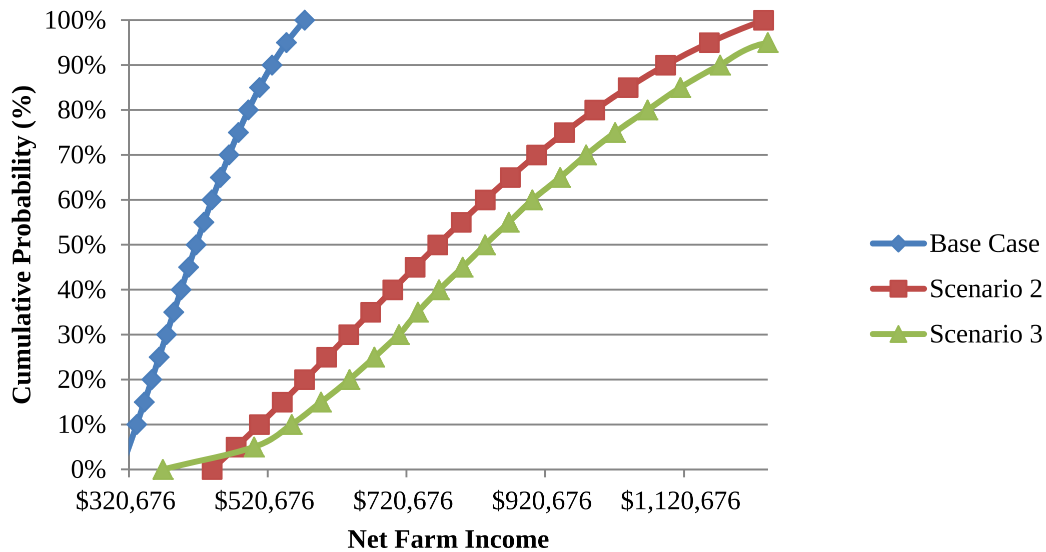
5.3.2. Yield Variable

This section looks at the results on net farm income for when corn yield is assumed to be normally distributed and is expressed as a stochastic term in the spreadsheet model. Table 5.8 and Figure 5.9 provide summary statistics and the CDF's of net farm income for each land tenure scenario.

Table 5.8: Probability of Earning a Given Net Farm Income Assuming Corn Yield is Normally Distributed

Cumulative Probability of Occurence	Base Case	Scenario 2	Scenario 3
0%	$309,142	$440,354	$369,469
5%	$320,676	$474,990	$501,128
10%	$331,915	$508,741	$555,209
15%	$342,840	$541,550	$597,451
20%	$353,588	$573,826	$638,592
25%	$364,205	$605,710	$674,338
30%	$374,758	$637,399	$709,810
35%	$385,265	$668,953	$737,040
40%	$395,867	$700,791	$767,543
45%	$406,607	$733,042	$801,805
50%	$417,513	$765,794	$833,935
55%	$428,714	$799,430	$868,149
60%	$440,258	$834,097	$902,143
65%	$452,296	$870,248	$942,273
70%	$464,950	$908,247	$979,618
75%	$478,380	$948,578	$1,021,331
80%	$492,858	$992,055	$1,068,247
85%	$508,836	$1,040,036	$1,115,617
90%	$526,820	$1,094,044	$1,172,680
95%	$547,782	$1,156,992	$1,241,375
100%	$573,879	$1,235,360	$1,484,160

Figure 5.9: CDF Results for Yield Stochastic Analysis



According to these results, Scenarios 2 and 3 have greater potential to generate a greater net farm income than the Base Case. In addition, scenario 3 clearly provides the highest probability of expected return and has the lowest risk of making a lower net farm income than the other two scenarios.

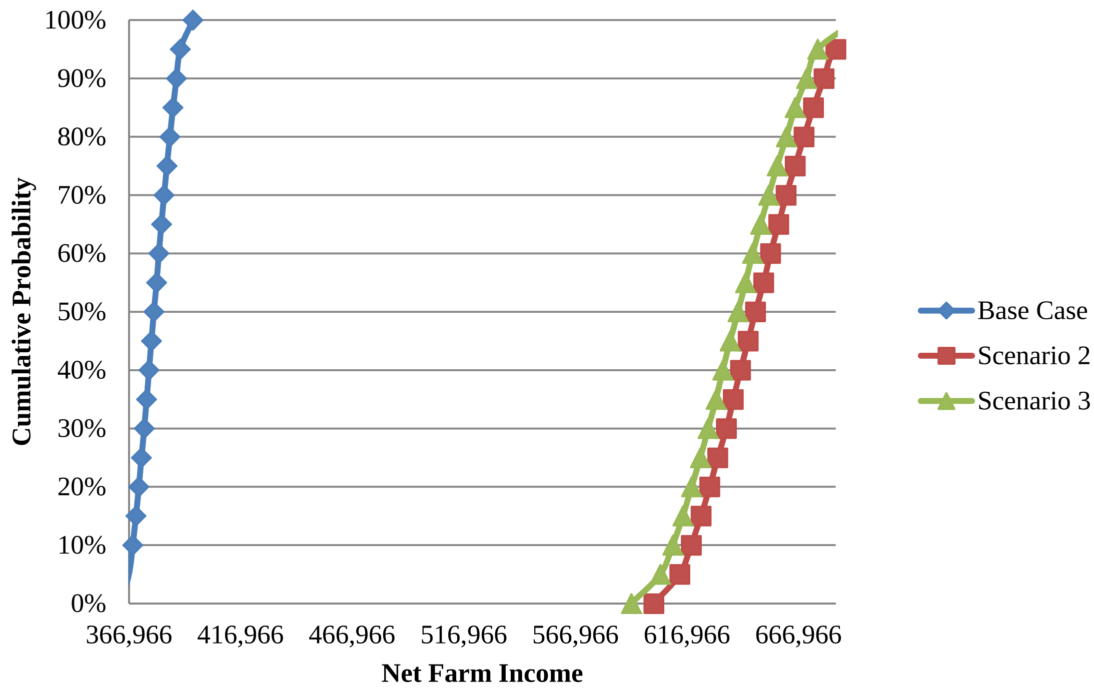
5.3.3. Fertilizer Variable

This section looks at the results on net farm income for when fertilizer expense is assumed to be normally distributed and is expressed as a stochastic term in the spreadsheet model. Table 5.9 and Figure 5.10 provide summary statistics and the cdf's of net farm income for each land tenure scenario.

Table 5.9: Probability of Earning a Given Net Farm Income Assuming Fertilizer Expense is Normally Distributed

Cumulative Probability of Occurence	Base Case	Scenario 2	Scenario 3
0%	$363,126	$602,066	$592,028
5%	$366,966	$613,725	$605,014
10%	$368,660	$618,866	$610,614
15%	$370,098	$623,235	$615,144
20%	$371,391	$627,159	$618,995
25%	$372,572	$630,745	$622,976
30%	$373,844	$634,605	$626,415
35%	$374,850	$637,661	$629,992
40%	$375,923	$640,917	$632,982
45%	$377,055	$644,354	$636,330
50%	$378,129	$647,617	$639,787
55%	$379,342	$651,299	$643,169
60%	$380,346	$654,346	$646,354
65%	$381,551	$658,007	$649,938
70%	$382,643	$661,320	$653,594
75%	$384,003	$665,450	$657,378
80%	$385,285	$669,342	$661,483
85%	$386,696	$673,626	$665,420
90%	$388,246	$678,333	$670,493
95%	$389,982	$683,602	$675,529
100%	$395,635	$700,764	$693,107

Figure 5.10: CDF Results for Fertilizer Stochastic Analysis



This analysis also confirms the previous two conclusions that Scenarios 2 and 3 have the potential to generate greater net farm income than the Base Case. In this situation, scenario 2 clearly provides the highest probability of expected return and has the lowest risk of making a lower net farm income than the other two scenarios.

As a general consensus according to this specific study, Scenario 2 provides the greatest return off the land. Furthermore, the stochastic and sensitivity analysis suggest that even in the midst of changes in price, yield and fertilizer expenses, that Scenario 2 consistently has a greater probability of increasing net farm income. Current conditions provide a prime opportunity to pursue this endeavor, especially in consideration of the USDA expectations that commodity prices will continue to stay high. However, the details of this implementation would need to be worked out, especially in regard to designation of a manager to orchestrate and organize the implementation.

Of course, there is a possibility of a significant decline in prices or a significant spike in cash expenses that provide a very real threat. This again exemplifies the risk and return principle that the Long Family Partnership must be aware of if they decide to take on this endeavor. By deciding to farm the land themselves, there will always be the possibility that more loss could incur than in their current share-crop agreements. However, according to this specific study and analysis, there is a much greater probability of increasing net farm income with Scenario 2 or 3 than net farm income decreasing.

CHAPTER VI: CONCLUSION

This chapter provides a summary of the research, the findings and potential avenues for future research.

6.1 Summary

The purpose of this research was to re-evaluate the Long Family Partnership farmland management strategy in light of the changing agricultural climate. The objective was to assess and compare the possibility of other options that could potentially generate greater net farm income. Three scenarios were considered. The “Base Case” or the current management strategy of share cropping the irrigated corn farmland and cash leasing dry land wheat was compared to two scenarios. Scenario 2 was a situation of the Long Family Partnership deciding to farm the irrigated corn land, hiring custom farm crews to plant, fertilize and harvest, and then continuing to cash rent the dry land wheat. Scenario 3 included the Long Family Partnership farming both their own irrigated corn and dry land wheat, and hiring custom crews to plant, fertilize and harvest. A spreadsheet model was then built to estimate the net farm income of the various scenarios. Sensitivity and stochastic analyses were then used to evaluate the variability and risk involved in each of the scenarios.

6.2 Findings

By just comparing the static budget results, Scenario 2 provided the greatest net farm income of $639,064, followed by Scenario 3, $629,457 and lastly the Base Case, $375,312. In doing the sensitivity analysis, Scenario 2 and 3 continued to generate greater net farm income, but also proved to be more sensitive to fluctuations in prices and yields. The stochastic analysis further confirmed that there was potential to generate greater net farm income with Scenarios 2 and 3, but variability in prices, yields and expenses altered which scenario may be the least risky and provide the highest expected return The consistency of the results suggests that in looking to increase net farm income, the Long Family Partnership should consider farming their own land and cash leasing their dry land wheat based upon the static net farm income comparison, as well as the sensitivity and stochastic analysis.

6.3 Potential Pitfalls

It is important to note that in building the budget model, errors could have been made due to lack of accuracy with budget variables. Expenses and yields vary from each farmer and each field because management practices vary. For instances, some farmers may choose to spend more money on fertilizer, while others plant seed more aggressively; or one field may require more water than another because of soil type. It is difficult to have extremely consistent values for the budget. Neil Hyer was the primary farmer interviewed, however several were consulted on their opinion of the accuracy of figures, but despite the extensiveness of the research put into building the needed enterprise budgets, there could still be potential errors. Lastly, the expense associated with hiring a farm manager was not included in the budget, but might be necessary if the Long Family Partnership decided to farm their own land. A farm manager could expect at least a $50,000 salary plus 35% fringe benefits.

6.4 Avenues for Future Research

In looking to expand upon this research, it would be possible to take into consideration the option of the Long Family Partnership deciding to buy their own equipment and hire their own labor force instead of hiring custom crews to plant, fertilize and harvest. This would entail expanding the budgets to include the financing and depreciation that would be associated with owning their own equipment. Furthermore, the scenarios could have been expanded to include more landowner options such as Flex-Rent.

Also, there is a possibility to look at the effect of what the increase in a cash expense other than fertilizer might have on net farm income. For instance, what about the possibility of an increase in diesel fuel or natural gas that would affect custom hire or irrigation motor expenses? These also pose very real threats to net farm income and would be interesting to see the results of such a study on various farm management strategies.

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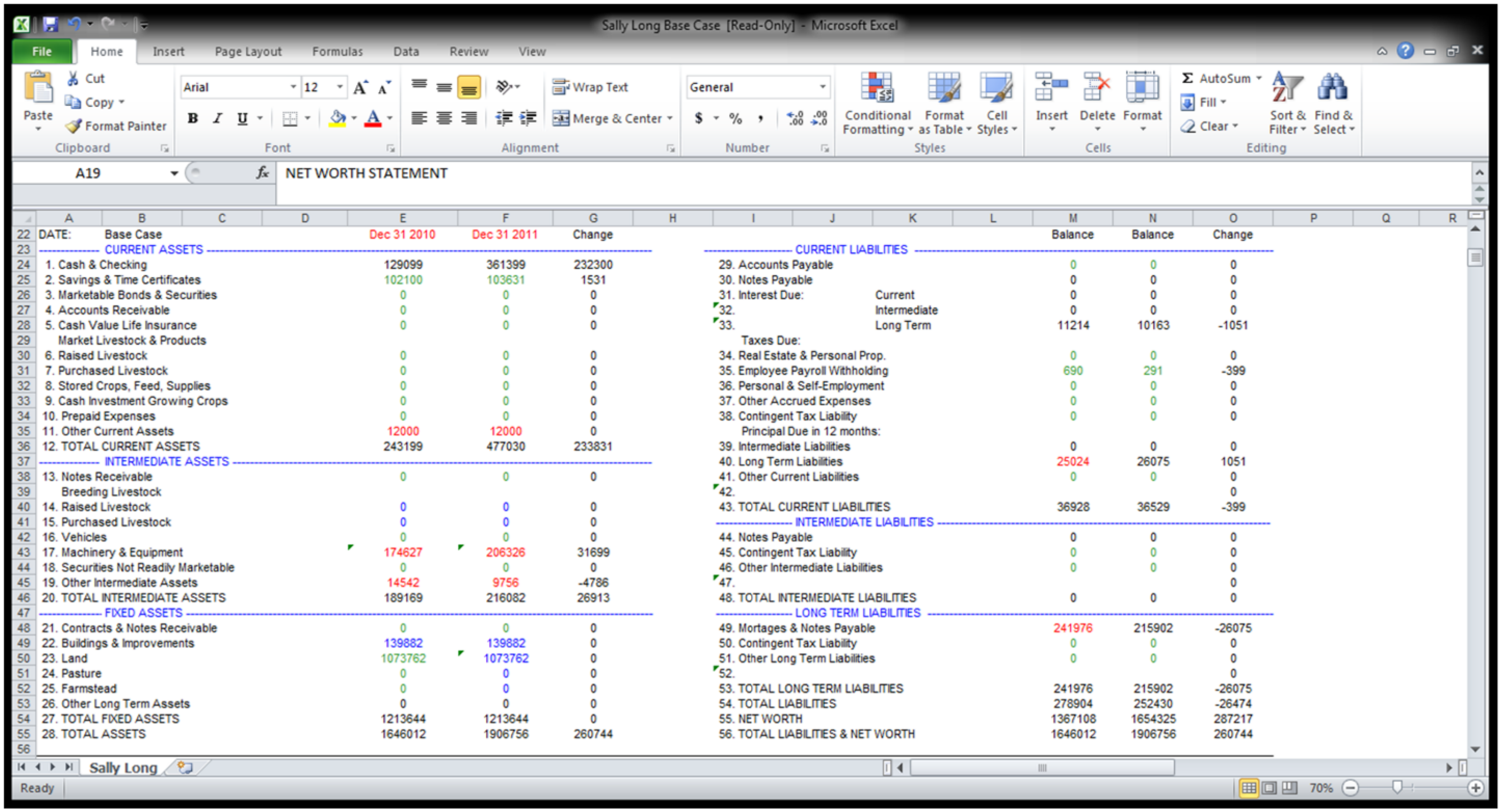
APPENDIX A: NET WORTH STATEMENT

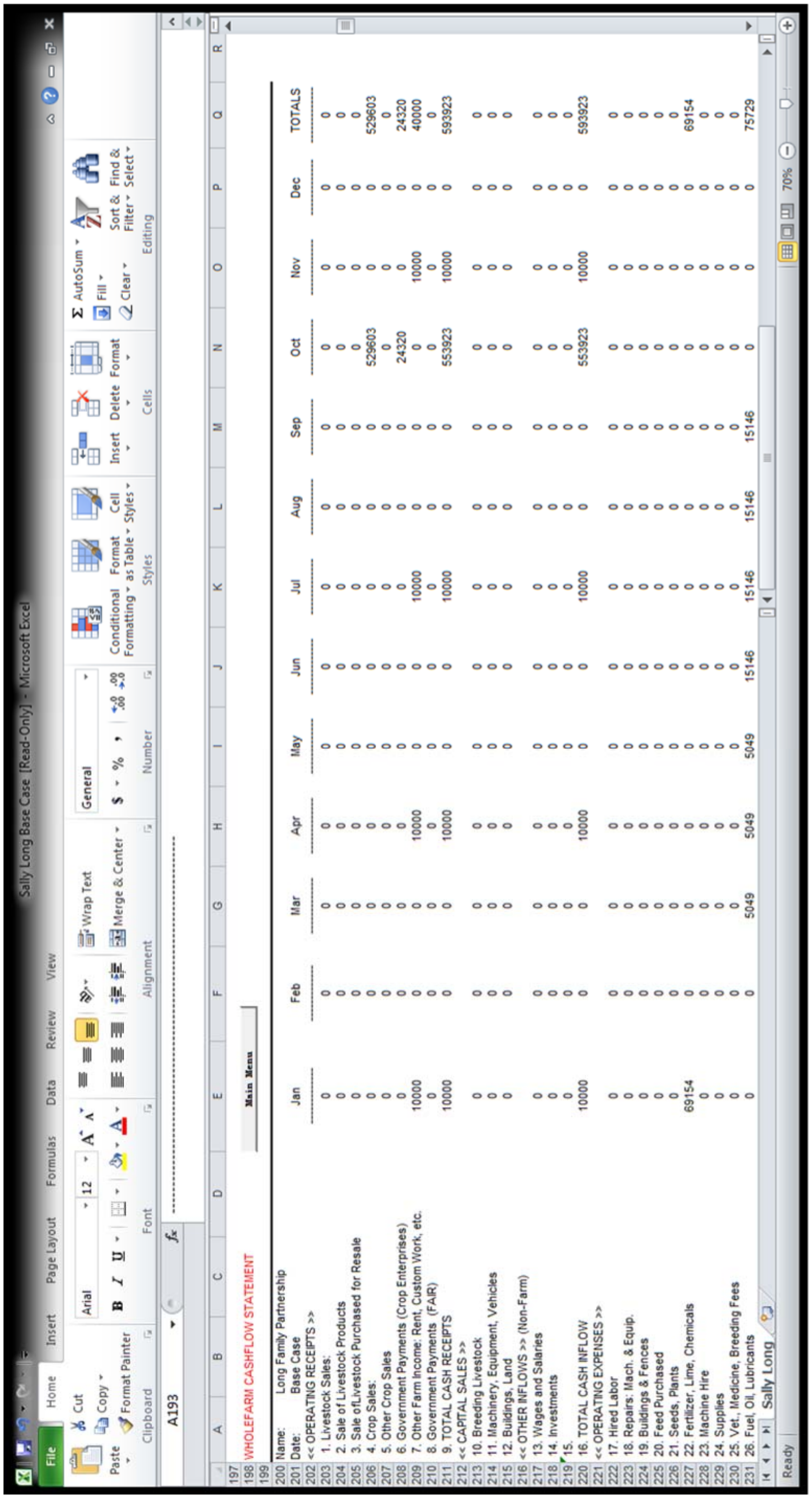


NET WORTH STATEMENT

DATE: Base Case	Dec 31 2010	Dec 31 2011	Change
CURRENT ASSETS			
1. Cash & Checking	129099	361399	232300
2. Savings & Time Certificates	102100	103631	1531
3. Marketable Bonds & Securities	0	0	0
4. Accounts Receivable	0	0	0
5. Cash Value Life Insurance	0	0	0
Market Livestock & Products			
6. Raised Livestock	0	0	0
7. Purchased Livestock	0	0	0
8. Stored Crops, Feed, Supplies	0	0	0
9. Cash Investment Growing Crops	0	0	0
10. Prepaid Expenses	0	0	0
11. Other Current Assets	12000	12000	0
12. TOTAL CURRENT ASSETS	243199	477030	233831
INTERMEDIATE ASSETS			
13. Notes Receivable	0	0	0
Breeding Livestock			
14. Raised Livestock	0	0	0
15. Purchased Livestock	0	0	0
16. Vehicles	0	0	0
17. Machinery & Equipment	174627	206326	31699
18. Securities Not Readily Marketable	0	0	0
19. Other Intermediate Assets	14542	9756	-4786
20. TOTAL INTERMEDIATE ASSETS	189169	216082	26913
FIXED ASSETS			
21. Contracts & Notes Receivable	0	0	0
22. Buildings & Improvements	139882	139882	0
23. Land	1073762	1073762	0
24. Pasture	0	0	0
25. Farmstead	0	0	0
26. Other Long Term Assets	0	0	0
27. TOTAL FIXED ASSETS	1213644	1213644	0
28. TOTAL ASSETS	1646012	1906756	260744

		Balance	Balance	Change
CURRENT LIABILITIES				
29. Accounts Payable		0	0	0
30. Notes Payable		0	0	0
31. Interest Due:	Current	0	0	0
32.	Intermediate	0	0	0
33.	Long Term	11214	10163	-1051
Taxes Due:				
34. Real Estate & Personal Prop.		0	0	0
35. Employee Payroll Withholding		690	291	-399
36. Personal & Self-Employment		0	0	0
37. Other Accrued Expenses		0	0	0
38. Contingent Tax Liability		0	0	0
Principal Due in 12 months:				
39. Intermediate Liabilities		0	0	0
40. Long Term Liabilities		25024	26075	1051
41. Other Current Liabilities		0	0	0
42.				0
43. TOTAL CURRENT LIABILITIES		36928	36529	-399
INTERMEDIATE LIABILITIES				
44. Notes Payable		0	0	0
45. Contingent Tax Liability		0	0	0
46. Other Intermediate Liabilities		0	0	0
47.				0
48. TOTAL INTERMEDIATE LIABILITIES		0	0	0
LONG TERM LIABILITIES				
49. Mortages & Notes Payable		241976	215902	-26075
50. Contingent Tax Liability		0	0	0
51. Other Long Term Liabilities		0	0	0
52.				0
53. TOTAL LONG TERM LIABILITIES		241976	215902	-26075
54. TOTAL LIABILITIES		278904	252430	-26474
55. NET WORTH		1367108	1654325	287217
56. TOTAL LIABILITIES & NET WORTH		1646012	1906756	260744

APPENDIX B: CASH FLOW STATEMENT

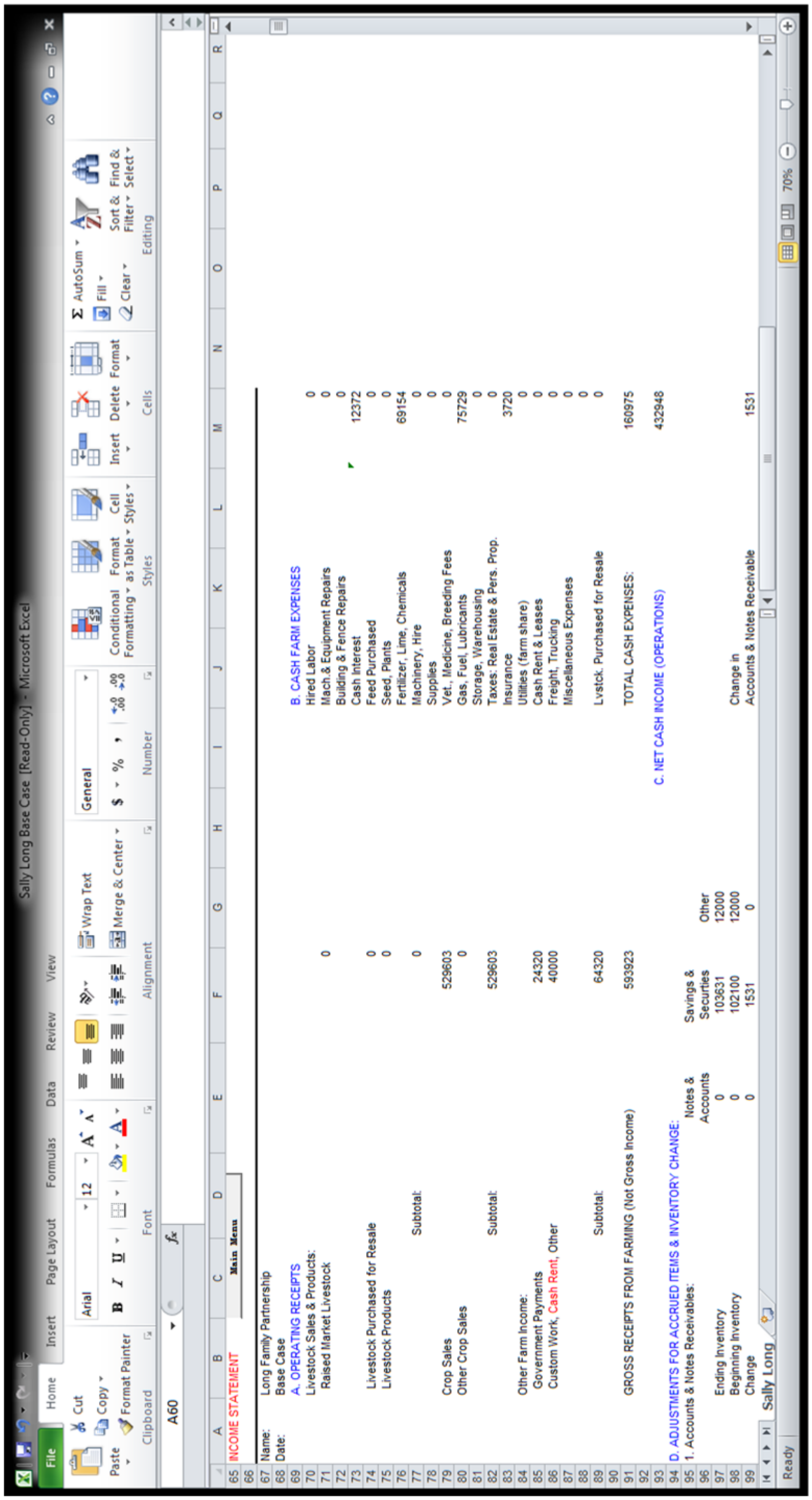


WHOLEFARM CASHFLOW STATEMENT

Name: Long Family Partnership
Date: Base Case

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTALS
<< OPERATING RECEIPTS >>													
1. Livestock Sales:	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Sale of Livestock Products	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Sale ofLivestock Purchased for Resale	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Crop Sales:	0	0	0	0	0	0	0	0	0	529603	0	0	529603
5. Other Crop Sales	0	0	0	0	0	0	0	0	0	0	0	0	0
6. Government Payments (Crop Enterprises)	0	0	0	0	0	0	0	0	0	24320	0	0	24320
7. Other Farm Income: Rent, Custom Work, etc.	10000	0	0	10000	0	0	10000	0	0	0	10000	0	40000
8. Government Payments (FAIR)	0	0	0	0	0	0	0	0	0	0	0	0	0
9. TOTAL CASH RECEIPTS	10000	0	0	10000	0	0	10000	0	0	553923	10000	0	593923
<< CAPITAL SALES >>													
10. Breeding Livestock	0	0	0	0	0	0	0	0	0	0	0	0	0
11. Machinery, Equipment, Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0
12. Buildings, Land	0	0	0	0	0	0	0	0	0	0	0	0	0
<< OTHER INFLOWS >> (Non-Farm)													
13. Wages and Salaries	0	0	0	0	0	0	0	0	0	0	0	0	0
14. Investments	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	0	0	0	0	0	0	0	0	0	0	0	0	0
16. TOTAL CASH INFLOW	10000	0	0	10000	0	0	10000	0	0	553923	10000	0	593923
<< OPERATING EXPENSES >>													
17. Hired Labor	0	0	0	0	0	0	0	0	0	0	0	0	0
18. Repairs: Mach. & Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0
19. Buildings & Fences	0	0	0	0	0	0	0	0	0	0	0	0	0
20. Feed Purchased	0	0	0	0	0	0	0	0	0	0	0	0	0
21. Seeds, Plants	0	0	0	0	0	0	0	0	0	0	0	0	0
22. Fertilizer, Lime, Chemicals	69154	0	0	0	0	0	0	0	0	0	0	0	69154
23. Machine Hire	0	0	0	0	0	0	0	0	0	0	0	0	0
24. Supplies	0	0	0	0	0	0	0	0	0	0	0	0	0
25. Vet., Medicine, Breeding Fees	0	0	0	0	0	0	0	0	0	0	0	0	0
26. Fuel, Oil, Lubricants	0	0	5049	5049	5049	15146	15146	15146	15146	0	0	0	75729

APPENDIX C: INCOME STATEMENT



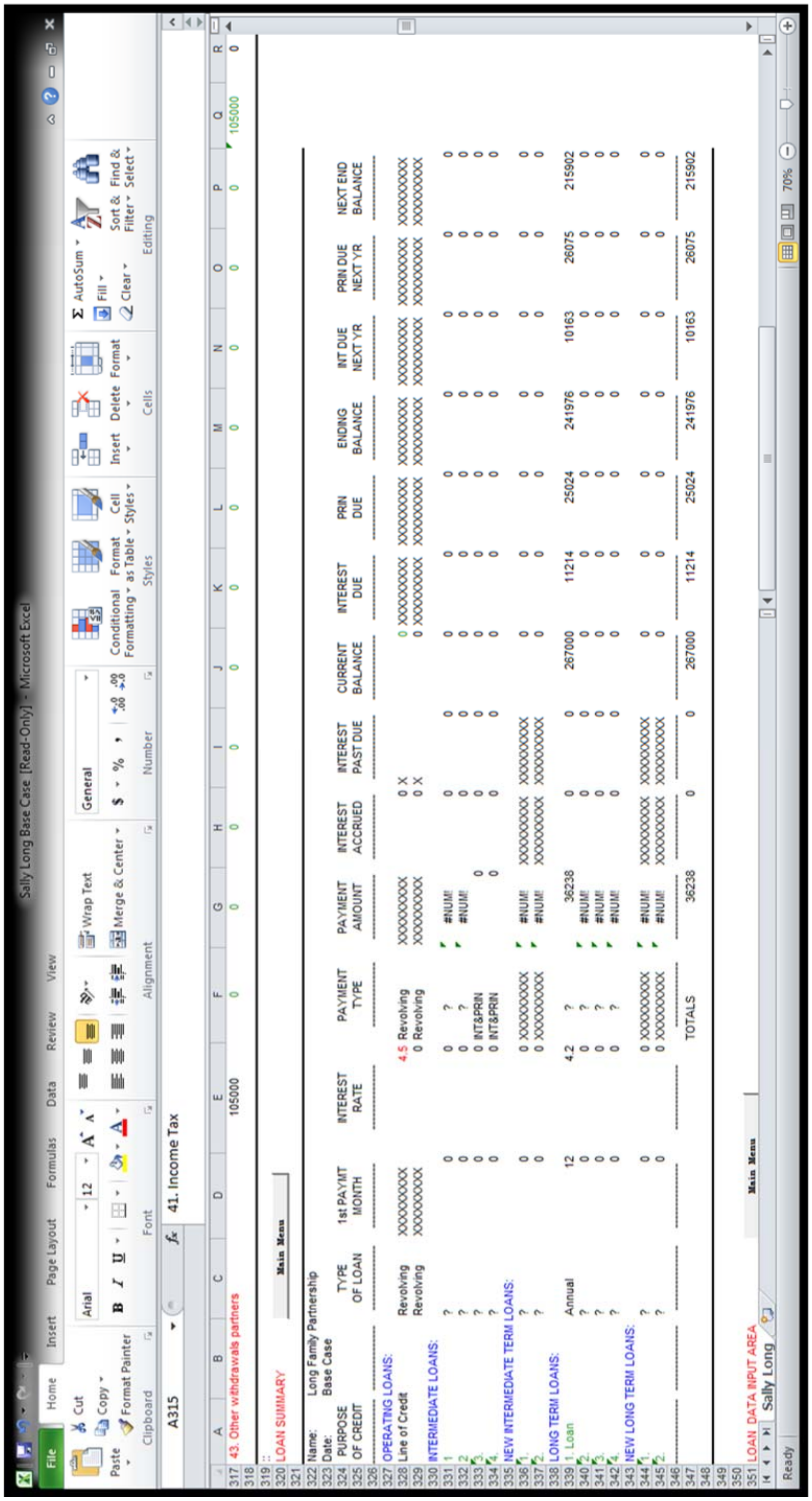
Sally Long Base Case [Read-Only] - Microsoft Excel

INCOME STATEMENT				
Name: Long Family Partnership				
Date: Base Case				
A. OPERATING RECEIPTS			B. CASH FARM EXPENSES	
Livestock Sales & Products:			Hired Labor	0
Raised Market Livestock		0	Mach.& Equipment Repairs	0
			Building & Fence Repairs	0
			Cash Interest	12372
Livestock Purchased for Resale		0	Feed Purchased	0
Livestock Products		0	Seed, Plants	0
			Fertilizer, Lime, Chemicals	69154
	Subtotal:	0	Machinery, Hire	0
			Supplies	0
Crop Sales		529603	Vet., Medicine, Breeding Fees	0
Other Crop Sales		0	Gas, Fuel, Lubricants	75729
			Storage, Warehousing	0
	Subtotal:	529603	Taxes: Real Estate & Pers. Prop.	0
			Insurance	3720
Other Farm Income:			Utilities (farm share)	0
Government Payments		24320	Cash Rent & Leases	0
Custom Work, Cash Rent, Other		40000	Freight, Trucking	0
			Miscellaneous Expenses	0
				0
	Subtotal:	64320	Lvstck. Purchased for Resale	0
GROSS RECEIPTS FROM FARMING (Not Gross Income)		593923	TOTAL CASH EXPENSES:	160975
			C. NET CASH INCOME (OPERATIONS)	432948

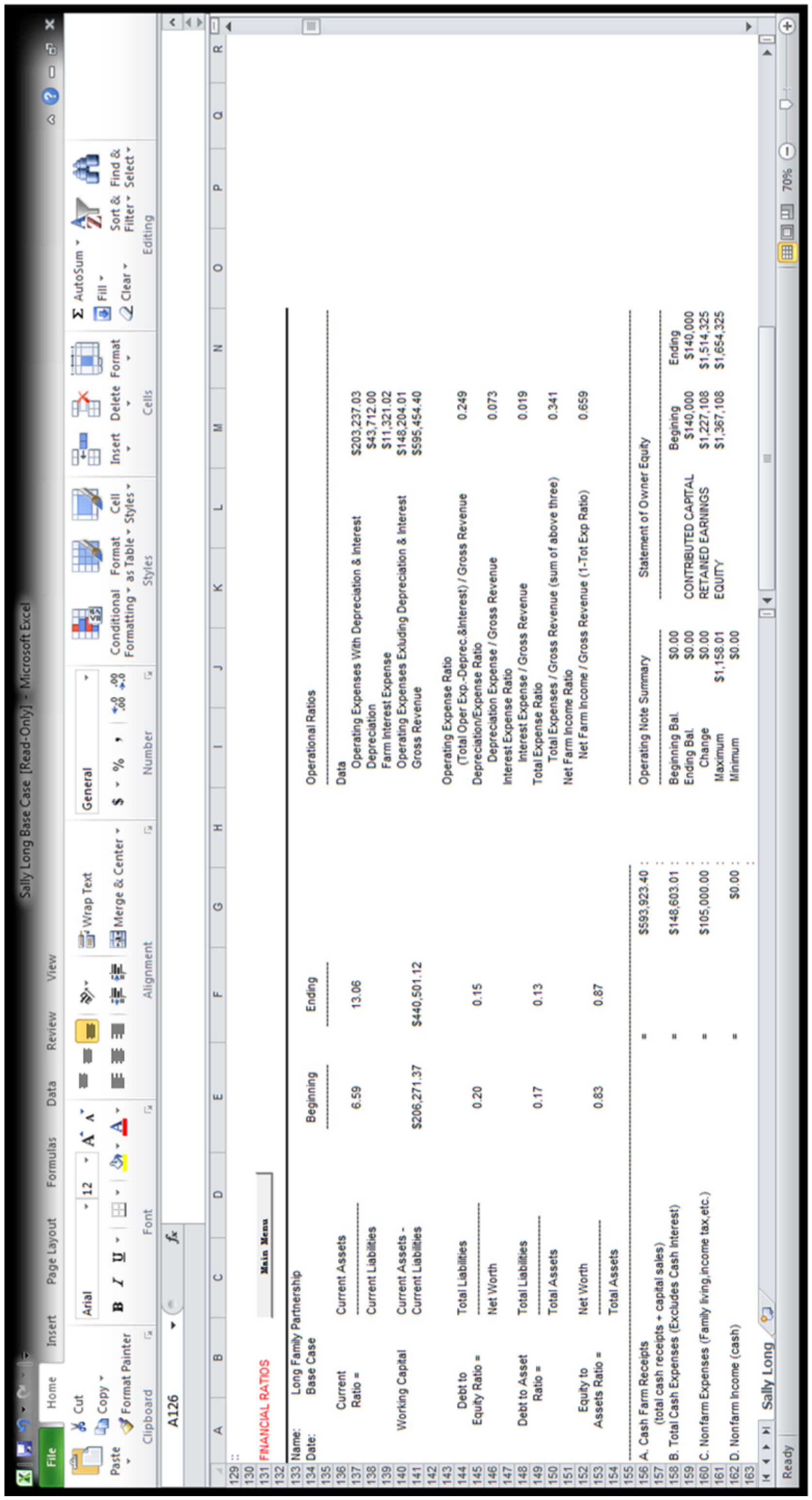
D. ADJUSTMENTS FOR ACCRUED ITEMS & INVENTORY CHANGE:

1. Accounts & Notes Receivables:	Notes & Accounts	Savings & Securities	Other		
Ending Inventory	0	103631	12000		
Beginning Inventory	0	102100	12000		
Change	0	1531	0	Change in Accounts & Notes Receivable	1531

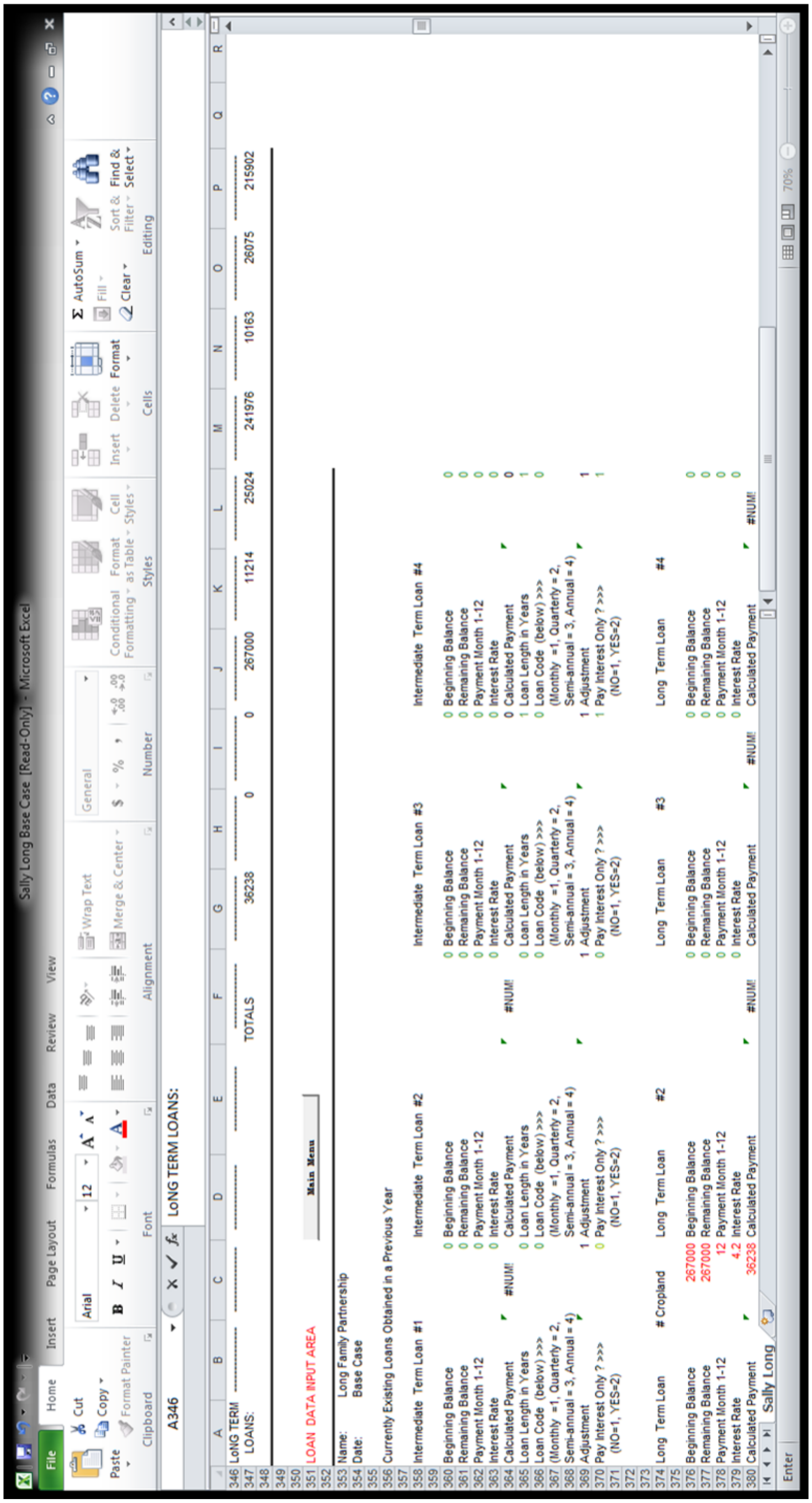
APPENDIX D: LOAN SUMMARY



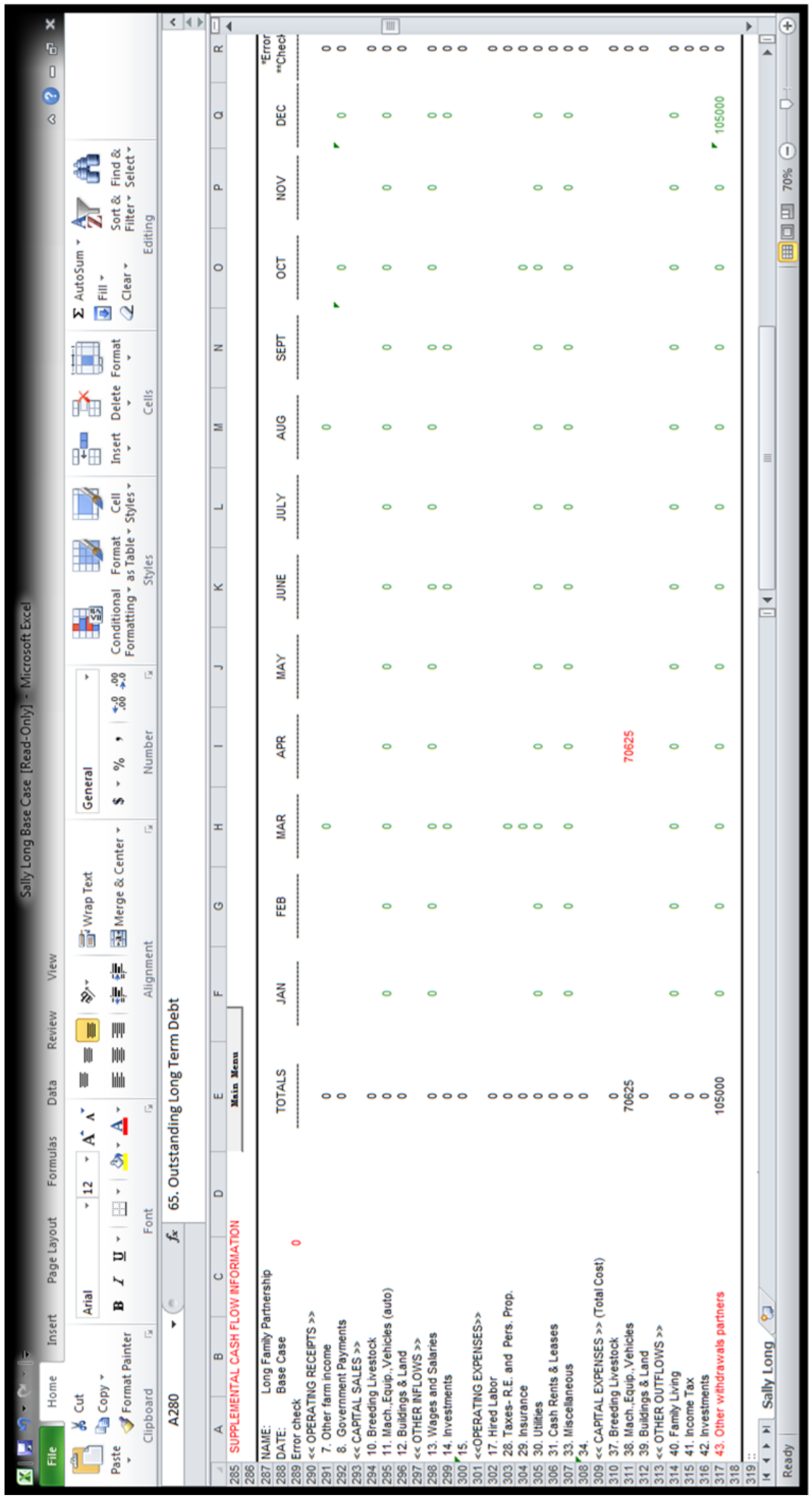
APPENDIX E: FINANCIAL ANALYSIS



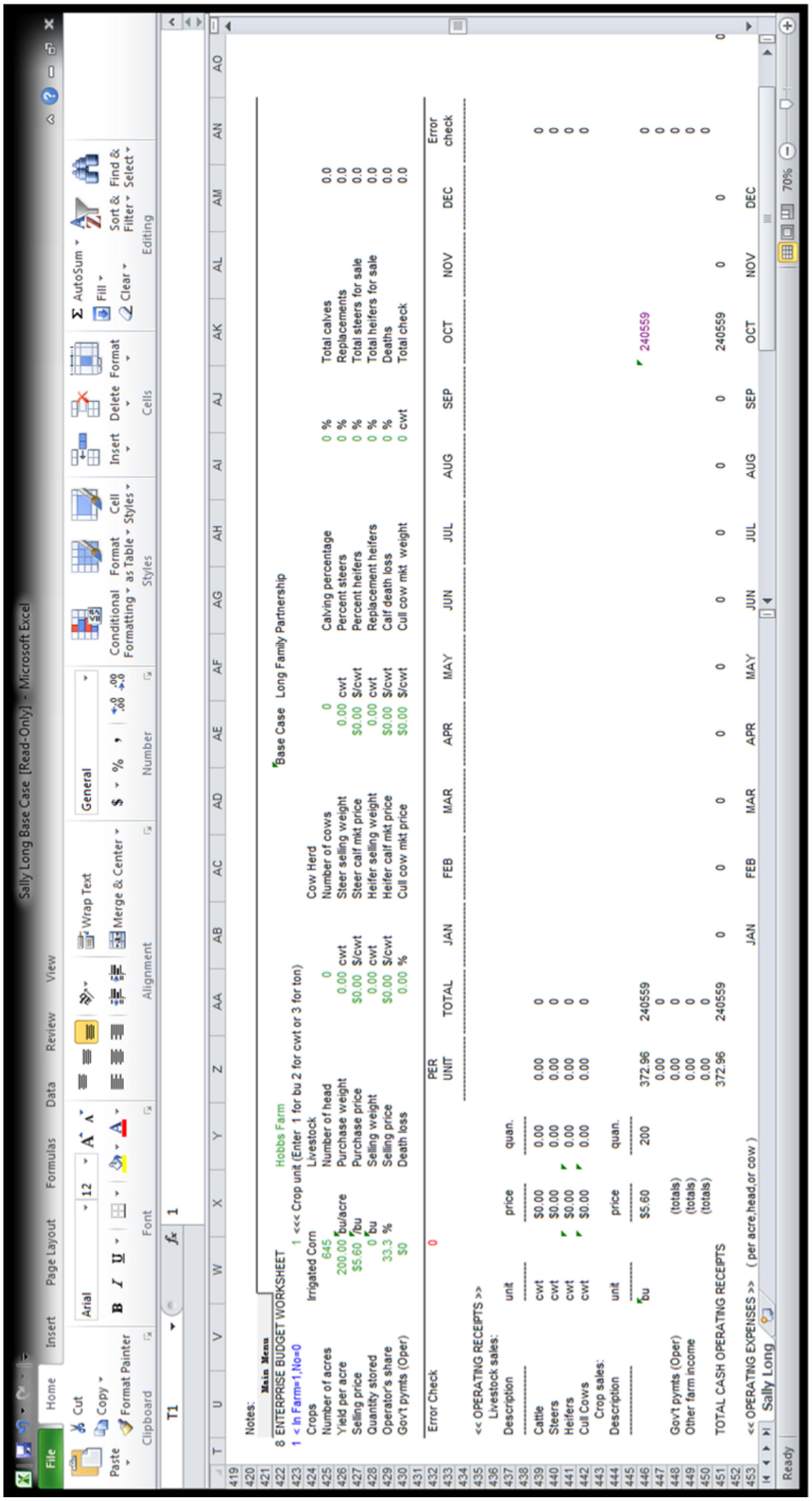
APPENDIX F: LOAN INFORMATION



APPENDIX G: SUPPLEMENTAL CASH FLOW



APPENDIX H: ENTERPRISE BUDGET, OPERATING RECEIPTS



APPENDIX I: ENTPERISE BUDGET, OPERATING EXPENSES