SHOULD WE PAY FARMERS NOT TO FARM?
A CASE OF THE CONSERVATION RESERVEPROGRAM

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CHAPTER I

INTRODUCTION

Title XII of the Food Security Act of 1985 established the Conservation Reserve Program (CRP). "The CRP is a voluntary program which offers financial incentives to private landowners to protect highly erodible and environmentally sensitive cropland by planting trees, grass, and other long-term cover"(U.S. Department of Agriculture 2011a). Until 2008, the program had not only been continued with each succeeding farm bill, but expanded.

In 2008, Congress reauthorized the program but with a lower acreage cap, reducing it from the 39.2 million acres established in the 2002 farm bill, to 32 million acres in the 2008 farm bill. The CRP has retired over 34 million acres nationwide, since its inception (Kansas Farm Bureau 2005), and currently enrolls 31.3 million acres. CRP was initially released to help control soil erosion, stabilize land prices, and control excessive agricultural production (Cowan 2010). Since then, the program has been expanded to include environmental goals (Cowan 2010). Today, the primary objectives of the CRP include: reducing sedimentation, improving water quality, fostering wildlife habitat, providing income support for farmers, and protecting the nation's long term capacity to produce food and fiber (U.S. Department of Agriculture 2011a).

The inception and expansion of the CRP has been particularly important for the Great Plains states, where much of the farmland is semi-arid, subject to wind erosion, and in some areas, economically marginal for crop production (Bangsund, Hodur, and Larry Leistritz 2004). Currently, the states with the highest amount of CRP acreage are: Texas, Kansas, Montana, North Dakota, and Colorado (U.S. Department of Agriculture 2012). Of these states, Colorado has the highest percentage of CRP acreage relative to total planted acres (U.S. Department of Agriculture 2011e). From 1982-2010, yields for corn, barley, wheat, sorghum and oats in Colorado have increased by 17%, 79%, 58%, 42%, and 25% respectively (U.S. Department of Agriculture 2011c). Farm technology has advanced significantly since 1982 and much of the increase in yield may be attributed to this. However, from the short span of 1982-2001, yield for the same crops increased, 8.5%, 44%, 17%, 30%, and 15%, respectively (U.S. Department of Agriculture 2011c). During this same time period, it was estimated that U.S. conservation programs led to a decline in soil erosion on all cropland from 3.1 billion tons/year to 1.8 billion tons/year (Burger Jr et al. 2006). Over 570 million tons/year can be attributed to CRP alone (Johnson and Quarles 1998). These numbers allude to the marginality of CRP land, therefore it could be inferred that the CRP had a hand in a portion of these increases given the timing of increases in average output per acre and the speculated amount of environmental improvements that occurred concurrently.

CRP is the largest private land retirement program operated by the federal government (Cowan 2010), retiring over 11% of farmland in the United States (U.S. Department of Agriculture 2011b). Between 2009 and 2014, more than 62% of CRP acres will expire, of which 71% reside in the plains states (Dicks 2008). CRP currently pays out 1,697,343,000 dollars per year in rental payments (U.S. Department of Agriculture 2012). The Prairie Gateway states of Texas, Oklahoma, Kansas, New Mexico, Nebraska, Colorado receive over 475 million dollars of this total payout, which is about 24%. Expiring CRP acres and the loss of such significant revenue could force producers to find alternative uses for their land to avoid acquiring idle assets (resources). There is a lot of discussion on what this use is going to be. A survey of CRP contract holders in North Dakota was conducted and the results indicated that 72% would return the land to crop production, 15% to hay production, 11% would be used for livestock grazing, and 2% would remain in permanent grass cover (Bangsund, Hodur, and Larry Leistritz 2004). According to Johnson and Quarles (1998), if the land is returned to crop production, "selection of the crop to be produced would depend on personal preference, price outlook, fertility levels, potential pest problems (weeds, diseases, insects, voles) and the amount of vegetative cover. Each crop has advantages and disadvantages that will influence the producer's choice." In considering haying or grazing, the producer should have concerns about the erodability of the land and infrastructure costs that could also be associated with making the transition (Elmore et al. 2011). Due to the various concerns regarding expiring CRP acres, producers will likely face tough decisions in those states that have become accustomed to the CRP.

In Oklahoma, the CRP currently provides $27,858,000 in revenue to farmers in the form of rental payments, with an average payment of $33.83 per acre (U.S. Department of Agriculture 2012). Oklahoma has 823,488 acres of land in CRP (U.S. Department of Agriculture 2012) which represents roughly 11% of the total farmland in the state (U.S. Department of Agriculture 2011b).

Oklahoma has a significant amount of land invested into the CRP, and for a long period of time, explorations of alternative uses to this land have been scarcely researched. The primary purpose of this paper is to examine the implications associated with alternative uses for CRP lands in Oklahoma. Specifically, the potential returns to producers to transition CRP land to cropland will be examined. Field level data in Northwest Oklahoma will be used to estimate potential yields using a "productivity index" from the state soil science lab, under a wheat-sorghum-fallow crop rotation. Using the results of this index the potential profits will be estimated on CRP lands for the given cropping practice. Oklahoma producers plant over 6 million acres of cropland (U.S. Department of Agriculture 2011e) and the potential of 823,488 "marginal" acres coming back into production raises many questions in terms of the suitability of the land and its potential impact on farm income.

CHAPTER II

PROBLEM STATEMENT

Since 2005, corn prices have risen significantly and other commodities have closely followed. Prices have recently been at all time highs for some crops. This has led to a call for CRP lands to be placed back into production. Ray Grabanski, president of Progressive Ag, said that "leaving these acres idle while the world is screaming for more production through current high prices doesn't make economic sense" (Grabanski 2011)! He claims that removal of the program would allow land that can viably raise good crops to be put into production when prices are high. He is not alone in the issue. According to Love (2011), "powerful agribusinesses are lining up to lobby congress to put millions of acres of land enrolled in CRP back into production. Groups representing grain and feed traders, livestock producers, fertilizer manufacturers, meatpacker Tyson Foods and others say that more land needs to be farmed to loosen the tight grain supplies that have sent commodity prices soaring in the past year." Additionally, certain groups believe that retiring land from productive agricultural use has had further implications. The president of the National Grain and Feed Association argues that CRP has had substantial impacts on agricultural production and rural communities, stating that the idling of productive land resources cuts off the economic multiplier in crop, livestock and poultry production having various negative economic consequences (Cowan 2010). Further, the fight to preserve CRP land may get even more difficult in the future due to a recent slow growing supply and a high expected world demand, which could result in higher commodity prices for the future (Organisation for Economic Co-Operation and Development 2011).

The federal government spends about $1.6 billion on the CRP on an annual basis (U.S. Department of Agriculture 2012). Consequentially, the recent national debt crises coupled with rising commodity prices are making the future of CRP increasingly uncertain. In August of 2011, Congress passed the Budget Control Act of 2011. This law created a congressional super committee comprised of members from the House and Senate, charged with the responsibility of reducing the U.S. national debt by $1.5 trillion over 10 years. Proposed cuts to the Agriculture budget have been as high as $33 billion (Good 2011) with conservation and the CRP receiving a share of the cuts.

When the CRP was initially created, it targeted marginal and highly erodible land (Bangsund, Hodur, and Larry Leistritz 2004) largely located in the great plains areas of the United States. Marginal land is land of poor quality with regard to agricultural use, and unsuitable for housing and other uses (Organisation for Economic Co-Operation and Development 2001). “One critical function of CRP is to reduce soil erosion, an indicator of soil quality” (Karlen, Gardner, and Rosek 1998). Coincidentally, it is estimated that 20-25 million acres of these fragile croplands cannot be continuously farmed, even under the best management practices available without an annual net soil loss and associated environmental damages (Dicks 2008). Further,Williams et al. (2010) found that when grassland is converted back to a conventional production cycle, over time a reduced yield occurs. This could be attributed to a depletion of microbial biomass, organic carbon and nitrogen, long-term infiltration, and aggregate stability, provided by the CRP (Karlen, Gardner, and Rosek 1998).

Many questions need to be answered before determining if production on CRP land would be the optimal solution for expiring contracts in the coming years. Since CRP targets marginal lands in the U.S., an important question is whether or not the land is capable of producing at all. Precipitation is the primary limiting factor to crop production (Letey 1985) and since the CRP is primarily situated in semi-arid regions and largely un-irrigated, precipitation and temperature could diminish the possibility of production on these lands, however it is not the focus of this study to examine the influence of these factors.

If the potential exists for production on CRP lands, would it even be profitable? A farmer could potentially add fertilizer to the soil to boost its potential to produce. However, a key issue is whether the land can produce at a profitable level before the operation faces diminishing marginal returns. Research suggests that that there is a point in which substitution of farm natural resources (i.e. fertilizer) will no longer be equitable because the substitute's ability to be utilized is maximized in the soil profile (Hoag 1998). These finding by Hoag (1998) verifies diminishing marginal returns are present in crop production. Finally, if crop production is initiated once again on these lands, will subsidies and insurance payments on the former CRP land cost more than the original CRP payment?

CHAPTER III

OBJECTIVES

The main objective of this research is to determine if bringing CRP land back into production will be profitable for contract holders. More specifically, this research will:

1. Determine if there is a statistically significant difference in Nitrogen, Phosphorus, Potassium, Percent Hydrogen, and Organic Matter between lands enrolled in CRP and lands currently cropped.
2. Determine if the CRP is capable of a production level that is profitable in its current state.

CHAPTER IV

SUPPORTING LITERATURE

The producer's choice alternative to CRP has been extensively reported. In Johnson, Misra, and Ervin (1997), a qualitative choice model was used on the basis of utility maximization of different producer alternatives. Using a survey of CRP contract holders in the Texas High Plains Region, the Johnson, Misra, and Ervin (1997) model was built using ten independent variables that would determine the amount of CRP returned to cropland post-contract. The analysis was grouped into three different producer alternatives: return all acres to crop production, return a portion of the acres to crop production, or maintain all acres in the established vegetative cover. It was revealed that 69% of CRP would be returned to crop production in the absence of a CRP extension. Similar results were found by Bangsund, Hodur, and Larry Leistritz (2004). Using a survey distributed in16 North Dakota counties to CRP land holders, questions were asked about previous uses, relative yields, and use if the land were to come out of contract. Depending on the geographic region of North Dakota, the amount that would have returned to cropland post-contract varied from 63%-82% with an average of 72%. Skaggs, Kirksey, and Harper (1994) cited various estimates that used similar methods from other studies in their literature review ranging from 42%-80% of CRP land that would be returned to cropland.

The Johnson, Misra, and Ervin (1997) model suggested that the decision to return the land to cropland is heavily dependent on the financial value of the commodity base; while in retrospect, the presence of a livestock enterprise in the contract holders' operation would increase the probability that the land would remain in cover. The study was conducted in the Texas High Plains and their model incorporated ten different variables, of which several were found to be significant. A few of these variables were key variables of interest. In particular, the presence of a soil type variable, and a sorghum crop base variable, were of interest. The soil type variable indicated if the producer had loamy sand or another soil type, while the sorghum base variable indicated the presence of a sorghum commodity base in their operation. Deep sand, sandy loam, loamy sand, and clay were all choices for soil type in the study, and loamy sand soil was assumed to be less erodible than the other soils listed. The model showed a higher probability that the producer would transition CRP land back to crop production, if the soil type was loamy sand. In Skaggs, Kirksey, and Harper (1994), it was found that land with soils perceived to have a higher erosion potential had a higher probability of remaining in vegetative cover and grazed. Therefore, if the assumption made by Johnson, Misra, and Ervin (1997) that loamy sand soils are less erodible holds, the resulting sign for the soil type variable is confirmed by Skaggs, Kirksey, and Harper (1994).

According to Johnson and Quarles (1998), "the selection of crop to be produced on a CRP field depends on personal preference, price outlook, fertility levels, potential pest problems (weeds, diseases, insects, voles) and the amount of vegetative cover." This follows what was found in Johnson, Misra, and Ervin (1997) where financial value and commodity base were determined to be significant criteria. In regard to these findings, the resulting sign of the sorghum base variable in Johnson, Misra, and Ervin (1997) suggests that a sorghum commodity base in the producers operation increased the likelihood of a transition back to cropland. This is of particular interest because Oklahoma planted 280,000 acres of sorghum in 2010. This represents 4.14% of all of Oklahoma's total planted acres during that year (U.S. Department of Agriculture 2011e). Of the 280,000 acres; 118,000 were planted in the Oklahoma Panhandle where over 50% (448,654 acres) of the CRP acres reside (U.S. Department of Agriculture 2011e, 2010). It could be assumed from the findings of Johnson, Misra, and Ervin (1997) and Johnson and Quarles (1998), that Oklahoma would face similar incentives to convert CRP in certain regions given the supporting statistics on the sorghum base for the state.

The production capability of CRP land has been examined by several researchers from various perspectives. A study by Unger (1999) centered in the Texas Panhandle explored the conversion of CRP grassland to the dryland crops, grain sorghum and wheat, using field experimentation. The study was conducted from 1995-1997 when the first wave of CRP acres was expiring. The paper emerged because there were problems with the similar research at the time. CRP land in the Texas Panhandle is predominantly grama-buffalo grass and bunch grasses (Skaggs, Kirksey, and Harper 1994) and there was no research on converting these types of grasses to cropland. Converting CRP lands and destroying these warm-season, bunch-type grasses proved to be more difficult in the Great Plains states, than the sub-humid and semiarid climates (Dao et al. 2000). The study was conducted on a Pullman Clay Loam and imposing climatic conditions occurred during the research period. Nitrogen was the only nutrient applied because phosphorus and potassium were said to have no effect on dryland yields. Nitrogen was applied at various rates and mixed results were found. In 1995, the Sorghum plot produced 11.4 bu/acre while the Texas High Plains Agricultural District average was 51 bu/acre. In 1996, Sorghum was not planted due to drought, although the district averaged 68.2 bu/acre. In 1997, the study averaged 55.44 bu/acre for sorghum, and the district averaged 61.1 bu/acre. In 1995-1996, both wheat crops failed, and in 1997, the experimental wheat plots averaged 26.25 bu/acre. The average wheat yield for the district in 1997 was 31.5 bu/acre (U.S. Department of Agriculture 2011c). The primary reason for the high variance in yields or the crop failures was said to be attributed to low soil water content at planting and during the study. Musick et al. (1994) found that stress effects caused by low soil water content could be mitigated by management practices that increase soil water storage at planting or by the application of irrigation water. They concluded; "a climate with high evaporative demand and limited precipitation restrict yield of winter wheat grown in semiarid U.S. Southern High Plains." These finding support the results of Unger (1999).

Another study conducted by Dao et al. (2000) measured the relative efficacy of four systems of transition from the CRP. These systems were the production of old world bluestem (OWB), dryland wheat, and cotton. Their experiment sites were in Northwestern Oklahoma near Forgan and Southwestern Oklahoma near Duke. The site in Northwestern OK was conducted on Dalhart fine sandy loam, and the site in the southwestern part of the state was conducted on La Casa-Aspermont clay loam. In the transition to CRP, OWB was used extensively as permanent soil cover in the Panhandles of Oklahoma and Texas and before the CRP, much of the land in Oklahoma was cropped annually to wheat; however cotton remained important in Southwestern Oklahoma.

The study was conducted over the period of 1994-1997, and various applications of nitrogen and phosphorus were made at the two sites. This differs from the study by Unger (1999) where phosphorus and potassium were said to have no effect on dryland yields. In Northwestern OK, OWB plots were not fertilized in the first year; but nitrogen applications were made in 1995-1997. Crude protein of the forage increased 76% in the fertilized plots of OWB vs. the unfertilized plots in 1995. In 1996, an improved management strategy was put in place on top of fertilizer application, resulting in a 170% increase in forage yields, however, favorable moisture conditions occurred in the months of January-July playing a role in the higher yields. In 1997, management practices were once again improved and forage yields tripled while crude protein increased by 49%.

In 1994, the study sites in the southwest also went unfertilized. In the years from 1995-1997, forage yields for OWB increased by an average of 170-400%, while crude protein increased 74-110% with improved management and fertilizers (N, P). Differential responses to fertilizer were claimed to be a testament to the "impact of soil-climate interaction on the productivity of the grass stands."

In 1994, problems in Northwestern OK associated with the release of CRP land for the experiment resulted in late plantings. Thus, OWB went unsuppressed for many months and soil water that would have been stored during that time period, was depleted. "The water depletion extended deep in the root zone of the Dalhart fine sandy loam soil." Hot temperatures and high evaporation potentially occurred, which dried the soil and sod mulch.

Under two different tillage practices in Northwestern OK, sweep tillage (ST) and no-tillage (NT), the no-till resulted in a 21% increase in yield in the various conditions. The Southwestern OK plots were cropped using disk tillage (DT) and no-till. The no-till pots manifested a difference of 15% in the region. In 1994-1995 and 1996-1997, the researchers experienced significant differences in the ST-NT and DT-NT operation. The 1995-1996 crop experienced a drought and resulted in lower yields for the no till plots in the northwest. Wheat yields for NT were: 15.79, 2.85, and 15.91 bu/acre for the northwest in 1994-1997 respectively. Wheat yields in the southwest were 24.68, 11.73, and 9.63 for NT from 1994-1997 respectively. Cotton in the southwest faced adverse conditions and performed poorly averaging 0.17 bales/acre in 1994-1995 and resulted in crop failure in 1996-1997.

Climatic factors were said to have affected the production capacity of the soils at these sites during the study, however in the southwest, growth responses to fertilizer application was consistently positive and at least 2 of the 3 years in the northwest. It was suggested that to convert CRP to “successful” annual crop production, fertilizer should be applied to improve the nutrient status of the soil and the timing and suppression of grass cover is critical to conserving soil water for optimal plant growth.

During the Dao et al. (2000) study there was a warning issued with using more robust tillage strategies since it could result in a loss of organic carbon (C). “Loss of soil carbon and often been associated with decline in soil productivity components that include such fundamental properties as aggregate stability, macroporosity, water-holding capacity, nutrient availability, and microbial diversity and activity” (Dao et al. 2000). It is suspected by many researchers that CRP has enhanced organic carbon in the soil

(Gebhart et al. 1994; Follett 2001; Ogle, Breidt, and Paustian 2005; Potter et al. 1997; Unger 2001). Bowman and Anderson (2002) set out with the objective to gain insight on carbon sequestration from CRP land, and the impact on accrued carbon when recropped to a wheat-based rotation. To estimate carbon sequestration, six CRP sites were selected in northeastern Colorado split into three different groups. These groups were categorized by the year the CRP land was entered into the program. Soil samples on Platner fine sandy loam soils were taken at 0-2 in and 2-6 in deep on the CRP and adjacent native sod, and continuous wheat-fallow land. In addition to soil organic carbon, total nitrogen, total soil P, soil texture, soil pH, and bulk density were analyzed in the experiment. Using an analysis of variance, differences in soil organic carbon content on all six sites at the two depths were determined. Half of the sites showed significant differences in accrual of soil organic carbon in the CRP treatment versus the wheat-fallow sites. However, two of the sites put in the CRP at the same time were shown to have differing amounts of sequestration. A study by Nichols (1984) attributed these differences to differing soil properties. Nichols (1984) used a step-wise multiple regression to assess the impact of soil characteristics on the soil organic carbon. They found a significant relationship between organic carbon and the clay content of the soil, while the other characteristics were found to have a weak or no significance. Bowman and Anderson (2002) further observed that the organic matter was strongly associated with total phosphorus implying that the phosphorus was also correlated with the clay content. Because of this, it is not surprising that they found the CRP land to have a low total phosphorus level given it was predominately sandy loam. The nitrogen content was found to be very low on CRP land and the pH content varied, ranging from near neutral to calcareous. Calcareous soils were said to slope more and have less developed B horizons. Soil horizons are layers of the soil with physical characteristics that differ from each other. The general sequence of horizons is O-A-B-C-R. The A horizon is the surface soil, and the B horizon is the subsoil. More developed horizons have higher production capability than less developed horizons.

A separate study by Bowman and Anderson (2002) was conducted in conjunction with the sequestration study to determine the impact of four different tillage systems on the soil organic carbon on CRP land enrolled in 1987. The tillage systems used were: no-till, reduced-till 1, reduced-till 2, and conventional-till. The studies were also conducted on a Platner Fine Sandy Loam soil and two samples per plot were taken at 6 inches then divided into 25 increments. Significant differences in soil organic carbon for the different practices were determined by "Duncan's Multiple Range Test." Winter wheat grain yield was greatest in the no-till and reduced-till 1 systems. There was a 10% decline in soil organic carbon in the reduced-till 1 treatment relative to the CRP control, however that percentage increased to 20% when compared to conventional-till and reduced-till 2 treatments.

A similar study by Sainju et al. (2006) was conducted in Havre, Montana on Scobey clay loam and Kevin clay loam. Their objectives were to examine the influence of six-years of tillage and crop rotations on the amount of biomass of wheat, pea, and lentil returned to the soil. Additionally they aimed to determine the amount of residue cover, C content, soil organic carbon, and particulate organic carbon under this cropping system. The study was conducted at two depths in dryland of the Northern Great Plains. The parameters from the study of the crop and Conservation Reserve Program planting were compared, and management practices that sequester C in dryland soils better than the tradition conventional till with wheat fallow system were determined. The total C concentration in residue and soils were determined by using a C and N dry combustion analyzer. It was found that crop rotation significantly influenced biomass yields of spring wheat, pea, and lentil returned to the soil. Biomass yield differed not only between crop rotations, but also between years. These differences were thought to be due to the type of crop rotation and the difference in the amount of moisture available in the soil at the time of planting between treatments. However, biomass was found to increase with increasing cropping intensity. Residue cover was greater in no-till than in conventional-till and greater in CRP land than in crop rotations. Residue amount and C content were greater in no-till with continuous wheat and wheat-wheat-fallow systems than other treatments, except in conventional till and no-till with CRP and in conventional till with wheat-fallow. Soil organic carbon at 2 inches of depth was greater in no-till than in conventional till but particulate organic carbon was not influenced by tillage and crop rotation. It was found that the soil organic carbon at the 0-2 inch depth in no-till with continuous cropping is similar to CRP where the content is generally higher than the cultivated soil. It was then concluded that carbon can be conserved in plant residue and soil in drylands of the Northern Great Plains by using no-till with continuous cropping and reduced fallow periods.

Torbert, Prior, and Runion (2004) looked at carbon sequestration in soil as a result of a change in land management in Central Alabama. In retrospect to the previous articles mentioned, their study evaluated the differences on two different types of soil: Blanton loamy sand and Urbo clay loam. Soil samples were taken on both parcels and analyzed for nitrogen, organic carbon, and soil C: N ratio. They found that there was little difference in the forested soil and permanent pasture management on the clay loam; however, there were large differences in carbon on the loamy sand between forested and permanent pasture sites. Ultimately it was determined that the vulnerability of soil to lose sequestered carbon will likely depend on soil type. Additionally it was concluded that the clay loam soil had a higher capacity to sequester carbon than the loamy sand.

The findings of Torbert, Prior, and Runion (2004) follow well with the results of the model built by Nichols (1984) and the results of Bowman and Anderson (2002) and Sainju et al. (2006). The Bowman and Anderson (2002) study was conducted on fine sandy loam soils and the Sainju et al. (2006) study was on a clay loam. As a result of this, Bowman and Anderson (2002) and Sainju et al. (2006) came to completely different conclusions. In Bowman and Anderson (2002), it was concluded that there wasn't a tillage practice that could keep the soil from losing its current carbon content, where in retrospect the study by Sainju et al. (2006) found that the losses to carbon could be halted and even continue to be sequestered under the right management. The underlying difference was soil type. Clay content was proven to have higher potential to sequester carbon and maintain it, where sandy soils struggle with carbon accrual and maintenance.

CHAPTER V

CONCEPTUAL FRAMEWORK

From the literature review it is clear that if the decision is made to reduce/eliminate the CRP, producers may be faced with obstacles that were unforeseen. Fertility of the lands could be one of those obstacles. Preliminary data from the Oklahoma State University “Soil, Water and Forage Analytical Laboratory,” taken from various locations and various crops in Texas County, provided us with a hypothesis. The data was split into three groups: wheat land, sorghum land (grain and hay), and bluestem & native grass land. It was assumed that soil data taken from parcels predominately bluestem or native grass would provide reasonable expectations for results of the actual CRP samples largely because much of Oklahoma was planted to bluestem or some other form of native grasses when the producers decided to enroll in the CRP (Elmore et al. 2011; Dao et al. 2000). The means, median, mode, range, and standard deviations were taken on three groups for N, P, and OM. This is shown in table 1.

Table 1: Preliminary N, P, and OM Summary

	Wheat (W)			Sorghum (S)		Bluestem/NG (OWB(NG))	
	N	P	OM	N	P	N	P
Mean	40.7	89.5	2.1	32.5	87.8	21.6	52.3
Median	25.0	51.5	2.2	24.0	49.0	10.5	48.0
Mode	17.0	45.0	N/A	8.0	37.0	9.0	19.0
Range	323.0	510.0	5.4	108.0	384.0	95.0	120.0
σ	43.2	90.5	1.2	26.3	92.7	24.0	34.9

Table 2 shows the difference between the means of (1) Wheat and Old World Bluestem/Native Grass (W-OWB(NG)) and (2) Sorghum and Old World Bluestem/Native Grass S-OWB(NG).

Table 2: Difference Between Means

Difference Δ		
	N	P
Δ W-OWB(NG)	19.1	37.2
Δ S-OWB(NG)	10.9	35.5

These results enabled the following hypotheses to be formed on the basis of the first study objective to determine if there is a statistically significant difference in N, P, and OM between lands enrolled in CRP and lands not enrolled in CRP in Texas County. For this study, potassium was not measured since Zhang and McCray (2009) reported that most of Oklahoma is high in potassium. This was also confirmed by the aforementioned preliminary data. The pH of Oklahoma soils tends to be low, however the majority of the low pH soils are located in the central part of Oklahoma (Zhang and McCray 2009).

Since the majority of the soils in Texas County have a high pH (Zhang and McCray 2009), potassium and pH were not be considered as limiting factors to production for this study. The hypotheses formed for objective one are shown in table 3.

Table 3: Hypotheses for Objective One

1	$H_0: N_c \geq N_{nc}$	$H_a: N_c<N_{nc}$
2	$H_0: P_c \geq P_{nc}$	$H_a: P_c<N_{nc}$
3	$H_0: OM_c \leq OM_{nc}$	$H_a: OM_c>OM_{nc}$

Where: H_o = Null Hypothesis
H_a = Alternative Hypothesis
N_c = Nitrogen level in CRP land
N_{nc} = Nitrogen level in non-CRP land
P_c = Phosphorus level in CRP land
P_{nc} = Phosphorus level in non-CRP land
OM_c = Organic Matter % in CRP land
OM_{nc} = Organic Matter % in non-CRP land

The first and second alternative hypotheses are that the mean nitrogen and phosphorus levels in CRP land will be significantly smaller than the matched means of the non-CRP land. The third hypothesis is that organic matter on CRP land is significantly greater than the non-CRP land. To determine this, a "critical effect" had to be determined to calculate an appropriate sample size. The critical effect by definition is a "difference worth detecting" (Gerstman 2003). For the purposes of this study, we are concerned with differences that could potentially inhibit production, because production is measured in terms of yield, and yield ultimately determines the amount of profit or loss.

Of greatest interest are critical effects that would deter the possibility of our second objective: to determine if the CRP land is capable of a production level that is profitable in its current state. Before determining if profitable production can occur on CRP lands, it was necessary to determine if the CRP land is capable of any level of production. Zhang and McCray (2009) reported that, in Oklahoma, a soil nitrogen level of less than 20 lbs/acre would require an application before proper seed establishment could occur. Therefore a difference between the non-CRP mean and minimum nitrogen level would be the critical effect. Since the mean nitrogen level on CRP land was lower than non-CRP land in the preliminary data set, it is of interest for this study if the difference becomes significant enough to stop production. Non-CRP land is the control group because this study is concerned with major differences in CRP land and land that is currently being cropped; assuming that land currently being cropped does not have a mean nitrogen level below what is required for proper seed establishment (20 lbs/acre). Therefore if this assumption holds, the critical effect for nitrogen would be:

$$\Delta N = \mu_{N(nc)} - 20 \tag{1}$$

Where: ΔN = Critical effect associated with nitrogen
$\mu_{N(nc)}$ = Mean nitrogen level in lbs/acre on non-CRP land
20 = Minimum 20 lbs/acre of Nitrogen required for seed establishment

Of the other two parameters in the hypotheses, only a lack of phosphorus (P) could potentially inhibit the growth. “Organic matter (OM) serves: as a reservoir of nutrients and water in the soil, aids in reducing compaction and surface crusting, and increases water infiltration” (Funderburg 2012). Although OM provides many advantages, it is not apparent that low levels reduce production potential. Phosphorus is different. At the Oklahoma State University Soil, Water and Forage Analytical

Laboratory, phosphorus is measured and reported on a soil test P index, or STP. This test measures the amount of available phosphorus for the whole growing season (Zhang and McCray 2009). The STP index is primarily used because P exists in many different forms in the soil, some of which are not readily available for use by the crop. The STP "has been calibrated with crop yield response in different parts of the state of Oklahoma to identify the degree of sufficiency and the amount of fertilizer P needed to correct any deficiency" (Zhang, Johnson, and Raun 1998). Soils with a STP of 65 or above are considered to be 100% sufficient for growth of both wheat and sorghum, and are said to be adequately supplied to meet 100% of the crops growth potential (Zhang and McCray 2009). The critical STP range is from 40-65 in Oklahoma, where a STP of 40 is considered to be moderately deficient resulting in a 5% crop loss (Johnson 2011). Therefore a STP of 40 and smaller is considered a major departure from the control mean (non-CRP), given the increasing effect that it would have on production as the STP continued to decrease. Since the preliminary dataset reported the mean STP's on land similar to CRP to be lower than non-CRP, it is of interest if this difference falls below the "critical range." Therefore, once again, non-CRP land is the control group because this study is concerned with major differences in CRP land and land that is currently being cropped. This is working under the assumption that land currently being cropped does not have a mean STP below 40. Thus resulting in the following equation:

$$\Delta P = \mu_{P(nc)} - 40 \tag{2}$$

Where: ΔP = Critical effect associated with phosphorus
$\mu_{P(nc)}$ = Mean STP level on non-CRP land
40 = Minimum STP required before major reduction in crop potential (<95%).

The hypothesis formed for organic matter is a bit different than those formed for nitrogen and phosphorus levels on CRP land. In a similar study, Gebhart et al. (1994) found that land enrolled in CRP for five years, averaged over five locations in three different states (Texas, Kansas, and Nebraska), had significantly greater organic carbon levels than adjacent non-CRP cropland. When the *Food Security Act of 1985* was originally passed, the objectives of the CRP where to “help control soil erosion, stabilize land prices, and control excessive agricultural production,” as stated in the introduction. Therefore, it can be assumed that soil enhancements of this nature would be a positive externality of the program’s original objectives. Organic carbon is equated as 57% of the organic matter in the soil profile, and has many benefits to production. For every 1% of organic matter, the soil releases 20-30 lbs of nitrogen, 4.5-6.6 lbs of P_2O_5, and 2-3 lbs of sulfur per year (Funderburg 2012). Additionally, “organic matter behaves somewhat like a sponge, with the ability to absorb and hold up to 90% of its weight in water” (Funderburg 2012). The great advantage of this is that the organic matter will release most of the water it absorbs to plants. It takes approximately 200,000 lbs of organic material to increase organic matter by 1% on an acre of land (Funderburg 2012). Therefore, a difference of 1% in soil organic matter is determined to be the “critical effect” parameter for OM in this study, and it is hypothesized that CRP land will exhibit greater amounts of OM than the non-CRP land by 1% or greater.

$$\Delta OM = 1 \tag{3}$$

Where: ΔOM = Critical effect associated with organic matter
1 = Percentage difference required to provide the added benefits above

The critical effects determined help give a sample size adequate for detecting whether a difference of the critical effect's magnitude exists. This is not to say that a smaller effect couldn't be detected, however the goal of a sample size calculation is to provide an approximation of the appropriate sample size to determine whether specific differences exist at a certain confidence level. Therefore, although it is the aim to detect differences that affect production, smaller differences could be detected if the differential between CRP and non-CRP land becomes great enough. Using the critical effects of nitrogen, phosphorus, and organic matter in addition to other key parameters, the appropriate sample size to test the hypotheses was calculated using the following equation (Lusk and Shogren 2008).

$$S = \frac{2(z_\alpha + z_\beta)^2\sigma^2}{\Delta^2} \qquad (4)$$

Where: S = Calculated sample size
σ = Expected standard deviation pooled across both populations
Δ = Critical effect size (discussed above)
α = Probability of type one error
β = Probability of avoiding type two error
Z_α = Z-statistic associated with α
Z_β = Z-statistic associated with (1-β)

This study was designed as an endpoint study (Kraemer and Thiemann 1987) to compare two groups, CRP and non-CRP land, using an independent t-test to determine statistical significance. Statistical significance is defined as true differences in one group over another, or in other words, differences that are seen are not defined by chance. The differences that this study attempts to identify are the critical effects of N, P, and OM that would alter production of wheat or sorghum on CRP land in Texas County. Other components of this equation include the alpha value, beta value (power), and pooled standard deviation. The alpha value and power are important to properly identify because they determine the extent to which type one and type two errors are mitigated in the sample. Type one error occurs when the null hypothesis is rejected and it is actually true. Type two errors occur when the researchers fail to reject the null hypothesis and the alternative hypothesis is true. The pooled standard deviation is fairly straightforward; it is the cumulative deviation of both samples in the study (i.e. combined σ of N on CRP and non-CRP land). Type one and type two errors can be summarized by Table 4.

Table 4: Type 1 & Type 2 Error Chart

Reality	**Fail to Reject Null Hypothesis:** There is no difference in the Means	**Reject the Null Hypothesis:** There is a difference in the Means
Diff. in μ	Type 1 Error	Correct
No Diff. in μ	Correct	Type 2 Error

An alpha of 5% and a power (1-β) of 80% is conventionally used (Kraemer and Thiemann 1987; Whitley and Ball 2002; Gerstman 2003) and thus was used in this study, given circumstances of the study and the importance of mitigating the specific types of error. For example, the precision of a medical trial would need to be a lot greater than the precision of a consumer preference trial for specific candy given that the error of the medical trial could result in massive and sometimes long term consequences for the participant, while a study on consumer preferences for a particular candy would not have that impact. This research is low impact to its participants and the potential for a 5% type 1 and 20% type 2 errors would not have life threatening consequences for the participants. Therefore, conventional numbers can be used. In this study, a type one error would occur if the statistical analysis showed a difference in the means of N, P and OM in the samples (reject the null) and in reality there was no difference. In retrospect, a type two error would occur if no difference in the means (reject the null) was found by the statistical analysis while in reality, a difference existed. These errors occur many times when studies are reported and they are too small to have enough power to detect the hypothesized effect (Whitley and Ball 2002). For this study, an alpha of 5% and a power of 80% were used. While the objective is to be as precise as possible, the sample size increases drastically by changing these values. A small change from 80% to 85% power changes the sample size by 15%, and lowering the alpha level from 5% to 1% changes the required sample size by 60%. The alpha and beta levels could be decreased and increased, respectively, to further mitigate these errors. However, obtaining a large enough pool of producers who are willing to participate in the study becomes increasingly unrealistic and resource constraints become an issue. Thus, the conventional values were used in this study.

To test the hypothesis for objective one, a one tailed test was used, therefore $\alpha/1$ rather than $\alpha/2$ for a two tailed test. This implies that it is not a concern if N and P on CRP land are higher than on non-CRP land, and OM is less on CRP land than non-CRP land. This is due to the assumptions made with the critical effect of each factor. N and P would not be reducing production potential if the mean of CRP were found to be higher than non-CRP (other side of the distribution). Further, OM would not be improving production if it was found to be less on CRP than non-CRP (other side of the distribution). These results would be outside the interest of the study and therefore not appropriate to proceed further. Therefore with an 80% power (1-β) and 5% alpha (α) level, Z_β and $Z\alpha$ were found to be equal to 0.8416 and 1.645, respectively.

The model that is formed for the study is based on a matched-groups design, CRP on non-CRP. However, neither the selection of CRP nor the non-CRP land was based on the other. Instead of matching subjects in the samples on a one-to-one basis, the entire group (as a group), is matched with another similar group. Therefore the groups are taken to be independent (Sprinthall and Fisk 1990) based on the sample size calculation above. The two-sample independent t test allows us to make a probability statement regarding whether two independently selected samples represent a single population (Sprinthall and Fisk 1990). Since the samples are of equal size, this is accomplished by using the following t-ratio formula.

$$t = \frac{(M_c - M_{nc}) - \mu_{M_c - M_{nc}}}{SE_d} \tag{5}$$

Where: t = t-ratio
$M_c - M_{nc}$= Difference between the means of the two samples for N, P, and OM.
$\mu_{M_c - M_{nc}}$= The mean of the differences between the samples
SE_d = Estimated standard error of differences for both groups combined

Using this formula, we assume that the mean of the factors in the randomly drawn samples pulled on CRP and non-CRP land are from normally distributed populations. Therefore the sample distribution is also assumed to be normally distributed and the overall mean of these factors in the sampling distribution will be identical with their respective means in the population (Lowry 1999).

$$M_P = N(M_S) \tag{6}$$

Where: M_P = Mean of the population
N() = Normally distributed
M_s = Mean of the sample

The assumption of normality that is made when a t-test is conducted can be relaxed a bit if the sample size is sufficiently large. “The t-statistic will converge in probability to the standard normal distribution by the law of large numbers” (Northwestern University 1997). Additionally; “If the sample sizes are approximately equal, and not too small, then the t statistic will not be much affected even if the population distributions are skewed, as long they have approximately the same skewness.” However, “if the sample sizes are not approximately equal, then the t statistic will be skewed in the same direction as shown by the smaller sample” (Northwestern University 1997).

In addition to the individual samples being normally distributed, it is also assumed that the difference between the means of the two samples belong to a sampling distribution that is normal with a mean equal to the population mean of the entire sampling distribution of differences (Lowry 1999; Sprinthall and Fisk 1990).

$$N\left(\mu_{M_c - M_{nc}}\right) = N(\mu_{P_c - P_{nc}}) \tag{7}$$

Where: $\mu_{P_c - P_{nc}}$ = The population mean of the entire sampling distribution of differences

However, if the individual samples are normally distributed, it can be assumed that this assumption holds as well.

For a t-test, it is expected that the mean of the entire distribution of differences is zero when both samples have been selected from a single population (Sprinthall and Fisk 1990). This follows the assumption of the null hypothesis (Lowry 1999). Therefore:

$$\mu_{P_1-P_2} = 0 = \mu_{M_1-M_2} \tag{8}$$

Since the actual standard deviation is the true deviation of the population being sampled, an estimated standard deviation will be derived in order to calculate the standard error (SE) in the t-ratio equation (est. σ_p), resulting in the following degrees of freedom (Lowry 1999).

$$df = (S_c - 1) + (S_{nc} - 1) \tag{9}$$

Where: df = Degree of freedom associated with est. σ
S_c = Number of observations in the sample of the CRP land
S_{nc} = Number of observations in the sample of the non-CRP land

To calculate the est. σ_p, the following equation was used:

$$est.\sigma_P^2 = \frac{SS_c + SS_{nc}}{df} \tag{10}$$

Where: $est.\sigma_P^2$ = Estimated variance of the population
SS_c = Sum of squares for CRP sample
SS_{nc} = Sum of squares for non-CRP sample

Using this information, the estimated standard error of both groups combined follows:

$$SE_d = \sqrt{\frac{est.\sigma_P^2}{S_c} + \frac{est.\sigma_P^2}{S_{nc}}} \tag{11}$$

Where: SE_d= Estimated standard error of difference for both groups

Since the null is assumed to be equal to zero, combining the components above results in the following t-ratio formula:

$$t = \frac{(M_c - M_{nc}) - 0}{\sqrt{\frac{\frac{SS_c + SS_{nc}}{(S_c - 1) + (S_{nc} - 1)}}{S_c} + \frac{\frac{SS_c + SS_{nc}}{(S_c - 1) + (S_{nc} - 1)}}{S_{nc}}}} \tag{12}$$

The sign of the t-ratio will depend on the direction of the difference between the two samples (Lowry 1999). If $M_c > M_{nc}$, the sign will be positive, however if $M_c < M_{nc}$, the sign will be negative.

Using the t-ratio, inferences can be drawn from the sampling distribution of **t** with **df** = $(S_c\text{-}1)+(S_{nc}\text{-}1)$ at various levels of significance. If our hypotheses for the soil factors on CRP and non-CRP land hold, the relevant critical values for **t** are those that pertain to a directional (one-tailed) test of significance. If the t-ratio value is above the critical values found at the different levels of significance, then the hypothesis is significant at that level. If the t-ratio is not above any level of significance, then the differences seen in the data are concluded to not be “statistically significant” at any level of interest. If the hypothesis fails (i.e. $N_c < N_{nc}$), there is no need to test for significance.

One of the assumptions of the t-test is the assumption of normality in the samples being tested. Parametric tests such as the t-test are often robust, and are relatively unaffected by small violations of these assumptions, however a situation can occur where there is markedly non-normal distributions (Robson 2002). Before the t-test is carried out, it should be verified that the data meet this assumption. To test if the samples follow this assumption, a common test used is the Kolmogorov-Smirnov goodness-of-fit test. The test has the following hypothesis:

$$H_0 = N(M_s) \tag{13}$$

$$H_a = M_s \neq N \tag{14}$$

The Kolmogorov-Smirnov test (KS-test) is a nonparametric test for the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution. The KS-test makes no assumptions about the underlying distribution of the data. Because there is no assumption to this regard, the Kolmogorov-Smirnov test can be used to test for normality of a distribution. To do this, samples are standardized and compared with a standard normal distribution using the following statistic (NIST/SEMATECH 2003).

$$D = \frac{Max}{1 \leq i \leq n}\left(F(Y_i) - \frac{i-1}{N}, \frac{i}{N} - F(Y_i)\right) \tag{15}$$

Where: D = Test statistic corresponding the Kolmogorov-Smirnov test
F = Theoretical cumulative distribution of the distribution being tested

The hypothesis regarding the distributional form is rejected if the test statistic, D, is greater than the critical value obtained. There are some limitations of the test in that it (1) only applies to continuous distributions (2) tends to be more sensitive near the center of the distribution than at the tails and (3) the distribution must be fully specified.

If it is determined that normality cannot be assumed, the non-parametric "Wilcoxon-Mann-Whitney" test can be used. The Wilcoxon-Mann-Whitney test is a rank-based test for comparing the location of two populations using independent samples.

There is no assumption of any particular distribution unlike the t-test. To use this test with the independent samples, S_c and S_{nc} are first aggregated and then values are ranked. Then the statistics, T and $T^{'}$, are calculated as follows.

$$T = min \sum rank\ (S_i) \tag{16}$$

Where: T = Sum of ranks in the smaller summed sample
$min \sum rank\ (S_i)$ = The smaller for the sums of S_c and S_{nc}

$$T' = S_c(s_c + s_{nc} + 1) - T \tag{17}$$

Where: $T^{'}$= Sum of ranks in the larger summed sample

Since the sample in this study is large, that is, $S_c+S_{nc} \geq 30$, the statistic, T or $T^{'}$ (whichever is smaller) has approximately normal distribution with:

$$\mu = S_c(s_c + s_{nc} + 1)/2 \tag{18}$$

$$\sigma = S_c S_{nc}(s_c + s_{nc} + 1)/12 \tag{19}$$

These parameter values are used to calculate a test statistic having a standard normal distribution. The null hypothesis is rejected if the value of the test statistic is smaller than $-Z_{\alpha/2}$; however, the procedure for a one-sided alternative hypothesis depends on the direction of the hypothesis. If the alternative hypothesis is that the mean of S_c is smaller than S_{nc}, as is in the case of this study for N and P, the ranks from S_c are summed and that sum is used as the test statistic. The null hypothesis would then be rejected if this sum is less than the α/2 quantile of the table. In the case of OM for this study, the sum of the ranks over S_{nc} are used as the test statistic with the same rejection criteria (Freund and Wilson 2002).

To evaluate the second objective of this study, total revenue and costs for a traditional Wheat-Sorghum-Fallow rotation on CRP land was calculated to determine if a profit or loss would occur. The theory behind the revenue calculation is as follows:

$$TR_{ik} = P_i * Q_k \tag{20}$$

Where: TR = Total Revenue
P = Price
Q = Yield
i = Price used in the calculation (EP, Min, Max)
k = Yield Level (Avg., Min, Max)

It is assumed that the producers objective is to maximize profit, thus revenue would have to be optimized subject to the cost constraint. These costs are associated with the field operations that the producer undertakes in the wheat sorghum fallow rotation.

Using these costs the following model was developed:

$$C_{jt} = S_j * N_j + \left(\sum FT + \sum CH\right)_{tl} + CI_{tl} + AOC_{tl} + \sum MO_{tl} + OC \tag{21}$$

Where: S = Seed Cost
N = Amount of seed planted
FT = Fertilizer applied
CH = Chemical applied
MO = Machine Operation
CI = Crop Insurance
OC = Opportunity Cost

All costs are assumed to be in the short term, so if total revenue drops below the total cost, the producers operation will shut down or incur debt. To evaluate this, profit is calculated as:

$$\pi_{ikjt} = TR_{ik} - C_{jt} \tag{22}$$

Where: π = Profit

CHAPTER VI

DATA AND METHODS

Evaluation of N, P, and OM

To determine if the pH, N, P, and OM content of CRP and non-CRP land in Texas County was significantly different, soil samples were obtained. Land use data for Texas County, including CRP contract data and Common Land Unit (CLU) data, were obtained from the Farm Service Agency. An random sample from each population was identified to evaluate the differences. CLU data is the smallest unit of land referenced by FSA. It contains information on permanent, contiguous boundaries of land, common cover and management, common owner, and common producer association. CLU's were created using a heads-up digitizing method by both private contractors and Farm Service Agency (FSA) employees. Field boundaries that were originally drawn on photo-maps were transferred to digital format in this digitizing process. After digitizing, CLU boundaries were reviewed by local county service center employees for accuracy and sent to farmers and landowners for final review. The CRP data records all parcels that are enrolled in CRP, their owners, how long they have been in the program, and when they are set to expire.

Since, Oklahoma has over 820,000 acres enrolled in CRP across the state; this study targeted the most concentrated area of the state due to resource constraints. Based on previous information and data collected for this study, over 50% of the CRP land in Oklahoma was located in the three counties of the Panhandle. Of that 50%, 44% of the CRP land was in Texas County and 61% of that land was in the Western half of the county, West of Guymon to the Texas county border (U.S. Department of Agriculture 2010). The Western part of Texas County represents 14.9% of the total CRP land in all of Oklahoma, and 1.2% of the CRP land in Texas, Kansas, Colorado, Oklahoma, New Mexico, and Nebraska (U.S. Department of Agriculture 2012). Given the concentration of CRP land in this area and constraints faced, this study focused on the Western portion of Texas County which has 122,995 CRP acres.

As previously mentioned in the conceptual framework, to determine an adequate sample size, preliminary numbers obtained for Texas County by the Oklahoma State University Soil, Water and Forage Analytical Laboratory (SWAFL) were used. These data were taken from various locations and various crops in Texas County from 2003-2010. This was the largest set of electronic data available and since the sample size calculations are approximate (Kraemer and Thiemann 1987; Kupper and Hafner 1989), this data was used. The data did not have a consistent number of observations per year and there were multiple crops represented in the set. Since a wheat-sorghum-fallow rotation had long been utilized and proven as a productive system in the Oklahoma Panhandle (*No-Till Wheat Sorghum Fallow Rotation* 2012), this study focused on the conversion of CRP land to such a system. The data on wheat, grain sorghum, and sorghum sudan hay were used to represent non-CRP land, while data on native hay or grass and bluestem was used to represent CRP data. This data was then divided into three categories: all wheat land data, all sorghum land data, and bluestem & native grassland (CRP) land data.

Following the assumptions set forth in the conceptual framework, and the critical values that were determined, sample sizes were calculated for phosphorus on wheat ground, nitrogen on wheat ground, phosphorus on sorghum, nitrogen on sorghum, and organic matter as a whole. The bluestem and native grass data was not actually used in the calculation but was used for comparison with numbers obtained from this study. The sample size calculations are shown in Table 5.

Table 5: Sample Size Calculations

Evaluation	SS
P on W	34.48
N on W	47.13
P on S	29.70
N on S	52.43
OM	18.11

Where: P on W = Phosphorus on Wheat
N on W = Nitrogen on Wheat
P on S = Phosphorus on Sorghum
N on S = Nitrogen on Sorghum
OM = Organic Matter

The conservative size that needed to be taken was 52.43. However, taking a sample on 0.43 or 43% of an acre would be hard to determine, and since this number is merely an approximation, it is appropriate to round up to 53 instead of 52.43. Therefore, a sample size of 53 was used. This is the number of samples that needed to be taken for each population in the study: CRP and non-CRP. Therefore, the total sample size for the study was 106.

The CLU data has several categories. Those of relevance to this study were: Tract Number, Farmer Number, Calculated Acres, CLU Classification Code, and the CLU Identification (CLUID). Tract Size for the CLU data set ranged from 0.03 to 748.16 acres for the non-CRP land, and 0.72 to 628.16 acres for the CRP data set. Each tract corresponds to a farmer number and each farmer has one or more tracts. The CLU classification code corresponds to the type or use of the land.

A completely random sample was needed from the two datasets that was representative of the CRP and cropland populations in Western Texas County. To do this, a stratified random sample was developed for the two populations. This is the process of dividing the entire data set into distinctive CRP and cropland groups. For the CLU data, all classification codes corresponding to something other than cropland were eliminated. Therefore all FSA data pertaining to some type of government program dealing with land units are a part of the CLU data. This includes CRP, and thus CRP data is a subset of the CLU data. Since the CRP data is merely a subset of the CLU data, and the CRP data was given as a separate set than the CLU by FSA, the CLU duplicates the CRP data in its set. The CLU identification number is distinctive to a given piece of land. Therefore the CLUID in the CRP data is the same for the CLU data for those instances where duplication occurs. Thus, in order to eliminate duplicates, the two sets were combined and sorted according to their CLUID with CRP coming first. The duplicates were then removed using the remove duplicates feature in Microsoft Excel

2007 leaving distinctive CRP and CLU data sets in one database. The CRP was then cropped out of the CLU data and placed as its own dataset.

Since the tract numbers ranged so greatly and the farmer numbers corresponded with the tract numbers to a large extent, parcels could not be selected in terms of these characteristics. This is because those farmers with a large number of distinctive tracts but a relatively lower number of total acres would, in theory, have more weight given to them in a selection than to farmers with few distinctive tracts and a large amount of total acreage. This would not be representative of the CRP and cropland population as a whole and therefore would bias the sample.

To ensure an unbiased sample, the data was sorted by farmer number and then the total number of acres was calculated for each one. There are 397 and 1183 different farmers/landowners in the Western part of Texas County for CRP and cropland, respectively. The goal was to weight each farmer according to their total number of acres in each respective data set. To do this, every acre in the Western part of the county was given an equal weight. This was done by taking the farmers total number of acres and creating an index with the farmer number. There are a total of 122,996 acres in CRP and 273,049 acres of cropland in the Western part of Texas County. Therefore, a range of acreage between 0-122,996 for CRP land holders and 0-273,049 for non-CRP land holders was assigned to correspond with a farmer number depending on how much they owned. For example, if a farmer owned 115 acres, that farmer would be assigned the range from 0-115; if the next farmer owned 1242 acres then they would be assigned to the range 115-1357, and so on. Each farmer number has one distinctive range.

A random number generator was set up to return an acreage value between 0 and 122,996 for the CRP data, and 0 and 273,049 for the cropland data. It was not assumed that every farmer would cooperate so some error was allowed in the selection. This error is similar to a "non-response error" that occurs in a survey. Therefore, the total number needed in each sample was taken and a 25% cooperation rate was assumed. Thus, the sample size was divided by .25 resulting in 212 farmer names for each population to be drawn. A random number within these ranges was generated 212 times for each set. This resulted in a random acreage number for the two populations for the sample size desired.

A "LOOKUP" function was then used to match the random acreage number drawn with a farmer number using the index. This process results in a random sample of farmer numbers subject only to bias of the random number generator, which returns a pseudo random number. Where this function has its criticisms, it was the best randomization method available for this study. Once the sample was obtained, each farmer was contacted and permission was requested to take one or more soil samples on their land.

Whereas many farmers were cooperative with the efforts of the study, we were unable to contact some of the farmers on the list. If that occurred, the farmer was removed from the list and the next farmer was contacted until a sample of 53 or more farmers/landowners willing to participate in each dataset was obtained.

The soil samples were taken on April 18 - April 22, 2012. Samples were obtained from the Texas-Oklahoma border to Hough, Oklahoma in the northwestern portion of the county. A large amount of the CRP samples were taken around Eva, Oklahoma where the program is heavily concentrated. A soil probe was used to pull all samples at approximately 6 inches of depth. 66% of the samples taken on the cropland were off dryland fields and roughly 34% were taken from irrigated land.

The samples were analyzed at Oklahoma State University's SWAFL under a routine soil test and an additional test for organic matter. The lab used the Mehlich 3 (M3) processes to obtain: NO_3 (N), soil test P (STP), and potassium (K) for the samples. To test for pH, the lab used the Sikora Buffer process, and the organic matter was tested by weighing out 0.263-0.337g of soil and analyzing using a "Leco Truspec CN analyzer."

Initial observations hinted that the data may not be normally distributed due to differences in farming operations, so the data was broken into three subsets: composite, dryland, and irrigated. Since it was not possible to determine this beforehand, observations such as this could be expected. There was also interest in determining if distinguishing between these farm practices had any impact on the test of significance for the soil characteristics. However, the dryland and irrigated samples were not the same size as the CRP sample, so adjustments had to be made and will be mentioned later.

Before any of the t-tests were determined, the data obtained were first tested for normality using the "Kolmogorov-Smirnov Goodness-of-Fit Test" for the soil characteristics pH, N, P, and OM for all sets and subsets of data. If the tests resulted in a correlation coefficient that was higher than the critical value at the alpha ≥ 10% level, the data was assumed to be sufficiently normally distributed. For the data that was found to be normally distributed, an independent T-Test was used to test for significant differences between pH, N, P, and OM. If a normal distribution could not be concluded for a data set, the non-parametric “Wilcoxon-Mann-Whitney” test was used to determine if significant differences existed between the data sets.

If the data were found to be normally distributed, Statistical Analysis Software (SAS) 9.2 (Appendix 1) was used to assess if statistically significant differences existed in the data between: CRP and the Composite, CRP and the dryland, and CRP and the irrigated land for pH, N, P, and OM using the PROC TTEST procedure. If the data failed to be verified as normally distributed then the PROC NPAR1WAY procedure was used with the “Wilcoxon” option to test for significant differences.

Since the non-CRP group was segregated out into three categories, the variances could potentially be different. When two samples have the same population variance, the independent t-test uses the pooled variance when computing the standard error. If this cannot be assumed, then individual variances need to be used instead and the degrees of freedom should be approximated (Park 2003). To test the equality of variance in these circumstances, SAS implicitly reports a “folded-F statistic.” The folded-F test is a two-tailed f-test and the null hypothesis is that the two samples have the same variance. The folded-F test assumes that the original populations are normally distributed and the F-values follow an F distribution. The specific F distribution depends on two degree’s of freedom values: the numerator degrees of freedom and the denominator degrees of freedom. For the folded-F test, the numerator degrees of freedom value is associated with the sample with the larger variance and vice-versa (Davis 2006). The statistic is as follows:

$$F - value = \frac{\max\,(S_1^2, S_2^2)}{\min(S_1^2, S_2^2)} \qquad (1)$$

Where: (S_1^2, S_2^2) = Sample variances

“The p-value is a measure of the likelihood that the samples come from populations where H_0 is true. Smaller values indicate less likelihood. That is, the more the data agrees with H_1, the more the F-value is greater than one, and the smaller the p-value” (Davis 2006).

In the case that the variances are not equal; degrees of freedom can be approximated using Satterthwaite’s approximation and/or the Cochran & Cox approximation. “The Cochran and Cox approximation of the probability level of the approximate t-statistic is the value of p” such that:

$$t' = \frac{w_1 t_1 + w_2 t_2}{w_1 + w_2} \tag{2}$$

Where: $w_1 = \frac{est.\sigma_P^2}{S_c}$

$w_2 = \frac{est.\sigma_P^2}{S_{nc}}$

$t_{1\&2}$ = Critical values of the t-distribution to a significance level of *p*.

Thus, the number of degrees of freedom is undefined when $S_c \neq S_{nc}$, and in general the Cochran and Cox test tends to be conservative (SAS Institute 1999). The Cochran and Cox approximation can be obtained from SAS by adding the Cochran option to the PROC TTEST statement. The Satterthwaites is given implicitly by SAS and the formula for the approximate t-statistic is calculated as follows:

$$df = \frac{(w_1 + w_2)^2}{\left(\left[\frac{w_1^2}{S_c - 1}\right] + \left[\frac{w_2^2}{S_{nc} - 1}\right]\right)} \tag{3}$$

The main difference in the Satterthwaites, Cochran and Cox test and the standard independent t-test is that the variance for each soil characteristic in each set and subset is divided by the sample or sub-sample number within the set. To be exact, for the variance of CRP; pH, N, P, and OM were divided by 53, the variance of the composite characteristics were divided by 53, the variance of the irrigated characteristics were divided by 18, and the variance of the dryland characteristics were divided by 35. These divisors are the number of observations in each of the categories: composite, irrigated, and dryland.

Enterprise Budgeting

To determine if CRP land would be profitable if it were transitioned to a wheat-sorghum-fallow rotation, enterprise budgets were built for a dryland wheat operation, sorghum operation, and fallow operation. Each one of these budgets was duplicated for a no-till, conservation-reduced till, and conventional till system. In each budget, average costs, minimum costs, and maximum costs were compared with the expected price, ten year high harvest price, and ten year low harvest price.

All of these estimates were then evaluated at the average yield, minimum yield, and maximum yield as reported by the NRCS web soil survey. The web soil survey provides average, median, minimum, and maximum yield estimates by the state soil scientist using the latitude and longitude of each soil sampling location.

These estimates were used to develop a sensitivity analysis for price, yield, cost, and tillage operation to determine potential points of profitability if the transition were to occur. The price received was also estimated. Assuming that some of these lands could come out of the program as early as 2013, an expected price received for harvest next year was desired. The original plan was to use the historical basis and the Hooker, OK spot price to calculate the 2013 expected harvest price, however recent findings by Hatchett, Brorsen, and Anderson (2010) found that due to recent structural changes in the market, use of the previous year's basis would provide a more accurate estimate of harvest price. Therefore, the following equation was used to estimate the expected harvest price:

$$EP_j = FP_{W/C} + \ Basis_{2012} \tag{23}$$

Where: EP = Expected Harvest Price for 2013
FP = Futures Price
w/c = wheat or corn
j = Wheat or Sorghum
Basis_{2012} = 2012 Basis for wheat or corn

The futures price for corn was used to estimate the basis for grain sorghum because grain sorghum futures do not exist.

A list of field operations was compiled for this crop rotation under no-till, conservation-reduced till, and a conventional tillage practices. A previous extension report by the University of Nebraska was written to advise producers on the costs associated with converting CRP to millet and wheat cropland in the Nebraska Panhandle (Lyon and Holman 1997). This report included a list of operations for no-till, conservation-reduced till, and conventional till systems. These operations were used as the basis for the operations reported in this study, however due to the amount of time since the list was compiled, location, and crop differences, revisions had to be made. After consulting local agronomists from the Oklahoma State University Panhandle Research and Extension Center, appropriate lists for these processes were put together. These field operations are found in Appendix 6. It was observed that no-till or conservation till were the predominant practices in Western Texas County, however the conventional till operation was still compiled for cost comparisons. It should be noted that implementation of conventional tillage in Western Texas County may not be possible due to conservation compliance standards set by NRCS.

The costs associated with the field operations were taken from the Oklahoma farm and ranch custom rates report for 2011-2012 by Doye and Sahs (2012). This report summarized data that was collected from Oklahoma farmers, ranchers, and custom operators during the summer of 2011. "Custom work is defined as machine operations performed for the customer with the custom operator furnishing the machine, fuel, labor and other inputs directly associated with the machine" (Doye and Sahs 2012), yet rarely do custom operators furnish the materials used in the operation such as seed and fertilizer. The custom rates for this report do not include the cost of the materials. Material costs were collected separately.

The Doye and Sahs (2012) report is broken into three regions, West, Central, and East Oklahoma. When a sufficient amount of data was present, specific estimates for those regions were reported as well as state average, high, and low costs of the operation. Under normal budgeting practices, machinery depreciation, fuel, lube, etc., are all included in the budget, however it is assumed that that custom rates implicitly incorporate these costs so no budgetary action on these items were required for this study.

An opportunity cost of the land was necessary to include as well. Opportunity cost is the cost of a good or service as measured by the alternative uses that are forgone by producing the good or service (Nicholson 1975). If this land is returned back to production while there is an opportunity to reenroll the land into the program, the opportunity cost assumed in this process is the cost of giving up the CRP rental payment.

It could be argued that there is an opportunity cost for forgoing grazing the land; however it is not the focus of this study to examine the CRP lands capability to graze and thus, it is assumed from previous literature that these lands will be returned to some form of crop production. Therefore, no opportunity cost for forgoing grazing the land was taken into account.

Revenue Protection crop insurance was included and calculated using the median yield supplied by the NRCS estimates at 100% of the projected harvest price. Crop insurance is partially subsidized by the government. The producer pays a premium in order to enroll in the program. This premium varies with the amount of average yield (NRCS estimates for study purposes) he or she wishes to insure. For 2012 wheat and grain sorghum, approximately 34% and 40% of producers were enrolled in the 65% coverage level in Oklahoma for wheat and sorghum respectively. Roughly 24% and 20% were enrolled in 70% coverage for wheat and sorghum. The remaining producers were enrolled in various other coverage levels, however these were the largest percentages (Federal Crop Insurance Corporation 2012).

The cost of annual operating capital is essential to include. Operating capital is cash that is used for the daily operation of the business. The cost associated with operating capital is the interest that could have been collected if those resources were not tied into the operation. Therefore the cost was calculated as follows:

$$AOC_{tlr} = \left(C_{jt} * \frac{M}{12}\right) * IR \qquad (24)$$

Where: AOC = Annual Operating Capital
C = Total Cost
S = Seed Cost
M = Months of capital use
IR = Interest rate

t = Tillage practice
l = Cost Level (Avg., Low, High)

Interest rates are the average effective interest rate on non-real estate bank loans made to farmers. In 2011, the interest rate for other current operating expenses was 5% and in the first quarter of 2012, the interest rate was 5%. "These data are estimates from the Federal Reserve System's Survey of the Terms of Bank Lending to Farmers. Effective interest rates are calculated from the stated rate and other terms of the loan and weighted by loan size. Quarterly estimates are based on loans made during the first full week of the second month of the quarter. Other Current Operating Expenses are loans used primarily to finance such items as current crop production expenses and care and feeding of livestock" (Federal Reserve Bank of Kansas City 2012). Since 2008, the rate has been consistent around 5%, thus 5% was used in this study (See Appendix 7).

To begin, a base budget with average costs and expected price was created for the three enterprises in a no-till, conservation-reduced till, and conventional till system (See Appendix 8 for details). As mentioned above, all costs for the machine operations in these budgets were taken from custom rates published by Doye and Sahs (2012). The material costs were collected from three separate cooperatives that serve the area: Perryton Equity, Hooker Equity, and Elkhart Equity. From these cooperatives a high, low and average price was determined for each one of the products. Crop insurance was estimated at the average rate of coverage in the area of 65% (Federal Reserve Bank of Kansas City 2012).

The resulting profit or loss for the three enterprises in each system was summed to give a total profit or loss over the three year rotation. This number was then divided by three to give the average profit or loss per year. The systems were then cross compared with one another (See appendix 8 table 1). In addition to this, to further determine the potential of the land to sustain production, a break-even yield and a break-even price were calculated for each enterprise as well. The calculations for these estimates follow.

$$BEQ_{ijt} = \frac{PR_{ij}}{TC_{tj}} \qquad (4)$$

$$BEP_{kjt} = \frac{\mathrm{Q_{kj}}}{\mathrm{TC_{tj}}} \qquad (5)$$

Where: BEQ = Break-Even Yield
BEP = Break-Even Price
i = Price used in calculation
j = Wheat or Sorghum
t = Tillage practice
k = Yield Level

Once the base budgets were compiled, the process was duplicated for each situation examined in the sensitivity analysis. The average ten year high and low harvest price received were taken from the National Agricultural Statistics Service quick stats database for the months of July and September for wheat and sorghum respectively (U.S. Department of Agriculture 2011d). In addition to the average level, crop insurance was estimated at the high levels of enrollment of 75% for wheat and 70% for sorghum. High and low machinery costs were taken from the custom rates, and material cost was determined in the process above. Once these numbers were gathered, costs and profits were determined in the same fashion as the base budgets. Each estimate of profit and loss for the budgets was then summed with their equivalent counterparts. This process resulted in a sensitivity analysis with a full range of scenarios subject to the numbers in the estimate. This analysis resulted in eighty-one estimates and each scenario was considered equally likely.

Upon completion of the analysis, the number of positive estimates under each tillage system was divided by the total number of estimates in the system. This gave the percentage of time in the analysis that the operation was profitable. Since we assume that each scenario is equally likely, this process manifests a measure of producer risk in the conversion process.

CHAPTER VII

RESULTS

Soil Test Analysis

Comparison of Preliminary Data and Sample Data

The preliminary data set was compared to the sample data obtained from this study to determine if discrepancies existed. As outlined in the conceptual framework and the methods section, the preliminary data was used to calculate the parameters for the sample size calculation. Unfortunately there was no way of determining where the preliminary numbers were taken from, so it could not be assumed that they were taken from dryland, irrigated land, or any particular part of the county, hence the large standard deviation. The only information that is certain about the preliminary data set is that all the samples were taken from Texas County, and were taken on specific crops. Therefore in comparison with the data obtained from the Western part of the county, the preliminary data could only be compared with the composite sample where no distinctions were made between irrigated and dryland parcels.

As shown in table 1 and table 2, the pH from the preliminary and composite data sets did not differ very much. The differences between the CRP and the NG/OWB were small. The differences between the irrigated and dryland data from Western Texas

County were similar. According to Zhang and McCray (2009), the average soil pH in the Western part of the state is high (Zhang and McCray 2009) and thus the results of the two data sets where expected. Ultimately, the differences were very small and the pHs on the parcels were essentially the same. Slight differences could be attributed to sampling location; however there is no way of concluding such assumptions since the location of the samples from the preliminary set were not revealed. The differences in the nitrogen levels were more robust. Phosphorus on CRP ground in Western Texas County resembled the NG/OWB data more closely than nitrogen.

The only preliminary data that was available on organic matter was on wheat land. In the calculation of the sample size, it was assumed that this would not affect that sample size outcome in one way or another. The location statistics for the data collected in Western Texas County were relatively close; however some larger differences resulted when comparing these data to the preliminary data. The standard deviations and means for all the soil characteristics were higher in the preliminary data than the data taken in Western Texas County. This could be because soil type was implicitly controlled by narrowing population to the Western portion of the county. By doing this, some of variance that would be present due to interactions between soil nutrients and soil type was eliminated. Soil type can change in short distance however the degree of change gets larger from one end of Texas County to the other. Interactions between the soil type and nutrients are mentioned in Nichols (1984) and Bowman and Anderson (2002).

Table 1: Summary of Statistics Preliminary Data

Preliminary Data (Ok State SWAFL)

	Mean	σ	Min	Max
NG & OWB PH	7.56	0.52101	6.5	8.3
Combined	7.65752	0.39303	6.55	8.2
Just Wheat	7.52059	0.48468	6	8.2
Just Sorghum	7.79444	0.30137	7.1	8.2
NG & OWB N	21.6	23.9851	1	96
Combined	36.6094	34.757	3.5	219
Just Wheat	40.6961	43.2244	4	327
Just Sorghum	32.5227	26.2895	3	111
NG & OWB P	52.2667	34.8553	9	129
Combined	88.6577	91.6216	13.5	460.5
Just Wheat	89.5098	90.536	10	520
Just Sorghum	87.8056	92.7072	17	401
OM	2.07787	1.21024	0.63788	6

Table 2: Summary of Statistics Western Texas County

Sampled Data (Western Texas County)

	Mean	σ	Min	Max
CRP pH	7.666	0.3777	6.6	8.2
Comp pH	7.3208	0.4262	6.5	8
pHd	7.2286	0.4637	6.5	8
pHi	7.5	0.2722	6.9	8
CRP N	6	2.9155	2	17
Comp N	27.9434	36.9107	3	176
Nd	9.5143	10.6395	3	50
Ni	63.7778	43.3828	9	176
CRP P	46.566	31.7148	15	189
Comp P	83.1509	58.019	25	262
Pd	73.4857	57.0801	25	262
Pi	101.9	56.6927	27	197
CRP OM	1.6619	0.3114	1.08	2.84
Comp OM	1.6987	0.4861	0.94	3.13
OMd	1.5923	0.4072	0.99	2.63
OMi	1.9056	0.5678	0.94	3.13

Comparison of N, P, pH, and OM on CRP and non-CRP land

Since both nitrogen and phosphorus on the CRP land was found to be lower than any of the categories of cropland, the initial statistics agreed with hypotheses formed in Table 3 of the conceptual framework. On the other hand, organic matter found in the CRP land was only greater than the dryland data. CRP was found to have a lower percentage of organic matter than both the composite cropland and irrigated land data. Thus, the hypothesis for OM was only met when the CRP land was compared to the dryland; it failed when CRP was compared to the other croplands. Therefore, the test for significant differences in the means between CRP and cropland were only appropriate on pH, N, P, and OM in comparison to dryland.

Given that there was no way to determine whether the data selected for the study was coming from irrigated or dryland parcels, it was uncertain if the data would hold the assumption of normality. It is probable that irrigated land in Western Texas County may have been managed more intensively and more frequent applications of soil nutrients could have been applied since low precipitation is less of a concern on irrigated lands.

The Kolmogorov-Smirnov test was conducted at the 10%, 5%, and 1% levels to test the soil characteristics on the various parcel types for normality. For the soil pH, the test failed to reject the assumption of normality for the CRP composite sample, dryland, and irrigated land at the 10%, 5%, and 1% levels (Appendix 3 Chart 1, 2, 3, and 4). This was not the case for nitrogen or phosphorus. The test failed to reject normality for the irrigated land at all levels (Appendix 3 Chart 7, 11), however it rejected the notion for the CRP, the composite, and the dryland data for both nutrients (Appendix 3 Chart 5, 6, 8, 9, 10, and 12). For OM content, normality failed to be rejected at the 1% level for CRP dryland, and irrigated land, and to the 5% level for the composite sample.

Since the tests for pH and OM failed to reject the notion that the samples came from a normally distributed population, the results of the t-test were assumed sufficient, and were ran at various levels. For the remaining soil characteristics, t-tests were ran and the results were compared to the results of the non-parametric Wilcoxon-Mann-Whitney test. This, in conjunction with the Cochran and Cox, and Satterthwaite approximations, were used to assess the fragility of the data to the assumptions underlying the standard t-test. If these test results agreed, it was assumed that either the data was large enough to sustain validity of the independent t-test, or the test was a robust enough estimate to suffice even outside of the assumptions for the particular data set being examined.

The null hypothesis associated with the folded-F test of: CRP pH vs. pH of composite, CRP pH vs. pH of dryland, and CRP pH vs. pH of irrigated land was rejected. In other words, the assumption of equal variances was not met between those sets. Therefore, both approximations were included with the standard t-test for pH in all three tests. It was found that the pH of the CRP land was significantly larger by the results of the t-test and both approximations for CRP pH vs. pH of composite and CRP pH vs. pH of dryland data, to the 1% level of significance. The pH on CRP land was found to be significantly larger than the pH on irrigated land at the 5% level by the t-test and approximations. In the test for a significant difference in the means of organic matter between the CRP land and dryland, the null hypothesis of the folded-F test was rejected. No significant difference between the mean of CRP land and dryland existed at any level based on the t-test and approximations. Although it was not an objective to determine if CRP land had significantly less organic matter than the other parcels, the tests were conducted to obtain a full range of analysis. Since the hypothesis failed to be met for the two other parcels, this test determined if the difference was significant in the opposite direction of the hypothesis. As with the test between the CRP land and dryland, the null hypothesis of the folded-F test was rejected for CRP in comparison to the composite and irrigated land as well. The test of CRP OM vs. composite OM was not significant at any level in the opposite direction, however the organic matter on the irrigated land was found to be significantly larger than the CRP land to the 5% level by both the t-test and Satterthwaite approximation.

Since normality could not be assumed for nitrogen and phosphorus, the Wilcoxon-Mann-Whitney test was run in addition to the usual tests. The null for the folded-F test was rejected for all three comparisons, CRP N vs. composite N, CRP N vs. dryland N, and CRP N vs. irrigated N. The t-test and Satterthwaite approximation found the nitrogen level to be significantly less on CRP land than the composite and irrigated samples to the 1% level, and CRP to the dryland sample to the 5% level. The Wilcoxon-Mann-Whitney test concluded a significant difference in the means between CRP and the composite and irrigated samples to the 5% level, however a significant difference failed to be recognized for CRP and dryland nitrogen levels. Therefore, since the dryland data for nitrogen was not found to be normally distributed it can be concluded that the there is no statistically significant difference between CRP and the dryland nitrogen levels. This result reveals a stronger sensitivity to the assumptions of the normality and equality of variance for the nitrogen data in these tests. Histograms and normal & kernel densities for these tests can be found in Appendix 4, panels 4-6.

The null of the folded-F test was rejected for all three comparisons of phosphorus: CRP P vs. composite P, CRP P vs. dryland P, and CRP P vs. irrigated P. The t-test and both approximations found phosphorus to be significantly smaller on CRP land than the composite, dryland, and irrigated samples to the 1% level. These results were supported by the Wilcoxon-Mann-Whitney test. This test found phosphorus to be significantly smaller on CRP in comparison to all three sets of cropland data to the 5% level. These results, in retrospect to the results of the nitrogen tests for significant differences, imply that there is little sensitivity to the assumptions of the t-test for the phosphorus data sets. Histograms and normal & kernel densities for these tests can be found in Appendix 4, panels 7-9.

Enterprise Budget Analysis

Using the enterprise budget format outlined in the methods section, profitability results were obtained for a wheat-sorghum-fallow rotation under the three tillage systems for the lands sampled in the Western part of Texas County. Under the base budgets using average costs, average yield, and expected price, the no-till system resulted in a $31.67 loss per acre, while conservation-till and conventional till systems resulted in $11.02 and $16.65 losses respectively. The costs associated with these operations totaled $207.73 and $173.62 per acre for wheat and sorghum and $52.04 per acre in fallow for no-till; $181.91, $152.71, and $36.83 for the wheat, sorghum and fallow respectively in conservation-reduced till, and $196.39, $153.90, and $38.05 for wheat, sorghum, and fallow respectively in conventional till. These results were found with an expected price and average yield for wheat of $7.01 bu and 23.48 bu/acre, and $5.88 bu and 29.56 bu/acre for grain sorghum (U.S. Department of Agriculture 2000-2011). Expected price was calculated using the June 7th 2012 basis and the 2013 harvest futures, while yields were taken from the estimates from the web soil survey discussed in the methods section.

To determine the proper application of fertilizer to get the maximum yields for each crop, a regression was built using the numbers from Zhang et al. (2009). This report presents tables for major crops in Oklahoma that are most commonly deficient for plant nutrients. It was stated in the report that the relationships between yield and the amount of nutrients presented in the tables of the report are valid for interpreting soil test values from the Oklahoma State University Soil, Water, and Forage Analytical Laboratory. The Nitrogen requirements in the table are based on a yield goal while the other nutrients are based on soil test values and their corresponding sufficiency level.

To obtain 100% sufficiency for growth in terms of phosphorus, it was shown that there needs to be a STP of 65 or above for both wheat and grain sorghum. When the regression for wheat was run for phosphorus, an adjusted R^2 of .94 resulted. Using the average STP of 46.57 found in the samples taken from Western Texas County with the coefficients generated in the regression, the adequate amount of phosphorus was determined. The model determined that 16.64 lbs/acre of phosphorus was needed for wheat production in the coming crop year. The same process was conducted for sorghum, and the model resulted in an adj. R^2 of .99. When the average STP was placed in this model, it was found that 15.82 lbs/acre of phosphorus needed to be applied for grain sorghum to be 100% sufficient.

Since it is the goal of the producer to maximize profits, one must aim for maximum yield in both wheat and sorghum production. This is with the exception that the added costs do not overcome the increased yield; however that is why a sensitivity analysis was conducted. Therefore, a regression was run on the nitrogen requirement in terms of yield for both crops. The models resulted in an adj. R^2 of .99 and .98 for wheat and sorghum, respectively. The web soil survey reported that maximum yields of 25 bu/acre for wheat and 44 bu/acre for sorghum were capable of being produced on the sampled lands in Western Texas County. Using this information in the regression, it was found that 47.31 lbs/acre of nitrogen needed to be applied to obtain these yields in wheat production. The regression for sorghum did not return realistic values for nitrogen application, so a visual estimation was made on the basis of the scale provided in the Zhang et al. (2009) report. It was estimated that roughly 40 lbs/acre was needed for maximum yields in grain sorghum.

The list of field operations called for an application of 11-52-0 to be put down at time of planting. The phosphorus requirement was to be met with 11-52-0 and the remaining nitrogen requirement was filled with an application of urea ammonium nitrate (32-0-0) shortly after planting. The application of 11-52-0 was combined with planting in order to reduce the cost per acre. Since 16.64 lbs/acre of phosphorus was needed for proper wheat production, a total of 31.995 lbs/acre of 11-52-0 was called for at planting. This application of fertilizer added 3.52 lbs/acre of nitrogen to the soil, and in turn resulted in dropping the required subsequent nitrogen application for wheat to 43.79 lbs/acre. This remaining nitrogen requirement translated into 136.84 lbs/acre of 32-0-0, and was filled shortly after planting. It is assumed that the phosphorus applied in the wheat season was entirely utilized, so in the phosphorus calculation for the grain sorghum crop, the average STP was used as well.

Since 15.82 lbs/acre of phosphorus was required for the grain sorghum crop, 30.43 lbs/acre of 11-52-0 needed to be applied. This application of 11-52-0 added 3.35 lbs/acre of nitrogen to the soil, leaving 36.65 lbs/acre of nitrogen left to fill for a grain sorghum yield of 44 bu/acre. Thus this resulted in an application of 114.54 lbs/acre of UAN (32-0-0) to fill the remaining requirement.

These calculations for the two fertilizer applications on wheat and grain sorghum were used for every scenario in the sensitivity analysis because it was assumed that although the producer may not have maximum yields at harvest, the operation will be set up so that the potential exists to do so. The costs of these fertilizers were taken from the same three locations as the rest of the material costs, and whereas the amount of the application was assumed constant, differences in costs were examined. A complete list of costs for the locations on June 7th 2012 is shown in table 7.

Table 7: Product Prices from Local Cooperatives

Product Prices from local Coop					
Chemical	Units N.	Equity 1	Equity 2	Equity 3	Avg. Price
11-52-0	Lb	$0.30	$0.33	$0.32	$0.31
32-0-0 (UAN)	Lb	$0.26	$0.25	$0.26	$0.26
Glyphosate	Oz	$0.10	$0.14	$0.11	$0.11
2-4-D Amine 4	Pint	$1.99	$1.94		$1.97
Dupont Ally XP	Oz	$13.86	$12.52	$13.00	$13.13
Atrazine 4L	Pint	$1.65	$1.61	$1.66	$1.64
Class Act	Oz	$0.08	$0.07	$0.08	$0.08
Interlock	Oz	$0.43	$0.41		$0.42
Superb HC	Pint	$2.60	$2.60	$1.38	$2.19

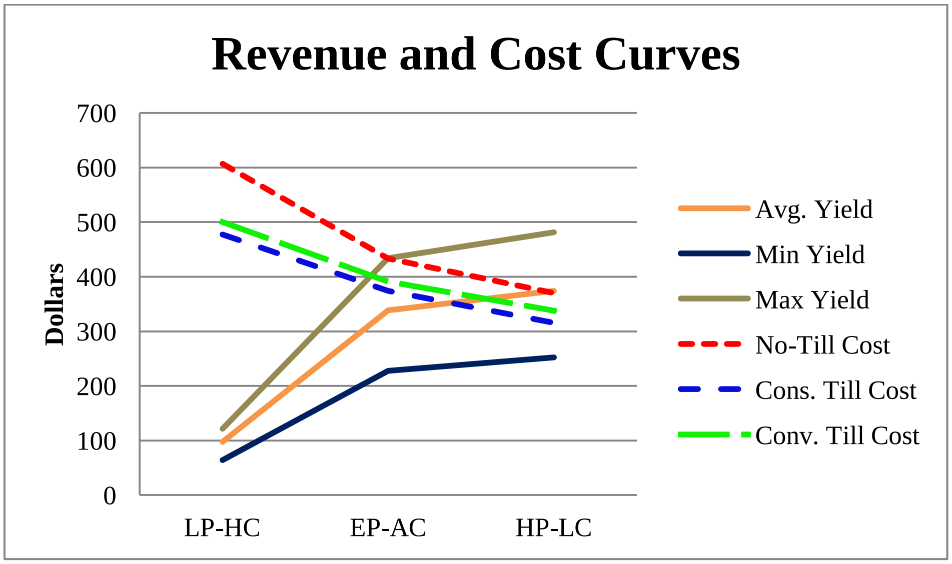
Using these costs and the field operations in appendix 6, the following per acre costs resulted for each crop under the specified tillage practice (table 8). These costs do not account for the opportunity cost of giving up the average CRP rental payment of $32.34 per acre in Texas County (U.S. Department of Agriculture 2010).

Table 8: Per Acre Costs Associated with Field Operations

Costs Per Acre Associated with Field Operations			
	Low Cost	Avg. Cost	High. Cost
No-Till Wheat	$181.03	$207.73	$283.27
No-Till Sorghum	$147.65	$173.62	$241.51
No-Till Fallow	$41.29	$52.04	$82.19
Conservation Wheat	$159.95	$184.40	$230.37
Conservation Sorghum	$128.23	$152.71	$197.90
Conservation Fallow	$27.30	$36.83	$49.35
Conventional Wheat	$175.82	$199.11	$251.01
Conventional Sorghum	$131.29	$153.90	$198.92
Conventional Fallow	$30.45	$38.05	$50.40

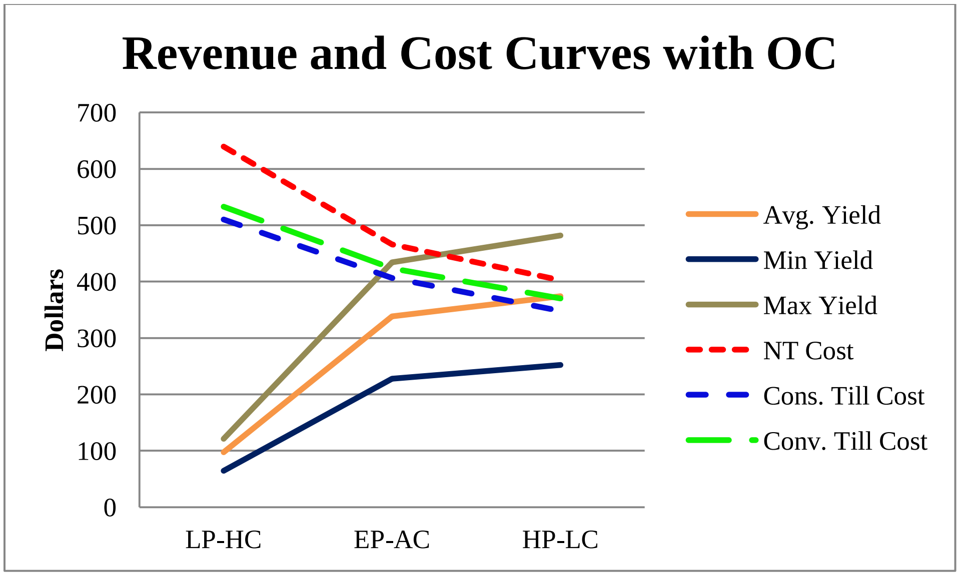
The low prices used for wheat and sorghum were $2.37 bu and $1.41 bu, while high prices were $7.54 bu and $6.66 bu respectively. These prices are the high and low prices over the last ten years during the harvest months for each crop. The sensitivity analysis using these prices and the costs listed can be found in table 1 of appendix 9. Assuming that each one of the scenarios are equally likely, it was found that the producer would be profitable in a no-till operation 14.81% of the time, while under conservation and conventional till systems they would be profitable 25.93% and 22.22% of the time (appendix 9, table 3). This is better depicted by in Figure 1.

Figure 1: Revenue and Cost Curves Not Accounting for CRP Opportunity Cost



When the opportunity cost is taken into account, profitability of the no-till operation drops to 3.7% of the time, while conservation and conventional till were found to be profitable 11.11% and 3.7% of the time respectively (appendix 8, table 3). The results of this sensitivity analysis can be found in appendix 9, table 2. Figure 2 helps to summarize this.

Figure 2: Revenue and Cost Curves Accounting for CRP Opportunity Cost



Following closely with the results of the sensitivity analysis are the results of the break even analysis. No break-even analysis was run for the fallow seasons given that no revenue or yields were generated during these time periods. Analysis on yield was conducted for the expected price, average price, and high price with average costs, low costs, and high costs. This resulted in nine analyses for each crop in each tillage system. Therefore, a total of fifty-four analysis were conducted. These analyses are shown in Table 9.

Table 9: Break-Even Analysis on Yield

Break-Even Yield									
	Avg. Cost			Low Cost			High Cost		
	EP	low P	high P	EP	low P	high P	EP	low P	high P
NT Wheat	29.63	87.65	27.55	25.83	76.39	24.01	40.41	119.52	37.57
NT Sorghum	29.53	123.03	26.05	25.11	104.63	22.16	41.08	171.14	36.24
CR Wheat	26.30	77.80	24.46	22.82	67.49	21.21	32.86	97.20	30.55
CR Sorghum	25.97	108.22	22.92	21.81	90.86	19.24	33.66	140.24	29.70
CV Wheat	28.40	84.01	26.41	25.08	74.19	23.32	35.81	105.91	33.29
CV Sorghum	26.18	109.05	23.09	22.33	93.03	19.70	33.83	140.96	29.85

With yields ranging from 14 bu/acre to 25 bu/acre for wheat, and 22 bu/acre to 44 bu/acre for grain sorghum, the percentage of time that these yields were above the break-even points in the analysis above were low. Under all three tillage systems, maximum yields for wheat and grain sorghum surpassed the numbers in the analysis 42.59% of the time, while the low yields were above these numbers only 5.56% of the time.

The break-even analysis on price was conducted in the same fashion. Analysis was generated for the average yields, low yields, and high yields with average costs, low costs, and high costs. This again resulted in nine analyses for each crop in each tillage system, for a total of fifty-four estimates. These results are shown in table 10.

Table 10: Break-Even Analysis on Price

Break-Even Price									
	Avg. Cost			Low Cost			High Cost		
	AY	LY	HY	AY	LY	HY	AY	LY	HY
NT Wheat	$8.85	$14.84	$8.31	$7.71	$12.93	$7.24	$12.06	$20.23	$11.33
NT Sorghum	$5.87	$7.89	$3.95	$4.99	$6.71	$3.36	$8.17	$10.98	$5.49
CR Wheat	$7.85	$13.17	$7.38	$6.81	$11.42	$6.40	$9.81	$16.46	$9.21
CR Sorghum	$5.17	$6.94	$3.47	$4.34	$5.83	$2.91	$6.69	$9.00	$4.50
CV Wheat	$8.48	$14.22	$7.96	$7.49	$12.56	$7.03	$10.69	$17.93	$10.04
CV Sorghum	$5.21	$7.00	$3.50	$4.44	$5.97	$2.98	$6.73	$9.04	$4.52

Prices ranged from $2.37 bu to $7.54 bu for wheat, and $1.41 bu to $6.66 bu for grain sorghum. Under the tillage systems examined, the top-end prices for wheat and grain sorghum surpassed the numbers in the analysis 42.59% of the time, while the low-end prices never broke the break-even point on either crop.

CHAPTER VIII

CONCLUSIONS

As stated in the literature review, many have speculated that the CRP had a positive effect on soil nutrients during its time in the program. Organic matter was considered to be one of the nutrients that benefited the most. The fact that organic matter on CRP land was not statistically greater than any of the other cropland data sets raises many questions as to whether these speculations are justified. Under the current conditions of the program, for these assertions to be correct, organic matter on CRP land would have been sufficiently lower than the dryland and irrigated cropland before the land was placed into the program. This is assuming that it has taken the period of enrollment for the organic matter to reach the point it was upon sampling. In other words, organic matter on land enrolled in CRP at the time of initial enrollment would have been drastically lower than cropland that did not enroll. While this is a possibility, it is somewhat unlikely. Another possibility that was also discussed in the literature review is that low precipitation and soil type resulted in a soil-climate interaction that was not conducive to OM accumulation. More intensive tillage strategies, certain soil types, and higher precipitation were found to promote the accrual of OM. Given that the area sampled has low precipitation on average and marginal soils, it could be assumed that these are more realistic reasons for the results for the data in this study.

On the other hand, N, P, and pH were less surprising. Since these soils had a high sand content and thus higher porosity, they have a greater and or accelerated tendency to leach. Nitrogen is a nutrient that moves through the soil throughout the year and the results could have been due to the timing of sampling; however no nitrogen has been applied in some time on these parcels so the ability to recharge the soil was also limited. The fact that dryland nitrogen means were similar with the CRP land and the variance on the CRP land for this nutrient was low, leads one to believe that lack of nutrient management could be the primary contributor to these low numbers.

According to Nichols (1984), phosphorus levels are highly correlated with clay content in the soil. Over 90% of the soils in the sample were clay loams. Clay loam can have anywhere from 25-50% sand content and 25-40% clay content. Given that the other predominant soil was a fine sandy loam, which is 40-70% sand, it is assumed that sand content was dominant in the samples pulled in this study. The phosphorus levels found on the CRP land followed directly with this finding. Since the CRP lands have not been managed in many years, the soil pH was found to be statistically higher than the non-CRP lands. Many of the non-CRP lands in the surrounding area have been exposed to continued use anhydrous ammonia and select other chemicals which lower the soil pH. This difference in land management could have been the offsetting factor in the differences in pH between the parcels.

When the budgets were built using these findings, a less than optimal result was found. Profit will be slightly higher in the years after the initial breakout, ceteris paribus; however the factors that will contribute to this increase are few. After the first year, there will be no need to mow the land before the herbicide applications or tillage occurs. This will drop the costs down $10-$20 per acre over the three year rotation. Additionally, a 48 oz application of herbicide under the no-till operation, a sweep till in the conservation system, and the chisel plow in the conventional system, will not be necessary. This will drop the cost $10-$19, $8-$13.50, and $10-$16 for the no-till, conservation-till, and conventional till systems over a three year rotation. The impact that these costs will make on the operation will be marginal, $6-$12, and will not make up for potential losses occurred under high costs or low prices. At best, this will change the percentage that the operation is profitable in the sensitivity analysis under a no-till operation from 14.81% to 18.52%, and from 25.93% to 29.63% for conservation till. Conventional-till will see no increase in the amount of time that it is expected to be profitable.

It was found using two different analyses byWilliams et al. (2010) that (1) risk-neutral and risk-adverse decision makers would prefer CRP to crop production under January 2006 prices and December 2008 costs, and (2) that moderately to strongly risk adverse individuals would prefer CRP to any tillage system using January 2007 prices and December 2008 costs. These assessments were made when the probability of returning a profit above the CRP rental payment was 38% for conservation-reduced till and 36% for no-till for the first analysis. In the second analysis, the probability for a profit above the CRP payment was 55% and 54% for conservation-reduced till and no-till respectively.

In this study, the potential for profit in the first three year rotation when accounting for the CRP opportunity cost is 3.7%, 11.11%, and 3.7% for no-till, conservation-till, and conventional-till systems, respectively. In the years after, the potential for profit above the CRP payment is 7.41%, 11.11%, and 11.11% at best for no-till, conservation-till, and conventional till systems, respectively. From these results, it is assumed that only the riskiest producers in the Western part of Texas County would attempt to return CRP to a continuous wheat-sorghum-fallow rotation. This assessment is made without any account for precipitation, temperature, soil water, humidity, etc. To fully gauge producer risk, one must include these factors as part of the equation; however it is out of the scope of this study to do so. One would think that the addition of these factors would further decrease the chances of profitability.

In short, if the producer chooses to return their CRP land to production, they have the potential to reap as high as $54.48 per acre profit or lose $163.41 per acre depending on the costs, price received, yield, and tillage system. This assessment is not accounting for the opportunity cost of forgoing the CRP payment. When this cost is accounted for, the producer could return a profit as high as $22.14 per acre or lose as much as $195.75 per acre. These results pertain specifically to Western Texas County, however given its geographic similarity to many other areas of the Prairie Gateway, they could be extended to other areas. Yet, in order to gain a full understanding of the potential that these lands have outside of this region, a multi-state project should be conducted.

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APPENDICES

Appendix 1: The T-Test and Wilcoxon-Mann-Whitney Test in SAS

The t-test procedure in SAS performs t-tests and computes confidence limits for one sample, pared observations, two independent samples, and the AB/BA crossover design. Additionally; two sided, TOST (two one-sided tests) equivalence, and upper and lower one-sided hypotheses are supported for means, mean differences, and mean ratios for either normal or lognormal data. Data can be input in the form of observation or in certain cases, summary statistics. Output under this procedure includes summary statistics; confidence limits for means, standard deviations, and coefficients of variation; hypothesis tests, and graphical displays including; histograms, densities, box plots, confidence intervals, Q-Q plots, profiles, and agreement plots (Jones and Huddleston 2009). These displays, activated by using the ODS graphics option, aid in determining whether a data set is normally distributed.

For a one-tailed two sample independent t-test, SAS is programmed as follows:

```
data data name;
input Class cat $ Var @@;
datalines;
Class 1 var
.
.
Class 2 var
;
run;

ods graphics on;

proc ttest cochran ci=equal umpu sides=L/U alpha=α;
class character variable;
var y;
run;

proc npar1way wilcoxon;
class character variable;
var y;
run;

ods graphics off;
```

The data statement is followed by the name of the data set being tested. For this study it will be either: pH, pHd, pHi, N, Nd, Ni, P, Pd, Pi, OM, OMd, OMi. Where the soil characteristics without an additional letter are the CRP lands compared to the composite sample, and the soil characteristics with a following "d" or "i" are the CRP lands compared to dryland and irrigated land, respectively. On the input line; the "Class cat" is what is being compared. That is weather it is CRP-composite, CRP-dryland, or CRP-irrigated. The ($) following the "Class cat" indicates to SAS that it is the character variable. "VAR" corresponds to which soil characteristic being compared, and the (@@) enable the procedure to read more than one observation. The "datalines" entry is the list of data in order by class. The first class determines the direction of the hypothesis test. The "ods graphics" statement is a request for graphical output and results in the plots mentioned above. The "CLASS" statement contains the variable that distinguishes the groups being compared, and the “VAR” statement specifies the response variable to be used in calculations. When unequal variances are suspected the “COCHRAN” option is used to obtain the Cochran and Cox (1950) approximation. This is in addition to the Satterthwaite approximation, which as previously mention, is by default. These tests result in p-values used to determine if statistically significant differences exist when variances cannot be assumed to be equal. The “equal umpu” statement following the “ci” command, results equal tailed and uniformly most powerful unbiased intervals for the standard deviation.

The “sides” command specifies the number of tails and direction of the t-test. “L” specifies a lower one-sided test in which the alternative hypothesis indicates a mean less than the null value. “U” is an upper sided test, in which the alternative hypothesis indicates a mean greater than the null. PH is a two tailed test while N, and P are lower one-tailed tests, and OM is an upper one-tailed test for all land categories. “Alpha” specifies the confidence interval. For our study we examined significant differences at the 10%, 5%, and 1% levels.

When the code was ran simple statistics for the two populations being compared was reported, as well as for the difference of the means between the populations. The type of t-test was reported under the methods column of the output. Each method was reported on a separate row, and the underlying assumption regarding the variance for that method was reported in the adjacent column. The pooled variance test assumed that the populations had equal variances with $S_c+S_{nc}-2$ degrees of freedom. When the normality assumption could not be met, the “PROC NPAR1WAY” command with the “Wilcoxon” option was used to run the non-parametric "Wilcoxon-Mann-Whitney" test to test for significant differences.

Appendix 2- Differences in Means

Table 3: Differences in Means

	Diff. in CRP and Composite	Diff. in CRP and Dryland	Diff. in CRP and Irrigated
pH	0.3453	0.4375	0.166
N	-21.9434	-3.5143	-57.7778
P	-36.5849	-26.9197	-55.3784
OM	-0.0368	0.0696	-0.2437

Appendix 3- Kolmogorov-Smirnov Goodness-of-Fit Test

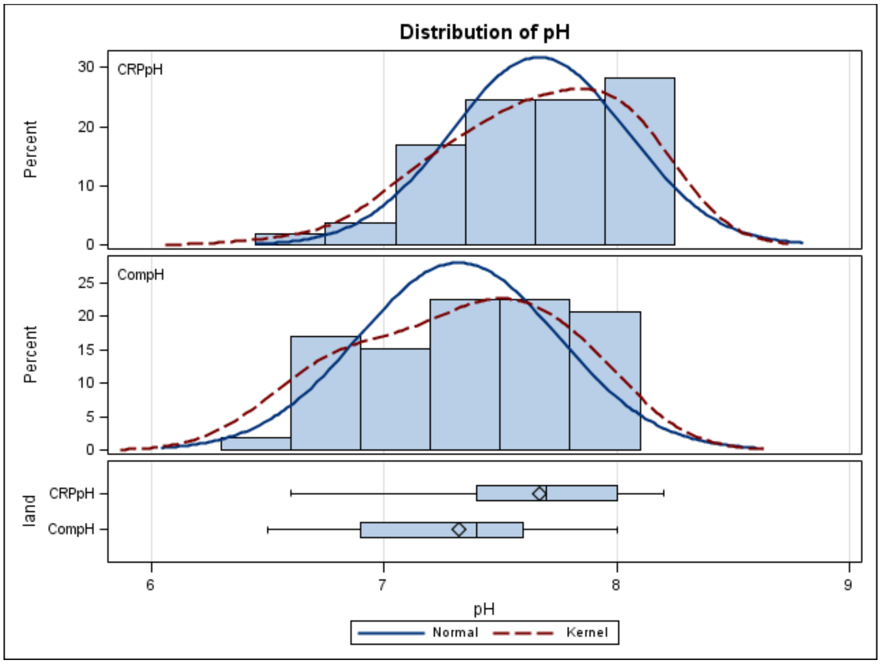
Table 1: Normality Table

	pH			OM		
	10%	5%	1%	10%	5%	1%
CRP	**N**	**N**	**N**	**N**	**N**	**N**
Composite	**N**	**N**	**N**	**N**	**N**	**X**
Dryland	**N**	**N**	**N**	**N**	**N**	**N**
Irrigated	**N**	**N**	**N**	**N**	**N**	**N**

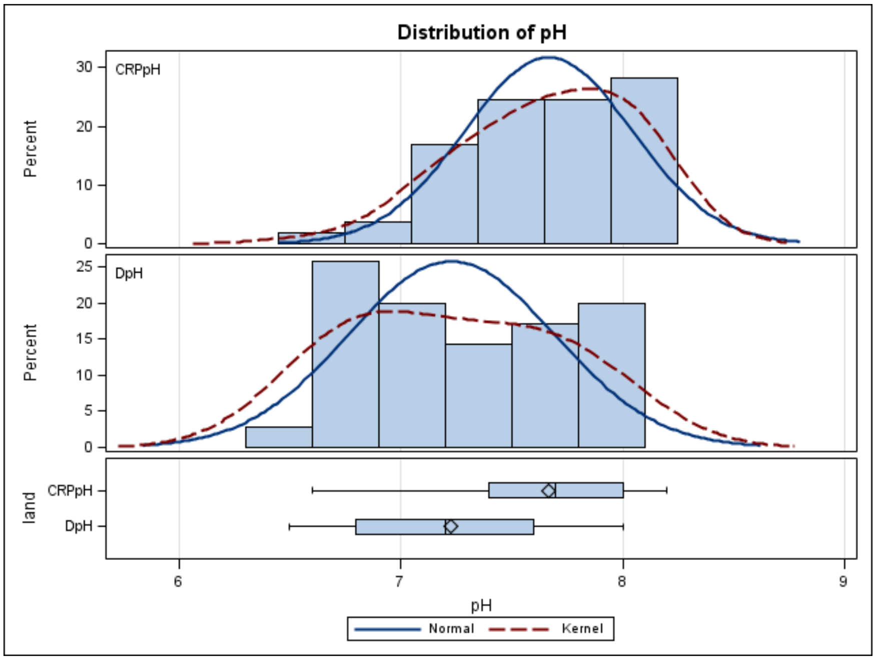
	N			P		
	10%	5%	1%	10%	5%	1%
CRP	**X**	**X**	**X**	**X**	**X**	**X**
Composite	**X**	**X**	**X**	**X**	**X**	**X**
Dryland	**X**	**X**	**X**	**X**	**X**	**X**
Irrigated	**N**	**N**	**N**	**N**	**N**	**N**

Appendix 4- SAS Summery Panels

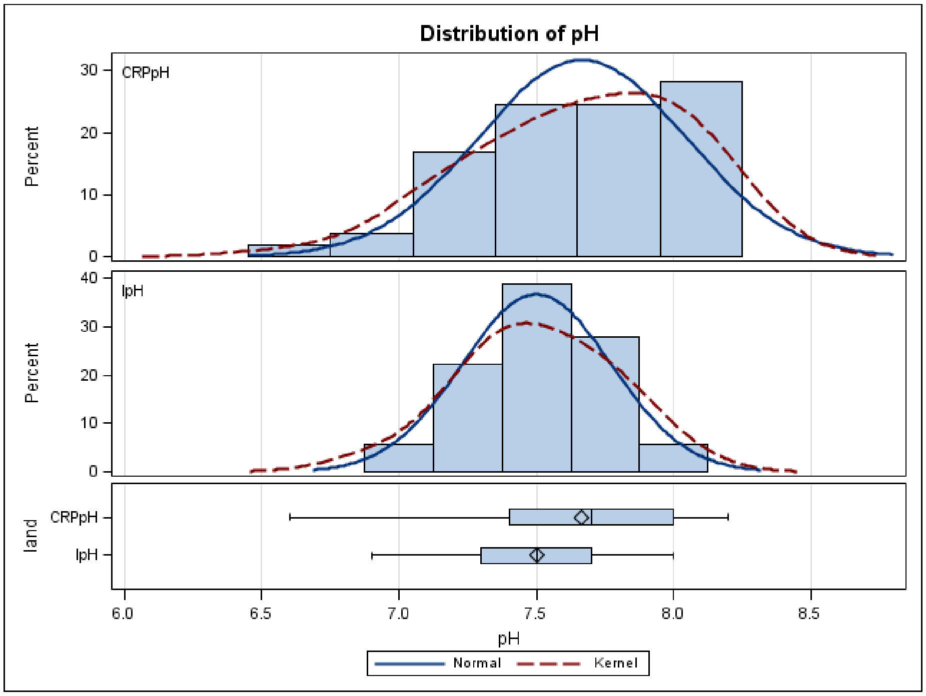
Panel 1: CRP pH vs. Composite pH



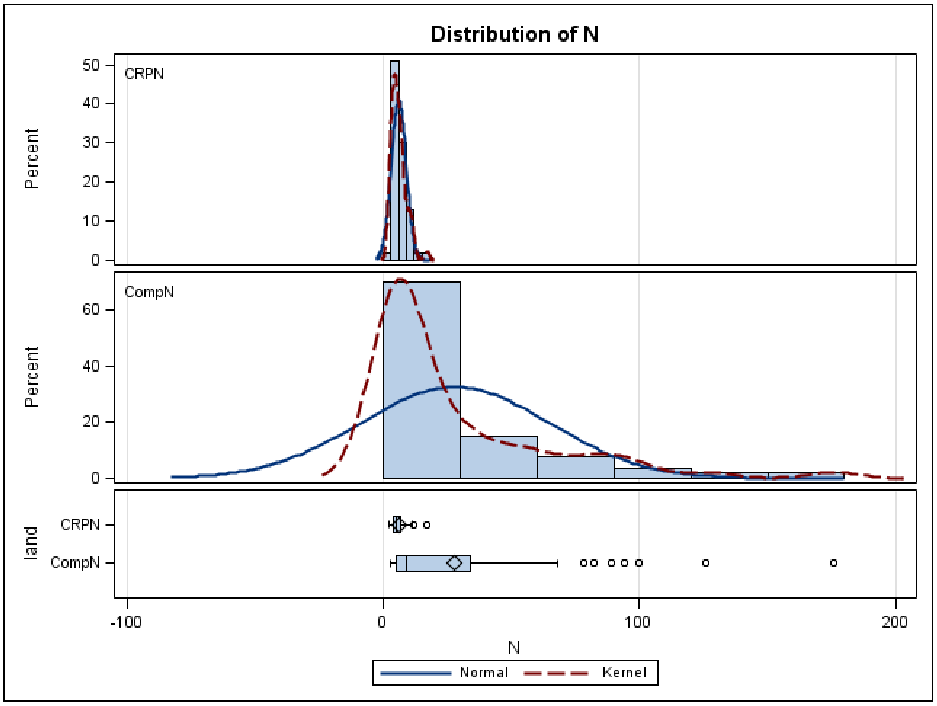
Panel 2: CRP pH vs. Dryland pH



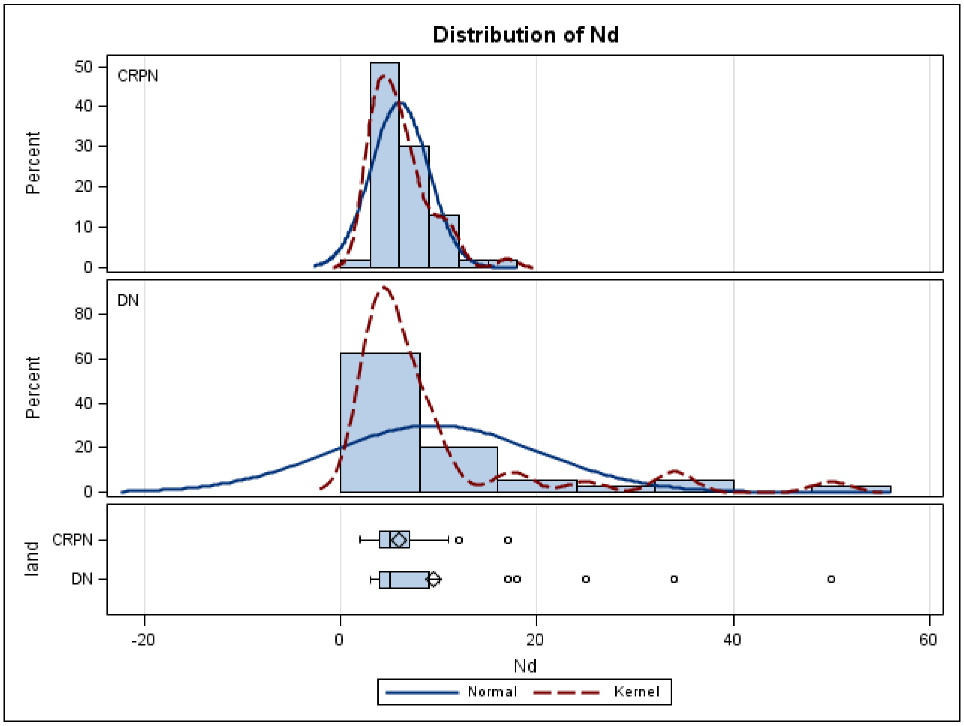
Panel 3: CRP pH vs. Irrigated pH



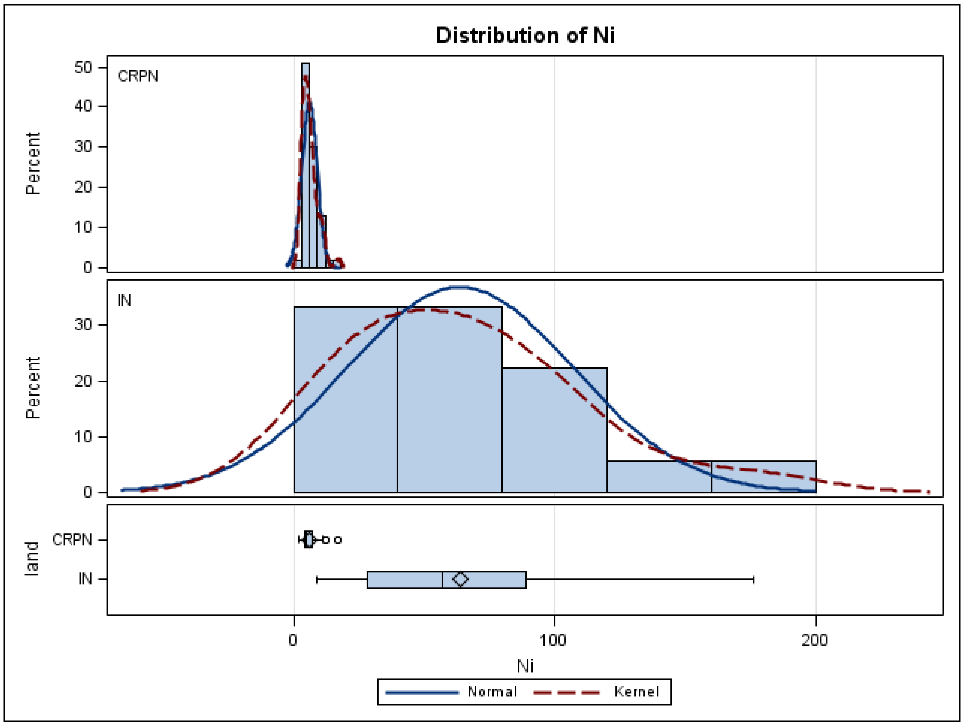
Panel 4: CRP N vs. Composite N



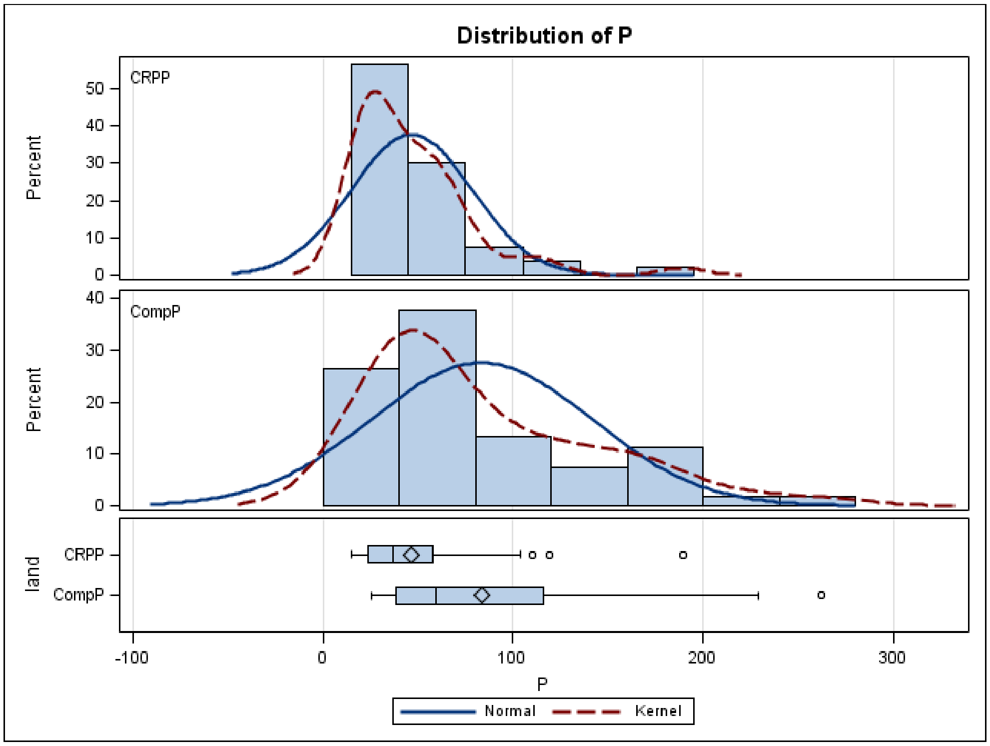
Panel 5: CRP N vs. Dryland N



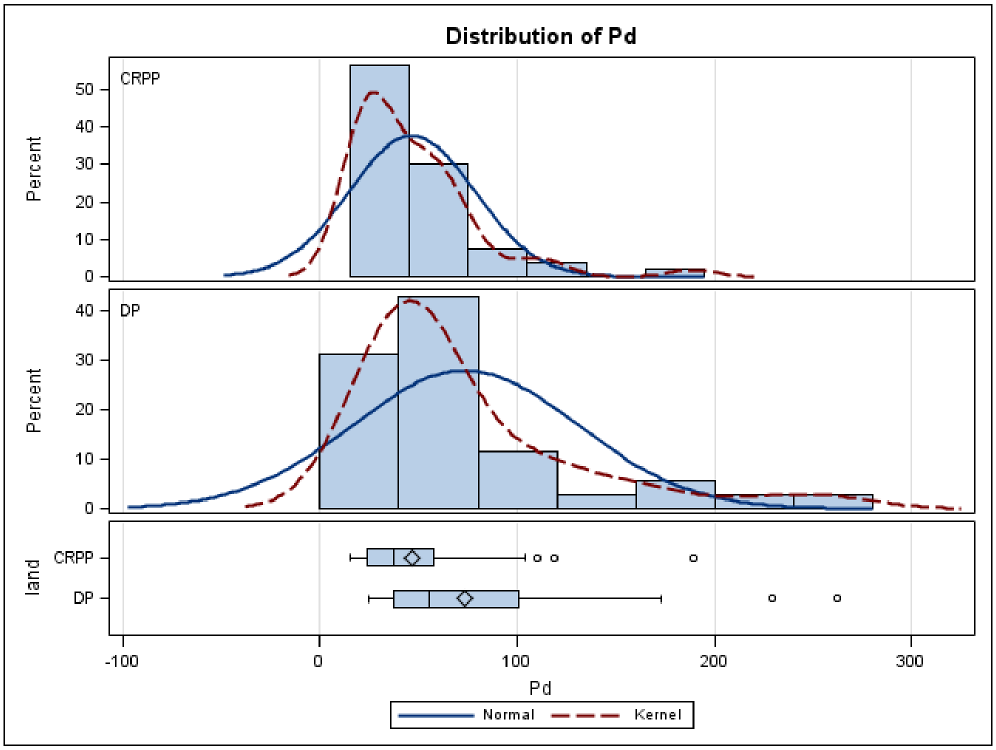
Panel 6: CRP N vs. Irrigated N



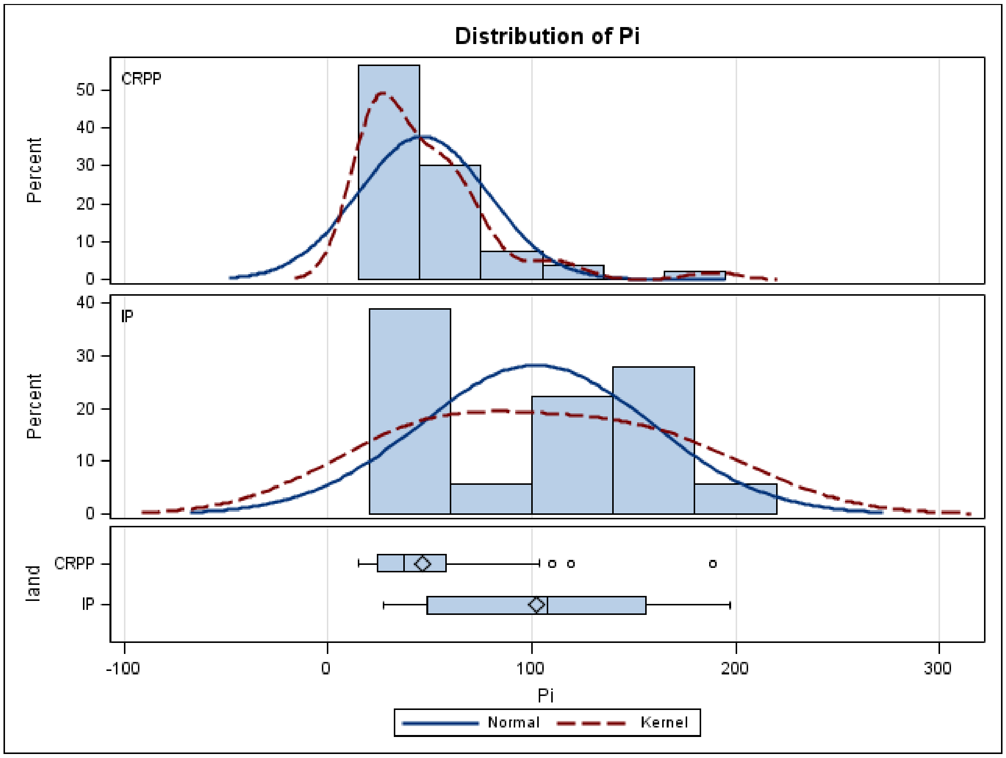
Panel 7: CRP P vs. Composite P



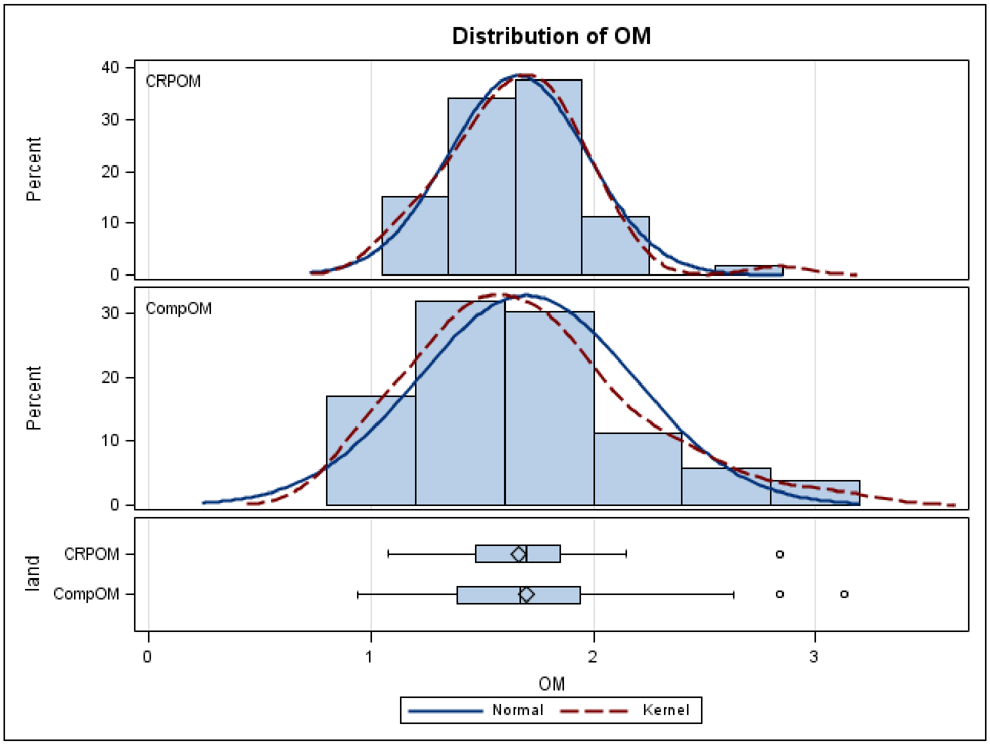
Panel 8: CRP P vs. Dryland P



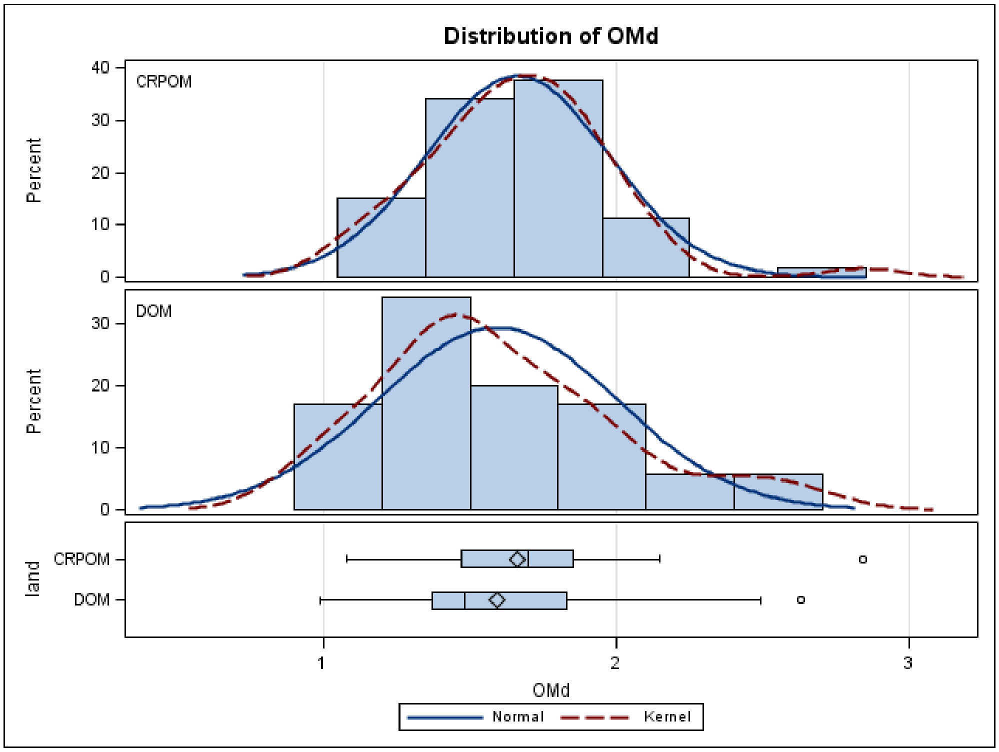
Panel 9: CRP P vs. Irrigated P



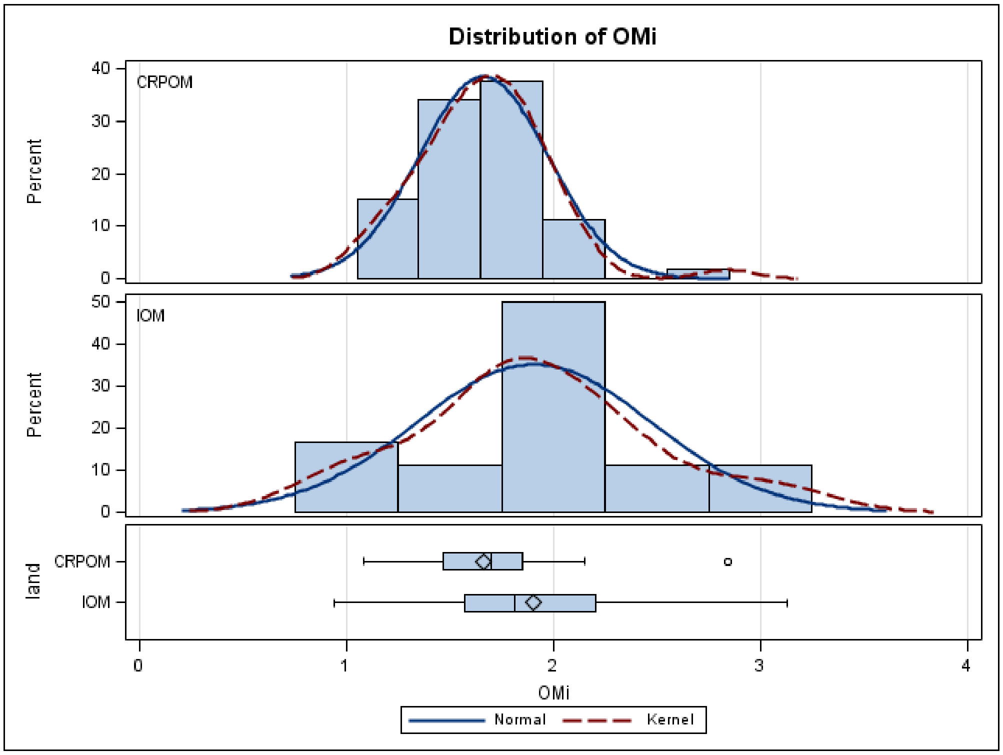
Panel 10: CRP OM vs. Composite OM



Panel 11: CRP OM vs. Dryland OM



Panel 12: CRP OM vs. Irrigated OM



Appendix 5: Field Operations for No-Till, Conservation, and Conventional Tillage Practice

Table 1: No Till Field Operations for a Wheat-Sorghum-Fallow Rotation

Year	Month	Operation	Machine Op	Amount	Unit	
1	April	Mow	Mower			Fallow
1	May	Glyphosate (Roundup) w/	Spray	48	oz/acre	
1		Adjuvant & Surfactant (Class Act) w/		0.48	oz/acre	
1		Drift Control (Interlock)		5	oz/acre	
1	June	Glyphosate (Roundup)	Spray	24	oz/acre	
1		Adjuvant & Surfactant (Class Act) w/		0.24	oz/acre	
1		Drift Control (Interlock)		5	oz/acre	
1	June	Broadleaf Control (2-4-D Amine 4) w/	Spray	4	pint/acre	
		Adjuvant & Surfactant (Superb HC) w/		1	pint/acre	
		Drift Control (Interlock)		5	oz/acre	
1	Sept	Glyphosate (Roundup) w/	Spray	24	oz/acre	
1		Adjuvant & Surfactant (Class Act)		0.24	oz/acre	
1		Drift Control (Interlock)		5	oz/acre	
1	Sept	Plant Wheat & apply	Air Seeder	60	lb/acre	Wheat
		Fertilize (18-46-0)		P Rec.	lb/acre	
2	Feb	Fertilize (32-0-0) (UAN)	Apply	Rem. N.	oz/acre	
2	March	Broadleaf Control (Dupont Ally XP) w/	Spray	0.1	oz/acre	
		Drift Control (Interlock)		5	oz/acre	
2	March	Broadleaf Control (2-4-D Amine 4) w/	Spray	1	pint/acre	
		Adjuvant & Surfactant (Superb HC) w/		1	pint/acre	
		Drift Control (Interlock)		5	oz/acre	
2	June	Harvest	Combine			
2	July	Glyphosate (Roundup) w/	Spray	24	oz/acre	Fallow

		Adjuvant & Surfactant (Class Act) w/		0.24	oz/acre	
		Drift Control (Interlock)		5	oz/acre	
2	July	Broadleaf and Grass Control (Atrazine 4L) w/	Spray	4	pints/acre	
		Drift Control (Interlock)		5	oz/acre	
3	March	Glyphosate (Roundup) w/	Spray	24	oz/acre	Sorghum
		Adjuvant & Surfactant (Class Act) w/		0.24	oz/acre	
		Drift Control (Interlock)		5	oz/acre	
3	April	Glyphosate (Roundup) w/	Spray	24	oz/acre	
		Adjuvant & Surfactant (Class Act) w/		0.24	oz/acre	
		Drift Control (Interlock)		5	oz/acre	
3	April	Plant Sorghum & apply	Air Seeder	3	lb/acre	
		Fertilize (18-46-0)		P Rec.	lb/acre	
3	June	Fertilize (32-0-0) (UAN)	Apply	Rem. N.	oz/acre	
3	June	Broadleaf Control (2-4-D Amine 4) w/	Spray	1	pints/acre	
		Adjuvant & Surfactant (Superb HC) w/		1	pint/acre	
		Drift Control (Interlock)		5	oz/acre	
3	Sept	Harvest	Combine			

Table 2: Conservation Till Field Operations for a Wheat-Sorghum-Fallow Rotation

Year	Month	Operation	Machine Op	Amount	Unit	
1	April	Mow	Mower			Fallow
1	May	Sweep Till 1	Sweep			
1	June	Sweep Till 2	Sweep			
1	Sept	Sweep Till 3	Sweep			
1	Sept	Plant Wheat & apply	Air Seeder	60	lb/acre	Wheat
		Fertilize (18-46-0)		P Rec.	lb/acre	
1	Sept	Fertilize (32-0-0) (UAN)	Apply	Rem. N.	oz/acre	
2	March	Broadleaf Control (Dupont Ally XP) w/	Spray	0.1	oz/acre	
		Drift Control (Interlock)		5	oz/acre	
2	June	Harvest	Combine			

2	July	Sweep Till 1	Sweep			Follow
3	April	Sweep Till 2	Sweep			
3	April	Plant Sorghum & apply	Air Seeder	3	lb/acre	Sorghum
		Fertilize (18-46-0)		P Rec.	lb/acre	
3	May	Fertilize (32-0-0) (UAN)	Apply	Rem. N.	oz/acre	
3	July	Broadleaf Control (2-4-D Amine 4) w/	Spray	1	pints/acre	
		Adjuvant & Surfactant (Superb HC) w/		1	pint/acre	
		Drift Control (Interlock)		5	oz/acre	
3	Sept	Harvest	Combine			

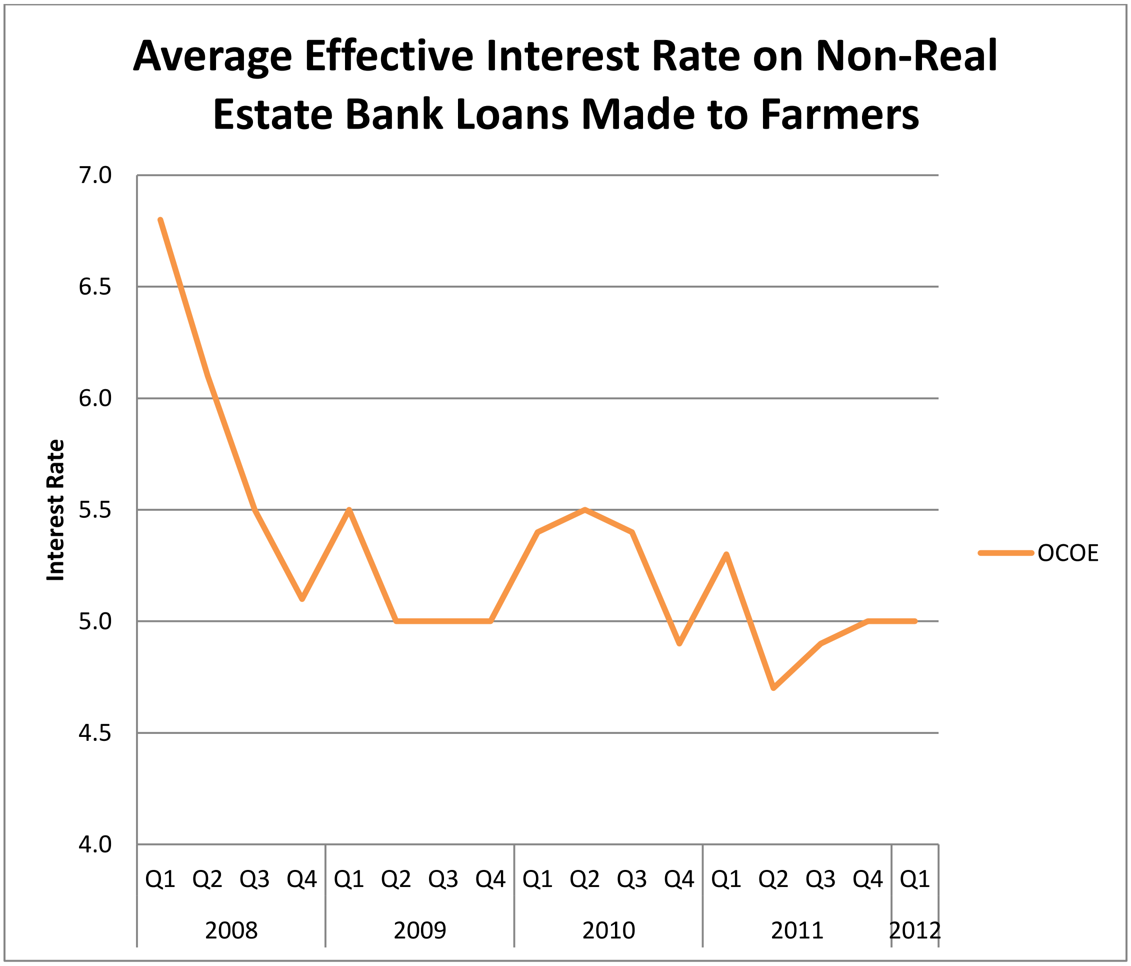
Table 2: Conservation Till Field Operations for a Wheat-Sorghum-Fallow Rotation

Year	Month	Operation	Machine Op	Amount	Unit	
1	April	Mow	Mower			Fallow
1	May	Chisel Plow	Chisel			
1	June	Tandem Disk	Tandem Disk			
1	Aug	Tandem Disk	Tandem Disk			Wheat
1	Aug	Chisel w/9 inch sweeps and harrow	Chisel			
1	Sept	Plant Wheat & apply	Air Seeder	60	lb/acre	
		Fertilize (18-46-0)		P Rec.	lb/acre	
1	Sept	Fertilize (32-0-0) (UAN)	Apply	Rem. N.	oz/acre	
2	March	Broadleaf Control (Dupont Ally XP) w/	Spray	0.1	oz/acre	
2		Drift Control (Interlock)		5	oz/acre	
2	June	Harvest	Combine			
2	July	Tandem Disk	Tandem Disk			Fallow
3	April	Tandem Disk	Tandem Disk			Sorghum
3	April	Plant Sorghum & apply	Air Seeder	3	lb/acre	
		Fertilize (18-46-0)		P Rec.	lb/acre	

3	May	Fertilize (32-0-0) (UAN)	Apply	Rem. N.	oz/acre	
3	July	Broadleaf Control (2-4-D Amine 4) w/	Spray	1	pints/acre	
		Adjuvant & Surfactant (Superb HC) w/		1	pint/acre	
		Drift Control (Interlock)		5	oz/acre	
3	Sept	Harvest	Combine			

Appendix 6: Average Effective Interest Rate on Non-Real Estate Bank Loans Made to Farmers

Table 1: Other Current Operating Expenses



Appendix 7: Enterprise Budgets for No-Till, Conservation-Reduced Till, Conventional Till Systems under Average Costs and Expected prices

Budget 1: No-Till Wheat

Dryland No-Till Wheat Enterprise Budget - Grain Only

2012 Harvest Price Projection
Wheat-Sorghum-Fallow Rotation

ITEM	Units	E Price ($)	Qt.	Excess	$/Acre
Returns to Wheat	Bu.	$7.01	23.48		$164.59
Total Revenue					$164.59
COST					
Seed	lb	$0.25	60		$15.00
Fertilizer					
11-52-0	lb	$0.31	32		$10.03
UAN (32-0-0)	lb	$0.26	136.84		$35.24
Herbicide					
Glyphosate (Roundup)	oz	$0.11	96		$10.92
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	5		$9.83
Broadleaf Control (Dupont Ally XP)	oz	$13.13	0.1		$1.31
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	1		$2.19
Adjuvant & Surfactant (Class Act)	oz	$0.08	0.96		$0.07
Drift Control (Interlock)	oz	$0.42	24		$10.01
Crop Insurance (65%) 2012	acre	$15.00	1		$15.00
Annual Operating Capital	%	0.05000	$144.80		$7.24
Machine Operation					
Mow	acre	$13.80	1		$13.80
Air Seeder with Fertilizer	acre	$15.58	1		$15.58
Fert. Liq. App	acre	$4.37	1		$4.37
Herb App	acre	$5.07	6		$30.42
Combine	acre	$21.06	1		$21.06
Extra charge for bu/acre > 30	bu	$0.21	3.48	$0.73	$0.73
Hauling Small Grains	bu	$0.21	23.48		$4.93
Total Cost					$207.73
Net Return to Land, Overhead, and Mgmt.					($43.13)
Net Return for 1/3 acre					($14.38)

Budget 2: No-Till Sorghum

Dryland No-Till Sorghum Enterprise Budget - Grain Only

2012 Harvest Price Projection
Wheat-Sorghum-Fallow Rotation

ITEM	Units	Price ($)	Qt.	>30	$/Acre
Returns to Sorghum	bu	$5.88	29.5616		$173.80
Total Revenue					$173.80
COST					
Seed	lb	$1.40	3.00		$4.20
Fertilizer					
11-52-0	lb	$0.31	30.43		$9.53
UAN (32-0-0)	lb	$0.26	114.54		$29.49
Herbicide					
Glyphosate (Roundup)	oz	$0.11	72.00		$8.19
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	1.00		$1.97
Broadleaf and Grass Control (Atrazine 4L)	pint	$1.64	4.00		$6.56
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	1.00		$2.19
Adjuvant & Surfactant (Class Act)	oz	$0.08	0.72		$0.06
Drift Control (Interlock)	oz	$0.42	20.00		$8.34
Crop Insurance (65%) 2012	acre	$11.00	1.00		$11.00
Annual Operating Capital	%	0.05000	$58.60		$2.93
Machine Operation					
Mow	acre	$13.80	1.00		$13.80
Air Seeder with Fertilizer	acre	$15.58	1.00		$15.58
Fert. Liq. App	acre	$4.37	1.00		$4.37
Herb App	acre	$5.07	5.00		$25.35
Combine	acre	$22.67	1.00		$22.67
Extra charge for bu/acre > 30	bu	$0.23	-0.44	-$0.10	$0.00
Hauling Small Grains	bu	$0.25	29.56		$7.39
Total Cost					$173.62
Net Return to Land, Overhead, and Mgmt.					$0.18
Net Return for 1/3 acre					$0.06

Budget 3: No-Till Fallow

Dryland No-Till Fallow Enterprise Budget - Grain Only

Wheat-Sorghum-Fallow Rotation

ITEM	Units	Price ($)	Qt.	>20	$/acre
Returns	bu	$0.00	0.00		$0.00
Total Revenue					$0.00
COST					
Herbicide					
Glyphosate (Roundup)	oz	$0.11	48.00		$5.46
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	4.00		$7.87
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	1.00		$2.19
Adjuvant & Surfactant (Class Act)	oz	$0.08	0.48		$0.04
Drift Control (Interlock)	oz	$0.42	12.00		$5.01
Crop Insurance (65%) 2012	acre	$15.00	0.00		$0.00
Annual Operating Capital	%	0.05000	$49.56		$2.48
Machine Operation					
Mow	acre	$13.80	1		$13.80
Air Seeder with Fertilizer	acre	$15.58	0		$0.00
Fert. Liq. App	acre	$4.37	0		$0.00
Herb App	acre	$5.07	3		$15.21
Combine	acre	$21.06	0		$0.00
Extra charge for bu/acre > 30	bu	$0.21	-20.00	-$4.20	$0.00
Fieldwork through Harvesting	acre	$86.67	0		$0.00
Hauling Small Grains	bu	$0.21	0.00		$0.00
Total Cost					$52.04
Net Return to Land, Overhead, and Mgmt.					($52.04)
Net Return for 1/3 acre					($17.35)

Budget 4: Conservation-Reduced Till Wheat

Dryland Conservation-Reduced Wheat Enterprise Budget - Grain Only

2012 Harvest Price Projection
Wheat-Sorghum-Fallow Rotation

ITEM	Units	Price ($)	Qt.	>20	$/Acre
Returns to Wheat	Bu.	$7.01	23.48		$164.59
Total Revenue					$164.59
COST					
Seed	lb	$0.25	60		$15.00
Fertilizer					
11-52-0	lb	$0.31	32		$10.03
UAN (32-0-0)	lb	$0.26	136.84		$35.24
Herbicide					
Broadleaf Control (Dupont Ally XP)	oz	$13.13	0.1		$1.31
Other Chemical					
Drift Control (Interlock)	oz	$0.42	4		$1.67
Crop Insurance (65%) 2012	acre	$15.00	1		$15.00
Annual Operating Capital	%	0.05000	$124.15		$6.21
Machine Operation					
Mow	acre	$13.80	1		$13.80
Sweep Till	acre	$10.64	3		$31.92
Air Seeder with Fertilizer	acre	$15.58	1		$15.58
Fert. Liq. App	acre	$4.37	1		$4.37
Herb App	acre	$5.07	1		$5.07
Combine	acre	$21.06	1		$21.06
Extra charge for bu/acre > 30	bu	$0.21	3.48	$0.73	$0.73
Hauling Small Grains	bu	$0.21	23.48		$4.93
Total Cost					$181.91
Net Return to Land, Overhead, and Mgmt.					($17.32)
Net Return for 1/3 acre					($5.77)

Budget 5: Conservation-Reduced Till Sorghum

Dryland Conservation-Reduced Till Sorghum Enterprise Budget - Grain Only

2012 Harvest Price Projection
Wheat-Sorghum-Fallow Rotation

ITEM	Units	Price ($)	Qt.	>30	$/Acre
Returns to Sorghum	bu	$5.88	29.56		$173.80
Total Revenue					$173.80
COST					
Seed	lb	$1.40	3.00		$4.20
Fertilizer					
11-52-0	lb	$0.31	30.43		$9.53
UAN (32-0-0)	lb	$0.26	114.54		$29.49
Herbicide					
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	1.00		$1.97
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	1.00		$2.19
Drift Control (Interlock)	oz	$0.42	4.00		$1.67
Crop Insurance (65%) 2012	acre	$11.00	1.00		$11.00
Annual Operating Capital	%	0.05000	$50.06		$2.50
Machine Operation					
Mow	acre	$13.80	1.00		$13.80
Sweep Till	acre	$10.64	2.00		$21.28
Air Seeder with Fertilizer	acre	$15.58	1.00		$15.58
Fert. Liq. App	acre	$4.37	1.00		$4.37
Herb App	acre	$5.07	1.00		$5.07
Combine	acre	$22.67	1.00		$22.67
Extra charge for bu/acre > 30	bu	$0.23	-0.44	- $0.10	$0.00
Hauling Small Grains	bu	$0.25	29.56		$7.39
Total Cost					$152.71
Net Return to Land, Overhead, and Mgmt.					$21.09
Net Return for 1/3 acre					$7.03

Budget 6: Conservation-Reduced Till Fallow

Dryland Conservation-Reduced Till Fallow Enterprise Budget - Grain Only

Wheat-Sorghum-Fallow Rotation

ITEM	Units	Price ($)	Qt.	>20	$/acre
Returns	bu	$0.00	0.00		$0.00
Total Revenue					$0.00
COST					
Herbicide					
Glyphosate (Roundup)	oz	$0.11	0.00		$0.00
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	0.00		$0.00
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	0.00		$0.00
Adjuvant & Surfactant (Class Act)	oz	$0.08	0.00		$0.00
Drift Control (Interlock)	oz	$0.42	0.00		$0.00
Crop Insurance (65%) 2012	acre	$15.00	0.00		$0.00
Annual Operating Capital	%	0.05000	$35.08		$1.75
Machine Operation					
Mow	acre	$13.80	1		$13.80
Sweep Till	acre	$10.64	2		$21.28
Air Seeder with Fertilizer	acre	$15.58	0		$0.00
Fert. Liq. App	acre	$4.37	0		$0.00
Herb App	acre	$5.07	0		$0.00
Combine	acre	$21.06	0		$0.00
Extra charge for bu/acre > 30	bu	$0.21	-20.00	- $4.20	$0.00
Hauling Small Grains	bu	$0.21	0.00		$0.00
Total Cost					$36.83
Net Return to Land, Overhead, and Mgmt.					($36.83)
Net Return for 1/3 acre					($12.28)

Budget 7: Conventional Till Wheat

Dryland Conventional Wheat Enterprise Budget - Grain Only					
2012 Harvest Price Projection Wheat-Sorghum-Fallow Rotation					
ITEM	Units	Price ($)	Qt.	> 20	$/Acre
Returns to Wheat	Bu.	$7.01	23.48		$164.59
Total Revenue					$164.59
COST					
Seed	lb	$0.25	60.00		$15.00
Fertilizer					
11-52-0	lb	$0.31	32.00		$10.03
UAN (32-0-0)	lb	$0.26	136.84		$35.24
Herbicide					
Broadleaf Control (Dupont Ally XP)	oz	$13.13	0.10		$1.31
Other Chemical					
Drift Control (Interlock)	oz	$0.42	4.00		$1.67
Crop Insurance (65%) 2012	acre	$15.00	1.00		$15.00
Annual Operating Capital	%	0.05000	$135.74		$6.79
Machine Operation					
Mow	acre	$13.80	1.00		$13.80
Chisel Plowing	acre	$11.69	2.00		$23.38
Tandum Disk	acre	$11.22	2.00		$22.44
Air Seeder with Fertilizer	acre	$15.58	1.00		$15.58
Fert. Liq. App	acre	$4.37	1.00		$4.37
Herb App	acre	$5.07	1.00		$5.07
Combine	acre	$21.06	1.00		$21.06
Extra charge for bu/acre > 30	bu	$0.21	3.48	$0.73	$0.73
Hauling Small Grains	bu	$0.21	23.48		$4.93
Total Cost					$196.39
Net Return to Land, Overhead, and Mgmt.					($31.80)
Net Return for 1/3 acre					($10.60)

Budget 8: Conventional Till Sorghum

Dryland Conventional Till Sorghum Enterprise Budget - Grain Only

2012 Harvest Price Projection
Wheat-Sorghum-Fallow Rotation

ITEM	Units	Price ($)	Qt.	> 30	$/Acre
Returns to Sorghum	bu	$5.88	29.56		$173.80
Total Revenue					$173.80
COST					
Seed	lb	$1.40	3.00		$4.20
Fertilizer					
11-52-0	lb	$0.31	30.43		$9.53
UAN (32-0-0)	lb	$0.26	114.54		$29.49
Herbicide					
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	1.00		$1.97
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	1.00		$2.19
Drift Control (Interlock)	oz	$0.42	4.00		$1.67
Crop Insurance (65%) 2012	acre	$11.00	1.00		$11.00
Annual Operating Capital	%	0.05000	$50.55		$2.53
Machine Operation					
Mow	acre	$13.80	1.00		$13.80
Tandum Disk	acre	$11.22	2.00		$22.44
Air Seeder with Fertilizer	acre	$15.58	1.00		$15.58
Fert. Liq. App	acre	$4.37	1.00		$4.37
Herb App	acre	$5.07	1.00		$5.07
Combine	acre	$22.67	1.00		$22.67
Extra charge for bu/acre > 30	bu	$0.23	-0.44	-$0.10	$0.00
Hauling Small Grains	bu	$0.25	29.56		$7.39
Total Cost					$153.90
Net Return to Land, Overhead, and Mgmt.					$19.90
Net Return for 1/3 acre					$6.63

Budget 9: Conventional Till Fallow

Dryland Conventional Fallow Enterprise Budget - Grain Only					
Wheat-Sorghum-Fallow Rotation					
ITEM	Units	Price ($)	Qt.	>20	$/acre
Returns	bu	$0.00	0.00		$0.00
Total Revenue					$0.00
COST					
Herbicide					
Glyphosate (Roundup)	oz	$0.11	0.00		$0.00
Broadleaf Control (2-4-D Amine 4)	pint	$1.97	0.00		$0.00
Other Chemical					
Adjuvant & Surfactant (Superb HC)	pint	$2.19	0.00		$0.00
Adjuvant & Surfactant (Class Act)	oz	$0.08	0.00		$0.00
Drift Control (Interlock)	oz	$0.42	0.00		$0.00
Crop Insurance (65%) 2012	acre	$15.00	0.00		$0.00
Annual Operating Capital	%	0.05000	$36.24		$1.81
Machine Operation					
Mow	acre	$13.80	1		$13.80
Tandum Disk	acre	$11.22	2		$22.44
Air Seeder with Fertilizer	acre	$15.58	0		$0.00
Fert. Liq. App	acre	$4.37	0		$0.00
Herb App	acre	$5.07	0		$0.00
Combine	acre	$21.06	0		$0.00
Extra charge for bu/acre > 30	bu	$0.21	-20.00	-$4.20	$0.00
Hauling Small Grains	bu	$0.21	0.00		$0.00
Total Cost					$38.05
Net Return to Land, Overhead, and Mgmt.					($38.05)
Net Return for 1/3 acre					($12.68)

Table 1: Profits-Loss with Average Costs with Expected Prices

Profit Avg. C & EP	
No-Till	($34.39)
Conservation	($13.35)
Conventional	($19.07)

Appendix 8: Sensitivity Analysis on Cost, Price, and Yield

Table 1: Without Accounting for Opportunity Cost

No-Till Sensitivity Analysis

	10 Year Low Price		
	HC	AC	LC
Max. Yield	($163.41)	($105.19)	($83.81)
Avg. Yield	($169.87)	($112.01)	($90.87)
Min Yield	($180.92)	($123.05)	($101.92)

	Expected 2013 Price		
	HC	AC	LC
Max. Yield	($59.21)	($1.00)	$20.39
Avg. Yield	($89.53)	($31.67)	($10.53)
Min Yield	($126.50)	($68.63)	($47.50)

	10 Year High Price		
	HC	AC	LC
Max. Yield	($43.28)	$14.93	$36.32
Avg. Yield	($77.65)	($19.78)	$1.35
Min Yield	($118.27)	($60.41)	($39.27)

Conservation-Reduced Till Sensitivity Analysis

	10 Year Low Price		
	HC	AC	LC
Max. Yield	($120.29)	($85.38)	($65.64)
Avg. Yield	($126.75)	($92.19)	($72.70)
Min Yield	($137.80)	($103.24)	($83.75)

	Expected 2013 Price		
	HC	AC	LC
Max. Yield	($16.09)	$18.82	$38.56
Avg. Yield	($46.41)	($11.85)	$7.64
Min Yield	($83.38)	($48.82)	($29.33)

	10 Year High Price		
	HC	AC	LC
Max. Yield	($0.16)	$34.74	$54.48
Avg. Yield	($34.53)	$0.03	$19.52
Min Yield	($75.15)	($40.59)	($21.10)

Conventional-Till Sensitivity Analysis

	10 Year Low Price		
	HC	AC	LC
Max. Yield	($127.86)	($91.08)	($73.00)
Avg. Yield	($134.32)	($97.90)	($80.07)
Min Yield	($145.37)	($108.94)	($91.11)

	Expected 2013 Price		
	HC	AC	LC
Max. Yield	($23.66)	$13.11	$31.20
Avg. Yield	($53.98)	($17.55)	$0.28
Min Yield	($86.83)	($54.52)	($36.69)

	10 Year High Price		
	HC	AC	LC
Max. Yield	($7.73)	$29.04	$47.12
Avg. Yield	($42.10)	($5.67)	$12.16
Min Yield	($82.72)	($46.30)	($28.46)

Table 1: Accounting for Opportunity Cost

No-Till Sensitivity Analysis

	10 Year Low Price		
	HC	AC	LC
Max. Yield	($195.75)	($137.53)	($116.15)
Avg. Yield	($202.21)	($144.35)	($123.21)
Min Yield	($213.26)	($155.39)	($134.26)

	Expected 2013 Price		
	HC	AC	LC
Max. Yield	($91.55)	($33.34)	($11.95)
Avg. Yield	($121.87)	($64.01)	($42.87)
Min Yield	($158.84)	($100.97)	($79.84)

	10 Year High Price		
	HC	AC	LC
Max. Yield	($75.62)	($17.41)	$3.98
Avg. Yield	($109.99)	($52.12)	($30.99)
Min Yield	($150.61)	($92.75)	($71.61)

Conservation-Reduced Till Sensitivity Analysis

	10 Year Low Price		
	HC	AC	LC
Max. Yield	($152.63)	($117.72)	($97.98)
Avg. Yield	($159.09)	($124.53)	($105.04)
Min Yield	($170.14)	($135.58)	($116.09)

	Expected 2013 Price		
	HC	AC	LC
Max. Yield	($48.43)	($13.52)	$6.22
Avg. Yield	($78.75)	($44.19)	($24.70)
Min Yield	($115.72)	($81.16)	($61.67)

	10 Year High Price		
	HC	AC	LC
Max. Yield	($32.50)	$2.40	$22.14
Avg. Yield	($66.87)	($32.31)	($12.82)
Min Yield	($107.49)	($72.93)	($53.44)

Conventional-Till Sensitivity Analysis

	10 Year Low Price		
	HC	AC	LC
Max. Yield	($160.20)	($123.42)	($105.34)
Avg. Yield	($166.66)	($130.24)	($112.41)
Min Yield	($177.71)	($141.28)	($123.45)

	Expected 2013 Price		
	HC	AC	LC
Max. Yield	($56.00)	($19.23)	($1.14)
Avg. Yield	($86.32)	($49.89)	($32.06)
Min Yield	($119.17)	($86.86)	($69.03)

	10 Year High Price		
	HC	AC	LC
Max. Yield	($40.07)	($3.30)	$14.78
Avg. Yield	($74.44)	($38.01)	($20.18)
Min Yield	($115.06)	($78.64)	($60.80)

Table 3: Percentage of the Time Profitable

Percentage of Time Profitable				
Without Accounting for OC			**Accounting for OC**	
No-Till would be profitable	14.81%		No-Till would be profitable	3.70%
Cons. Till would be profitable	25.93%		Cons. Till would be profitable	11.11%
Conv. Till would be profitable	22.22%		Conv. Till would be profitable	3.70%

VITA

Lance Jackson Weaver

Candidate for the Degree of

Master of Science

Thesis: SHOULD WE PAY FARMERS NOT TO FARM? A CASE OF THE CONSERVEATION RESERVE PROGRAM

Major Field: Agricultural Economics

Biographical:

Education:

Completed the requirements for the Master of Science in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in July, 2012.

Completed the requirements for the Bachelor of Science in Agricultural Economics at Sam Houston State University, Huntsville, Texas in 2010.

Experience:

Graduate Research Assistant, Oklahoma State University Department of Agricultural Economics, January 2010 to May 2011;

U.S. House Committee of Agriculture Intern, Washington D.C., August 2011-December 2011

Winfield Solutions Regional Agronomist Trainee, West Texas Summer 20110

Professional Memberships:

Agricultural And Applied Economics Association January 2011-Present

Name: Lance Weaver Date of Degree: July, 2012

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: SHOULD WE PAY FARMER'S NOT TO FARM? A CASE OF THE CONSERVATION RESERVE PROGRAM

Pages in Study: 101 Candidate for the Degree of Master of Science

Major Field: Agricultural Economics

Scope and Method of Study:

The Conservation Reserve Program (CRP) is the United States largest conservation initiative. The program retires over 30 million acres of "marginal" cropland. The programs objectives are to reduce sedimentation, improve water quality, foster wildlife habitat, provide income support for farmers, and protect the nation's long term capacity to produce food and fiber. Recently there have been many advocates to return the program land back to continuous production. It was the main purpose of this study to determine in the case that these lands were returned to production, would the producers assume a profit or loss.

Field level data was taken on 106 different parcels in Western Texas County in Oklahoma. This data was analyzed for nutrient content and used to evaluate differences in CRP and non-CRP land. These differences, if any existed, were taken into account and enterprise budgets were formed for various farming practices. Profit and or loss was determined then a sensitivity analysis was put together on, price received, costs, yield, and farming operation. This analysis was used to determine points of profitability.

Findings and Conclusions:

It was found that many differences existed between CRP and non-CRP land; however the most surprising result was that there was no significant difference in organic matter. Profit was scare in all situations. Under the most profitable tillage practice the producer only saw positive returns 29.63% of the time.

ADVISER'S APPROVAL: Dr. Jody Campiche