CONSERVATION ADOPTION PREFERENCES,

DETERMINANTS OF CONSERVATION PROGRAM

ENROLLMENT AND CONSERVATION ADOPTION IN

OKLAHOMA'S FORT COBB RESERVOIR

WATERSHED


By

BENJAMIN HARLOW TONG
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Thesis  Approved:


Dr. Tracy Boyer

Thesis Adviser

Dr. Larry Sanders


Dr. Arthur Stoecker


Dr. Garey Fox

Outside Committee Member

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Abstract: The first essay (CHAPTER I) found the on-farm and socio-demographic characteristic determinants of agricultural producers' in Oklahoma's Fort Cobb Reservoir Watershed for both conservation program enrollment and the number of conservation practices adopted. A 2014 survey of agricultural producers in the Ft. Cobb Watershed was used. To discover the determinants of program enrollment a logistic model is utilized. To discover the determinants of the number of conservation practices adopted on the farm a poisson model was used. Results indicate that the percent of income derived from farming, farm size, attitudes concerning stewardship or the environment, gender and formal education are important characteristics that play into conservation enrollment decisions. For the number of conservation practices adopted on the farm, the percent of income form farming the experience of the farmer in years, the number of informational sources used for adoption decisions, attitudes concerning the environment and stewardship, and gender are important factors influencing soil and water conservation practice implementation. Policy makers who want to affect enrollment and adoption quickly should focus on more experienced, females who are highly educated producers. If they want to target producers who are not enrolling and adopting frequently they should target younger less experienced male producers.

      The second essay (CHAPTER II) determines the most important to least important benefits or characteristics of a conservation practice during both producers' and non-farming and absentee landowners' conservation adoption decision-making process. A 2014 survey of landowners in the Ft. Cobb reservoir watershed was used. This study utilizes maximum-difference scaling, also called best-worst analysis. Results indicated that the most important reason landowners adopt conservation practices is if a practice benefits the farm ecosystem. The second most important reason for adoption is if the practice improves profit. However, the decision making process for non-farming and/or absentee landowners and landowning agricultural producers are found to be statistically different from one another. This is shown in the order of how the two groups rank the reasons for adopting conservation practices and also the percentage of each group that ranks each benefit as the most important reason for adoption. Results indicate that current incentives are not as attractive for absentee landowners that producers and that different land tenure groups make adoption decisions differently.

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# WATER AND SOIL CONSERVATION PRACTICE ADOPTION IN A HIGHLY EROSIVE WATERSHED: THE CASE OF SOUTHWEST OKLAHOMA'S FT. COBB WATERSHED


## ABSTRACT

Water degradation in watersheds with agricultural production results both from naturally occurring surface runoff and excess nutrient runoff and sedimentation from agricultural production. In-stream, stream bank, and riparian conservation/management practices can reduce sediment loading solely or in conjunction with improved upland practices. Survey results of owners and operators in the Ft. Cobb Reservoir watershed, a highly erosive watershed in southwest Oklahoma with a history of state and federal conservation programs, provide information for improving understanding of landowners and operators likelihood of adoption. Two models of soil and water conservation were estimated, a logit model of the likelihood of adoption and a poisson model analyzing the determinants of the total number of practices adopted. Results reinforced previous literature that showed and highly educated farmers were more likely to enroll in soil and water conservation programs. In addition, to measure the public goods aspect of soil and water conservation, attitudes concerning stewardship and environmental protection are

also increased adoption.  In terms of the total number of practices adopted over time, farming experience, gender, and attitudes towards conservation increase the number of practices adopted.  Older farmers and operators with larger farms are also more likely to adopt multiple practices simultaneously.

**Introduction**

In agricultural landscapes, although agriculture is not the only cause, production practices are a primary source of water quality impairment and reservoir sediment loading (Fallon and Smolen, 1998).  As one of the most erosive watersheds in the Midwestern United States and primary recipient of government soil and water conservation  (SWC) program attempts, the Fort Cobb watershed is ideal for examining the success and failure of programs such as the Conservation Reserve Program (CRP), the Environmental Quality Incentives Program (EQIP), and the Conservation Stewardship Program (CSP).  The Ft. Cobb Reservoir watershed remains impaired for its current listed uses, including municipal water supply and aesthetic uses, due to phosphorus and chlorophyll (Oklahoma Department of Environmental Quality, 2014).  Understanding why producers adopt conservation measures can guide local and federal programmatic efforts to better meet targets for enrollment in programs and in order to foster the implementation of site-specific conservation practices that will help ameliorate the erosion, sediment loading, and other environmental externalities such as eutrophication of downstream reservoirs present in areas such as the Ft. Cobb Reservoir watershed.

The primary objective of this research was to identify determinants of conservation practice adoption and program enrollment for farmers and ranchers in the Ft. Cobb Reservoir watershed.  More specific objectives were to determine how socio-

demographics related to adoption of conservation programs and the total number of conservation practices. Secondly, the paper sought to determine if attitudes concerning stewardship of land oriented toward improving private or public land, habitat, and water quality influenced adoption. Specifically, our hypothesis was that views of the meaning of stewardship or conservation of natural resources differed by operator characteristics and that farmers who value land stewardship as protecting water quality and other benefits including ecosystem services of plants and animals were more likely to adopt soil and water conservation practices. Understanding why agricultural producers decide to implement conservation practices in the Ft. Cobb Reservoir watershed is important for policy makers, so they may craft appropriate policies and incentive programs for landowners such that producers adopt practices that further reduce the downstream pollution costs caused by current land management practices.

**Background**

The Ft. Cobb Reservoir Watershed, covering 314 $mi^2$, is located in southwestern Oklahoma and is an important primary source of water for the municipal population and as a source of irrigation for agricultural producers. In 2007, approximately 88 percent of the land area in the watershed was used for agricultural production or pasture (Garbrecht et al., 2008). Land in the Ft. Cobb Reservoir watershed is comprised of highly erosive, fine sandy loam soils, which even under natural conditions contribute to erosion, sediment loading, stream bank and channel instability. The soils and terrain, combined with current agricultural practices, increase rates of sediment loading in the Ft. Cobb Reservoir and result in excess phosphorus loading and reservoir capacity depletion (Guertault et al., 2016). The continued sedimentation in the Ft. Cobb Reservoir, despite

conservation efforts, demonstrates the need to expand adoption of conservation methods, both privately and publically funded.

Conservation programs in the United States developed from a need to address widespread soil depletion during the Great Depression and dust bowl era of the 1930's (Cain and Lovejoy, 2004). One of the first programs, the Soil Conservation act of 1935, used environmental concerns as a means to provide relief funds for rural communities through agricultural producers (Cain and Lovejoy, 2004). The primary way programs affected agriculture between the 1930's and 1985 was as a system of price supports or supply controls. Basically, early efforts used these means to increase income for farmers, with conservation as a justification. In 1985, the Conservation Reserve Program, was enacted in the Farm Bill and is often considered the first conservation program that was primarily designed to protect agricultural lands. Since then, various other conservation programs such as the Conservation Stewardship Program and the Environmental Quality Incentives Program and others have been developed to provide incentives for further conservation advancements on agricultural lands (Cain and Lovejoy, 2004).

In the United States today, some of the most commonly adopted soil and water conservation programs provided by the federal government are the CRP, EQIP, and CSP. According to the USDA (2015), the CRP provides annual payments for removing a portion of enrolled land from production and installing or maintaining certain plant species that reduce erosion and improve water quality. Producers enrolled in the CSP are given two kinds of payments; one is for installing new conservation methods, and the other is for adopting crop rotation (USDA, 2015). EQIP is a program that dispenses financial and technical assistance to producers to plan and implement conservation

methods through cost sharing (USDA, 2015). Some states such as Minnesota have adopted enhanced conservation programs such as the Conservation Reserve Enhancement Program (CREP) to permanently retire erosion sensitive lands; although there is a program entitled CREP in Oklahoma this program does not permanently retire highly erosive agricultural land (FSA, 2015).

Producers in the Ft. Cobb Reservoir Watershed have followed the national trend by enrolling in conservation programs such as CRP, CSP, and EQIP. Despite the positive effects of these programs, agencies such as the Oklahoma Conservation Commission (OCC), Oklahoma Department of Environmental Quality (OKDEQ), the Natural Resource Conservation Service (NRCS) list this area as a focal point for implementing more effective conservation measures in order to improve water quality. Furthermore, Fort Cobb was named a water quality priority watershed by USEPA for 2001-2007 (Oklahoma Conservation Commission, 2014). In addition, the OCC began a 319 project in 2001 to improve water quality through best management practices such as riparian buffers, pasture management, human waste management and no-till farming with costs split between state funds, federal funds, and landowner cost shares (Oklahoma Conservation Commission, 2014). These programs were focused on cropland conversion rather than other conservation practices such as riparian buffers (Oklahoma Conservation Commission, 2009). Unfortunately, these programs, while effective, have not completely reduced sediment loading in the Ft. Cobb Reservoir such that it can be delisted as impaired according to the Oklahoma Department of Environmental Quality 303d list (Oklahoma Department of Environmental Quality, 2015).

Soil erosion is estimated to cost the United States $37.6 billion in lost productivity per year (Uri 2001). Quantifying downstream and off-farm costs of erosion is more problematic and often requires non-market valuation techniques to value location specific costs (Steiner et al. 1995). In economics, downstream costs as a result of production for which the producer does not pay are termed negative externalities. Since farmers do not compensate society for the direct effects of erosion downstream, policy and government intervention may be appropriate to best protect agricultural output and water quality (Pigou, 1952; Krutilla, 1967; Valentin et al., 2004). Camboni and Napier (1993) assert that an incentive system overhaul is needed to obtain the best practice implementation relative to national goals to get farmers to internalize the costs of the externalities caused by their production practices. Osmond et al. (2012) also find that past attempts at incentivizing agricultural producers to implement conservation practices has not met societal goals for off farm control in some areas of the United States. By examining characteristics and attitudes of farmers who have and have not enrolled in the past, this study informs future tailoring of conservation program incentives, targeting, and marketing.

## Literature Review

Since the early 1980's a substantial amount of literature has focused on the determinants of conservation practice and BMP adoption for agricultural producers (Prokopy et al., 2008; Baumgart-Getz et al., 2012). The literature supports various socio-demographic factors and farm characteristics as determinants of conservation practice adoption such as: the profitability of the practice, land tenure, income, farm size, farming experience, access to informational sources, attitudes about the environment, gender, and education

level (Camboni and Napier, 1993; Cary and Wilkinson, 2008; Prokopy et al., 2008; Tosakana et al., 2010; Baumgart-Getz et al., 2012;  Gedikoglu and McCann, 2012 Druschke and Secchi, 2014).  However, not all studies find the same relationships between adoption and the same determinants.  This may be due to variations in agriculture practices, farmers' attitudes, and farmers' socio-demographic characteristics in different geographic areas (Prokopy et al., 2008; Osmond et al., 2012).  Most studies find that farmers are more likely to implement conservation practices if they believe the practice improves the profitability of their operation (Camboni and Napier, 1993; Cary and Wilkinson, 2008; Tosakana et al., 2010).  However, some conservation practices, such as riparian buffer strips, may decrease profit even though they are good for the environment (Gedikoglu and McCann, 2012).  Since all conservation practices may not improve the profitability of a farm enterprise and the government is the largest source of conservation funding (Wang and Berman, 2014), different economic incentives, often tailored to needs at the local level, may be required to incentivize conservation practice adoption (Osmond et al., 2012; Ribaudo, 2015; Carlisle, 2016).

There is little and conflicting evidence of the effectiveness of non-price mechanisms ability to influence adoption.  Gedikoglu and McCann (2012) argued that attitudes concerning water quality themselves were not important to conservation practice implementation.  Camboni and Napier (1993) found psychological dispositions were inadequate indicators of adoption inferring that moral suasion was at most a marginal factor influencing farmers' decision making process.  They assert that it was unlikely that farmers would adopt practices, even if they believed they should, if there was no perceived chance for profit.  While others suggested farmers' attitudes were important

(Prokopy, 2008), most studies generally failed to make a logical link between attitude measures and adoption (Baumgart-Getz et al., 2012). However, in some cases attitudes and other non-price mechanisms, combined with incentives may tip the balance (Osmond et al., 2012). Osmond et al. (2012) stated that understanding farmers' attitudes concerning conservation practice adoption at a watershed level was important for future conservation implementation. Furthermore, greater economic incentives may be required to incentivize conservation practice adoption at the level needed.

Gould et al. (1989) found older operators were more likely to adopt practices than younger farmers, because older farmers were more likely to have noticed changes in their land. However, in they found some older farmers failed to adopt new and profitable technology for fear of change and the decreased length of the planning horizon for farm operators approaching retirement. Younger, less experienced farmers were more likely to adopt conservation practices even if they did not notice changes in the farm environment, because educational and extension outreach programs may be reaching these younger farmers more efficiently (Gould et al., 1989). Other studies found the opposite to hold true (Prokopy et al., 2008). The age of the producer was found to be negatively related to the adoption of conservation tillage in Oklahoma (Vitale et al., 2011), and was also generally true throughout the rest of the U.S. (Baumgart-Getz et al., 2012).

Education (Traore et al., 1998) and female gender (Druschke and Secchi, 2014) have both been found to positively affect adoption rates. Druschke and Secchi (2014) found that producers who are women are more likely to adopt than men. Although formal education has often been found to affect adoption rates (Prokopy, 2008),

extension outreach educational programs have also been found to be more effective than years of formal education in determining adoption (Baumgart-Getz et al., 2012).

Farm characteristics such as size have been found to affect adoption (Baumgart-Getz et al., 2012; Vitale et al., 2011). However, the effects of farm size on adoption may vary by region and the type of production activity. Land tenure also may affect adoption because producers renting land may have different interests than the actual landowners concerning the productive capacity of the land over time (Boumtje, 1999). Farmers who operate larger proportions of rented land were less likely to adopt (Norris and Batie, 1987). Furthermore, producers who do not own all of their land were less likely to adopt that producers who own all of their land (Varble et al., 2015).

Income levels and income derived from farming were important influences on soil and water conservation (Norris and Batie, 1987; Baumgart-Getz et al., 2012). The percent of income was often included in econometric models to indicate how financially important farming was to the individual (Baumgart-Getz et al., 2012). However, as farmers become more risk averse they may decide to invest in non-farm portfolio options because risk aversion increases with age (Boumtje et al., 2001; Palsson, 1996).

There has been less research concerning the attitudinal determinants of conservation program enrollment. Luzar and Diagne (1999) investigated how attitudes and other sociodemographic factors played into the Wetland Reserve Program (WRP) in Louisiana. They found many of the previously discussed variables were significant determinants of WRP enrollment in Louisiana. In their model they included the previously discussed farm and socio-demographic characteristics and use the theory of

reasoned action perhaps to emphasize attitudinal roles in WRP enrollment. However, utility theory has historically been used as the basis of adoption studies in economics.

**Conceptual Framework and Hypotheses**

The following social demographic characteristics, taken from the literature, are expected to explain both conservation practice enrollment and practice adoption. Land tenure is expected to affect both enrollment and adoption in that the more land one owns relative to the total amount of land they operate, the more likely the producer will be to enroll in a program and adopt. Special provisions on land rent contracts are expected to have a positive effect on both because provisions will cause those renting land from others to adopt or enroll. The larger the farm size the more likely the farmer will adopt or enroll (Rham and Huffman, 1984). Formal education level will have a positive influence on both (Traore et al., 1998). Years farming will have a positive influence on adoption and enrollment. The number of sources of information used for adoption will likely be positively correlated with adoption and enrollment, because people who are more actively researching methods or have attended extension workshops are more likely to both enroll in programs and adopt conservation practices. Females are expected to adopt and enroll more than males, because men have been shown to be less likely to implement conservation practices (Druschke and Secci 2014). As the percent of income from farming rises, enrollment and adoption levels will also increase. Attitudes concerning a producer's beliefs and definition of stewardship will affect adoption and enrollment. Producers who believe stewardship means they should protect more aspects of the environment such as water and habitat , rather than just on farm profitability, will be more likely to adopt a conservation practice or to enroll in a conservation program.

## Materials and Methods

A pilot survey was performed at an irrigation and agricultural extension education conference on August 18, 2014, in Binger, Oklahoma.  Twenty three Oklahoman farmers and ranchers completed the pilot survey.  Using these responses, minor revisions were made in the format of the survey.

No known accessible list of farmers and ranchers in the Ft. Cobb watershed exists, land ownership records were generated  using PvPlus software, which is a product of County Records Incorporated located in Owasso Oklahoma, to identify all privately held agricultural land holdings over 50 acres in the watershed.  A list of 648 current addresses and landowners was identified (PvPlus, County Records Incorporated).

A mail survey was conducted using the Dillman method, without an incentive provided (Dillman et al., 2009).  The mail survey was distributed to 648 people on October 28, 2014 and a post card reminder sent 15 days later on November 11, 2014.  Because the 648 recipients were not necessarily farmers, but rather landowners in the Ft. Cobb watershed, a low percentage of farmer-operators responded.  A second mailing was planned with a revised cover letter indicating that recipients should forward the survey to renter-operators on the land.  On November 24, 2014, the second mail survey was distributed to 641 recipients.  A total of 132 surveys were returned by mail.  Of the returned surveys, 67 respondents indicated they were both agricultural producers and were identified that they operated a farming operation in the Ft. Cobb watershed by the zip code of their agricultural land.

Data from the USDA *Survey of Agriculture* (2012) was used to estimate how representative the responses might be of the watershed.  The Ft. Cobb Reservoir

watershed is located in 3 counties in Oklahoma: Caddo, Washita, and Custer counties. The average farm size listed by the USDA (2012) *Survey of Agriculture* is 615 acres. Since the watershed consists of approximately 284 square miles of agricultural land (Garbrecht et al., 2008), roughly estimated there will be 296 agricultural producers in this area. As a result, an estimated of 22.6% of agricultural producers in the Ft. Cobb Reservoir watershed were reached.

The following farm production characteristic variables and operator demographic characteristics were included in the survey and are given in Table 1.1: conservation program enrollment (CPE) indicated if a producer operated a farm that is enrolled in any conservation program. conservation practice adoption (CPA) represented a count of the number of conservation practices implemented on the farm. CPA was constructed by asking producers to indicate which conservation practices they adopted on their operation. The list of conservation practices included in (CPA) were as follows: livestock restriction or exclusion from stream areas, alternate livestock watering sources, stabilized stream cattle crossings, terraces, streambank stabilization and/or restoration, grass waterways, vegetated buffers, cover crops low-flow irrigation, retention/detention ponds, near stream invasive species management, minimum/no till farming methods, farmland to grass, drop down drains, and crop rotation. Percentage owned of total land farmed (PEROWN) is, in percentage form, the land area a producer owned divided by the area of land he or she operated. The percentage of total income from farming is segmented by percentage bracket ($PERINC_1$, $PERINC_2$, $PERINC_3$, $PERINC_4$) at four levels $PERINC_1$, $PERINC_2$, $PERINC_3$, $PERINC_4$ indicates if the farm family receives less than 30%, 30-49%, 50-79%, and greater than 80% of its total income from farming,

respectively. PEROPPRO is an interaction term with the percentage of acres the producer operates and if there are special provisions for conservation practices within the rental contracts. Total farm revenue is the variable used to indicate farm size and is segmented at 4 levels. $TFR_1$ indicates that the total farm revenue is less than $40,000 per year, $TFR_2$ indicates the total farm revenue falls between $40,000 and $99,999 per year, $TFR_3$ indicates the total farm revenue is between $100,000 and 249,999 per year, and $TFR_4$ indicates the annual total farm revenue is above $250,000 per year.

Attitudes concerning stewardship and conservation are often difficult to measure. In this study, attitudinal variables measured the farm operator's attitudes concerning his or her definition of stewardship. An appropriate measure of attitudes towards the environment was to gauge interest in environmental effects (Kaiser et al., 1996). The attitudinal variable, $ST_1$, represented a producer whose definition of stewardship was to only consider protecting the profitability of his or her land. The attitudinal variable, $ST_2$, indicated that the producer believed that stewardship was more than protecting profit, but also included protection of the land and water quality on the farm. The attitudinal variable, $ST_3$, indicated that the producer defined stewardship as the environmental protection of land, water, and flora and fauna. The last category represented a farmer who valued protecting not just on farm land and water, but plants and wildlife. The survey question from which attitudinal variables were derived is included in Figure 1.1.

The variable, INFOSOURCES, indicated the number of sources used by that producer when making conservation adoption decisions. This was a count of the number of sources used such as extension fact sheets, extension seminars, soil and water testing, asking a friend or neighbor, attending field days, utilizing the private sector, and web

sites. Sociodemographic and characteristic variables included the numbers of years of farming experience (YF) and gender (GEN). Educational variables included were as follows: $ED_1$ represented producer whose highest level of education attained was a high school diploma or less, $ED_2$ indicated that highest level of educational attainment was a bachelor's degree and $ED_3$ represented a producer who had completed a graduate degree. The variable name, description, and expected effect on adoption are included in Table 1.1.

### Empirical Models

Two model types were used for data analysis. The first model is named the enrollment model to estimate what farm and sociodemographic characteristics affected enrollment in conservation programs. In the Enrollment Model, a logit model was used where the dependent variable takes the value of one if the producer was enrolled in a conservation program, and zero if the producer is not enrolled in a conservation program. The second model is called the Count Model and it estimated the determinants of the total number of practices undertaken by operators. In the Count model, the dependent variable was a count of the total number of conservation practices that producers have adopted, and was estimated as a Poisson model (Nkegbe and Shankar, 2014).

*Enrollment Model*

In the Enrollment model the dependent variable was defined as binary where it takes the value of one if the producer had enrolled in any conservation program and zero otherwise (Greene, 1997). Therefore, let $Y_e$ and $Y_{ne}$ represent the utility derived from a producer's choice to enroll in a conservation program or not enroll in a conservation program, respectively. Now the utility may be described as $U^a$ and $U^b$, where $U^a$ is equal to $Y_e$ and

$U^b$ is equal to $Y_{ne}$. This implied that the $i^{\text{th}}$ observed indicator equaled 1 if and only if $U^a$ > $U^b$, which indicated program enrollment, and 0 if and only if $U^a \leq U^b$, which indicated no enrollment. This relationship was linearized as:

$$U^a = \beta_a X + \mathcal{E}_a \quad \text{and} \quad U^b = \beta_b X + \mathcal{E}_b \tag{1}$$

Where $\beta_a$ and $\beta_b$ are the vectors of the parameter estimates associated with the variables contained in the $X$ matrix and $\mathcal{E}_a$ and $\mathcal{E}_b$ are the error terms. Then, if $Y=1$ is defined as the $i^{\text{th}}$ producer's enrollment in a conservation program:

$$\text{Prob}[\, Y = 1 \mid X] = \text{Prob} \, [\, U^a > U^b] \tag{2}$$

now with substitution:

$$\text{Prob}[\beta_a X + \mathcal{E}_a - \beta_b X - \mathcal{E}_b > 0 \mid X] \tag{3}$$

which simplifies by factorization to:

$$\text{Prob}[(\beta_a - \beta_b)X + \mathcal{E}_a - \mathcal{E}_b > 0 \mid X] \tag{4}$$

Now let $\beta = \beta_a - \beta_b$ and $\mathcal{E} = \mathcal{E}_a - \mathcal{E}_b$:

$$\text{Prob}[(\beta X + \mathcal{E}) > 0 \mid X] = F(XB) \tag{5}$$

where the cumulative distribution function of the model is represented by $F(XB)$.

Since the error terms were assumed to follow the logistic cumulative distribution, the logit model was an appropriate econometric method to apply for the enrollment model. The logit model may be written generally as:

$$P(Y= 1) = \frac{e^{(X'\beta)}}{1+ e^{(X'\beta)}} \tag{6}$$

where X represents the matrix of independent variables and $\beta$ represents a vector of the associated regression coefficients that affect the likelihood of program enrollment. Two versions of the enrollment model were included in the analysis. The first included

attitudinal variables and the second excluded attitudinal variables while keeping all other variables from the first model.

## *Count Model*

To investigate determinants of conservation practice adoption over time in the Fort Cobb Reservoir Watershed a Count Model was estimated using a Poisson model(Nkegbe and Shankar, 2014; Mbaga-Semgalawe and Folmer, 2000). Since this variable takes on a discrete count of conservation practices adopted by a producer farm, this variable represented the total number of conservation practices adopted by each producer. Since this model followed the Poisson distribution it may be written as:

$$\text{Prob}[\ Y_i = y_i \mid x_i] = \frac{e^{-\lambda_i}\lambda^{y_i}}{y_i!}, \ \ \lambda_i \in \mathbf{R}^n \ , \ y_i = 0,1,2,3,\ldots \tag{7}$$

where the mean number of conservation practices implemented is $\lambda$ and $y_i$ represented the number of conservation practices adopted by the $i^{th}$ farm (Kutner et al., 2008). The matrix of independent or explanatory variables is represented by the matrix X; therefore the farm and sociodemographic characteristics of $x_i$ represents the characteristics of the $i^{th}$ farm and operator.

## Results and Discussion

Descriptive statistics for the sample are given in Table 1.2. Since respondents sometimes failed to fill in all questions missing observations in the data set were filled in as follows. The missing entry for percentage of income from farming was filled in as the mode of the responses for that question, which was less than 30 percent of total income. The mean of the responses for years farming was substituted for three missing entries in that category. Education was missing for five responses, indicating that some of the respondents may be

sensitive to this question; therefore, the respondents who did not complete this question were assumed to represent producers who completed high school.

The survey sample data indicated the sample population had an average farm size of approximately 1054 acres and the average amount of farmland owned by the farmer was 627 acres (Table 1.2). The average number of years farming experience was 32.7 years and approximately 10% of the respondents were female. Also 94% of the respondents identified their race to be Caucasian, 4.5% identified they were Native American, and 1.5% did not respond to this question. In order to examine if the sample data was representative of the population, the survey data was compared to summary statistics from the USDA's *Census of Agriculture* (2012) for Caddo, Washita, and Custer Counties. According to the USDA in 2012, the average total farm revenue was $107,906 per year. USDA reported the average age of a producer was 57 years and 95.9% of the farming population was Caucasian, 3.3% were Native American, 0.8% identified as another race, and 7.4% were female. The average farm size in acres for these three counties was 615 acres. Overall, the survey data from the Ft. Cobb Reservoir watershed included farms that were larger than the average farm size indicated in the USDA *Survey of Agriculture* (2012) both farm size measures: total farm revenue and farm size in acres. Females are over represented by 3 percent. If it is assumed that the average age of a producer beginning to farm is 23 years of age after college, then farming experience and average farming age were similar in number between the sample and the USDA statistics. The distribution of race was also similar to the distribution given in the *Census of Agriculture* (2012).

***Enrollment Model Results and Discussion***

The Enrollment Model estimation results are given in Table 1.3. Several variables in the enrollment models with and without attitudinal variables were significant and have the expected sign; furthermore, the Pseudo $R^2$ value for the model including attitudinal variables was higher than the model that excluded attitudinal variables and both of the attitudinal variables were significant. However, the likelihood ratio test statistic was 0.519 with two degrees of freedom, indicating that the models were not significantly different concerning explanatory power. Since the Pseudo $R^2$ value was higher in model 1, which included attitudes, which included attitudes this model will be discussed.

The results of the logistic regression are interpretable only by the sign or direction of effect on adoption (Table 1.3). The log-odds table combined with the signs from the logistic regression output shown in Table 1.4 allows for not only directional relationship interpretations, but also for interpretation of the magnitude of the effect of changes in that variable compared to those not in that category.

Using the log-odds results and the corresponding signs for the logistic regression coefficients in the enrollment model the significant determinants in the Enrollment Model had the following effects on conservation program enrollment. The percent of income derived from farming activities ($PERINC_2$) was significant at the 90% confidence level. The percent of total income derived from farming activities may be thought of as a measure of the financial importance of farming for the producer. In this instance producers who receive between 30% and 50% of their total income from farming are approximately 6 times more likely to enroll in a conservation program than farmers who receive less than 30% of their income from agriculture. Total farm revenue ($TFR_4$) had an expected positive sign and was significant at the 90% confidence level. Total farm

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revenue was used as the measure of farm size; therefore, this indicates that the larger farms which have annual receipts above $250,000 are approximately 10 times more likely to enroll in conservation programs compared to farms with annual total farm revenue below $40,000 per year.

Attitudinal variables were significant in the enrollment model. Because definitions are subjective, the language for the question from the survey that defines attitudes concerning stewardship from the survey is included in Figure 1.1. In essence, $ST_1$ represents a producer only concerned with profitability and no other extraneous effect of their production activities on the bottom line. $ST_2$ represents the mindset of producers who believe that taking care of the overall environmental quality of their farm is their responsibility to ensure the future productive continuity although it may affect profit. $ST_3$ represents a producer who is concerned both with about protecting on farm resources, but also includes ecosystems and fauna. The results of the enrollment model indicated both of the attitudinal variables ($ST_2$ and $ST_3$) are significant at the 95% and 90% confidence level respectively. Furthermore, both variables had an expected positive sign, indicating that stewardship attitudes were important to farmers who make enrollment decisions. The $ST_2$ variable indicates that farmers who define stewardship as also protecting water resources in addition to maintaining on farm profitability, were approximately 12 times more likely to enroll in conservation programs than those who view stewardship to mean only protecting the profitability of their operations. Furthermore, farmers in the $ST_3$ category are concerned with protecting ecosystem benefits. This indicated they believe stewardship should include protecting wildlife. This implies farmers who agree with the statement group may value external benefits of

conservation more highly than farmers in other groups. These producers are approximately 15 times more likely to enroll in a conservation program than producers only concerned with protecting the profitability of their land.

The coefficient for gender (GEN) was significant at the 95% confidence level and had a positive sign. This indicated that female agricultural producers were approximately 20 times more likely than men to enroll their land in conservation programs. Education levels ($ED_2$, $ED_3$) were also significant at the 90 and 95% confidence levels, respectively, and both had a positive sign. This shows increased enrollment in conservation programs for both groups relative to the comparison group, those with only high school education. Producers whose highest level of formal education attained is an undergraduate degree are approximately 4 times more likely to enroll in conservation programs than those who have completed high school or have not achieved a high school diploma. Producers who have completed a master's degree or higher are about 6 times more likely to enroll in a conservation program compared to those who have only completed high school.

### Count Model Results and Discussion

The results of the count model estimating the determinants of the number of conservation practices undertaken are given in Table 1.5. The Count model uses the same independent variables as the logit model (Table 1.5). The independent variables represent factors that may increase or decrease a farmer's likelihood of adoption over time. Again the regression coefficients were not directly interpretable except the sign of the coefficient, which indicated whether the variable had a positive or negative affect on practice adoption. However, the marginal effects derived from the adoption model allowed for more meaningful interpretation. The marginal effects of the count model are given in

Table 1.6 and may be interpreted as the effect of a one unit change in the count of adopted practices per unit change in the independent variable, all other factors held constant.

In the count models the likelihood ratio test statistic of 0.05 also indicated the two models were not significantly different from one another. The adoption model with attitudes (model 3) is discussed. In the modelling framework of the count models, many of the determinants had a significant effect on the number of conservation practices adopted including the percent of income from farming, years of farming experience, the number of sources used when making adoption decisions, attitudes, and gender.

All of the percent of income from farming variables (PERINC$_2$, PERINC$_3$, PERINC$_4$) were significant at the 95, 99, and 99% confidence levels, respectively, and had a positive sign in the model. Since the percent of income variables are dummy variables they are compared to the dropped variable in this category which is farmers who received less than 30% of their total income from production activities. Therefore, the mean count of conservation practices adopted on farms where producers received between 30-49% of their income from agricultural production increased by approximately three practices per operation compared to producers receiving less than 30% of their income from farming. Likewise, producers receiving between 50-80% and more than 80% of their income from farming are likely to adopt approximately three and two more practices on their farms than the base group, respectively.

The number of years a producer has farmed (YF) was significant at the 95% confidence level and positively associated with adoption levels. For every one year increase in farming experience the number of practices adopted also increased by

approximately 0.044 practices, likely indicating the more experience a farmer has the more likely they are to have noticed that new and improved conservation practices work. The number of sources used to make adoption decisions (NS) also had the expected positive sign and was significant at the 99% confidence level; the more a farmer seeks information concerning adoption the more likely he or she is to actively try to protect the soil and water on the land. For every informational source utilized by a producer the number of practices adopted increased by approximately 0.6 practices per informational source.

Producer's attitudes concerning stewardship ($ST_2$ and $ST_3$) towards agricultural practices and their effect on the environment are found to be significant at the 99% and 95% confidence levels respectively and to have the expected positive sign. These two attitudinal variables are compared to producers who take the attitude that stewardship means only protecting the profit continuity of their farms. Producers who take the position that stewardship means protecting the water resources, including water quality on their farm, adopt 3.9 more conservation practice types on average. Producers who believe that including the welfare of wildlife in their definition of stewardship, adopt an average of 3.7 more practices on their operation than those who are only concerned with protecting the profit of their farm business.

Finally, gender (GEN) had the expected sign, and was significant at the 95% confidence level. Females were more likely to adopt than males and adopt on average two to three more conservation practices on their farm than men.

### Summary and Conclusions

Many of the expected results proved true, i.e, higher revenue farms, farmers with greater education and more land ownership all were more likely to enroll in conservation programs. Farms with higher total farm revenues were more likely to enroll. Female farmers were more likely to enroll in conservation programs than male farmers and the higher the level of education attained is a strong indicator of program enrollment. The percentage of land owned that is operated by the farmer, the percentage of land that is rented with special provisions placed on the land, number of informational sources used during adoption decisions, and percentage of total income derived from farming proved insignificant factors affecting program enrollment.

Like most studies the more educated producers are more likely to enroll. If agencies wish to increase program enrollment quickly they may wish to target these producers who have a higher level of education with new or expanded programs. However, if agencies goals are to increase new enrollment for groups that do not enroll frequently, they may wish to target male producers who have not completed a college degree.

Because the count model estimates the determinants of the number of practices total that farmers implemented, regardless of program enrollment, we can determine that income, information, and attitudes matter. The percent of total income from farming operations, years of farming experience, number of outside sources used for adoption decisions, attitudes concerning adoption, and gender. The factors that proved insignificant in their effect on total number of practices undertaken were the percentage of land that is owned that a farmer operated, the percentage of land that is rented with special provisions placed on the land, total farm revenue in general, and education level.

The last two findings, revenue and education are counter to the adoption of formal programs model and may point to an educational and capital investment barrier to formal investment in practices.  More incremental practices may be more accessible to farmers with smaller operations and less education, suggesting an avenue for marketing extension education to this group in particular.

The count model demonstrated that Oklahoma State University Extension education materials are influential factors contributing to increasing the number of conservation practices on the farm (Table 1.5).  This information is encouraging in that, considered along with other parts of this multidisciplinary project, educational efforts will likely affect farmers' adoption decisions in this area that use conservation educational resources and possible site-specific programs designed to improve new conservation practice efficacy.

Agencies concerned with increasing adoption rates quickly should target older producers and also increase the amount of outreach programs available.  If the goal is to increase adoption rates for producers who do not already adopt frequently they should target producers who are younger and receive a small portion of their total income from farming.

Avenues for continuing research may include absentee and non-farming landowners.  When receiving the responses to the survey, it was evident almost half of the landowning respondents in the Ft. Cobb watershed are absentee and/or non-farming landowners.  In the literature there is only a small body of research concerning absentee landowners and their preferences concerning natural resource conservation.  Simply based on observation of the raw data 76 respondents were non-farmers or absentee

landowners.  Only 21 of these non-farming or absentee landowners place special

provisions on the rental contracts of their land concerning conservation practices.  Only

about 16.7% of absentee landowners form the survey enroll in a conservation program.

This may indicate that educational efforts to inform absentee landowners in compromised

watersheds are not understood or not reaching the right audience.  Therefore, future

research concerning the Ft. Cobb watershed, and even the larger Red-Washita watershed

for which Ft. Cobb is a part, may need to investigate non-farming and absentee

landowners and the way they make decisions concerning contracts for renters operating

on their land.  Using this research may help inform programs like agricultural law

extension training programs with landowners to aid in increasing awareness about how to

craft and enforce provisions in rental contracts to ensure that renters maintain current

conservation practices and cooperatively enroll in future opportunities where possible.

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**Table 1.1.**
**Variable description and expected effect on program adoption or soil water conservation practices undertaken**

| Variable | Variable Description | Expected effect on adoption and program enrollment |
|---|---|---|
| CPE | If enrolled in a conservation program then 1=yes, 0 otherwise | Dependent variable for the logit model |
| CPA | Count of the number of practices adopted | Dependent variable for the Poisson Model |
| PEROWN | Percent of acres of land owned/operate | + |
| PEROPPRO | Percent of acres operated that are rented interacted with provisions on rental contracts | + |
| $PERINC_1$ | If income from farming is less than 30% of total income, 1=yes, 0 otherwise | Comparison dummy variable (dropped) |
| $PERINC_2$ | If income from farming is between 30% and 49% of total income, 1=yes, 0 otherwise | + |
| $PERINC_3$ | If income from farming is between 50% and 80%, of total income, 1=yes, 0 otherwise | + |
| $PERINC_4$ | If income from farming is above 80% of total income, 1=yes, 0 otherwise | + |
| $TFR_1$ | If total farm revenue is less than $40,000 per year, 1=yes, 0 otherwise | Comparison dummy variable (dropped) |
| $TFR_2$ | If total farm revenue is between $40,000 and $99,999 per year,1=yes, 0 otherwise | + |
| $TFR_3$ | If total farm revenue is between $100,000 and $249,999 per year, 1=yes, 0 otherwise | + |
| $TFR_4$ | If total farm revenue is more than $250,000 per year, 1=yes, 0 otherwise | + |
| YF | Number of years of farming experience | + |
| INFOSOURCES | Count of the number of sources used for adoption decisions | + |
| $ST_1$ | If stewardship means only protecting profit, 1=yes, 0 otherwise | Comparison dummy variable (dropped) |

| | | |
|---|---|---|
| $ST_2$ | If stewardship means protecting profit and water resources, 1=yes, 0 otherwise | + |
| $ST_3$ | If stewardship means protecting flora, fauna, water and profit, 1=yes, 0 otherwise | + |
| GEN | 1 if female, 0 if male | Females are more likely than males to adopt and/or enroll |
| $ED_1$ | If the highest education level achieved is high school or less, 1=yes, 0 otherwise | Comparison dummy variable (dropped) |
| $ED_2$ | If the highest level of education achieved is an undergraduate degree, 1=yes, 0 otherwise | + |
| $ED_3$ | If the highest level of education achieved is a graduate or professional degree, 1=yes, 0 otherwise | + |

**Table 1.2.**
**Descriptive Statistics of Fort Cobb Reservoir Watershed Operators N=67**

| Variable* | Mean | Std. Dev. | Min | Max | Count |
|---|---|---|---|---|---|
| CPE | 0.55 | 0.5 | 0 | 1 | 37 |
| CPA | 5.045 | 3.15 | 0 | 14 | 67 |
| PEROWN | 84.81 | 74.5 | 0 | 566.67 | 67 |
| PEROPPRO | 12.55 | 24.2 | 0 | 100 | 67 |
| $PERINC_1$ | 0.4 | 0.49 | 0 | 1 | 10 |
| $PERINC_2$ | 0.15 | 0.36 | 0 | 1 | 8 |
| $PERINC_3$ | 0.12 | 0.33 | 0 | 1 | 22 |
| $PERINC_4$ | 0.33 | 0.47 | 0 | 1 | 23 |
| $TFR_1$ | 0.34 | 0.48 | 0 | 1 | 23 |
| $TFR_2$ | 0.21 | 0.41 | 0 | 1 | 14 |
| $TFR_3$ | 0.19 | 0.4 | 0 | 1 | 13 |
| $TFR_4$ | 0.25 | 0.44 | 0 | 1 | 17 |
| YF | 32.7 | 16.76 | 3 | 67 | 67 |
| INFOSOURCES | 3.73 | 2.54 | 0 | 9 | 67 |
| $ST_1$ | 0.12 | 0.33 | 0 | 1 | 8 |
| $ST_2$ | 0.69 | 0.47 | 0 | 1 | 46 |
| $ST_3$ | 0.19 | 0.4 | 0 | 1 | 13 |
| GEN | 0.1 | 0.31 | 0 | 1 | 67 |
| $ED_1$ | 0.4 | 0.49 | 0 | 1 | 27 |
| $ED_2$ | 0.33 | 0.47 | 0 | 1 | 22 |
| $ED_3$ | 0.27 | 0.45 | 0 | 1 | 18 |

**\*Refer to Table 1.1 for variable definitions.**

**Table 1.3.**
**Logit Estimates for the Enrollment Model (Dependent Variable, Enrollment=1, 0 otherwise, N=67)**

| Variable | Model 1 With Attitudes | Model 2 Without Attitudes |
|---|---|---|
| Intercept | -5.4924*** | -2.4345** |
|  | (2.0278) | (1.1426) |
| PEROWN | -0.000276 | -0.00023 |
|  | (0.00426) | (0.004) |
| PEROPPRO | 0.006 | 0.00702 |
|  | (0.0135) | (0.0129) |
| $PERINC_2$ | 1.8294* | 1.1665 |
|  | (1.0936) | (0.9569) |
| $PERINC_3$ | -1.9130 | -1.5296 |
|  | (1.3274) | (1.1932) |
| $PERINC_4$ | -1.4136 | -0.894 |
|  | (1.1325) | (1.0519) |
| $TFR_2$ | 1.8001 | 0.8676 |
|  | (1.135) | (0.9422) |
| $TFR_3$ | 1.6955 | 1.0541 |
|  | (1.2027) | (1.0889) |
| $TFR_4$ | 2.3059* | 1.4612 |
|  | (1.3106) | (1.2306) |
| YF | 0.035 | 0.0274 |
|  | (0.029) | (0.0202) |
| INFOSOURCES | 0.029 | 0.0276 |
|  | (0.1547) | (0.1424) |
| $ST_2$ | 2.5239** | - |
|  | (1.2519) | - |
| $ST_3$ | 2.6904* | - |
|  | (1.448) | - |
| GEN | 2.9889** | 2.4374* |
|  | (1.3735) | (1.2736) |
| $ED_2$ | 1.4742* | 1.4778* |
|  | (0.8519) | (0.7751) |
| $ED_3$ | 1.7340** | 1.6264* |
|  | (1.7340) | (0.8396) |
| N | 67 | 67 |
| -2 Log L | 92.149 | 92.149 |
| Pseudo $R^2$ | 0.2816 | 0.2252 |

**\*, \*\*, \*\*\* represent the 90%, 95%, and 99% confidence levels, respectively.**
**Standard errors are in parentheses.**

**Table 1.4.**
**Odds Ratio Estimates for the Enrollment/Logit Model (N=67)**

| Variable | Model 1<br>With Attitudes | Model 2<br>Without Attitudes |
|---|---|---|
| PEROWN | 1.00 | 1.00 |
| PEROPRO | 1.01 | 1.01 |
| $PERINC_2$ | 6.23* | 3.21 |
| $PERINC_3$ | 0.15 | 0.22 |
| $PERINC_4$ | 0.24 | 0.41 |
| $TFR_2$ | 6.05 | 2.38 |
| $TFR_3$ | 5.45 | 2.87 |
| $TFR_4$ | 10.03* | 4.31 |
| YF | 1.04 | 1.03 |
| INFOSOURCES | 1.03 | 1.03 |
| $ST_2$ | 12.48** | - |
| $ST_3$ | 14.74* | - |
| GEN | 19.87** | 11.44* |
| $ED_2$ | 4.37* | 4.38* |
| ED3 | 5.66* | 5.09* |

**\*, \*\*, \*\*\* represent the 90%, 95%, and 99% confidence levels, respectively.**

**Table 1.5.**
**Poisson Model Estimates for the Total Count of Conservation Practices Adopted (# Practices Adopted as Dependent Variable) N=67**

| Variable | Model 3 With Attitudes | Model 4 Without Attitudes |
|---|---|---|
| Intercept | -0.2739 | 0.5168** |
| | (.3496) | (0.2371) |
| PEROWN | 0.0005 | 0.0004 |
| | (0.0008) | (0.0008) |
| PEROPPRO | -0.0005 | 0.0017 |
| | (0.0028) | (0.0025) |
| PERINC$_2$ | 0.5659*** | 0.4024** |
| | (0.1913) | (0.1839) |
| PERINC$_3$ | 0.5468** | 0.6000*** |
| | (0.2175) | (0.2166) |
| PERINC$_4$ | 0.4016* | 0.5899*** |
| | (0.2093) | (0.2081) |
| TFR$_2$ | 0.2933 | 0.0621 |
| | (0.1943) | (0.1759) |
| TFR$_3$ | -0.0250 | -0.3118 |
| | (0.2429) | (0.2281) |
| TFR$_4$ | -0.3191 | -0.5562** |
| | (0.2504) | (0.2416) |
| YF | 0.0088** | 0.0094** |
| | (0.0039) | (0.0038) |
| INFOSOURCES | 0.1207*** | 0.0964*** |
| | (0.0300) | (0.0278) |
| ST$_2$ | 0.7716*** | - |
| | (0.2336) | - |
| ST$_3$ | 0.5512** | - |
| | (0.2462) | - |
| GEN | 0.4626** | 0.3288* |
| | (0.1920) | (0.1862) |
| ED$_2$ | 0.0051 | 0.1236 |
| | (0.1583) | (0.1547) |
| ED$_3$ | 0.2761 | 0.3724** |
| | (0.1752) | (0.1706) |
| Pearson Chi-Square | 81.6065 | 90.1773 |
| Log Likelihood | 238.7838 | 232.4452 |
| Full Log Likelihood | -148.7868 | -155.1254 |
| AIC | 329.5736 | 338.2508 |

**\*, \*\*, \*\*\* represent the 90%, 95%, and 99% confidence levels respectively.**
**Standard errors are in parentheses.**

**Table 1.6.**
**Marginal Effects of Count Model (Poisson Model, # Practices adopted as dependent variable)**

| Variable | Model 3 With Attitudes | Model 4 Without Attitudes |
|---|---|---|
| Intercept | -1.382 | 2.601** |
| PEROWN | 0.003 | 0.002 |
| PEROPPRO | 0.003 | 0.009 |
| $PERINC_2$ | 2.855*** | 2.030** |
| $PERINC_3$ | 2.758** | 3.027*** |
| $PERINC_4$ | 2.026* | 2.976*** |
| $TFR_2$ | 1.480 | 0.313 |
| $TFR_3$ | -0.126 | -1.573 |
| $TFR_4$ | -1.610 | -2.806** |
| YF | 0.044** | 0.047** |
| INFOSOURCES | 0.609*** | 0.486*** |
| $ST_2$ | 3.893*** | |
| $ST_3$ | 3.780** | |
| GEN | 2.521** | 1.659* |
| $ED_2$ | 0.026 | 0.624 |
| $ED_3$ | 1.393 | 1.879** |

**\*, \*\*, \*\*\* represent the 90%, 95%, and 99% confidence levels respectively.**

**Figure 1.1 Attitudinal and Stewardship Variable Survey Question**

Which Statement best defines land stewardship for you?

- o    a) Environmental protection of your land including flora and fauna

- o    b) Sustaining the profitability of your land

- o    c) Conservation of land and water quality of your land

- o    Both a and b

- o    Both b and c

- o    Both a and c

- o    All choices a, b, and c

CHAPTER II


EXTERNALITIES, PROFIT, AND LAND STEWARDSHIP: CONFLICTING
MOTIVES FOR SOIL AND WATER CONSERVATION ADOPTION AMONG
ABSENTEE LANDOWNERS AND LAND-OWNING PRODUCERS

**Abstract**

This research aims to illicit non-framing absentee landowners' and producers
preferences for the benefits and characteristics derived from conservation practices
during adoption decisions.  Maximum difference scaling, also called best-worst scaling,
was used to rank the most important to least important benefits and characteristics of a
conservation practice during the adoption decision-making processes of both groups.  The
two groups we shown to have ranked and valued the attributes and reasons for adoption
of conservation practices differently by using a log likelihood ration test which prove
significant at the 95% significance level.  Producers ranked "practice benefits the farm
ecosystem" as the most important consideration when making conservation practice
decisions on their operation 29.7% of the time.  This was followed by the attribute,
"practice improves profit," chosen as the most favored reason by 29.4% of producers.
Non-farming/absentee landowners ranked "practice benefits the farm ecosystem" as the
most important factor 33.4% of the time, but they choose "practice improves profit" only
23.4%.  This difference, combined with variations in the rankings of the reasons for

adopting conservation practices between the two groups, reinforced the importance of land tenure in decision making.  This indicated the need for both new extension educational efforts and economic incentives aimed at tenant farmers to reduce negative externalities from sediment loading and eutrophication that could be ameliorated by increased adoption of soil and water conservation practices.

## Introduction

The United States Department of Agriculture (USDA) estimates that by the year 2050, agricultural output must increase 60% from current levels in order to feed an estimated world population of 9 billion people (USDA, 2015).  However, increases in production in erosive watersheds may result in increased non-point source pollution (NSP), sediment loading, and eutrophication of lakes and reservoirs downstream from agricultural production (Fallon and Smolen, 1998).  This is primarily caused by NSP pollution and erosion generated from current agricultural practices.  Increased downstream pollution from agricultural practices often imposes costs on users such as downstream recreationists or municipal users of water.  When producers fail to pay for these costs it is termed a negative externality (Tietenberg, 2003).  The principal approach in the United States toward NSP from agricultural lands that occur at multiple sites along the landscape has been to subsidize adoption of conservation practices or provide payments for land retirement, rather than taxing inputs such as nitrogen and fertilizer (Shortle and Horan, 2001).

Since the Great Depression and dust bowl era the United States has used several conservation programs.  However, until 1985 these programs used natural resource conservation as an excuse to provide financial support to rural areas through agricultural

producers.  During this era the government primarily used price supports and methods of controlling supply to accomplish provide this support to rural communities.  In 1985 the CRP was developed and is often considered the first program that focuses on natural resource conservation seriously (Cain and Lovejoy, 2004). Currently, to address environmental concerns such as water quality impairment and on-farm erosion, states and the U.S. federal government employ a variety of conservation programs such as the Conservation Reserve Program (CRP), Conservation Stewardship Program (CSP), and Environmental Quality Incentives Program (EQIP).  These programs may retire land from production, provide monetary incentives, cost-share payments and/or technical assistance to land-owners and producers so they will adopt conservation practices or retire land from production.  These programs have been effective in reducing nutrient loading and erosion in some areas of the United States (Osmond et al., 2012).  However, in areas where water bodies are listed as impaired, such as the Ft. Cobb Reservoir Watershed (Oklahoma Department of Environmental Quality, 2015), site-specific methods and programs must be explored to meet local goals (Osmond et al., 2012). Understanding what benefits from practices are preferred is vital to provide more effective conservation policies and land tenancy agreements.  This will help develop policy to target both producers and non-farming/absentee landowners.

The main objective of this study was to determine, rank, and discover the relative importance of the reasons farm operators' and absentee landowners' adopt conservation practices.  To discover the importance of the preferences for these two groups, best-worst scaling or maximum difference scaling was used (Finn and Louviere, 1992).  This method conducted using to six common reasons for adoption of conservation practices

ranging from profit motivations to altruistic intentions for protection of off farm ecosystems.  The second objective is to discover if non-farming/absentee landowners (NFAL) rank the reasons for conservation practice adoption differently than agricultural producers.  This paper adds to the literature by using the best-worst methodology to rank and compare conservation and stewardship ranking values for the first time. In addition, it is used to examine differences in values that drive adoption of conservation measures between absentee-landowners and agricultural producers.

## Background

The Ft. Cobb Reservoir Watershed (FCRW) of Southwestern Oklahoma consists of 314 square miles, and is part of the larger Red-Washita watershed.  As of 2005, approximately 89% of the FCRW land area was devoted to the agricultural production of row crops such as wheat, other grains, peanuts, cotton, and pasture (Starks et al., 2011). The soils in the FCRW consist of fine sandy loam soils which are highly erosive; these soil characteristics together with current agricultural practices on upland areas increase erosion, sediment loading, stream bank and channel instability, which in turn contribute to sediment loading and eutrophication in the Ft. Cobb reservoir (Guertault, et al., 2016).

To offset erosion in the Ft. Cobb Reservoir Watershed, a series of conservation programs and practices have been deployed (Oklahoma Conservation Commission, 2014).  The federal government offers conservation programs such as CRP, CSP, or EQIP to offset production losses or expenses for retiring marginally productive lands or adopting new tillage or cropping systems.  Those farms enrolled in CRP receive annual payments for the adoption of conservation practices, such as planting native plant species or using conservation tillage to reduce erosion, or payments to retire land from

production.  Farms enrolled in EQIP are given financial and technical assistance when planning and adopting conservation methods (USDA, 2015).  Farms enrolled in the CSP may receive two payment types: one is for adopting less erosive crop rotations; the other is for adopting new conservation methods (USDA, 2015).  The survey sample shows that landowners and non-farming/absentee landowners in the FCRW are most commonly enrolled in CSP, EQIP, and CRP.

As of 2013, the suite of government conservation programs had not reduced sediment loading in the FCRW to targeted levels, as evidenced by the Natural Resource Conservation Service (NRCS), Oklahoma Conservation Commission (OCC), and the Oklahoma Department of Environmental Quality listing the FCRW as a focal point for applying more effective conservation practices (Oklahoma Department of Environmental Quality, 2014).  Furthermore, the Environmental Protection Agency (EPA) named the FCRW as a water quality priority watershed for 2001-2007 (Oklahoma Conservation Commission, 2014).  In 2001 the OCC implemented a "319 project" funded by the state and the federal government to improve water quality through a variety of best management practices (BMP) in conjunction with incentive payments (Oklahoma Conservation Commission, 2009).  Despite these focused efforts, water quality downstream remains impaired according to the Oklahoma Department of Environmental Quality 303d list (Oklahoma Department of Environmental Quality, 2014).

**Literature Review**

In 2001, the cost of production losses from soil erosion in the United States was estimated to be $37.6 billion (Uri, 2001).  However, finding an appropriate number for the estimate of off-farm or downstream costs is more elusive in that this often involves

using non-market valuation in order to find the location-specific costs (Steiner et al., 1995).

The costs associated with off-site pollution of water resources such as sediment loading and eutrophication represent negative externalities. These negative effects are not paid for by the owners of the farmland.  Instead downstream users such as recreationists and municipal systems suffer the costs. Because producers and NFAL do not pay all costs associated with their activities, incentives provided by the government may be appropriate measures to best protect society's goals and nudge producers and landowners to reduce external effects of production caused by current agricultural management practices (Pigou, 1952; Krutilla, 1967; Valentin et al., 2004).

Much research over the past several decades has focused on producers and the determinants of their adoption decisions (Prokopy et al., 2008).  While this is important, considerably less research has focused on NFAL and their land stewardship practices and preferences.  Yet, the amount of agricultural land owned by absentee/non-farming entities is increasing and these NFAL behave differently given economic stimuli than do producers (Brady and Nickerson, 2009).  As the rates of NFAL increase, they become less involved in adoption and other management decisions.  Therefore, implementation of conservation practices are expected to decrease (Soule et al., 2000).

Education and outreach efforts are generally not as effective with NFAL compared to producers.  The Great Lakes Basin Absentee Landowners Project has demonstrated that new educational and outreach efforts tailored to NFAL can work (Petrzelka et al., 2009).  Perhaps the most convincing evidence that NFAL make adoption decisions differently than producers is that their interests are not always aligned.  NFAL

prefer cash-rents over share-rent agreements and producers vice-versa (Boumtje et al., 2001). As a result, NFAL have a stronger incentive to adopt conservation practices than renting producers. Thus, conflicts between the contract participants may arise over time because producers are motivated to a greater extent by short-run profit. The absentee landowner is more concerned with the productive value of the land over time (Boumtje, 1999). Varble et al. (2015) give further evidence that land tenure affects adoption decisions. They find that producers who own only part of the land that they have in production are less likely to adopt than producers who own all of their land.

Ervin and Ervin (1982) suggest that producers use a logical approach during conservation decisions and undergo a generalized three stage process. The first stage is identifying that a problem exists. The second stage is where the producer decides whether or not to adopt a conservation practice. The third stage is where the decision is made concerning what level of adoption is necessary. Camboni and Napier (1993) also assert producers adopt conservation methods through logical reasoning and implement practices only if they are viewed as profitable, affordable, and necessary. Yet not all conservation practices improve profit and help the environment (Gedikoglu and McCann, 2012; Osmond et al, 2012). For example not fertilizing within 100 feet of the edge of a field helps reduce NPS pollutants, but decreases profit (Gedikoglu and McCann, 2012). According to Camboni and Napier (1993) this type of practice would not likely be implemented because it will likely not be considered profitable or necessary from the producer's point of view if they are not concerned with external effects of production activities. The federal and state governments provide various incentives to farmers in

order to help them afford to adopt conservation practices that reduce external effects (USDA, 2016).

Past attempts at providing incentives to farmers to reduce negative externalities have helped reduce erosion and nutrient loading in some areas, but have been less successful in others (Osmond et al, 2012). This suggests an incentive system overhaul is warranted to provide effective conservation programs (Camboni and Napier, 1993; Dobbs and Pretty, 2004; Shortle et al., 2012; Osmond et al, 2012). This situation is exacerbated by increasing percentages of NFAL, who behave differently concerning economic incentives than owner-operators and are also less likely to adopt practices or enroll in conservation programs (Brady and Nickerson, 2009). Furthermore, the problem is further confounded because many heirs have never been directly involved in agriculture (Soule et al., 2000).

The literature focuses primarily on producers. Considerably less research has attempted to discover how and why NFAL make conservation decisions. While the literature supports the primary reason farmers adopt practices is profit driven (Tosakana et al., 2010; Cary and Wilkinson, 2008; Camboni and Napier, 1993) evidence suggests that NFAL have different motivations and reasons to adopt conservation practices (Brady and Nickerson, 2009). Recent literature suggests that understanding producers' attitudes towards conservation and stewardship are important for future conservation practice implementation (Ribaudo, 2015; Osmond et al., 2012) and the same is true for NFAL (Brady and Nickerson, 2009).

**Conceptual Framework and Hypothesis**

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To rank the relative importance of a non-specific conservation practice during adoption decisions from most preferred to least preferred maximum difference scaling is used. Attitudes concerning stewardship and conservation were represented by the following variables. If the, "practice benefits the farm ecosystem" (PBFE), it was assumed the decision maker is concerned with protecting the productive capacity of the farm over time. This likely represented the traditional producers' mindset in that many farmers assert that: if they take care of the land it will take care of them in return. The variable, "the practice improves profit" (IMPPROFIT) is included to represent a practice that is expected to increase the profitability of the operation. If the, "practice benefits the ecosystem downstream" (PBED), the decision maker was assumed to be more thoughtful of the consequences to others and the environment both on and off the production site. This represented a progressive producer view and was not likely the traditional view for most agricultural producers.

Two variables were used to represent practice risk. If the variable, "practice is similar to the way a farming family has farmed in the past" (LIKEOLD), the practice was assumed not to represent a significant amount of change in the operational aspect of the farm. To the producer sticking with old ways may appear less risky. Similarly, the variable, "neighbors have shown the practice works" (NEIGHBOR), the practice did represent change. However, since the practice has been proven to work, this also represented less risk to a producer.

If a "government provided cost share or subsidy was provided" (GS) was included to determine how effective or desirable a government conservation program was during adoption decisions. This characteristic will give the importance of a government

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program during adoption decisions. To determine the importance of off-farm effects of production practices are, "the practice benefits the ecosystem downstream" (PBED) was included. This characteristic of a conservation practice allows for an understanding of the importance during adoption of off-farm effects of production during adoption decisions.

A hypothesis was that the most important benefit from a conservation decision will be that the practice improves profit (IMPROFIT).. The second most important benefit of a conservation practice was if a government subsidy was provided (GS), because this offset revenue loss and provides sustainable financial flows to the producer. The third most important factor was if the practice benefited the farm ecosystem (PBFE). This is likely important because many recognize that if they take care of the land the land will provide more production and non-production benefits on the farm such as yield and hunting. Fourth was the hypothesis that if neighbors have shown the practice worked (NEIGHBORS), farmers value this because it represented less risk than if they were the first to try a new practice. The attribute representing a practice is similar to those used by the family farming operation in the past (LIKEOLD) will be ranked fifth. This was likely due to the relative small change in operational methods; hence, the perception of reduced risk of this type of adoption decision. Finally, the least important of all the categories was if the practice benefited the ecosystem downstream (PBED). The reason was that this scenario does not necessarily directly benefit the producer in any way and the costs were paid by those downstream.

For non-farming/absentee landowners, it was hypothesized the order and ranking will be significantly different from producers (Brady and Nickerson, 2009). The interests of the two groups were not the same as evidenced by land rent contract preferences. Producers prefer crop-share rental contracts over cash rents and NFAL prefer cash rent contracts (Boumtje et al., 2001). If in fact producers are acting in their best interest, this would imply NFAL were likely making decisions that increase profit and transfer risk to producers (Boumtje, 1999). It was hypothesized that NFAL will prefer PBFE over IMPPROFIT. Furthermore, landlords have a greater interest than tenants concerning long-term conservation practice adoption (Boumtje, 1999).

Finally, both producers and NFAL are pooled into one model to test whether the two groups have significantly different rankings based on a log-likelihood ratio test. One hypothesis was that since both groups were expected to rank the benefits or attributes of a conservation practice differently, this model would allow for the demonstration of the statistical difference of the groups when making adoption decisions. This could also show how ignoring ownership and operation characteristics results in a misrepresentation of rankings for conservation adoption.

## Methods and Procedures

On August 18th 2014, in Binger, Oklahoma, a pilot survey was performed at an irrigation and agricultural extension program. Twenty-three Oklahoman agricultural producers completed the pilot survey. Based on the responses of these producers, some minor revisions to the survey format were required.

There was no available list of producers in the FCRW; therefore, PvPlus software was used, a product of County Records Incorporated, to access landowner records which

allowed for the generation of a list of all owners of parcels over 50 acres in size in the

FCRW. There were 1370 land parcels that were privately held. After reducing

landowners who possess more than one land parcel to one entry, a list of 648 owners was

identified (PvPlus, County Records Incorporated).

Using a modified Dillman method with no incentive provided (Dillman et al.,

2009) a mail survey was sent to the 648 title holders on October 28, 2014. A post card

reminder was sent 15 days post-survey. A second replacement mailing of the survey was

conducted on November 24, 2014.

A final total of 132 respondents were identified as owners or operators of

agricultural property within the FCRW. Sixty-seven of the respondents were producers

and 65 respondents were NFAL with agricultural property within the watershed. Data

from the USDA was utilized to estimate how representative the responses might be of the

FCRW. The watershed is located in three of Oklahoma's counties: Caddo, Custer, and

Washita. Using the USDA (2012) *Survey of Agriculture* for these three counties, the

mean farm size was approximately 615 acres. Since 284 square miles of this watershed

was used for agricultural production (Garbrecht et al., 2008), this land area was converted

to acres and then divide by the average farm size, for the three counties. Using this

method, there are approximately 296 farms and ranches in the FCRW yielding an

estimated 22.6% for the producer representation.

To estimate how well the NFAL sample represents the population and the

response rate, the total number of acres owned was divided by just the NFAL respondents

34,060 acres by the total number acres devoted to agriculture in the watershed, which is

181,760 minus the total number of acres owned by owner-operators from the survey

respondents. This yielded a conservative response rate estimate of 25.5% in the sample, although this number may be higher.

Respondents sometimes chose to skip questions or others skipped the choice sets all together. A total of 41 of the 67 producers and 36 of the 65 non-farming/absentee landowners completed the best-worst section. Therefore the overall response rate for this choice experiment was estimated to be 13.9% for producers and 16.6% for NFAL

Using the literature review and input from the multidisciplinary grant team six benefits or characteristics of a generic conservation practice were identified and included in the model. In Table 2.1 the benefits and characteristics are given, also included are the variable name, description and expected ranking of each attribute included in the best-worst scaling choice experiment.

## Empirical Model

Finn and Louviere (1992) first introduced the maximum difference scaling method, also called the best-worst scaling method. The method has since become an increasingly popular tool in many fields, including agricultural economics (See Flynn et al., 2001; Finn and Louviere 1998; Lusk and Briggeman, 2009). The best-worst method forces the respondent to make a trade-off during each choice set which more closely approximates how people make decisions and avoids bias caused from personal perception during analysis (Finn and Louviere, 1992). The terms best and worst in best-worst is not meant to convey that one attribute is always best and one always worst, rather the term refers to one attribute being least preferred and one being most preferred. In this study, the respondents were asked to rank the most important reason for adoption of a conservation practice and the least important reason for choosing a practice in each set of choices, thus

it does not imply that certain conservation methods are better or more effective than another.

Maximum difference scaling, is a way to elicit and rank preferences or attributes. In this method, each respondent sees several choice sets which vary in the number of choices in each set or may use a balance complete block design (BIBD). In a BIBD each choice set has the same amount of choices and each choice is represented the same amount of times throughout the experiment. An example of a choice set is given in Figure 2.1. In each choice set the respondent is asked to select the most important or most preferred attribute and also to choose the least important or least preferred attribute present in the choice set as a reason for adopting a conservation practice. Once the respondents complete all choice sets, their responses allow for an attribute to be ranked relative to the other attributes. Thus results are given on a ratio scale. On the ratio scale comparison of results between sample populations becomes much easier because there is one and only one way to make a choice which eliminates perception bias concerning levels in other methods such as discrete choice experiments (Flynn and Louviere, 2007).

In Table 2.1, the six benefits and characteristics of a conservation practice included in the model are described and listed. A $2^6$ present/absent orthogonal design is used to design the choice sets; five of the choice sets include three benefits received from a conservation practice, and the last choice set includes all choices included in the experiment. The variable, "Practice benefits the ecosystem downstream" was slightly over-represented in the design, because an attempt was made to discover how important an obvious externality is to landowners during adoption decisions. Both producers and absentee/non-farming landowners were asked to choose which benefits of a conservation

practice was most important or least important to them when they make adoption decisions on their farm or farmland.

The best and worst choice (most and least preferred) benefit from a conservation practice in a choice set may be thought of as producer's or NFAL's preferences regarding incentives and the utility derived from adopting a practice on their operation or farmland, given programs such as CRP, CSP, EQIP etc. or no program at all. Following Finn and Louviere (1992) and the outline set by Lusk and Briggeman (2009), let $\lambda_j$ be the location of the jth value on the scale of relative importance of the benefits or attributes of a conservation practice adopted and the real or true level of importance of this $\lambda_j$ be $I_{ij} = \lambda_j + \varepsilon_{ij}$, where $\varepsilon_{ij}$ is the error term such that it takes an extreme value distribution. The probability that a producer or non-farming/absentee landowner chooses to maximize the distance between $i$ and $k$, that is, as the best and worst out of $J$ benefits of a conservation practice, is the probability that the difference in $I_{ij}$ and $I_{ik}$ is the greatest of all other possible values $J(J-1)-1$ possible differences in that choice set. Therefore, a model utilizing the conditional logit may be used:

$$\text{Prob}(j \text{ is most and } k \text{ least preferred}) = \frac{e^{\lambda_j - \lambda_k}}{\sum_{l=1}^{j} \sum_{m=1}^{j} e^{\lambda_l - \lambda_m} - J} \tag{1}$$

where, $m$ are the benefits the producer or NFAL are presented but did not choose from the choice sets. Each best-worst possible pair is coded in SAS where 1 is entered into the appropriate cell in a column representing the choice if chosen. One variable, LIKEOLD, is dropped from the model as the variable of comparison against which the other attributes variables are ranked.

## Results and Discussion

The average farm operation for producers responding to the best-worst choice set is 1,012 acres and the average amount of farmland owned is 639 acres (Table 2.2).  The average farmer has 30.1 years production agriculture experience and approximately 15% of respondents were female.  Producers identified by race as 92.7% Caucasian and 7.3% Native American.  Average annual total farm revenue was $138,780 per annum.  Sixty-one percent of producers participate in at least one conservation program.  The summary statistics of the sample data were compared to the average values found in the USDA's *Census of Agriculture* (2012) for Caddo, Custer, and Washita County which bound the Ft. Cobb Watershed.  According to the USDA in 2012, the average total farm revenue is $107,906 per annum.  The average age of a producer was 57 years and 95.9% of the farming population was Caucasian, 3.3% were Native American, 0.8% identified as another race and 7.4% were female.  The average farm size in acres for these three counties was 615 acres.  Overall the survey data from the Ft. Cobb Reservoir watershed included operations that are slightly larger than the average farm size indicated in the USDA *Survey of Agriculture* (2012) for both measure in land mass and total revenue. Females were overrepresented by approximately double compared to the data from the USDA data.  Assuming the average beginning age upon entrance to the production agriculture sector was 23, allowing for post-secondary education attainment, then the age of the average farmer was very close to those listed in the USDA data.  The distribution of respondent's identification to racial group was also similar to the USDA *Census of Agriculture* (2012).

The descriptive statistics for the NFAL are given in Table 2.3.  There was no publically available data to which to compare the demographics of NFAL in the sample.

Of those responding, the average amount of farmland leased was approximately 566 acres. Forty percent of respondents indicated they rent the land on a cash-rent basis. Eleven percent stated they use a share-rent contract, 14% percent lease farmland using both cash-rent and share-rent contracts, and 34% did not specify the nature of the lease agreement. Most NFALs receive less than 30% of their total income from rents and only 17% own land enrolled in a conservation program. Approximately 19% indicated they had no farming experience, and 19% indicated they had less than 5 years of farming experience. Female respondents represented 33% of the NFAL sample and the distribution of racial identification was similar to the makeup of the producers. Less than one third of the respondents indicated that the highest level of education they had obtained was a high school diploma or less, while 44% had completed undergraduate studies and almost 27% had obtained a graduate degree.

Table 2.4 gives the raw data describing the choices made by all individuals in each model are given. This is the number of times each group chose a variable as the most and least preferred benefit or characteristic of a conservation practice are listed.

The model estimates are given in Table 2.5. For the multinomial logit estimates (MNL), the higher the parameter estimate was, the more preferred the benefit or attribute of the conservation method was compared to other benefits and attributes with a lower MNL parameter value. Standard errors are reported in parentheses. Importance scores are given in brackets and may be interpreted as the fraction of each group that would choose that category as the most important relative to the other options. The preferences are given a numerical ranking and the importance score is converted to a percentage in Table 2.6. This importance score in percentage form may be interpreted as the percent of

members of the respective group expected to choose the attribute or benefit as most preferred.

The operators and NFALs have different preference orders. This is shown in the difference in preference rankings and order shown graphically in Figure 2.1, where the difference in the magnitude of the MNL estimates between the two groups are seen. Figure 2.3 graphically presents the importance scores which are percent of the respondents who prefer each attribute as the most desirable reason to adopt a conservation practice.

Brady and Nickerson (2009) assert that producers and absentee landowners respond differently to incentives. In the study, the likelihood ratio test yields a test statistic of 11.9 for the pooled model, the critical value associated with the 95% level with five parameter values is 11.1. Therefore, the log-likelihood test shows that at the 95% level producers and NFAL have different preferences during adoption than producers, supporting the hypothesis that renters and owners have significantly different overall preference orderings (Table 2.6).

The most important factor for both producers and non-farming/absentee landowners when making adoption decisions is if the practice benefits the farm ecosystem. Although this conflicts with the hypothesis that IMPPROFIT would be the most desirable benefit derived from a practice for producers, only 0.3% of farmers choose this category over profit. This likely reflects the common colloquialism that if "you take care of the land it will take care of you." However, despite the ranking of the two choices being the same, NFAL have a much larger margin between the PBFE and IMPPROFIT. These NFAL choose the PBFE as the most desirable characteristic of an

adoption decision by a 10% margin over IMPPROFIT.  This may indicate that NFAL are more interested in the long-run profitability of the enterprise than agricultural producers.

To further demonstrate the differences between the two groups, the order of the rankings of the next two attributes are not the same, although it is of note that GS is not found significant for NFAL the order is still important.  Producers rank GS and NEIGHBOR as the third and fourth best choice, respectively.  The importance score for GS is chosen as most important by 15.3% and NEIGHBOR 10.1% of the time.  NFAL rank these attributes opposite the producers in that they prefer NEIGHBOR 12.4% of the time over the 11.2% that GS.  This may indicate that information, incentives, and educational efforts concerning government programs fail to motivate or reach NFAL as effectively as producers, which reinforces the findings of Petrzelka et al. (2009).

One hypothesis was that the least important reason to adopt a practice for both groups to be if the practice benefits the ecosystem downstream.  While the order of PBED and LIKEOLD is not the same as the hypotheses, these two characteristics both come in last.  PEBD came in as the fifth most important factor with 9.5% of producers and 10.8% of NFAL choosing this as the most important factor, although for NFAL this variable was not significant.  LIKEOLD was least preferred with 5.9% of producers and 8.8% of NFAL choosing this attribute as the best reason to adopt a practice.  This is encouraging news to both those in production economics and natural resource economics in that this implies both groups may be more interested in trying new, more effective farming methods and protecting the downstream environment as a whole than staying with the status quo.

**Summary and Conclusions**

Findings may be useful for educational and extension efforts geared towards engaging non-farming/absentee landowners. Furthermore, findings may be useful for policy-makers when developing new incentive types for both producers and non-farming/absentee landowners. An encouraging result is that agricultural producers valued protecting the environment off-farm more as a reason to adopt a conservation method than using outdated production methods similar to those used in the past. This indicates that they are aware that current farming methods negatively affect the environment and they are more interested in conserving the environment than continuing to produce using non-sustainable practices.

Both producers and non-farming/absentee landowners rank the practice benefits my farm ecosystem as the best reason to adopt a practice; however, a larger proportion of producers are driven by short-run profit considerations than non-farming absentee landowners. Furthermore, the groups rank the reasons they adopt practices differently. Producers rank a government subsidy or cost share as the third most important reason for adopting new methods Non-farming/absentee land owners rank this as the fourth best reason, although it proved insignificant. This may imply that government subsidies and cost-shares do not benefit landowners as much as producers or that non-farming/absentee landowners are not aware of the on-farm benefits offered by the government-provided cost-shares and subsidies.. Furthermore, this makes logical sense, because NFAL are more interested in the long-term rents obtained from the land than producers whose incentives are tied more strongly to the present, the analysis results reinforce this (Boumtje et al, 2001). Consider CRP, if removing land from production does not pay as much as cash rents, the NFAL will likely avoid that government program because the

NFAL is better off in the short term keeping the land in production, but may still want to adopt practices or enroll in programs that do not take land out of production to keep their soils from eroding.

Therefore, to provide appropriate and effective incentives to both groups, this research supports Camboni and Napier (1993), Dobbs and Pretty (2004), and Shortle et al. (2012) in the assertion that the current incentive system may need restructuring. Programs may be developed and tailored to the preferences of the land tenure groupings. This will nudge both groups towards reducing external production effects caused from current agricultural practices and reduce production losses caused by outdated methods. This, in conjunction with educational efforts designed to reach both producers and non-farming/absentee landowners concerning the benefits of government programs that provide more attractive incentives to various land tenure groups will help reduce the losses society experiences from agricultural production.

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**Table 2.1. Conservation Method Benefits and Attributes**

| Benefit or Attribute | Description |
| --- | --- |
| PBFE | The conservation practice benefits the farm ecosystem |
| IMPPROFIT | The conservation practice increases the profit of the enterprise |
| GS | A government subsidy or cost-share is provided for adopting practice |
| NEIGHBOR | Neighbors have shown this practice works |
| PBED | The practice benefits the ecosystem downstream |
| LIKEOLD | The practice is similar to the ways used on the operation in the past |

**Table 2.2. Descriptive Statistics for Producers N=41**

| Characteristic | Obs | Percent | Mean | Std. Dev. | Min | Max | Count |
|---|---|---|---|---|---|---|---|
| Farm Size in Acres | 41 | - | 1012 | 1135.3 | 60 | 3880 | - |
| Acres Owned | 41 | - | 638.9 | 658.2 | 10 | 2520 | - |
| % of total income derived from farming | 41 | - | 53.20% | 22.90% | <30% | >80% | - |
|   less than 30% | 41 | 39.0% | 0.39 | - | 0 | 1 | 16 |
|   Between 30% and 49.9% | 41 | 14.6% | 0.15 | - | 0 | 1 | 6 |
|   Between 50% and 79.9% | 41 | 9.8% | 0.10 | - | 0 | 1 | 4 |
|   Above 80% | 41 | 36.6% | 0.37 | - | 0 | 1 | 15 |
| Total Farm Revenue per Year | 41 | - | $138,780 | $88,993 | <$40,000 | >$250,000 | - |
|   TFR < $40,000 | 41 | 31.7% | 0.32 | - | 0 | 1 | 13 |
|   $40,001 < TFR < $99,999 | 41 | 14.6% | 0.15 | - | 0 | 1 | 6 |
|   $100,000 < TFR < $249,999 | 41 | 24.4% | 0.24 | - | 0 | 1 | 10 |
|   $250,000 < TFR | 41 | 29.3% | 0.29 | - | 0 | 1 | 12 |
| Enrolled in a Conservation Program | 41 | 61.0% | 0.61 | - | 0 | 1 | 25 |
| Number of Years Farming Experience | 41 | - | 30.1 | 17.7 | 3 | 67 | - |
| Number of Conservation Practices Adopted | 41 | - | 5.2 | 2.9 | 0 | 14 | - |
| Gender (1 if female) | 41 | 14.6% | 0.15 | - | 0 | 1 | 6 |
| Identification by Race | 41 | | | | | | |
|   Caucasian | 41 | 92.7% | 0.93 | - | 0 | 1 | 38 |
|   Native American | 41 | 7.3% | 0.07 | - | 0 | 1 | 3 |
| Education Level | 37 | | | | | | |
|   High School Diploma or Less | 37 | 18.9% | 0.19 | - | 0 | 1 | 7 |
|   Undergraduate Degree | 37 | 54.1% | 0.54 | - | 0 | 1 | 20 |
|   Graduate Degree | 37 | 27.0% | 0.27 | - | 0 | 1 | 10 |

**Table 2.3. Non-Farming Absentee Landowners (NFAL) Descriptive Statistics N=36**

| Characteristic | Obs | Percent | Mean | Std. | Min | Max | CountT |
|---|---|---|---|---|---|---|---|
| Acres of Land Leased | 35 | - | 565.8 | 884.8 | 40 | 4000 | - |
| Acres Leased by Contract Type | | | | | | | |
|    Cash lease Contracts | 35 | 40.0% | 162.7 | 180.3 | 40 | 590 | 14 |
|    Share Rent Contracts | 35 | 11.4% | 302.5 | 252.8 | 160 | 680 | 4 |
|    Mix of Cash and Share | 35 | 14.3% | 481.2 | 170 | 320 | 750 | 5 |
|    Did Not Describe Contract | 35 | 34.3% | 1061. | 1415.7 | 80 | 4000 | 12 |
| % of Total Income From Land | 33 | - | 37.7% | 17.2% | <30 | >80 | - |
|    less than 30% | 33 | 78.8% | 0.79 | - | 0 | 1 | 26 |
|    Between 30% and 49.9% | 33 | 6.1% | 0.06 | - | 0 | 1 | 2 |
|    Between 50% and 79.9% | 33 | 3.0% | 0.03 | - | 0 | 1 | 1 |
|    Above 80% | 33 | 12.1% | 0.12 | - | 0 | 1 | 4 |
| Enrolled in a Conservation | 36 | 16.7% | 0.17 | - | 0 | 1 | 6 |
| Number of Years Farming | | | | | | | |
|    No Farming Experience | 36 | 19.4% | 0 | 0 | 0 | 0 | 7 |
|    Less Than 5 Years | 36 | 19.4% | 2.7 | 1.38 | 1 | 4 | 7 |
|    More Than 5 Years | 36 | 61.1% | 37 | 25.1 | 5 | 100 | 22 |
| Number of Practices Adopted | 36 | - | 2.83 | 2.14 | 0 | 8 | - |
| Gender (1 if female) | 36 | 33.3% | 0.33 | - | 0 | 1 | 12 |
| Identification by Race | | | | | | | |
|    Caucasian | 36 | 91.7% | 0.92 | - | 0 | 1 | 33 |
|    Caucasian and Native- | 36 | 5.6% | 0.06 | - | 0 | 1 | 2 |
|    American | 36 | 2.8% | 0.03 | - | 0 | 1 | 1 |
| Education Level | | | | | | | |
|    High School Diploma or | 34 | 29.4% | 0.294 | - | 0 | 1 | 10 |
|    Undergraduate Degree | 34 | 44.1% | 0.441 | - | 0 | 1 | 15 |
|    Graduate Degree | 34 | 26.5% | 0.265 | - | 0 | 1 | 9 |

**Table 2.4. Frequency of Best or Worst Rating for Each Attribute**

| Characteristic or | Producers | | NFAL | | Both | |
|---|---|---|---|---|---|---|
| | Best | Worst | Best | Worst | Best | Worst |
| PBFE | 65 | 9 | 62 | 5 | 157 | 38 |
| IMPPROFIT | 69 | 12 | 53 | 15 | 95 | 35 |
| GS | 42 | 42 | 27 | 57 | 86 | 83 |
| NEIGHBOR | 21 | 29 | 23 | 25 | 46 | 55 |
| PBED | 34 | 86 | 30 | 64 | 42 | 133 |
| LIKEOLD | 15 | 68 | 21 | 50 | 36 | 118 |
| Totals | 246 | 246 | 216 | 216 | 462 | 462 |

**Table 2.5** Relative Importance of Soil and Water Conservation Attributes

|  | MNL Estimates | MNL Estimates | MNL Estimates |
|---|---|---|---|
| Parameter | PRODUCERS | NON-FARMING OWNERS | BOTH |
| PBFE | 1.611*** | 1.339*** | 1.464*** |
|  | (0.198) | (0.202) | (0.140) |
|  | [0.297] | [0.334] | [0.314] |
| IMPPROFIT | 1.604*** | 0.985*** | 1.297*** |
|  | (0.2003) | (0.198) | (0.14) |
|  | [0.295] | [0.234] | [0.265] |
| GS | 0.951*** | 0.248 | 0.609*** |
|  | (0.171) | (0.169) | (0.119) |
|  | [0.153] | [0.112] | [0.133] |
| NEIGHBOR | 0.536*** | 0.350** | 0.445*** |
|  | (0.172) | (0.177) | (0.123) |
|  | [0.101] | [0.124] | [0.113] |
| PBED | 0.471*** | 0.211 | 0.343*** |
|  | (0.159) | (0.161) | (0.112) |
|  | [0.095] | [0.108] | [0.102] |
| LIKEOLD | 0 | 0 | 0 |
|  | [0.059] | [0.088] | [0.072] |
| Log Likelihood | -436.991 | -399.298 | -842.243 |
| Likelihood Ratio | 139.54 | 91.323 | 218.95 |
| N respondents | 41 | 36 | 77 |

*, **, *** represent the 90%, 95%, and 99% confidence levels, respectively.

Standard errors are reported in parenthesis ( ).

No standard error reported for the dropped variable LIKEOLD.

Importance Scores are in Brackets [ ].

Log likelihood test statistic was 11.9, the chi square critical value for 95% level is 11.1

**Table 2.6. Preference Shares by Producer, Non-Farming Landowner, and Pooled Model**

| Parameter | PRODUCERS | NON-FARMING LANDOWNERS | BOTH |
|---|---|---|---|
| PBFE | 1 | 1 | 1 |
| | 29.7%*** | 33.4%*** | 31.4%*** |
| IMPPROFIT | 2 | 2 | 2 |
| | 29.4%*** | 23.4%*** | 26.5%*** |
| GS | 3 | 4 | 3 |
| | 15.3%*** | 11.2% | 13.3%*** |
| NEIGHBOR | 4 | 3 | 4 |
| | 10.1%*** | 12.4%** | 11.3%*** |
| PBED | 5 | 5 | 5 |
| | 9.5%*** | 10.8% | 10.2%*** |
| LIKEOLD | 6 | 6 | 6 |
| | 5.9% | 8.8% | 7.2% |

*, **, *** represent the 90%, 95%, and 99% confidence levels, respectively.

Relative rank reported with numeral 1-6

Importance Scores are converted to percentage and presented with % following the numeral

| | | | |
|---|---|---|---|
| **Figure 2.1. Example of best-worst scaling choice set** | | | |

If you had a choice among soil and water conservation techniques on your land, please check your most and least preferred reasons out of the following.  (Check only one that is most preferred on the left and one that is least preferred on the right)

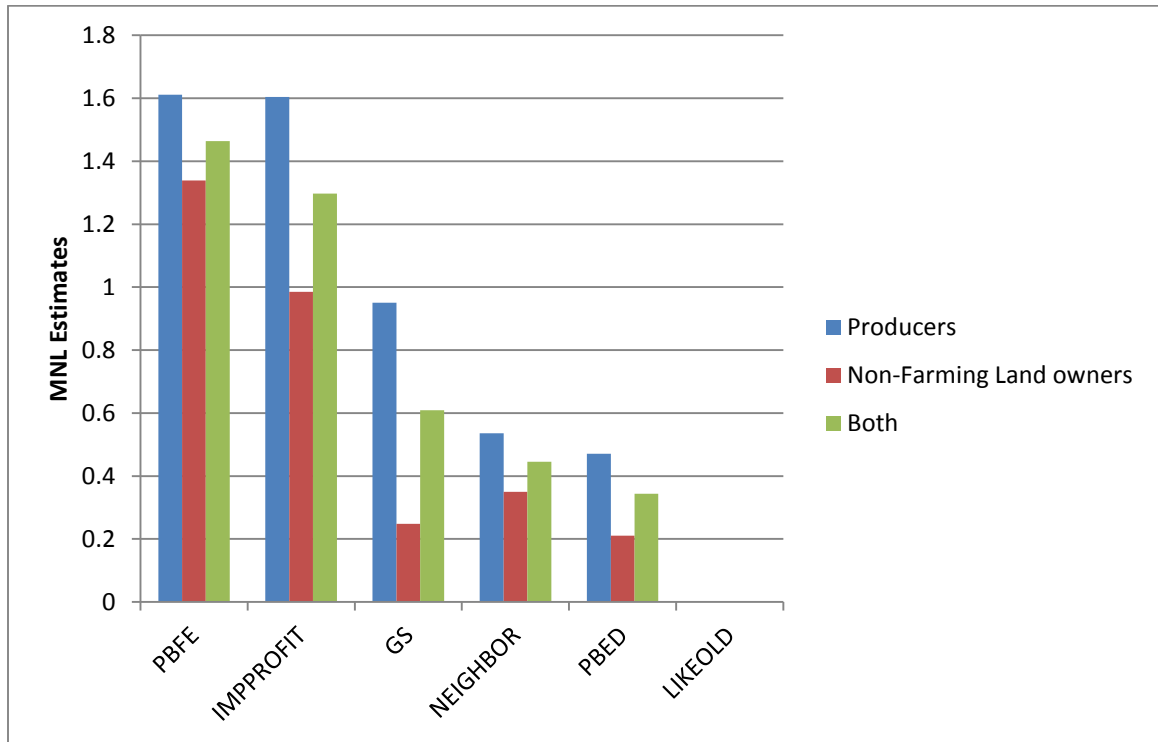| Most Preferred | | Least Preferred |
|:---:|:---|:---:|
| ○ | The practice benefits my farm ecosystem | ○ |
| ○ | Neighbors have shown the practice works | ○ |
| ○ | The practice increases profit | ○ |
| ○ | The practice benefits ecosystem downstream | ○ |
| ○ | The government provided a cost-share or subsidy | ○ |
| ○ | The practice is similar to the way our family has always farmed | ○ |

**Figure 2.2. Best-Worst MNL Relative Importance Estimates**

**Figure 2.3. Preference Shares for Highest Importance of Attributes**
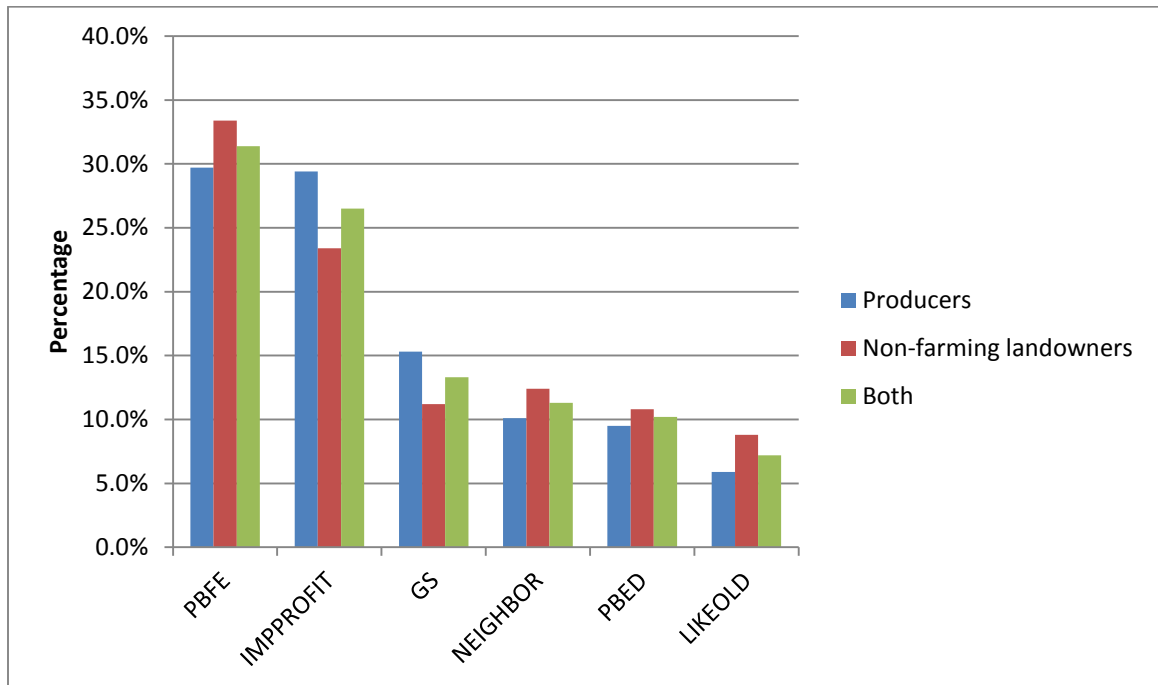
# APPENDICES

*Acknowledgements*

VITA

Benjamin Harlow Tong

Candidate for the Degree of

Master of Science

Thesis:    CONSERVATION ADOPTION PREFERENCES, DETERMINANTS OF
          CONSERVATION PROGRAM ENROLLMENT, AND CONSERVATION
          ADOPTION: OKLAHOMA'S FORT COBB RESERVOIR WATERSHED

Major Field:  Agricultural Economics

Biographical: Born in Texarkana, Texas, USA, the son of Isaac and Melinda Tong

          Education: Completed the requirements for the Master of Science in
               Agricultural Economics at Oklahoma State University, Stillwater,
               Oklahoma, USA in May, 2016.