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Importance of Contract Attributes on Conservation Reserve Program Enrollment Decisions  
in the Prairie Pothole Region

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## Abstract

Interest in the Conservation Reserve Program in the U.S. has waned. Enrollment for 2015 was targeted at 26 million acres but as of the end of February, actual enrollment had declined to 24.6 million acres (USDA, 2015). Available studies point to recent fluctuations in commodity prices as a predominant factor in this enrollment gap. Other potentially influencing factors remain understudied, including farmer preferences for contract design. A choice experiment was conducted in the Prairie Pothole region to assess these preferences. An exploded logit model was used to evaluate the preference heterogeneity among program attributes. Results indicate that an increase in maximum allowed rental payment, length of contract, and the government's share of establishment cost increase utility of farmers, whereas, fixing terms at the beginning of the contract, and imposing more land use restrictions on enrolled land have a negative impact.

Land retirement programs have a long history in the United States. They were initiated in the 1930s in response to decreasing commodity prices. By removing land from production, these programs met the objectives of supporting commodity prices by reducing agricultural supply and stimulating agricultural conservation. The Conservation Reserve Program (CRP) is an example of such a program. It too had an initial focus on commodity price support although, over time, objectives have shifted to conservation.

Administered by the U.S. Department of Agriculture (USDA), the CRP has a current enrollment of 24.3 million acres on 365,000 farms. Enrollment has been affected by fluctuations in commodity markets. For example, in 2007-2008, mounting commodity prices increased the opportunity cost of CRP and other land retirement programs. Acreage in the CRP decreased 17.1 million acres between FY2007 and FY2014 (Stubbs, 2014). The cost of declining acreage in land retirement programs includes loss of benefits associated with improved wildlife habitat, prevented erosion, and reduced carbon sequestered in soils after land is re-introduced to production. Maximum benefits are provided by those lands which remain under a land retirement program for the longest period (Farm Service Agency, 2014).

The focus of this study was to investigate farmers' responses to alternative CRP program contracts by identifying the effects of contract attributes on farmer utility and willingness to enroll. This study follows findings from the literature that, in order to keep this program competitive, viable, and working towards its intended goals, CRP payments must keep pace with rising farmland rental rates. This is accomplished by investigating the extent to which farmers are willing to trade off payments for less restrictive program requirements.

The study was conducted in the Prairie Pothole Region (PPR; Figure 1) of the United States including parts of Montana, North Dakota, South Dakota, Minnesota and Iowa. The

PPR is the most important waterfowl production area in North America, covering approximately 185,000 square miles of wetlands.

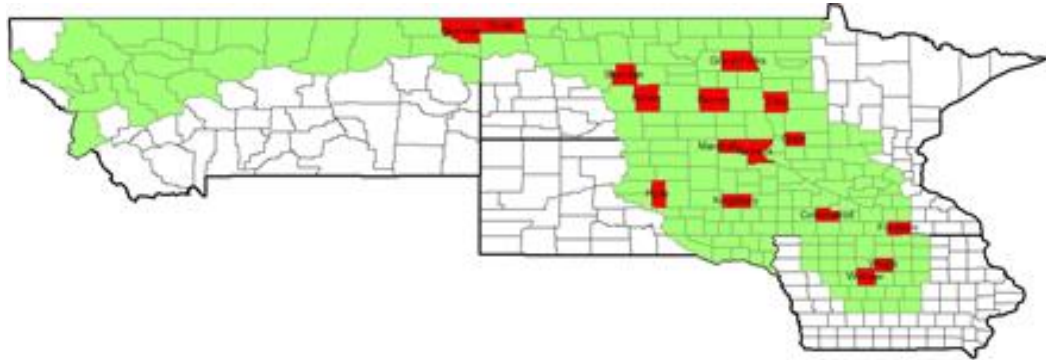


Figure 1 Prairie Pothole Region of United States

Source: USDA, [http://www.rma.usda.gov/data/pothole/2008/all\\_states.pdf](http://www.rma.usda.gov/data/pothole/2008/all_states.pdf)

Specific objectives are to:

1. Examine preferred levels of attributes for the CRP
2. Identify how attributes affect the enrollment decision
3. Identify socio-economic characteristics and attitudes that impact farmers' preferences, and
4. Estimate willingness to tradeoff (WTT) between rental payments and other contract attributes.

## **Methods**

A quantitative model was applied to identify how contract specifications influence farmers' willingness to participate in the CRP and identify the heterogeneity of preferred level of attributes within defined subsets. The empirical analysis is based on the discrete choice experiments (DCE) completed by 76 farmers from family farms during 2014.

Farmers were offered two CRP contracts defined by five attributes and an opt-out option. They were asked to rank-order the three options. The CRP contract attributes are shown here.

- Maximum payment (% of NRCS local county rental rates, at 80%, 100% or 120%)
- Terms of contract payment (fixed at start or re-adjusted every 5 years)
- Length of the contract (10 or 15 years)
- Establishment sharing (50% or 100 government cost share)
- Land use restrictions (Idle or graze/hay every other year)

Figure 2 an example of a choice set.

Figure 2. Example Choice Set

Option A	Option B	Option C
<p><u>Maxbid</u> 100 %</p> <p><u>Terms</u> Readjusted at five years</p> <p><u>Length of contract</u> 15 years</p> <p><u>Establishment cost</u> 100 %</p> <p><u>Land use restriction</u> Graze/hay permitted</p>	<p><u>Maxbid</u> 120 %</p> <p><u>Terms</u> Readjusted at five years</p> <p><u>Length of contract</u> 10 years</p> <p><u>Establishment cost</u> 50 %</p> <p><u>Land use restriction</u> Idle only</p>	<p><u>No contract</u></p> <p>Do not enroll in CRP</p>

SAS software was used to generate 23 choice sets, representing a reduced orthogonal experiment design with a D-efficiency of 89%. Prior to conducting the survey, pre-tests of the survey and choice experiment were conducted with samples of farmers.

### *Model Estimation*

In economic theory, discrete choice modeling is compliant with Lancaster's consumer theory (Lancaster, 1966) and random utility theory (McFadden, 1974). Lancaster consumer theory is based on the underlying assumption that what consumers are seeking to acquire is not goods themselves but the characteristics they contain, and these characteristics/attributes give rise to utility.

In this study, respondents were asked to rank the alternatives in each choice set according to their preference order. To evaluate the individual's choice in relation to different attributes and characteristics of a contract, an exploded logit model with no ties in ranking was used. In the economics literature, this is also known as rank-ordered logit model. It is a generalization of the binomial logistic regression model.

## **Results**

### *Descriptive Statistics*

The average respondent was 54.2 years old, slightly younger than the average age of US farmers at 58.3 years (USDA, 2012 Census of Agriculture). Total farm distribution was skewed right, with a mean farm size of 3,666 acres and median of 2,500 acres. Average total arable land was 2,122 acres. Fifty-eight percent of participants have native grasses on their land and 47% raise cows on their farms. Wheat, corn and soybeans are the three most common crops in participants' rotations while alfalfa and grass hay are also common for operators with livestock.

Sixty-seven percent of farmers were enrolled in at least one CRP contract and 48% said they intended to re-enroll their contracts. Seventy-seven percent of farmers are participating in one or more conservation programs apart from CRP. Forty-nine percent of participants' households reported having some off-farm income; that could be an important factor for those valuing the income stability associated with long-term land retirement programs.

Farmers were asked to respond to an open-ended attitudinal statement. Seven percent of farmers stated a concern about the annual maximum payment allowed. Five percent of farmers expressed concern that there were different guidelines for the same program under the terms of the CRP. Concerns were also expressed about change in eligibility of land previously enrolled in CRP (31% of respondents); administrative processes such as filling paperwork for enrollment (41%); and terms of the contract to include rental payment received, penalties for early termination of contract, restrictions on farming, length of the contract, and midterm management (69%). Farmers also listed specific midterm management requirement concerns (35%) and those associated with who receives the payments (3%) as well as the effect of the CRP on young farmers (29%).

*Estimation Results:*

Sixteen percent of participants gave the highest rank to the opt-out option in every choice set indicating they are opposed to the CRP as defined in the current program or it does not suit their farming operation. Alternative-specific constants were estimated for Option A and Option B, which in have nearly identical negative coefficients that are statistically different from the opt-out alternative at the 1% significance level, but indistinguishable from each



other. The negative signs of the alternative-specific constants indicate that, barring sufficient compensatory contract attributes; the survey participants will not enroll in the program. Interaction terms with demographic variables were included in the analysis. The McFadden pseudo  $R^2$  ( $\rho^2$ ) of 0.203 represents a good model fit.

The signs of the exploded logit coefficients are generally as expected. The coefficient on 'maxbid' (maximum rental rate) is positive and strongly significant which represents that the higher the payment is allowed, the more likely a farmer is to choose a CRP contract. The positive effect of higher rental rates decreases with increasing age of farmers, as illustrated by the statistically discernible negative coefficient (-0.0003455) of the 'age\*maxbid' interaction term. Conversely, those farmers with concerns about the terms of the current contract and rules implementation are more responsive to increases in the maxbid as shown by the positive coefficients for the related interaction terms 'terms of contract\*maxbid' (0.00800) and 'rules implementation\*maxbid' (0.00939). Increases in maxbid have less of an effect on the likelihood of enrolling in CRP for farmers with concerns about the application process (-0.0127).

The independent variable 'Terms' in the model represents the attribute defining if rental payments are fixed at the beginning of contracts or re-adjusted after every five years on the basis of market conditions. The flip side of market based adjustments was explained to respondents; specifically that if local rental rates decline then the annual CRP payment will also decline. The fixed rental rate at the beginning of CRP contract reduces the probability of selecting a CRP alternative, which causes a statistically diminishing effect (-0.96497) on the likelihood ratio of enrolling in CRP. The interaction term 'age\*terms' has a positive significant (0.01322) effect which indicates that as a landowner gets older they prefer to have

the more restricted option of fixed payment for the life of the contract. Other cross terms are statically insignificant. Contract term length diminishes the likelihood of participating in CRP alternatives (-0.11689) but the interaction term between length and concern related to different eligibility criteria (eligibility\*length) (0.04259) increases the likelihood farmers with this concern will choose a CRP alternative. Cross term between concerns with rules implementation and length of the contract 'rules implementation \*length' shows a negative effect on the likelihood of selecting CRP alternatives (-0.07196). Interactions between 'length' and other variables do not have significant effect on the likelihood ratio of enrolling in a CRP contract.

The negatively significant coefficient for the variable 'land-use' (-2.08740) represents that the requirement that CRP land remain idle has a negative effect on the likelihood of enrolling in CRP. Likewise, cross terms between land\_use and livestock and land\_use and concerns regarding rules implementation also have a negative effect on the enrollment alternative. Livestock owners are more likely to value use of the land for grazing. Conversely, older farmers prefer more restrictions on usage of land.

We expected a higher level of establishment cost paid by the contract to increase likelihood of enrollment. All other cross variables with establishment cost are insignificant.

#### *Probability of Enrollment Decisions and Willingness-to-Tradeoff (WTT) Decision*

Coefficients of different attributes and interaction terms indicate the effects of changes on the likelihood ratio of enrolling into a contract due to the changes in respective attributes. A convenient way of making these coefficients understandable is by computing marginal effects on utilities and marginal willingness to tradeoff (WTT) of policy attributes

and farmer characteristics. For dummy variables, the discrete change in the probability of choosing a CRP alternative (*ceteris paribus*) is evaluated by changing the dummy's value from zero to one. Also, these WTT estimates represent the percentage monetary equivalent of increasing the attribute value by one unit. For example, a marginal WTT of 18.23 for the land use attribute represents that a landowner's compensation needs to increase by 18.23% for a contract to have an equal utility as when the contract moves from one allowing grazing / haying to one that requires land be idle.

In this analysis, the impacts of various socio-economic factors on the probabilities of enrollment decisions are also evaluated. To investigate the possible source of variability in preference orders, mean value of age and mode (most commonly chosen) variables of utility parameters are used as a base contract, which is presented in table 1. Then, with the help of equation 1, the impact of these base contracts' estimates on the probability of participation was quantified.

$$P_{enroll} = \frac{\exp(V_{enroll})}{1 + \exp(V_{enroll})} \quad (1)$$

According to the results shown in Table 1, the base case is a 54.2 year old farmer without livestock who has issues related to the CRP program such as different guidelines in different counties, eligibility criteria, application process, and terms of the contract. This farmer is offered a CRP contract with following contract specifications:

- 1) 10-year longer contract
- 2) 100% Maxbid
- 3) Flexible terms of the contact

- 4) 50% of establishment cost
- 5) Grazing and haying allowed every other year.

The probability of this farmer accepting a CRP contract is 0.8523. Table 1 also presents (i) variables of the base case, (ii) the impacts of change in utility due to change in the respective variable (iii) the impacts of change on probabilities due to the changes in various socio-economic factors, and (iv) estimates of the variables' marginal effects on the likelihood of the 'CRP' alternative. To measure the significance level of change in utilities and its statistical impact on probability and willingness to tradeoffs, the Krinsky and Robb parametric bootstrapping method was used.

Table 1: Discrete change in probability, marginal effect in utilities, and tradeoffs

<b>Variable</b>	<b>Mean</b>	<b>Marginal Effect on utilities</b>	<b>Willingness to tradeoffs (WTT) w.r.t to Maxbid</b>	<b>Probability of Participation</b>	<b>Change in Probability</b>
AGE	54.2	0.0312***	-0.9096	0.8561	0.0039
Livestock	0	-0.7948***	21.2840	0.7248	-.1274
DG	1	-0.6111*	21.2527	0.7608	-0.0915
Elig	1	-0.2594**	7.4889	0.8172	-0.351
AP	1	0.8439*	18.3118	0.9302	0.0779
RI	0	-0.1847	4.1906	0.8278	-0.0245
TC	1	-0.7127*	5.7937	0.7396	-0.1127
MaxBid	100	0.3468***	--	0.8565	0.0042
Terms	1	0.0973	2.8070	0.8390	-0.0133
Length	10	0.0196	-0.5680	0.8548	0.0025
Estb	50	0.0088***	-0.2544	0.8534	0.0011
Land_Use	1	-0.6323**	18.2350	0.7547	-0.0976

Notes: \*, \*\*, \*\*\* represents significance levels at the 10%, 5%, and 1% levels, respectively, calculated by using Krinsky Robb method.

Change in maxbid has a positive impact on the probability of enrollment, as expected. An increase in the maxbid by 1% would increase the probability of enrollment by .0039. On

average, producers are willing to trade off flexibility in contract terms with an increase in the maximum bid of 2.81% in order to maintain the initial utility. The probability of respondents' participation decision into CRP program would increase by .0025 for each year increase in contract length. Ceteris paribus, farmers are able to retain the same utility when they forego 5.7% of their maximum payment for accepting a year longer contract. An increase in the government's share of the establishment cost by 1% would only increase the probability of participation decision by .0011. However, the WTT of this variable shows that for an additional 1% establishment cost, farmers are willing to accept a payment (bid rate) cut of nearly .25%.

The elasticity of the probability with respect to land use restriction is found to be relatively high (-0.0976). An increase in the restriction on land usage would reduce the probability of farmers' participation in the CRP by 0.0976. This result is consistent with literature examining the importance of land usage to farmers (Cooper and Osborn, 1998). The WTT estimate of 18.23 for 'land use' means that farmers are willing to accept more restrictions on usage of enrolled land with an increase in maxbid by 18.23%.

In terms of socio-economic factors, older farmers are expected to participate more in the CRP. To compensate livestock farmers, an additional 21.28% of max bid is required as shown by WTT estimate.

This analysis also examines the impacts of various concerns raised by farmers related to existing characteristics of the contracts. Based on the results, differences in contract guidelines, especially between adjacent counties, inconsistent eligibility criteria, requirements for midterm management, and characteristics of the current program have a negative effect on the probability of enrollment. The respective changes in probabilities of

these factors are -0.0915, -0.351, -0.0245 and -0.1127. As shown by WTT estimates, an additional 21.25% and 7.5 % payment are required to compensate farmers who had an issue with the different guidelines or inconsistent eligibility criteria, respectively, to maintain constant utility.

Any modification in the midterm management rules would reduce the probability of participation into CRP. An improvement in issues related to application process would increase the participation decision by 0.078. Results also show that farmers are ready to accept payment cut by 18.31% to avoid hassles involved with the administrative process.

### *Conclusions*

The choice experiment revealed that payment (maxbid), length of the contract, and land use restrictions are the most influential factors associated with the likelihood of farmer's enrollment in the CRP; consistent with the literature. We found that farmers are willing to trade-off program attributes for higher rental payments. We acknowledge that tradeoffs of preferences and specific requirements are indeed case specific. As a consequence, the robustness of these tradeoffs needs to be more explicitly examined. Nevertheless, the detailed focus on individual preference for the desired contract requirements through the use of choice experiments provides a new way to consider the kind of changes desired in the current rules and restrictions of this program.

The results most directly relevant to policy include: 1) haying and grazing allowances as an important factor for the farmers, particularly those with cow/calf operations; 2) if the rental payment can be accessed and adjusted periodically based on prevailing market conditions (we considered after every five 5 years in this study), farmers

would be more encouraged to stay in the contract for a longer period; 3) rental rate is one of the most significant factors influencing a farmer's decision to participate in the program. A well-targeted increase in rental rates may help meet program objectives; and 4) farmers have issues related to the policy and management of the program which might influence their willingness to participate. These fundamental barriers if reconciled could increase farmers' interest in the program.

This study also has some limitations to be addressed in future work. First, the findings should be generalized only with caution due in part to limitations associated with stated preferences methodology. In stated-preference studies, respondents may overstate required benefits (hypothetical bias). In the present study, we worked to reduce hypothetical bias by explaining each policy attribute and difference in the categories in person and including in the description references to current CRP policies that farmers are familiar with and by asking respondents to rank the choices instead of selecting best suitable option. A second limitation is that the population was a convenience sample. Farmers were selected by FSA directors in specific counties to represent a variety of producers, production systems and land types. This convenience sample may be more interested in CRP than the average farmer. Using a random sample would increase confidence in reliability of the results. Third, on the basis of Ruto and Garrod (2009), this study also predicted (like others) that by allowing higher payments, the government can enforce longer and more restrictive contracts but this does not mean lesser rent or financial incentive is required by some farmers to enroll into shorter and less restrictive contracts. Different farmers have different attribute preferences; different trade-off preferences and opportunity costs could also differ on the basis of region,

size of the farm and other factors. Further research is required to identify the correlation between tradeoffs and the opportunity cost of participation.

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