An Economic Analysis of Riparian Landowners' Willingness to Participate in Oregon's Conservation Reserve Enhancement Program

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In October, 1998 the Secretary of Agriculture and the Governor of Oregon announced that the U.S. Department of Agriculture (USDA) and the State of Oregon would join together in an initiative to help restore fresh water ecosystems that provide habitat for salmon and trout listed under the Federal Endangered Species Act. The partnership was formed through USDA's Conservation Reserve Enhancement Program (CREP), a joint federal and state conservation program that targets significant environmental issues related to agriculture. The CREP is a voluntary program that uses financial incentives to encourage farmers and ranchers to enroll in the Conservation Reserve Program. In response to declining native fish populations, Oregon's CREP requires that all participants suspend production on their riparian land for up to 15 years and convert it to one of three riparian conservation practices; forested buffer, filter strip or wetland restoration. Approximately $250 million is available to enroll up to 95,000 acres of riparian land and 5,000 acres of wetland along streams where native salmon and trout exist or are known to have historically existed.

The goal of this study is to model the probability of participation in Oregon's CREP as a function of the incentive payment and a vector of socio-economic variables. A secondary goal is to determine possible reasons for nonparticipation. Obtaining non-participant information increases the range of possible policy instruments to encourage enrollment (Lohr & Park, 1994).

An Economic Approach to Assessing the Probability of Participation

Eliciting a landowner's willingness to participate in Oregon's CREP is analogous to the types of questions typically addressed in contingent valuation (CV) studies. For the purpose of obtaining valuation responses, a dichotomous choice (DC) approach is preferred to direct elicitation (Department of Commerce, 1995). With the dichotomous choice format, the respondent is asked to provide a "yes" or "no" response to a particular bid contained in the participation question,

where the bid amount is varied across the respondents. Rather than attempting to identify an individual's profit function to determine a minimum incentive to induce participation, dichotomous choice allows for determining whether or not an individual's minimum willingness to accept (WTA) is less than or equal to the offered incentive payment.

Economic theory provides some insight as to how respondents make the decisions necessary to complete a dichotomous choice question. The participation decision process can be modeled as a random utility model, assuming that the axioms of rational choice and utility theory are met[1]. When individuals are presented with the dichotomous choice of participation in Oregon's CREP they are faced with comparing their utility with and without participation. From utility theory, an individual will accept \$A to enroll in Oregon's CREP if the individual perceives him or herself as better off with the incentive payment and the program than without; i.e., if $U(0,y;\mathbf{x}) \leq U(1,y+A;\mathbf{x})$, where 0 is the initial state and 1 is the state where the individual participates in Oregon's CREP, y is an individual's income, A is a "net" incentive payment and $\mathbf{x}$ is a vector of additional attributes that may influence the participation decision. Allowing variable A to be the net incentive payment assumes that the pecuniary costs of participation and non-participation are considered. Because an individual's utility, $U(i,y;\mathbf{x})$, is unknown it can be considered a random variable for the researcher. The observable portion of an individual's utility function can be denoted by the indirect utility function $V(i,y;\mathbf{x})$, the mean of the random variable, U. Through addition of an independent and identically distributed (iid) error term, ε_i, the individual's decision to accept \$A and participate in Oregon's CREP can be re-expressed as:

$$V(0,y;\mathbf{x}) + \varepsilon^0 \leq V(1,y+A;\mathbf{x}) + \varepsilon^1. \qquad (1)$$

[1] For discussion of utility theory and the axioms of rational choice see Nicholson, 1995 pages 75-80.

If $V(i,y;\mathbf{x}) = \mathbf{x'}\boldsymbol{\beta}^i + \alpha y$, where $\alpha > 0$, for $i = 0,1$, then an individual will accept \$A and participate in the program when;

$$\mathbf{x'}\boldsymbol{\beta}^0 + \alpha y + \varepsilon^0 \leq \mathbf{x'}\boldsymbol{\beta}^1 + \alpha(y+A) + \varepsilon^1 \qquad (2)^2$$

Following Cooper and Keim (1996), the decision to accept \$A and participate in the program can be expressed in probability framework as:

$$\text{pr}\{\text{WTA} \leq \$A\} = \text{pr}\{V^0 + \varepsilon^0 \leq V^1 + \varepsilon^1\} = \text{pr}\{\varepsilon^0 - \varepsilon^1 \leq V^1 - V^0\};$$

$$\text{where; } V^1 - V^0 = \Delta V = \mathbf{x'}\boldsymbol{\beta} + \alpha A \text{ and } \mathbf{x'}\boldsymbol{\beta} = \mathbf{x'}\boldsymbol{\beta}^1 - \mathbf{x'}\boldsymbol{\beta}^0. \qquad (3)$$

Maximum likelihood procedures are used to fit a logit model to the cumulative probability of participation. The logistic distribution used to model the probability of participation is: $\text{pr(yes)} = [1+ e^{-(\Delta V)}]^{-1} = [1+ e^{-(\mathbf{x'}\boldsymbol{\beta} + \alpha A)}]^{-1}$ (refer to equation 3); where $\mathbf{x}$ is a vector of attributes aside from the bid offer that may influence the participation decision, $\boldsymbol{\beta}$ is a vector of estimated coefficients related to the attributes, α is the coefficient on the bid variable, and A is the bid variable. When the probability of accepting the bid equals 0.5, the average individual will be indifferent between a 'yes' and 'no' response given the mean bid value and mean values of the additional explanatory attributes. Thus, the median WTA can be derived by setting the probability of accepting the bid equal to 0.5 and solving for A.

Conceptual Framework for the Economic Model

Development of the conceptual framework for analyzing the participation decision was based upon a review of literature pertaining to adoption of various conservation practices. The traditional diffusion of innovation model (Rogers, 1962; Napier et al., 1988; and Camboni et al., 1990) and the farm structure-institutional constraints perspective (Napier et al., 1988 and 1994; Camboni et al., 1990; Lohr & Park, 1994; and Cooper & Keim, 1996) were particularly useful in deciding which variables should be included in the WTA model. Previous studies have focused on

[2] Adapted from Cooper and Keim, 1996

identifying socioeconomic characteristics of landowners and their property that are correlated with decisions to adopt conservation practices. Typical factors hypothesized to influence the participation decision include financial incentives, income, land value, farm size, tenure, age, and environmental attitudes and perceptions (Lant, 1991; McLean-Meyinsse et al., 1994; Lohr & Park, 1994; Cooper & Keim, 1996; Lant et al., 1995a,b; and Konyar & Osborne, 1990).

Riparian landowners, in general, recognize the limited direct benefits of adopting conservation practices meant to reduce off-site damages to freshwater habitat and water quality. Under Oregon's CREP, establishing forested riparian buffer strips means foregoing production possibilities in the riparian area for periods of up to 15 years. Contracts lasting up to 15 years prohibit landowners from changing management in their riparian areas regardless of commodity prices or additional farm program incentives. In addition, there are costs associated with establishing and maintaining permanent forest cover for the buffer strip; cost-share available through Oregon's CREP only covers 75% of the cost of establishing the practice and a $5 per acre per year maintenance payment. For each individual there is a threshold where the benefits from receiving a guaranteed yearly payment compensates for the loss in production revenue, the cost of establishing and maintaining the buffer strip and the risk involved with participation.

The relationship between the payment offered and the participation decision is hypothesized to be conditioned on sociological and past experience variables as well as 3 economic constraints: opportunity costs, future expectations, and preferences (Table 1).
The opportunity cost of an action is the value of the foregone alternative action (Pearce, 1992). For an individual to consider participation in Oregon's CREP the yearly payment should compensate for the expected revenue foregone (either direct or indirect) over the contract period.

An individual's expectation about the future determines their planning horizon and may be a critical component influencing the participation decision. Future expectations regarding product prices, environmental regulation, and planned retirement are all components hypothesized to influence the participation decision. Preferences, past experiences and sociological demographics provide the guidelines by which individuals make utility maximizing decisions.

Table 1: Variables Expected to Influence the Participation Decision

Categories & Variables	Variable Description	Expected Relationship
PAYMENT	Annual payment for participation	+
Opportunity Costs		
ACRES	Total acreage of the property	+
HIGHLAND	Total acreage dedicated to high value crops	-
LOWLAND	Total acreage dedicated to low value production	+
FARMINC	Percent of income from farm sources	-
Future Expectations		
PLNRET2	Planned retirement within 10 years	+
SB	Compliance with SB 1010	+
REGUL	Compliance with future regulations	+
FLX	Flexibility of future land use	-
Preferences		
ENVIMP	Low importance placed on fish & water quality	-
ENVSAT	Low satisfaction with fish & water quality	+
ENVPER	No perception of an environmental problem	-
AG	Required interaction with a State or Federal Agency	-
NEIB	Acceptance by neighboring landowners	+
SHARE	Availability of cost-share	+
EC	Reduced economic returns	-
Sociological		
AGE	Age of respondent	-
EDUX	Completion of some education beyond high school	+
RET	Retired	+
Past Experience		
CRP	Familiarity with Conservation Reserve Program	+
CREP	Prior knowledge about Oregon's CREP	+
PRGPART2	Past participation in a USDA program	+

Survey Design and Population Description

The entire population of riparian landowners along 5 streams in Union County and 6 streams in Washington County was surveyed for their willingness to participate in Oregon's CREP following the Total Design Method (Dillman, 1978). These counties were chosen to reflect the diverse climate and management regimes in Oregon. Situated west of the Cascade Mountain

Range, in the Willamette Valley, annual precipitation in Washington County ranges 0.54 inches during the summer months to 6.59 inches during the winter. Union County, located in the Northeast, receives significantly less precipitation, ranging from 0.61 inches in the summer to 1.64 inches in the spring. Temperatures also vary between the two counties: Union has colder winters and longer periods of dry, hot summer weather. The mean maximum and minimum temperatures are 83.7 and 23.5 degrees Fahrenheit, respectively. Extreme high's and lows range from 108 to –24 degrees F. Washington County, under maritime influences, has a more temperate climate with mean maximum and minimum temperatures of 80.5 and 33.3 degrees F, respectively. Extreme high and low temperatures range from 106 to –2 degrees F. Climatic variability accounts for the different management regimes among the counties. Individual producers in Union County are predominantly involved in the ranching industry, with a limited amount of land dedicated to irrigated crops. Washington county producers have a more diverse cropping system with land dedicated to vegetables, berries, nuts, grass etc. with limited involvement in ranching.

In a mail survey, we presented 216 Union County and 1116 Washington County riparian landowners with a hypothetical opportunity to accept or reject an annual payment to participate in Oregon's CREP. The questionnaire provided a brief description of the benefits that might accrue to society, the operational components of the program, the enhanced incentives offered, and the program requirements. Recognizing the difference in value between irrigated and dry land, one of the enhanced incentives included an increased annual payment for irrigated land. Consistent with dichotomous choice, each respondent was asked to either accept or reject the specified annual payment to enter into Oregon's CREP. Respondents who were unwilling to participate were asked to complete scaled response questions as to possible reasons for their non-participation decision.

All respondents were asked to identify reasons that potentially make a difference in their decision to establish buffer strips as well as descriptive data about themselves and their property.

Of the 1332 surveys distributed to the population, the overall response rate was 63.7% (65.3% in Union County and 63.3% in Washington County). Data was analyzed from 290 respondents who identified eligible land for Oregon's CREP; 123 of these could not be used in the logit analysis due to incomplete responses to critical analysis variables. 500 questionnaires were returned by respondents ineligible to participate in CREP because the they did not own riparian land or did not meet the requirements of the CREP program (cropped two of the past 5 years or grazed within the last 5 years). 28 questionnaires were declined and 47 questionnaires were sent to wrong addresses. Descriptive statistics for the 167 observations analyzed in the logit model are listed in Table 2.

Table 2: Mean statistics of the populations

Variable	Dry Land Respondents	Irrigated Land Respondents
ACRES	1069.4	157.3
HIGHLAND	30.943	56.062
LOWLAND	49.108	59.716
FARMINC	25.89	47.855
PLNRET2*	0.26371	0.32895
SB*	0.46154	0.61842
REGUL*	0.52747	0.59211
FLX*	0.75824	0.85526
ENVIMP**		1.4474
ENVSAT**	3.0989	
ENVPER**	1.4066	1.5395
AG*		0.56597
NEIB*	0.28571	0.32895
SHARE*	0.61538	0.72368
EC*	0.48352	0.75
AGE	58.132	54.934
EDUX*	0.85714	0.77632
RET*		0.13158
CRP***	2.3297	2.2237
CREP*		0.64474
PRGPART2*	0.40659	0.46053

* Interpreted as percentage. ** Interpreted on a scale of 1 to 5 (1 = very important, very satisfied, strongly perceived; 5 = unimportant, not satisfied and not perceived, respectively). *** Interpreted on scale of 1 to 3 (1 = very familiar, 2 = somewhat familiar and 3 = not at all familiar).

Results

Separate econometric models, were analyzed for dry land riparian landowners and irrigators. Both models have a high percentage of correct prediction, 90.1% and 92.1% respectively, indicating that the models do a good job of predicting the response to the 'willingness to participate' question. Estimated coefficients and their respective T-ratio's for both models are provided in table 3.

Table 3: Logit Model Parameter Estimates for the Participation Decision

	Dry Land		Irrigated Land	
Variable	Coefficient	(T-Ratio)	Coefficient	(T-Ratio)
BID	0.048	(2.58)[2]	-0.041	(-2.22)[2]
PUNION	0.013	(0.30)	0.171	(2.36)[2]
ACRES	0.002	(-0.83)	0.035	(2.24)[2]
HIGHLAND	-0.007	(-0.57)	-0.041	(-2.05)[2]
LOWLAND	0.012	(1.65)[4]	-0.042	(-2.32)[2]
FARMINC	-0.052	(-2.37)[2]	0.034	(1.30)[4]
PLNRET2	-2.189	(-1.51)[4]	6.714	(2.41)[2]
SB	2.377	(2.03)[2]	-1.100	(-0.90)
REGUL	-2.203	(-1.86)[3]	2.587	(1.75)[3]
FLX	-2.314	(-1.76)[3]	-9.575	(-2.45)[1]
ENVIMP			-2.509	(-1.78)[3]
ENVSAT	-0.517	(-1.24)		
ENVPER	-1.148	(-1.15)	-2.807	(-2.90)[1]
AG			-2.346	(-1.80)[3]
NEIB	3.955	(2.70)[1]	0.665	(0.55)
SHARE	5.179	(3.07)[1]	3.812	(2.28)[2]
EC	-2.280	(-1.80)[3]	3.806	(2.27)[2]
AGE	-0.068	(-1.66)[4]	-0.076	(-1.02)
EDUX	-3.934	(-2.10)[2]	5.039	(2.55)[1]
RET			6.162	(1.98)[3]
CRP	0.658	(0.83)	2.657	(1.87)[3]
CREP			1.472	(0.83)
PRGPART2	1.586	(1.45)[4]	-1.708	(-1.22)
INTERCEPT	8.092	(1.06)	1.371	(0.31)
N	76		91	
Observations at 1	38		34	
Observations at 0	38		57	
Percentage of correct Predictions	90.1		92.1	
Estimated Mean WTA				
Union County	$144.38		$149.87	
Washington County	$194.99		$204.55	

[1] Significant at the 1% level. [2] Significant at the 2.5% level. [3] Significant at the 5% level.
[4] Significant at the 10% level. The dependent variable is participation in Oregon's CREP (1 if yes).

The influence of the yearly payment (BID), as expected, significantly influences the participation decision under all circumstances. In order to separate the influence of the BID for Union and Washington County respondents (for both dry and irrigated land), a dummy variable was added to the analysis. The dummy variable (PUNION) was the product of the bid rate offered and a county dummy (1 if Union). Inclusion of this variable allowed for an independent coefficient on the BID variable and an independent calculation of the mean willingness to accept (WTA). The coefficient of the BID variable is positive for both Union and Washington County dry land respondents as well as for Union County irrigators, however; the coefficient is negative for Washington County irrigators. This latter result is unexpected but may be related to the diversity of irrigated crops grown in the county and the limited range of bids offered to the respondents.[3]

The variables chosen to represent the "opportunity cost" further help explain the participation decision. Landowners who dedicate their acreage to producing high value crops, as expected, have a decreased probability of participation for both irrigated and dry land (significant only for irrigated land). Also as expected, landowners dedicating their dry land to haying or grazing have an increased probability of participation. However, irrigators who dedicate their land to haying or grazing have a decreased probability of establishing forested riparian buffer strips through Oregon's CREP. This latter result is not surprising as irrigated riparian land dedicated to grazing and producing hay is often times the most productive land of the property. It is not unreasonable to expect the probability of participation to decrease for these types of producers.

[3] A recent Maryland CREP focus group, including 364 farmers, indicated that the incentives offered were not a major factor in improving the impression of the program or increasing likely participation. Some farmers participating in the focus group indicated that their interest in the program had little to do with financial incentives because these incentives only marginally affected their "bottom-line" (NA, 1999)

Future expectations appeared to significantly influence participation for both irrigators and non-irrigators. Results indicate that individuals who place importance on the flexibility of future land use will be less likely to participate in CREP. Perhaps this indicates that the contract periods are too long in duration or do not provide for enough flexibility. This result is consistent with previous researchers who have found that allowing flexibility in conservation programs will increase participation rates (Purvis, 1989; Lant, 1991). The importance of a conservation program to provide compliance with current or future land use regulations was significant but of opposite sign for irrigators and non-irrigators. It appears that the more importance placed on compliance with future regulations the less likely dry land riparian owners are to participate in CREP, while the opposite is true for irrigators.

Preferences, sociological variables and past experience also help explain participation. Landowners recognize the benefits of the cost-share component of Oregon's CREP. Individuals who place importance on the availability of cost-share to establish conservation practices have an increased probability of participation. The perception of an environmental issue needing to be addressed on streamside property also increases the likelihood of participation. Respondents were asked to assess how strongly they agreed (1) or disagreed (5) with the need to address a number of environmental issues on the streams running through their property. As the level of disagreement increased the probability of participation decreased.

The mean WTA for irrigators and non-irrigators for each county is provided in Table 3. It is of interest to note that each of the estimates is at the high end of (or exceeds) the values currently being offered by the Farm Service Agency for participation in Oregon's CREP. Also of interest is the small difference between the mean WTA for irrigated and dry land in each of the

counties. This difference was expected to be larger as estimates indicate that on average irrigated land rents for twice the rate of dry land in Oregon.

While the results from the logit analysis may assist policy makers in their efforts to understand the factors that influence participation in Oregon's CREP, perhaps of equal interest are the reasons why respondents chose not to participate in the program. Respondents who indicated that they would not participate in Oregon's CREP were asked to address possible reasons for not participating. The mean results of these questions are reported in Table 4.

Table 4: Mean Responses of Unwilling Respondents*

Reason	N	Mean	Standard Deviation
A. Annual payment insufficient …..	153	2.3	1.11
B. Too expensive to **establish** conservation practice …….	153	2.5	1.12
C. Too expensive to **maintain** conservation practice …….	153	2.3	1.07
D. Reduced flexibility to change land uses as economic conditions warrant ……...	158	1.8	1.00
E. Interference with management of remaining property ……	155	2.1	1.18
F. Riparian land is too productive to convert to "no-use" ……...	151	2.4	1.20
G. Concern about restrictions at the end of the contract period …….	157	1.6	0.96
H. I do not want to enter into a contractual arrangement with the **federal** government ……	162	2.0	1.11
I. I do not want to enter into a contractual arrangement with the **state** government ……	160	2.0	1.10
J. Opinions from neighboring land owners prevents me from considering enrollment ……..	150	3.7	1.13
K. I believe that riparian areas can be restored with proper management ……..	154	1.8	0.89

* 1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree

Of the original 290 survey's used in the analysis, 171 individuals indicated that they would not participate in the program, 103 indicated a positive willingness to participate and 16 declined to answer the question. The number of respondents (N) to each statement varies due to the fact that

some respondents did not address all of the reasons provided in the questionnaire. It appears that the primary reasons for non-participation include reduced flexibility to change land use as economic conditions warrant, concern over restrictions at the end of the contract, and a strong belief that riparian areas can be restored through proper management. In addition, a number of respondents indicated that they already have a riparian buffer strip in place.

Policy Implications

These results indicate that approximately 50% of irrigators and 37% of dry land riparian landowners will participate in Oregon's CREP, as described in the questionnaire, at yearly payments close to those currently offered. Some changes, or clarification, of Oregon's CREP may assist in increasing participation. While the annual payment offered influences participation, it is clearly not the sole driver of the participation decision. Increasing the annual payment may induce participation, but other changes to the program may be necessary as well. Clarifying the regulations that pertain to enrolled land at the end of the contract period appears to be essential. In addition, providing flexibility for land management during the contract seems desirable. Communication between land owners and resource agencies may also help to increase participation as those who perceive a need to address environmental issues are more responsive to the program.

The mixed findings for the importance of compliance with current or future land use regulations may imply that some respondents do not perceive these regulations as pertaining to their property. Agencies may want to communicate with landowners regarding whether their land management practices meet current and anticipated water quality regulations and the key role that conservation programs can play.

References

Camboni S.M., T.L. Napier, and S.B. Lovejoy. 1990. Factors Affecting Knowledge of and Participation in the Conservation Reserve Program in a Microtargeted Area of Ohio. Pages 202-222 *in* T.L. Napier, ed. Implementing the Conservation Title of the Food Security Act of 1985. Soil and Water Conservation Society, Ankeny, Iowa.

Cooper J.C. and R.W. Keim. 1996. Incentive Payments to Encourage Farmer Adoption of Water Quality Protection Practices. American Journal of Agricultural Economics 78(February):54-64.

Department of Commerce. 1995. National Oceanic and Atmospheric Administration. Natural Resource Damage Assessments. Federal Register 60(149):39804-39834.

Dillman D.A. 1978. Mail and Telephone Surveys: The Total Design Method. John Wiley & Sons, Inc. New York.

Konyar K. and C.T. Osborn. 1990. A National-Level Economic Analysis of Conservation Reserve Program Participation: A Discrete Choice Approach. The Journal of Agricultural Economics Research 42(2)5-12.

Lant C.L. 1991.Potential of the Conservation Reserve Program to Control Agricultural Surface Water Pollution. Environmental Management 15(4):507-518.

Lant C.L., S.E. Kraft and K.R. Gillman. 1995a. Enrollment of Filter Strips and Recharge Areas in the CREP and USDA Easement Programs. Journal of Soil and Water Conservation 50(1):193-200.

----------. 1995b. The 1990 Farm Bill and Water Quality in Corn Belt Watersheds: Conserving remaining wetlands and restoring farmed wetlands. Journal of Soil and Water Conservation 50(2):201-205.

Lohr L. and T. Park. 1994. Discrete/Continuous Choices in Contingent Valuation Surveys; Soil Conservation Decisions in Michigan. Review of Agricultural Economics 16(January):1-15.

McLean-Meyinsse P.E., J. Hui and R. Joseph Jr. 1994. An Empirical Analysis of Louisiana Small Farmers' Involvement in the Conservation Reserve Program. Journal of Agricultural and Applied Economics 26(2):379-385.

NA. 1999. A Chesapeake Alliance for Sustainable Agriculture. Duplicates from a Maryland Farmers focus group meeting. May 5, 1999.

Napier T.L., C.S. Thraen and S.M. Camboni. 1988. Willingness of Land Operators to Participate in Government Sponsored Soil Erosion Control Programs. Journal of Rural Studies 4(4):339-347.

Pearce D.W. 1992. The MIT Dictionary of Modern Economics. The MIT Press, Massachusetts.

Purvis A., J.P. Hoehn, V.L. Sorenson, and F.L. Pierce. 1989. Farmers' Response to a Filter Strip Program: Results from a contingent valuation study. Journal of Soil and Water Conservation 44(5):501-504.

Rogers E.M. 1962. Diffusion of Innovations. The Free Press of Glencoe, New York. Pages 1-19 and 76-120.