

# Program Participation Behavior of Nonindustrial Forest Landowners: A Probit Analysis

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## ABSTRACT

This study provides an analysis of nonindustrial private forest (NIPF) landowners' participation in forestry assistance programs. A probit model was used for data collected from a random sample of 329 Indiana landowners. The analysis revealed that total land owned, commercial reasons for ownership, government sources of information, and membership in forestry organizations influenced NIPF landowners' program participation. Age, fear of loss of property rights, and duration since the first wooded tract was acquired also influenced program participation. Location of landowners' residence on their wooded land and landowners' knowledge of and willingness to participate in a conservation easement influenced the participation in cost-share programs.

**Key Words:** classified forestry programs, cost-share programs, nonindustrial private forest landowners, participation behavior, probit.

Wooded land occupies 4.4 million acres, or 19.3% of the total land area of 23 million acres in Indiana. Nonindustrial private forests (NIPF) represent 87% of the commercial forest land and supply 93% of the sawtimber harvested (Smith and Golitz). Several government programs, both with and without financial incentives, have been developed to encourage NIPF landowners to reforest, improve timber stands, increase wildlife habitat, reduce soil erosion, and protect water quality

and the environment. Tax incentives, technical guidance, provision of seedlings, and cost sharing are among the methods used for promoting sound conservation and forest management practices.

In general, voluntary woodland management programs have met with limited success (Clawson). One reason for this has been a program emphasis on woodland owners as people involved in timber production (Hyberg). However, there is increasing awareness among forest researchers that woodland owners have many other individual and societal motivations for owning and developing their wooded land (Jones). For example, landowners may have recreation, aesthetics, wildlife, land stewardship, enhancement of land value, amenity values, etc., among the other needs and wants to be satisfied through their forest land (Kurtz and Lewis; Young and Reichen-

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bach). In order to design forestry programs that will attract a large number of participants, it is necessary to understand the distinguishing characteristics, motivations, attitudes, and beliefs of wooded landowners to ensure that these are satisfied through the programs targeted to these groups. Increasing the participation of NIPF landowners requires alternative marketing strategies. Programs may also have to be modified to suit the interests of NIPF landowners.

There are two general types of government forestry assistance programs. The first, identified as classified forestry programs, includes Indiana's Classified Forests, Indiana's Classified Wildlife Habitat, and Indiana's Classified Windbreaks. The incentives for participation in any of the state's classified programs are that the assessed value of land is reduced to \$1 per acre and free technical advice and assistance are available from the Indiana Department of Natural Resources. If the land is withdrawn from any of the classified programs, tax relief is foregone because reduced assessment value for the prior 10 years must be repaid.

The second category, cost-share programs, includes the Forestry Incentives Program (FIP), Stewardship Incentive Program (SIP), Agricultural Conservation Program (ACP), and Conservation Reserve Program (CRP). Cost-share programs are funded by the federal government up to 50–75% of cost for eligible practices like tree planting, timber stand improvement, or site preparation for natural regeneration. The programs are administered by federal agencies such as the U.S. Department of Agriculture (USDA), Agricultural Stabilization and Conservation Service (ASCS), and Soil Conservation Service (SCS). In Indiana, these programs are implemented by state agencies such as the Indiana Department of Natural Resources (IDNR) Division of Forestry, IDNR Division of Fish and Wildlife, and IDNR Division of Soil Conservation.

Participation behavior of NIPF landowners in the forestry assistance programs has not been the focus of a great deal of study. An exception was a recent study by Bell et al.,

in which the likely effects of cost-share incentives were examined based on survey data of individuals' willingness to participate in the Tennessee Forest Stewardship Program. In the current study, we address factors influencing Indiana NIPF landowner participation in forestry programs, based on actual participation.

### Conceptual Framework and Empirical Specification

NIPF landowners are assumed to have adoption behavior similar to that attributed to farmers. Forestry programs involve technical assistance as an important element in influencing NIPF landowners' management of forest land. Hence, landowners' participation in the forestry programs is equated with adoption of forestry technology.

Rahm and Huffman developed a general model where individuals were assumed to make adoption decisions based on utility maximization. Let us denote  $t = 1$  for participation in programs and  $t = 0$  for nonparticipation in programs. The underlying utility function which ranks the preference of the  $i$ th individual is given by  $U(H_{it}, M_{it})$ . Utility depends on  $H_{it}$ , a vector of personal attributes (e.g., age, education, income, occupation) and woodland characteristics (e.g., tract size), and  $M_{it}$ , a vector of management characteristics (e.g., activities enjoyed, ownership reasons, information sources, attitudes) associated with the specific programs. The relation shown in (1) below does not restrict the function  $F$  to be linear:

$$(1) \quad U_{it} = \alpha_t F_i(H_{it}, M_{it}) + e_{it}, \\ t = 1, 0; \quad i = 1, \dots, n,$$

where the utilities  $U_{it}$  are random, and the  $i$ th individual participates in programs ( $t = 1$ ) if  $U_{1i} > U_{0i}$ , or if the nonobservable random variable  $y_i^* = 1$  if  $(U_{1i} - U_{0i}) > 0$ , otherwise  $y_i^* = 0$ . The probability that  $y_i^* = 1$  (i.e., the individual participating in the program) can be written as a function of the independent variables:

$$\begin{aligned}
 (2) \quad P_i &= P_r(y_i^* = 1) = P_r(U_{1i} > U_{0i}) \\
 &= P_r[\alpha_1 F_i(H_{1i}, M_{1i}) + e_{1i} > \alpha_0 F_i(H_{0i}, M_{0i}) + e_{0i}] \\
 &= P_r[e_{1i} - e_{0i} > F_i(H_{0i}, M_{0i})(\alpha_0 - \alpha_1)] \\
 &= P_r[\mu_i > F_i(H_{0i}, M_{0i})\beta] = F(X_i'\beta),
 \end{aligned}$$

where  $P_i$  is a probability of the  $i$ th individual adopting the program;  $\mu_i = e_{1i} - e_{0i}$ , and is a random disturbance term;  $\beta = \alpha_0 - \alpha_1$ , and is a vector of parameters to be estimated;  $X_i'$  is the vector of explanatory variables; and  $F(X_i'\beta)$  is the cumulative distribution function for  $\mu_i$ , evaluated at  $X_i'\beta$ .

Equation (2) cannot be estimated directly without knowledge of the form of  $F$ . The distribution of  $F$  depends on the distribution of the random term  $\mu_i = e_{1i} - e_{0i}$ . If  $\mu_i$  is normal, then  $F$  is a cumulative normal, and if  $\mu_i$  is uniform, then  $F$  is triangular (Rahm and Huffman).

Woodland owners choose to participate in one or both of the two types of forestry programs, or they choose not to participate. This provides a yes or no response for the dependent variable. A probit model is used to analyze this type of decision problem. The probit model follows a normal cumulative distribution function which, evaluated at  $X_i'\beta$ , will generate an unobservable utility index,  $I_i$ . This model is based on utility theory or rational choice perspective on behavior as developed by McFadden.

It is reasonable to assume that if the unobservable utility index  $I_i$  crosses some critical or threshold level of the index denoted  $I_i^*$  (i.e., if  $I_i$  exceeds  $I_i^*$ ), then the NIPF landowner will participate in the forestry assistance program. Otherwise the landowner will not participate. Given the assumption of normality, the probability that  $I_i^*$  is less than or equal to  $I_i$  can be computed from the standardized normal cumulative distribution function as:

$$\begin{aligned}
 (3) \quad P_i &= P_r(Y = 1) = P_r(I_i^* \leq I_i) = F(I_i) \\
 &= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{I_i} e^{-z^2/2} dt,
 \end{aligned}$$

where  $I_i = X_i'\beta$ , and  $z$  is a standardized normal

variable with zero mean and unit variance, i.e.,  $z \sim N(0, 1)$ .

The main advantage of the probit functional form is that it is bounded between 0 and 1, and here the problem of predicted values lying outside the probability range is overcome. Furthermore, it compels the disturbance term to be homoskedastic because the form of the probability depends only on the difference between the error term associated with one particular choice and another (Amemiya; Domencich and McFadden).

The probit model specified in this study to analyze NIPF landowners' decisions about whether or not to participate in forestry assistance programs can be expressed as follows:

$$\begin{aligned}
 (4) \quad Y_i &= 1 = X_i'\beta + e_i \quad \text{if } X_i'\beta + e_i > I_i^* \\
 &= 0 \quad \quad \quad \text{if } X_i'\beta + e_i \leq I_i^*,
 \end{aligned}$$

where  $Y_i$  is the NIPF landowner's decision variable, which takes on the value of one if the landowner participates in the forestry assistance programs and zero otherwise;  $I_i^*$  is the critical value or threshold point; and  $e$  is an independently distributed disturbance term with zero mean and unit variance, i.e.,  $e_i \sim N(0, 1)$ . The probit function is estimated by the maximum likelihood method.

Two statistical software programs, SAS (SAS Institute, Inc.) and LIMDEP (Greene), were used to obtain the maximum likelihood estimates of the probit analysis for the models developed in this study. The partial derivatives, which measure the change in probability of participation in government assistance programs for a unit change in the independent variable, were calculated by differentiating the probability of program participation with respect to each continuous attribute variable in the linear equation utilizing the following formula:

$$(5) \quad \frac{\partial P}{\partial X} = \frac{\partial F(X_i'\beta)}{\partial X} = f(X_i'\beta)\beta,$$

where  $P$  is the probability of program participation,  $F(\cdot)$  is the cumulative density function of  $X_i'\beta$ ,  $f(\cdot)$  is the standard normal function of  $X_i'\beta$ ,  $\beta$  is a vector of estimated parameters for the independent variables, and  $X_i'$  is a vector

of means of the independent variables. The goodness of fit is evaluated by using three different  $R^2$  measures:

- (a) the Zavoina-McKelvey (ZM) pseudo  $R^2$ :  
Pseudo  $R^2 = \text{ExSS} / (\text{ExSS} + N)$ , where ExSS is explained sum of squares, and N is total sample size;
- (b) the Aldrich-Nelson (AN) pseudo  $R^2$ :  
Pseudo  $R^2 = \chi^2 / (N + \chi^2)$ , where  $\chi^2$  is the chi-square statistic, and N is total sample size; and
- (c) the normalized  $R^2$  (Royer):  
Normalized  $R^2 = \text{AN } R^2 / 0.333$ .

The empirical model of NIPF landowners' participation in the government forestry assistance programs was specified as a function of landowner characteristics, woodland characteristics, management characteristics, information sources, and landowners' attitudes and beliefs about the programs:

$$(6) \quad PP = f(OC, WC, MC, IS, AT),$$

where  $PP$  is participation in programs (1 if landowner participates, 0 otherwise);  $OC$  is owner characteristics of NIPF landowners;  $WC$  is characteristics of woodland owned by the NIPF landowners;  $MC$  is use and management characteristics of woodland;  $IS$  is information sources used by landowners; and  $AT$  is attitudes of the NIPF landowners.

#### Owner Characteristics

Several earlier studies found that age has an influence in the adoption process. Sales managers' age was negatively associated with the export participation of southern hardwood lumber mills (Hammett, Cubbage, and Luppold). Age of farmers was positively associated with the adoption of soil conservation practices (Ervin and Ervin), the adoption pattern of minimum tillage practices (Korsching et al.), and the adoption of integrated pest management among peanut producers (McNamara, Wetzstein, and Douce). It is hypothesized here that age, a measure of experience, influences positively the NIPF woodland own-

ers' decision to participate in forestry programs.

The level of education is considered to have a positive relationship in the adoption process. Sales managers' export participation (Hammett, Cubbage, and Luppold) and the intensity of effective use of the Forestry Incentives Program (Boyd) were positively associated with level of education. In the present study, a positive relationship is assumed between educational level and the probability of landowners' participation in forestry assistance programs, i.e., owners with more education are expected to be better able to understand the benefits associated with participation.

Income level increases the capacity to acquire more acres of woodland and access to information sources such as government departments and private consultants. Thus, a positive relationship is hypothesized between income and landowners' participation in the forestry assistance programs.

Finally, occupation is hypothesized to influence program participation behavior. Farmers are treated as one occupation category; professionals, owner-managers, and executives are grouped as another category. If the landowner belongs to these occupational groups, the probability of program participation is expected to increase, as the landowner would be more familiar with government programs and how to participate in them.

#### Woodland Characteristics

In the adoption decision behavior of technical assistance foresters (Hodges and Cubbage), conservation practices (Napier et al.), minimum tillage practices (Korsching et al.), integrated pest management (McNamara, Wetzstein, and Douce), and tract size were associated positively with adoption. For the present study, a positive relationship is expected between the amount of total land owned by the landowners and the probability of participation in forestry programs. Similarly, as the proportion of woodland increases, the probability of program participation in-

creases because the potential benefits from the assistance programs increase.

NIPF landowners attach importance to their residence being located on their wooded land (Yang). Thus, we assume a positive relationship between location of residence in the wooded land and the probability of participation in government forestry assistance programs because owners living on their woodland would have easier access to the land.

The measure of number of years since acquiring the first wooded acres may indicate landowners' interest in wooded land. A positive relationship between this variable and participation is hypothesized because longer-term owners would receive more benefits from participation.

#### *Woodland Use and Management Characteristics*

Woodland owners undertake activities such as developing plans, supervising labor, computing financial returns, etc., which can provide mental stimulation/enjoyment. Land ownership also might require physical activity, such as timber stand improvement, cutting firewood, or maintaining paths, which can provide enjoyment. It is hypothesized that if the landowners enjoy either mental or physical management activities, their probability of program participation increases because they would be more willing to comply with program requirements.

Reasons for owning woodland is another factor influencing landowners' participation in assistance programs. The reasons may be commercial, like timber stand improvement, harvesting timber for commercial purposes, or increasing value of land investment. Noncommercial reasons may be aesthetic enjoyment, recreation, timber harvesting for use by family or friends, or that the woodland is part of the individual's residential land. It is assumed that if the reasons for owning woodland are commercial, then the probability of program participation increases because it can increase the owners' returns.

#### *Information Sources*

It has been established that technology adopters rely on more sources of information and exhibit more social participation than nonadopters (Rogers). Early adopters are more likely than others to be members of more organizations (Palmer et al.). Hodges and Cubbage found that the use of communication channels significantly influenced the adoption decisions of technical assistance foresters. Two types of information sources for landowners can be distinguished: government and nongovernment. It is hypothesized that if NIPF landowners consider government personnel as very important or important sources of information for managing their wooded land, then it will have a positive impact on their decision to participate. Similarly, government sources of written information are also hypothesized to increase the probability of program participation, as owners with more information would be more familiar with programs.

Membership in forestry organizations is another factor which may influence landowners' participation in programs. Hodges and Cubbage found a negative impact on the adoption decision behavior of technical assistance foresters who were members of the Society of American Foresters (SAF). In this study, it is hypothesized that membership in forestry organizations which are directly involved in helping the NIPF farmers, such as the Indiana Forestry and Woodland Owners' Association, the Christmas Tree Growers' Association, the Walnut Council, and the Indiana Tree Farm Committee, will increase the probability of landowners' participation in the programs because these organizations provide an arena for enhanced awareness of the benefits associated with program participation. The American Forestry Association was excluded from the list of forestry organizations since it is a general-interest organization and may not have direct impact on NIPF farmers' participation in the forestry assistance programs.

#### *Attitudes*

Two attitude variables are used to test how owners' attitudes influence program partici-

pation. If the landowners feel that participation may result in a loss of options or rights in managing their property with respect to harvesting timber, managing timber/wetlands, or managing farm operations, then they may choose not to participate in the government assistance programs. Accordingly, the probability of program participation decreases if the landowners feel they would experience a resulting loss of options or rights to manage their property. If the NIPF landowners are familiar with the concept of conservation easements and if they are willing to consider selling an easement on their land, then the probability of participation in forestry assistance programs also increases.

### **Data and Methods**

Data were collected by mail survey from NIPF landowners in Indiana during the winter of 1994 (Vasan). A sequential random sampling method was used to ensure a statewide distribution of respondents. Indiana counties were ordered according to the area of forest land. Within counties, parcels were ordered by township northwest to northeast. The sample sections of land were then chosen by identifying the section containing every 40,000th acre of wooded land. Within each county, wooded land was assumed to be evenly distributed, as data on acres of woodland per section or parcel are not available. Parcels were ordered by section, beginning in the northwest and going east by section row. Areas identified as urban or lands whose ownership was more than 50% U.S. Forest Service were excluded from the sample frame. The total wooded land in each section was approximated using U.S. Geological Survey topographic maps. Sections with fewer than 20 acres of wooded land were disregarded. Addresses of landowners in these sections, who own at least 10 acres of land with trees, were collected from the respective Indiana county offices.

Detailed questionnaires were sent to a total of 789 landowners. Valid responses were received from 436 respondents. However, due to missing values for some variables, the final study sample was limited to 329 respondents.

The survey questionnaires collected descriptive data on wooded land and owner characteristics as well as information on wooded land use and management, and management assistance. Of the 92 counties in Indiana, 77 were represented in the sample. Detailed descriptions of data can be found in Vasan and in Nagubadi. The definitions for data used in the analysis are presented in table 1.

The sample size was 329 respondents for the empirical analysis, comprised of 91 participants in classified forestry programs, 55 participants in cost-share programs, and 183 non-participants. There were 33 respondents who participated in both classified forestry and cost-share programs.

NIPF landowner participation behavior was examined separately for participants in classified forestry programs and cost-share programs. The separate models allowed for examination of the differences in the participation behavior of NIPF landowners within the two program categories. Generally, participation in cost-share programs requires greater commitment and involvement in terms of activities and participants' share of the cost of such activities than does participation in the classified forestry programs.

### **Results and Discussion**

#### *Mean Values of Independent Variables*

The mean values of independent variables and their standard deviations are presented in table 2. On average, the program participants are slightly older in age, are represented by a higher percentage of respondents having education beyond high school, and have higher levels of income than the nonparticipants. Further, the cost-share program participants have slightly higher income levels than the classified forestry program participants. The percentage of respondents whose occupation is farming is highest for cost-share program participants and lowest for the nonparticipants. The percentage of professionals/owner-managers/executives is approximately the same across all categories. On average, the cost-share program participants have larger tracts

**Table 1.** Independent Variables and Definitions

Independent Variables	Definitions	Independent Variables	Definitions
<b>Owner Characteristics:</b>		<b>Information Sources:</b>	
<i>AGE</i>	Landowner's age in years	<i>GGIS</i>	Consulting/personnel sources of landowner's information in managing woodland considered very important or important: 1 if district forester/Indiana Div. of Forestry, or district wildlife biologist/Indiana Div. of Fish and Wildlife, or extension educator/Purdue University, or soil conservation agent; 0 otherwise
<i>EDUC</i>	Landowner's education: 1 if beyond high school; 0 otherwise	<i>GGWS</i>	Written sources of information considered by landowner as very important or important: 1 if publications of Indiana Dept. of Natural Resources, or Purdue University Extension Service, or Soil Conservation Service; 0 otherwise
<i>INC</i>	Combined household income: 1 = < \$10,000, 2 = \$10,000-\$19,999, 3 = \$20,000-\$29,999, 4 = \$30,000-\$39,999, 5 = \$40,000-\$49,999, 6 = \$50,000-\$59,999, 7 = \$60,000-\$74,999, 8 = \$75,000-\$99,999, 9 = \$100,000 and above	<i>FORGZ</i>	Membership in forestry organizations: 1 if member in one or more of the following: Indiana Forestry and Woodland Owners' Assn., Christmas Tree Growers Assn., the Walnut Council, Indiana Tree Farm Committee; 0 otherwise
<i>FARMER</i>	Primary occupation of landowner: 1 if farmer; 0 otherwise	<b>Attitudes:</b>	
<i>PR/MG/EX</i>	Primary occupation of landowner: 1 if professional, owner-manager, or executive; 0 otherwise	<i>LOSSPR</i>	Feeling of owner about loss of property rights or options to manage property: 1 if owner responded "yes" with respect to harvesting timber, or managing timber or wetlands, or managing farm operations; 0 otherwise
<b>Woodland Characteristics:</b>		<i>EASE</i>	Knowledge of landowner about conservation easements and willingness to consider selling an easement: 1 if landowner responded "yes," 0 otherwise
<i>TLAND</i>	Number of total acres owned by landowner		
<i>WLPER</i>	Percent of woodland in total acres owned		
<i>LOCA</i>	Location of landowner's residence: 1 if in owner's woodland; 0 otherwise		
<i>DURA</i>	Number of years since first acres of wooded land acquired by landowner		
<b>Management Characteristics:</b>			
<i>ENJOY</i>	Activities enjoyed by landowner: 1 if enjoys either mental or physical, or both; 0 otherwise		
<i>CCRS</i>	Landowner's reason for owning wooded land: 1 if owner reported land investment or timber production for sale as very important or important; 0 otherwise		

**Table 2.** Means and Standard Deviations of Independent Variables

Independent Variables	Classified Participants (n = 91)		Cost-Share Participants (n = 55)		Nonparticipants (n = 183)		F-Statistic
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
AGE	56.59	14.54	56.53	12.82	54.97	14.74	0.50
EDUC	0.64	0.48	0.65	0.48	0.59	0.49	0.51
INC	5.51	2.51	5.96	2.19	4.80	2.31	6.28**
FARMER	0.22	0.42	0.25	0.44	0.12	0.33	3.85**
PR/MG/EX	0.38	0.49	0.36	0.49	0.37	0.48	0.04
TLAND	254.37	387.59	339.79	363.49	114.80	194.73	15.65***
WLPER	56.81	31.55	51.57	27.04	58.82	31.37	1.18
LOCA	0.48	0.50	0.60	0.49	0.54	0.50	0.94
DURA	22.59	20.92	27.89	15.60	22.34	20.57	1.73
ENJOY	0.79	0.41	0.89	0.31	0.74	0.44	2.76*
CCRS	0.51	0.50	0.65	0.48	0.21	0.41	27.31***
CGIS	0.85	0.36	0.78	0.42	0.36	0.48	44.77***
GGWS	0.55	0.50	0.56	0.50	0.25	0.43	17.30***
FORGZ	0.13	0.34	0.20	0.40	0.01	0.10	14.65***
LOSSPR	0.05	0.23	0.16	0.37	0.10	0.31	2.28
EASE	0.36	0.48	0.49	0.50	0.27	0.45	4.82**

Notes: Total sample size = 329 respondents. Single, double, and triple asterisks (\*) indicate that the means of the groups significantly differ from each other at the 10%, 5%, and 1% levels of probability, respectively.

of total land (340 acres) than either the classified program participants (254 acres) or the nonparticipants (115 acres). Further, the percentage of woodland in the total land is highest for nonparticipants and lowest for cost-share program participants. The proportion of respondents who locate their residences in their wooded land is highest for cost-share program participants and lowest for the classified program participants. The cost-share program participants acquired their first acres of wooded land earlier than both the classified program participants and the nonparticipants.

The percentage of respondents who enjoy mental or physical types of activities, or both, relating to wooded land is higher for cost-share and classified program participants than for the nonparticipants. The percentage of respondents who consider commercial interests very important or important for owning their woodland is highest for cost-share participants and lowest for nonparticipants.

Classified program participants and cost-share program participants consider government sources of information for technical assistance and management, as well as government sources of written information,

very important or important. With respect to membership in forestry organizations, cost-share program participants claim a higher percentage (20%) of respondents as members in forestry organizations (except the American Forestry Association) than do classified program participants (13%) and nonparticipants (1%).

The proportion of respondents who feel loss of options or rights to manage their wooded properties is higher for cost-share program participants than for classified program participants and nonparticipants. The percentage of landowners who know about conservation easements and are willing to consider selling an easement on their lands is highest for cost-share participants and lowest for the nonparticipants.

In general, comparisons of mean values of variables for participants and nonparticipants are consistent with results of earlier research. Older people tend to adopt or participate (Ervin and Ervin; Korsching et al.; McNamara, Wetzstein, and Douce). Education has been shown to have a positive influence on adoption/participation (Boyd; Hammett, Cubbage, and Luppold). The variable of farm size or

**Table 3.** Participation Behavior of NIPF Landowners in Classified Forestry Programs

Independent Variables	Means	Coefficients	Asymptotic <i>t</i> -Ratios	<i>P</i> -Values	Change in Probability <sup>a</sup>
<i>INTERCEPT</i>	-2.3399				
<b>Owner Characteristics:</b>					
<i>AGE</i>	55.678	0.0120*	1.674	0.094	0.0043
<i>EDUC</i>	0.614	0.2853	1.426	0.154	0.1010
<i>INC</i>	5.192	-0.0241	-0.529	0.597	-0.0086
<i>FARMER</i>	0.170	0.2266	0.868	0.385	0.0840
<i>PR/MG/EX</i>	0.374	0.2503	1.207	0.227	0.0913
<b>Woodland Characteristics:</b>					
<i>TLAND</i>	191.020	0.0013***	3.118	0.002	0.0005
<i>WLPER</i>	57.052	0.0023	0.717	0.473	0.0008
<i>LOCA</i>	0.532	-0.1268	-0.686	0.493	-0.0458
<i>DURA</i>	23.340	-0.0094*	-1.767	0.077	-0.0034
<b>Management Characteristics:</b>					
<i>ENJOY</i>	0.781	-0.0600	-0.267	0.789	-0.0217
<i>CCRS</i>	0.365	0.5372***	2.909	0.004	0.1975
<b>Information Sources:</b>					
<i>GGIS</i>	0.565	1.3535***	6.083	0.000	0.4428
<i>GGWS</i>	0.386	-0.0159	-0.078	0.937	-0.0057
<i>FORGZ</i>	0.076	0.9716**	2.545	0.011	0.3726
<b>Attitudes:</b>					
<i>LOSSPR</i>	0.100	-0.5099*	-1.686	0.092	-0.1632
<i>EASE</i>	0.334	0.0493	0.270	0.787	0.0178

Notes: Single, double, and triple asterisks (\*) indicate significance levels at  $\alpha = 0.10, 0.05,$  and  $0.01,$  respectively. Total number of observations = 329 (participation "Yes" = 124, "No" = 205). Log likelihood for normal = -145.11;  $\chi^2$  with 16 df = 145.72; predicted  $Y = -0.450;$   $P$  at means = 0.360; ZM pseudo  $R^2 = 0.611,$  AN pseudo  $R^2 = 0.307,$  and normalized  $R^2 = 0.922.$  Percentages of correct predictions: Yes = 71%, No = 83.4%, and Yes and No = 78.7%.

<sup>a</sup> Calculated at mean values of the independent variables. For dummy variables, the change in probability is calculated due to the change in the value of the independent variable from 0 to 1.

land holdings also has been associated with participation (Napier et al.; Korsching et al.; McNamara, Wetzstein, and Douce), as has involvement in professional associations (Rogers; Palmer et al.; Hodges and Cubbage).

#### *Classified Forestry Participation Model*

The results of the probit model examining NIPF landowner participation behavior in classified forestry assistance programs are presented in table 3. One owner characteristic, *AGE*, has a significant and positive association with participation behavior in classified forestry programs at the 10% level of significance. The change in probability indicates that a one-year increase in age of the NIPF land-

owner would increase the probability of participation by 0.43%, *ceteris paribus*.

One woodland variable (*TLAND*), representing number of total acres owned, was found to be positively and significantly associated with participation behavior at the 1% level of significance. The change in probability indicates that a one-acre increase in *TLAND* would increase the probability of participation by 0.05%, *ceteris paribus*. Another woodland variable (*DURA*), which indicates the duration of the period since the first wooded acres were acquired by the landowner, has a negative sign (contrary to hypothesis) significant at  $\alpha = 0.10.$  The partial derivative for this variable indicates that if the first wooded acres were acquired one year earlier by the

landowner, at the mean level, then the landowner's probability of participation would decrease by 0.34%. The negative sign on *DURA* might reflect the difference between more recent purchasers and earlier purchasers in their reasons for purchasing wooded land.

A management variable, commercial reasons of ownership (*CCRS*), has a positive coefficient that was statistically significant at  $\alpha = 0.01$ . The change in probability shows that landowners with commercial ownership objectives have a 19.7% higher probability of participation than those who own land for non-commercial reasons.

The coefficients for the information variables, access to government sources of information (*GGIS*) and membership in forestry organizations (*FORGZ*) were statistically significant at  $\alpha = 0.01$  and 0.05, respectively. This shows that there is a significant positive association between these variables and participation in classified forestry programs. The change in probabilities indicates that landowners who have access to government sources of information have a 44.3% higher probability of participation. Landowners who are members of forestry organizations are 37.3% more likely to participate, *ceteris paribus*.

The coefficient for the attitude variable, *LOSSPR*, indicating fear of loss of property rights or management options, has a negative coefficient connoting a negative relationship with the participation behavior. The change in probability suggests that if a landowner fears loss of property rights or management options, his/her probability of participation would decrease by 16.3%, *ceteris paribus*.

In brief, the landowners who are most likely to participate in the classified forestry programs have larger holdings under their ownership, acquired their first acres of woodland more recently, own the woodland for commercial reasons, actively seek information from government sources, are members of forestry organizations providing technical guidance, and do not have fears about loss of property rights or management options resulting from participation.

The model for participation behavior in classified forestry programs correctly classi-

fied 78.7% of the overall cases, with 71% for program participation respondents ("yes" responses), and 83.4% for nonparticipation respondents ("no" responses). The various measures of goodness of fit—the Zavoina-McKelvey (ZM) pseudo  $R^2$  (0.611), the Aldrich-Nelson (AN) pseudo  $R^2$  (0.307), and the normalized (Royer)  $R^2$  (0.922)—reveal that the model explains substantial variation in the dependent variable, i.e., participation behavior in classified forestry programs.

#### *Cost-Share Participation Model*

The parameter estimates for participation behavior of landowners in cost-share programs are provided in table 4. None of the owner characteristics variables were statistically significant at the .10 level. Owner characteristics do not provide much insight into the participation behavior of the NIPF landowners in the cost-share programs.

One woodland characteristic variable (*LOCA*), indicating location of residence on the landowner's woodland, is positively associated with participation in cost-share programs at  $\alpha = 0.10$ . The change in probability indicates that a landowner residing on his/her woodland is 7.8% more likely to participate.

The variable representing commercial reasons for ownership (*CCRS*) has a positive coefficient statistically significant at  $\alpha = 0.01$ . The change in probability reveals that the landowner with commercial reasons for ownership would have a 16.3% greater probability of program participation.

Among information sources, membership in forestry organizations (*FORGZ*) exhibits a significant positive association with participation behavior at  $\alpha = 0.10$ . Landowners who are members of a forestry organization have a 14.2% greater probability of participation.

A variable related to attitudes (*EASE*), reflecting landowners' knowledge of conservation easements and willingness to sell an easement on their woodland, has a positive coefficient significant at the .10 level. The partial derivative for this variable indicates that if a landowner has a favorable attitude toward

**Table 4.** Participation Behavior of NIPF Landowners in Cost-Share Programs

Independent Variables	Means	Coefficients	Asymptotic <i>t</i> -Ratios	<i>P</i> -Values	Change in Probability <sup>a</sup>
<i>INTERCEPT</i>	-2.6170				
<b>Owner Characteristics:</b>					
<i>AGE</i>	55.678	0.0015	0.190	0.849	0.0003
<i>EDUC</i>	0.614	0.0936	0.429	0.668	0.0189
<i>INC</i>	5.192	0.0796	1.609	0.108	0.0171
<i>FARMER</i>	0.170	0.0942	0.353	0.724	0.0200
<i>PR/MG/EX</i>	0.374	-0.1063	-0.474	0.635	-0.0214
<b>Woodland Characteristics:</b>					
<i>TLAND</i>	191.020	0.00008	0.267	0.789	0.00002
<i>WLPER</i>	57.052	-0.0029	-0.819	0.413	-0.0006
<i>LOCA</i>	0.532	0.3855*	1.871	0.061	0.0780
<i>DURA</i>	23.340	0.0047	0.892	0.372	0.0010
<b>Management Characteristics:</b>					
<i>ENJOY</i>	0.781	0.2686	0.995	0.320	0.0503
<i>CCRS</i>	0.365	0.7121**	3.481	0.001	0.1626
<b>Information Sources:</b>					
<i>GGIS</i>	0.565	0.2187	0.910	0.363	0.0441
<i>GGWS</i>	0.386	-0.0254	-0.117	0.907	-0.0052
<i>FORGZ</i>	0.076	0.5468*	1.749	0.080	0.1422
<b>Attitudes:</b>					
<i>LOSSPR</i>	0.100	0.3335	1.225	0.221	0.0789
<i>EASE</i>	0.334	0.3175*	1.672	0.095	0.0690

Notes: Single and double asterisks (\*) indicate significance levels at  $\alpha = 0.10$  and  $0.01$ , respectively. Total number of observations = 329 (participation "Yes" = 55, "No" = 274). Log likelihood for normal = -122.21;  $\chi^2$  with 16 df = 52.59; predicted  $Y = -1.155$ ;  $P$  at means = 0.2043; ZM pseudo  $R^2 = 0.441$ , AN pseudo  $R^2 = 0.138$ , and normalized  $R^2 = 0.414$ . Percentages of correct predictions: Yes = 16.4%, No = 96.7%, and Yes and No = 83.3%.

<sup>a</sup> Calculated at mean values of the independent variables. For dummy variables, the change in probability is calculated due to the change in the value of the independent variable from 0 to 1.

conservation easements, then the landowner has a 6.9% higher probability of participation.

In summary, the likely participants in the cost-share programs are those who reside on their woodland, are interested in commercial forestry activities, are members in forestry organizations, and have a favorable attitude toward conservation easements. The model explained 13.8% of variation in the dependent variable according to the Aldrich-Nelson (AN) pseudo  $R^2$ . According to the Zavoina-McKelvey (ZM) pseudo  $R^2$ , the model explained 44.1% of variation, and the normalized (Royer)  $R^2$  explained 41.4% of variation. The model was able to correctly classify 83.3% of all responses with respect to cost-share programs. Specifically, the model correctly classified

96.7% of nonparticipation responses, while 16.4% of participation responses were classified correctly.

## Discussion

The results do not provide much insight into how the personal characteristics of NIPF landowners influence their program participation behavior. While owner characteristics such as age, education, income, and occupation have been associated with adoption of agricultural technologies or practices, these variables generally are not associated with participation behavior in forestry programs independently of other factors in this analysis. Forestry in Indiana is not usually a household's central busi-

ness or main source of income. Therefore, landowners may attach less importance to forestry-related activities. The intensity of management exercised by landowners with respect to agricultural lands and forest lands also differs. Whereas agriculture-related technologies or practices would produce results in a short period, the forestry-related practices would give results over a comparatively longer period of time. Thus, the owner's personal characteristics may play a different role in agriculture-related activities as compared to the forestry-related activities.

Total land owned is an important determinant of landowners' participation in classified forestry programs. Owners with larger tracts of land have a higher probability of participation. This may be due to the fact that the land may be suitable for program participation. The larger the tract size, the greater would be the economic interest in the woodland as well as the potential cost savings of lower taxes. Hence, probability of participation increases as the size of total land increases.

Landowners who reside on the woodland are more likely to participate in the cost-share programs. Close proximity of the woodland to the owners' residence would increase the landowners' ability to oversee the implementation of the programs and to undertake activities related to physical and mental enjoyment for themselves and their family members. The landowners' desire for increasing the amenity values of woodland on which they reside may prompt them to participate in the cost-share programs to increase the value of their land.

Another woodland characteristic, the duration of years since the first wooded acres were acquired, was negatively associated with the participation behavior of NIPF landowners in respect to classified forestry programs. The longer the duration, the greater may be the possibility that the timber has already been cut. Hence, the landowners might think that there would be no substantial further benefits by participating in the classified forestry programs. Alternatively, this result might reflect differences in reasons for purchasing wooded land over time.

Landowners with commercial interests have a higher probability of participation in both types of forestry programs. Several reasons can be proposed for this finding. Landowners invest to increase the value of land and returns from it. More intensive management of woodland is rational when the landowner has commercial objectives. Those landowners who have commercial interests have better knowledge of the benefits associated with participation in the forestry programs. A separate model for participation behavior of NIPF landowners who were participants in both classified and cost-share programs (the results of which are not presented here) revealed that the commercial reason was the only significant variable associated with participation behavior (Nagubadi). This result also reinforces the fact that the commercial motive drives the NIPF landowners into participation in the forestry programs.

Information sources, both from government and forestry organizations, exhibit significant positive association with participation behavior in the classified forestry programs. This might be due to the government agencies providing information about programs and technical guidance through personal contact, and emphasizes the importance of government agencies providing technical guidance to NIPF landowners through close personal contact for maximizing participation in the forestry assistance programs. Another interesting finding is that the changes in probabilities indicate that factors related to information sources are far more influential than commercial motives for the participation behavior in the classified forestry programs. Although the participants in the classified forestry programs have commercial interests in mind, they are probably more influenced by close contact with public and private agencies when they participate in forestry assistance programs.

The results point to the importance of forestry organizations in promoting landowner participation in forestry assistance programs. Forestry organizations which provide information and technical guidance for the benefit of members might influence landowners to participate in forestry programs by convincing

them of the benefits. Forestry organizations also act as a link between the landowners and the public agencies. To increase participation of landowners in forestry programs, a useful strategy may be to approach the forestry association to gain its assistance in making members aware of participation benefits. The analysis also suggests that attitudes and beliefs of NIPF landowners have an important role in influencing their program participation behavior. The favorable attitude toward conservation easements promotes participation in cost-share programs. Participants in cost-share programs, while also having fears about loss of property rights or management options, might be more aware of the benefits of conservation measures on the woodland than the classified program participants. Such results also suggest that there is an awareness of the importance of public goods, such as conservation of soil and protection of the environment and natural resources, in the interest of future generations.

### Implications

Information and management factors are the most influential in predicting the probability of participation in forestry assistance programs. Landowners who actively seek information about programs and technical assistance through public and private agencies have a higher probability of participation. Activities aimed at providing information and technical assistance through close personal contact with NIPF landowners could be an effective strategy for increasing program participation. The forestry assistance programs could be targeted toward NIPF landowners who have earlier sought information on forestry programs and/or technical assistance on forestry and conservation activities. These landowners may be identified from participation records or records of individuals who seek information from various departments about forestry, wildlife, and conservation activities. These landowners could also be identified from membership records of forestry organizations which provide active guidance to their members.

Landowners who are motivated by commercial interests and are involved in commer-

cial forestry activities have a higher probability of participation in forestry programs. Thus, landowners who are involved in commercial forestry could also be targeted for participation.

The results also suggest that the size of landholding is an important determinant of participation in forestry assistance programs in general, and classified forestry programs in particular. If the Division of Forestry's objective is to maximize the land treated with forestry and conservation measures, then the current strategy of targeting programs at large land holdings should be advanced. This is particularly true when the Division of Forestry operates under limited resources and also when economies of scale do not permit small landowners to actively participate in the programs. Alternatively, special programs may have to be devised to suit the interests of small landowners to encourage their participation in the forestry programs.

The fact that attitudes and beliefs play an important role in participation in both classified and cost-share programs emphasizes the need to concentrate efforts at changing the attitudes of landowners to maximize participation in forestry assistance programs. This points to the importance of fostering more favorable attitudes toward forestry and conservation activities by devising and implementing educational programs on environmental and conservation activities. This focus is necessary to increase awareness and to underscore the importance of public goods such as protecting the environment and conserving natural resources.

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