Nonindustrial Private Forest Landowners' Participation in Mississippi Forest Resource Development Program*

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Abastract: Non-industrial private forest (NIPF) landowners are key players in increasing forest productivity and improving forest health. In order for landowners to benefit from government programs intended to improve forest productivity and health, NIPF landowners must first be aware of these programs. This study investigates: 1) what factors are associated with awareness of Mississippi Forest Resource Development Program (FRDP), and 2) given awareness of this program, what factors are associated with participation in FRDP. Examined factors included an array of land, ownership, management, and demographic characteristics. Data were obtained through a phone survey of 2,229 randomly selected NIPF landowners in Mississippi. A two-step discrete/discrete econometric model was used to analyze participation behavior conditional on NIPF landowner knowledge of FRDP. Interest in timber production, education, and membership in forestry organizations influenced NIPF landowner knowledge of incentive programs and were significant predictors of participation.

Keywords: Mississippi Forest Resource Development program, nonindustrial private forest landowners, participation behavior, two-step estimation

Introduction

Non-industrial private forest (NIPF) landowners have been major players in forestry. Nationwide, timberlands are owned by the public (29%), forest industry (13%), and NIPF landowners (58%); they accounted for 11%, 30%, and 59% of the timber harvested in 1996, respectively (Smith *et al.* 2004). Forests generate timber as raw material for the forest industry, and contribute environmental protection, including soil conservation, carbon storage, and maintenance of air and water quality (Wear and Greis 2002; Alig 2003). Therefore, public agencies have provided NIPF landowners a variety of public assistance programs to help achieve their management goals and meet societal needs.

Forestland management can be capital-intensive, particularly when establishing stand. Forests also require a long period of growth before producing income. Public assistance programs can influence the management of NIPF lands, compensate NIPF landowners for high costs of tree

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planting, and encourage better forest stewardship (Wear and Greis 2002). The goal of many regeneration assistance programs is to reduce the financial burden and encourage NIPF landowners to replant their lands after harvest.

Mississippi's Forest Resource Development Program (FRDP) was established in 1974. It is a state cost-share program for reforestation and timber stand improvement (Nagubadi *et al.* 1996). The FRDP was developed to provide financial assistance to eligible landowners. This program offsets a landowner's expenses by sharing the cost of implementing specific forestry practices to produce timber and enhance wildlife development. The FRPD requires that applicants submit a management prescription for the desired treatment area, comply with Mississippi Forestry Commission standards during operations, and maintain practices for at least 10 years. Cost-share payments of FRDP cover 50% to 75% of the total cost of implementing forest practices, with a maximum annual assistance of $5,000 (Gunter *et al.* 2001).

Many studies have been conducted to analyze the behavior of NIPF landowners with regard to their participation in governmental incentive programs and their decisions in silvicultural activities (Amacher *et al.* 2003). Previous studies generally agreed that these programs have successfully influenced the management of NIPF lands and stimulated more planting activities (Boyd 1984; Nagubadi *et al.* 1996; Mehmood and Zhang 2001). However, in spite of the benefits, these studies also revealed that NIPF landowners have not always taken advantage of these programs. For example, in a recent study the majority (54.3%) of 427 Mississippi NIPF landowners who regenerated their timber stands following a harvest during the 5-year period from 1994 to 1998 did not receive public cost-sharing funds for regeneration under Forestry Incentive Program (FIP), Mississippi's FRDP, Conservation Reserve Program (CRP), or Mississippi Reforestation Tax Credit (RTC) (Gunter *et al.* 2001). Among the 829 landowners that responded to the survey, only 38% were aware of FIP, 24% were aware of FRDP, and 27% were aware of RTC.

Many empirical studies have examined NIPF landowner participation behavior in governmental incentive programs. Most commonly these studies have relied on a binary choice model (e.g., (Bell *et al.* 1994; Nagubadi *et al.* 1996). Independent variables included owner demographics (e.g., income, education) and land features (e.g., acreage). Landowner participation in public assistance programs has been positively associated with total acres owned, membership in forestry organizations, interest in timber production, income, and location of residence on the landowner's woodland (Straka *et al.* 1984; Konyar and Osborn 1990; Nagubadi *et al.* 1996). Unfortunately, an oversimplified binary model might be inadequate in analyzing landowner participation of incentive programs. As revealed in studies like Gunter *et al*. (2001), many NIPF landowners were unaware of the existence of these incentive programs. Thus, it is inappropriate to examine landowner participation in government programs that they are not aware of. A binary choice model is derived from an individual's utility maximization from comparing two choices: participation or no participation. If an individual does not know of the program and did not make the comparison, the dependent variable is actually a missing value, instead of zero. In other words, zero-values for the dependent variable in previous studies might come from two sources: individuals who knew of the program and decided not to participate in it, and individuals who did not know of the program and did not consider the participation at all.

The problem with previous studies has originated from their over simplified assumption in the binary choice model with regard to landowners' behavior. A more suitable approach would be a two-step decision model for a NIPF landowner examining their participation in governmental incentive programs. The innovation is to recognize the reality in forestry that many NIPF landowners are not aware of these programs. The appropriate econometric technique is the sample selection estimation (Greene 2003), which has been widely applied in the literature to other issues (e.g., Lee *et al.* 2003; Katchova and Miranda 2004).

This paper focused on the government program participation behavior of NIPF landowners in Mississippi, a typical southern state where forest industries are important. In Mississippi, NIPF landowners owned 72% of forestlands in the state and produced 67% of state timber outputs in 2002 (Smith *et al.* 2004). The objective of this study was to examine NIPF landowners' knowledge of FRDP in Mississippi and their participation in this program from 1996 to 2006. A two-step sample selection model was developed to determine factors associated with landowners' awareness of FRDP, and conditional on landowners' awareness, factors affecting the probability of their participation in this program.

Conceptual Framework, Survey Data, and Variables

Analytical Framework

This research used a cross-sectional survey data from Mississippi to determine how land features, forest management experiences, and landowner characteristics influence NIPF landowner knowledge and enrollment probability for FRDP. The study period covered 1996 to 2006. The empirical design was a two-step sample selection model. It assumed that a landowner's participation in an incentive program was contingent upon whether the landowner was aware of the program.

In the first stage, a landowner's knowledge of a program, z_i, was modeled as a function of variables, w_i, that were related to land features, forest management experiences, and landowner characteristics:

(1) Selection equation: $z_i = g(w_i)$

where z_i was a binary dummy variable that measured the knowledge of landowner i about FRDP. z_i was zero if a landowner had no knowledge of the program, and one if the landowner was aware of the program.

In the second stage, the landowner decision to participate in FDRP was modeled as a function of land features, forest management experiences, and landowner characteristics, x_i:

(2) Outcome equation: $y_i = f(x_i)$, y_i observed only when $z_i = 1$

where y_i was a binary variable for landowner participation in FRDP during the study period. y_i was zero if a landowner did not participate in program, and one if the landowner participated in the program. The motivation for modeling knowledge (z_i) and participation (y_i) of NIPF landowners together was that they were related but distinct characteristics, and might be influenced by a same set of factors to a different degree. Therefore, x_i might be different from w_i.

The nature of dependant variables, z_i and y_i, allowed a bivariate probit model with sample selection. In estimating the model, a predicted value was computed in estimating the selection equation. It was then used in the outcome equation to analyze participating probability. The econometric details of the model are presented in the next section.

Questionnaire and Variables

The survey questionnaire was designed to collect information on the variables needed for the empirical analysis as described in Table 1. There were two binary dependent variables, z_i and y_i. One defined landowner's knowledge of FRDP; another recorded a landowner's participation in this program during the study period.

The independent variables contained in w_i and x_i were divided into three groups: land features, forest management experiences, and landowner characteristics. First, three variables were used to represent land features: *Acreage*, *Land type*, and *Forest type*. *Acreage* was the total land area owned by the landowner in Mississippi. *Land type* was a binary variable equal to one if the predominant land use was forest, and zero for agricultural or other uses. *Forest type* was a binary variable equal to one if the predominant forest type was planted pine, and zero for all other types.

Second, three variables were constructed to represent forest management experience of the landowner: *Year*, *Timber*, and *Regeneration*. *Year* was the number of years that the landowner owned the land. *Timber* was a binary variable representing landowner interest in timber production that equaled one if the landowner was interested in timber production, and zero if not. *Regeneration* was the number of times that the landowner regenerated during the study period.

Finally, eight variables were used to represent demographic characteristics of individual landowner: *Age*, *Education*, *Income*, *Employment*, *Race*, *Gender*, *Membership*, and *Residence*. *Age* represented landowner's age in 2006. *Education* was equal to one for those landowners who had bachelor's or higher degree, and zero otherwise. *Income* represented the landowner's household income before taxes in 2005. *Employment* was equal to one if the landowner was retired, and zero if employed. *Race* was equal to one for Caucasian landowners, and zero otherwise. *Gender* was equal to one for male landowners, and zero for females. *Membership* was equal to one if the landowner was a member of any forestry organization (e.g., Mississippi Forestry Association, Mississippi County Forestry Association, Society of American Foresters, Southern Forestry Association), and zero if not. *Residence* was equal to one if the landowner resided on their forestland, and zero if not.

Methodology

The underlying idea of sample selection models is that an outcome variable is only observed if some criterion, defined with respect to a selection variable, is met (Greene 2003). For the research issue in this study, a two-step model with sample selection examines landowner participation in FRDP, conditional on their knowledge of the program. Specifically, in the selection stage, landowner awareness of FRDP (z_i) can be estimated with a probit model. In the outcome stage, the binary variable reflects whether or not participation in this program is

observed, conditional on landowner awareness of FRDP. Thus, participation (y_i) can be modeled using a probit regression, based on landowner knowledge of FRDP. Formally, the two-step model can be expressed as (Greene 2003):

(3) Selection equation: $z_i^* = w_i\gamma + e_i$

$z_i = 1$ if $z_i^* > 0$; 0 otherwise

$\Pr(z_i = 1) = \Phi(w_i\gamma)$

$\Pr(z_i = 0) = 1 - \Phi(w_i\gamma)$

(4) Outcome equation: $y_i^* = x_i\beta + \varepsilon_i$

$y_i = 1$ if $y_i^* > 0$; 0 otherwise

y_i observed only when $z_i = 1$

where z, y, w and x are variables as defined in the previous section and indexed by landowner i; γ and β are parameters to be estimated; Φ is the normal cumulative distribution function; and e and ε are error terms. In the selection equation, z is a realization of an unobserved continuous variable (z^*) having a normally distributed, independent error, e, with zero mean and constant variance σ_e^2. In the outcome equation, y is a realization of an unobserved continuous variable (y^*) and is observed for value of $z = 1$. y has error ε, with zero mean and constant variance σ_ε^2.

Preliminary analysis revealed that majority of Mississippi's NIPF landowners who harvested timber did not participate in FRDP. Thus, the binary dependent variable measuring participation, y, was skewed. This motivated us to employ the Gompertz model, which has been used for estimating models with skewed binary data (Greene 2002). Formally, the probabilities of a Gompertz model for y conditional on z determined by a probit model can be expressed as follows (Greene 2002):

(5) $\Pr(y_i = 1) = \exp\left\{-\exp\left[-x_i\beta - \varepsilon_i\Phi(w_i\gamma)\right]\right\}$

$\Pr(y_i = 0) = 1 - \exp\left\{-\exp\left[-x_i\beta - \varepsilon_i\Phi(w_i\gamma)\right]\right\}$

If y is simply regressed on x using observations for which $z = 1$, the estimates of β will be both biased and inconsistent. In estimating the model, a typical way of addressing this problem involves two steps (Murphy and Topel 1985). The essential part of this model is the correction of the estimated asymptotic covariance matrix for the estimator in the outcome equation for the randomness of the estimator carried forward from the selection equation (Greene 2002). Let V_1 be the estimator of the asymptotic covariance matrix for the parameter estimates obtained in the selection equation. Let V_2 be the uncorrected covariance matrix computed in the outcome equation, using the parameter estimates obtained in the selection equation as if they were known. Both of these estimators are based on the respective log likelihood functions. In addition, define:

(6) $C = \sum_{i=1}^{n}\left[\frac{\partial \log f(x_i)}{\partial \beta}\right]\left[\frac{\partial \log f(x_i)}{\partial \gamma'}\right]$

$$R = \sum_{i=1}^{n} \left[\frac{\partial \log f(x_i)}{\partial \beta} \right] \left[\frac{\partial \log g(w_i)}{\partial \gamma'} \right]$$

where n is the number of observations. With these in hand, the corrected covariance matrix for the estimator of the outcome equation, V_2^*, is as follows:

$$(7) \qquad V_2^* = V_2 + V_2 \left[CV_1C' - RV_1C' - CV_1R' \right] V_2 .$$

Overall, first estimate the probit model through maximum likelihood and denote the estimated parameter as $\hat{\gamma}$. Then, estimate the Gompertz model in which a predicted value from the model in the selection equation appears on the right hand side of the outcome equation and denote the full set of parameters as $\hat{\beta}$. This predicted value can be expressed as follows:

$$(8) \qquad PIV = \frac{\phi(z_i^*)}{1 - \Phi(z_i^*)}$$

where $\phi(.)$ and $\Phi(.)$ are, respectively, the density and distribution function for the selection equation. *PIV* is included in the explanatory variables of the outcome equation, *x*. When the coefficient of estimated *PIV* is significant, it implies the parameter estimators for the outcome stage would be biased if two-step estimation procedures were not used.

Finally, the two sets of explanatory variables, *w* and *x*, can be the same or different. If *w* is equal to *x*, or *w* is a subset of *x*, then it may be possible to identify the parameters of the outcome equation because of the nonlinearity of the model (Breen 1996). To deal with this issue, two models for FRDP were estimated. First, a general model that treated *w* and *x* as the same, respectively in selection and outcome equations, was employed. However, the estimation results for many important explanatory variables were not significant. This suggested a collinearity problem among these variables. Thus, through preliminary analysis, some variables were deleted that had some collinearity with other important explanatory variables but did not affect the outcome stage. Therefore, in a restricted model, the variables in the outcome equation, *x*, was a subset of the variables in the selection equation, *w*.

Empirical Results

Survey Results and Descriptive Statistics of Variables

Of the 9,925 landowners contacted by phone, 2,126 owned less than 100 acres and another 2,132 did not harvest timber in the past 10 years, so these landowners were excluded from the survey. There were also 1,110 wrong phone numbers. Other reasons for unsuccessful calls included communication problems, refusal to participate, and deceased owners. A total of 2,229 valid and complete observations were recorded and available for the statistical analysis. The completion rate was 50%, i.e., 2,229 / (9,925 - 2,216 - 2,132 - 1,110).

Approximately 40% of the 2,229 landowners were aware of FRDP while 60% did not. This is consistent with the findings from a previous survey in Mississippi (Gunter *et al.* 2001). Furthermore, among the 2,229 landowners surveyed, a total of 63 NIPF landowners participated in FRDP with 2.8%.

The average acreage by surveyed landowners was 507 acres. For most landowners (77%), forestland was the predominant land use. For about half of the landowners (51%), pine was the predominant forest type and the rest had either hardwood or mixed forest types. The average length of ownership was 35 years. Most of these landowners (88%) were interested in timber production. The average number of times a landowner regenerated after harvesting during the survey period was 0.3 per landowner.

On average, surveyed landowners were 66 years old, 47% had a bachelor's or higher degree, and their household income in 2005 was $66,127. In addition, 55% of respondents were retired, 97% were Caucasian, and 70% were male. Approximately, 25% were members of a forestry organization. Finally, 48% resided on their forest lands. To address the study objective, the determinants of landowners' knowledge of these incentive programs are examined first, followed by examining the determinants of landowners' participation in these programs.

Determinants of Landowner Knowledge of FRDP

Regression results on NIPF landowner awareness of FRDP are reported in Table 2. Among the land features, the coefficient for *Acreage* was positive and significant. Thus, landowners with more land were more likely to be aware of FDRP. *Land type* and *Pine forests* were not significant. Among the three measures of land management experience, only the coefficient for *Timber* was positive and significant, suggesting that landowner interest in timber production motivated them to learn more about the program. *Regenerate* and *Year* were not significant. Finally, five demographic characteristics (i.e., *Education*, *Gender*, *Membership, Employment*, and *Residence*) had positive and significant coefficients. Thus, landowners with better education, males, member of forestry organizations, retired status, or residence on forest land were more likely to know about FDRP. *Age* and *Race* were not significant.

Overall, landowner knowledge of FDRP was positively related to *Acreage*, *Timber*, *Education*, *Gender*, *Membership*, *Employment*, and *Residence*. Among these variables, *Membership* had the largest marginal effect, 0.208 for FRDP. *Timber* and *Gender* also had relatively large marginal effects. Landowners with these characteristics were either better motivated or have better access to information related to FRDP.

Determinants of Landowner Participation in FRDP

In the unrestricted two-step sample selection model, there was only one significant variable for FRDP, suggesting a collinearity problem among variables in outcome equations. Hence, in the restricted model, *Acreage*, *Pine forests*, and *Age* were excluded from the outcome equation because they were correlated with *Income*, *Timber*, and *Employment*. The restricted model produced more statistically significant results. Further, in the restricted model, the coefficient on

P1V was significant and positive. This suggested that the parameter estimators for landowner participation in FRDP would be biased if two-step estimation procedures were not used.

Land features had no effect on landowner participation in FRDP. Among the set of variables representing management experience, *Regenerate* was positive and significant. Among significant landowner characteristics, *Education*, *Gender*, and *Membership* positively influenced participation in FRDP. When landowners were aware of the program, their participation probability was higher for landowners with these characteristics. *Membership* had the largest marginal effect on participation probability with 0.115. *Education* and *Regenerate* had relatively large marginal effects. Landowners with these characteristics were either more connected with timber production, or are more likely to regenerate.

Overall, when landowners were aware of FRDP, they were more likely to participate if they had more regeneration experience, better education, male, or belonged to forestry organizations. The largest marginal effects were associated with *Membership*.

Conclusions

This study estimated how land features, management experiences, and landowner characteristics influenced participation in FRDP, a typical state incentive program. A two-step sample selection model was used to analyze the probability of participation conditional on NIPF landowners' awareness of this program. A combination of binary probit and Gompertz models was used. Modeling the participation probability conditional on landowner awareness generated more accurate results than simple binary regression typically used in the literature.

Only about 40% NIPF landowners in Mississippi were aware of FRDP. A total of 63 NIPF landowners out of 2,229 participated in the program during the survey period. On average, these landowners owned 507 acres. For majority of landowners (77%), forestry was the dominant land use. Pines were the predominant forest type for 51% of landowner. NIPF landowners averagely owned the land for 35 years. Most of these landowners were interested in timber production. The average age was 66 years; 47% had a bachelor's or higher degree; and their household income in 2005 was $66,127. About 25% were members of a forestry organization and 48% resided on their forestland.

The two-step regression with sample selection generated several results. Landowner knowledge of FRDP was positively correlated with land acreage, interest in timber production, better education, gender, and membership in forestry organizations. Furthermore, when landowners were aware of this program, participation was higher for those with more regeneration experience, better education, gender, or membership in forestry organizations. These results have several policy implications for promoting and implementing government incentive programs.

Given that most NIPF landowners in Mississippi have no knowledge or limited understanding of FRDP, these results suggest that efforts should be made to disseminate this information within the forestry community. Based on these results, extension services can be more effective through forestry organizations. The result also suggested that motivating landowners to be

interested in timber production would be an effective approach to increasing NIPF landowner awareness of this program in the forestry community.

Empirical results also pointed out the importance of membership of forestry organizations in promoting landowner participation in FDRP. Forestry organizations typically provide information and technical assistance and thus affect landowner participation in assistance programs by emphasizing the benefits. Therefore, a useful strategy may be to make members aware of participation benefits by gaining the assistance of forestry organizations.

Discussion

Given the continued emphasis on incentive programs, concerns regarding future strategies for financial assistance programs related to reforestation are illustrated. Still more studies needs to be done to carry forward insights obtained from this research. Future research on incentive programs might improve on this study by enlarging the surveyed scope. Although we attempted to overcome data limitations by employing different regression models based on the characteristics of dependent variables (e.g., a combination of binary/count models) and different transformations of explanatory variables (e.g., transform the continuous number of *Acreage* to the natural logarithm of *Acreage*), these efforts still encountered the problem of the skewed distribution of data. Another concern is that financial assistance, constrained by governmental budget, creates a challenge of how to efficiently allocate the budget to achieve the maximum participation. Given limited budget, the cost of increasing participation by improving NIPF landowner awareness must be compared with the start-up cost. The identification of such costs is vital to make sound policy decisions regarding the most efficient way to promote financial assistance programs.

Literature Cited

Alig, R.J. (2003). U.S. landowner behavior, land use and land cover changes, and climate change mitigation. *Silva Fennica* 37(4):511-527.

Amacher, G.S., M.C. Conway, and J. Sullivan (2003). Econometric analyses of nonindustrial forest landowners: is there anything left to study? *Journal of Forest Economics* 9(2):137-164.

Bell, C.D., R.K. Roberts, B.C. English, and W.M. Park (1994). A logit analysis of participation in Tennessee's Forest Stewardship Program. *Journal of Agricultural and Applied Economics* 26(2):463-472.

Boyd, R.G. (1984). Government support of non-industrial production: The case of private forests. *Southern Economic Journal* 51(1):89-107.

Breen, R. (1996). *Regression models: Censored, sample-selected, or truncated data*. Sage University Paper series on Quantitative Applications in the Social Science, series no. 07-111. Thousand Oaks, CA: Sage.

Greene, W.H. (2002). *LIMDEP Version 8.0 Econometric Modeling Guide*. Econometric Software, Inc. 15 Gloria Place, Plainview, New York, United States.

Greene, W.H. (2003). *Econometric Analysis*. Pearson Education, Inc., Delhi, India.

Gunter, J.E., S.H. Bullard, M.L. Doolittle, and K.G. Arano (2001). Reforestation of harvested timberlands in Mississippi: behavior and attitudes of non-industrial private forest landowners. FWRC Research Bulletin #FO 172, Forest and Wildlife Research Center, Mississippi State University. 25p.

Gunter, J.E., J.O. Idassi, and J.E. Granskog (2001). Financing investments in reforestation with government sponsored loans (a Mississippi case study). FWRC Research Bulletin #FO 194. Forest and Wildlife Research Center, Mississippi State University. 17p.

Katchova, A.L., and M.J. Miranda (2004). Two-step econometric estimation of farm characteristics affecting marketing contract decisions. *American Journal of Agricultural Economics* 86(1):88-102.

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.

Lee, E., J. Lee, and D. Eastwood (2003). A two-step estimation of consumer adoption of technology-based service innovations. *Journal of Consumer Affairs* 37(2):256-282.

Mehmood, S.R., and D.W. Zhang (2001). Causes for continuation of state cost-share programs for nonindustrial private forest landowners. *Forest Science* 48(3):471-478.

Murphy, K.M., and R.H. Topel (1985). Estimation and Inference in Two-Step Econometric Models. *Journal of Business & Economic Statistics* 3(4):88-97.

Nagubadi, V., K.T. McNamara, W.L. Hoover, and W.L. Mills (1996). Program participation behavior of nonindustrial forest landowners: a probit analysis. *Journal of Agricultural and Applied Economics* 28(2):323-336.

Smith, W.B., P.D. Miles, J.S. Vissage, and S.A. Pugh (2004). Forest resources of the United States 2002. *USDA Forest Service Gen. Tech. Rep. NC-241*.

Straka, T.J., H.W. Wisdom, and J.E. Moak (1984). Size of forest holding and investment behavior of nonindustrial private owners. *Journal of Forestry* 82:495-496.

Wear, D.H., and J.G. Greis (2002). Southern forest resource assessment. *Southern Research Station. Gen. Tech. Rep. SRS* 53:175-223.

Table 1. Definitions and descriptive statistics for the variables from a survey of Mississippi NIPF landowners in 2006

Variables	Definitions	Mean	Std. Dev.
	Dependent variables		
Selection equation (z_i)			
Knowledge of FRDP	Dummy = 1 if the landowner knows of FRDP; 0 otherwise	0.398	--
Outcome equation (y_i)			
Participation in FRDP	Dummy =1 if the landowner participated in FRDP; 0 otherwise	0.028	--
	Independent variables		
Land feature			
Acreage	Total acreage owned by the landowner	506.555	1,007.470
Land type	Dummy = 1 if forest land is the predominant land use; 0 otherwise	0.769	--
Pine forests	Dummy = 1 if pine forests are the dominant forest type; 0 otherwise	0.510	--
Management experience			
Years	Years of land ownership	34.719	19.766
Timber	Dummy= 1 if the landowner is interest in timber production; 0 otherwise	0.882	--
Regenerate	Number of regeneration activities during the survey period	0.312	0.573
Landowner characteristics			
Age	Landowner age	66.127	11.070
Education	Dummy = 1 if the landowner has a bachelor degree or better; 0 otherwise	0.473	--
Income	Household income before taxes in 2005 ($1,000)	62.961	27.956
Employment	Dummy = 1 if the landowner is retired; 0 if retired	0.550	--
Race	Dummy = 1 if Caucasian; 0 otherwise	0.966	--
Gender	Dummy = 1 if male; 0 otherwise	0.704	--
Membership	Dummy = 1 if the landowner is a member of any forestry association; 0 otherwise	0.253	--
Residence	Dummy = 1 if the landowner resides on the land; 0 otherwise	0.480	--

Table 2. Results of NIPF landowner knowledge of and participation in Mississippi Forest Resource Development Program (FRDP)

	Selection equation		Outcome equation		
			(Unrestricted)	(Restricted)	
	Coeffi. (*t*-ratio)	Marginal Effect	Coeffi. (*t*-ratio)	Coeffi. (*t*-ratio)	Marginal Effect
Constant	-0.809***	-0.312	-0.791	-1.455***	-0.054
	(-2.900)		(-0.469)	(-3.322)	
Land features					
Acreage	1.183E-4***	4.553E-5	1.603E-4	--	--
	(3.081)		(0.560)		
Land type	-0.012	-0.004	-0.029	-0.023	-0.003
	(-0.172)		(-0.135)	(-0.159)	
Pine forests	-0.020	-0.008	-0.186	--	--
	(-0.363)		(-0.957)		
Management experience					
Years	0.001	3.779E-4	0.002	0.001	2.563E-5
	(0.629)		(0.309)	(0.210)	
Timber	0.200**	0.075	0.430	0.126	0.013
	(2.204)		(0.700)	(0.532)	
Regenerate	0.068	0.026	0.967***	0.850***	0.032
	(1.389)		(3.576)	(6.796)	
Landowner characteristics					
Age	-0.005	-0.002	-0.005	--	--
	(-1.485)		(-0.274)		
Education	0.113*	0.044	0.428	0.251*	0.029
	(1.888)		(1.143)	(1.672)	
Income	-0.001	-2.623E-4	-0.001	1.447E-4	5.385E-6
	(-0.615)		(-0.273)	(0.061)	
Employment	0.174**	0.067	0.351	0.131	0.015
	(2.445)		(0.632)	(0.882)	
Race	0.119	0.045	0.032	-0.167	-0.021
	(0.761)		(0.062)	(-0.571)	
Gender	0.279***	0.105	0.790	0.385*	0.039
	(4.463)		(0.948)	(1.688)	
Membership	0.533***	0.208	1.576	0.751**	0.115
	(8.299)		(0.989)	(1.985)	
Residence	0.101*	0.039	0.370	0.221	0.025
	(1.748)		(1.057)	(1.515)	
P1V	--		-6.780	-2.807*	-0.104
			(-0.882)	(-1.642)	
Log Likelihood	-1,421.979		-201.769	-203.211	
Chi-squared	153.384		170.003	167.118	
Observation	2,229		2,229	2,229	

***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.