



## Factors associated with landowner involvement in forest conservation programs in the U.S.: Implications for policy design and outreach

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### ABSTRACT

One-third of the forestland in the U.S. is owned by 10.4 million family forest owners. Their collective decisions have a great impact on the sustainability of forest landscape across the country. Public policies and programs for encouraging landowners to properly manage their land include cost-share, forest certification, and conservation easements. However, to date, less than 6% of the family forest owners have participated in a cost-share program, less than 1% have certified their land, and less than 2% have an easement. By analyzing data from USDA Forest Service's National Woodland Owner Survey, we examined the characteristics of family forest owners who had participated in these programs and identified strategies to capitalize on these landowner characteristics to improve current programs and attract a wider range of participants. We found that family forest owners with larger land holdings were more likely to participate in all three types of programs. Obtaining forest management information or advice was important for program participation; however, the effects differed depending on the types of programs and the sources of information. Income was not significant in predicting participation in cost-share programs, implying family forest owners from lower-income strata were not more likely to use cost-share program. The results also suggest the importance of targeting the right audience when promoting forest certification programs, namely those who are participants of cost-share programs, own forestland for reasons other than farming or ranching, and plan to harvest sawlogs or pulpwood in the future. Age was not significant in any of the empirical models. This result is particularly intriguing in the context of conservation easement, considering recent discussions about the high cost of dying unprepared and the potential for promoting conservation easement as part of estate planning among older family forest owners. Finally, few variables were significant in the model predicting landowner decision about donating or selling an easement, suggesting the easement decision is very different from cost-share and forest certification decisions and further efforts are needed to understand the dynamics of this increasingly popular conservation policy tool. In summary, this study provides a better understanding of the relationship between program participation and the demographics, attitudes and behaviors of family forest owners. This understanding contributes to the development of outreach strategies for improving landowner interest in forest conservation programs.

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### Introduction

In the U.S., 56% of the forestland is privately owned and of this 62% (264 million acres or 107 million hectares) are owned by families, individuals, trusts, estates, family partnerships, and other unincorporated groups of individuals—collectively called family forest owners (Butler, 2008). Most of these 10.4 million family forest owners hold relatively small tracts of land; however, their

collective behavior has a great impact on the sustainability of forest landscape across the country. To encourage sustainable forest management and land conservation, government agencies and non-profit organizations have established a range of policies and programs, including technical assistance, tax incentives, cost-share, forest certification, conservation easements, and outreach education. To date, most of these programs have attracted less than 10% of family forest owners nationwide (Butler, 2008). Considering the large number of family forest owners and the low rate of participation, two questions arise: (1) What are the characteristics of family forest owners who choose to participate in forest conservation programs? (2) How can we draw on these landowner characteristics to improve current programs and attract a wider

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range of participants? By analyzing data from USDA Forest Service's National Woodland Owner Survey, we were able to address these questions with a focus on three types of forest conservation programs: cost-share, forest certification, and conservation easements. We investigated the relationship between family forest owners' participation in these programs and their characteristics, attitudes and behavior. In addition to contributing to the literature, our study identifies the importance of tailoring program requirements to target landowner characteristics and needs and offers insights on strategies for improving program participation.

## Background

Cost-share, forest certification, and conservation easements are three types of programs for promoting sustainable forest management and land conservation among family forest owners. Cost-share programs provide landowners with financial assistance to help plant trees, control soil erosion, enhance wildlife habitat, protect riparian areas and wetlands, or apply other types of practices to achieve federal or state resource management and conservation goals (Haines, 1995). Examples include Conservation Reserve Program, Environmental Quality Incentives Program, and Wildlife Habitat Incentives Program. Eligibility for participation varies between federal and state programs and across states, but generally includes minimum or maximum ownership or project size, site productivity ranking, and priority ranking of projects according to federal or state resource management and conservation goals (Haines, 1995). Most federal and state programs require landowners to develop a written forest management plan. In addition, retention of the supported practices is often required for a set period. For example, cost-share recipients are required to maintain their properties in forest land use and to protect and maintain supported practices in a fully viable condition for a period of 10 years in the state of Washington. Failure to meet this obligation may require the applicant to repay the government for all, or part, of the cost-share funds received.

Forest certification provides a voluntary opportunity for landowners to undergo an independent, formal assessment to verify that their properties are being managed according to a pre-defined set of standards for sustainable forest management (IATP, 2004). Forest certification focuses on the process by which forests are regenerated, managed, and harvested in a sustainable system to protect soil, air, water, biodiversity, and other forest benefits (Hughes et al., 2008). Existing certification systems in the U.S. include American Tree Farm System, Green Tag Forestry, Sustainable Forest Initiative, and Forest Stewardship Council. The exact steps to certification vary across systems, but the general process involves initial discussions, a pre-assessment, field inspection and verification, obtaining a certification status, and follow-up audits and inspections (Hughes et al., 2008). In addition, developing a forest management plan is generally required prior to obtaining certification status.

A conservation easement is either voluntarily donated or sold by a landowner and constitutes a legally binding agreement between the landowner and a non-profit organization or government agency, which prevents development or other uses from taking place on the land in perpetuity while the land remains in private hands (TNC, 2009). An example of such a non-profit organization is The Nature Conservancy and an example of a governmental program is the Forest Legacy Program. Generally speaking, a conservation easement process starts with a preliminary discussion between a landowner and an easement organization or program. An on-site visit is then conducted, following which the easement project will be presented for approval. Once approved, an easement will be drafted and a qualified independent appraiser will assess the value of the easement donation for any landowner who intends to

take an income tax deduction from the donation. The condition and ecological variables present on the property will be documented and periodically inspected for monitoring reasons. In some jurisdictions, placing an easement on a property may result in property tax savings (LTA, 2010). By removing the land's development potential, the easement also lowers the property's market value, which in turn lowers potential estate tax for landowners (LTA, 2010).

Existing literature on forest conservation programs has mostly focused on three areas of research: (1) investigating family forest owners' awareness and perceptions of existing programs; (2) examining the impact of existing programs on sustainable forest management and land conservation; (3) identifying challenges of and potential for improving existing programs. Past studies have mostly focused on issues related to landowners' awareness and perceptions of forest certification programs. As early as 1999, Hayward and Vertinsky examined non-industrial private forest (NIPF) owners, forest industries, and public land managers' perceptions of the benefits and costs of certification. They found that NIPF owners sought certification largely out of a commitment to forest stewardship and were concerned about the direct costs associated with certification. Meanwhile, forest industries and public lands managers considered certification as a venue to improve profits, defend market access, and earn public confidence; they also expected a price premium for certified wood. Later, Perera et al. (2007) investigated Louisiana and Mississippi NIPF owners' understanding of certification, their willingness to pay for certification, and their general perceptions of the implementation requirements and processes. Their study found that NIPF owners generally believed that certification in the U.S. was driven by environmental non-profit organizations rather than by demand in the marketplace. Although NIPF owners were generally not averse to having certifiers monitor their forest management activities, they were unwilling to bear the cost of certification. In a different study, Leahy et al. (2008) found that Minnesota family forest owners were generally unfamiliar with the concept of forest certification. Their initial attitudes toward forest certification only became more entrenched as landowners were provided additional information about certification—skeptics became more disinterested while those inclined to participate became even more so.

Considerable effort has been made to examine the impact of cost-share programs on promoting land conservation practices, particularly forest regeneration. Through a study of pine regeneration on harvested NIPF properties in the South, Hardie and Parks (1991) concluded that cost-share encouraged regeneration investment and suggested that changing the cost-share incentive was an effective way to change the amount of acreage regenerated in the region. In the Southern U.S., it is generally recognized that a positive relationship exists between regeneration and the availability of public financial assistance programs (Zhang and Flick, 2001), and that a lower level of cost-share assistance contributes to a decrease in NIPF regeneration activities (Kline et al., 2002). In addition to research examining the impact of cost-share programs on forest regeneration, a study was conducted by Kilgore and Blinn (2004) to assess the effectiveness of various policy tools in promoting sustainable timber harvesting practices in the U.S. and Canada. They found that cost-share programs consistently ranked among the most effective policy tools for encouraging loggers, landowners, and foresters to apply best management practices. Despite the documented effectiveness of cost-share programs, concerns have been raised that landowners who participated in cost-share programs would have undertaken the supported practice anyway, although the financial assistance often enabled the landowners to treat additional acres beyond what would otherwise have occurred (De Steiguer, 1984; Hardie and Parks, 1991; Kilgore et al., 2007; Sun, 2007).

Finally, a number of studies have discussed the challenges of and potential for improving existing forest conservation programs. Mehmood and Zhang (2002) discussed the causes for establishing and reasons for continuing forestry cost-share programs. They suggested that healthy state finances and NIPF owners' political power to influence forest industry may contribute to the promotion of state cost-share programs. Busby et al. (2007) used a timber supply model to assess the potential of bonus payments for increasing the rate of certification in western Oregon. They found that within a 100-year time horizon, 20% and 60% of total acres would be certified, respectively, giving a \$28/1000 board feet (mbf) and a \$56/mbf certification bonus payment. Bense (2001) identified three major barriers to forest certification in Pennsylvania, including perceptions of high cost of certification, stringent requirements for meeting certification standards, and short tenure among NIPF owners. Rickenbach (2002) further suggested that owners of small forest parcels were generally not interested in timber production and thus, may be uninterested in seeking certification. Insufficient markets and lack of price premiums for certified wood products were also suggested as barriers to the adoption of certification practices (Rickenbach, 2002). In terms of conservation easement programs, LeVert et al. (2009) estimated the family forest owners' willingness to sell easements to preserve forestland in Western Massachusetts and Southern Vermont. Their study suggested that policies promoting early development of management plans and cooperation with neighbors appeared to increase the likelihood that landowners would convey conservation easements.

Thus far, existing literature has provided a good understanding of landowner awareness and perceptions of cost-share, forest certification and conservation easement programs, the impacts of these programs on sustainable forest management and land conservation, and the potential barriers to and opportunities for promoting these programs. Lacking is an understanding of the relationship between individual landowner characteristics, attitudes and behavior and their participation in particular programs. Although empirical research on factors affecting landowner participation in cost-share, forest certification, and conservation easement programs is limited, many studies of landowner decision making in other contexts, such as timber or wildlife habitat management, have identified factors that may be important for understanding landowner participation in these programs.

Research has shown that landowners' management and conservation decisions have been influenced by size of land holding, land tenure, residence, personal values, economic considerations, past behavior, future plans, advice or information received, as well as various socio-demographic factors (Brook et al., 2003). For instance, a small segment of family forest owners, often referred to as model owners, are generally committed to active management and likely to adopt various programs that promote forest or land stewardship (Kittredge, 2004; Langer, 2008). In other words, those who are participants of one program are also likely to be participants in other programs. Landowners with larger acreage are more likely to harvest timber (Binkley, 1981; Catanzaro et al., 2007; Dennis, 1989; Kittredge et al., 2003) and participate in forestry education (Blatner and Baumgartner, 1991) and endangered species protection programs (Mehmood and Zhang, 2005). How long someone has owned land and whether they live on it, have been shown to be positively correlated with forest management decisions as well (Vokoun et al., 2006). Many studies suggest that family forest owners value the natural beauty, privacy, and other non-consumptive amenities provided by their forests and, in general, financial gain is not a primary reason for owning forestland (Birch, 1996; Butler, 2008; Butler and Leatherberry, 2004; Erickson et al., 2002; Finley and Kittredge, 2006; Johnson et al., 1997; Kendra and Hull, 2005; Kuuluvainen et al., 1996). This may be another key to help understand landowner participation in current forest management and land conservation

programs. Research has also shown that previous experience with forest management is expected to positively affect active management behavior and participation in forest stewardship programs (Bell et al., 1994). Landowners who are wealthier and more educated appear to be less likely to engage in harvesting activities or participate in programs with a focus on harvesting (McDonald et al., 2006; Dennis, 1989). Age is also considered an influential factor in predicting participation behavior in forestry programs; however, some argued age being positively related to participation (Nagubadi et al., 1996), while others suggested the opposite (Langpap, 2004). The effect of landowner occupation on participation in forestry programs has been generally undetermined. Some believed that agriculture or forestry-related occupations may increase the likelihood of participation because of familiarity with government programs and farm or forestry practices and production factors (Bell et al., 1994; Nagubadi et al., 1996); while others suggested that landowners whose livelihood was directly dependent on resource exploitation (such as farmers and ranchers) may have a strong negative attitude toward conservation (Langpap, 2004). In addition, the information exchange between natural resource management professionals and landowners is important in determining whether landowners would adopt certain stewardship practices or participate in particular programs (Gootee et al., 2010). For instance, Kilgore et al. (2007) found that landowners tended to trust forest certification related information from a forest landowner association, but not from a government organization.

Building upon past studies, we used data from USDA Forest Service's National Woodland Owner Survey and examined landowner participation in cost-share, forest certification, and conservation easement programs. This paper describes the landscape of participation across the country. More importantly, this paper identifies factors characterizing family forest owners who participated in these programs, investigates the relationship between landowner participation and their characteristics, attitudes and behavior, and provides insights on strategies for attracting a wider range of participants.

## Methods

### *The National Woodland Owner Survey*

The data for this study were drawn from the 2002–2006 National Woodland Owner Survey (NWOS) conducted by USDA Forest Service's Forest Inventory and Analysis program (Butler, 2008). The NWOS is the nation's census of forest owners. On a recurring basis, the NWOS selects random points across the U.S. and uses remotely sensed imagery and ground truthing to determine if sample points are forested. For the forested points, ownership information is collected from publicly available property tax records. A self-administered mail survey is the primary data collection method and telephone interviews are used to increase response rates and test for non-response bias. The NWOS asks forest owners questions about the forestland they own (not parcel-specific), their reasons for owning it, how they use it, if and how they manage it, sources of information about their forests, their concerns and issues related to their forests, their intentions for the future of their forests, and demographics. Detailed information on data collection procedures are described in Butler et al. (2005).

The dataset we used contained 15,799 observations across 48 states. Interior Alaska, Hawaii, Nevada, western Oklahoma, and western Texas were excluded because no NWOS data were collected in these areas between 2002 and 2006. The overall cooperation rate was 51.3% (Butler, 2008). Tests were performed to identify potential non-response bias. Responses from early respondents and late respondents were compared as a proxy for detecting differences between respondents and non-respondents. Additional

**Table 1**  
Explanatory variables used in the empirical models for estimating participation in cost-share, forest certification, and conservation easement programs.

Variable	Description
PART_CS	Binary—1, if participated in one of the three forest conservation programs (cost-share, forest certification, conservation easement); 0, otherwise
PART_FC	Continuous—natural logarithm of acreage owned in a state
PART_CE	Continuous—number of years having owned forestland
ACRE	Binary—1, if owning a farm or ranch within one mile of any forestland owned; 0, otherwise
TENURE	Binary—1, if primary residence is more than one mile away from any forestland owned; 0, otherwise
FARM	Continuous—reasons for owning forestland (principal component loadings, see Table 2)
ABSENT	Binary—1, if having leased or collected money (other than from logging) for allowing people to use the forestland; 0, otherwise
OWN_REA	Binary—1, if a land manager or forester makes most of the decisions for the forestland owned; 0, otherwise
LEASE	Binary—1, if harvested sawlogs or pulpwood; 0, otherwise
DECISION	Binary—1, if having a written management or stewardship plan; 0, otherwise
HRV_COMM	Nominal—six categories: 0, if never received advice or information about the forestland owned in the last 5 years; 1, if received from a government source; 2, if from extension foresters or other university employees; 3, if from private consultants, forest industries or loggers; 4, if from non-profit organizations; 5, if from other forest landowners, neighbors or friends
MGMT_PLAN	Binary—1, if planning to harvest sawlogs or pulpwood; 0, otherwise
SOURCE_ADV	Binary—1, if planning to sell some or all of forestland owned; 0, otherwise
FUTURE_HRV	Binary—1, if planning to pass some or all of the forestland on to children or other heirs; 0, otherwise
FUTURE_LAND	Binary—1, if 65 years or over; 0, otherwise
FUTURE_HEIR	Binary—1, if having some college or a higher level of education; 0, otherwise
AGE	Binary—1, if household annual income is \$50,000 or more; 0, otherwise
EDU	Nominal—each state has a FIPS code
INCOME	
STATE	

tests were conducted using ancillary data (e.g., size of parcels from tax records) and by segregating data using various spatial units to test for differences along the urban–rural continuum. No statistically significant biases were detected.

Using the observations in the dataset, we were able to estimate family forest land area and number of family forest owners at a population level. Due to the sampling design different procedures were used for estimating areas and owners (Butler et al., 2005). Every private, forested acre in an estimation unit had an equal selection probability and simple random sample estimation procedures were used (e.g., Thompson, 1992); where the probability of an owner being selected was a function of the total area of forestland, the sampling intensity, and the acres of forestland he/she owned, as such estimates of the numbers of owners were made using the Horvitz–Thompson, probability proportional to size estimator (e.g., Horvitz and Thompson, 1952). More information on the statistical estimation procedures can be found in Butler et al. (2005).

#### Logistic regression analysis

Three separate empirical models, described below, were developed to examine participation in three types of forest conservation programs. The response variable represents participation in one of the three programs: cost-share (PART\_CS), forest certification (PART\_FC), and conservation easements (PART\_CE). The response variable takes the value 1 if a landowner participated in a particular program and 0 otherwise. The empirical models also include a number of explanatory variables described in Table 1, measuring landowner current participation in conservation programs, land

characteristics, ownership characteristics, past management decisions, venues for receiving advice or information, future plans, and demographics. For instance, if we use PART\_CS as the response variable, explanatory variables will include PART\_FC and PART\_CE in order to examine whether a landowner's participation in forest certification and conservation easement programs is associated with his/her participation in cost-share programs. Because family forest owners tend to own relatively small tracts of land (Butler, 2008), the distribution of acreage owned in a given state is heavily skewed to the right. A log transformation was performed, and ACRE in the empirical model represents the natural logarithm of acreage owned by a respondent in a given state. In addition, OWN\_REA measures the extent to which a respondent owned forestland for amenity or financial reasons. The composition of this variable is explained in the section "Principal component analysis".

To estimate the empirical model, binary logistic regression procedure was adopted. In binary logistic regression, probabilities are assigned to each of the two possible outcomes. For a binary response variable  $Y$  and a vector of explanatory variables  $X$ , these probabilities are:

$$P(Y_i = 1) = P_i = \frac{e^{\beta X_i}}{1 + e^{\beta X_i}}$$

$$P(Y_i = 0) = 1 - P_i = 1 - \frac{e^{\beta X_i}}{1 + e^{\beta X_i}} = \frac{1}{1 + e^{\beta X_i}}$$

where  $P_i$  represents the probability that landowner having participated in a forest conservation program,  $\beta$  is a vector of regression coefficients,  $\beta X_i$  is a standard notation representing the right hand side of a regression model. Unlike ordinary least squares (OLS) regression, the logistic procedure involves estimating the regression parameters by maximizing a likelihood function, and the coefficient estimates in a logistic regression do not carry the implication of per unit impact of individual explanatory variables as in the OLS case (Mehmood and Zhang, 2005). To draw such implications, marginal effects for each explanatory variable were calculated as follows:  $dP_i/dX_i = P_i(1 - P_i)\beta$ . However, in this paper, the interpretation of the logistic regression results was mainly focused on the identification of significant explanatory variables and their associated signs.

#### Principal component analysis

One of the explanatory variables included in the empirical model is OWN\_REA, which measures the extent to which a respondent owned forestland for amenity or financial reasons. There were 10 original items in the NWOS questionnaire measuring ownership reasons (Table 2). High correlations among several of these items indicated that the data were not one-dimensional, which warranted a data reduction procedure. Principal component analysis (PCA) is a statistical technique allowing for the transformation of a large number of correlated variables to a smaller set of uncorrelated, composite variables called principal components (PCs) with a minimal loss of information (Finely et al., 2006). PCA involves the calculation of the eigenvalue decomposition of a data covariance matrix or can utilize singular value decomposition of the data matrix (Samish, 2009). The results of a PCA are usually discussed in terms of PC loadings. A PC loading represents the correlation between the survey item and the PC, and is used to define and name each PC. Absolute PC loadings greater than 0.50 are considered significant and indicate a strong association among survey items used to generate that particular PC (Finely et al., 2006; Hair et al., 1998). Those items that do not load significantly on derived PCs are often left to stand alone in later analyses.

In this study, PCA was performed on 9,688 complete records and 10 ownership reason items. Table 2 displays the PC

**Table 2**

Description and summary of survey items measuring reasons for owning forestland along with principal component analysis summary statistics.

Ownership reason survey items <sup>a</sup>	Mean (Std. Dev.)	Rotated principal component loading		Cronbach's Alpha	
		PC.1	PC.2		
To enjoy beauty and scenery	2.18 (1.67)	<b>0.77</b>	−0.26	0.77	
To protect nature and biodiversity	2.59 (1.78)	<b>0.67</b>	−0.19		
Part of my home or vacation home	3.06 (2.40)	<b>0.62</b>	−0.23		
For privacy	2.71 (2.11)	<b>0.75</b>	−0.19		
For recreation, other than hunting or fishing	3.63 (2.25)	<b>0.63</b>	0.02		
For production of timber products	4.45 (2.31)	0.07	<b>0.76</b>		0.50
For land investment	3.19 (2.12)	0.19	<b>0.61</b>		
For hunting or fishing	3.16 (2.27)	0.49	0.36		
To pass land on to my heirs	2.63 (2.03)	0.44	0.41		
Part of my farm or ranch	3.90 (2.61)	0.35	0.23		
Eigenvalue		2.99	1.49		
Variance explained		0.30	0.15		

<sup>a</sup> Item scale: 1 = very important, 7 = not important.

loadings for the first two PCs. Both PCs had an eigenvalue greater than one and allowed for practical interpretation of the meaning of the PCs. Based on the associated item themes, we defined PC.1 as owning forestland for amenity reasons, represented by variable OWN\_REA\_AMEN; and PC.2 as owning forestland for financial reasons, represented by variable OWN\_REA\_FINAN. Combined, OWN\_REA\_AMEN and OWN\_REA\_FINAN accounted for 49% of the total variance in reasons for owning forestland. As a measure of scale reliability, Cronbach's Alpha was calculated for each PC (Cronbach, 1951). Because OWN\_REA\_FINAN did not meet suggested Cronbach's Alpha minimum of 0.70 (Nunnally, 1978), caution is needed when interpreting results related to the financial reasons for owning forestland (Finley and Kittredge, 2006).

## Results

### Rate of participation

Nationwide, the rates of participation among family forest owners in the three types of forest conservation programs differed greatly. The rate of participation in a state or federally sponsored cost-share program was considerably higher (19.4% of area, 5.2% of owners) than in a forest certification (4.2% of area, 0.8% of owners) or conservation easement program (3.4% of area, 1.7% of owners). Participation rates at the national, regional and sub-regional levels are shown in Table 3.

When looking at cost-share programs in particular, the South had the highest participation rate in terms of forest land area (26%); while the Rocky Mountain had the highest participation rate in terms of owner (9.3%). Regarding forest certification programs, the Pacific Coast had the highest participation rate in terms of both forest land area (5.2%) and owner (1.4%); while the Rocky Mountain had the lowest participation rate in terms of both forest land area

(1.5%) and owner (0.2%). Regarding conservation easement programs, again, the Pacific Coast had the highest participation rate in terms of both forest land area (5.9%) and owner (2.8%); while the North, South, and Rocky Mountain were quite comparable. The North had a slightly higher percent of owners with an easement (2.1%); while the Rocky Mountain had a slightly higher percent of forest land area with an easement (4.0%).

When comparing participation rates across programs in terms of owner, the Pacific Coast had the highest rates of participation in both forest certification (1.4%) and conservation easement programs (2.8%), but the second-lowest rate of participation in cost-share programs (4.8%). The North had the second-highest rates of participation in both forest certification (0.9%) and conservation easement programs (2.1%), but the lowest rate of participation in cost-share programs (4.6%). Finally, the Rocky Mountain had the highest rate of participation in cost-share programs (9.3%), but the lowest rates of participation in both forest certification (0.2%) and conservation easement programs (1.1%).

### Factors influencing participation

In order to detect multicollinearity among explanatory variables used in the empirical model, correlations were calculated between each pair of explanatory variables and variance inflation factors were calculated for each regression. Both analyses indicated no multicollinearity that may adversely affect the regression estimates. The log likelihood tests of the empirical model for estimating participation in the three types of programs were all significant ( $p < 0.01$ ). The results of the logistic regressions are reported in Table 4.

For estimating participation in cost-share programs, significant explanatory variables include PART\_FC, PART\_CE, ACRE, TENURE, LEASE, DECISION, HRV\_COMM, SOURCE\_ADV, FUTURE\_HRV, and

**Table 3**

Participation in cost-share, forest certification, and conservation easement programs in the U.S. by region/sub-region.

Region/sub-region	Cost-share		Forest certification		Conservation easement	
	Area (%)	Owner (%)	Area (%)	Owner (%)	Area (%)	Owner (%)
U.S.	19.4	5.2	4.2	0.8	3.4	1.7
North	11.8	4.6	3.6	0.9	3.0	2.1
Northeast	9.7	3.8	4.3	1.3	3.9	2.6
North Central	12.6	5.6	3.0	0.5	1.7	2.3
South	26.0	5.2	5.0	0.7	3.3	1.1
Southeast	28.7	5.5	4.3	0.6	5.1	1.1
South Central	24.2	4.9	5.5	0.8	2.1	1.1
Rocky Mountain	17.5	9.3	1.5	0.2	4.0	1.1
Great Plains	16.6	21.2	0.4	4.4	1.6	3.1
Intermountain	17.7	4.7	1.7	0.3	4.4	0.7
Pacific Coast	17.9	4.8	5.2	1.4	5.9	2.8

**Table 4**

Logistic estimates of the empirical models for estimating family forest owners' participation in cost-share, forest certification, and conservation easement programs.

Explanatory variables	Participation in the following programs					
	Cost-share		Forest certification		Conservation easement	
PART_CS	–		0.022**	(0.006)	0.012	(0.006)
PART_FC	0.118**	(0.031)	–	–	0.008	(0.008)
PART_CE	0.082*	(0.034)	0.012	(0.009)	–	–
ACRE	0.016**	(0.004)	0.006**	(0.001)	0.003*	(0.001)
TENURE	0.001**	(0.000)	0.000	(0.000)	–0.000	(0.000)
FARM	0.017	(0.013)	–0.013**	(0.004)	0.004	(0.005)
ABSENT	0.001	(0.011)	–0.005	(0.003)	–0.003	(0.004)
OWN_REA_AMEN	–0.003	(0.008)	–0.004	(0.002)	–0.002	(0.003)
OWN_REA_FINAN	–0.011	(0.008)	–0.006*	(0.002)	0.005	(0.003)
LEASE	0.033*	(0.015)	–0.003	(0.003)	0.001	(0.005)
DECISION	0.067**	(0.018)	–0.000	(0.003)	0.006	(0.006)
HRV_COMM	0.046**	(0.012)	0.005	(0.004)	–0.007	(0.005)
MGMT_PLAN	–	–	–	–	0.025**	(0.009)
SOURCE_ADV: government	0.240**	(0.031)	0.032**	(0.012)	0.012	(0.009)
SOURCE_ADV: extension	0.242**	(0.057)	0.079*	(0.034)	0.040	(0.023)
SOURCE_ADV: private	0.154**	(0.022)	0.029**	(0.008)	0.003	(0.006)
SOURCE_ADV: non-profit	0.430**	(0.109)	0.029	(0.026)	0.041	(0.035)
SOURCE_ADV: peer	0.243**	(0.033)	0.029**	(0.011)	–0.004	(0.006)
FUTURE_HRV	0.036**	(0.012)	0.011**	(0.004)	–0.006	(0.004)
FUTURE_LAND	0.008	(0.018)	–0.003	(0.004)	0.009	(0.009)
FUTURE_HEIR	–0.006	(0.013)	0.001	(0.004)	0.001	(0.005)
AGE	0.004	(0.012)	–0.000	(0.003)	0.008	(0.005)
EDU	0.048**	(0.011)	0.010**	(0.003)	0.002	(0.005)
INCOME	0.006	(0.011)	–0.000	(0.003)	0.009*	(0.004)
# of observations		4,260		3,942		4,026
Pseudo R <sup>2</sup>		0.28		0.30		0.16

Notes: Coefficients shown are marginal effects. Standard errors are in parentheses. STATE was used as a control variable. Forty-seven dummy variables were included in the regressions for 48 states. They were excluded from this table due to limited space. Three ownership objective items (part of my farm or ranch, to pass land on to my heirs, for hunting or fishing) did not load significantly on the two principal components and were therefore left as stand-alone variables in the regressions. They were not statistically significant, and were excluded from this table due to limited space. Multiple cut points were used to define binary variables AGE, EDU, and INCOME. For instance, for AGE, we tried 55 years and 75 years and for INCOME, we tried \$25,000 and \$100,000. Binary variables created using those cut points were not statistically significant. Missing values in various explanatory variables limited the number of observations used in the regressions to fewer than 4,500.

\*  $p < 0.05$ .\*\*  $p < 0.01$ .

EDU, all with positive signs. For instance, respondents having certified their land or with a conservation easement had a higher probability of using a cost-share program. Respondents owning more forestland were more likely to be participants. The longer respondents had owned forestland, the more likely they had participated in a cost-share program. Those who had harvested or a plan to harvest sawlogs or pulpwood and those who had leased their land for purposes other than logging were more likely to have participated in a cost-share program. Respondents who had their land managers or foresters make most decisions about their land (e.g., harvest trees) also had a higher probability of using a cost-share program. In addition, if a respondent had received forest management advice in the last 5 years, the respondent had a higher probability of using a cost-share program. Interestingly, this positive impact did not differ depending on the source of advice. In other words, regardless of whether respondents obtained advice from a government, extension, private, non-profit, or peer source, there was always a positive relationship between obtaining advice and participating in a cost-share program. Finally, respondents with some college education or more had a higher probability of using a cost-share program than those with only high school education or less.

For estimating participation in forest certification programs, PART\_CS was significant with a positive sign, implying that respondents having participated in a cost-share program had a higher probability of certifying their forestland. ACRE, FUTURE\_HRV, and EDU were also significant with positive signs, implying that respondents owning more forestland, planning to harvest sawlogs or pulpwood, or having at least some college education were more likely to have their forestland certified than otherwise. On the contrary, FARM was significant with a negative sign, implying that

respondents owning a farm or ranch within one mile of their forestland were less likely to certify their forestland. Interestingly, OWN\_REA\_FINAN was also significant with a negative sign, suggesting that respondents who owned forestland for financial reasons were less likely to participate in a certification program. In addition, having obtained forest management advice in the last 5 years had a positive impact on participation in forest certification programs; however, the significance of this impact depended on the source of advice. Significant relationship was observed between participation and obtaining advice from a government, extension, private, or peer source, but not between participation and obtaining advice from a non-profit source.

For estimating participation in conservation easement programs, three significant and positive variables (ACRE, MGMT\_PLAN, and INCOME) were identified. Respondents owning more forestland were more likely to have donated or sold a conservation easement. The probability of a respondent having an easement was higher if he/she had a written forest management plan. In addition, wealthier respondents were more likely to have an easement.

## Discussion

Only one factor was correlated with participation in all three types of programs. All else being equal, respondents owning more forestland were more likely to participate in cost-share, forest certification, and conservation easement programs. Thus, when promoting these programs, it may be a good idea for forest agencies and organizations to concentrate their outreach efforts on landowners with large land holdings, for example, 100 acres or more. It is also important to recognize that the average size of family forest holdings in the U.S. is 25 acres and 61% of family forest owners

own less than 10 acres of forestland (Butler, 2008). This suggests a limited potential for increasing participation rates of existing cost-share, forest certification, and conservation easement programs. To promote sustainable forest management and land conservation, additional efforts are needed to develop innovative programs to address the needs and concerns of landowners with small forest holdings who may not be attracted to traditional programs.

Obtaining forest management advice was also an important factor affecting program participation; however, the effects differed depending on the types of programs and the sources of information. For instance, a positive relationship between obtaining advice and participating in a cost-share program was observed regardless of whether respondents obtained advice from a government, extension, private, non-profit, or peer source; while advice from non-profit organizations did not affect landowner participation in forest certification programs at all. It is also worth noting that none of the five common sources of forest management advice or information had any statistically significant effect on landowner participation in conservation easement programs. Together, these findings suggest a need for better understanding family forest owners' perception of different sources of advice or information, examining why advice or information only affects certain types of programs, characterizing programs that may be promoted by providing advice or information, and identifying effective delivery strategies tailored toward the preference of potential participants of different programs.

The results of this study suggests that family forest owners who harvested, leased land for non-logging purposes, or had a plan to harvest were more likely to have participated in a cost-share program. This implies that landowners with financial needs or interests were likely participants of cost-share programs. However, controlling for other variables, income was not a significant explanatory variable in the empirical model for estimating participation in cost-share programs, suggesting family forest owners from low-income strata were not more likely to use cost-share programs than those from high-income strata. This may be explained by a number of reasons. For instance, financial assistance alone may not be sufficient to attract landowner participation. If this speculation is true, efforts promoting cost-share programs should not only focus on the financial aspect of the programs, but also highlight conservation benefits to be gained by adopting supported activities, such as enhanced water quality, soil protection, and wildlife habitats. Alternatively, there may be a need to evaluate the adequacy of current cost-share rates. Perhaps even with the help of cost-share programs, low-income respondents were still not able to afford desired conservation practices, therefore, decided to not participate. Under this scenario, consideration needs to be given to prioritize activities supported by federal and state programs at current funding levels and increase the rates for prioritized activities accordingly. Further research is needed to identify the underlining reasons why no difference in participation was observed between low-income and high-income landowners.

This study also identifies several important issues related to forest certification. Family forest owners having used a cost-share program had a higher probability of participating in forest certification programs. Thus, there may be a potential for promoting forest certification programs among those who participated in cost-share programs. Those owning a farm or ranch nearby or having no plan to harvest had a lower probability of having certified their forestland. This suggests the importance of targeting the right audience when promoting certification programs, namely landowners who own forestland for reasons other than farming or ranching and those who plan to harvest sawlogs or pulpwood in the near future. It was also observed that family forest owners owning forestland for financial reasons were less likely to certify. This confirms previous studies suggesting the cost of certification, insufficient markets, and lack of price premiums for certified wood products as barriers to the

adoption of certification practices (Kilgore et al., 2007; Rickenbach, 2002).

In addition, although tenure was significant in the cost-share model, it was not significant for predicting participation in forest certification and conservation easement programs. This is rather counter-intuitive. One would assume that tenure increases the probability of adopting sustainable forest management and land conservation practices in a long term. However, the results of this study suggest that landowners who owned land for more years were not necessarily more likely to certify their land or donate or sell a conservation easement than those new owners. Therefore, when promoting such programs, the target audience should be broad to include not only the established landowners but also individuals and families that newly acquired land.

Having a written forest management plan is a qualifying condition for private landowners to participate in cost-share and forest certification programs; therefore, the variable could bias the estimation and was excluded from the empirical models of these two programs. Nonetheless, it is important to consider the implication of imposing management plans as part of program eligibility requirements. Currently, only about 4% of family forest owners nationwide have developed such plans (Butler, 2008). To motivate landowners and improve program participation, government agencies and forestry professionals need to better assess the extent to which a plan is necessary for sustainable practices, especially considering that the majority of family forest owners own their land primarily for amenity reasons and may not want nor need a plan (Alexander, 1986; Butler, 2008; Jones et al., 1995). On the other hand, because landowners are not required to develop a management plan to sell or donate an easement, the variable was included in the empirical model for estimating conservation easement programs. Our result confirms previous research suggesting the potential for promoting early development of management plans as a strategy to increase the likelihood of landowners conveying conservation easements (LeVert et al., 2009).

Controlling for other variables, age was not a significant explanatory variable in any of the empirical models for estimating program participation. This result is particularly intriguing in the context of conservation easement. According to recent studies, more than a third of family forest owners are 65 years or older (Butler, 2008). A large number of intergenerational land transfers are expected in the next 10–20 years. There have been discussions about the high cost of dying unprepared and the potential for promoting conservation easement as part of estate planning among older family forest owners (Siegel et al., 2009). However, the empirical evidence presented in this study does not support targeting specific age groups for conservation easement programs. In fact, recently landowner focus groups suggested that when considering passing land on to their children or grandchildren, some older owners were concerned about protecting the future of their land, thus interested in donating or selling the development rights associated with their land; while others tended to be concerned about the equitability of their inheritance, and were reluctant to donate or sell a conservation easement that would tie the hands of their children and grandchildren (Langer, 2010). Additional work is needed to better understand why the current rate of participation in conservation easement programs is low, what are the needs and concerns of the landowners who will be making intergenerational land transfer decisions in the next 10–20 years, and what are the opportunities for promoting easements among these landowners.

Finally, it is worth noting that although the log likelihood test of the empirical model for estimating participation in conservation easement programs was significant ( $p < 0.01$ ), few variables were significantly important in predicting landowners' decision about donating or selling an easement. This suggests that the easement

decision is very different from other decisions. Particularly, neither professional nor peer advice or information had an effect on landowner participation in relevant programs. Further efforts are needed to better understand the dynamics of this particular alternative, which has become more important in recent years, and identify more influential factors that may affect landowner decision making about conservation easements.

## Conclusions

Considering the current low rate of participation in forest conservation programs in the U.S., it is important to understand what kinds of family forest owners are attracted to what types of programs. The results of this study provide a better understanding of the relationship between family forest owners' participation in cost-share, forest certification, and conservation easement programs and their characteristics, attitudes, and behavior. This understanding should help state and local policy makers, program administrators, community planners, landowner organizations, and natural resource professionals identify outreach strategies for improving landowner interest and participation in the aforementioned programs.

It is also worth noting that not everyone interested in participating in forest conservation programs is eligible. For instance, cost-share programs may require a minimum property size for participation or prioritize certain management activities due to funding constraint. Similar issues may apply in the case of conservation easement programs. It is important for policy makers and program administrators to clarify the goals for program improvement. If increasing participation is desired, adjusting program requirements may be necessary; however, if a program intends to target medium to large land holdings or selected conservation practices, current program requirements may prove to be appropriate. The key is to develop participation requirements to reflect program goals.

Although we focused on cost-share, forest certification, and conservation easement programs in the U.S., the approach used in this study is applicable to other types of forest conservation programs and in settings outside of the U.S. Similar methods could be used to investigate landowners' preferences and likelihood to participate in technical assistance, tax incentive, and education programs, or to understand the dynamics between landowner decision making and broader land management policy making beyond the U.S. For the various other programs or locations, the specific explanatory variables will need to be reconsidered, but methods similar to those used in this paper could be applied.

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