Nonindustrial private forest landowner perspectives on forest certification: A look at awareness and barriers

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ABSTRACT

Sustainable forest management is a universally desired goal to provide ecological, economic, and social benefits. Sustaining forest benefits across the landscape in Arkansas depends on nonindustrial private forest landowners (NIPF) who own 58% of forestland in the state. Forest certification is an effective "market based" mechanism for improving forest management to achieve sustainability. A mixture of mail and online surveys collected data on Arkansas NIPF landowners' demographic and forestland characteristics, ownership motivations, and attitudes regarding perceived benefits and drawbacks of forest certification. A binary logistic regression model revealed that age, gender, education, timber harvest intentions, motivations for owning forestland, and perspectives regarding the potential benefits of forest certification influenced landowners' awareness and interests in forest certification. These findings provide insight into NIPF landowners' attitudes in participating in a forest certification program. The findings are useful for developing outreach and education programs promoting NIPF landowners' participation in forest certification in Arkansas and other southern states.

1. Introduction

According to the U.S. Endowment for Forestry and Communities (2020), only 13% of forests in the U.S. were enrolled in the certification programs which could be ascribed to the large share of forestland owned by Nonindustrial private forest landowners (NIPF) landowners. In Arkansas, 487,826 acres are certified in the American Tree Farm System, 1,629,730 acres in Forest Stewardship Council, and 928,680 acres in the Sustainable Forestry Initiative. The FSC and SFI acres are industrial. In the U.S., about 63% of forestland is under private ownership and this fraction increases to 86% for the southern forests (Butler and Leatherberry, 2004; Butler et al., 2013). Specifically, about 200 million acres of forest land are owned by private forest owners among the total 232 million acres of forests across the South (Butler et al., 2013). Nonindustrial private forest landowners (NIPF) account for the majority of those private forest acres, on average, two out of every three acres of private forest land is owned by nonindustrial landowners (Conner and Hartsell, 2002; Williams et al., 1996; Butler et al., 2013). Specific to Arkansas, over half of the state's 18.9 million acres of forestland (10.4 million acres) is owned by 345,000 nonindustrial private landowners. Since the primary certification system for NIPF landowners in Arkansas is ATFS, only 5% of NIPF is certified. NIPF landowners' management

decisions in Arkansas have an important influence on the social, economic, and ecological sustainability of forests but certification systems affect only a limited amount of the state's forest landscape.

In the Southern United States, forests cover more than 40% of the land and play a key role in providing a variety of ecosystem services such as water protection, biological diversity, and carbon sequestration, etc. and they are an important source of renewable income from timber production. Therefore, the forest sector is an important contributor to state economies across all the13 Southern states. The forest sector contributed over 2% of the South's economic output and generated more than 1.1 million jobs in 2011 (Henderson, 2014). Arkansas has a high dependency on the forest economy: forestry contributed 5% of the state's gross domestic product (GDP) (Pelkki and Sherman, 2020), the highest rate of any state in the South. Overall, forests are vital in sustaining the rural economy and in defending sustainable development given they provide additional amenity benefits and services to landowners and the public.

Forest certification as a market-based mechanism aims to achieve sustainable management and use of forest resources and provides a voluntary opportunity for landowners to have their forestland assessed and verified. There are two types of forest certification including certification of forest management and certification of the chain of custody

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(COC). Certification of forest management primarily focuses on evaluating and assessing whether the forests are managed according to pre-defined standards; while COC is a certification for sources/materials of end-products that connect forests with the final consumers. Forest certification has been shown to be an effective strategy for sustainable forest management and is becoming more prevalent. The major certification programs in the United States include the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), and American Tree Farm System (ATFS); though there are differences in terms of certification schemes' standards and processes, they all are recognized as improving sustainable and environment-friendly management of forests. Forest certification systems are becoming a gateway to markets for forest landowners as industry is complying with consumer demand for sustainable forest products. Therefore, certification is also a key factor in economic development of forest resources through the expansion of wood-using industries. Therefore, understanding the NIPF landowners' decision-making with regard to forest certification in the Southern United States plays a key role in promoting and sustaining forestland management in this region.

Numerous studies have been carried out for examining NIPF landowners' perceptions and attitudes toward forest certification and the potential barriers/constraints for landowners to participate in a forest certification program. Literature has found different attitudes and concerns regarding forest certification among NIPF landowners. For example, Vlosky (2000) reported that most Louisiana NIPF landowners were not supportive of certifying private lands, whereas Newsom et al. (2003) found that landowners who communicated frequently with forestry professionals or had attended some outreach programs were more likely to support forest certification. Regarding the barriers that NIPF landowners might face, previous studies have found two possible constraints: certification cost and stringent requirements of certification (Bensel, 2001; Rickenbach, 2002; Kilgore et al., 2007; Perera et al., 2007; Kilgore et al., 2008; Leahy et al., 2008; Zhao et al., 2011; Ma et al., 2012; Chen and Innes, 2013; He et al., 2015; Tian et al., 2018a, 2018b; Tian et al., 2021). For instance, Bensel (2001) reported that certification cost was a major concern for Pennsylvania NIPF landowners; likewise, Perera et al. (2007) revealed that landowners in Louisiana and Mississippi were not willing to pay any costs related to forest certification and a very similar results were reported by Kilgore et al. (2007) and Leahy et al. (2008) for landowners in a Minnesota study. This barrier also exists in a global context, like Tian et al. (2018a, 2018b, 2021) reported that the high certification cost was a major concern for landowners in China. The barrier of stringent certification requirements mainly refers to the required components of a management plan. Kilgore et al. (2007) and Leahy et al. (2008) found that complex management plan requirements were negatively associated with landowners' interests in adopting forest certification in a Minnesota study. In addition, lack of knowledge and information related to forest certification is another possible factor for limiting landowners to participate in a forest certification program. For example, Newsom et al. (2003) revealed that NIPF landowners generally have little understanding of the concept of forest certification and many of them either unfamiliar with certification programs or not sure which program was appropriate for them to participate in. Considering the barriers of certification cost and stringent requirements of certification, the low participation rate of NIPF landowners has hindered the expansion of forest certification in the U.S.

In addition, numerous researchers have attempted to explore and identify factors that are associated with landowners' decision-making for forest certification. For example, studies of Ma et al. (2012) and Tian et al. (2018a) reported that landowners' education and income level were positively associated with their willingness of certifying forestland. Besides, both Kline et al. (2000) and Knoot et al. (2015) reported that female landowners were more willing to participate in environment-friendly certification programs than their male counterparts. Moreover, some studies have found that forestland characteristics and management objectives were related to landowners' decision-

making regarding forest certification (Ma et al., 2012; Tian et al., 2018a; Tian et al., 2018b). For example, Tian et al. (2018a) and Tian et al. (2021) reported that landowners having a larger ownership size (acreage of foreland), planning to harvest timber, and having a management plan were more inclined to have their forestland certified compare to their correspondents.

The published results from elsewhere such as Pennsylvania (Bensel, 2001) and Minnesota (Kilgore et al., 2007; Leahy et al., 2008) as well as Mississippi and Louisiana (Perera et al., 2007) provide a good perception for NIPF landowners attitudes/perspectives toward forest certification. However, these results might not apply to Arkansas since social and cultural context is different spatially and temporally (Lieske, 2010). Besides, a research gap of examining factors that impact NIPF landowners' awareness of forest certification and their interests in having forestland certified exits. Arkansas's forest industries have undergone structural and ownership changes that reflect the increasing globalization of production and markets. As a result, mills are increasingly requiring certificated fiber. To bridge the gap, this study aims to address: 1) NIPF landowners' awareness of forest certification and their interests in adopting forest certification and 2) potential factors associated with landowner awareness and interests in certification programs. These findings will be helpful to better understand NIPF landowners' attitudes toward participating in a forest management certification program. Meanwhile, the findings will be useful for the development of outreach and education programs to promote the active participation of NIPF landowners in certification systems in Arkansas and the western Gulf region of the US South.

2. Methods

2.1. Data collection

This study examined the attitudes of Arkansas NIPFs toward participating in a forest management certification program. To be consistent with landowner surveys (e.g., Butler, 2008), we conducted this survey for forest landowners who at least own 10 acres of forestland in Arkansas. Before implementing, the designed survey was reviewed and approved by the University of Arkansas at Monticello's Institutional Review Board (IRB# FNRf-01). Data required for this study were collected through a combination of mailing and online surveys in 2020. In the delivered mails, a prepaid and pre-addressed returned envelope together with an online survey link was included. The information regarding NIPF landowners' mailing addresses was purchased from Dynata Inc., which is a reliable mailing list provider (i.e. Wang et al., 2020). This questionnaire was mailed to 4000 NIPFs following the Tailored Design Method (Dillman, 2000). Two hundred and ninety-eight names were eliminated because of bad addresses, death, changed land-use, or not own any forestland anymore, etc. A total of 562 effective surveys were returned which yield a response rate of 15.2%.

The survey was designed to help understand NIPF landowner's awareness and interests in forest management certification. Questions associated with landowners' demographics, ownership and forestland characteristics, as well as landowners' perceptions for possible benefits and drawbacks of certification were included in the survey. Meanwhile, to test if landowners' awareness and interests in forest certification were related to any of their motivations for owning forestland, we included a motivation question in the survey with numerous choices. As a result, a total of 28 questions were included in the questionnaire composing of Likert-scale items regarding NIPFs' familiarity (1 = not at all familiar, 5 = very familiar) and interests (1 = not at all interest, 5 = very interest) in a forest certification program, and NIPFs' motivations of owing forestland (1 = not at all important, 5 = very important). Besides, other questions such as forestland and ownership characteristics (size, acquisition mode, tenure, etc.), land-use plan (timber harvest plan and history) and future ownership plan (sell, bequeath to family, or self-manage), as well as owner demographics (age, education, income,

etc.) were also included in the survey (Table 1).

2.2. Data analysis

Statistical analysis methods adopted in this study included descriptive statistics, principal components analysis (PCA), and binary logistic regression. PCA was used for variable reduction and logistic regression was employed to examine the relationship between the dependent variable and a series of independent variables. The first dependent variable represents landowners' interests in adopting a forest management certification program, it equals 1 if a landowner was interested in participating in a forest certification program and 0 otherwise. Likewise, the second dependent variable also had two levels (1 = Yes, 0 = No) in terms of NIPF landowners' familiarity with the conception of forest certification. Because of the binary scale of the dependent variables, binary logistic regression was used. Mathematically, the binary logistic regression model was expressed as follows (Eq. 1)

$$p_i = E(y_i = 1|x_i) = \frac{e^{\beta x_i}}{1 + e^{\beta x_i}} \tag{1}$$

Where: p_i is the probability that a landowner is familiar with or interested in adopting forest certification, β represents the vector of regression coefficients, i denotes the ith respondent. To be noted, the parameters in the logistic regression model were estimated by maximizing a likelihood function and the coefficients could not be explained by per unit change for each explanatory variable (Mehmood and Zhang, 2005). To obtain a valid explanation of explanatory variables, marginal effects should be computed for each explanatory variable using Eq. 2. However, the primary goal of this study is to explore the significant factors that influence NIPF landowners' familiarity and interests in forest certification; thus, we mainly focused on the identification of significant explanatory variables and their associated signs.

$$\frac{dp_i}{dx_i} = p_i \times (1 - p_i) \times \beta \tag{2}$$

The explanatory variables included in the logistic regression models consisted of landowners' demographic, ownership and forestland characteristics, motivation of owning forestland, and landowners' attitudes toward likely benefits and drawbacks related to forest certification (Table 1). Sixteen different motivations for owning forestland were measured using a 5-Likert scale (1 = not at all important, 5 = very important) (Table 2). Several of those items have high correlations with each other, suggesting that the data were not one-dimension and needed a reduction procedure. Hence, the widely used PCA technique was utilized for reducing dimensionality by creating new uncorrelated variables while preserving as much of the data's information as possible. Finding such new variables, called principal components (PCs), actually is a process of computing the eigenvalue/eigenvector of the data's covariance matrix and its results are generally discussed using PC loadings.

3. Results

3.1. Descriptive statistics of respondent profiles

The average age for the survey respondents was 61 years, 70% were male landowners. Regarding education attainment, 47.7% of respondents reported having a college degree or higher, and 31.5% indicating high school or less. Over two-thirds (66.7%) of respondents indicated their annual household income was above $50,000. The mean size of forestland owned by survey respondents was 68.6 acres with 17% of the respondents reporting ownerships of at least 100 acres of forestland. The average tenure of ownership was 33 years and 8% of respondents indicated that the property had been owned by their family for at least 100 years.

We asked NIPF landowners' familiarity with forest certification

Table 1

Explanatory variables included in the binary logistic regression model to explain NIPFs' interest in forest certification.

Variable	Description	Mean (Std. Dev.)
Sociodemographic		
AGE	Binary—1, if age of forestland owners is greater than 60; 0 otherwise	0.60 (0.49)
GENDER	Binary—1, male; 0, otherwise	0.70 (0.46)
EDU_LEV	Ordinal—1, if highest education is less than 12th school; 2, if having a high school/GED; 3, if having some college education; 4, if having an associate degree; 5 if having a bachelor's degree; 6, if having an advanced degree	3.71 (1.51)
INCOME	Binary—1, if household annual income is $50,000 or more; 0, otherwise	0.67 (0.47)
Ownership and forestland characteristics		
ACRE	Continuous—base 10 logarithm of forestland acreage owned by a landowner	1.84 (2.23)
TENURE	Continuous—base 10 logarithm of the number of years having owned forestland	1.52 (1.48)
ACQU	Nominal—1, if acquired forestland through purchase; 2, if through inherit;	1.18 (0.39)
HRV_HIST	Binary—1, if harvested; 0, otherwise	0.47 (0.50)
MGMT_PLAN	Binary—1, if having a written management plan; 0, otherwise	0.17 (0.38)
ADVIS	Binary—1, if received any management advice for forestland from other sources (i.e., neighbors, friends, State Division of Forestry, etc.); 0, if never received advice in the last 5 years	0.52 (0.50)
HRV_FUTR	Binary—1, if planning to harvest; 0, otherwise	0.34 (0.48)
FUTR_MGMT	Binary—1, if planning to self-manage some or all of forestland owned; 0, otherwise	0.52 (0.50)
FUTR_PASS	Binary—1, if planning to pass on some or all of the forestland to children or other heirs; 0, otherwise	0.43 (0.50)
OWN_MOT	Ordinal—motivations of owning forestland (principal component loadings, see Table 2)	–
Attitudes toward possible benefits of FC		
ITGR_HEA	Ordinal—1, if not at all agree on forest certification will increase timber growth and health; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	3.36 (1.35)
EX_MAR	Ordinal—1, if not at all agree on forest certification will help expand markets for harvested forest products; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.71 (1.34)
PR_PRE	Ordinal—1, if not at all agree on having a price premium for certified forest products; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.80 (1.39)
PR_FP	Ordinal—1, if not at all agree on forest certification will bring a good public recognition for responsible forest practices; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.67 (1.38)
ENV_BENE	Ordinal—1, if not at all agree on forest certification will bring environmental friendly timber harvesting; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	3.10 (1.40)
BETT_MANA	Ordinal—1, if not at all agree on forest certification will improve management practices; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	3.29 (1.37)
Attitudes toward possible drawbacks		
MANA_COST	Ordinal—1, if not at all agree on forest certification will increase management cost; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.86 (1.29)
IPA_RE	Ordinal—1, if not at all agree on forest certification will bring more paperwork and recordings; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.91 (1.32)
ION_INS	Ordinal—1, if not at all agree on forest certification will increase on-site inspections; 2, if slightly agree;	2.64 (1.31)

Table 1 (*continued*)

Variable	Description	Mean (Std. Dev.)
AMANA_PLAN	3, if somewhat agree; 4, if moderately agree; 5, if extremely agree Ordinal—1, if not at all agree on forest certification will require landowners adhere to a management plan; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.67 (1.29)
DHAR_DIV	Ordinal—1, if not at all agree on forest certification will decrease the diversity of timber harvesting practices; 2, if slightly agree; 3, if somewhat agree; 4, if moderately agree; 5, if extremely agree	2.65 (1.28)

Table 2

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

Motivations of owning forestland	Mean (Std. Dev.)	Principal Component Loading				Cronbach's Alpha
		PC1	PC2	PC3	PC4	
To learn from nature	3.45 (1.35)	**0.72**	−0.37	−0.06	0.00	
To supply food and habitat for wildlife	3.91 (1.19)	**0.72**	−0.12	−0.33	−0.02	
For recreation other than hunting and fishing (hiking, family gatherings, etc.)	3.31 (1.39)	**0.70**	−0.21	0.11	−0.13	**0.75**
To protect nature and biodiversity	4.21 (1.07)	**0.64**	−0.34	−0.29	0.14	
For hunting or fishing	3.34 (1.55)	**0.58**	0.40	−0.06	−0.05	
For privacy	4.24 (1.17)	**0.51**	−0.50	0.22	−0.08	
To have trees around home	3.93 (1.26)	**0.50**	−0.21	0.30	−0.14	
To enjoy scenery	4.42 (2.48)	**0.51**	0.39	0.00	−0.39	
For timber production	2.26 (1.44)	0.32	**0.58**	−0.38	0.07	**0.78**
For long-term financial investment	2.98 (1.53)	0.42	**0.53**	−0.13	−0.20	
For grazing livestock	2.41 (1.94)	0.23	0.35	**0.58**	0.29	**0.79**
Because land cannot be farmed	2.38 (1.42)	0.28	0.18	−0.21	**0.60**	**0.78**
Part of my farm	3.41 (1.54)	0.40	0.38	0.28	0.24	
Part of my family heritage	3.09 (1.66)	0.49	0.40	0.02	−0.22	
To pass on to children or other heirs	3.69 (1.42)	0.21	−0.34	−0.23	0.42	
To collect firewood	2.50 (1.36)	0.47	0.16	0.40	0.24	
Eigenvalue		4.12	2.20	1.18	1.05	
Variance explained		0.26	0.39	0.47	0.53	

before receiving this survey, 68.7% of the respondents reported that they were not at all familiar with this concept and 28.5% indicated some level of familiarity, and only 2.9% of them indicated that they were very familiar with forest certification. When asked whether they were interested in participating in a forest certification program, 45.8% of the respondents reported some level of interest and still more than half (54.2%) reported no interest at all. Fig. 1 displayed the percentage
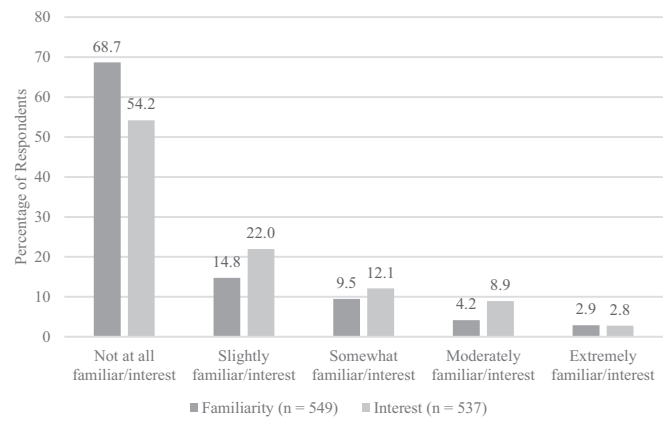

Fig. 1. Descriptive results of familiarity and interest in forest certification among respondents.

distribution for respondents' familiarity and interests in forest certification.

3.2. PCA results of ownership motivations

There was a question asking NIPF landowners to rate the importance (5-Likert scale) of a series of reasons for owning forestland property in the questionnaire and the specific reasons were summarized in Table 2. Based on the computed mean score (Table 2), the top three important reasons for owning forestland were: to enjoy the scenery (4.42), for privacy (4.24), as well as to protect nature and biodiversity (4.21). By contrast, respondents indicated the least important reason for owning forestland was for timber production (2.26).

In this study, PCA was conducted on the 16 ownership reason/ motivation items. When performing PCA, orthogonal varimax rotation was applied to create factors without inter-correlated variables and the coefficients of Cronbach's alpha were estimated to identify the internal consistency within indices. According to UCLA Academic Technology Services (2004), Cronbach's alpha scale of 0.7 was employed to identify acceptable analysis results. Based on the acceptable Cronbach's alpha score, PCA yielded four factors, which were displayed in Table 2. According to the items included in each factor, we defined PC1 as owning forestland for amenity displayed as AMEN, PC2 as owing forestland for financial investment, represented by FINAN; PC3 as owning forestland for grazing livestock, denoted by GRAZ; PC4 showed as NFARM which described the reason of having forestland because of land could not be farmed. In combination, those four factors accounted for 53% of the total variance.

3.3. Logistic regression results

Multicollinearity among independent variables was examined by computing the variance inflation factor (VIF) for each regression; since the estimated VIFs were less than the acceptable threshold of 10 (Freund and Wilson, 1998), we concluded that multicollinearity would not adversely affect the regression results. The log-likelihood tests for both binary logistic regression models were significant ($p < 0.01$) and the regression results were displayed in Table 3.

In the group of sociodemographic variables, age, gender, and education were statistically significantly related to respondents' interests in adopting forest certification. To be specific, a negative association was found for age ($p < 0.05$), suggesting that respondents who are older than 60 years were less likely to participate in a forest management certification. On the contrary, gender and education ($p < 0.05$) were both positively related to respondents' interests in participating in forest certification, indicating that male respondents and respondents with at least some college education were more interested in certifying their

Table 3
Results of binary logistic regression models.

Variable	Interests in FC	Familiarity with FC	VIF
	Coefficient (S.E.)	Coefficient (S.E.)	
Sociodemographic			
AGE	−0.50 (0.2447)**	−0.13 (0.2718)	1.30
GENDER	0.59 (0.2549)**	0.49 (0.2873)*	1.18
EDU_LEV	0.19 (0.0801)**	−0.11 (0.0920)	1.30
INCOME	0.23 (0.2641)	0.22 (0.2947)	1.36
Ownership and forestland characteristics			
ACRE	0.60(0.2667)**	0.29 (0.2863)	1.58
TENURE	−0.08(0.2763)	0.50 (0.2898)*	1.61
ACQU	0.08 (0.3239)	0.19 (0.1366)	1.43
HRV_HIST	0.56 (0.2548)**	0.05 (0.2774)	1.42
MGMT_PLAN	0.36 (0.3218)**	1.08 (0.3153)***	1.26
ADVIS	−0.13 (0.2377)	0.73 (0.2645)***	1.27
HRV_FUTR	0.58 (0.2536)**	0.21 (0.3683)	1.36
FUTR_MGMT	−0.30 (0.2307)	−0.12 (0.5479)	1.56
FUTR_PASS	0.37 (0.2250)*	−0.33 (0.2623)	1.06
Motivations of owning forestland			
AMEN	0.14 (0.1593)	0.10 (0.1755)	2.51
FINAN	0.21 (0.1017)**	0.06 (0.1114)	1.90
LIVE	−0.04 (0.0915)	0.05 (0.0575)	1.48
NFARM	−0.03 (0.1254)	−0.04 (0.0232)	1.52
Attitudes toward possible benefits of FC			
ITGR_HEA	0.51 (0.1262)***	−0.14 (0.1444)	2.65
EX_MAR	−0.19 (0.1663)	0.20 (0.1843)	5.36
PR_PRE	0.05(0.1633)	−0.23 (0.1787)	5.45
PR_FP	0.30 (0.1100)**	0.28 (0.1177)**	2.15
ENV_BENE	0.04 (0.1255)	0.008 (0.1397)	3.09
BETT_MANA	0.15 (0.1414)	0.02 (0.1523)	3.47
Attitudes toward possible drawbacks			
MANA_COST	0.05 (0.1537)	−0.01 (0.1743)	3.86
IPA_RE	−0.08 (0.1552)	−0.08 (0.1702)	4.03
ION_INS	0.10(0.1533)	−0.08 (0.1672)	4.01
AMANA_PLAN	−0.16 (0.1642)	0.33 (0.1764)*	4.58
DHAR_DIV	0.05 (0.1416)	−0.15 (0.1260)	3.15

***$p \leq 0.01$; **$p \leq 0.05$; and *$p \leq 0.10$. VIF: variance inflation factors.

forestland than the correspondents. Regarding respondents' familiarity with forest certification, only the variable of gender ($p < 0.10$) was significant in the model and the positive sign indicated that male respondents were inclined to report greater familiarity with the conception of forest certification than female respondents.

Among the variables describing forestland and ownership characteristics, ACRE ($p < 0.05$), HRV_HIST ($p < 0.05$), MGMT_PLAN ($p < 0.05$), HRV_FUTR ($p < 0.05$), and FUTR_PASS ($p < 0.10$) were significantly related to respondents' interests in certifying their forestland. The positive coefficient on ACRE implied that respondents who own larger forestland acreage were more likely to participate in a forest certification program compared to those small-size owners. Similarly, the coefficient of HRV_HIST with a positive sign suggested that respondents who have harvested timber products in the past five years were more willing to certify their forestland than those who never harvested. By the same token, the significant and positive coefficient of MGMT_PLAN indicated that respondents who have a management plan were more interested in forest certification than those who do not have one. Positive coefficients were also found for HRV_FUTR and FUTR_PASS, implying that respondents who intend to harvest forest products in the next five years and those who plan to pass forestland on through family were more likely to participate in a forest certification program than the correspondents. For examining NIPF landowners' familiarity with forest certification, regression results showed that TENURE ($p < 0.10$), MGMT_PLAN ($p < 0.01$), and ADVIS ($p < 0.01$) were significant with positive signs, suggesting that respondents with longer tenure, having a management plan, and have received management advice from a variety of sources were more familiar with the concept of forest certification than the correspondents.

Among the group of motivation variables, four factors (AMEN, FINAN, LIVE, NFARM) resulted from PCA analysis were included in the regression models. FINAN ($p < 0.05$) was significantly and positively associated with landowners' interest in forest certification, indicating that respondents whose primary reason for owning forestland is for financial investment were more likely to have their forestland certified. AMEN, LIVE, and NFARM were not statistically significant in our regression analysis.

Specific to variables in terms of landowners' attitudes toward possible benefits and drawbacks related to forest certification, ITGR_HEA ($p < 0.01$) and PR_FP ($p < 0.05$) were found significant in the regression model. Specifically, the positive sign before ITGR_HEA indicated that respondents who agree that certification can increase timber growth and health were more interested in participating in forest certification. Likewise, the positive coefficient of PR_FP suggested that respondents who believe that forest certification helps raise public recognition for responsible management practices were more inclined to adopt certification. Moreover, PR_FP ($p < 0.05$) and AMANA_PLAN ($p < 0.10$) were found significant and positive in the familiarity model, implying that respondents who agree on the benefit of public recognition and related requirements of following a management plan were more familiar with forest certification.

4. Discussion

The results of this study indicate that NIPF landowners in Arkansas have a relatively low level of knowledge and awareness regarding the concept of forest certification and these results are consistent with previous studies. Butler (2008) reported that most family forest landowners in the United States never heard about forest certification; in addition, studies of Kilgore et al. (2007) and Leahy et al. (2008) found in a Minnesota survey that family forest landowner have a general low familiarity with forest certification. A more geographically close study in Mississippi and Louisiana reported that less than half of the NIPF landowners have a minimal understanding of forest certification (Perera et al., 2007). The familiarity results indicate that more outreach and education efforts are needed in Arkansas to increase NIPF landowners' awareness and knowledge of forest certification. As reported by Auld et al. (2001, 2003), much forest certification information and outreach are primarily targeting industrial landowners, state ownerships, and wood products manufacturers. Regarding NIPF landowners, certification programs need to increase their accessibility and focus on certification-related information and knowledge.

Based on the previous associated research, we hypothesized that NIPF landowners' awareness and interests in forest certification were associated with ownership, motivation, forestland characteristics as well as demographic variables. Among the demographic variables, the binary logistic regression results demonstrated that NIPF landowners' willingness of adopting forest certification was impacted by age, gender, and education. The finding that landowners who are over 60 years were less interested in forest certification is in consistent with the study of Longpap (2004), who reported a negative association between age and landowners' participation in forestry programs. Male landowners were more likely to participate in a forest certification program than female landowners. This agrees with the findings of Tian et al. (2018b), who reported that female landowners were less likely to participate in a forest certification program. Furthermore, male landowners indicated that they were more knowledgeable about forest certification than the female correspondents, which probably contributes to the finding of male landowners are more interested in participation. Moreover, landowners with a higher education level were more likely to certify their forestland, which is in line with the results of Ma et al. (2012) and Tian et al. (2018a), who reported that education positively impacts landowners' willingness to participate.

Landowners who owned a larger acreage of forestland were more likely to adopt forest certification, which agrees with the results of Ma

et al. (2012) and Tian et al. (2018b), who found that ownership size positively impacted landowners' participation behavior of forest certification. This observation can be explained economies of scale in certification costs. NIPF landowners were more inclined to have their forestland certified if they harvested timber before or intended to harvest in the future. This observation is in line with the findings of Ma et al. (2012), who reported that landowners who have a harvesting plan were more interested in adopting forest certification. The finding that NIPF landowners were more willing to have their forestland certified if they have a written management plan is consistent with the results of Tian et al. (2018a), who found a positive influence of management plan on landowners' willingness to participate in forest certification. Besides, landowners who planned to pass on their forestland to future generations through family were more likely to participate in a forest certification program. Landowners with longer tenure indicated greater familiarity with forest certification. This suggests that longer tenure enables landowners to acquire more information regarding forest certification. Long tenure also enables landowners to make long-term management plans which in turn, contributes to their willingness to pursue knowledge and information about forest certification. Landowners with a management plan and who have obtained management advice were more familiar with forest certification. Those observations were not surprising given the fact that NIPF landowners could acquire forest certification-related information through frequent communications with forestry professionals (Newsom et al., 2003).

With regard to various motivations of owning forestland, landowners who had forestland primarily for financial-related reasons were more willing to adopt forest certification. This finding is in line with the results of Kilgore et al. (2007), who found a positive association between landowners' likeliness of participating in forest certification with the importance that they placed on timber production. However, a contrasting result reported by Ma et al. (2012) suggesting that landowners who owned forestland for financial reasons were less interested in forest certification. One possible explanation behind the mixed results could be landowners' different beliefs on the economic benefits of certification. Some might believe that certification could bring a higher price for timber or increase the ease of selling timber with economic benefits outweighing certification costs.

Arkansas NIPF landowners' perceptions on possible benefits of forest certification, benefits of timber growth, health improvement, and public recognition of responsible management are positively associated with likelihood of certifying forestland. Public recognition of good forestry positively influences landowners' familiarity with forest certification. Likewise, the requiring a management plan as part of certification positively influences landowners' knowledge and familiarity with forest certification. This is not a surprise considering that this requirement might encourage landowners into more interactions with forestry professionals.

5. Conclusions

This study examined NIPF landowners' awareness and attitudes toward forest certification and explored the potential influencing factors with regression models. The results provide a better understanding of the association between landowners' familiarity and participation in forest certification programs with their ownership and forestland characteristics, attitudes, and behaviors. Those findings should be helpful for state and local policy-makers as well as certification program administrators to identify education and outreach strategies to increase NIPF landowners' knowledge and willingness to participate. Given the relatively low level of familiarity with forest certification among NIPF landowners, it is necessary to increase information availability and outreach efforts on NIPF landowners. In addition, landowners' familiarity with forest certification was influenced by some of their ownership characteristics. For example, male landowners and those who own their forestland property for a longer period of time as well as those who

obtained management advice in the previous years reported to be more knowledgeable with certification than their counterparts. Similarly, NIPF landowners' participation in certification programs was also impacted by their demographic, forestland characteristics, motivations of owning forestland property as well as their perspectives on the benefits of certification. In summary, interested landowners are those who own large acreages of forestland, have harvested or plan to harvest timber, have a management plan, intend to bequeath forestland to the future generation, and those who place high importance on financial motivation. Those findings should provide a data-driven baseline for policy-makers to identify what kind of NIPF landowners to target for more education efforts to improve their participation in forest certification.

It is worth noting a few caveats of this study. First, though the response rate was less than desirable, it was on par with other landowner surveys (i.e., Nicosia et al., 2014). There was no follow-up survey given the budget restriction and large mailing sample. However, considerable similarities were found between our sample profile and the results of the National Woodland Owner Survey in Arkansas (Butler et al. 2020). For example, the average age in our sample was around 61 years old and 70% of them were male while it was 67 and 78% in the national survey. In addition, 47.7% in our sample indicated a college degree or higher while it was 46% in the national survey. Second, some of the variables used in the regression models were measured using a 5-Likert scale in the original questionnaire, but converted to dummy variables for a better-fit model which is very common in empirical model analysis, the effect on the results are currently unclear and cannot be thoroughly ruled out. Third, considering the acreage effect on landowners' participation in certification programs, future studies need to focus on grouping certification especially for those small-holder landowners.

Declaration of Competing Interest

The authors declare no conflict of interest.

References

Auld, G., Cashore, B., Newsom, D., 2001. A look at forest certification through the eyes of United States wood and paper producers. In: Global Initiatives and Public Policies: First International Conference on Private Forestry in the 21st Century, March 2001, Atlanta, GA.

Auld, G., Cashore, B., Newsom, D., 2003. Perspectives on forest certification: A survey examining the differences among the forest sector's views of their forest certification alternatives. In: Teeter, L., Cashore, B., Zhangh, D. (Eds.), Forest Policy for Private Forestry: Global and Regional Challenges. CAB Publishing, Wallingford, Oxon, UK, pp. 271–282.

Bensel, T., 2001. Promoting certified sustainable forestry on private woodlots in North-Western Pennsylvania: challenges and opportunities. Local Environ. 6, 257–278.

Butler, B., Wear, J., David, N., 2013. Forest ownership dynamics of southern forests. In: Wear, David N., Greis, John G. (Eds.), The southern Forest futures project: technical report. Gen. Tech. Rep. SRS-GTR-178. USDA-Forest Service, Southern Research Station, Asheville, NC, pp. 103–121.

Butler, B.J., 2008. Family forest owners of the United States, 2006. US For. Serv. Gen. Tech. Rep. NRS-27, 72.

Butler, B. J., Butler, S. M., Caputo, J., Dias, J., Robillard, A., Sass, E. M., 2020. Family forest ownerships of the United States, 2018: results from the USDA Forest Service, National Woodland Owner Survey. Gen. Tech. Rep. NRS-199. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. pp.52. [plus 4 appendixes] https://doi.org/10.2737/NRSGTR-199.

Butler, B.J., Leatherberry, E.C., 2004. America's family forest owners. J. For. 102, 4–14.

Chen, J., Innes, J.L., 2013. The implications of new forest tenure reforms and forestry property markets for sustainable forest management and forest certification in China. J. Enviro. Manage. 129, 206–215.

Conner, R.C., Hartsell, A.J., 2002. Forest area and conditions. In: Wear, D., Greis, J. (Eds.), The Southern Forest Resource Assessment. Gen. Tech. Rep. SRS-53. U.S. Department of Agriculture Forest Service, Southern Research Station, Asheville, NC, pp. 357–402.

Dillman, D.A., 2000. Mail and Internet Surveys: The Tailored Design Method, 2nd ed. John Wiley & Sons, New York, NY, USA, p. 464.

Freund, R.J., Wilson, W.J., 1998. Regression Analysis: Statistical Modeling of a Response Variable. Academic Press, San Diego.

He, M., Wu, Z., Li, W., Zeng, Y., 2015. Forest certification in collectively owned forest areas and sustainable forest management: a case of cooperative-based forest certification in China. Small. Scale. For. 14, 245–254.

Henderson, J., 2014. The economic importance of forestry in the South-2013. In: Mississippi State University Extension Service; Leslie Boby, Southern Regional Extension Forestry, ASRED; and Bill Hubbard. Southern Regional Extension Forestry, ASRED. https://sref.info/resources/publications/the-economic-importance-of-fores try-in-the-south-2013.

Kilgore, M.A., Leahy, J.E., Hibbard, C.M., Donnay, J.S., 2007. Assessing family forestland certification opportunities: a Minnesota case study. J. For. 105, 27–33.

Kilgore, M.A., Snyder, S.A., Schertz, J., Taff, S.J., 2008. What does it take to get family forest owners to enroll in a forest stewardship-type program? For. Policy. Econ. 10, 507–514.

Kline, J., Alig, R.J., Johnson, R.L., 2000. Fostering the production of nontimber services among forest owners with heterogeneous objectives. For. Sci. 46, 302–311.

Knoot, T.G., Rickenbach, M., Silbernagel, K., 2015. Payments for ecosystem services: will a new hook net more active family forest owners? J. For. 113, 210–218.

Leahy, J.E., Kilgore, M.A., Hibbard, C.M., Donnay, J.S., 2008. Family forest landowners' interest in and perceptions of forest certification: focus group findings from Minnesota. North. J. Appl. For. 25, 73–81.

Lieske, J., 2010. The changing regional subcultures of the American states and the utility of a new cultural measure. Political. Res. 63 (3), 538–552.

Longpap, C., 2004. Conservation incentives programs for endangered species: an analysis of landowner participation. Land Econ. 80 (3), 375–388.

Ma, Z., Butler, B.J., Kittredge, D.B., Catanzaro, P., 2012. Factors associated with landowner involvement in forest conservation programs in the U.S.: implications for policy design and outreach. Land Use Policy 29, 53–61.

Mehmood, S., Zhang, D., 2005. Determinants of forest landowner participation in the Endangered Species Act Safe Harbor Program. Hum. Dimens. Wildl. 10, 249–257.

Newsom, D., Cashore, B., Auld, G., Granskog, J.E., 2003. Forest certification in the heart of Dixie: A survey of Alabama landowners. In: Teeter, L., Cashore, B., Zhangh, D. (Eds.), Forest Policy for Private Forestry: Global and Regional Challenges. CAB International, pp. 291–300.

Nicosia, K., Daaram, S., Edelman, B., et al., 2014. Determining the willingness to pay for ecosystem service restoration in a degraded coastal watershed: a ninth grade investigation. Ecol. Econ. 104, 145–151.

Pelkki, M., Sherman, G., 2020. Forestry's Economic Contribution in the United States, 2016. Forest Prod. J. 70 (1), 28–38. https://doi.org/10.13073/FPJ-D-19-00037.

Perera, P., Vlosky, R.P., Hughes, G., Dunn, M.A., 2007. What do Louisiana and Mississippi nonindustrial private forest landowners think about forest certification? South. J. Appl. For. 31, 170–175.

Rickenbach, M.G., 2002. Forest certification of small ownerships: some practical challenges. J. For. 100, 43–47.

Tian, N., Poudyal, N.C., Lu, F., 2018a. Understanding Landowners' interest and willingness to participate in forest certification program in China. Land Use Policy 71, 271–280.

Tian, N., Lu, F., Joshi, O., Poudyal, N.C., 2018b. Segmenting landowners of Shandong, China based on their attitudes towards Forest certification. Forests. 9, 361–375.

Tian, N., Poudyal, N., Lu, F., 2021. Assessments of Landowners' willingness to accept compensation for participating in forest certification in Shandong. China. Sustain. 13, 903. https://doi.org/10.3390/su13020903.

UCLA Academic Technology Services, 2004. What Does Cronbach's Alpha Mean? http://www.ats.ucla.edu/stat/spss/faq/alpha.html (Retrieved March 16, 2021).

U.S. Endowment for Forestry and Communities, 2020. The State of America's Forests. https://usaforests.org/. Accessed on June 9, 2021.

Vlosky, R.P., 2000. Certification: Perceptions of non-industrial private forestland owners in Louisiana. In: Working Paper 41. Louisiana Forest Products Laboratory, Louisiana State University Agricultural Center, Baton Rouge, LA, p. 12.

Wang, T., Jin, H., Kreuter, U., et al., 2020. Challenges for rotational grazing practice: views from non-adopters across the Great Plains, USA. J. Environ. Manag. 256 (15), 1–10. https://doi.org/10.1016/j.jenvman.2019.109941.

Williams, R.A., Voth, D.E., Hitt, C., 1996. Arkansas' NIPF landowners' opinions and attitudes regarding management and use of forested property. In: Baughman, M.J. (Ed.), Proc. of the Symp. on Non-industrial Private Forests: Learning From the Past, Prospects for the Future. Minnesota Extension Service, St. Paul, MN, pp. 230–237.

Zhao, J., Xie, D., Wang, D., Deng, H., 2011. Current status and problems in certification of sustainable forest management in China. Environ. Manag. 48, 1086–1094.