# Factors shaping consulting foresters' services to family forest landowners

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## ABSTRACT

Consulting foresters provide a wide range of services to forest landowners. These services play a crucial role in meeting the many goals of forest landowners and maintaining sustainable, healthy forests. There is limited information about the extent to which foresters engage in consulting work to fulfill the forest management objectives of family forest landowners (FFLs). Using the online survey tool Qualtrics, we sent survey questions to registered foresters from West Gulf Coastal Plain regions of the United States (Arkansas, Louisiana, Oklahoma, and Texas). In this study, we described registered foresters' employment level of practicing consulting work (full-time vs part-time) and used a dichotomous logistic regression model to quantify the practice of consulting forestry by foresters (full-time vs. part-time), impacts of foresters' socio-demographic characteristics (e.g., age and income), landowners' forestland characteristics (e.g., forest types- pine and mixed), and services requested by landowners (e.g., site preparation, planting, thinning, and timber sale) on the choice of practicing consulting foresters. Results indicate about two-thirds (63 %) of the respondents were practicing as full-time consultants, and the remaining were considered part-time. Full-time foresters had a higher number of clients and clients with larger pine forestland ($p < 0.05$). In addition, consultant income was negatively significant with the level of employment ($p < 0.05$). Designing and developing outreach programs that facilitate awareness of and use of the benefits of technical services provided by consulting foresters could improve forest management returns among FFLs.

## 1. Introduction

Family forest landowners (FFLs) own and manage approximately 272 million acres or 39 % of forestland in the United States (US), a higher percentage than any other ownership category (Butler et al., 2021). FFLs are highly diverse in terms of ownership motivation and management objectives. According to Butler et al. (2021), the three most cited reasons for owning forestland were "to enjoy beauty or scenery," "to protect wildfire habitat," and to protect nature." Other common ownership goals of FFLs include timber production, recreation, aesthetics, and providing a legacy for future generations (Joshi et al., 2013; Goyke and Dwivedi, 2021; Grebner et al., 2021). These landowners supply vital ecosystem services such as drinking water, habitat for endangered species, soil erosion control, carbon storage, and recreation (Kamal et al., 2015; Bennett et al., 2018). Since various public goods and services stem from private forests, sustaining forest resources within this ownership is crucial for society's well-being. A substantial portion of those goods and services is provided by FFLs (USDA Forest Service, 2009).

Family forest lands account for 42 % of annual wood removals in the US, with that number closer to 69 % in the US southern region of the country (USDA Forest Service, 2023; Butler and Sass, 2023). FFLs also provide roughly 50–60 % of the annual timber removals in the US since the 1950s (Adams et al., 2006). Evidence shows that these landowners have been instrumental in supplying ecosystem services and determining timber supply for domestic and international markets (Butler and Leatherberry, 2004; Wear and Greis, 2013; Caputo and Butler, 2017; Butler and Sass, 2023). However, marketing the potential economic benefits through timber sales and hunting leasing of their forestland have not met the ownership's objective because landowners lack technical expertise in forest management (Measells et al., 2005, 2006; Andersson and Keskitalo, 2018), and in marketing and administering timber sales when compared to professional timber buyers (Measells et al., 2005; Landefeld and Schumacher, 2006).

To fill this gap, trained foresters play a vital role by providing an extensive range of services and offering expertise for FFLs. With some exceptions (e.g., Texas and Louisiana), foresters in most states must be licensed (registered) by their respective state to perform consulting

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services. The most common forestry services that registered foresters provide are preparing written forest management plans, site preparation, planting, timber cruising, and marketing timber sales (Wright and Munn, 2016). These services could increase landowners' monetary benefits, increase landowners' level of satisfaction, decrease the possible site impacts associated with logging operations, and realize the value of forest management practices (Clark et al., 1992; Clark, 2015; Schelhas et al., 2018).

Consulting foresters mainly work on private lands by either owning a consulting firm or working for other firms, either as an employee or on a contract basis. Firm structure varies significantly, from one-person to large corporate consulting firms (Bullard and Straka, 2014). The primary motivations for foresters to own their consulting firm include taking control of their business, advancing their career goals, adapting from job displacement from another forestry sector, and bolstering their earnings through supplementary income (Bullard and Straka, 2014). From a work hours perspective, the literature identifies two types of consultants, full- and part-time (Field, 1986; Wright and Munn, 2016). Full-time consultants usually work on their single job to provide services to forest landowners, whereas part-time consultants earn additional income. Following Field (1986), we assumed that consultants who make 100 % of their total income from consulting are considered full-time consultants. Several factors influence the practice of consulting work full versus part-time consulting. Many consultants were not able to generate enough business to support a job as a full-time consultant and were involved in other closely related businesses, notably land survey, real estate, appraisal, and certified burner (Field, 1986). Many of these activities have become standard services for consulting foresters and have been added into the practice of consulting forestry. The employment level of consulting foresters could be affected by the landowners' forest types and landowners' characteristics. Chhetri et al. (2018) found that FFLs with large forestland holdings and who were well-educated were willing to employ consulting foresters. For instance, FFLs with less than 50 acres of forestland were less likely to utilize forest management services (Mook and Dwivedi, 2022). Zhang and Mehmood (2001) found household income has had a significant effect on hiring consulting foresters. Literature shows one-fourth of landowners in Mississippi (Chhetri et al., 2018), nearly half of the landowners in South Carolina (Hiesl, 2018) hired consulting foresters, and about 58 % of the landowners in Alabama sought assistance from foresters (both private and public foresters) for timber harvesting, timber marketing, planning, and other forest management activities (Zhang et al., 1998). Nelli et al. (2007) indicated competition from public foresters as the largest source of competition for their services. However, a recent thesis (McCauley, 2023) suggests that there is an untapped potential business for consulting services from FFLs, but that consultants must make greater efforts to market their services to this group to generate additional business to alleviate some competitive pressures faced by consultants.

Only a little information about the employment level of consulting foresters is found in the literature. Schnepf and Baumgartner (1988) conducted a survey-based study and found that more than half of the consultants were full-time and spent, on average, 194 days consulting. Most of the clients for full-time clients were FFLs. Only a few landowners realized the benefits of consultants; as a result, much of the family-owned forest land is not actively managed (Barry, n.d.; Measells, 2006). One area that has not been well explored is sorting behavior between full-time and part-time forestry service providers. We posit the following: employment level of consulting foresters could be affected by landowner management objectives, which can affect management intensity and, thus, the frequency and amount of needed forest management interventions. Among the different forest types, pine plantation requires intensive management due to its high productivity (Shiver, 1998; Arano, 2002; Siry, 2002; Diaz et al., 2019). Therefore, the landowners who own pine plantation forests should require more management interventions throughout the life of the stand. Therefore, pine owning forest landowners would be more likely to require full-time

services (due to management intensity) and seek out full-time consultants. Alternatively, forest landowners with mixed forests typically do not require the number and level of interventions on their forest stands and would need consulting services less frequently. This is because mixed forest types in the southern US are predominantly of natural origin (Shell et al., 2021), so site preparation, planting, and fertilization are less likely to occur in these naturally regenerated forests. Therefore, creating a market for forest landowners that require lower management intensity, with which part-time consultants can do business. This is self-reinforcing as full-time consultants are less likely to contract with more passive landowner types, and part-time consultants do not have the time to commit to more active management landowners.

## 2. Methods

### 2.1. Study area

The study was conducted in the West Gulf Coastal Plain (WGCP) region of the US, consisting of Arkansas, Louisiana, Oklahoma, and Texas, covering 57.17 million acres of forestland (Fig. 1). Pine (33.73 %) and Oak-Hickory (31.00 %) shared a comparable proportion of the forest land, followed by bottomland hardwoods (21.08 %) (USDA Forest Service, 2023). Among the four states of the study area, Arkansas's forestry sector contributes the most (4.1 %), and Texas has the lowest contribution (0.9 %) to its total gross domestic product (GDP). The most recent report published by the Arkansas Center for Forest Business reported that the WGCP region generated more than 130,000 direct employment in the forestry sector (ACFB, 2023).

### 2.2. Survey and data collection

To assess the consulting foresters' level of employment, an internet-based survey instrument was developed and sent to 608 registered foresters working in WGCP regions using Qualtrics. The lists of registered foresters were obtained from multiple sources, e.g., the Board of Registration for Foresters, State Forestry Association, Association of Consulting Foresters, Land Conservation Assistance Network, and State Forestry Service. We modified the Dillman Tailored Design Method to administer the survey, where we made three contacts (an initial contact was made through an email with an invitation for participation in the survey, a follow-up email after three weeks of initial email, and a reminder email after two weeks of follow up email) (Dillman et al., 2009).

The survey instrument included four parts. Two parts of the questionnaire were used in this analysis. Part I included whether the participants were full-time or part-time consulting foresters (Full-time, Part-time with no other work, Part-time with other work, and Retired part-time) and willing to continue practicing consulting services. The dependent variable, EMPLOY, was used in the analysis to indicate if participants were full-time versus other employment types (or part-time). EMPLOY was re-coded as two binary values: full-time (1) and part-time (0).

Other questions in Part I included a number of clients (open-ended) and services requested by forest landowners (Likert scale ranges 1 to 3). The primary forestry-related services were listed, and participants were asked to rate the services they provided to forest landowners (e.g., chemical site preparation: 1- Never, 2- Occasionally, and 3- Frequently). Further, the Likert scale responses were treated as ordered categorical variables. In addition, the number of years of consulting services provided to FFLs was collected.

Part IV asked for the respondents' socio-demographic information, including age, gender, race, income, and the highest education degree. Three variables (age, gender, and race) were also not used in the final model. This is because age and income were highly correlated, and the distribution of gender and race was homogenous. The income variable was treated as an ordered categorical variable. The other variables, such
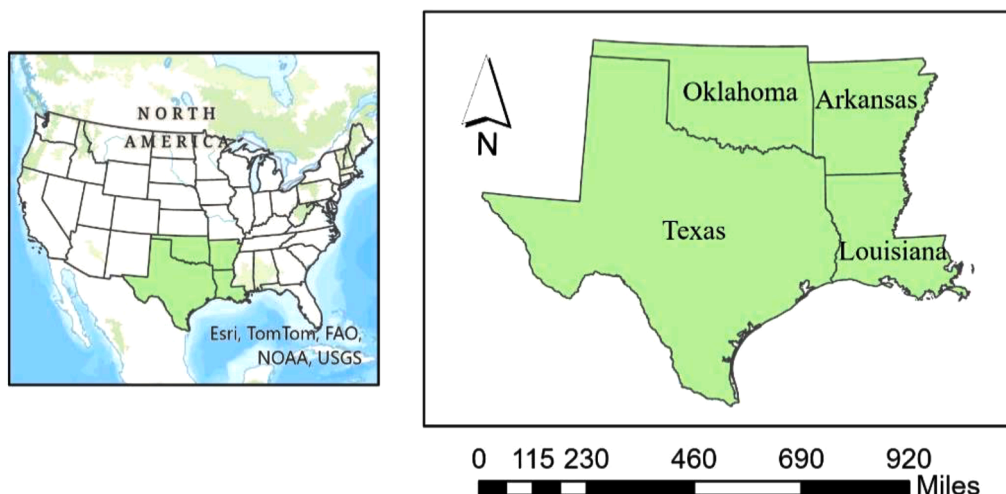
**Fig. 1.** The study area consists of four states of the West Gulf Coast Plain region.

as gender, race, and the highest education level, were not used in the analysis because almost all of the respondents were male, white, and had at least a bachelor's degree in education level.

### 2.3. Variable description

The descriptive statistics of the dependent and explanatory variables used in the final results are included in Table 1. The independent variables included attributes of consulting foresters' clients and examined

**Table 1**
Description and statistical summary of variables used in the logit model for the level of employment of consulting foresters.

| Variables | Type | Description | Mean | SD* |
|---|---|---|---|---|
| | | *Dependent variable* | | |
| EMPLOY | Binary | Full-time employment as a consulting forester, 1 if yes, 0 otherwise | 0.63 | 0.48 |
| | | *Independent variables* | | |
| PINE | Continuous | Consulting foresters' clients with the proportion of the pine forest land (in percent) | 54.84 | 30.51 |
| MIXED | Continuous | Consulting foresters' clients with the proportion of mixed forest land (in percent) | 16.67 | 16.06 |
| LNONUM | Continuous | Total number of clients (family forest landowners) of consulting foresters: a natural logarithm of total number | 3.97 | 1.52 |
| CSP | Ordered categories | Chemical site preparation service requests received by consulting foresters (1=never, 2=occasionally, 3=frequently) | 2.45 | 0.72 |
| THINNING | Ordered categories | Thinning service requests received by consulting foresters (1=never, 2=occasionally, 3=frequently) | 2.65 | 0.52 |
| CRUISE | Ordered categories | Timber cruising service requests received by consulting foresters (1=never, 2=occasionally, 3=frequently) | 2.56 | 0.57 |
| SALE | Ordered categories | Forest product sale service requests received by consulting foresters (1=never, 2=occasionally, 3=frequently) | 2.65 | 0.58 |
| INCOME | Ordered categories | Consulting forester's annual income, seven categories ranging from 1(<$60,000) to 7 (>$160,000) | 5.73 | 1.95 |

* Standard Deviation.

socioeconomic variables specific to the consultant. The attributes of consulting foresters' clients included the proportion of pine forest land (PINE), the proportion of mixed forest land (MIXED), and the number of clients (LNONUM), which is a log-transformed variable. We observed that the relationship between the two variables would be logarithmic (i. e., consulting foresters' marginal utility starts declining if the number of clients increases after a certain number). In other words, after a consultant has enough clients to meet full-time employment requirements, additional client's marginal impact is small on the employment decision. These variables are continuous in type. In addition, FFLs most frequently services chemical site preparation (CSP), thinning (THINNING), timber cruising (CRUISE), and forest produce sale (SALE) were ordered categories type independent variables used in the model. Moreover, consulting foresters' annual household income (INCOME) was also another independent variable that has seven categories ranging from less than $60,000 to greater than $160,000. While other socioeconomic variables were collected, none appeared to be significant predictors in data exploration and model development (e.g., age).

### 2.4. Model specification

A binary logistic regression model was used to estimate the effects of several factors associated with the level of employment using the R statistical software 4.1.2 using the RStuido (RStudio, 2023). The dependent variable was a respondent's answer to the dichotomous choice of whether or not the consulting forester practiced full-time consulting work. In this study, we defined that the foresters who do not have other jobs than consulting services are considered full-time consultants, which was denoted as "1″ and otherwise "0″.

The general form of the model:

$$\log(Y_i) = ln\left(\frac{p_i}{1 - p_i}\right) = \alpha + \beta'X_i \qquad \text{(I)}$$

where,

$Y_i$ level of employment (whether consulting foresters work full-time or part-time)

$p_i$ the probability of $Y_i$,

$\alpha$ intercept

$\beta'$ vector of regression coefficients

$X_i$ vector of explanatory variables (e.g., income, number of clients)

To estimate the probability of occurrence of the level of employment, the equation (I) can be rewritten as (Peng et al., 2002):

$$\Pr(Y_i = 1 | X_i) = \frac{e^{\alpha + \beta' X_i}}{1 + e^{\alpha + \beta' X_i}} = \frac{1}{1 + e^{-(\alpha + \beta' X_i)}} \qquad \text{(II)}$$

Moreover, we calculated the variance inflation factors to examine the presence of multicollinearity using artificial regression between the explanatory variables. A certain degree of correlation between explanatory variables is expected. However, VIF greater than 10 considered that the estimation of the explanatory variables suffered from multicollinearity (Ghimire et al., 2014; Tian et al., 2023).

## 3. Results

### 3.1. Survey response and non-response bias test

A total of 121 responses were obtained from the online survey. After removing invalid email addresses that resulted in failed deliveries, an adjusted survey response rate was 23.13 %. A similar range of response rates was found in other surveys of foresters (Boby et al., 2016; Godar Chhetri et al., 2022; Merry et al., 2022; Bettinger et al., 2023). However, only 55 responses, approximately 10 %, were usable after removing those with incomplete responses from the questionnaire.

We compared key socio-demographic variables such as age, gender, education, and annual income between the study sample and statistics reported by previous similar studies (Table 2). A similar method of testing non-response bias in which a comparison of key variables between the sample data and the previous study was used by several studies (Miller et al., 2012; Adhikari et al., 2021; Gutierrez-Castillo, 2022). There were no differences in the mean values of the key variables. Thus, the comparisons suggested that non-response bias did not exist in the survey data, with the usual caveat.

### 3.2. Respondents' characteristics

Tables 3 and 4 provide the respondents' profiles. The median age of our respondents was 55 years. Almost all (96 %) respondents were white males (two respondents did not prefer to answer). Over two-thirds of respondents had less than $80,000 or over $160,000 annual household income. All respondents had at least a bachelor's degree of education level. Almost ninety percent of the respondents had been practicing forestry for more than 11 years, and a significant portion (67 %) had worked as consultants for more than 20 years.

More than forty percent of WGCP registered foresters were members of the Society of American Foresters (SAF), and approximately 22 % were members of the Association of Consulting Foresters (ACF). Over half, 57 %, were members of the state Forestry Associations. Almost 15 % of registered foresters were real estate license holders, and about 14 % were certified prescribed burners. Approximately ten percent were licensed timberland appraisers. Over 12 % of the respondents reported they were registered to practice forestry in at least two WGCP states.

### 3.3. Major forestry services requested by family forest landowners

Consulting foresters provide several services to FFLs through full-time and part-time employment. Our results show that "forest product sale" was the most frequently requested service, 85.5 % of the consulting

**Table 3**

Socio-demographic characteristics of the respondents in the West Gulf Coastal Plain of the US based on an online survey conducted in 2023.

| Socio-demographic characteristics | Count (%) |
|---|---|
| **Age (years)** | |
| 30–40 | 4 (7.27) |
| 41–50 | 17(30.91) |
| 51–60 | 11(20.00) |
| More than 60 | 22(40.00) |
| Prefer not to answer | 1(1.82) |
| **Gender** | |
| Male | 54(98.18) |
| Female | 0(0) |
| Prefer not to answer | 1(1.82) |
| **Race** | |
| White/Non-Hispanic | 53(96.36) |
| Hispanic | 0(0) |
| Black | 0(0) |
| American Indian | 0(0) |
| Others | 0(0) |
| Prefer not to answer | 2(3.64) |
| **Income** | |
| $40,000-$79,999 | 21(38.18) |
| $80–000-$119,999 | 8(14.55) |
| $120,000-$159,999 | 7(12.73) |
| More than $160,000 | 19(34.55) |
| **Education** | |
| Lower than a Bachelor's degree | 0(0) |
| Bachelor's degree | 51(92.73) |
| Master degree | 4(7.27) |
| **Experience** | |
| Less than a year | 1(1.82) |
| 1–5 years | 3(5.45) |
| 6–10 years | 2(3.64) |
| 11–20 years | 16(29.09) |
| More than 20 years | 33(60.00) |

($N = 55$).

**Table 4**

Credentials profile of the respondents in the West Gulf Coastal Plain of the US.

| Professional membership | Count (%) |
|---|---|
| Society of American Foresters | 38(40.43) |
| State Forestry Association | 54(57.44) |
| Association of Consulting Foresters | 21(22.34) |
| Real Estate License | 14(14.89) |
| Certified Prescribed Burn License | 13(13.83) |
| Licensed Appraiser | 9(9.57) |
| Registered Foresters in two or more states | 12(12.8) |

($N = 94$).

foresters had received this request from FFLs (Table 5). Over 69 % of the consulting foresters had "frequently" received requests for chemical site preparation, thinning, and planting services from FFLs. Tax services, prescribed burning, and mechanical site preparation were the least commonly requested services from FFLs. Interestingly, we did observe stark differences in the intensity level of services provided demarcated by full-time and part-time consultants. For example, contingency tables indicated across site preparation-related activities, full-time forest consultants were more likely to work with pine landowners who were more

**Table 2**

Comparison of average values for key socio-demographic variables of consulting foresters in the sample responses and those reported in similar studies.

| Survey | Age (mean years) | Race (White) | Gender (Male) | Education (at least a Bachelor's degree) | Membership (Association of Consulting Foresters) |
|---|---|---|---|---|---|
| Sample | 50–60 | 98 % | 98 % | 100 % | 22 % |
| Study I (Merry et al., 2022) | NA | NA | NA | 99 % | NA |
| Study II (Boby et al., 2016) | NA | NA | 94 % | 97 % | NA |
| Study III (Schnepf and Baumgartner 1988) | 50 | 94 % | 99 % | 95 % | 27 % |

NA: Not available.

**Table 5**

Family forest landowners' most requested forestry services in the West Gulf Coastal Plain in the US.

| Forestry services | Level of requisition (%) | | | |
|---|---|---|---|---|
| | Never or rarely | Occasionally | Frequently | Median ranking |
| Mechanical site preparation | 29.09 | 47.27 | 23.64 | 2 |
| Chemical site preparation | 12.73 | 18.18 | 69.09 | 3 |
| Planting | 10.91 | 20.00 | 69.09 | 2 |
| Prescribed burning | 34.55 | 43.64 | 21.82 | 2 |
| Thinning | 1.82 | 29.09 | 69.09 | 3 |
| Timber cruising | 1.82 | 38.18 | 60.00 | 3 |
| Forest product sale | 1.82 | 12.73 | 85.45 | 3 |
| Timberland appraisal | 12.73 | 41.82 | 45.45 | 2 |
| Tax services | 41.82 | 40.00 | 18.18 | 2 |

($N = 55$).

**Table 6**

Results of logistic regression explaining the consulting foresters' level of employment to provide services to family forest landowners.

| Variables | VIFs | Parameter | SE | z-value | P-value |
|---|---|---|---|---|---|
| INTERCEPT | | 10.037 | 5.175 | 1.939 | 0.053 |
| PINE | 1.93 | 0.053 | 0.021 | 2.493 | 0.013* |
| MIXED | 1.60 | −0.081 | 0.031 | −2.563 | 0.010* |
| LNONUM | 1.40 | 0.645 | 0.327 | 1.971 | 0.049* |
| CSP | 2.03 | −1.394 | 0.862 | −1.617 | 0.106 |
| THINNING | 3.27 | 1.287 | 1.529 | 0.842 | 0.400 |
| CRUISE | 2.66 | −2.370 | 1.397 | −1.697 | 0.090 |
| SALE | 3.38 | −0.246 | 1.236 | −0.199 | 0.843 |
| INCOME | 1.89 | −0.892 | 0.432 | −2.063 | 0.039* |
| *Goodness-of-fit statistics* | | | | | |
| Null deviance | | 60.154 | 54(d.f.) | | |
| Residual deviance | | 35.515 | 46(d.f.) | | |
| AIC | | 53.515 | | | |
| No. of observations | | 55 | | | |

* Significant at 0.05 level of significance; d.f. stands for "degree of freedom.";
 SE: Standard Error;
 VIFs: Variation Inflation Factors.

likely to have a higher request frequency for mechanical site prep, chemical site prep, and other site preparation activities.

These results were examined to determine if the part-time consultants were merely younger consultants without a developed network, but more than 60 % of part-time consultants had more than 20 years of experience. Alternatively, we examined if the part-time consultants were perhaps older consultants who were at the end of their careers and were working part-time to continue to earn semi-steady incomes. However, the data showed that 70 % of part-time consultants planned to continue working for more than five more years. Combined with the income reported by both groups, with 65 % of part-time consultants reporting more than $160,000 (per annum) in income—the highest income bracket (only 35 % of full-time consultants reported in this category), despite the lack of service frequency provided, indicates other sources of employment for the part-time consultants. This leads us to tentatively conclude that part-time consultants are utilizing this as a secondary source of income. However, we should note that 60 % of those reporting as part-time consultants reported their age as 60-plus, despite the desire to continue working for more than five years from the time of the survey response.

### 3.4. Results from the logistic regression model

Our results indicate that 63 % of the respondents worked as full-time forestry consultants, and all of them (100 %) were willing to continue their consulting forester jobs for more than five years. Sixty percent of the part-time consultants held full-time positions elsewhere, typically as procurement foresters for wood-using mills and also as real estate agents, while the other 40 % were part-time only and reported no additional sources of income—indicating retirees who wished to continue earning some income. Several variables in the model had a statistically significant relationship with the consulting foresters' level of employment (Table 6). The FFLs' status and consulting foresters' economic status were associated significantly with the consulting foresters' employment level. However, other variables that represented primary forestry services requested by FFLs had no significant effect.

For every percentage of the increase in the area of pine forestland of the clients (FFLs), consulting foresters were 5 % more likely to work as full-time consultants. Similarly, with a one-unit increase in the number of clients, the probability that a consultant would be employed full-time would be 0.65 %. However, with a one percent increase in the clients' mixed forestland, consulting foresters were 8 % less likely to work as full-time consultants. Likewise, with a one percent increase in income of the consulting forester, 89 % were less likely to be full-time consultants.

The variables related to the primary forestry services, such as chemical site preparation, thinning, timber cruising, and forest product sale, were not significant. Furthermore, the interaction variables

between forest species (PINE and MIXED) and forestry services (e.g., PINE x CSP, MIXED x CSP, PINE x THINNING, MIXED x THINNING, and so on) had no significant effect. Thus, interaction variables were not included in the final model.

## 4. Discussions

This study identified the family FFLs' attributes influencing the practicing employment level of practicing consulting foresters. Our data indicates that there is a sorting of employment level of consulting foresters and which type of forest those consultants conduct their services on. This is intuitive from a cashflow perspective, the full-time consultant who relies purely on their provided services as the primary source of income is more likely to seek out landowners who need more frequent interventions (pine landowners). Likewise, these landowners desire someone who is able to conduct these practices and is available on a full-time basis. The alternative holds for mixed-stand landowners and part-time consultants.

Consulting foresters are more likely to be full-time consultants if they have more clients. One possible explanation is that if consultants do not get enough clients, they may not generate the desired level of income and would have to secure alternative employment. On the other hand, part-time consultants do not provide services to a large number of clients. Consulting foresters' possibility of receiving requests for a wide range of forestry services increases as the number of clients increases.

Our findings suggest that full-time consultants have lower annual incomes than part-time consultants. The majority of our part-time consulting forester respondents have a high annual income because they work full-time in another company. The minority respondents (who did not report other employment) are retired and have substantial retirement dividend income and maintain their consulting practice for supplemental income. They work more closely with passive forest landowners due to the needs/wants of both the landowner and the consultant. Based on their income levels, they have a high opportunity cost, and the most profitable consulting activities (e.g., timber sales) occur far more frequently relative to their typical management activities mentioned previously. They were also more likely to conduct appraisals and provide tax services on these properties as well in comparison to the full-time counterparts, which would tend to be costlier compared to other management-based interventions and require specialized knowledge and they were older on average. This combination of factors leads us to speculate that these part-time consultants are well-known in their forestry network, highly skilled, and have a high opportunity cost to conduct forest management. This might explain their higher% reporting for the above-mentioned special activities (e.g., appraisal, tax services).

## 5. Recommendations

On average, prices for stumpage products marketed and sold by forestry consultants led to excess landowner returns that exceeded the consultant's fees (Cubbage et al., 1985; Munn and Franklin, 1995). Despite this, most forest landowners do not retain forestry consulting services (Chhetri et al., 2018). However, McCauley (2023) reports that the opposite is true, that landowners are open to utilizing consultants. Seemingly paradoxical findings can likely be explained with further investigation. Chhetri et al. (2018) indicate several reasons for landowners not retaining services from consultants. These landowners tended to have smaller forest tracts, lower income, and lower education levels compared to those that did retain services. The landowners who chose not to use consultants were, on average, older as well. This may be, in part, a function of a lack of knowledge of how consultants benefit forest landowners and suggest efforts to educate landowners by University and Extension personnel could bear fruit, in addition to increased marketing efforts by consultants, as mentioned by McCauley (2023), perhaps focusing on younger landowners. However, these studies did not account for different forms of employment among consultants. This raises more questions with respect to the part-time service providers. Are their clients non-resident? Perhaps these offsite landowners recently inherited the property and are unaware of the benefits of intensive management and are hesitant to expend capital for an asset that they do not understand well. Are they resident landowners who are not interested in intensive management by choice or because they will not utilize the property frequently? Or can they simply not afford full-time services that require large capital outlays? A study bridging these two strands of literature is needed to map this relationship better.

Our analysis allows us to make some tentative recommendations. If these passive landowners are non-resident but have properties large enough to justify intensive management, outreach and extension efforts could focus on collecting ownership rolls and contacting these landowners with educational materials on intensive management so the landowners can determine if full or part-time consultants are more appropriate for their needs and objectives (see Measells et al., 2006). If they prefer to maintain their property in a more passive management regime, education on management interventions that could benefit this form of ownership (e.g., Timber Stand Improvement, Invasive Species Management) and alternative income streams available to those willing to forego some timber production income (e.g., participation in carbon offset programs) could be valuable assuming the consultant has not previously brought these to their attention. As well, education on the tax benefits/tradeoffs between active and passive management can be highlighted, as this is an area that typically is not well understood by consultants who do not have tax training. If recently inherited, these owners may be interested in maximizing their timberland investment through more active management. Lastly, it may be that these landowners have a part-time consultant due to income constraints (real or perceived), and a better understanding of this group, which often is underserved, can help determine appropriate educational and management needs (Measells, 2005).

Lastly, how this might alter the full-time vs part-time selection by consultants requires more investigation into the motivations of part-time consultants, if they would be willing to move to full-time at all. Nevertheless, developing stronger networking opportunities between consultants who wish to work part-time with forest landowners who manage naturally regenerated forests could itself lead to more efficient management of forest resources.

## CRediT authorship contribution statement

**Sagar Godar Chhetri:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Shaun Tanger:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology. **Matthew Pelkki:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Funding acquisition, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The data that has been used is confidential.

## References

ACFB, 2023. 2023 U.S. Forestry Economic Contribution by State. Arkansas Center for Forest Business, College of Forestry, Agriculture and Natural Resources. University of Arkansas at Monticello, Monticello AR, p. 230. Accessed on. https://www.uamont.edu/academics/CFANR/acfb.html.

Adams, D.M., 2006. *Estimated Timber Harvest By U.S. Region and Ownership, 1950-2002* (Vol. 659). U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Adhikari, R.K., Grala, R.K., Grado, S.C., Grebner, D.L., Petrolia, D.R., 2021. Landowner concerns related to availability of ecosystem services and environmental issues in the southern United States. Ecosyst. Serv. 49, 101283 https://doi.org/10.1016/j.ecoser.2021.101283.

Andersson, E., Keskitalo, E.C.H, 2018. Adaptation to climate change? Why business-as-usual remains the logical choice in Swedish forestry. Glob. Environ. Change 48, 76–85. https://doi.org/10.1016/j.gloenvcha.2017.11.004.

Arano, K.G., Cushing, T.L., Munn, I.A., 2002. Forest management expenses of Mississippi's nonindustrial private forest landowners. Southern J Appl. Forest. 26 (2), 93–98. https://doi.org/10.1093/sjaf/26.2.93.

Barry J.E. n.d. Consulting Foresters for Private Landowners. University of Arkansas Division of Agriculture Research & Extension, University of Arkansas System. FSA5019.

Bennett, D.E., Pejchar, L., Romero, B., Knight, R., Berger, J., 2018. Using practitioner knowledge to expand the toolbox for private lands conservation. Biol. Conserv. 227, 152–159. https://doi.org/10.1016/j.biocon.2018.09.003.

Bettinger, P., Merry, K., Fei, S., Weiskittel, A., Ma, Z., 2023. Usefulness and need for digital technology to assist forest management: summary of findings from a survey of registered foresters. J. For. 121 (1), 1–11. https://doi.org/10.1093/jofore/fvac028.

Boby, L., Hubbard, W., Megalos, M., Morris, H.L., Brody, B., Hosty, M., Northway, S., 2016. Southern foresters' perceptions of climate change: implications for educational program development. J. Extens. 54 (6), 10. https://doi.org/10.34068/joe.54.06.10.

Bullard, S.H., Straka, T.J., 2014. Bullish On Forestry Careers, 404. Faculty Publications. https://scholarworks.sfasu.edu/forestry/404.

Butler, B.J., Butler, S.M., Caputo, J., Dias, J., Robillard, A., Sass, E.M., 2021. Family Forest Ownerships of the United States, 2018: Results from the USDA Forest Service, National Woodland Owner Survey. USDA Forest Service, Northern Research Station, Madison, WI, p. 52. Gen. Tech. Rep. NRS-199.

Butler, B.J., Leatherberry, E.C., 2004. America's family forest owners. J. For. 102 (7), 4–14. https://doi.org/10.1093/jof/102.7.4.

Butler, B.J., Sass, E.M., 2023. Wood supply from family forests of the united states: biophysical, social, and economic factors. Forest Sci. 69 (6), 629–642. https://doi.org/10.1093/forsci/fxad034.

Caputo, J., Butler, B., 2017. Ecosystem service supply and capacity on US family forestlands. Forests 8 (10), 395. https://doi.org/10.3390/f8100395.

Chhetri, S.G., Gordon, J.S., Munn, I.A., Henderson, J.E., 2018. Factors influencing the use of consulting foresters by non-industrial private forest landowners in Mississippi. Forest. Chron. 94 (3), 254–259. https://doi.org/10.5558/tfc2018-03.

Clark, J., 2015. The value of consulting forester. Resourcewise. Accessed from. https://www.forest2market.com/blog/the-value-of-a-consulting-forester.

Clark, B.J., Howard, T.E., Parker, R.G., 1992. Professional forestry assistance in New Hampshire timber sales. Northern J. Appl. Forest. 9 (1), 14–18. https://doi.org/10.1093/njaf/9.1.14.

Cubbage, F.W., Thomas, M.S., Christopher, D.R., 1985. An economic evaluation of the Georgia rural forestry assistance program. In: Ag. Exp. Stns. Athens, Georgia University of Georgia, p. 59.

Diaz, D.D., Loreno, S., Ettl, G.J., Davies, B., 2019. Tradeoffs in timber, carbon, and cash flow under alternative management systems for Douglas-fir in the Pacific Northwest. Forests 9 (8), 1–25.

Dillman, D.A., Smyth, J.D., Christian, L.M., 2009. Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method. Wiley-Interscience, New York.

Field, D.B., 1986. Consulting foresters. J. For. 84 (2), 25–29. https://doi.org/10.1093/jof/84.2.25.

Ghimire, R., Green, G., Poudyal, N., Cordell, H.K., 2014. Do outdoor recreation participants place their lands in conservation easements? Nat. Conserv. 9, 1–18.

Godar Chhetri, S., Parker, J., Izlar, R.L., Li, Y., 2022. Forest management practices and costs for family forest landowners in Georgia, USA. Forests 13 (5), 665. https://doi.org/10.3390/f13050665.

Goyke, N., Dwivedi, P., 2021. Ascertaining differences between farmer and non-farmer African American forest landowners in Georgia, United States. Trees. For. People 5, 100118. https://doi.org/10.1016/j.tfp.2021.100118.

Grebner, D.L., Bettinger, P., Siry, J.P., Boston, K., 2021. Introduction to Forestry and Natural Resources. Academic Press.

Gutierrez-Castillo, A., Tanger, S.M., Penn, J., Blazier, M.A., 2022. Assessing conservation easement landowners adoption of thinning. Forest Sci. 68 (5–6), 548–558. https://doi.org/10.1093/forsci/fxac033.

Hiesl, P., 2018. A survey of forestry extension clientele in South Carolina, USA. Small-Scale Forest. 17 (3), 309–321. https://doi.org/10.1007/s11842-018-9389-2.

Joshi, O., Grebner, D.L., Munn, I.A., Hussain, A., Gruchy, S.R., 2013. Understanding landowner preferences for woody biomass harvesting: a choice experiment-based approach. Forest Sci. 59 (5), 549–558. https://doi.org/10.5849/forsci.11-075.

Kamal, S., Grodzinska-Jurczak, M., Brown, G., 2015. Conservation on private land: a review of global strategies with a proposed classification system. J. Environ. Plan. Manag. 58, 576–597. https://doi.org/10.1080/09640568.2013.875463.

Landefeld, M., Schumacher, S., 2006. Timber harvest management workshop. J. Extens. 44 (5), 27.

Measells, M.K., Grado, S.C., Hughes, H.G., 2005. The status of Mississippi forest landowners. P. 157-166 in Competitiveness of Southern forest product markets in a global economy. In: Carter, D.R., Alalapati, J.R.R. (Eds.), Proc. of the 2004 South. For. Economics Workshop. St. Augustine, FL.

Measells, M.K., Grado, S.C., Hughes, H.G., Dunn, M.A., 2006. Educational needs of southern forest landowners. J. Extens. 44 (5), 13.

McCauley, J., 2023. Open Conversations: Findings Ways to Improve Communication Between Family Forest Landowners and Consulting Foresters. Master thesis. Department of Forestry and Wildlife Science. Auburn University.

Merry, K., Bettinger, P., Siry, J., McNulty, S., Gavazzi, M., 2022. Forester preferences on revising Silvics of North America: a survey of registered foresters in four states. J. For. 120 (1), 1–9. https://doi.org/10.1093/jofore/fvab042.

Miller, K.A., Snyder, S.A., Kilgore, M.A., 2012. An assessment of forest landowner interest in selling forest carbon credits in the Lake States, USA. For. Policy. Econ. 25, 113–122. https://doi.org/10.1016/j.forpol.2012.09.009.

Mook, A., Dwivedi, P., 2022. Satisfaction of family forest landowners with forest-management services in Georgia, United States. Trees. For. People 7, 100179. https://doi.org/10.1016/j.tfp.2021.100179.

Munn, I.A., & C.E. Franklin. 1995. Do consultants really generate higher timber prices? Consultant Winter edition:26–29.

Nelli, D., McGill, D.W., Arano, K.G., Grushecky, S.T., 2007. Forestry consulting fees and services in West Virginia. North. J. Appl. For. 24, 252–257.

Peng, C.-Y.J., Lee, K.L., Ingersoll, G.M., 2002. An introduction to logistic regression analysis and reporting. J. Educ. Res. 96 (1), 3–14. https://doi.org/10.1080/00220670209598786.

R Core Team, 2023. R: a Language and Environment For Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. Accessed from. https://www.R-project.org.

Schelhas, J., Hitchner, S., Dwivedi, P., 2018. Strategies for successful engagement of African American landowners in forestry. J. For. 116 (6), 581–588. https://doi.org/10.1093/jofore/fvy044.

Schnepf, C.C., Baumgartner, D.M., 1988. Consulting foresters in the Pacific Northwest. Western J. Appl. Forest. 3 (3), 74–76. https://doi.org/10.1093/wjaf/3.3.74.

Shell, A.B., Ojha, S.K., Sharma, A., 2021. Region-wide characterization of structural diversity of the US Outer Coastal Plain Mixed Forests Province. For. Ecol. Manage. 488, 118979 https://doi.org/10.1016/j.foreco.2021.118979.

Shiver, B.D., 1998. Increasing Forest Productivity Through Intensive Management, 57. Forest Landowner, pp. 46–49.

Siry, J.P. 2002. Intensive Timber Management Practices. In: Wear, D.N., John, G. (Eds.), Southern Forest Resource Assessment. General Technical Report SRS-53. U.S. Department of Agriculture Forest Service, Southern Research Station, Asheville, NC.

Tian, N., Chhetri, S.G., Gutierrez-Castillo, A., Gan, J., Pelkki, M., 2023. Understanding nonindustrial private forest landowners' perspectives on the benefits associated with sustainable forest management certification. Forests. 14 (2), 241. https://doi.org/10.3390/f14020241.

USDA Forest Service, 2009. More About Ecosystem Services. Accessed on. http://www.fs.fed.us/ecosystemservices/About_ES/index.shtml/. Wildlife Associated Recreation. 164.

USDA Forest Service, 2023. Custom Data Retrieval from the USDA Forest Service, Forest Inventory and Analysis Database. USDA Forest Service, Forest Inventory and Analysis, Washington, DC.

Wear, D.N., Greis, J.G., 2013. The Southern Forest Futures Project: Technical Report. USDA-Forest Service, Southern Research Station, Asheville, NC, p. 542. Gen. Tech. Rep. SRSGTR-178.

Wright, W.C., Munn, I.A., 2016. 2013 Fees and Services of Mississippi's Consulting Foresters, p. 3. Forest and Wildlife Research Center. *Research Bulletin FO460, Mississippi State University*.

Zhang, D., Mehmood, S.R., 2001. Predicting non-industrial private forest landowners' choices of a forester in harvesting and tree planting assistance in Alabama. South. J. Appl. For. 25 (3), 101–107. https://doi.org/10.1093/sjaf/25.3.101.

Zhang, D., Warren, S., Bailey, C., 1998. The role of assistance foresters in nonindustrial private forest management: Alabama landowners' perspectives. Southern J. Appl. d Forest. 22 (2), 101–105. https://doi.org/10.1093/sjaf/22.2.101.