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**Centralblatt**  
für das gesamte  
Forstwesen**Family Forest Landowners in Alabama, USA: Assessment of Income  
Generation and Forest Management Values****Familienwaldgrundbesitzer in Alabama, USA: Bewertung der Werte für  
Einkommensgenerierung und Waldbewirtschaftung**Zachary Singh<sup>1</sup>, Adam Maggard<sup>1\*</sup>, Rebecca Barlow<sup>1</sup>, John Kush<sup>1</sup>**Keywords:** Supplemental Income, Forest Management, Ownership Characteristics**Schlüsselbegriffe:** Nebeneinkommen, Waldmanagement, Eigentum, Kleinwald**Abstract**

Of Alabama's 9.31 million hectares (23 million acres) of forestland, over 5.27 million hectares (13 million acres) of it is owned by family forest landowners (FFLs). Therefore, they play a pivotal role in the future of Alabama's forests. Due to a combination of shift in ownership and land parcelization, forestland is becoming separated into smaller parcels. In consequence, management is likely becoming more deficient, as smaller tracts are less likely to have a management plan or received forest management advice. Educating and improving income generating opportunities can also provide opportunities and motivation for FFLs to manage their forestland to support healthy, sustainable forests. The purpose of this study is to assess FFLs in Alabama to gain knowledge about income generation from their forestland and to better understand their motivation, or lack thereof, for managing their forestland. Using county tax records, we distributed a survey to approximately 1,000 FFLs in Alabama who own four or more hectares of forestland. FFLs have interest in generating income from their forestland. Forest management has been identified to be important for FFLs. Those FFLs, that generate income from forests, are also managing their forests. These results highlight the potential for using income generating opportunities on smaller

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tracts of forestland as an approach to improve forest management on these lands and opportunities for improvements to native ecosystems.

## **Zusammenfassung**

Die Waldfläche von Alabama mit einer Fläche von 9.31 Millionen Hektar ist mit über 5.27 Millionen Hektar zu einem wesentlichen Teil im Besitz von Familienwaldbesitzern (FFLs). Diese spielen somit eine zentrale Rolle in der Zukunft der Wälder Alabamas. Durch Eigentumsverschiebung wird Wald vermehrt in kleinere Gebiete aufgeteilt. Das Management dieser ist häufig defizitär, da kleinere Gebiete häufig keinen Waldbewirtschaftungsplan haben bzw. keine Beratung für die Waldbewirtschaftung erhalten. Forstliche Ausbildung und Verbesserung der Möglichkeiten zur Einkommensgenerierung kann auch Möglichkeiten und Motivation für FFLs bieten, ihre Wälder zu bewirtschaften, um gesunde und nachhaltig bewirtschaftete Wälder zu fördern. Ziel dieser Studie ist es, FFLs in Alabama zu bewerten, um Wissen über die Einkommensgenerierung aus ihren Wäldern zu gewinnen und ihre Motivation oder ihren Mangel für die Bewirtschaftung ihrer Waldflächen besser zu verstehen. Anhand von County Tax Records verteilten wir eine Umfrage an etwa 1.000 FFLs in Alabama, die vier oder mehr Hektar Wald besitzen. Die befragten FFLs haben Interesse daran, Einnahmen aus ihren Wäldern zu erzielen. Die Waldbewirtschaftung wurde von den FFLs als wichtig identifiziert. Diejenigen FFLs, die Einkommen aus dem Wald generieren, bewirtschafteten auch ihre Waldflächen. Diese Ergebnisse verdeutlichen das Potenzial, Einkommen aus kleineren Waldgebieten zu generieren und dieses für die Verbesserung der Waldbewirtschaftung auf diesen Flächen und Möglichkeiten zur Verbesserung einheimischer Ökosysteme zu nutzen.

## **1. Introduction**

Within the United States, private forest owners hold approximately 56% (171 million hectares or 423 million acres) of the country's forestland (Butler, 2008). In the southern United States, they own approximately 86% of the forestland (Wear and Greis, 2013). In Alabama, approximately 93% of the 9.31 million hectares of forestland is privately owned (Hartsell, 2018). Of that private forestland, approximately 88% is owned by non-industrial private forest owners (NIPF) (AFC, 2017). Family forest landowners (FFL), a subset of NIPF, hold approximately 60% or 5.27 million hectares of the state's total forestland (Butler, 2008; Butler and Butler, 2016). Therefore, FFLs are vitally important to the future of natural resources within the state. FFLs include individuals, families, family partnerships, estates, and trusts and have diverse backgrounds and experiences, diverse range of management objectives, and reasons for owning their forestland (Zhou, 2010).

In Alabama, FFLs with fewer than 4.05 hectares (10 acres) of land often commonly use this land for residential or developmental purposes, while FFLs with greater than 202.34 hectares (500 acres) are more likely to have goals and objectives driven by

timber production (Zhou, 2010). Further, FFLs who own between 4.05 hectares and 202.34 hectares make up 98% of the total family forest ownerships, approximately 3.3 million hectares, and own it for a variety of reasons (Butler and Leatherberry, 2004; Butler *et al.*, 2016). Specifically, non-timber-related reasons for ownership such as legacy, aesthetics, and wildlife are the most prevalent with these forest owners (Zhou, 2010; Butler *et al.*, 2016). However, top reasons for owning forestland in Alabama can be dependent on both size of a tract of forestland and where it is located within the state. Specifically, the larger the tract of forestland, regardless of its location, and the further south it is located in the state, the more ownership objectives are influenced by timber markets and financially driven objectives (Zhou, 2010).

Threats to southern forests such as land parcelization, a generation shift, increased frequency and severity of droughts, severe weather events, catastrophic wildfires, insects and diseases, and invasive species are expected to increase in the coming years (Wear and Greis, 2012). Managed forests in good health and vigor are better equipped to withstand such threats, but appropriate landowner education and involvement are needed (Megalos, 2016). Due to forestland being separated into smaller tracts (Wear *et al.*, 2007), it can make management more difficult and can cause a lack of management altogether. This can lead to degradation and loss of opportunity. Educating, supporting, and improving the opportunities for FFLs to manage and generate income from their forestland can improve their livelihood and support the health and sustainability of forests.

The lack of management plans for FFLs is a concern. As of 2013, it was reported that 12%, 12%, and 13% of FFLs had a written management plan in Alabama, the Southeast, and the United States, respectively (Butler and Butler, 2016; Butler *et al.*, 2016). Lack of knowledge, financial resource capacity and costs, fear of wrongdoing, and prolonged suppression of timber markets are some reasons contributing to this result (Butler, 2011). Effective engagement in educating and motivating FFLs about the importance of managing their land and taking steps to implement and maintain it is important for improving the health and resiliency of forests and meeting the current and future demand for timber products (Arano and Munn, 2006).

Landowner decisions about their forests can be influenced by numerous parameters, such as financial reasons and personal values (Butler and Leatherberry, 2004; Majumdar *et al.*, 2008). It is recognized that forestland decisions of landowners are important factors in determining outcomes of conservation goals (Bean and Wilcove, 1997; James, 2002). Some landowners, fearing restriction to land use, may alter property management in an effort to eliminate species of concern (Wilcove *et al.*, 1996; Zhang 2004). For instance, Zhang (2004) concluded that without financial compensation, landowners have no incentive to voluntarily use their forestland for additional habitat for Red-cockaded woodpeckers (RCW), which could lead to timber harvest just to prevent RCW establishment in order to protect or enhance property value. Similarly, if there is a monetary cost to conservation, activities to promote it are less likely to

occur (Carr and Tait, 1991; McCann *et al.*, 1997).

For more than a decade now, pine sawtimber markets in Alabama and across the Southeast have been depressed and pine pulpwood markets have been variable at best (The Frank W. Norris Foundation, 2018). This is in large part due to decreased demand and increased supply, causing stumpage values to decrease. Supplemental income or income generated in addition to timber harvest or to supplement timber harvest is a common interest among forestland owners during these times because the value of their timber is less. Forest ownership offers a variety of financial opportunities to diversify income. Among such opportunities for FFLs, recreational activities and non-timber forest products (NTFPs) are two of the most popular (Finley, 2016).

One of the recreational enterprises gaining interest across the Southeast is leasing land for hunting rights (Jones and Miller, 2016). Demand for quality hunting areas has created a vast market and an incentive for FFLs to consider this type of supplemental income enterprise (Harper *et al.*, 1999). The hunting lease market is the most developed of forestland recreational markets (Hussain *et al.*, 2013). However, hunting lease revenue potential varies and has been found to depend on numerous factors such as the land having a variety of habitat types, location and access factors (Poudyal *et al.*, 2012), amenities such as road infrastructure, lodging, game species present on the land, and localized competitor pricing (Stribling *et al.*, 1992; Zhang *et al.*, 2006, and Rhynne and Munn, 2008). These factors may be hurdles for some FFLs considering entering the hunting lease market, but hunting leases can provide a positive annual cash flow and add value to forestland appraisals (Straka, 2011).

NTFPs offer a wide range of supplemental income opportunities for FFLs (Barlow *et al.*, 2015). Options for NTFP enterprises are dependent on region of location and market availability, and knowledge of native species and site requirements are essential for NTFP operations (Finley, 2016; Chamberlain *et al.*, 2018). Although interests in managing forests for NTFPs has grown considerably, there is still very little known about the characteristics of raw materials, those who collect them, or the enterprise that market and produce them (Chamberlain and Predny, 2003).

The overall objective of this project is to collect and assess information needed to better understand income generation on forestland held by FFLs, as well as their forest management activities and philosophies. Specific aims of this project are to better understand characteristics of FFLs who are generating income and those that are not, FFLs interests in supplemental income activities, forest management philosophies, and concerns, and to assess potential relationships among income generation, forest management, and forest health and resiliency as factors in FFLs decision making. To address these aims and the overall objective of this project, we developed a questionnaire to gain further information regarding such characteristics of FFLs in Alabama, reasons for owning, income generation, forest management practices, and concerns with forestland.

## **2. Material and Methods**

### **2.1 Questionnaire Development**

This survey was expected to take approximately 10 to 15 minutes to complete. There was a total of 18 questions, consisting of multiple-choice, select all that apply, 5-point Likert-type scale, and free-response questions (Likert, 1932). Likert-type scales were used to gauge participant agreement or disagreement to statements regarding income generation and forest management practices. Questions in the survey were formed and guided by the need to better understand how many FFLs generate income from their forestland, how they manage such practices or businesses, the financial aspects involved in their decision making, experiences with past and present markets, the views on future markets, concerns and issues with operating a forest enterprise, and past, current, and future forest management philosophy and plans (Singh, 2020).

### **2.2 Survey Design and Distribution**

The survey design and distribution followed Dillman's Tailored Design Method, which utilized a pre-notice letter, first-round survey packet, reminder letter, and a second-round survey packet, to administer the surveys (Dillman, 2014). All components of the survey, its documents, and its protocols were approved by Auburn University's Institutional Review Board (protocol #18-123 EX 1804).

In fall 2018, the survey process was initiated. A random sample of 1,000 FFLs in Alabama who owned at least 4.05 hectares (10 acres) of forestland was obtained from county tax roll records. FFLs randomly selected for the sample were mailed a pre-notice letter in August of 2018. This pre-notice letter informed recipients about the research project and invited them to participate in the coming questionnaire. Within approximately 10 business days from mailing the pre-notice letter, a cover letter, the main questionnaire, and a prepaid return envelope were mailed to all addresses deemed valid. The cover letter provided further information to recipients about the research and helped recipients understand that their participation was completely voluntary. Within approximately 15 business days from mailing the cover letter and questionnaire, a reminder letter and another copy of the survey were mailed. The reminder letter thanked participants that had already answered and urged those that did not answer to do so. An online version of the questionnaire was also available, and the link was included in the cover letter and reminder letter mailed to each FFL.

### **2.3 Statistical Analysis**

Based on the data type (categorical, ordinal, continuous, etc.), the appropriate non-parametric statistical test was conducted using R Studio (RStudio, 2018). For the non-parametric test of correlation, Spearman Rho ( $\rho$ ) was used. To determine if there were

any statistical significance in ordinal responses among groups, the Mann-Whitney U Test was used. Sample size was determined per question as not every participant responded to every question.

### 3. Results

#### 3.1 Assessment of FFL and Income Generation

Out of 1,000 surveys sent to randomly selected landowners, 46 surveys were returned due to invalid addresses for a total of 954 valid surveys distributed. In total, there were 193 completed surveys returned, yielding a 20.2% response rate. Respondents were categorized based on forestland owned. Forest ownerships ranged from a minimum of 4.05 hectares to a maximum of 32,374.85 hectares (80,000 acres), with an overall median of 46.13 hectares (114 acres). When forest ownership was classified into categories based on hectares owned, the largest category was 4.05 hectares to 20.23 hectares (50 acres), which consisted of 27% of respondents (Figure 1).

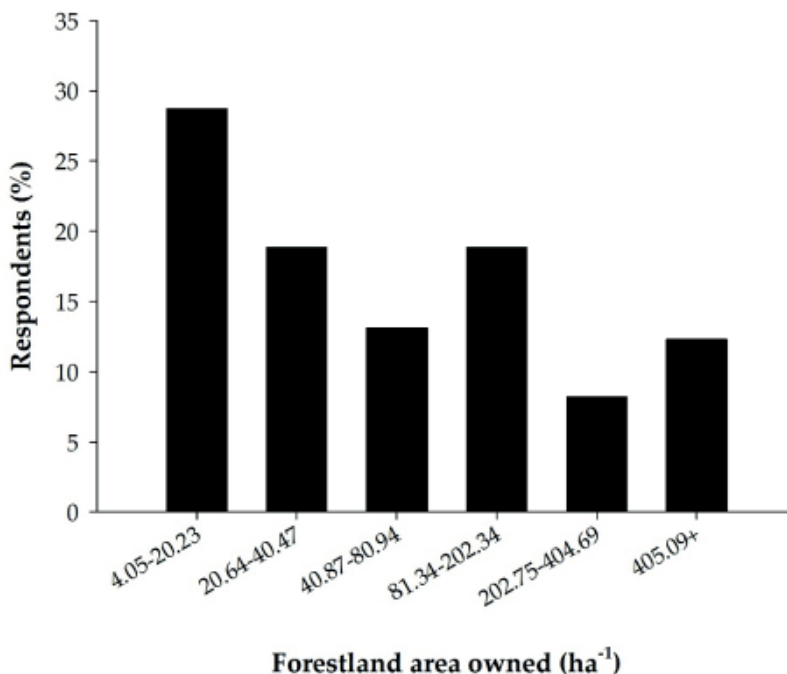


Figure 1: Classification of forestland hectares owned in 2018 based on percent response from family forest landowners in Alabama (n = 122).

Abbildung 1: Klassifizierung der sich im Besitz befindenden Waldhektaren im Jahr 2018 auf der Grundlage der prozentualen Antwort von Familienwaldbesitzern in Alabama (n = 122).

The primary reason for owning forestland was diverse among participants. The top three reasons were multiple use (40.5%), timber production (16.0%), and where participants lived (12.2%) (Figure 2). Participants who selected multiple options were categorized as multiple use.

A series of questions were asked to assess income generation from forestland. Specifically, participants were asked "do you have interests in generating income from your forestland?", "do you currently generate income from your forestland?", "do you currently or have you ever generated income from harvesting timber on your forestland?", and "do you currently or have you ever generated income from your forestland other than from harvesting timber?" For the last question in this series, if participants answered "yes", they were instructed to select from a list of methods in which income was derived other than from timber harvest with a write-in option if their method(s) was not listed. Most respondents (68.6%) were interested in generating income from their forestland and only 3.3% of participants said they definitely were not interested. Most respondents (61.7%) did not generate any income from their forestland. However, our findings indicated that as hectares owned increased, the percentage of FFLs who did or were generating income from their forestland at the time of the survey increased (Figure 3).

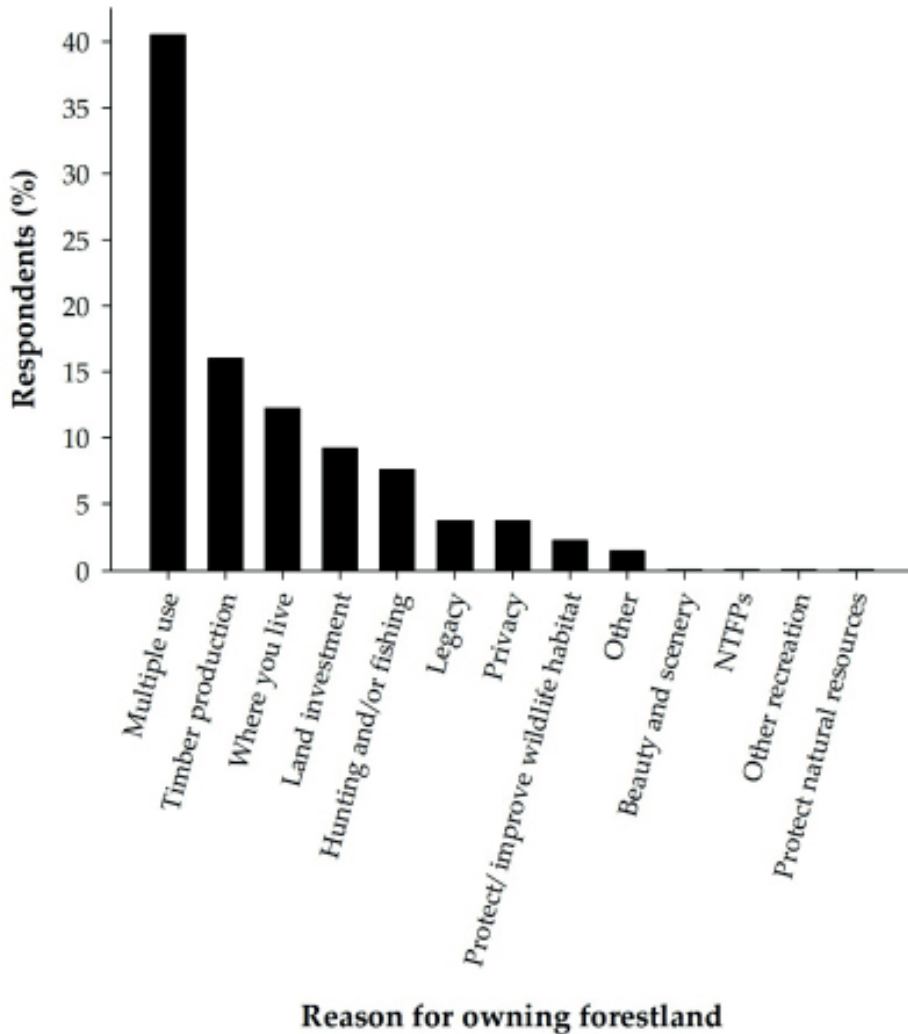


Figure 2: Primary reasons for owning forestland based on percent response in 2018 from Alabama family forest landowners (n = 131).

Abbildung 2: Hauptgründe für den Besitz von Waldflächen auf der Grundlage der prozentualen Antwort im Jahr 2018 von Familienwaldbesitzern in Alabama (n = 131).



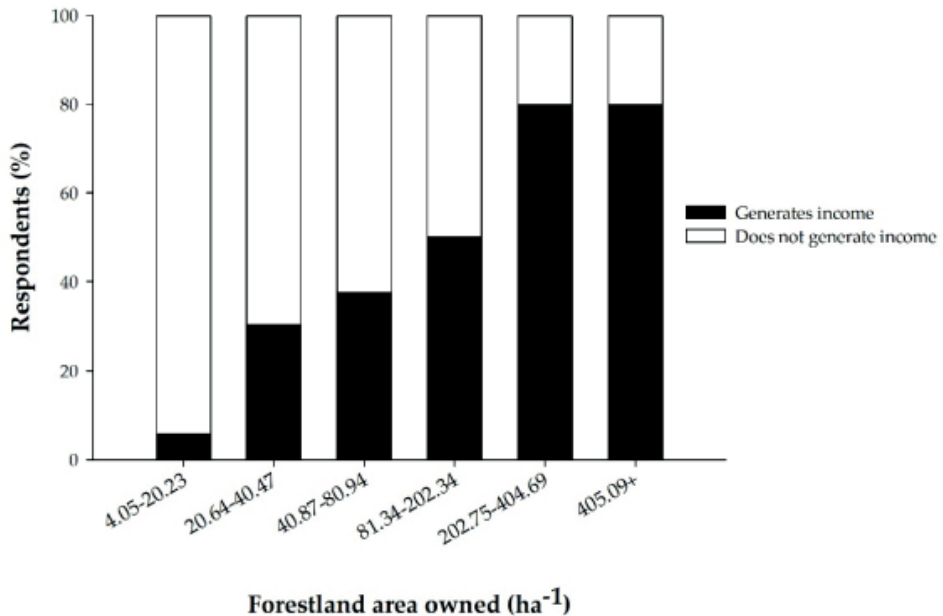


Figure 3: Proportion of income generating Alabama family forest landowners (FFLs) grouped by classes of owned forest hectares in 2018 (n = 128).

Abbildung 3: Anteil der Familienwaldbesitzer (FFLs), die aus der Waldbewirtschaftung Einkommen erwirtschaften, in Alabama gruppiert nach Größe des Waldbesitzes im Jahr 2018 (n = 128).

It was clear that those who generated income from their forestland wanted to continue to do so, as 86.7% of respondents stated they would “definitely” do so. Of respondents that generated income from their forestland, 61.2% obtained income from means other than timber harvest (supplemental income). Among those respondents, hunting and fishing leases (53.3%) were the most common source of supplemental income followed by pine straw harvests (16.6%), and multi-source (16.6%) (Figure 4). The “other” category consisted of honey production, conservation reserve programs (CRP), and entertainment such as a venue for parties and weddings.

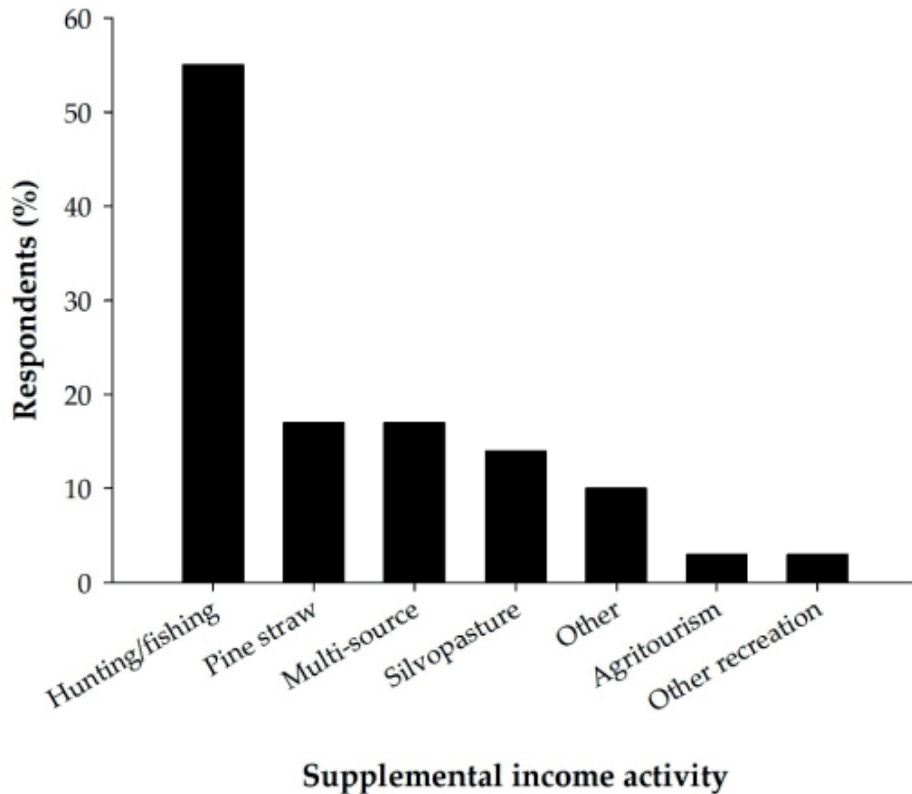


Figure 4: Supplemental income activities in 2018 of Alabama family forest landowners based on percent response from survey participants who generate income from sources other than timber ( $n = 30$ ).

Abbildung 4: Ergänzende Einkommensaktivitäten im Jahr 2018 für die befragten Familienwaldbesitzer in Alabama, basierend auf der prozentualen Antwort der Umfrageteilnehmer, die Einkommen aus anderen Quellen als Holz erzielen ( $n = 30$ ).

### 3.2 Assessment of Forest Management Practices and Forest Health Concerns

A series of questions were asked to assess forest management values and forest health concerns of FFLs. Specifically, participants were asked "how important is managing your forestland to you?", "are you concerned about the health and resiliency of your forestland?", "do you get assistance managing your forestland and who from?", "what do you manage for on your forestland?" and "if you do not manage your forestland, what is keeping you from doing so?". Following the question about their concerns for their forestland, they were asked to rate a list of common forest health concerns ranging from

“a great deal” to “none at all” with the option to write in a concern if not on the provided list. Most respondents (69.0%) viewed forest management as “extremely” important. Only 4.0% of respondents stated forest management is not at all important.

Similarly, most respondents (89.3%) were at least “moderately” concerned with the future health and resiliency of their forest and its current condition. Nearly half of those respondents (43.0%) stated they were concerned “a great deal”. Only 10.7% of respondents indicated little to no concern. Further, the top three concerns were insects and disease (43.1%), invasive species (32.4%), and severe storm damage (25.2%) with climate change the least concerning (13.2%) (Figure 5). Participants were also asked to list any other concerns they may have and with six responses, government regulation and/or intrusion and timber prices were listed.

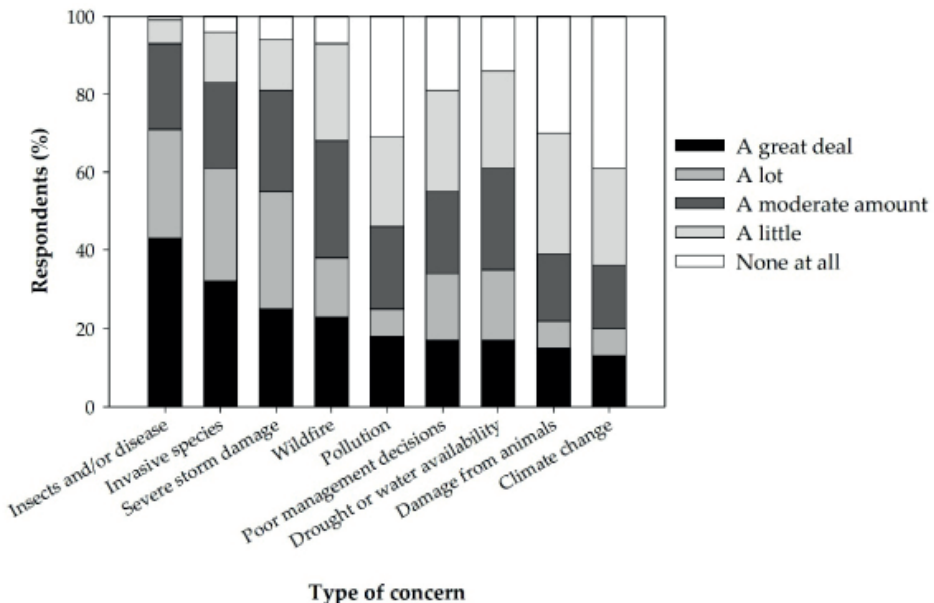


Figure 5: Concern level of various aspects of forest health and resiliency based on percent response from Alabama family forest landowners in 2018 (n = 95).

Abbildung 5: Besorgnis über verschiedene Aspekte der Waldgesundheit und -resilienz basierend auf der prozentualen Reaktion von Familienwaldbesitzern in Alabama im Jahr 2018 (n = 95).

FFLs were asked the following three questions: 1) Did they ever receive management advice?; 2) Did they currently manage their forestland?; and 3) Did they have a written management plan? Over half of the respondents (56.5%) had received some sort

of management advice about their forestland, and 64.7% stated they currently managed their forestland. However, 75.2% of respondents did not have a written management plan.

For those participants that stated they did currently manage their forestland, the greatest percentage of respondents (33.7%) indicated that they managed their forestland on their own, followed by 28.1% who received assistance from multiple sources, and 24.7% who received assistance from a private consultant (Figure 6). For activities managed for on their forestland, participants could select all that applied (Figure 7). Timber (83.8%) and wildlife (75.7%) were the most common management activities if separated out from multiple use, which made up 85.6% of responses (Figure 7).

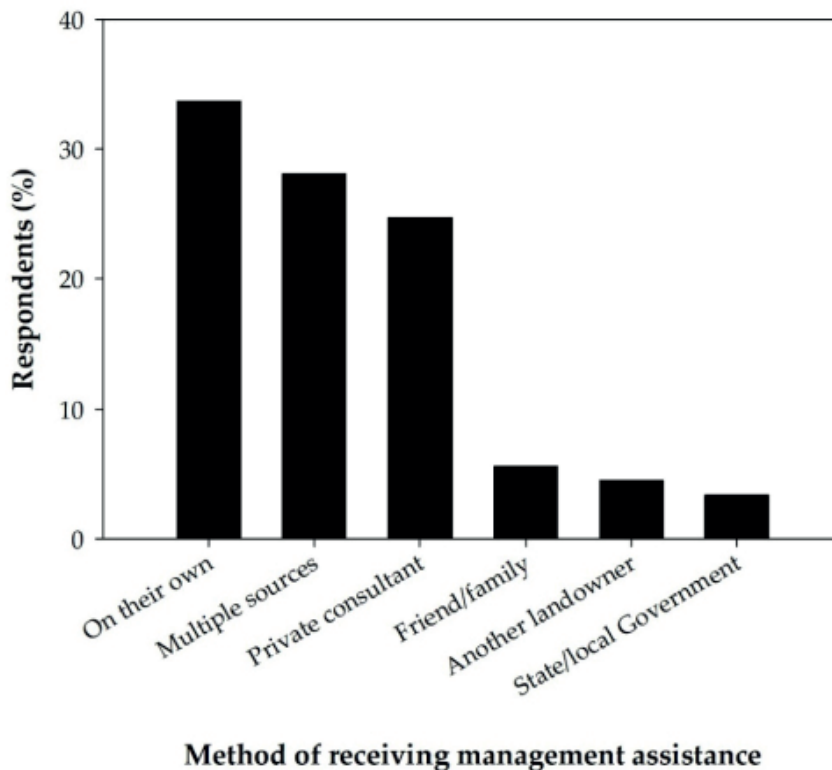


Figure 6: Method used by Alabama family forest landowners in 2018 for receiving assistance in managing their forestland based on percent response from survey participants (n = 89).

Abbildung 6: Art der Unterstützung bei der Verwaltung ihrer Waldflächen, die von Familienlandbesitzern in Alabama im Jahr 2018 erhalten wurde, basierend auf der prozentualen Antwort der Umfrageteilnehmer (n = 89).

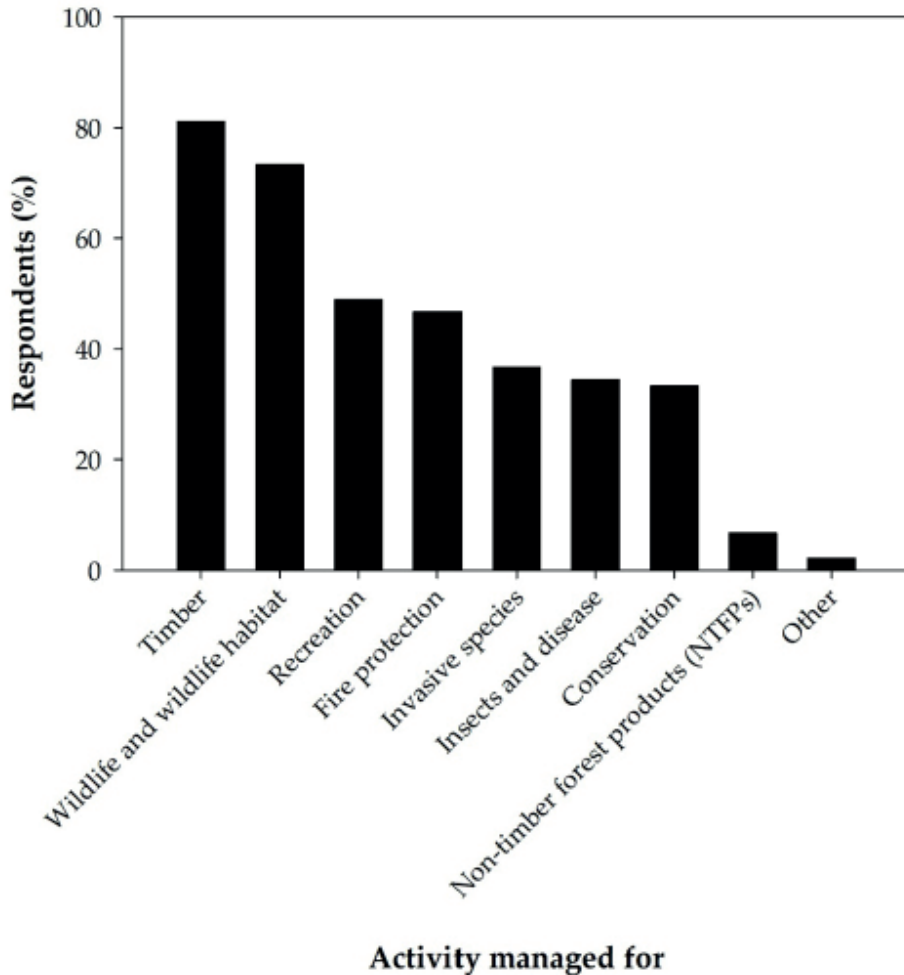


Figure 7: Activities that Alabama family forest landowners pursued for managing their forestland in 2018 based on percent response from survey participants ( $n = 90$ ).

Abbildung 7: Aktivitäten, für die Familienwaldbesitzer in Alabama ihre Waldflächen im Jahr 2018 bewirtschafteten, basierend auf der prozentualen Antwort der Umfrageteilnehmer ( $n = 90$ ).

For those participants that did not manage their forestland, 71.8% were interested and 28.2% were not interested ( $n = 64$ ). Of those interested, 63.0% stated they were not sure what to do, 14.0% said they did not have the time, 13.0% said it was too expensive, and 10.0% stated "other" reasons prevented them from managing and included lack of equipment or manpower, fear of property destruction, and not enough acres available.

### **3.3 Relationships among Income Generation, Forest Management, and Forest Health and Resiliency**

When observing the mean ranks produced by the Mann-Whitney U tests, FFLs that generated income from their forestland owned significantly more hectares than their counterpart ( $p < 0.001$ ) (Table 1). FFLs that received forest managed advice owned significantly more hectares than those that had not received advice ( $p < 0.001$ ) (Table 1). FFLs that currently managed their forestland owned significantly more hectares than FFLs that did not manage ( $p < 0.001$ ) (Table 1). Similarly, the mean ranks showed that FFLs who had a written management plan owned significantly more hectares of forestland than FFLs that did not have a written management plan ( $p < 0.001$ ) (Table 1). From mean ranks produced, FFLs that generated income viewed forest management as significantly more important than FFLs that did not generate income from their forestland ( $p < 0.001$ ) (Table 2).

*Table 1: Mann-Whitney U test of differences for (A) hectares of forestland owned by Alabama family forest landowners (FFLs) in 2018 that generated income and FFLs that did not generate income from their forestland, (B) hectares of forestland owned between FFLs that have received forest management advice and FFLs that have not received forest management advice, (C) hectares of forestland owned between FFLs that currently manage their forestland and FFLs that do not currently manage their forestland, (D) hectares of forestland owned between FFLs that have a written forest management plan and FFLs that do not have a written forest management plan.*

Tabelle 1: Mann-Whitney U-Test der Unterschiede für (A) Hektar Waldflächen im Besitz von Familienwaldbesitzern (FFLs) in Alabama im Jahr 2018, die Einkommen generieren und FFLs, die keine Einnahmen aus ihren Waldflächen generieren, (B) Hektar Waldflächen im Besitz von FFLs, die Beratung in Waldbewirtschaftung erhalten haben und FFLs, die keine Beratung in Waldbewirtschaftung erhalten haben, (C) Hektar Waldflächen im Besitz von FFLs, die derzeit ihre Wälder verwalteten und FFLs, die derzeit nicht verwalteten, (D) Hektar Waldfläche im Besitz von FFLs, die über einen schriftlichen Waldbewirtschaftungsplan verfügen, und FFLs, die keinen schriftlichen Waldbewirtschaftungsplan haben.

<b>A</b>	<b>Hectares owned</b>	<b>N</b>	<b>Mean rank</b>	<b>U</b>	<b>P</b>
	Generating income	46	84.93		
	Not generating income	74	45.31	578	0.000***
	Total	120			
<b>B</b>	<b>Hectares owned</b>	<b>N</b>	<b>Mean rank</b>	<b>U</b>	<b>P</b>
	Received management advice	56	61.49		
	Not received management advice	40	30.31	392.5	0.000***
	Total	96			
<b>C</b>	<b>Hectares owned</b>	<b>N</b>	<b>Mean rank</b>	<b>U</b>	<b>P</b>
	Currently manages forest	67	55.31		
	Does not manage forest	29	32.76	515	0.000***
	Total	96			
<b>D</b>	<b>Hectares owned</b>	<b>N</b>	<b>Mean rank</b>	<b>U</b>	<b>P</b>
	Has written management plan	24	84.93		
	Does not have written management plan	72	45.31	578	0.000***
	Total	96			
<b>***P ≤ 0.001</b>					

*Table 2: Mann-Whitney U test of differences for rankings of importance of forest management between Alabama family forest landowners (FFLs) in 2018 that generated income and FFLs that did not generate income from their forestland.*

Tabelle 2: Mann-Whitney U-Test der Unterschiede der Rangfolge von Bedeutung der Waldbewirtschaftung zwischen Familienwaldbesitzer (FFLs) in Alabama im Jahr 2018, die Einkommen generierten und FFLs, die keine Einnahmen aus ihren Waldflächen generierten.

<b>Importance of management</b>	<b>N</b>	<b>Mean rank</b>	<b>U</b>	<b>P</b>
Generating income	44	73.61		
Not generating income	74	51.11	1007	0.000***
Total	118			
<b>***P ≤ 0.001</b>				

Spearman Rho correlation tests showed a moderate, significant, positive correlation between rankings of interest in income generation and forest management importance ( $p = 0.001$ ,  $\rho = 0.478$ ), a weak, significant, positive correlation between interest in income and concern for forest health and resiliency ( $p = 0.03$ ,  $\rho = 0.269$ ), and a strong, significant, positive correlation between forest management importance and concern for forest health and resiliency ( $p = 0.001$ ,  $\rho = 0.601$ ) (Table 3).

*Table 3: Spearman Rho correlation tests between Alabama family forest landowners (FFLs) in 2018 interests in income and their view on the importance of forest management, FFLs interest in income and their concern about forest health and resiliency of their forest, and FFLs view on the importance of forest management and their concern about forest health and resiliency of their forest.*

Tabelle 3: Spearman Rho Korrelationstests von Familienwaldbesitzern (FFLs) in Alabama im Jahr 2018 zwischen ihrem Interesse an Einkommen und ihrer Ansichten zur Bedeutung der Waldbewirtschaftung, ihrem Interesse an Einkommen und ihrer Sorge um die Waldgesundheit und Ausfallsicherheit ihres Waldes, sowie den Ansichten der FFLs zur Bedeutung der Waldbewirtschaftung und ihrer Sorge um die Waldgesundheit und Ausfallsicherheit ihres Waldes.

<b>Comparison of FFL values</b>	<b>P</b>	<b><math>\rho</math></b>
Interest in income vs Importance of forest management	0.001	0.478
Interest in income vs Concern about forest health	0.003	0.269
Importance of forest management vs Concern about forest health	0.001	0.601



## 4. Discussion

Previous studies on FFLs have shown that they own forestland for a variety of reasons and often have multiple motivations behind those reasons (Butler, 2008; Butler and Butler, 2016; Butler and Leatherberry, 2004; Butler *et al.*, 2016; Zhou, 2010). However, none to our knowledge have assessed FFLs on income generation or analyzed relationships among FFLs attitudes towards income generation, forest management, and forest health and resiliency. Our results indicate that there is high interest in generating income by FFLs. However, most FFLs surveyed in our study did not generate income of any type from their forestland and for most, it was due to lack of knowledge and experience on what to do and how to do it. Our findings further indicate that FFLs who generate income from their forestland own larger tracts and those that own larger tracts were more likely to be currently managing their forestland, receiving management advice, and have a written management plan.

Ownership objectives of FFLs are widely studied and in large part from the National Woodland Owners Survey has been periodically tracked over time dating back to 1978 (USDA Forest Service, 2020). How FFLs ownership objectives are characterized in the literature varies (Bliss and McNabb, 1992; Kluender and Walkingstick, 2000; Kennedy and Roche, 2003; Majumdar *et al.*, 2008). This is likely due to the fact that FFLs ownership objectives are diverse and hence the need to better understand their behavior and motivations persists. A study in 2008, used a multivariate cluster analysis approach to characterize FFLs in Alabama, Georgia, and South Carolina based on their views towards forest stewardship and reasons for owning forestland. It was found that FFLs are diverse in their ownership reasons but could be categorized as multiple-objective, timber motivated, and non-timber motivated, where the largest category based on their findings was multiple-objective (Mujumdar *et al.*, 2008). That same study defined multiple objective as FFLs who indicated equal importance to financial and non-financial objectives. In our study, multiple use was the largest categorical reason for owning forestland supporting the results of Mujumdar *et al.* (2008). In our study, categorized multiple use was categorized based on respondents who selected multiple reasons for owning and the majority of multiple-use respondents (79%) included financial objectives (timber production and land investment) and non-financial objectives, indicating the importance of both.

When forestland ownerships were categorized by parcel size, the most common response was between 4.05 and 20.23 hectares. This is consistent with similar studies that found the largest percentage of forest ownership for FFLs is between 4.05 and 20.23 hectares (Butler and Butler, 2016; Butler *et al.*, 2016). Smaller tracts of forestland have been acknowledged to be more difficult to manage due to lack of capital, time, or knowledge (Gan and Kolison, 1999). This could lead to a lack of management altogether, which can cause degradation of the forestland and loss of opportunity (Arano and Munn, 2006). Lack of appropriate management practices can cause increased risks from disease, insect attacks, drought, and wildfire (Amacher *et al.*, 2005) that

negatively impact wildlife habitat (Owens *et al.*, 2014) and tree productivity (Moser *et al.*, 2003).

FFLs in our study were aware of the importance of forest management, and many received management advice, but most lacked a written management plan. It is well documented that written management plans are few among FFLs (Butler and Leatherberry, 2004; Butler, 2008; Majumdar *et al.*, 2008; Butler, 2011). It is also documented that FFLs with written management plans own larger tracts of forestland (Romm *et al.*, 1987; Joshi *et al.*, 2015). Our results support this as FFLs in our study who have a written management plan owned significantly more acres of forestland than those who did not have a written management plan.

Research shows that the size of forestland holdings has an impact on timber production objectives for FFLs (Zhou, 2010; Khanal *et al.*, 2020). Specifically, regarding FFLs in Alabama, it has been found that hectares owned and location within the state can make a difference in FFLs attitudes towards ownership objectives and management decisions (Zhou, 2010). FFLs with larger tracts of forestland or those owning land in areas where farming and forest production are predominant industries were found to have more timber production-oriented goals and financially driven objectives than areas where such industries or markets are not as prevalent (Kennedy and Roche, 2003; Zhou 2010). Our results supported these findings in terms of size of holdings as participants in our study who generated income typically owned 202.34 hectares (500 acres) or more and managed for timber production. Location of participants in the state may have also been a factor based on the distribution of questionnaires, but we were unable to accurately assess this because we did not have the means to determine specific location of forestland holdings per respondent. Although, nearly two-thirds (72%) of our questionnaires were mailed to FFLs considered to be located in central or south Alabama, where forest production is most prominent. This location factor may have played a role in the results we observed for reasons for owning forestland, as timber production was the second most common reason for ownership in our study behind multiple use, which is similar to results found by Zhou (2010). Further, of the participants who had multiple reasons for ownership in our study, 64% included timber production.

Most FFLs in our study did not generate income of any type from their forestland. Of those that did, just over a third generated supplemental income. The majority of supplemental income came from hunting or fishing lease revenue. Hunting and fishing leases have been gaining popularity across the South (Zhang *et al.*, 2006; Straka, 2011; Jones and Miller, 2016). These types of leases have several advantages for FFLs, such as reliable stream of income, reduction in trespass problems, and assistance in managing for wildlife habitat. Such leases can also increase forestland value (Baen, 1997; Jones *et al.*, 2006; and Hussain *et al.*, 2013). Our findings of hunting lease income as the most common source of supplemental income by respondents in our study is not surprising, as the demand for access to private lands for recreational uses

continues to grow (Hussain *et al.*, 2007; Mozumder *et al.*, 2007; Cordell, 2008; Straka, 2011; Jones and Miller, 2016). Larger tracts of forestland have been linked to increased landowner participation in adopting hunting leases (Jones *et al.*, 2006; Zhang *et al.*, 2006; Hussain *et al.*, 2007; Hussain *et al.*, 2013). Income generation in our study, including supplemental income, was significantly greater on larger tracts of forestland, with hunting lease income accounting for over half of all participants who are participating in supplemental income activities.

Few FFLs in our study generated supplemental income from means other than hunting or fishing leases ( $n = 14$ ). Supplemental income opportunities on forestland can be dependent on location and local markets (Finley, 2016; Chamberlain *et al.*, 2018). In Alabama and much of the United States, markets for NTFPs, recreation activities outside of hunting leases, and many other possible opportunities have not been well documented. Many of these markets lack standards to be followed by landowners (Chamberlain *et al.*, 2018). Specifics about market dynamics and factors that influence such markets for many NTFPs are relatively limited and comprehensive information on product valuation, harvesting, and trading is lacking (Barnes, 2012; Barlow *et al.*, 2015; Maggard *et al.*, 2020). This poses information gaps for FFLs that are interested in such enterprises and could be contributing to the lack of implementation. The education barrier likely extends beyond the landowners to the natural resource professionals and educators (Chamberlain *et al.*, 2018). For FFLs, finding foresters and other natural resource professionals with expertise in NTFPs may also be a challenge (Barlow *et al.*, 2015). This could be a factor impacting FFLs participation in supplemental income activities.

FFLs in our study were concerned about the health and resiliency of their forestland. The most common concern reported in our study was insects and disease. Prior research has documented concerns of FFLs in the country, regions, and state (Butler and Leatherberry, 2004; Butler, 2008; Butler, 2011; Butler and Butler, 2016; Butler *et al.*, 2016). However, these studies included options for concerns such as legacy, trespassing, and taxes that were often top concerns. In our study, we focused more on options that could directly impact forest health without proper management or action. When looking at such concerns, our study compared to a recent study of FFLs in Alabama by Butler and Butler (2016), was similar in findings with insects and disease being a high concern and animal damage and climate change being less of concerns. One of the top three concerns in our study was severe storm damage, which has not been a top concern in studies of FFLs in the past (Butler and Leatherberry, 2004; Butler, 2008; Butler, 2011; Butler and Butler, 2016; Butler *et al.*, 2016). This could be attributed to the increase in catastrophic storms that impacted the Gulf Coast in recent years. Since 2012, seven major hurricanes have impacted Gulf Coast States (Isaac 2012, Hermine 2016, Matthew 2016, Irma 2017, Nate 2017, Michael 2018, Barry 2019), of which the latest significant damage to Alabama and its forestland was Hurricane Michael in 2018. It caused an estimated \$20.8 million in timber damage in Alabama (ACES, 2018). Further, Alabama had significant tornado outbreaks in 2011, 2012, 2019, and most recently in 2020 with hurricanes Sally and Zeta. With more frequent

severe weather events likely to occur (Easterling *et al.*, 2000; Collins *et al.*, 2013; Walsh *et al.*, 2014), FFLs awareness of such risks and interests in what can be done to mitigate the impacts of such events could be increasing.

Our results highlight a need for assisting FFLs in Alabama on ways to generate income from their forestland. Given the lack of comprehensive information on supplemental income opportunities for FFLs, further research is warranted that focuses on the operations, management, market dynamics, and trade of such income opportunities. This starts with the need for collaborating and establishing partnerships with FFLs who have natural resource enterprises or are generating supplemental income from their forestland to enhance research efforts and opportunities. Lastly, education efforts are needed beyond just landowners as foresters and other natural resource professionals would benefit from improved knowledge of business management, planning and operating natural resource enterprises, and supplemental forest product markets other than timber. This will enable more effective engagement between natural resource professionals and landowners which can enhance the ability to directly meet landowner needs and address problems that may arise with supplemental enterprises and forest management.

## 5. Conclusions

This study found that FFLs in Alabama are interested in generating income from their forestland and they recognized the importance of forest management. However, most FFLs are not generating income from their forestland. Those that are generating income are actively managing their forestland and own larger tracts of forestland. Further, lack of knowledge and experience is preventing FFLs from engaging in income-producing activities on their forestland. These findings highlight the potential of income production on smaller tracts of forestland as an approach to improve forest management on these lands. Such income-producing opportunities could offset or reduce the cost of management. Further, this highlights potential opportunities for improvements of native ecosystems by educating and engaging FFLs on management and business practices and the creation of income opportunities through the development of natural resource enterprises. Interest from FFLs is apparent, but knowledge and experience on what to do and how to do it are lacking. This underlines the need for further research to better understand the suitability, management, and markets of such opportunities. A better understanding of this information will allow natural resource professionals to better bridge the gaps among sound forest management, healthy forests, and generating income and thus more effectively educate and engage FFLs.

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