SMALL SCALE FORESTRY

IN SOUTHEASTERN

OKLAHOMA

By

RIDER REYNOLDS

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Thesis Approved:

Dr. Difei Zhang

Thesis Adviser

Dr. Thomas Lynch

Dr. Brian Adam

Dr. Sheryl A. Tucker

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Although a great deal is known about the ecological and economic nature of the forests in southeastern Oklahoma, there has been comparatively little investigation into the specific nature of private forest management there. Information regarding the nature of private forestry operations in this area would be useful for any further analysis of them. This project will gather information regarding ownership, management practices, timber harvests, private timber processing, and ecological knowledge and preferences of private owners of more than 50 acres of forested land in southeastern Oklahoma by survey. Three individual cases will also be reviewed and used for comparison. For the purposes of the study southeastern Oklahoma is limited to Atoka, Chocaw, Johnson, Latimer, LeFlore, McClain, McCurtain, Pittsburg, and Pushmataha counties. From this information, the project will perform an economic analysis of the landowners' land and operations including a net present value calculation and a travel cost model. The economic analysis combined with analysis of the survey data can be used to develop a profile of private forestry operations in this area, which will be useful for better understanding the nature of private landowners' economic natures, operations, habits, and preferences.

This understanding would be useful in designing and modifying consulting services, programs, and policies so that they could better target and interact with these private landowners. This is of particular significance because the vast majority of forested land in Oklahoma is

privately owned. Identifying specific patterns or flaws in private forest management could be useful to consulting services. Many programs and policies, such as carbon credit programs, could benefit greatly from further understanding of how to better appeal to these private landowners.

Definition of problem

The problem this study hopes to address is rooted in the fact that the state of Oklahoma does not keep track of privately owned forested land. Specifically, there is no differentiation between forests and other types of land in tax related surveys of land use as their focus is agriculture (Holley et al., 2008). This complicates the process of surveying these private landowners, and can limit understanding of them to personal experience in dealing with landowners who initiated the consulting process. Forests play an important environmental, economic, and social role in southeastern Oklahoma. However, approximately77% of forested land is southeastern Oklahoma is privately owned (Smith et al., 2002). Though private landowners are unlikely to provide the same quality of management that a forestry professional could, this problem can be remedied through consulting with forestry professionals, or participating in various forestry programs, or adhering to policy. These activities could be more effective if assisted by more detailed information regarding these private landowners' forest management practices and preferences.

Statement of purpose

The objective of this project is to provide management information that can be used to better customize consulting services, programs, and policies so that they can target private owners of forestland in southeastern Oklahoma specifically, and better meet their specific needs. This objective will be met primarily by developing a profile for private owners of forested land in this area. Research questions that this project will attempt to address are:

- Are there significant sub-categories within private landowners from southeastern Oklahoma?
- Does consulting have an observable effect on how private landowners manage their stands?
- Are these private management practices sustainable?
- Does willingness to manage for carbon sequestration reflect other management practices or preferences?

Concepts central to this study that provide a foundation for these questions are the nature of private forestland in Oklahoma, the nature of private forest management, survey construction methodology, net present value, and travel cost modeling.

The issue of potentially significant sub categories is important because scaling could be an issue. The scale of this study is set at southeastern Oklahoma because that is the region of interest for the research questions outlined above, so the area itself is as central to the purpose as the landowners. Although it would be impractical for these purposes to include out-of-state data in the sample, it might be better to consider landowners in different, smaller groups, if these different groups have significantly different management habits.

Consulting with forestry professionals almost certainly improves all private management, but whether or not it has an observable effect is still a valid question. Exploring this question will yield information on the degree to which it improves private practices or the ways in which it tends to improve them. This could reveal any strengths, weaknesses, or tendencies in existing consulting services, so that they can be improved in the future. Showing that there is an observable benefit to consulting could also encourage more landowners to utilize these services.

Similar to the effects of consulting, sustainability issues would be more a question of degree rather than presence or absence. Examining how the sustainability of these privately

managed forests compares to publicly managed forests, private lands in other areas, or each other could reveal a great deal about the nature of southeastern Oklahoma's forest resource sustainability. Even if it did not reveal problems, this question might provide some insight into how this issue could be better approached.

Many landowners are not willing to manage for carbon sequestration. This willingness or unwillingness might be correlated with other management practices or preferences. If this were the case, this information could very beneficial to carbon credit programs as it could be used to explore how to work around them or alter carbon related programs to target them more specifically.

Through addressing these questions in addition to exploring the data, it should be possible to develop a profile for the average private landowner in southeastern Oklahoma. With this profile, organizations that interact with private owners of forested land could modify their strategies in order to be more beneficial to private landowners and their forests.

Limitations

This project is chiefly limited by area and demographic constraints, because its purpose is to determine properties specific to this locale and this demographic. Only forested land within Atoka, Chocaw, Johnson, Latimer, LeFlore, McClain, McCurtain, Pittsburg, and Pushmataha counties in Oklahoma is considered, and only when more than 50 acres of it is owned by a private individual. Though providing a more detailed examination of the topic, this practice naturally limits the portability of the findings. Approaching this issue with survey data also carries with it the risk of imperfect information, as subjects are not obligated to answer or answer precisely. Though specialized and somewhat limited, the study will provide data that could be useful for future investigations. While this project will provide detailed information pertaining to small,

private forest operations in southeastern Oklahoma, it could be useful for the efficient operation of most private forestry projects in the area as some aspects are universal.

This project is also limited because many of its respondents being involved in the forest stewardship program on some level. Lack of records of who owns forested land limits address records to those who have expressed interest in some forestry program at some point. This will bias the sample towards increased interest and participation in various cost-share programs and an increased amount of sustainability information to which the landowner has been exposed. Forest stewardship provides some economic incentives, so willingness to participate in forest stewardship could be motivated by economic reasons. However, it could also be indicative of deeper concern with sustainability than the average private landowner. This project will attempt to account for this limitation by comparing the natures of program participants and non-participants from other studies conducted in other states. The deviation of the management practices of private landowners involved in forestry programs from the average private forest manager can be inferred and accounted for in this way. It could be that there is no significant difference between all private landowners and those participating in forest stewardship, but it is more likely they only differ in a few distinct ways.

Statement of project's significance

The majority of this project's significance lies in its usefulness to entities that interact with private forest landowners in southeastern Oklahoma. Consultants and policy makers could tailor their projects to these landowners better if they knew more about them. This project will provide information specific to Oklahoma landowners, particularly economic information, that likely could improve the effectiveness of these entities.

Due to the lack of records in Oklahoma, some information regarding Oklahoma landowners specifically is unclear. Though most of the project's significance is in potential

application, it will also provide a wide variety of information. The data could be used to inform future research as it could identify subjects deserving further investigation or be used for purposes of comparison.

CHAPTER II

REVIEW OF LITERATURE

The essential part of this study is developing a profile of private landowners in southeastern Oklahoma. This investigation is possible because of the foundation of ideas upon which it stands. Privately owned forested land in Oklahoma has a few unique characteristics that warrant some further investigation. The nature of private forest management is dramatically different from public forest management, and is influenced by different kinds of effects. In order to properly capture the relevant aspects of the nature of these private landowners and their management, the survey construction must involve a few special considerations. Net present value is a useful way of interpreting some of this survey data. Travel cost modeling can provide some insight into the nature of aspects that would otherwise be difficult to analyze.

Private Forestland in Oklahoma

Although the determinants of landowner behavior can usually be generalized across a region, there are a few unusual qualities evidenced by history and previous studies that indicate that private landowners in Oklahoma may be a slightly more unknown quantity, but no less significant because of it. This point is of particular importance due to the large volume of research into the nature of private landowners in various places (Gregory et al., 2003). The majority of Oklahoma is not heavily forested. However, timber and other forest resources have played a major role in Oklahoma's development (Hill, 1910). The initial management of these

timber resources was not particularly sustainable. The demographics associated with those people willing to move into Indian Territory were significantly different from those of the rest of the nation. Similarly, the cultural properties associated with the American "West" held different attitudes towards natural resources. Though times have changed, and these demographics and cultural properties would only have influenced private forest management at the time, many landowners in Oklahoma are older individuals who inherited their property. It is possible that these properties continue to shape some of these landowners' attitudes towards forest management, making them different from landowners in states that were settled earlier. State policy regarding forestland has also been shaped by historical events. More traditionally, profitable land uses in Oklahoma have been crop and cattle production, so these land uses have been regarded as important for surveying purposes. The various land surveys conducted in the area in the past only recorded forestland as wasteland or unused land, as forestry was not perceived to be valuable in the past. This has led to difficulties in identifying which areas really are forested to any extent, much less which forested areas are more or less productive or managed specifically for timber or some other forest resource.

Due perhaps to these restrictions, there have been comparatively few previous studies of privately owned forests in southeastern Oklahoma. Three of the more significant studies are Bovée and Holley, 2003; Thomson and Jones, 1981; and Holley et al., 2008. The Thomson and Jones study was principally concerned with the economics of tract size. They found that as tract size increased, landowners were increasingly more likely to manage for timber. Though this study is somewhat limited in scope, several significant points can be drawn from it. The most significant shift in private forest management occurs at approximately owning 50 acres of land. Another point that this study introduces is that some of these landowner groups are so different, it is more reasonable to analyze them separately. The Bovée and Holley study collected data regarding the nature of private landowners and their management for purposes of customizing

outreach programs. Though this broadness of scope provides many useful bits of information, survey data is not limited or divided up by property size. This would lead to the profiles of those owning fewer than 50 acres for recreational purposes and those owning more than 50 acres for economic reasons to be blended together. This study also indicated that few landowners had a forest plan, but it is difficult to determine whether this is due to the effects of tract size. In 2008, Holley et al. surveyed Native American private landowners in southeastern Oklahoma. This study provided a bit more analysis than the other two, and indicated which variables are likely to be most important and why. It provides a good example of determining an average profile of a group of private landowners. Though these studies do not sufficiently describe some aspects of the nature of private landowners in southeastern Oklahoma, they provide a great deal of useful information on how to survey them.

Though forests are not often associated with the state of Oklahoma, they are still significant. Timber is the third most valuable agricultural crop produced in Oklahoma (Lewis, 2001). It is also valuable compared to particularly profitable non-agricultural industries in the state, such as oil. Most of Oklahoma's forests are in the southeastern part of the state, which is approximately 55% covered in forest (Birdsey and May, 1988). However, the vast majority of the forestland in this area is owned privately, and private landowners are not as effective forest managers as professional foresters (Smith et al., 2002, Lewis, 2001, Birdsey and May, 1988). This can be remedied in part through consulting with professionals, but this is an optional activity. It is important, then, that consultants, programs, and policies designed to improve private forest management are able to interact with these private landowners effectively. This can be facilitated by familiarity with a profile of these private landowners' management practices and preferences.

The profile of private landowners owning more than 50 acres of forested land in southeastern Oklahoma is both complex and important to understand. The importance is rooted in

how much of Oklahoma's forestland they own and how valuable it is, especially to Oklahoma's economy. The complications associated with studying this group of landowners lie in its history, but can be overcome with proper methodology.

Private Forest Management

Although landowners all behave differently and all sites have different qualities, there are some generalizations that can be made for both. Sustainability and productivity are both important elements of a site, usually regardless of other strengths and weaknesses a site might have. Consulting habits and willingness to participate in various programs are important landowner qualities to assess in order to better address such things as sustainability and productivity.

Improving timber productivity is an important objective for many consulting services, programs, and policies because timber is so important to Oklahoma's economy. However, sustainability is equally important, if not more so. On a spatial scale, the effects of sustainability are similar to those of productivity, but on a temporal scale, sustainability's effects are far more important. Fortunately, it is possible to manage for both objectives at once (Deal and White, 2005). One of the more significant problems with private landowners' sustainability is their understanding of it. However, with sufficient consulting, private landowners could improve the efficacy with which they manage for sustainable production.

Private landowners are often not as good at managing forests as public managers, principally because they are not under an obligation to do so. "Good forest management requires a thorough knowledge of the resource base and the factors affecting it," but such knowledge is not a requirement to owning forested land (Birch, 1994). Few private landowners plan for the future of the forest, fragmentation of the landscape can lead to forest sustainability issues, and emphasis on private objectives can be detrimental to the environment's value to the public

(Sampson and Decoster, 2000). This can be remedied through a variety of means. The primary means of addressing this issue is consulting, but the effectiveness of consulting is limited by the fact that the landowner has to initiate it. Various programs can also assist landowners in reaching their management objectives. Cost-share programs are the most common sort of program designed to benefit landowners by encouraging them to manage their forests in certain ways, but carbon credit programs are also well-known. Though there has been fairly little participation in carbon credit programs so far, there is some potential for these programs to improve private forest management (Fischer and Charnley, 2010). The success of these programs is often tied to the attitudes of the landowner, rather than just the financial incentive. Taxation can also be used to alter landowners' behaviors. The success of policies such as taxation is similarly limited, as it may not always be clear which forest practices are related to increased taxes correspond. Although private landowners tend to make comparatively poor forest management decisions, through consulting, programs, and policies private forest management can be improved.

So much forestland is privately owned that it is important to understand the nature of land and landowners. Privately owned forestland can be analyzed through the examination of its productivity and sustainability. Private landowners can be analyzed in part through examination of their wiliness to manage for carbon sequestration and consulting habits.

Survey Construction Methodology

By their nature, surveys cannot provide all information desired for a population. This extends both to the kinds of questions asked and the individuals who are selected to participate in a survey. Too few questions will result in lack of information regarding some critical variables, while too many questions will likely result in respondents becoming increasingly less willing to participate. Too narrow a mailing list could result in bias, while too broad a list could result in accidental inclusion of subjects who do not meet the survey criteria. In order for a survey to

capture the desired amount of the desired kind of information, some balance must be achieved. From previous studies of private landowners in southeastern Oklahoma it was determined that the transition point at which private landowners became significantly more active forest managers was owning more than 50 acres of land. Due to complications regarding forestland record keeping in the state and the fact that most previous studies did not include property size limitations, previous studies were more likely than this study to have received responses from owners of non-forested land or forestland owners uninterested in forest management. Although size limitation and restriction of the mailing list to individuals that really do fit the specified criteria will dramatically decrease the responses this study will receive, accuracy gained from careful targeting will likely outweigh accuracy lost through smaller sample size. Particularly in the case of private forestland owners, case studies and surveys can complement one another very well (Bliss and Martin, 1989). It is important to examine and compare the results of both survey data and individual cases for purposes of confirmation, but it is also important to compare potential survey questions to what individual cases seem to show in order to assess their validity. Questions included in the survey should also be fairly diverse in order to fully develop the profile (Zhang 2007, Zhang 2010). Through careful construction of both the survey and its associated mailing list, a sufficient amount of the appropriate data can be collected.

Net Present Value

Although there are many tools meant to assess economic value in some way, one of the most relevant to forestry is net present value (NPV). Managing forests, due to the physiology of trees, is essentially a long-term project. Compounded with the fact that tree responses to various forest practices are often complicated and can interact with a number of other elements, this makes thinking about the future of a forest difficult. There are so many forest practices that have the possibility of improving growth that it is necessary to have a decision making tool to simplify things. Net present value essentially enters in all the costs and benefits of forest practices into a

table, often using a growth equation to determine the effect of these practices on final yield, and then transforms the future values associated with the costs and benefits to present value so that they can be summed. This is one way of exploring the costs and benefits of individual practices to decide whether to perform them or not. For example, commercial thinning is often beneficial in that it improves total harvest volume at the end of rotation through increased growth and will generate some amount of income, but these benefits may or may not be larger than the cost of pre-commercial thinning. This is most useful however, in determining the investment value of a forest managed for timber production. Because NPV is revenue minus costs in present value it is directly comparable to other potential investments. Bare Land Value (BLV) is similar in nature, calculation, and usage, but it is more useful for buying or selling land than for investing in management.

Net present value has a few strengths and weaknesses. Its foremost strengths are simplicity and immediacy of use. This is particularly helpful because privately owned forests are so variable and complex, and private landowners often require a simpler means of analysis. Because of its simplicity, it should be compared with other measures. For example, to consider opportunity cost, it should be compared with an alternative rate of return (Ross, 1995). NPV can be very effective when used with other tools as part of an analysis rather than the sole decision-making tool. The processes that control forest growth are fairly fixed, so NPV has some use as site evaluation even if it is not used in decision making at all. Another consideration associated with NPV is that discount rates must be chosen very carefully, as they are difficult to predict. This can be remedied by performing the same calculation for a range of possible values of interest rate and examining the distribution of corresponding results. With some modifications, NPV can be a valuable part of an economic analysis.

Travel Cost Modeling

Another useful tool for the analysis of the nature of private landowners in southeastern Oklahoma is travel cost modeling (TCM). Travel cost modeling is a kind of contingent valuation used to associate an economic value with an activity that would otherwise be difficult to quantify in a meaningful way. TCM is based on the idea that if people are willing to travel to an area, the costs associated with traveling would be an approximation of their willingness to pay. Coupled with information regarding frequency of travel this could be used to develop a demand equation. As TCM is a revealed preference method of valuation, it can also be compared to stated preference data. These qualities make travel cost modeling particularly useful for examining the nature of how hunting leases for privately owned forestland in this area are bought and sold.

As with any analytical tool, there are some considerations that should be addressed before travel cost modeling is used. Foremost among these concerns is how the cost of traveling is approximated and how the decisions are examined, particularly for trips with multiple purposes (Parsons, 2012). The travel element of travel cost can be estimated in a number of different ways. Due to the fact that private landowners selling hunting leases may not know where exactly their clients live, distance traveled will be difficult to estimate. Given these limitations, the best approach would be to calculate travel cost by zone. A zonal travel cost model would generalize distance to a series of zones, such as within or outside of county or state, and estimate the costs of traveling that way. The other complications indicated by the literature lie in teasing apart some of the more subtle relationships like site choice or the purpose of the trip. Although the nature of the hunters buying leases is indirectly important to private landowners and making a few assumptions regarding hunter motivation in order to stay within the limits of the study will decrease the robustness of the model, such a model would still be sufficient for the purposes of this study. Despite these potential weaknesses, travel cost modeling could be useful in exploring the nature of private landowners in southeastern Oklahoma.

CHAPTER III

METHODOLOGY

Before the profile of a private landowner in southeastern Oklahoma can be developed fully, certain considerations must be more fully examined. The deviation between private landowners participating in forest stewardship and all private landowners will be inferred from literature. Similar studies originating from states that maintain records of forested and non-forested land will be used for this purpose. This will be used to examine potential bias within the sample, both with regard to which variables are likely to be affected by it and the degree to which they are likely to be affected. With this information, certain aspects of the profile might be shown to likely be biased and will receive less consideration than variables that are more likely to be unaffected.

Survey

These effects will help shape the profile of the average private landowner in southeastern Oklahoma, which will be generated by survey data and three specific examples of a private individual who owns forested land in southeastern Oklahoma. The survey data will include the topics of ownership, management practices, timber harvests, private timber processing, and ecological knowledge and preferences (Zhang 2010). The survey design follows the protocol in New Hampshire's sawmill industry and its forest resource base (Zhang 2007). Description of

forestland ownership items include such things as where the property is located, when and how it was acquired, if it was acquired through sale or inheritance, if it will be sold or passed on as inheritance, and whether it is maintained as a trust, a partnership, or individually owned. The forest resource management section principally includes the nature of the forest owned, what is produced on the land other than trees, who do the landowners consult with and how often, who has input into the management decisions made regarding the land, whether or not there is a plan for the forest, and which cost share programs the landowners has participated in, if any. Forest economics items include treatments such as harvesting, planting, and thinning, with dollar amounts associated with these items. This section also includes information regarding taxes and leases. The section titled private timber processing operation is concerned with the particulars of any private landowners who own their own sawmills. Wildlife, recreation, and ecosystem valuation includes data concerning invasive and endangered species, biodiversity and sustainability, landowner opinions regarding climate change, and preferences regarding carbon credit programs. For purposes of analysis, data collected from this survey will be divided into categories of short answer, multiple choice, table, and long answer. Short answer data will be analyzed so as to determine the average, minimum, maximum, standard deviation, and 90% confidence intervals. Nominal short answer data will be listed. Additional analysis, usually in the form of a percentage, will be used as needed. An example would be the percentage of landowners who live on their land. Multiple choice data will be analyzed as percentage of responses. Tabular data will include both an average ranking and a chi square analysis. Long answer data will be reported as is. A net present value calculation and travel cost model will also be constructed. From the responses to these various topics, it will be possible to develop a profile for private landowners in southeastern Oklahoma.

Individual Cases

Additionally, the profile will be considered in the context of three specific examples of a privately owned tract of forested land in southeastern Oklahoma. This data includes such relevant topics as forest planning, objectives, harvesting and reforestation, special activities, multiple use considerations, consulting preferences, and affiliation with forest related organizations. These management practices and preferences are derived from records and interaction with these landowners for purposes of consulting. Consequently, this data is a great deal more detailed than provided by the survey , and does not have the same potential problems as the survey, particularly with regards to interpretation, understanding, and fully capturing all pertinent variables. These three landowners also received the same survey. Using these specific examples, it will be possible to further explore some of the elements of the profile and to examine to some extent how well the nature of these private forestry operations was captured by the survey.

Sub-Categories

Once the survey data has been examined by itself, it will be possible to address several research questions. The question that could guide further inquiry and has the most potential for application is whether or not there are significant sub-categories within the general category of private landowners in southeastern Oklahoma. The sub-categories to be examined are whether or not the landowner's home is located on their forested property, whether they inherited the land or bought it themselves, whether they own a single parcel of land or many, whether their land is partially or entirely forested, whether they live in Oklahoma or another state, whether they own a great deal of property or a small amount, and the relative monetary value of their property. Differences in these particular categories are most likely to account for differences in management style. The categories of home status, acquisition, parcel, state status are reflective of how landowners regard their property, while the categories of degree forested, property size, and

property value are fairly likely to account for different management schemes. These variables will be compared to each other as well as other variables. These other variables include the number of times the landowner has harvested their property, the total per acre revenue from the harvest, whether or not they reforested after harvest, whether or not they had a timber plan at the time of harvest, whether or not they are interested in managing for carbon sequestration, and the intensity of their management. Management intensity will be approximated as a sum of the various forest practices they used, which include fertilization, control of insects or disease, planting seedlings, site preparation, prescribed fire, pre-commercial thinning, commercial thinning, herbicide application, and pruning. These variables are most indicative of management style. Examining the interactions between these variables might reveal some significant correlations. Such associations could be indicative of a meaningful relationship between a demographic and management style.

Consulting

In order to address the question of whether or not consulting with a forestry professional has an observable effect on the management of these private landowners this study will compare those respondents who have contacted some kind of forestry professional in the past to those that did not, as well as those respondents who have a timber plan to those who do not. Assessment of the two groups who have and have not consulted in the past will include examination of their respective final harvest values, whether or not they reforested after harvest, whether or not they have a long-term timber plan, and whether or not they have participated in some of the various cost share programs available to them. The per acre final harvest values will be computed by dividing total harvest value by acres included in the harvest. Comparison of these values between the two groups could indicate superior or inferior timber management, though there will be a great deal of variance due to site quality.

Reforestation could also be used as a loose indicator of good forest management. However, since much of the valuable timber in this area is southern pine, which often regenerates well after a clearcut, it is occasionally economically feasible to allow a stand to naturally regenerate. There are many cost-share programs available to private landowners in southeastern Oklahoma. Though these programs have certain requirements, many landowners could make use of these opportunities. Participation in these programs being correlated to consulting habits could indicate that consultation is beneficial. These programs include the Wildlife Habitat Incentive Program (WHIP), the Forest Incentive Program (FIP), the Stewardship Incentive Program (SIP), the Conservation Reserve Program (CRP), the Wetland Reserve Program (WRP), or the Environmental Quality Incentive Program (EQIP). Examining the relationship between consultation and timber planning could be illuminating, as there are a few landowners who prepared a timber plan and have not consulted with a forestry professional in the past.

The question of whether or not consulting has a significant effect is rooted in the idea that privately management forested land is not as effective as professional management. Consulting with professionals could remedy this to some extent, but so could effective planning. In addition to examining how previous consultation could have potentially effected management, this study will compare those respondents who report having a timber plan to those who did not. The variables of final harvest revenue, reforestation after harvest, and participation in forestry programs will be re-examined. It could be that forest planning is a better indicator of private forest management improvement that past consulting habits. Despite the variability of these elements, examining how consulting and timber planning affect them should provide a general measure of how beneficial these practices can be to private forest management in southeastern Oklahoma.

Sustainability

Sustainability is an important consideration in any kind of forest management. However, sustainability is difficult to define and quantify, and it is especially difficult to assess through use of a survey because responses will be filtered through the lens of the respondents perceptions. Before attempting to examine sustainability itself, this study will attempt to examine how well landowners assess the sustainability of their land. This will be done by comparing how well they rate the sustainability of their management to their responses for whether or not they reforested after harvest, whether or not they have a timber plan, and how badly affected their land is by invasive species. Reforestation by planting is a good indicator of sustainable forest management, but many areas in southeastern Oklahoma have sufficient natural regeneration for sustainable management to occur without planting. Having a timber plan is also usually indicative of sustainability, but it is not strictly necessary for sustainable management. One of the foremost forestry problems in southeastern Oklahoma is invasion of eastern red-cedar (*Juniperus virginiana*), which landowners might consider to be a sustainability issue. Though these variables are would not be perfectly correlated with sustainability, examining how well correlated they are with the landowners' perception of their management would provide some insight into how well they assess sustainability.

Once the issue of perceptions has been addressed, the question of whether or not private forest management in southeastern Oklahoma is sustainable or not can be explored. In addition to the landowners' self-assessments, this study will compare the indicators of reforestation and timber planning to the rates of these variables found in studies conducted in other nearby states. This comparison will provide insight into how sustainable private landowners in southeastern Oklahoma are relative to private landowners elsewhere.

Carbon credit programs are becoming increasingly more available to private landowners in southeastern Oklahoma. In order for these programs to be as effective as possible, it is necessary to explore how the characteristics of landowners who are and are not willing to manage for carbon differ. This study will contrast the two groups by examining the potential correlations between willingness to manage for carbon and home status, property acquisition, number of parcels, forested proportion, state status, property size, property value, number of harvests, harvest revenue, reforestation, timber planning, fertilization, control of insects or disease, planting seedlings, site preparation, prescribed fire, pre-commercial thinning, commercial thinning, herbicide application, pruning, and general management intensity. Any patterns in the demographic variable would improve the targeting of carbon related programs, while the general and specific management information could improve their ability to work harmoniously with current management. This information could be used to improve such a program's potential success both through improved understanding of how to appeal to the less willing group, and its benefits through improved understanding of how to work with its participants.

CHAPTER IV

SUMMARY OF INDIVIDUAL DATA

Case studies will be developed concerning each of three landowners separately who own 680, 345, and 130 acres respectively in southeastern Oklahoma. A forest management plan was developed for the landowner owning 680 acres in 2010, and data was collected for tracts owned by the other two in 2011 for similar purposes. The details of the forest stands, objectives, and preferences of these three landowners were considerations in developing a forest plan. In addition, the Oklahoma Department of Agriculture, Food, and Forestry is very knowledgeable about the management history of these stands, the landowners' objectives and methods, and the characteristics of the stands themselves. With this information it would be possible to explore the profile of the average private landowner in southeastern Oklahoma.

First Case

The first landowner's first tract is approximately 160 acres in size, and consists of naturally regenerated shortleaf pine. Although this stand is adjacent to some shortleaf-bluestem ecosystems, it has some problems with eastern red-cedar and hardwood invasion that they do not have. This could be accounted for by the prescribed fire the adjacent shortleaf-bluestem stands controlling the red-cedar. In addition to being a little hilly there are a number of rocks scattered along the forest floor. These two qualities are related to soil types in

the area and will have an impact on site index. There are several perennial streams throughout the stand, but no permanent ones which would require special management. The roads were well drained. Even when rainwater flowed across the road as a small stream, there was not a great deal of erosion. These qualities would make the best management practices concerns in a forest plan minimal. Though hardwoods are beginning to appear in the stand, there are comparatively fewer of them in this stand than in some adjacent ones due to landowner management of them. The vast majority of the stand is shortleaf pine, all of which is naturally regenerated. The regeneration is quite high on the site though, so there is a high basal area and a lot of competition on the stand. Most of these shortleaf pine average approximately 30 feet tall and 8 inches in diameter at breast height (DBH), which is 4.5 feet from the ground. Although the high density would likely produce more biomass and consequently store more carbon than a lower density stand, having timber as the primary objective means that this site would likely benefit from additional thinning. The current sizes and densities indicate that more frequent thinning would be more preferable to more intense thinning. Although the density of the stand prevents the site from being as profitable as a professionally managed timber stand, the money saved through natural regeneration offsets this a little. Overall, the stand is in good shape.

The landowner's only objective is timber, and the landowner is uninterested in pursuing such things as revenue from hunting leases or carbon credits, particularly on this stand. The landowner currently wants to remove all hardwood and red-cedar from the stand so that it is only stocked with shortleaf pine. To this end, the red-cedar was cut down and sold to the nearby sawmill to be marketed as various sorts of interior wood. This revenue covers the cost of the red-cedar's removal, so that there is little to no cost associated with the remaining trees benefiting from reduced competition. Whenever the stand is thinned the landowner instructs the loggers to fell all hardwood and red-cedar in addition to the shortleaf pine they intend to take, and to leave the felled hardwood and red-cedar there. Though there is some market for red-cedar and

hardwood, removing them so that additional shortleaf pine can grow is still more profitable than the alternative even if they cannot be sold. The landowner also has some interest in prescribed burning, both as a means of eliminating eastern red-cedar and of potentially converting the stand into shortleaf-bluestem. The stand was thinned in 1995 and 2004. The first thinning was to increase timber volume, while the second thinning was a salvage operation. Recovering timber lost to the ice storm was the primary objective of the second thinning, but the whole stand was thinned to improve the growth of the residual trees as well. The landowner also uses herbicides to control hardwood, and would not be opposed to further herbicide use or controlled burning. The landowner is also a forest steward. The stand is well managed for timber production, and a forest plan would have little to add to that. A forest plan constructed for this stand that would be beneficial to this landowner should focus on efficiency issues by including further economic analysis of this stand, should explore the costs and benefits of other potential management objectives, and use a growth and yield model to predict exactly when and how severely the stand should be thinned.

The first landowner's second tract has a slightly different nature and covers 185 acres. The landowner intends for this to primarily be a timber stand as well. The majority of it is also naturally regenerated shortleaf pine, but loblolly pine has been planted in several places. The current rotation of this stand is about 30 years old. The landowner is waiting until the pine market turns around before harvesting, though the landowner is confident it will eventually do so. This stand has fewer problems with red-cedar than the first, but does have a number of clear patches where pine will not regenerate. Loblolly pine was planted in these patches. After a tornado in 2011, a salvage cut was conducted in many patches. Red-cedar and hardwoods are also controlled in this stand, and were felled and left where they fell during this salvage of damaged loblolly and shortleaf pine. These salvaged patches will have their slash dozed into piles, they will be ripped, and containerized loblolly pine seedlings will be planted. There is a great deal of emphasis on

reforestation on this site, as natural regeneration is insufficient. There is a stream running through this stand, which the landowner wishes to keep untouched for wildlife. The landowner intends to keep a buffer around the creek that is 100 feet in width, and using prescribed fire in this area to further benefit wildlife. The landowner also maintains a cabin near this creek which will have a similar buffer where timber will not be harvested, though for aesthetic rather than wildlife reasons. The landowner is not willing to lease any part of this stand for hunting, regardless of the price. A forest plan for this stand that would benefit the landowner should focus on best management practice and wildlife information for the entire stand, but with emphasis on the creek. The presence of the cabin means that a forest plan should also include wildfire safety information, particularly since the landowner is interested in exploring prescribed fire. Though the landowner's objectives for this stand are heavily focused on non-timber issues, multiple-use forestry is certainly possible, and a good forest plan should fully describe this option.

The landowner's ultimate plans for both stands are to convert parts of the second stand into recreational areas while keeping the first completely in timber. The landowner is older, very experienced with timber management, lives out of state, and visits these two stands roughly six times a year. Though the procedural nature of the landowner's forest management ensures that it is sustainable, it can also lead to inefficient management. Current management plans are that if there is an eastern red-cedar or hardwood it will be cut down, and if there is a clear space a loblolly pine will be planted there. These practices contribute to full stocking, but indicate that the landowner would benefit from an economic analysis as an unusually large amount of effort is often put into solving comparatively minor problems. However, the landowner is quick to addresses problems that come up, is very skilled in timber management, and is willing to explore new methods. A forest plan that benefits this landowner would include a detailed economic analysis, which is the focus of the landowner's interest and experience, and some new

suggestions such as multiple use management and managing for carbon sequestration as part of a carbon credit program.

Second Case

The second landowner's stand covers 130 acres, and consists entirely of planted loblolly pine. It is managed a bit intensely compared to other privately owned stands in the area, using management practices that closely resemble what is used for industrial pine plantations. The land itself has a very high site index, and the landowner prefers to use a paid professional consultant rather than ODAFF. These consultants tend to focus on such high productivity areas and tend to produce forest plans that are more industrial in nature. All of the trees are loblolly pine planted in rows, and thinned twice per rotation. After harvest, the site is sprayed with herbicide and reforested. The stand is divided into several sections, with each section being even-aged and at a slightly different age, such that when one section is harvested and reforested another will be approaching maturity. This allows the stand to produce timber regularly, even though all the component stands are even-aged. Currently the landowner does allow people to hunt deer on his land, but does not charge for it. A good forest plan for this site would attempt to expand beyond traditional plantation pine management, possibly into managing the stand for wildlife habitat or carbon sequestration as well.

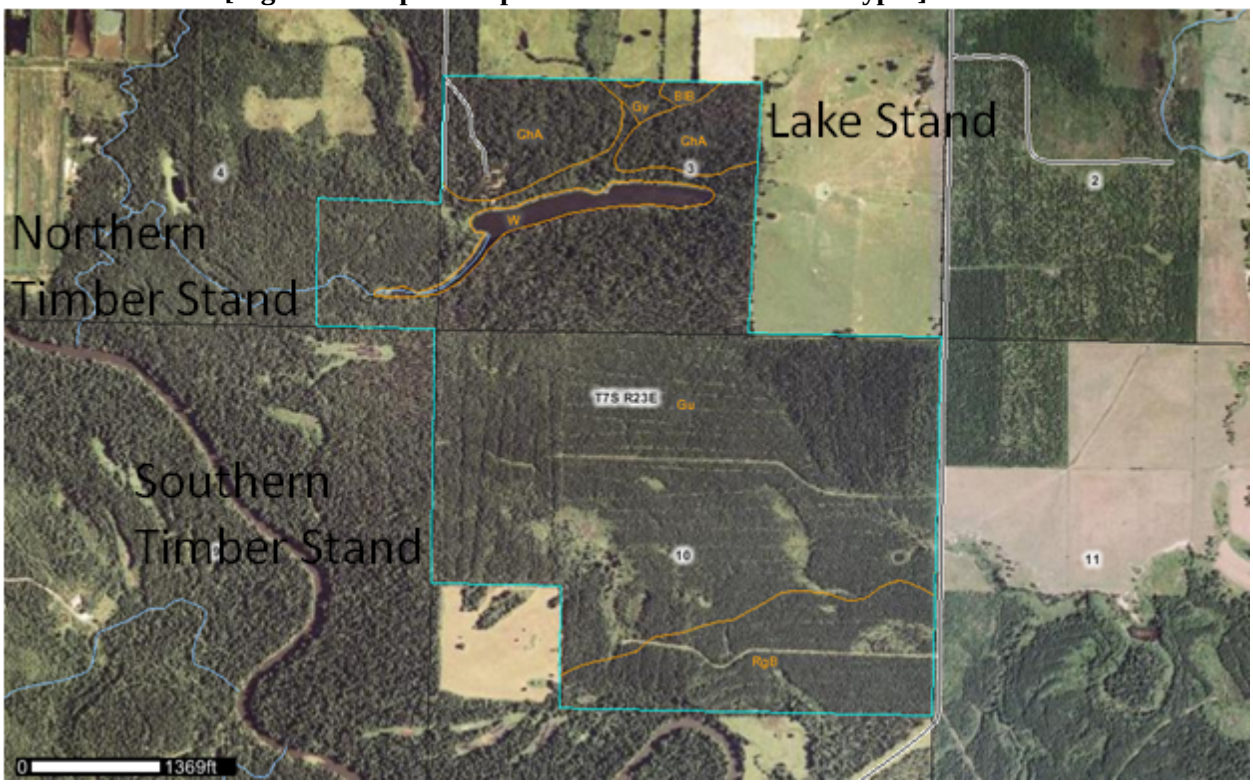
In most cases, private forest management is inferior in some ways to professional forest management. However, this landowner's management is very effective because it so closely resembles a pine plantation managed by industry. This style of management is the landowner's strength and weakness both. The forest plan that would be most beneficial to this landowner would be one focusing on the options of multiple-use forestry and non-traditional management practices. The consultant would be inclined to advise even-aged management as it is most profitable, so a forest plan should also examine the potential suitability of uneven-aged

management. Though the landowner's current focus is limited to timber, it might be useful to him to consider other potential management objectives.

Forest Plan for Third Case

The third landowner owns three tracts of forested land in southeastern Oklahoma. His objectives for two of these tracts are to maximize returns from timber production, while his objectives for the third plot emphasize recreation and aesthetics. The two timber stands are referred to as the northern and southern timber stands, which are respectively 40 acres and 440 acres, while the recreation stand is referred to as the lake stand and occupies 200 acres. Both timber stands were inherited, and were originally established as a trust to pay for future education expenses.

[Figure 1: Map of Properties and Associated Soil Types]



Timber Stands

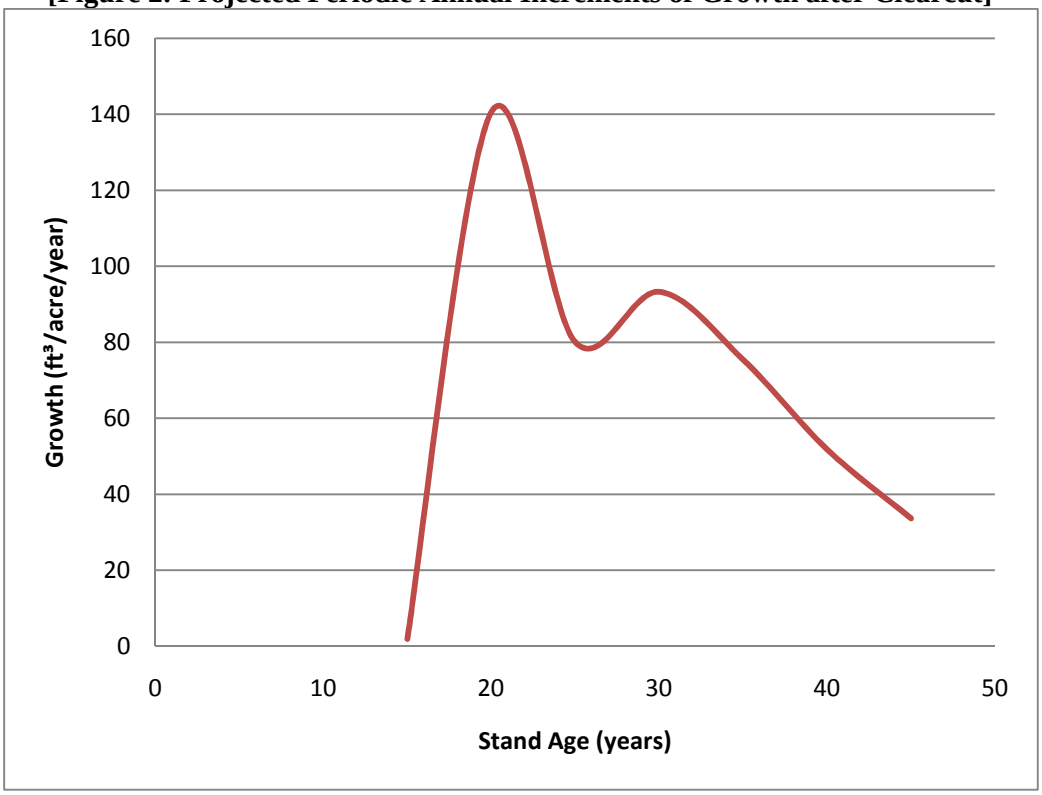
Though there are some differences between the two timber stands, they are so similar that the same prescription applies to both. Both timber properties were previously owned by Weyerhaeuser, which manages a great deal of timberland in the area. These two stands were originally planted by the company, so they are loblolly pine in rows. The northern timber stand is older than the southern, somewhat drier and has a stream flowing through it. The southern timber property is more moist, which caused some patches of pine to die off and be replaced by bottomland hardwoods. For this reason Weyerhaeuser originally bedded the southern timber stand. Large quantities of green-briar are found on both stands, but in the southern timber stand they only grow on the original raised beds. There are a number of ephemeral streams within the southern timber stand. Within both stands, the planted loblolly has grown well. Though these two sites did not appear to be as economically productive as the large company would have liked, it is likely that the loblolly pines' growth is sufficient to generate some return if managed for timber.

Since Weyerhaeuser began the rotation on both properties, its standard methodology for plantation pine in southeastern Oklahoma would be a good starting point for generating a prescription for these stands. Currently, both stands have been thinned, so all that remains for this rotation is harvest. Clearcut is the harvest method most conducive to the regeneration of the landowner's desired species, loblolly and shortleaf pine. However, a clearcut would also require some site preparation as natural regeneration of pine on these sites is fairly low. If the landowner wished to avoid site preparation he might consider a seed-tree cut in order to encourage pine regeneration (Schwartz et al., 2010). Such a cut would only require leaving roughly ten mature trees per acre standing, preferably trees that demonstrate preferable characteristics such as straightness and size, so that their offspring might inherit these characteristics. It is likely that a clearcut would be the far better choice, but the growth and yield of both prescriptions will be analyzed for purposes of comparison. Regardless of which cut is selected, both sites would

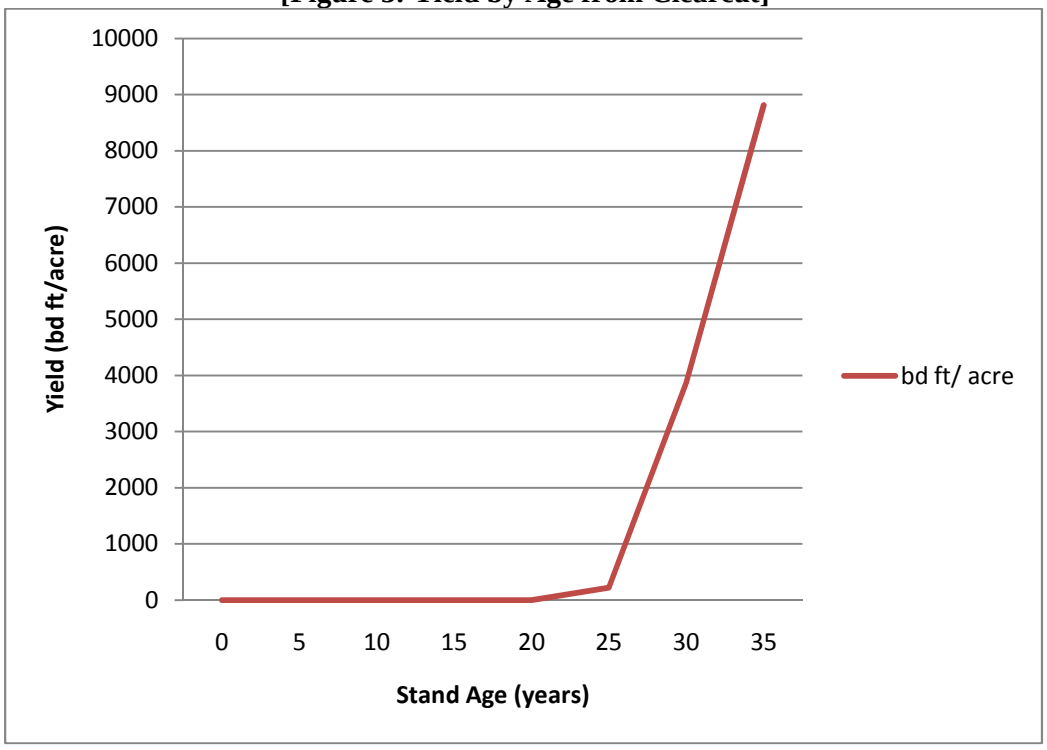
benefit greatly from site preparation and replanting. If there is no site preparation then a seed-tree cut would be more desirable. Site preparation should include herbicides for hardwood control in both stands, and bedding in the majority of the southern timber stand. Arsenal would be a suitable choice of herbicide. Ripping should not be necessary. Replanting should consist of half bare-root and half containerized loblolly pine seedlings at a density of eight by eight feet, because that is the combination that has proven most efficient in this area. At approximately fifteen years of age both stands should be thinned. The trees should be large enough by this time that the thinned trees could be sold as pulpwood, making this a commercial thin. Harvesting this next rotation in one of the two recommended ways as before concludes the silvicultural prescription for these two stands.

In order to better understand the nature of the stand and better estimate the volume to be removed by the commercial thin, the growth and yield of these stands must first be examined. To this end the Forest Visualization System (FVS) from the U.S. Forest Service was used. Provided the location and that these sites were both clearcut previously by Weyerhaeuser, FVS indicates that the trees should reach 70 feet in height by year 25. This is reflective of what was found in the northern timber stand which is approximately 25 years old. The natural biological rotation age of loblolly pine in this area is shown to be 35 years (Figure 2). At this rotation age the stand should have around 8,810 board feet per acre (Figure 3). However, the economic rotation age based on costs and returns of management does not necessarily require maximum yield, and so may be much sooner than the biological rotation age.

[Figure 2: Projected Periodic Annual Increments of Growth after Clearcut]

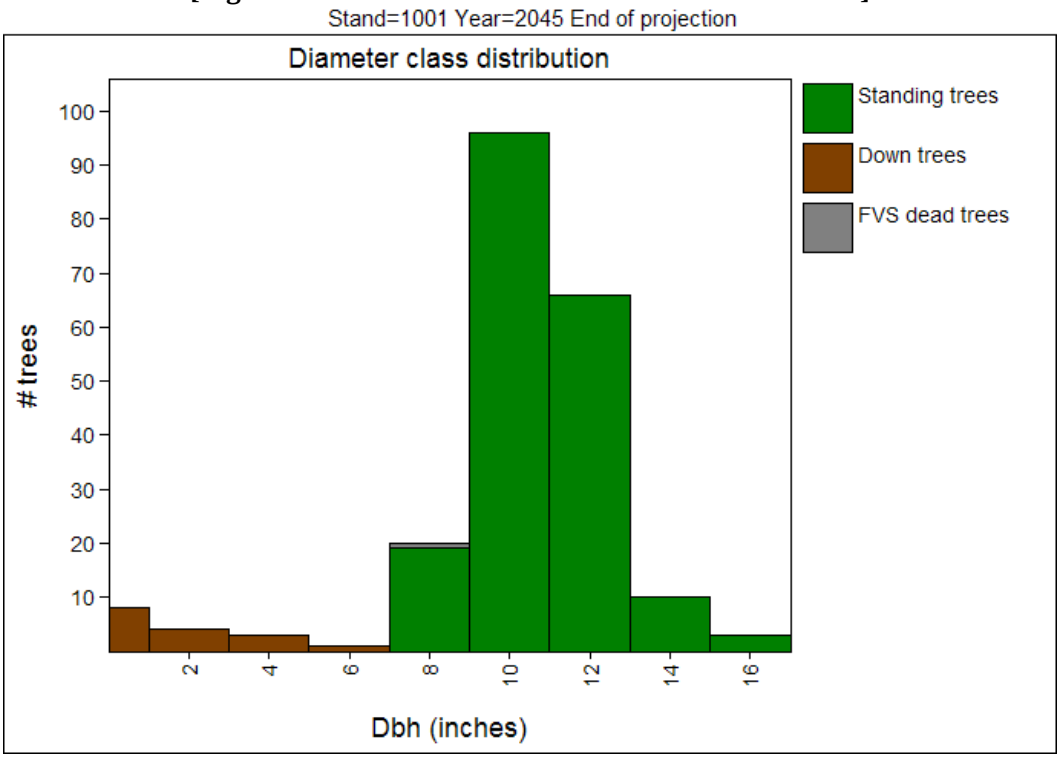


[Figure 3: Yield by Age from Clearcut]



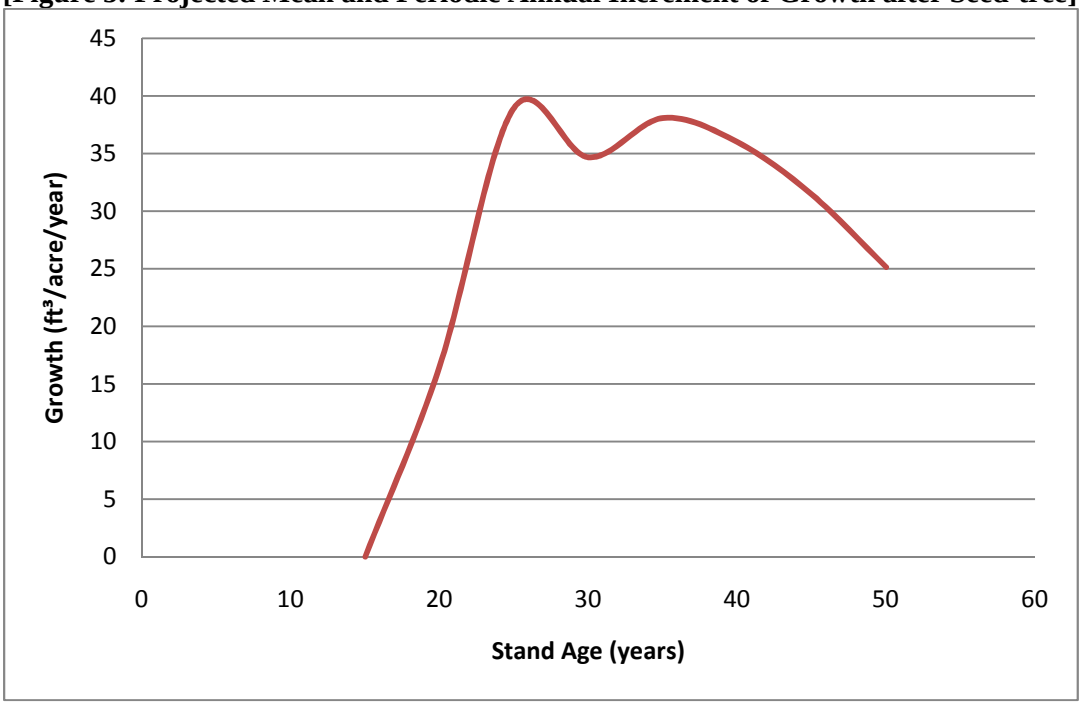
At the end of this rotation, and of any future rotations that were started with a clearcut, the diameter class distribution shows that the majority of the trees with be 10 to 12 inches in DBH (Figure 4). This is typical of a plantation, while a seed-tree cut will be more variable.

[Figure 4: Diameter Class Distribution from Clearcut]

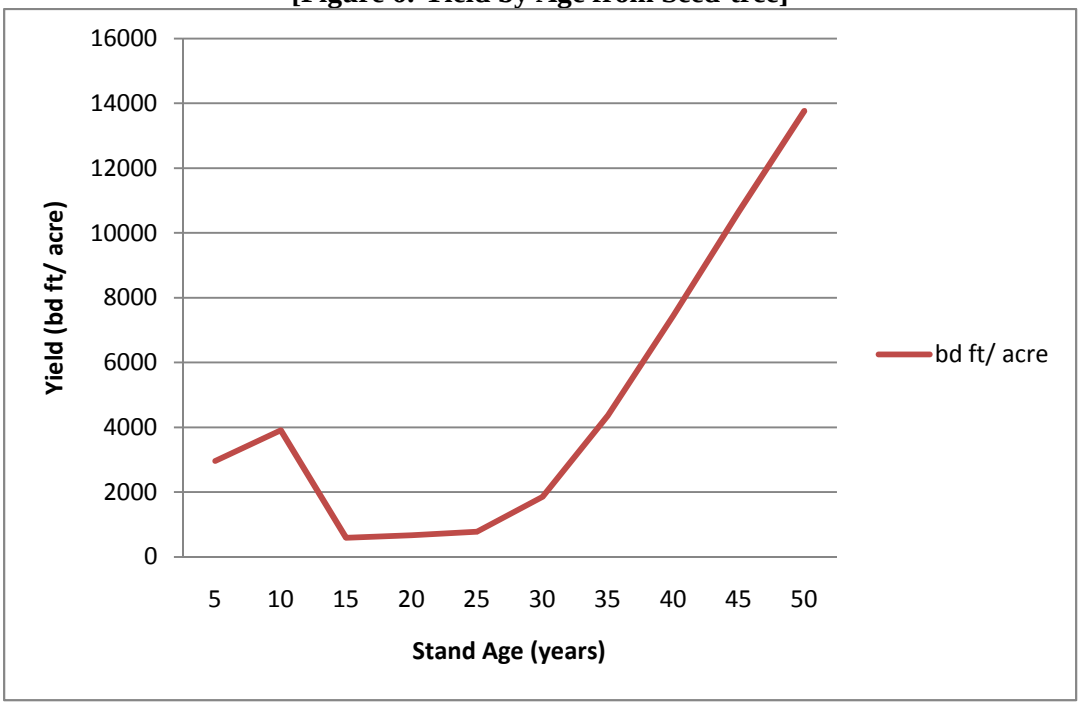


The seed-tree method of harvesting would be less expensive to implement and manage, but it would also produce a lower volume of wood. This is because it will take several years for the natural regeneration to really cover the site, while replanting after a clearcut gets the seedlings in place immediately. The biological rotation age for a stand in this area started with a seed-tree cut is 39 years (Figure 5). At the year 35 of rotation a seed-tree cut stand would produce 4356 board feet per acre of volume, and the average DBH would be 9.5. At its biological rotation age of 39 years it would produce close to 7440 board feet per acre (Figure 6). Though this is comparable to the volume produced by a clearcut, this volume would be realized several years after the clearcut stand would be ready to harvest again in addition to being slightly less. This is because the natural regeneration will not necessarily be at the ideal density as it would be if it were planted.

[Figure 5: Projected Mean and Periodic Annual Increment of Growth after Seed-tree]



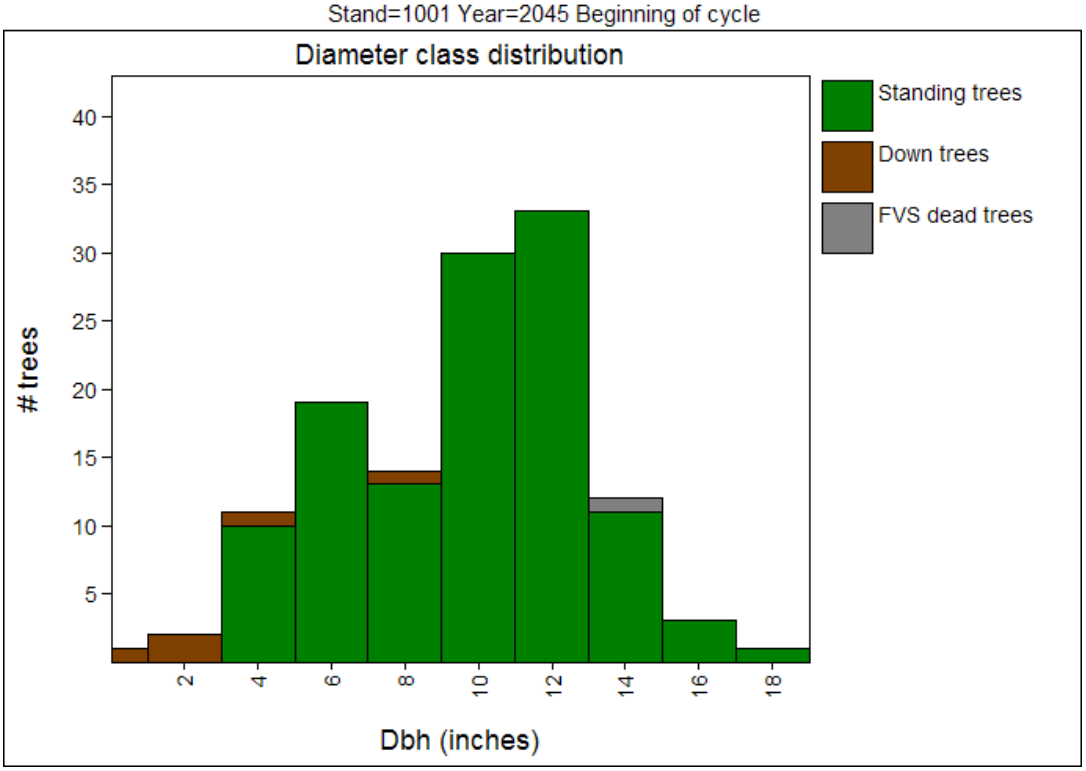
[Figure 6: Yield by Age from Seed-tree]



In comparison to the clearcut growth and yield, a seed-tree generated loblolly plot would grow at a slower rate. The decrease that is present in the yield by age graph is due to the removal of the

seed-trees. This dip is not present in the clearcut and plant yield because the there are no seed trees in a plantation. Diameter class distribution is still typical of an even-aged stand, but it has a much higher variance than the distribution associated with a clearcut (Figure 7). This is due to the erratic spacing of natural regeneration.

[Figure 7: Diameter Class Distribution from Seed-tree]



From these figures and graphs it is possible to determine that a clearcut with planting of these stands would yield a fair bit more timber volume than a seed-tree cut, and several years sooner. Although the site preparation and reforestation are somewhat costly, these costs will likely be offset by the increase in timber volume.

The major objective of both timber stands is to maximize profit. In order to ensure that this objective is met an economic analysis of total revenue of the two sites will be done, as well as a per acre Net Present Value and Bare Land Value including both sites. Timber stumpage prices will be extracted from *Timber Mart-South Market News Quarterly*. Based on cruise data and

timber prices it is possible to determine the separate revenue for both stands if they were clearcut immediately.

Table 1: Southern Timber Stand Revenue/acre			
	Volume (tons/acre)	Price ($/ton)	Revenue ($/acre)
Hardwood Pulp	2.35	$8.72	$20.53
Pine Sawtimber	53.08	$28.15	$1,494.10
Pine Pulp	0.61	$7.65	$4.63
Σ			$1,514.63

Table 2: Northern Timber Stand Revenue/acre			
	Volume (tons/acre)	Price ($/ton)	Revenue ($/acre)
Hardwood Pulp	7.50	$8.72	$65.37
Pine Sawtimber	74.61	$28.15	$2,100.36
Pine Pulp	1.40	$7.65	$10.70
Σ			$2,165.73

Pine sawtimber prices are currently still low because of the housing market. However, in the future the pine sawtimber market is likely to rebound. The northern timber stand is currently more valuable because it is much older than the southern timber stand (Table 1, Table 2). The southern timber stand suffered some damage during a recent ice storm and may require salvage. If the landowner does decide to salvage this stand, he should be able to get something close to this amount though it will be lower because of the damaged wood. The northern timber stand is very close to the estimated biological rotation age now, and so should probably also be harvested soon. Based on some additional values it would be possible to determine the NPV and BLV of the stands for future rotations as well as this one (Table 3). Volumes for the commercial thin and final harvest will be predicted by the FVS. Input costs will be taken from the Sep/Oct 2009 issue of *Forest Landowner*. Average annual property tax will be derived from historical data from the County Treasurer.

[Table 3: NPV and BLV Calculations]

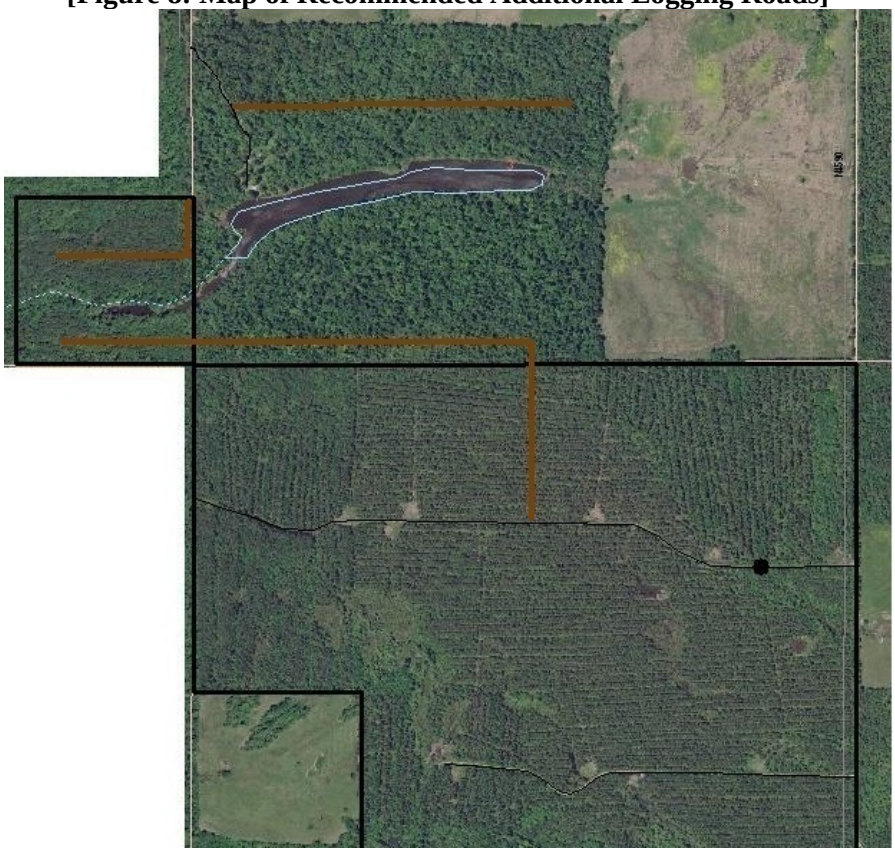
Year	Activity	Cost per Acre	Present Value Discount rate = 2.00%	4.00%	6.00%	8.00%	10.00%
Annual	Taxes	-10.00	-249.99	-186.65	-144.98	-116.55	-96.44
0	Site Prep	-250.00	-250.00	-250.00	-250.00	-250.00	-250.00
0	Planting	-97.50	-97.50	-97.50	-97.50	-97.50	-97.50
10	Pre-commercial Thin	-40.00	-32.81	-27.02	-22.34	-18.53	-15.42
20	Commercial Thin	217.88	146.62	99.44	67.93	46.74	32.39
35	Harvest	1908.05	954.08	483.53	248.25	129.05	67.90
		NPV	720.38	208.44	-53.65	-190.23	-262.64
		BLV	1440.85	279.19	-61.68	-204.03	-272.33

Net Present value is the total value of the stand discounted to today's dollars. Bare land value is the potential worth of the land if timber was grown on it perpetually. BLV is usually used to compare different potential investments. The discount rate used for these calculations is very difficult to determine, so several were calculated for comparison. Likely, the discount rate will be between 4% and 6%. Though this could mean that growing timber on these tracts of land will have higher costs than revenue, they might prove profitable if the prices of pine sawtimber increase in the future as they are likely to do. The net present value is so close to zero within this range that such a change in market could make quite a difference. If the NPV and BLV really are lower than zero, the landowner would be better advised to sell the land and invest the money elsewhere.

Some of the foremost concerns of these stands have to do with water. In the northern timber stand there is an annual stream around which a buffer should be maintained. This buffer should ideally have 50 square feet per acre of basal area or more and extend 50 feet on either side of the stream. Within the southern timber stand most of the streams are ephemeral. However, if

they are flowing at the time of harvest a buffer should also be maintained around them as harvesting could put a great deal of sediment into the stream to be washed away. The swampy nature of much of the southern timber stand should also be taken into account. Though the harvesting machines often have very wide tires to reduce soil compaction, next to many of the previously used landings there is a great deal of water. Use of these old landings could move a great deal of sediment. Before harvest, loggers should look at and redesign where they will put their landings. Many of the old logging roads could still be used without any damage. However, some new roads should be put in (Figure 8).

[Figure 8: Map of Recommended Additional Logging Roads]



These additional roads will ensure that all areas of the two timber properties can be accessed with minimum stream crossings.

Lake Property

Objectives for the lake property can be met by turning the area into a pine savanna, though it is also suitable as it is now. This would be the ideal habitat for deer, increasing the hunting potential of the stand. Taking current conditions into consideration, a pine savanna can be established on this site by thinning the basal area down to 60 square feet per acre by thinning from below, and burning the site every four or so years. If the stands was thinned but not burned, deer habitat would still be increased a little. If the stand was burned regularly but not thinned, recreational value would increase as the reduction of briar, ticks, and detritus would make the stand easier to walk through.

The two most limiting factors for white-tailed deer in this area are available food and cover. Tree species in Oklahoma known to be preferred by deer are all present on the lake property, but there are few forbs on the site currently. This could be remedied partially by the prescribed fire and almost certainly by the thin. Cover can be accounted for by thinning, or if thinning is insufficient, by clearcutting small sections to create little clearings for the deer to bed in. Studies in the Pushmataha Wildlife Refuge in southeastern Oklahoma have demonstrated that both thinning and prescribed fire can increase the amount of deer found on the site. More detailed studies have shown that the specific combination of thinning and prescribed fire is very effective at increasing white-tailed deer habitat suitability in this area.

Although it is difficult to determine the value of recreation and aesthetics to the landowner, it would be possible to determine whether or not it would be worth trying to sell the thinned trees from the lake stand based on harvest and transportation costs. There is some benefit associated with leaving the trees on the site, as they provide some nutrients for future rotations, so being unable to generate profit from the thin is not necessarily a bad thing. Though there were a few pine trees in the stand, the only potentially valuable wood would come from the hardwoods.

[Table 4: Hardwood Inventory of Lake Property]

DBH	#trees tallied	BA (ft^2/acre)	F_t (per-acre expansion factor)	trees/acre	F_v (volume per acre per tree tallied)	pounds/acre	tons/acre
4	6	1.875	114.59	21.49	16801.27	3150.24	1.57512
5	5	1.5625	73.34	11.46	20835.77	3255.59	1.627794
6	7	2.1875	50.93	11.14	22147.09	4844.68	2.422338
7	7	2.1875	37.42	8.19	22471.85	4915.72	2.457859
8	7	2.1875	28.65	6.27	22432.7	4907.15	2.453577
9	7	2.1875	22.64	4.95	22256.69	4868.65	2.434325
10	5	1.5625	18.34	2.86	22032.22	3442.53	1.721267
11	4	1.25	15.15	1.89	21796.18	2724.52	1.362261
12	7	2.1875	12.73	2.79	21905.34	4791.79	2.395896
13	8	2.5	10.85	2.71	21994.41	5498.60	2.749301
14	8	2.5	9.35	2.34	22069.91	5517.48	2.758739
15	8	2.5	8.15	2.04	22135.77	5533.94	2.766971
16	9	2.8125	7.16	2.01	22194.47	6242.19	3.121097
17	6	1.875	6.34	1.19	22247.66	4171.44	2.085719
18	11	3.4375	5.66	1.95	22296.49	7664.42	3.832209
19	12	3.75	5.08	1.90	22341.74	8378.15	4.189077
20	7	2.1875	4.58	1.00	22384.02	4896.50	2.448252
21	9	2.8125	4.16	1.17	22423.77	6306.68	3.153342
22	15	4.6875	3.79	1.78	22461.32	10528.75	5.264373
23	10	3.125	3.47	1.08	22496.96	7030.30	3.51515
24	10	3.125	3.18	0.99	22530.9	7040.91	3.520453
25	16	5	2.93	1.47	22563.32	11281.66	5.640831
26	9	2.8125	2.71	0.76	22594.38	6354.67	3.177334
27	11	3.4375	2.52	0.86	22624.18	7777.06	3.888531
28	6	1.875	2.34	0.44	22652.85	4247.41	2.123705
29	6	1.875	2.18	0.41	22680.48	4252.59	2.126295
30	2	0.625	2.04	0.13	22707.15	1419.20	0.709598
31	2	0.625	1.91	0.12	22732.92	1420.81	0.710404
32	5	1.5625	1.79	0.28	22757.87	3555.92	1.777958
33	0	0	1.68	0.00	22782.04	0.00	0
34	3	0.9375	1.59	0.15	22805.49	2138.01	1.069007
35	2	0.625	1.50	0.09	22828.25	1426.77	0.713383
36	0	0	1.41	0.00	22850.38	0.00	0
37	0	0	1.34	0.00	22871.91	0.00	0
38	0	0	1.27	0.00	22892.87	0.00	0
39	0	0	1.21	0.00	22913.3	0.00	0
40	2	0.625	1.15	0.07	22933.21	1433.33	0.716663
41	0	0	1.09	0.00	22952.64	0.00	0
42	1	0.3125	1.04	0.03	22971.61	717.86	0.358931
43	0	0	0.99	0.00	22990.14	0.00	0
44	0	0	0.95	0.00	23008.26	0.00	0
45	1	0.3125	0.91	0.03	23025.98	719.56	0.359781
Σ		73.125		96.05		162455.09	81.23

Thinning from below until stand Basal area is 60 square feet per acre could be accomplished by removing all trees with diameters of ten inches or less (Table 4). This thin would generate approximately 15 tons per acre (Table 5).

[Table 5: Thinned Trees in Lake Property]

DBH	#trees tallied	BA (ft^2/acre)	F_t (per-acre expansion factor)	trees/acre	F_v (volume per acre per tree tallied)	pounds/acre	tons/acre
4	6	60	114.59	21.49	16801.27	3150.24	1.57512
5	5	50	73.34	11.46	20835.77	3255.59	1.627794
6	7	70	50.93	11.14	22147.09	4844.68	2.422338
7	7	70	37.42	8.19	22471.85	4915.72	2.457859
8	7	70	28.65	6.27	22432.7	4907.15	2.453577
9	7	70	22.64	4.95	22256.69	4868.65	2.434325
10	5	50	18.34	2.86	22032.22	3442.53	1.721267
Σ		13.75		66.36		29384.56	14.69

As the trees are all small diameter, this thin would be sold as all hardwood pulp, which would go for approximately $18 per ton as sold as stumpage. The trucks to be used can carry approximately 25 tons, so this thin would require a total of 118 separate trips to the sawmill. Revenue produced by the lake property stand would be $264.42 per acre, and $52,884 in total. This would likely be sufficient to pay for the taxes and administrative costs on the land, so it would be worth it to attempt to sell the thinned timber rather than paying to have it cut down and left on the site.

These estimates do not take into account the numerous cost share programs that would apply to converting the stand into a different type of ecosystem for habitat improvement. Such programs would almost certainly pay for a great deal of this activity. Though the costs of prescribed fire should be included in the overall cost of conversion to pine savanna, these costs are also likely to be reduced through various cost-share programs as well. Applicable programs include the Wildlife Habitat Improvement Program (WHIP) and the Forest Stewardship Program. WHIP is available to any landowner in Oklahoma, though it does require a ten year contract with

the Wildlife Department. This program will pay for 75% of an approved wildlife habitat improvement project up to $5,000. Activities this program covers are somewhat limited, so it may not be possible to cover the initial thin with this program. Forest Stewardship will pay upwards towards $10,000 per year for the pursuit of a stewardship plan. Landowners must own less than 1000 acres and present such a plan in order to qualify. The landowner's plan may be sufficient for this.

The lake stand already largely meets its objectives. These objectives can be further met by transforming the area into a pine savanna, but this is not necessary. However, whether or not the landowner decides to leave this stand as it is or change it, there are some additional complications to consider. As this stand will primarily be managed through prescribed fire, and it is a fairly large tract, it might be worth considering carbon credit. In southeastern Oklahoma this is done through use of aggregators. Some carbon sequestration trading has occurred in southeastern Oklahoma. Though this site is unlikely to be heavily disturbed other than by the initial thinning, best management practices should be considered before thinning. The location of roads for the initial thinning is an important consideration, but maintenance of these roads is not so important as they will likely only be used once. Roads are of particular concern on this site as there are many ephemeral streams feeding into the lake. Proper drainage of the roads as well as minimizing the number of stream crossings are the major concerns on this site. The recommended location of logging roads is shown in figure 2, above. Stream-side management zones are the other major concern on this stand. Buffers should be placed around both the various streams as well as the lake itself so that thinning activity does not cause a large amount of sediment to get into the water. In southeastern Oklahoma there are a number of species that may be attracted to the oak/pine savanna that would be the management objective of this plan. . Some of these species are endangered, so their presence on the site would severely restrict how it could be managed. This would make management for the landowners current objectives impractical.

However, drawing endangered species to the site is unlikely, and the site largely meets the landowner's objectives as it is currently.

Other Concerns

One of the most noticeable problems in the southern timber stand was the poor condition of a section of road (Figure 9). The culvert that was supposed to channel water under the road had failed, so the stream flowed quickly across the gravel road. A very large quantity of both sediment and gravel had been washed away. On many of the other roads culverts had been poorly installed, such that they stuck up above the level of the road so that the weight of passing vehicles was put directly onto the surface of the hollow culvert. Should these culverts collapse, something similar to the failed culvert in the southern stand would occur.

[Figure 9: Failed Culvert and Erosion]

This problem can be solved by the reinstallation of many of the culverts, and in many cases the installation of a larger diameter culvert than was used before. Another general concern for all stands is that herbicide application may be difficult with the large quantity of moving water on all three stands. Around the lake and various streams there should be a buffer for herbicide application as well.

Summary

The foremost thing that this plan has to offer is harvesting information for the two timber stands. All other items in timber management have already been addressed, it is close to time to harvest the timber, and this is one of the landowner's major objectives. This plan also provides an option other than leaving it as is for how recreation and aesthetics objectives for the lake property might better be met. The plan also points out the problems with the roads and culverts both in and around the separate stands. Despite the damaged timber in the larger southern timber stand and the poor prices for pine sawtimber for the time being, the landowner is likely to realize some returns from the two timber stands.

CHAPTER V

SUMMARY OF SURVEY DATA

The survey was designed to cover all areas pertinent to the construction of a profile of private landowners in southeastern Oklahoma with emphasis on the management practices and preferences of these private landowners. Survey results are divided by the same divisions within the survey, which are description of forestland ownership, forest resource management, forest economics, private timber processing operation, and wildlife, recreation, and ecosystem valuation. From this data it is possible to examine in some detail the forest dynamics, biodiversity, and sustainability of privately owned forested land in southeastern Oklahoma. The data can also be used to develop a profile of private landowners in the area, covering both the forestry practices they administer as well as their preferences and opinions regarding forestry issues. Data from this survey is grouped into five sections. Aggregate data can be found in the appendix.

Description of Forestland Ownership

The fact that the average year of property acquisition was 1975 and the most recent property acquisition was in 2004 indicates that these landowners are more likely to be middle to late aged. The long length of time that these landowners have held the property also means that they are likely familiar with the fine details of their forestry operation, and the issues associated with it. Roughly one third of respondents live on their property and own a single parcel of land.

Many respondents live out of state, and the average number of parcels owned was 7, with the maximum number of parcels owned being 75. This illustrates the great diversity of these private landowners, and would indicate that they might have very different opinions and practices. The fairly small range of acres of forested land per parcel does not so much show similarity between groups holding one rather than several parcels as it does that land in the area is fragmented in a similar way. This is likely due to how the land was surveyed and sold originally. Only one third of the respondents have completely forested stands, but the unforested acreage represents a much smaller proportion of their holdings than forested land, so while there is some room for grazing cattle, the focus of most of these landowners would be timber. Most of the holdings receive some number of annual visitors, so these properties are used for recreation as well as for investment purposes.

Virtually all respondents bought or inherited their property, own it individually, and will pass it on to their children or grandchildren. The only deviation from this pattern is a property occasionally being maintained as a trust. One third of the landowners recreate upon the property daily, but two thirds recreate on less than 25% of it. This may indicate that recreation tends to be focused on a single area like a cabin by the lake. Landowners indicated that they maintain their land for personal and economic reasons primarily, and then recreational reasons secondarily. The most prominent economic reason was profit from timber harvesting, while the most important personal reasons were ownership tradition and ties to the land. The most important recreational reasons were viewing scenery and hunting. This illustrates that most landowners emphasize timber production over alternatives, but still enjoy the possession of the land and the associated recreational opportunities.

Forest Resource Management

Few landowners manage their land for the production of anything other than timber. Those landowners that do so report managing for hay, pecans, beef cattle, river gravel, and firewood, which can all be managed without affecting timber management in any way. These products also do not require a great deal of preparation. This seems to support the idea that these landowners are very focused on timber production. One third of landowners do not have a timber plan, and the ones that do have a plan that is 16 years old on average. Though this is more likely to indicate that landowners just haven't taken the time to develop or revise a plan, it could also indicate that landowners are so familiar with their stand that they can adapt to small changes without a frequently updated plan. Over 90% of respondents do not have a wildlife plan. Wildlife could be a consideration in the timber plan, or it could simply be that private landowners focused on timber production do not regard wildlife as an important aspect of their stand. Over 80% of respondents have consulted with professionals in the past, and only a few were charged. This seems to show that landowners have a more informal or less intensive relationship with these professional consultants. Fewer landowners will seek professional help in updating their timber or wildlife plans in the future than have contacted professionals in the past. Given that they express satisfaction with the consulting services they received, this would indicate that landowners feel as though they have learned enough from consulting to manage their land without a plan formulated by a professional. No respondent was under contract to produce timber. Of those with a timber plan, 40% used forest practices that were not part of the timber plan. Though landowners have a timber plan, their preferences can cause them to act independently of it. There is no particular pattern in the distribution of forest type in respondents. Respondents indicate that a variety of people influence their management decisions, but that the final decision is the landowner's. This supports the idea that private landowners tend to both consult and act independently. Those who had timber or wildlife plans had their plans prepared by the Oklahoma Department of

Agriculture, Food, and Forestry, though the landowners did have input into those plans. Internet access was not reported to be a problem, but only half of the respondents have looked up forestry information online. This could be due to trusting other sources of information more. In the section regarding opinions of forest practices, the chi square indicates that the rankings were very varied. The only two proposed opinions that received consistently strong ratings were agreeing that it is possible to manage for both wildlife and timber without reducing overall income and that forest resources must be managed to ensure that they will be available for future generations. This echoes other responses in which landowners expressed their interest in and concern with sustainability. Respondents report being mostly satisfied with the quality of all consulting services they dealt with. Information sought while consulting has mostly to do with timber production, reinforcing their emphasis on timber, and the only sources of information considered to be trustworthy were brochures and workshops, reinforcing their reliance on certain sources of information. Every respondent had heard of almost every cost share program, though only a small proportion of them participated in these programs. In commenting on what information they would like to have, most landowners requested either information on where to get more information, such as workshop times and locations, or information on specific issues, like oil and gas drilling. Few of these requests were for general information, illustrating how well informed these landowners are. When participating in cost share programs, the programs tended to either pay for red-cedar control or site preparation, planting, and the other practices that lead into reforestation.

Forest Economics

Average property value is $500,000 and average annual taxes are $1,300. Most of the landowners have harvested in the past, but only half of them have done so after 2006. Acres harvested and cost and returns from the harvest are all highly variable within the group of respondents. Landowners have overseen an average of four timber harvests on their property, and

estimate that the property was harvested approximately four times before they inherited it. Approximately 95% of landowners do not harvest by rotating between a series of even aged plots, such that the whole stand can be harvested at a regular interval. Those that do either harvest or thin an individual plot every of 15 years on average, and have plot sizes that average 115 acres. Though this low number of landowners who harvest in rotation seems to contradict their emphasis on timber production, it would be inconvenient to convert parcels of land that size into many separate rotation plots, particularly when the stand is likely to be clearcut when it is the right age, so not harvesting in rotation is not an uninformed decision. The vast majority of landowners sold stumpage, and only two respondents reported an approximate transportation cost for taking timber to the mill. Only one third of landowners had a timber plan in place directly after the harvest, though most of them did plan on reforesting. Trees were mostly individually marked for harvest, with the loggers being responsible for marking trees one third of the time. Some landowners had communication with the sawmill, but most let the logging contractors handle all the harvest details. Most respondents reported being satisfied with the condition of their land after harvest, and will harvest again in the future. Over 70% of landowners reforested after harvest. Reforestation was performed mostly by leaving seed trees or planting seedlings. Half of the respondents were motivated to reforest of their own volition rather than having it suggested to them by someone else. Though sustainability is put in jeopardy to some extent by allowing loggers to handle all the harvest details, landowner interest in sustainability is evidenced by their motivation to reforest. Surprisingly few landowners leased their land for any purpose. Most of the timber sold was sold as sawlogs, which was also the most profitable product type, but some timber was sold as other product types. The two highest average ranking opinions regarding why timber was harvested were that the timber was mature, or it was harvested as a thinning to improve growth. That these opinions were chosen over the alternatives further supports landowner interest in timber production to the exclusion of other things. Landowners unanimously agreed that the major reason to reforest is to keep the land in timber production,

which is also the most sustainable option put forth. The landowners that did not reforest after harvest ranked that the forest will naturally regrow to its condition prior to harvest as being a more important factor than that the cost was too high, showing that even landowners that did not reforest have some interest in sustainability. Those few landowners that have not harvested had varied opinions of why they made this decision, but these opinions tend to indicate a general distaste for the idea of harvesting rather than some specific external cause. Comments regarding what could motivate landowners to reforest their land echoed that natural regeneration was sufficient, but that they could be motivated to take more direct action if money was no longer a problem.

Private Timber Processing Operation

There was only one respondent who reported having a private timber processing operation. This landowner reported employing four people with an average salary of $30,000, and made a $10,000 profit annually from running the mill. This operation principally deals with mill demand for resaw, sells to local locations, and sells equally to other individuals and other mills. The mill equipment includes a White 60" Civel circular saw, two bandsaws, and a woodchiper, while other equipment includes a harvester, loaders, trucks, limbers, and skidders. This landowner comments, “We do our own operation from forest management, harvest, and product production.” Provided all this information, it is more likely that this individual works as a logging contractor of some sort and happens to own land. As opposed to, a private landowner who started up a personal sawmill for their own private use rather than deal with contractors and a large sawmill. However, other landowners comment in this section that they have heard of or dealt with such operations in the past.

Those that sell hunting or fishing leases sell them for an average of $4 per acre. Respondents comment that they believe forest activity increased the stand's amenability to wildfire. Half the respondents regard climate change as important, but only 20% believe that their property could affect it. One third of landowners never received carbon credit information from the state. One third of landowners would be willing to manage for carbon in the future, and think it could be worth the money. When asked if they would be willing to manage for carbon if it could be demonstrated that they could make money doing so, roughly half of the respondents said that they would not manage for carbon. More than half of landowners do not recall professional consultants mentioning carbon management during their consultation, or how much carbon is or could be sequestered by the property. Roughly one third will ask consultants about potentially managing for carbon in the future. If data from this series of questions were to be regressed there would be major multicollinearity problems as respondents tended to be either uniformly negative or uniformly positive in their responses. In order to analyze the responses to some of these questions it would be best to divide the data into two different sets beforehand. Once grouped by generally favorable responses versus generally reluctant responses, the data would be better suited to describing whether or not a landowner will inquire about carbon management when next consulting. When asked if they would prefer to deal with the Chicago Climate Exchange or the Oklahoma Conservation Commission for carbon credits, landowners indicated that they preferred the local alternative. Respondents report that of the reasons hunters purchase leases enjoying the activity is the most important and getting meat is the least important. The principal quarry that hunters pursue is deer. Landowners state that they have problems with eastern red-cedar, and comment that they are attempting to control it. The ways in which they describe their control of eastern red-cedar are all the advisable ways of doing so. Closing comments on the survey were all

concerning the carbon credit section, and all stated that the landowners regarded carbon credits as an untrustworthy prospect and so would not participate in it.

CHAPTER VI

FINDINGS

In order to further develop this profile, four research questions will be addressed and a net present value calculation and travel cost model will be generated. These questions will be explored principally through inference from multivariate binomial regression. Models and variables used to examine these questions will be based on theory, and so will not require model comparison as per the model selection process or examination of variable combinations as per the variable selection process. Due to the sample size and number of null responses, exploration along the lines of forward elimination is the most productive method of examining interaction among the variables. Additionally, survey data will be compared and contrasted to other surveys from literature and the case studies described in Chapter III in order to assess its significance, potential bias, and how well it represents private owners of forested land in southeastern Oklahoma.

Significance of Sample

Though this data could be useful in many circumstances, the quantity and quality of data from the literature regarding private forest landowners raises the question of whether or not landowners in southeastern Oklahoma are significantly different in their behavior than landowners elsewhere. Now that the data has been fully collected the significance of the sample can be addressed. There have been many studies of private forest management over the years, as

great deal of the forested land in the continental United States is privately owned. However, there have been comparatively few studies of private forestry in Oklahoma, as Oklahoma does not differentiate between forested and non-forested land in its record keeping. It would be reasonable to assume that private landowners in Oklahoma are similar to private landowners in other states, but comparison of survey data to data from literature indicates that Oklahoma landowners are significantly different from others in a few ways.

Although there are many factors associated with location that could affect the nature of private landowners such that they are significantly different from others, it is sufficient for these purposes to determine only that they are significantly different. One study in Oregon found that approximately 55% of the survey respondents indicated that their families influenced their management decisions, and when a professional was involved they charged for their services 36% of the time (Elwood et al., 2003). Whether or not these two effects are related, there is a significant difference in the findings of the Oregon study and this study, which found family members to be involved in the management process 19% of the time, and consultants only charging 25% of the time. This could be indicative either of different demographics of landowners and consultants, or it could indicate that there are different dynamics associated with private forest management in Oregon and Oklahoma. The Oregon study also found that those private landowners with forest plans used them to determine which forest practices to use at least annually, and often more frequently. This 100% use contrasts sharply with the 27% use of forest plans after harvest found by this study. This could be a matter of landowner perception of how useful a forest plan is, or it could indicate that landowners in southeastern Oklahoma rely on their plans more leading up to harvest than after it. A study in Wisconsin comparing private landowners who participate in forestland owner organizations to those who do not found that approximately 30% non-participants have harvested in the past and 40% of participants harvested in the past (Rickenbach et al., 2006). However, this study found that 87% of respondents in

southeast Oklahoma have harvested in the past. Though this is a single figure, it represents a remarkable difference in the type of management practiced in Wisconsin as compared to southeastern Oklahoma. Due to the Wisconsin study's inclusion of different types of private landowners, that sample is not likely to have reduced timber harvesting values because of a focus on a specific group. Another study in Utah divided their sample into groups based on management objectives, and found that all groups relied primarily on friends and family as a source of forestry information and very few have harvested in the past (Salmon et al., 2006). Over 80% of respondents from southeastern Oklahoma have contacted a forester in the past, in addition to the full spectrum of sources of forestry information between, from timber industry personnel to a local agriculture teacher. This could be indicative of a communication problem in that area of Utah. Although landowner behavior is superficially similar regardless of area, there are several significant differences between private landowners in southeastern Oklahoma and elsewhere, and several of these differences have far reaching effects. More importantly, there is not an obvious pattern to these differences so it would be extremely difficult to account for them if landowner properties were to be generalized across areas.

Though private landowners in southeastern Oklahoma have somewhat different qualities than those in other areas, this could be due to the large distance between the two areas. Oklahoma landowners may be so similar to private landowners in the same geographic area that the two groups could be generalized. However, this does not appear to be the case either. In a survey of private landowners in Arkansas, one study found that between 50 and 60% of landowners lived on their forestland (Walkingstick et al., 1997). Only one third of respondents from southeastern Oklahoma reported living on their forestland. The Arkansas study also showed that their results vary a great deal from county to county, and indicated that this might be due to differing types of environment, such as coastal and delta. A survey of private landowners from Arkansas, Louisiana, Mississippi, and Tennessee found that while some attributes were very similar

between states, others were not (Measells et al., 2005). In general, the attributes similar across states were similar to the results of this study, such as demographics, and those results that were diverse differed from this study. This suggests that even if the landowners themselves are similar, there are other factors influencing their management that differ from state to state.

In the absence of site specific data, it would be reasonable to try to infer the nature of private landowners in southeastern Oklahoma from the literature by assuming that they are similar to private landowners elsewhere. However, there are significant differences in private landowners' management practices and preferences in different areas, and there are so many variables controlling these differences it would be impossible to effectively separate them out. Through comparison of this sample to samples taken in other areas, it is possible to identify that despite the difficulties in collecting information about forestland in Oklahoma, this sample is more suitable to the purposes of this study than the alternative of inference from literature.

Potential Bias

Due to the way in which the survey mailing list was compiled, it is possible that some bias exists in the sample. However, whether or not this bias is significant enough to distort the results can be examined through comparison to other, similar studies. As previous studies of southeastern Oklahoma were conducted under the same limitation, they could be similarly affected. However, examining some of these studies can be illuminating. Of particular interest is the study conducted by Bovée and Holley in 2003. Their study used very similar methods to this one, and was focused principally on the potential factors contributing to a private landowner developing a forest plan. Roughly 9% of respondents to their survey reported possession of a long-term timber plan, while 61.29% of respondents to this survey reported possession of a timber plan. However, this survey was focused on landowners holding between 50 and 5,000 acres of land, while the Bovée and Holley study examined landowners of all property sizes. They

did find that there was a correlation between property size and forest planning, and that "almost 60 percent of planners have more than 200 acres while about 55 percent of non-planners have less than 100 acres." The characteristics of the respondents reported by Bovee and Holley (2003) are similar to the findings of this study, but due to the correlation between planning and property size it is difficult to determine if these are the characteristics of forest stewards or the characteristics of private landowners owning more than 50 acres of forested land. Although comparison to this study supports the possibility of bias in this sample, it does not provide sufficient information to determine this with some accuracy. This issue is further illuminated by an older study by Thomson and Jones in 1981. Their study was focused on the properties of landowners managing different sizes of land, and makes a convincing case that likelihood of managing for timber increases with property size. Though managing for timber and forest planning are somewhat correlated, one does not necessitate the other. This increase in managing for timber could indicate that difference in planning is a function of property size rather than participation in forest stewardship, but it is difficult to determine which is the case. If property size does have an effect on likelihood of forest planning, then it is likely that the potential bias related forest stewardship is relatively minor.

In addition to these studies in southeastern Oklahoma, there have been several similar studies in other states that describe the differences in management practices and preferences between landowners who are involved in a forest stewardship program and those who are not. Through examination of these differences and comparison to survey data it might be possible to identify the variables most affected by this potential bias. The study that most illuminates this issue is English et al., 1997, which attempts to assess which landowner qualities impact the likelihood of their participation in a forest stewardship program. They found that of all demographic qualities, having sought information in the past is easily the most significant variable. The t-ratios presented in this paper also indicate that it is nearly the only significant

variable, which implies that forest stewardship has little correlation with other demographic information. Survey data seems to support this, as comparison to other surveys shows there to be a large number of respondents who have consulted in the past while other forestland ownership properties are generally similar. A qualitative study of private landowners in Wisconsin attempted to link management style with personal character (Bliss and Martin, 1989). They concluded that "external incentives appear primarily to influence the timing and extent of management activities." Though participation in forest stewardship is likely tied to character, this would indicate that forest stewards might not be extremely different in nature, so much as in degree. In the governmental report on the success of forest stewardship across the nation, the primary management changes described were listed as implementation of a new activities, increases in seeking information, and increases in interest in consulting (Esseks and Moulton, 2000). As most of these new activities relate to multi-purpose forestry, many sections of the survey would not be so affected by this potential bias.

It is likely that some bias exists due to the nature of data collection. However, within the size constraints of the sample, it is likely that this bias is fairly minor. Description of forestland ownership is very unlikely to be affected by this bias, while responses related to information seeking and wildlife, recreation, and ecosystem valuation are likely to be the most affected by this bias. With these considerations it would still be possible to apply some of this study's findings to the larger category of private landowners in southeastern Oklahoma who own more than 50 acres of land, and may or may not participate in forest stewardship.

Survey Analysis

Through examination of the significance and potential bias of the sample, what the survey data respectively can and can not explain has been addressed. Taking these limitations into

consideration, the profile can be expanded through the analyses of net present value, travel cost modeling, and the four research questions.

- Are there significant sub-categories within private landowners from southeastern Oklahoma?
- Does consulting have an observable effect on how private landowners manage their stands?
- Are these private management practices sustainable?
- Does willingness to manage for carbon sequestration reflect other management practices or preferences?

Net Present Value

Using the average costs of all forest practices it is possible to estimate the net present value and bare land value of these privately owned forested stands (Mckinley and Zhang, 2011). This net present value calculation was performed for the potential discount rate of 2%.

[Table 6: Net Present Value]

Practice	Average costs per acre ($)	Year into rotation	Present Value ($) Discount rate = 2.00%
Annual taxes	-9.45	Annual	-18.90
Site preparation	-66.44	0	-66.44
Tree planting	-581.71	0	-581.71
Herbicides	-255.75	0	-255.75
Prescribed burning	-430.69	10	-353.31
Pre-Commercial Thinning	-461.67	10	-378.73
Fertilizing	-383.33	10	-314.47
Forest insect or disease control and/or salvage	-1033.33	25	-629.85
Pruning	-1100.00	25	-670.48
Thinning	130.00	25	79.24
Harvest	1392.21	35	696.14
		NPV	-2494.26
		BLV	-4988.80

Though this calculation shows NPV to be well below zero for this discount rate, this calculation also assumes that every one of these forest practices will be utilized (Table 6). Based on survey data, a landowner is likely to only use half of these practices. This could result in positive NPV if the practices some of these practices are not profitable.

[Table 7: Frequency of Silvicultural Practice Use]

Practice	Average costs per acre ($)	% Used
Annual taxes	-9.45	-
Site preparation	-66.44	25.00%
Tree planting	-581.71	35.71%
Herbicides	-255.75	72.41%
Prescribed burning	-430.69	57.14%
Pre-Commercial Thinning	-461.67	48.28%
Fertilizing	-383.33	70.00%
Forest insect or disease control and/or salvage	-1033.33	54.84%
Pruning	-1100.00	50.00%
Thinning	130.00	35.71%
Harvest	1392.21	-

These frequencies are more similar to the case studies than the assumptions of the NPV calculation (Table 7). The positive NPV of the case studies could be more indicative of the overall NPV in southeastern Oklahoma than what can be derived from the survey. These values could also be lower than what could be reasonably expected in the future, as prices for pine sawtimber are currently lower than historical values, and pine sawtimber is the bulk of local timber sales. Future increases in the price of pine sawtimber would likely have a positive effect on the NPV of privately owned land in southeastern Oklahoma.

Travel Cost Model

Travel Cost models are a form of contingent valuation that essentially assumes that how far someone is willing to travel for an experience is reflective of how much they value it. The travel cost model was based on individual data for how much the hunting leases were sold for and how far the lease purchasers traveled in order to hunt on their leased land (Table 8). Desirable animals that can be found on these properties included whitetail deer, turkey, and wild hogs. Landowners selling hunting leases tended to have large tracts of land, and were mostly situated in LeFlore and Pusmataha counties. The three zones used to calculate distance traveled were within the county, outside the county but within Oklahoma, and outside Oklahoma. These distances were approximated to be 20 miles and 100 miles, respectively, and there were no people coming in from outside the state. Total cost was calculated based on the sum of twice the miles traveled multiplied by the price of gasoline, and number of acres leased multiplied by the price of the lease per acre.

[Table 8: Travel Cost Data]

people from the county	Average	2.75		standard deviation	1.258306
	Minimum	1		90% confidence upper bound	3.784864
	Maximum	4		90% confidence lower bound	1.715136
people from outside the county	Average	4.333333		standard deviation	3.05505
	Minimum	1		90% confidence upper bound	7.234582
	Maximum	7		90% confidence lower bound	1.432084
people from outside the state	Average	0			
	Minimum	0			
	Maximum	0			

people who bought a lease	Average	2.25		standard deviation	2.5
	Minimum	1		90% confidence upper bound	4.306067
	Maximum	6		90% confidence lower bound	0.193933

total acres leased	Average	1208.5		standard deviation	853.4747
	Minimum	239		90% confidence upper bound	1910.42
	Maximum	2300		90% confidence lower bound	506.5796

cost of lease	Average	3		standard deviation	1.825742
	Minimum	1		90% confidence upper bound	4.501539
	Maximum	5		90% confidence lower bound	1.498461

By dividing the total acres leased by the number of people who bought leases and multiplying this by the cost of those leases will yield the base cost element of the model per landowner.

$$BC_j = \frac{Acrese\ Leased_j}{Total\ Leases_j}\left(Cost\ of\ Lease_j\right) \quad (6.1)$$

Assuming that the average vehicle gets 20 miles to gallon as many lease owners are likely to drive pickup trucks, and that a gallon of gasoline is approximately $3.50, dividing the price of gasoline per gallon by miles per gallon multiplied by two to generate a roundtrip figure will yield

a partial travel cost element of the model. Multiplying this partial travel cost by the miles traveled as determined by zone will yield the travel cost element of the model.

$$TC_P = \frac{3.50}{20}(2) \tag{6.2}$$

Adding base cost and travel cost will generate the formula:

$$Y_{ij} = BC_j + \delta_1(20)TC_p + \delta_2(100)TC_p + \varepsilon \tag{6.3}$$

In which:

Y_{ij} = Total value of landowner j's lease to lease owner i

BC_j = Base cost of lease from j^{th} landowner

TC_P = Travel cost for a single mile

δ_1 = Indicator variable for i^{th} lease owner from zone 1

δ_2 = Indicator variable for i^{th} lease owner from zone 2

Weighting the travel cost by the number of people traveling from that zone will then yield an approximate economic value of hunting on privately owned forested land in southeastern Oklahoma.

[Table 9: Travel Cost Model]

	Base cost	Travel Cost Zone 1	Travel Cost Zone 2		Total cost
Mean	2951.79	4.81	28.44		2985.04
Minimum	478	1.75	0		492
Maximum	9200	7	61.25		9201.75
Standard Deviation	4179.06	2.20	28.91		4159.22

This indicates that the base cost of purchasing the lease is greater than the cost of traveling there (Table 9). This effect is due to the comparatively large price of a hunting lease,

and how comparatively local the market is. However, though those lease owners willing to pay such a large base cost for a hunting lease would surely be willing to pay a reasonably high travel cost, there are no lease owners from out of state. This local effect could be because private landowners do not have the means to appeal to a larger crowd, or it could simply be that lease owners prefer more local locations.

Sub-categories

Within each of the various potential sub-categories there is a relationship to other elements of the landowners and their management. These relationships will be approximated with binomial regression, using a logit link function. As binomial regression applies to the dependent variable, the independent variables do not necessarily have to be one or zero. In cases where the dependent variable is not binomial, ordinary linear regression will be used. For the purposes of this study, both types of models are interpreted the same way, which is the estimate and variance of the individual variables (Table 10).

[Table 10: Regression Variables]

Variable Type	Variable Name	Description
Binomial	Home Status	Living on property = 0, living elsewhere =1
	Acquisition	Purchased = 0, inheritance = 1
	Forested Proportion	100% forested = 0, less than 100% forested = 1
	Parcels	Many parcels = 0, single parcel = 1
	Planting	Did not plant seedlings = 0, planting = 1
	Timber Planning	No timber plan = 0, possesses timber plan = 1
	Carbon Interest	No interest in carbon = 0, interest in carbon = 1
	State Status	Lives in Oklahoma = 0, out of state = 1
Continuous	Property Size	Size of property in acres
	Property Value	Value of property in dollars
	Harvest Frequency	Number of times landowner has harvested
	Harvest Revenue	Value of most recent harvest
	Sustainability Rating	0 – 5 scale of self-ranked sustainability
	Program Participation	Sum of cost-share programs participated in
	Management Intensity	Sum of silvicultural practices used

The most significant and potentially useful of these sub-categories is whether or not the landowner lives on their property (Table 11). The least significant categories are whether the landowner owned one parcel or many, whether it was completely forested or not, and whether live they lived in Oklahoma or not. None of the potential sub-categories showed trends in reforestation or interest in carbon sequestration.

[Table 11: Sub-category Estimation]

Dependent Variables	Independent Variables	Estimate	Standard Error	Z-value	P(>|Z|)
Home status	Forested proportion	-2.621	1.147	-2.285	0.0223
	Parcels	1.6094	0.9068	1.775	0.0759
	Property Size	-0.0011022	0.0006363	-1.732	0.0833
	Management intensity	-0.2805	0.1577	-1.779	0.0753
Acquisition	Forested proportion	2.197	1.145	1.919	0.0550
	Harvest revenue	0.011172	0.006563	1.702	0.0887
Forested Proportion	State status	-2.8904	1.2065	-2.396	0.0166
Property value	Property size	409.2	205.2	1.994	0.0625
	Harvest revenue	53441	25253	2.116	0.0527
	Management intensity	71427	39700	1.799	0.0888

Property that is completely forested is very tightly negatively correlated with living out of state. It is also correlated with living on the property itself. As there is naturally correlation between living in state and living on the property, it is difficult to say which is the better indicator of completely forested land. However, the relationship between where the landowner lives and maintaining rangeland in addition to forested land helps define the nature of the private landowners living in southeastern Oklahoma. Living on the property and owning a single parcel of land are correlated as well. Living on the property is also associated with having a smaller amount of property and managing less intensely. These four properties are what could be reasonably expected of the home status sub-category. Acquiring the property through inheritance is not well associated with living on or off the property, but it is associated with having non-

forested tracts. This could be an artifact of historical management. Inherited properties also tended to produce slightly higher per acre harvest revenue, without higher property value. This could show that acquisition to inheritance is indicative of a landowner caring more for the land, and consequently manages more effectively. Or it could indicate that all the good land was bought up first and is now being inherited, while lower quality sites are all that is left for contemporary landowners to purchase. Property total value and property size are unsurprisingly well correlated. However, per acre harvest revenue is also well correlated with total property value, which could indicate that potential timber value is a consideration in valuation of the property itself. This could also be due to management intensity also being generally higher for properties with higher values, as very intense management is often more profitable.

Consulting

Between the variables of having consulted with a professional at some point in the past and having a timber plan, timber planning seems to be a better indicator of improved management (Table 12). However, consulting is positively correlated with and generally conducive to timber planning, so much of these effects could still be due to consultation rather than planning.

[Table 12: Consulting Estimation]

Dependent Variables	Independent Variables	Estimate	Standard Error	Z-value	P(>|Z|)
Consulting	Harvest revenue	0.0002842	0.0035583	0.080	0.936
	Planting	-0.4055	1.2162	-0.333	0.7388
	Timber Plan	2.7081	1.1925	2.271	0.0232
	Program participation	0.3465	0.4959	0.699	0.4847
Timber Plan	Harvest revenue	0.0008923	0.0023532	0.379	0.705
	Planting	0.2513	0.8997	0.279	0.780
	Program participation	1.7930	1.1013	1.628	0.104

A positive relationship between consulting and harvest revenue would have been a useful tool in convincing landowners to consult more. However, data indicates that this is a small effect if it exists at all, which is very unlikely. It is unusual that consulting would not be significantly

related to planting, which is an indicator of reforestation which a consultant would advise, but planting is not necessarily the most efficient means of regeneration. Forestry consultants would examine whether or not natural regeneration is a viable alternative, so it might be that consultants are just as likely to recommend planting as not. Consulting doesn't have a significant influence on program participation either. This could indicate a weakness in consultants' approach, if they are not fully exploring cost-share opportunities with the landowners. Though having consulted in the past does not superficially seem to have a positive influence, it is well correlated with establishing a timber plan which does seem to have a positive influence on management. Timber planning is correlated with program participation, and could be responsible for a relatively high increase in it. This could be due to timber planning getting the landowner involved, while consulting involves more passive interaction. Though a consultant would tell them about an opportunity, information that is only heard would likely get less consideration than information that is worked into a long-term plan. It could also be that consultants who assist in timber planning are more likely to provide information on cost-share programs. State foresters are likely to recommend both, while other consultants, like a local ag teacher, are less likely to recommend either. Though respondents who indicate that they have consulted in the past and have a timber plan seem to have better management practices than those who only have consulted or planned, or neither, these four groups are too small to infer anything significant.

Sustainability

Only a single model was evaluated for sustainability, with the dependent variable of sustainability ranking. Of the variables tested, only reforestation through planting after harvest significantly explained the landowners' perceptions of the sustainability of their practices (Table 13).

[Table 13: Sustainability Estimation]

Independent Variables	Estimate	Standard Error	Z-value	P(>|Z|)
Planting	-0.5556	0.2921	-1.902	0.0703
Timber Plan	-0.1529	0.2927	-0.523	0.606
Invasive species	0.1447	0.1497	0.966	0.34288

Though planting is correlated to perception of sustainability, it is a negative relationship. This could indicate that landowners who plant are more aware of sustainability, and that being aware of sustainability makes landowners rate themselves as being less sustainable. This could be due to awareness leading to identification of problems in their own management, so they may think that their practices are less sustainable than landowners who do not report such problems due to unawareness. This effect could also extend to reasons for planting. If planting is preferable because natural regeneration is not sufficient, the landowner may perceive planting as being necessary because of problems with the site, even though a planted stand is likely more sustainable as a naturally regenerated one. Although planning for the future is very sustainable, forest planning was not correlated with sustainability ratings. This could be generated by a similar problem. A consultant is likely to point out problems that a landowner might not have noticed, so by planning for sustainable management a landowner could become increasingly more aware of sustainability issues and regard their practices as being less sustainable than they really are. Problems with invasive species are prevalent in southeastern Oklahoma, and they might be regarded by landowners as a sustainability issue. However, the lack of significant relationship between the two indicates that this is not the case. Compared to other surveys as discussed in the potential bias section, the answer to the question of whether or not the management of these private landowners is sustainable is yes. Though the ratings the respondents provided are ordinal data without a consistent starting level that all respondents agree upon, data suggests that private landowners in southeastern Oklahoma are not necessarily good judges of the sustainability of their forestry operations relative to their neighbors.

Carbon Management

Only one model was estimated for carbon management, with the independent variable of willingness to manage for carbon. Few variables could be significantly correlated with willingness to manage for carbon. The most significant were whether or not the property is completely forested, number of times the landowner has harvested the property, and management intensity (Table 14). Willingness to manage for carbon was not correlated with either planting or timber planning. Neither was it well correlated with future interest in managing for carbon. This is likely due to future interest in carbon sequestration being a non-committal matter of receiving more information, while willingness to manage for carbon is a more practical matter.

[Table 14: Carbon management Estimation]

Independent Variables	Estimate	Standard Error	Z-value	P(>|Z|)
Forested proportion	-1.0862	0.8182	-1.328	0.184
Times harvested	0.3178	0.2582	1.231	0.218
Management intensity	0.3238	0.1534	2.110	0.0348
Site preparation	2.1595	0.8861	2.437	0.0148

The negative relationship with forested proportion indicates that landowners with completely forested land are more likely to be willing to manage for carbon sequestration. This could indicate that landowners with some non-forested land are less comfortable with such a forest oriented objective. This could also be related to landowners living on their land or having acquired their land through inheritance, as these things are correlated with forested proportion. Willingness to manage for carbon is also associated with higher numbers of times the property has been harvested. The number of times a stand has been harvested is a function of both rotation age, and how long the landowner has had the property. This relationship could then be due to landowners with longer rotations feeling like they have more to loose by gambling on a new way of doing things. It could also be that landowners who have harvested many times because they have owned property longer feel that they are experienced enough managers to pursue the

objectives of both carbon sequestration and timber. The most significant relationship with willingness to manage for carbon is that of management intensity. However, of all the different components of management intensity, the only well correlated management practice was site preparation. Though it stands to reason that land managers who manage very intensely are more willing to try different objectives, site preparation does not have an obvious association with carbon sequestration. Site preparation is very well correlated to overall management intensity, with a correlation coefficient of 0.804279. This could indicate that site preparation is only so significant because of its association with overall management, but it could also be that management intensity seems significant because of its association with site preparation. Management intensity could lead to willingness to manage for carbon because such managers already utilize most traditional forest practices, so the only ones left to capitalize upon are the new ones. Site preparation could also lead to willingness to manage for carbon because it indicates that a site is bad enough that some problems need to be resolved before seedlings can be planted, so any new source of income would be welcome. It could also be that sites requiring site preparation in order to produce merchantable timber would be more suited to generating biomass instead.

Survey Representation Value

The survey data itself and these further analyses are similar to what could be inferred through examination of the three detailed cases. Descriptions of forestland ownership fit perfectly with the three landowners examined. The differences between the three are not any larger or smaller than the differences between survey responses. Forest resource management does not fit perfectly, but it does fit very well. All three cases prioritized timber, but were also all willing to explore other objectives such as wildlife habitat. The more varied objectives illustrated by the survey match the interests of the cases despite their practices. Forest economics revealed differences in scale not observed in the three cases. However, these larger or more valuable

properties were shown to be managed in more or less the same way as all the others as well as the cases. Wildlife, recreation, and ecosystem valuation provided variable results, but the attitudes that these results are based on are very similar between the survey respondents and the three cases.

Analyses of the survey data is also largely consistent with what could be inferred from the cases. The issue of sub-categories showed that there is likely a difference in attitudes and preferences between those landowners who live on their property and those who do not. This difference could also be detected among the three cases, albeit to a lesser extent. Consulting was not shown to be a very significant influence on the coarse indicators of management quality, which could be due in part to the landowner being already experienced. The cases who did not utilize a great deal of consulting were still competent forest managers with good coarse indicators. The issue of sustainability indicated that landowner assessment of the sustainability of their management was not accurate. This could be a matter of increased awareness leading to an increased number of issues detected. The most sustainable management of the three cases was also the most conscientious of sustainability, and would be likely to provide a similarly flawed self-assessment. Carbon management preferences were shown to be linked to forested proportion, harvest experience, management intensity, and site preparation. Though all three cases had similar forested proportions and harvesting experience, the landowner with the highest management intensity also expressed the most interest in participating in a carbon credit program. These general conclusions as well as the general profile are compatible with, if not partially supported by, the individual and detailed cases of private landowners in southeastern Oklahoma about which much is known.

CHAPTER VII

CONCLUSION

The objective of this study is to provide information that can be used to better customize consulting services, programs, and policies so that they can appeal more effectively to their target audience, better assist in meeting landowner wants and needs, and address the strengths and weaknesses of their private forest management. This objective can be met through the development of a profile of landowners in southeastern Oklahoma. This profile can be further developed through addressing several research questions and constructing a few economic models.

Profile

Survey data indicates that the average private landowner in southeastern Oklahoma has owned their property for several decades. There are many different types of landowners, such as those living on or off of their property or who have completely forested or partially un-forested land. Similarly, there is a wide distribution of recreation habits, with one third recreating on their property daily and some that only recreate on a small portion of the property annually. However, all landowners visit their property at least annually, so their attitudes towards their property are likely more developed than regarding it strictly as an investment. All landowners either inherited their property, or bought it themselves, or both. It is likely that in the case of both means of acquisition, inheritance usually preceded buying. Landowners also tended to hold their land for

more personal or economic reasons than recreation, with personal or emotional ties to the land and income from timber being the most significant reasons, respectively. Few landowners manage for anything other than timber, and these products can be managed for without negatively impacting timber management. Two thirds of private landowners have a timber plan, and one tenth have a wildlife plan. Many expressed interest in wildlife planning in the future. Most have utilized consulting services in the past, were satisfied with the information and will do so again in the future. Most landowners seemed particularly focused on timber management. The vast majority of these landowners have harvested timber in the past, but few do so in rotation. Marking trees was primarily left to the loggers, and nearly all timber was sold as stumpage. However, rates of planting were high. Most landowners did not sell hunting leases, and several were not willing to do so. There is a fairly even divide between those interested and uninterested in carbon sequestration.

Further analysis of survey data indicates that the net present value associated with different landowners is very variable. Generally, less intensely managed private forestland seems to be more profitable than intensely managed private forestland, but regardless of management intensity there is the potential of profitable private forest management. Travel cost modeling shows that the market for hunting leases is comparably local. The high cost could also be indicative of wealthier consumers. Sub-categories do exist within the sample, particularly in forested proportion, but the nature of the relationships is not so clear. Consulting estimations indicate that timber planning dramatically increases the likelihood of consulting, but consulting does not necessarily increase the likelihood of timber planning. Most landowners have sustainable practices, but the more sustainable their management, the more likely they are to regard their management as having sustainability problems. Carbon management estimations show that there is a positive relationship with willingness to manage for carbon and higher forested proportions, number of times timber has been harvested in the past, and management

intensity. Though this seems counter intuitive as these properties are all indicators of emphasis on timber management, this likely indicates that landowners are aware that multiple objectives can be considered in management simultaneously. This generalized profile of private landowner management practices and preferences could be useful in many different applications.

Applications

Information provided by this study would be useful in improving interactions with these landowners primarily in the capacity of a consultant advising them in a way that identifies and improves deficiencies in their long-term forest management, a cost-share of information providing program meant to improve management in a very specific way, or a policy that limits management in a specific way. These groups could use management information in order to identify which aspects of private management should be their focus. These groups could also use information relating to management properties in order to identify how to best appeal to certain groups of landowners, or which groups of landowners are most often associated with the management styles that are the focus.

These groups could use the separate elements of the profile in a few specific ways. Information regarding forestland ownership could be useful for targeting purposes. Though some patterns are difficult to isolate, there tend to be a few distinct types of landowner and land. How they came to possess land and why they continue to hold it likely informs many of their management decisions, and so is important information for identifying management types. Forest resource management information is useful for identifying the strengths and weaknesses of current consulting services. Though most landowners focused on timber, there was a great deal of interest in wildlife, so this might be a subject to cover in future consultations. The high percentage of landowners who have and are willing to consult indicates few problems with recruitment. Forest economics data indicates that a large number of landowners reforested under

their own admonition, so sustainability is something landowners are likely to be concerned with already. However, that so many of them sold stumpage and did not pay attention to which trees the loggers marked could be problematic if the logging contractor was dishonest. Future consulting should likely mention this possibility. No evidence of private timber processing was found, but some respondents provided anecdotal evidence of such operations existing in the area. Infrequency of selling hunting leases indicates that perhaps future consultations should provide information in this area. The number of landowners willing to manage for carbon sequestration shows that there is at least some market for buying and selling carbon credits in southeastern Oklahoma.

There are several other aspects of the profile that influence how it could be applied. The significance of the sample shows that there is some value in extracting information from southeastern Oklahoma itself, rather than examining information about other private landowners elsewhere. The sample is certainly useful for interacting with forest stewards in southeastern Oklahoma, but the potential bias of including so many forest stewards in the survey indicates that the consulting, sustainability, and carbon aspects of the profile may be more positive than what could be found in the general population of forest landowners. The net present value calculation shows that there may be some profit to be had from private timber management. However, many practices should be used with discretion. Travel cost modeling shows that leasing land for hunting could be worth doing for many landowners. Sub-category estimations indicate that future interactions with private landowners in this area could benefit from dividing subjects into different groups and considering them separately. Consulting estimations show that timber planning might be a better indicator of management style than whether or not a landowner has used consulting services in the past. It also seems that timber planning is more indicative of a landowner's willingness to learn than having used consulting services in the past. This relationship also shows that there is still some room for improvement with regards to consultants

recommending developing a forest plan. Sustainability estimations show that private landowners in this area do not assess their own sustainability very well, so self-ratings should not be relied upon for sustainability assessment. Carbon management estimations shows that emphasis on timber does not decrease the likelihood of willingness to manage for carbon sequestration, as would be expected. This relationship even seems to be positive, which could be indicative of a different attitude of forest management in which maximizing value is a higher priority than other views. All of this information appears similar to what can be inferred from case studies, so it is unlikely that collecting data through survey significantly distorts or fails to capture significant data.

Application Limits

Although this profile is more descriptive of forest stewards in southeastern Oklahoma, applying the conclusions to private landowners with more than 50 acres might not be accurate in some areas. In particular, information regarding consulting and other forms of information seeking as well as considering multiple-use forestry and interest in other sorts of management might not be reflective of reality. However, the bulk of the information presented by this study should not be very significantly affected by this potential bias. Naturally, this information is also ideally limited to the survey area, which is limited to Atoka, Chocaw, Johnson, Latimer, LeFlore, McClain, McCurtain, Pittsburg, and Pushmataha counties. Some information could be generalized for other purposes, but this information is the most relevant to southeastern Oklahoma.

Further Research

The question of whether or not a subject should be researched further is often complicated. The benefit of further research is constrained by what has been done before, and comes at the potential cost of researching other, similar areas. In the case of private landowners

from southeastern Oklahoma, there is some difficulty in isolating which subjects are legitimately in the sample and which are not. As there are some sharp differences in behavior and attitudes between landowners with different sizes of property or farmers rather than owners of forestland, inclusion of subjects who don't have the right properties could hopelessly confuse the data. This leads to a decision in data collection of whether to have a smaller, and consequently more certain but less significant, sample or a larger one that might be biased. However, this limitation also means that it is likely that less is known about private landowners in southeastern Oklahoma than elsewhere. Though there are other areas that would be useful to research, lack of specific data in this area leaves some questions unanswered. If there is some change in how the State of Oklahoma keeps track of forested land, further research of private landowners in Oklahoma would be a considerably more fruitful endeavor.

The most significant implications of this study concern consultation, an example of sustainable private management, the nature of Oklahoma landowners, and identification of lack of information. Though some of the findings, such as the issue of sub-categories, are more important issues, they are not entirely unexpected. However, the idea that consultation does not necessarily improve management quality is unexpected, and has many further implications. The example of sustainable management provided in the third case indicates that private management can indeed be sustainable. Though somewhat minor, the difference between Oklahoman private landowners and those found in other states indicates that private landowners in Oklahoma may have comparably unique natures. This study identifies a few significant areas about which little is known, such as private timber processing operations and some of the determinants of willingness to lease land for hunting. Focus on these or other such areas could increase the value of further research. Despite these difficulties, private landowners in southeastern Oklahoma warrant further research at some point in the future.

REFERENCES

Birch, Thomas W. *Private Forest-land Owners of the United States, 1994.* [Radnor, Pennsylvania:] USDA Forest Service, Northeastern Experiment Station [1994]. Web. <http://books.google.com/books?id=aPh7ho_cvO4C >

Birdsey, Richard A. and Dennis M. May. *Timber resources of East Oklahoma*. [New Orleans, Louisiana:] USDA Forest Service, Southern Forest Experiment Station [1988]. Web. <http://www.srs.fs.usda.gov/pubs/1810>

Bliss, John C. and A. Jeff Martin. "Identifying NIPF Management Motivations with Qualitative Methods." *Forest Science* 35.2 (1989): 601-622. Web. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/fs/1989/00000035/00000002/art00025>

Bovée, Jennifer K., and A. Gordon Holley. 2003. “Planners Vs Non-Planners: Characteristics and Differences Between Non-Industrial Private Forest Owners in Southeastern Oklahoma Who Engage in Planned and Non-Planned Forest Management.” P. 254–267 *in* Proc. of the 2002 Southern Forest Economics Workshop,Amacher, G.S., and J. Sullivan (eds.). Blacksburg, VA.

Deal, Robert L. and Seth M. White. *Understanding Key Issues in Sustainable Wood Production in the Pacific Northwest*. [Portland, Oregon:] USDA Forest Service, Pacific Northwest Research Station, [2005]. Web. <citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.156.8274&rep=rep1&type=pdf#page=34>

Elwood, N. E., E. N. Hansen, and P. Oester. "Management Plans and Oregon's NIPF Owners: A Survey of Attitudes and Practices." *Western Journal of Applied Forestry* 18.2 (2003): 127-132. Web. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/wjaf/2003/00000018/00000002/art00008>

English, Burton C., Caroline D. Bell, Garland R. Wells, and Roland K. Roberts. "Stewardship Incentives in Forestry: Participation Factors in Tennessee." *Southern Journal of Applied Forestry* 21.1 (1997): 5-10. Web. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/sjaf/1997/00000021/00000001/art00003>

Esseks, J. D., and R .J. Moulton, (2000). *Evaluating the forest stewardship program through a national survey of participating forest land owners*. The Center for Governmental Studies, Social Science Research Institute, Northern Illinois University. 44, 67-80.

Fischer, A. Paige, and Susan Charnley. "Social and Cultural Influences on Management for Carbon Sequestration on US Family Forestlands: A Literature Synthesis." *International Journal of Forestry Research* 2010 (2010): 1-14. Web. *Hindawi Publishing Corporation*. <http://dx.doi.org/10.1155/2010/960912>

Gregory, S. Amacher, M. Christine Conway, andJay Sullivan. "Econometric analyses of nonindustrial forest landowners: Is there anything left to study?" *Journal of Forest Economics* 9.2 (2003): 137–164. Web. *ScienceDirect*. <http://dx.doi.org/10.1078/1104-6899-00028>

Hill, Luther B. *A history of the state of Oklahoma, Volume 1*. The Lewis Publishing Company: Chicago, 1910. Web. *GoogleBooks*. <http://books.google.com/books?id=XTwVAAAAYAAJ>

Holley, A. Gordon, Eric L. Taylor, and William G. Ross."Native American Nonindustrial Private Forest Landowners in Southeastern Oklahoma." *Southern Journal of Applied Forestry* 32.4 (2008): 149-153. Web. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/sjaf/2008/00000032/00000004/art00001>

Lewis, David K. “Oklahoma’s Forest Ecosystems: Their Current Condition and Potential Contribution.” *Oklahoma Academy of Science* 81 (2001): 31-40. Web. *OSU Digital Library* <http://digital.library.okstate.edu/oAs/oas_pdf/v81/p31_40.pdf >

Mckinley, Craig and Difei Zhang, 2011. *Economics for Forest Landowners*, fact sheet nrem-5050, 2011.

Measells, Marcus K., Stephen C. Grado, H. Glenn Hughes, Michael A. Dunn, JoshuaIdassi, and Bob Zielinske. "Nonindustrial Private Forest Landowner Characteristics and Use of Forestry Services in Four Southern States: Results from a 2002–2003 Mail Survey." *Southern Journal of Applied Forestry* 29.4 (2005): 194-199. Web. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/sjaf/2005/00000029/00000004/art00004>

Parsons, George R. “The Travel Cost Model.” *Encyclopedia of Energy, Natural Resources and Environmental Economics* (2012). Web. *SelectedWorks*. <http://works.bepress.com/george_parsons/31>

Rickenbach, Mark G., Raymond P. Guries, and Daniel L. Schmoldt. "Membership matters: comparing members and non-members of NIPF owner organizations in southwest Wisconsin, USA." *Forest Policy and Economics* 8.1 (2006): 93-103. Web. *ScienceDirect*. <http://dx.doi.org/10.1016/j.forpol.2004.05.006>

Ross, Stephen A. "Uses, Abuses, and Alternatives to the Net-Present-Value Rule." *Financial Management* 24.3 (1995): 96-102. Web. *JSTOR*. <http://www.jstor.org/stable/3665561>

Salmon, Olivia, Mark Brunson, and Michael Kuhns. "Benefit-Based Audience Segmentation: A Tool for Identifying Nonindustrial Private Forest (NIPF) Owner Education Needs." *Journal of Forestry* 104.8 (2006): 419-425. Web. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/jof/2006/00000104/00000008/art00006>

Sampson, Neil and Lester Decoster. “Forest Fragmentation: Implications for Sustainable Private Forests.” *Journal of Forestry* 98.3 (2000): 4-8. Web. *IngentaConnect*. < http://www.ingentaconnect.com/content/saf/jof/2000/00000098/00000003/art00005 >

Schwartz, Alex, Jake Beale, Adam Esau, Kaitlyn Dugan, Rider Reynolds, Donald Hawthorne. “Forestry Consulting Property Management Plan.” Capstone May, 2010.

Smith, Brad W., Patrick D. Miles, John S. Vissage, and Scott A. Pugh. *Forest Resources of the United States*. [St. Paul, Minnesota:] USDA Forest Service, North Central Research Station [2002]. Web. <http://www.nrs.fs.fed.us/pubs/gtr/gtr_nc241.pdf>

Thomson, Richard P., and J. Greg Jones."Classifying Nonindustrial Private Forestland by Tract Size." *Journal of Forestry* 79.5 (1981): 288-291. *IngentaConnect*. <http://www.ingentaconnect.com/content/saf/jof/1981/00000079/00000005/art00014 >

Walkingstick, Tamara, Donald E. Voth, Richard A. Williams, Jeffery Earl, and Carl P. Hitt. "A Characterization of the Nonindustrial Private Forest Landowners of Arkansas." P. 85–109 in Proc. of the symp. on Arkansas forests: A conference on the results of the recent forest survey of Arkansas, North Little Rock, AR, May 30–31, 1997. Guldin, J. (comp.). US For. Serv. Gen. Tech. Rep. SRS-41, South. Res. Stn., Asheville, NC. 125 p.

Zhang, Difei. 2010. *Forest Sector Modeling and Green Accounting in New Hampshire*. Freiburger Forstliche Forschung. Heft 84:159-172, 2010, ISSN: 1436-1566

Zhang, Difei. 2007. *Sustainability of New Hampshire's Sawmill Industry and Its Forest Resource Base*. PhD Dissertation May, 2007. University of New Hampshire. 278 pages.

APPPENDICES

The survey was designed to cover all areas pertinent to the construction of a profile of private landowners in southeastern Oklahoma with emphasis on the management practices and preferences of these private landowners. Survey results will be reported as aggregate data; no individual responses will be identified. These results are divided by the data types of short answer, multiple choice, fill in the table, and long answer type responses, for which differing analyses were used. Within these data types, data is reported in the same order as the survey was constructed, with those questions pertinent to travel cost modeling and net present value calculation placed in the appropriate sections. This ordering corresponds to the original divisions within the survey, which are description of forestland ownership, forest resource management, forest economics, private timber processing operation, and wildlife, recreation, and ecosystem Valuation.

In table type questions the responses of yes, highest ranking, strongly agree, and satisfied are all represented by 1, while their counterparts are on the other end of the spectrum. The structure of choices will be noted at the bottom of the table type questions.

Appendix A: Short Answer Type

Description of Forestland Ownership:

year acquired property	Average	1975.517		standard deviation	14.73485
	Minimum	1949		90% confidence upper bound	1980.018
	Maximum	2004		90% confidence lower bound	1971.017

lives in	Johnson
	McCurtain
	Minnesota, FL
	Pittsburg
	Pott
	Pushmataha
	Tulsa
	out of state*

*Many respondents indicated that they lived outside of Oklahoma, but did not specify where.

property in	Atoka
	Chocaw
	Johnson
	Latimer
	LeFlore
	McClain
	McCurtain
	Pittsburg
	Pushmataha

how far from home	%live on property	33.33%			
	average	640.4117		standard deviation	2545.892
	minimum	0		90% confidence upper bound	1404.963
	maximum	14000		90% confidence lower bound	-124.139

number of parcels	% have 1 parcel	36.67%			
	average	7.2		standard deviation	14.39923
	minimum	0		90% confidence upper bound	11.5242
	maximum	75		90% confidence lower bound	2.875798

acres forestland	average	683.5172		standard deviation	987.3354
	minimum	1		90% confidence upper bound	985.0906
	maximum	4620		90% confidence lower bound	381.9439

acres unforested land	% all forested	36.67%			
	average	120		standard deviation	168.1235
	minimum	0		90% confidence upper bound	170.4888
	maximum	700		90% confidence lower bound	69.51119

annual visitors	average	8.954545		standard deviation	6.34318
	minimum	0		90% confidence upper bound	11.179
	maximum	20		90% confidence lower bound	6.730094

Forest Resource Management:

non-timber products	hay
	pecans
	beef cattle
	river gravel
	firewood

timber plan? Year	% no	36.67%			
	average	1996.294		standard deviation	9.156724
	minimum	1982		90% confidence upper bound	1999.947
	maximum	2010		90% confidence lower bound	1992.641

wildlife plan? Year	% no	93.33%			
	average	2004		standard deviation	0
	minimum	2004		90% confidence upper bound	0
	maximum	2004		90% confidence lower bound	0

*Respondents who indicated they had a wildlife plan often did not specify when it was made.

contacted for forest advice	% yes	80.65%
	% no	19.35%

contacts charged	% charged $0	75.00%
	amount:	$10/acre
		$40/hour
		500
		percentage of timber sale

seek future advice on timber plan	% yes	44.83%
	% no	55.17%

seek future advice on wildlife plan	% yes	70.00%
	% no	30.00%

under contract	% yes	0.00%
	% no	100.00%

practices part of plan	% yes	60.71%
	% no	39.29%

Forest Economics:

value of land	average	503887.5		standard deviation	498040.5
	minimum	30000		90% confidence upper bound	687067
	maximum	1680000		90% confidence lower bound	320708

amount of taxes	average	1371		standard deviation	1478.655
	minimum	60		90% confidence upper bound	1847.988
	maximum	5000		90% confidence lower bound	894.0121

harvested in past?	% yes	87.10%
	% no	12.90%

year harvested	%before 2006	40.74%			
	average	2004.667		standard deviation	5.883484
	minimum	1990		90% confidence upper bound	2006.529
	maximum	2011		90% confidence lower bound	2002.804

acres harvested	average	216.1111		standard deviation	277.4582
	minimum	30		90% confidence upper bound	303.9411
	maximum	1500		90% confidence lower bound	128.2811

cost of harvest	average	5397.4		standard deviation	4679.005
	minimum	500		90% confidence upper bound	8839.28
	maximum	10000		90% confidence lower bound	1955.52

returns from harvest	average	55831.39		standard deviation	82956.07
	minimum	0		90% confidence upper bound	87993.1
	maximum	300000		90% confidence lower bound	23669.68

times landowner harvested	average	4.217391		standard deviation	5.418458
	minimum	0		90% confidence upper bound	6.075791
	maximum	20		90% confidence lower bound	2.358992

times harvested in total	average	3.611111		standard deviation	4.7914
	minimum	0		90% confidence upper bound	5.468716
	maximum	20		90% confidence lower bound	1.753506

rotation	rotation age:	average	15		standard deviation	14.14214
		minimum	5		90% confidence upper bound	25.40297
		maximum	40		90% confidence lower bound	4.597032
	size of sections:	average	113.3333		standard deviation	41.63332
		minimum	80		90% confidence upper bound	152.8707
		maximum	160		90% confidence lower bound	73.79597
	don't know		10.00%			
	don't harvest in rotation		90.00%			

transportation costs	$10/ton
	$100

plan ready imidiately after harvest?	% yes	27.78%
	% no	72.22%

Private Timber Processing Operation:

employ	4
average salary	30000
revenue	140000
cost of running it	10000
spent purchasing timber	

Wildlife, Recreation, and Ecosystem Valuation:

minimum $/acre to lease	average	3.785714		standard deviation	3.080275
	minimum	1		90% confidence upper bound	5.70071
	Maximum	10		90% confidence lower bound	1.870719
	not willing, no matter the price	59.09%			

Appendix B: Multiple Choice Type

Description of Forestland Ownership:

acquired through	gift or inheritance	33.33%
	Marriage	0.00%
	purchase or trade	66.67%
	Other	0.00%

ownership category	Individual or family	68.57%
	partnership	5.71%
	corporation	5.71%
	Estate	2.86%
	Trust	14.29%
	Other	2.86%

fate of property	it will be passed on to children or grandchildren	61.36%
	it will be sold to children or grandchildren	0.00%
	it will be maintained in an estate or trust	27.27%
	it will be sold to pay retirement	6.82%
	it will be sold by breaking it into smaller tracts	0.00%
	haven't thought of it yet	0.00%
	other	4.55%

home/property location	yes	40.00%
	no, not on my forestland property, but in this county	10.00%
	no, not in this county, but in Oklahoma	20.00%
	No, not in Oklahoma	30.00%

recreation occurrence	daily	29.03%
	weekly	9.68%
	monthly	12.90%
	annually	35.48%
	less than once a year	12.90%
	less than 25%	64.00%
	between 25% and 50%	24.00%
	between 50% and 75%	0.00%
	more than 75%	12.00%

Forest Resource Management:

forest type	planted pines	20.24%
	natual pines	21.43%
	mix of pines and hardwoods	27.38%
	bottomland hardwoods	13.10%
	upland hardwoods	16.67%
	don't know	1.19%

influence decisions	state or federal land management assistance personel	38.60%
	family members	19.30%
	professional forestry consultant	21.05%
	logging contracter	10.53%
	other	10.53%

makes final decision	landowner	81.82%
	another partner	3.03%
	two or more partners agree	15.15%
	a consulting forester	0.00%
	other	0.00%

prepared timber plan	private consulting forester	12.00%
	an industrial forester	0.00%
	ODAFF/NRCS	68.00%
	myself	16.00%
	other	4.00%

prepared wildlife plan	private consulting forester	0.00%
	an industrial forester	0.00%
	ODAFF/NRCS	66.67%
	myself	33.33%
	other	0.00%

internet access	No, I do not have access	12.12%
	Yes, I have access in my home	78.79%
	Yes, I have access in my business	9.09%
	Yes, I have access but not at home, business, or place of employment	0.00%

looked up forestry info	Yes	60.00%
	No	40.00%

Forest Economics:

percent harvested	Less than 25%	12.00%
	between 25% and 50%	28.00%
	between 50% and 75%	24.00%
	more than 75%	36.00%

how trees were chosen	all timber was removed	15.79%
	individually selected marked trees cut	44.74%
	trees over a specific diameter cut	23.68%
	trees left in rows, trees outside rows cut	5.26%
	trees under a specific diameter cut	5.26%
	don't know	0.00%
	other	5.26%

marking responsibility	owner	36.36%
	logger or timber buyer	30.30%
	private forestry consultant	24.24%
	industry forester	0.00%
	state or federal forester	6.06%
	don't know	0.00%
	other	3.03%

sold to	sold to sawmill directly	29.63%
	have own sawmill	3.70%
	sold timber to loggers	59.26%
	other	7.41%

satisfied?	yes	81.48%
	no, why not?	18.52%
	haven't been there since harvest	0.00%

sell again?	yes	81.48%
	no-why not?	14.81%
	undecided	3.70%

reforested?	yes	74.07%
	no	25.93%
	it will be converted to non-forestry use	0.00%

reforestation practices	left mature trees standing	25.00%
	prepared seedbed using heavy machinery	10.00%
	planted seedlings or seed	23.33%
	controlled competition with hebicide	15.00%
	controlled competition with fire	11.67%
	made sure area was stocked with younger trees or sprouts	13.33%
	don't know	0.00%
	other	1.67%

suggested reforestation	self	50.00%
	state or federal land management assistance personnel	25.00%
	family members	10.71%
	professional forestry consultant	7.14%
	logging contractor	3.57%
	other	3.57%

Private Timber Processing Operation:

sell to	other mills	25.00%
	private business	25.00%
	other individuals	25.00%
	use for self	25.00%

Wildlife, Recreation, and Ecosystem Valuation:

activities caused response	no	15.38%
	don't know	34.62%
	yes-describe	50.00%
	describe:	I don't own any mineral rights. People looking for gas production caused fires via their truck exhausts twice.
		Slash
		wildlife increase
		increase wild fire
		improved wildlife growth, cut fireload
		burning increased turkey, quail, and deer
		Improved wildlife habitat, but increased fire damage and susceptibility
		The thinning activity was initially very favorable to wildlife, although harvested area will eventually be more predominantly pine woodland.
		wild fire susceptibility decreased by thinning, pruning, and controlled burning
		improves food availability

received invasive info	Yes	53.33%
	no	36.67%
	don't remember	10.00%

climate change important	yes	43.33%
	somewhat	13.33%
	no	30.00%
	not sure	13.33%

Property can affect it	yes	20.69%
	somewhat	17.24%
	no	37.93%
	not sure	24.14%

received c.credit info	never got info from OK	40.00%
	yes	36.67%
	no	23.33%

future interest in c.credits	yes	32.26%
	no	45.16%
	not sure	22.58%

consider managing for carbon	yes	16.13%
	I would if I could make money	38.71%
	I would not manage for carbon	45.16%

professional mention carbon	yes	25.00%
	no	53.57%
	don't remember	21.43%

mention how much	yes	10.71%
	no	71.43%
	don't remember	17.86%

ask professional about carbon	yes	41.94%
	maybe	25.81%
	no	32.26%

preferred organization	Chicago Climate Exchange	3.45%
	Oklahoma Conservation Commission	58.62%
	they're both the same	6.90%
	wouldn't deal with either of them	31.03%

Appendix C: Table Type

Description of Forestland Ownership:

		average	χ^2
personal ranking	Part of farm or ranch	1.923077	0.9999998
	pride of ownership	2.130435	0.98483358
	desire for privacy	2.777778	0.99925292
	emotional/spiritual ties to land	1.533333	1
	family ownership tradition	1.75	1
	other	2.142857	1

economic ranking	income from timber	1.423077	1
	potential for development	2.230769	0.9997238
	oil and gas exploration	2.444444	0.99999949
	part of an estate plan	2.058824	0.99999715
	leases (hunting/fishing, oil, gas)	2.555556	0.99999876
	farming or ranching	2.181818	0.99999999
	other	2.166667	1

recreational ranking	viewing scenery	1.545455	1
	hunting and/or fishing	1.764706	0.99999999
	horseback riding	3	1
	hiking and/or camping	2.375	0.99999999
	viewing wildlife	2.285714	0.98483358
	off-road vehicle use	2	1
	other	2	1

overall ranking	economic	1.903226	0.95638946
	recreational	2.433333	0.18409329
	personal	1.633333	0.99999715

Forest Resource Management:

opinion of practices	Protecting my forest from fire, insects, and disease should be the responsibility of the Oklahoma Forestry Services.	3.066667	4.1089E-12
	It is possible to manage for both wildlife and timber without reducing overall income.	1.612903	0.99999876
	Government regulation is necessary to ensure forest management practices are environmentally sound.	3.6	3.7878E-23
	The use of herbicides on forestlands does not harm the environment.	2.433333	0.00717008
	I am willing to pay for professional help to make better land management decisions on my forestland.	2.566667	2.83E-05
	Too much timber is being harvested in Southeastern Oklahoma.	3.931034	1.2671E-24
	Harvesting timber does not permanently harm forests.	2.064516	0.16360906
	Forest resources must be managed to ensure that they will be available for future generations.	1.548387	0.99995094
	Endangered species must be protected on private land.	2.83871	3.1931E-08
	Habitat for endangered species must be protected on private land.	3.032258	1.4949E-11
	I believe there is enough useful forest management information available.	2.166667	0.51188958
	The government has the right to limit and/or regulate management practices on my land.	3.8	8.3429E-29

satisfied with info	Private Consulting Forester	1.84	0.99953917
	Other Forestland Owners	1.68	0.99953917
	Industrial Forester	2.24	0.83508828
	Local Ag Teacher	2.84	0.02501696
	University Department of Forestry	1.592593	0.99997434
	County Extension Personnel	1.92	0.96573266
	Oklahoma Forestry Services	1.307692	1
	Oklahoma Department of Wildlife Conservation	2.52	0.2302567
	NRCS (Soil Conservation Service)	1.846154	0.99190825
	OSU Cooperative Extension Personnel	1.615385	0.9997238
	Oklahoma Forestry Association	1.84	0.98882085
	Oklahoma Woodland Owners Association	1.5	0.99999993
	Other	2	1

information on	Forest Management?	1.038462	1
	Wildlife Management?	1.68	1
	Timber or other forest products?	1.153846	1
	Insects or diseases?	1.36	1
	Forestry cost-share/incentive programs?	1.32	1
	Tree planting?	1.16	1
	Estate planning?	1.88	0.99999993
	Financial planning/taxes?	1.8	0.99999999
	Wildlife cost-share/incentive programs?	1.72	1
	Pond building?	1.846154	0.99999993
	other	2	1

reliable?	Fact sheets/brochures	1.241379	1
	Internet (World Wide Web)	1.96	0.99995094
	Magazines	1.928571	0.99600178
	Newspapers	2.321429	0.68737776
	Radio	2.642857	0.11214827
	Television news programs	2.586207	0.1448244
	Television nature programs	2.275862	0.61864309
	other	1	1

Forest Economics:

programs	WHIP—Wildlife Habitat Improvement or Incentive Program	1.363636	1
	FIP—Forest Incentive Program	1.84	0.9942542
	SIP—Stewardship Incentive Program	1.727273	0.99990969
	CRP—Conservation Reserve Program	1	1
	WRP—Wetland Reserve Program	1.055556	1
	Environmental Quality Incentive Program	1.875	0.99999379

lease for	Hunting and/or fishing?	1.833333	0.99999876
	Oil and/or gas?	1.733333	0.99999993
	Off-road vehicle use?	2	0.99995094
	Grazing?	1.709677	0.99999993
	other	1.5	1

product percent and value	Saw logs	65.36842
	Posts, poles and pilings	24.83333
	Pulpwood	28.66667
	Fuel wood	11.5
	I don't know	84
	Saw logs	162200
	Posts, poles and pilings	28050
	Pulpwood	25500
	Fuel wood	0

reason to sell	To clear land for a non-forestry purpose	4.318182	2.7051E-24
	The trees were mature	1.75	0.9999998
	A good price was offered	2.416667	0.34269676
	To improve recreation/hunting	3.565217	2.1415E-12
	Thinning to improve growth	1.88	0.95638946
	To improve scenic quality	3.272727	1.7113E-05
	To improve wildlife habitat	2.916667	0.00038832
	To salvage insect, disease or storm damaged trees	2.291667	0.2302567
	Needed money	2.666667	0.00094058
	other	3	1

reason to reforest	Felt the land should be kept in timber production	1	1
	Anticipating future profits from forest production	1.25	1
	Advice of professional forester	1.529412	1
	Had revenues from harvesting to finance reforestation	1.789474	0.99999999
	Availability of cost-sharing from public agencies	1.578947	1
	Availability of tax credits and tax deductions	1.684211	1
	other	1	1

reason to not reforest	Forest will naturally regrow to what it was before it was harvested	1.272727	1
	Cost too high	1.545455	1
	Other uses for harvest revenue	2.111111	1
	Financial return from reforestation too low	1.909091	1
	Difficulty involved in applying for cost-sharing or technical assistance	2.111111	1
	Denied cost-sharing funds	2	1
	Not yet decided future use of land	2.285714	1
	Investment in reforestation too risky because of fire, insects and disease	1.888889	1
	other	0	0

reason to not harvest	Prices for timber are too low.	4.384615	5.35E-11
	Trees on this land are too small.	3.416667	0.05538427
	Harvesting would reduce the economic value of this land.	3.230769	0.02952716
	It is hard to find a logger that can be trusted.	3.461538	0.00019513
	Cutting trees is wrong.	1.461538	1
	Harvest will reduce the future economic value of this land.	2.538462	0.75153195
	There is not enough timber to make harvesting worth it.	2.461538	0.96573266
	Harvest would reduce the quality of hunting on this land.	2.416667	0.78126974
	I don't know how to sell timber.	2.5	0.85889343
	Harvesting would damage forest health.	2.333333	0.98483358
	Harvesting would damage wildlife habitat.	2.333333	0.98483358
	Overall, the harvesting would damage the land too much.	2.5	0.93223562
	other	0	0

Wildlife, Recreation, and Ecosystem Valuation

why do they buy lease	Enjoying the activity of hunting or fishing	1	1
	Getting meat	2	1
	Being in a wild setting	1.5	1
	Enjoying the scenery	1.75	1
	Spending time with family members	1.5	1

Condition	Biodiversity?	1.84	0.99995094
	Sustainability?	1.714286	0.99997434
	Overall forest health?	1.862069	0.99727673
	Wildlife habitat?	1.821429	0.99990969
	Invasive species?	2.785714	0.00019513
	Endangered species?	2.666667	0.04757297

Appendix D: Long Answer Type

Description of Forestland Ownership:

What information and/or advice about forestland management would you use if it were available and easily accessible?
available TSI programs. Care of mixed aged timber, insect problems (or potential problems), timber thieves (if any).
have adequate accessibility now
entomology, estate planning
timber prices, information about grants, timber marketing, taxes
field days, seminars
forester contact information, OSU bulletins
Harvesting and sell of products, how it's done
I'm getting as much as I want
prices of timber
courses, forest measurements
hunting lease info, oil and gas drilling info
low impact sustainable forestry/wildlife management information. Cedar control with minimal financial input.
web based information, factsheets

If you participated in one or more of these cost-share programs what did they help pay for, and how much did they pay? If you participated in a program not on the list please describe it.
injection of herbicide use, 75%. Killed trees are left standing
planting, 20%
pond building, 33%
herbicide application and tree planting
TSI, reforestation, most
work will be done in 2011
Brush and red cedar control through NRCS - $5909.85, Controlled burn on 250 acres by ODAFF which we paid for, they were very helpful
Site preparation, tree planting, invasive species control
timber stand improvement
Equip - fences, ponds, cedar control
TSI and reforestation
remove trash trees, paid 75%
controlled burn - ripping and replanting after forest fire - 50-70%

Forest Resource Management:

If you sold your timber to one or more large sawmills, please indicate which ones, and where they are.
Woods - Idabel Bleuwood, - OSB Idabel
Weyerhaeuser, Wright City
Weyerhaeuser, International Paper, various
Weyerhaeuser - Wright City, Wood Lumber - Idabel
Weyerhaeuser - Idabel, International Paper -Valiant, Huber - Broken Bow, Wood Lumber Co. - Idabel
? - Mansfield, Arizona
Travis lumber co., Arkansas
Travis lumber co. - Mansfield Arkansas, Wexcp - Idabel, Woods - Idabel

If you have your own sawmill or way of processing timber, please provide a brief description of it.
White 60" Civel, 2 bandsaws, woodchiper
have hired a portable sawmill in the past

What would encourage you to reforest your land?
My land is completely forested and natural regeneration is very good. Can't think of any reason to reforest beyond the natural way.
A year ago, use of machinery - now, nothing.
I would have to be younger, I'm 85
Maintenance of forest production
Good markets.
Knowing that a stable good paying market will exist in the future.
more money
carbon credits with variable cost
already self-seeded
federal/state incentive programs

Private Timber Processing Operation:

What kinds of machines does your mill use?
Harvester, Loaders, Trucks, Limbers, Skidders

What kinds of products does your mill produce?
Mill cut demand for re-saw

When you sell these products, which county and state or county are they bound for?
Push and McCurtain OK, and Ark TX

Please provide a brief description of any information about your overall operation that you feel was not covered above.
We do our own operation from forest management, harvest, and product production

Wildlife, Recreation, and Ecosystem Valuation:

Please list what kinds of animals or fish people go after on your property when they have this lease, and roughly estimate how many they usually catch in a day.
deer, turkey
deer, wild hogs, turkey
whitetail deer

If you have one or more invasive species present on your property, please list it and describe its severity.
Russian olive, sold by OK nursery without warning about how invasive Russian olive is.
None,cut down beetle infested pine
Junipers - heavy water users. Kill mature undesirable trees. Constantly trying to control.
Red-cedar and privet hedge, cutting and burning cedar
Virginia pine - I had to do a lot of cutting with chainsaws to control it. It's still a problem.
Red-cedar - have attempted more prescribed burning
Red-cedar
Eastern red-cedar - relatively minor problem, controlled with chainsaw
Yellow thistle, musk thistle, dog fennel, goat heads, eastern red-cedar
Not a major factor
Juniper - selective removal/mowing/fire

Additional comments regarding entirety of survey:
I think carbon credits, etc., are a joke. The industries need to clean up their act instead of manipulating this stupid idea to save money on better equipment.
This took longer than 20 minutes. More like an hour, I didn't check the records. However, I'm glad to do it since OSU has been very helpful to us.
I think carbon credits/global warming is a bunch of crap! I would burn my land before I submit it to this crap!
Anthropogenic climate change is a hoax - a scam - little ice age returning in 40 years. Al Gore was very smart to promote this hoax - made millions! It's a scheme for liberals to control more of the economy and hurt capitalism.
I do not think that carbon credits should be should be bought or sold because of the increased costs of energy to the consumer which is myself
Carbon credits would be "cap and trade" which I oppose. While climate change and global warming appear to be real, I am not convinced that burning fossil fuels are the only/primary reason.

VITA

Rider Reynolds

Candidate for the Degree of

Master of Science

Thesis: SMALL SCALE FORESTRY IN SOUTHEASTERN OKLAHOMA

Major Field: Forest Resources

Biographical:

Education:

Completed the requirements for the Master of Science in Forest Resources at Oklahoma State University, Stillwater, Oklahoma in May, 2012.

Completed the requirements for the Bachelor of Science in Forest Management at Oklahoma State University, Stillwater, Oklahoma in 2010.

Experience:

Graduate Research Assistant for Dr. Difei Zhang, Department of Natural Resource Ecology & Management, Oklahoma State University, Stillwater, Oklahoma, 2010-2012.

Third author of "Development of Volume Equations using Data Obtained by Upper-stem Dendrometry with Monte Carlo Integration: Preliminary Results for Eastern Redcedar " with Dr. Thomas Lynch and Dr. Rodney Will. Article presented at 15th Biennial Southern Silvicultural Research Conference November, 2008.

Volunteered with Blue Thumb, stream monitoring program of the Oklahoma Conservation Commission, 2007.

Professional Memberships:

Xi Sigma Pi – Forestry Honor Society

Name: Rider Reynolds Date of Degree: May, 2012

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: SMALL SCALE FORESTRY IN SOUTHEASTERN OKLAHOMA

Pages in Study: 104 Candidate for the Degree of Master of Science

Major Field: Forest Resources

Scope and Method of Study: The objective of this study is to provide information that can be used to better customize consulting services, programs, and policies so that they can appeal more effectively to their target audience, better assist in meeting landowner wants and needs, and address the strengths and weaknesses of their private forest management. This objective can be met through the development of a profile of landowners in southeastern Oklahoma. This profile can be generated from survey data and be further developed through addressing several research questions and constructing a few economic models. This survey was sent to private owners of more than 50 acres of forested land in Atoka, Chocaw, Johnson, Latimer, LeFlore, McClain, McCurtain, Pittsburg, and Pushmataha counties.

Findings and Conclusions: This study found that there were significant sub-categories within the sample, such that it would be more illuminating to divide the sample into these categories in the future. Timber planning was linked to consulting, but consulting was not as good an indicator of timber planning. This indicates that timber planning is the better indicator of management style. Landowners were shown not to be excellent judges of how sustainable their forest practices were. This is likely due to considering sustainability issues leading to perceiving them more often in one's own management. Willingness to manage for carbon sequestration was linked to forested proportion, number of times timber was harvested by the landowner, management intensity. With this information it would be possible for private landowner related consultants, programs, and policies to more effectively identify and interact with their target audience.

ADVISER'S APPROVAL: Dr. Difei Zhang