PRIVATE LANDOWNER INTENT TO SUPPLY FOREST BIOMASS FOR ENERGY IN KENTUCKY

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PRIVATE LANDOWNER INTENT TO SUPPLY FOREST

BIOMASS FOR ENERGY IN KENTUCKY

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the College of Agriculture at the University of Kentucky

By

Zachary John Leitch

Lexington, KY

Director: Dr. John M. Lhotka, Assistant Professor of Silviculture

Lexington, KY

2012

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ABSTRACT OF THESIS

PRIVATE LANDOWNER INTENT TO SUPPLY FOREST BIOMASS FOR ENERGY IN KENTUCKY

The Commonwealth of Kentucky is taking steps to expand bioenergy production in response to federal policy initiatives as well as environmental and energy security concerns. The success of this industry will be impacted by the supply of feedstock available from private individuals who own a majority (78%) of forest resources in the state. Despite a developing body of bioenergy research, little is known concerning the social availability of forest biomass for energy production. This study measures intent to harvest energy wood among family forest owners using a mail-based survey and tests the effect of educational materials provided to participants. The theory of planned behavior is used to model factors that affect landowner intentions. Two-thirds of respondents reported that they intend to include energy wood in future harvests, but the educational material treatment did not affect intentions. Respondents’ attitudes, perceived subjective norms, and perceived control each had a significant effect on intent to harvest. Respondents also identified barriers that may prevent them from harvesting, providing forestry professionals with a list of challenges to overcome if supply is to be maximized. The results of this study are valuable for all stakeholders involved in the development of a sustainable biomass and bioenergy industry.

KEYWORDS: Bioenergy, Biomass, Theory of Planned Behavior, Wood Energy, Family Forest Owner

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March 9, 2012
PRIVATE LANDOWNER INTENT TO SUPPLY FOREST BIOMASS FOR ENERGY IN KENTUCKY

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# Table of Contents

Acknowledgements ........................................................................................................... iii  
List of Tables ....................................................................................................................... vi  
List of Figures ....................................................................................................................... vii  
Chapter One: General Introduction ................................................................................... 1  
Chapter Two: Literature Review .......................................................................................... 5  
  Biomass Availability ......................................................................................................... 6  
  Stakeholder Perspectives on Biomass and Bioenergy ....................................................... 8  
  Conceptualizing Family Forest Owners ........................................................................... 10  
  Theory of Planned Behavior ............................................................................................ 12  
  Research Rationale ........................................................................................................... 14  
  Literature Cited ................................................................................................................. 16  
Chapter Three: Manuscript .................................................................................................. 21  
  Private Landowner Intent to Supply Forest Biomass for Energy in Kentucky .............. 21  
  Introduction ...................................................................................................................... 21  
  Methods ............................................................................................................................. 24  
    Theory of Planned Behavior .......................................................................................... 24  
    Experimental Treatment ............................................................................................... 26  
    Survey Development ...................................................................................................... 26  
    Population Sample ......................................................................................................... 30  
    Data Collection .............................................................................................................. 31  
    Statistical Analysis ........................................................................................................ 32  
  Results ................................................................................................................................ 33  
  Discussion .......................................................................................................................... 38  
  Conclusion .......................................................................................................................... 44  
  Literature Cited ................................................................................................................. 46  
Chapter Four: General Conclusions ................................................................................... 48  
  Contributions ..................................................................................................................... 49  
  Limitations ......................................................................................................................... 50  
  Future Research ............................................................................................................... 51  
Appendix ............................................................................................................................... 53  
  5.1 Survey Instrument ....................................................................................................... 53  
  5.2 Bioenergy Education Packet ...................................................................................... 61  
  5.3 Response Frequencies ............................................................................................... 68  
  5.4 Multiple Regression Results ..................................................................................... 89  
  5.5 Variable Analysis Results ......................................................................................... 91  
  Literature Cited ................................................................................................................. 92  
  Vita ....................................................................................................................................... 97
List of Tables

Table 3.1, Attitude and Subjective Norms Survey Questions........................................29
Table 3.2, Perceived Control, Prior Knowledge and Intent Survey Questions.............30
Table 3.3, Descriptive Statistics of Survey Participants................................................34
Table 3.4, Significant Regression Variables and Coefficients......................................36
Table 3.5, Internal Reliability of Composite Measures................................................37
List of Figures

Figure 3.1, Theory of Planned Behavior Model.................................................................25
Figure 3.2, Participant Woodland Representation by County.............................................35
Figure 3.3, Landowner Reported Barrier Frequency by Category......................................38
Chapter One: General Introduction

Demand for clean renewable energy sources has increased in the last decade due to heightened awareness of global climate change caused by greenhouse gas accumulation and the desire to achieve energy independence from petroleum exporting nations. The Commonwealth of Kentucky is currently taking steps to improve its energy production portfolio through expansion and diversification of renewable energy sources. In 2009, Governor Steve Beshear created the Executive Task Force on Biomass and Biofuels purported to “facilitate the development of a sustainable biomass and biofuels industry in Kentucky” (Anderson et al. 2009). The most direct rationale for this goal is a federal mandate that requires states to meet a minimum amount of fuel usage through renewable sources.

The Renewable Fuels Standards, originally established by the Energy Policy Act of 2005, were updated in 2007 with the passage of the American Security and Independence Act (United States Environmental Protection Agency, 2012). This standard requires that Kentucky increase its use of renewable fuels from 150 million to 775 million gallons by 2022. Additionally, these mandates limit the amount of corn-based ethanol that can contribute to the total renewable fuel goal. Kentucky currently produces only 24% of the biofuel it consumes yearly, with the remainder being imported from states with more advanced production capabilities. As mandates require increased usage from renewable sources, Kentucky must expand its production of non-corn biofuel to avoid purchasing it from out-of-state sources (Anderson et al. 2009).
In addition to the renewable fuel standards of the American Security and Independence Act, Congress has given considerable attention to the creation of federal renewable portfolio standards (Anderson et al. 2009). These would require states to replace a percentage of their electricity usage with energy from renewable sources. Kentucky could be required to buy energy credits from outside sources, or pay fines, if it fails to create its own production system, thus increasing energy costs for citizens (Anderson et al. 2009). RPS mandates or goals have already been adopted by 33 other states in the US (United States Environmental Protection Agency, 2012) and there is bipartisan support for development of a cap and trade system. A major obstacle to renewable electricity production in Kentucky is the limited option for common renewable power sources such as solar, wind, geothermal, and hydroelectric (Debolt et al. 2009). Perhaps the most formidable barrier towards adopting new sources of energy is the state’s vast supply of coal, which provides it with cheap energy.

Kentucky has the potential to meet its renewable energy goals for both electricity and liquid fuel production due to its abundant opportunities for biomass supply. Approximately 89% of the biomass on Earth exists in standing forests (Petrou and Pappis, 2009) and Kentucky is 47% forestland (Thomas et al. 2007). Therefore, woody biomass, or energy wood, from Kentucky’s forest resources will likely contribute significantly to the supply of bioenergy feedstock. The Governor’s Executive Task Force on Biomass and Bioenergy estimated that 25 million tons of biomass would be necessary every year to meet potential renewable energy goals by the year 2025. A significant portion of the necessary woody biomass will likely
be sourced from Kentucky’s forests as residual materials generated during traditional timber harvests. This material will typically be collected together with traditional timber products during commercial harvest operations, at least until dedicated bioenergy crops, such as switchgrass or short-rotation plantations are widely established. In this paper, energy wood harvest will refer to a harvest that removes traditional products together with low-value material appropriate for bioenergy production. Because a majority of the forestland in Kentucky is privately owned, establishing a wood energy supply chain in the state will require participation from family forest owners - approximately 423,000 individuals privately own 78% of the forested land in Kentucky (Thomas et al. 2007). The remaining land is either public or industry owned. While there are areas of public forestland that could be utilized, wood energy harvesting is largely excluded on National Forests in the United States.

Creating a sustainable biomass and biofuels program in Kentucky will require feedstock from family forest owners. This supply of biomass must be reliable enough to support continued development of the markets and infrastructure necessary for success and growth of the industry. A crucial step in determining the availability of feedstock is to understand whether or not forest landowners intend to harvest energy wood from their property. Estimates of landowner intent and an increased understanding of factors affecting landowner decisions will help stakeholders define avenues of progress toward meeting Kentucky’s bioenergy production goals. This information will be invaluable for policymakers working to design and implement an effective statewide supply chain
strategy, industry professionals planning the construction of conversion facilities, logging companies investing in specialized harvesting equipment, organizations that work with private landowners and state agencies planning Kentucky’s future energy production strategy.

The research presented here aims to analyze the social availability of energy wood using a survey of private forest owners across the state of Kentucky. This survey was designed to quantify current intent to harvest energy wood among landowners and determine what influences those intentions using a widely accepted theoretical framework of behavioral intent, called the Theory of Planned Behavior (Ajzen, 1991). This study also contains an experimental factor. Approximately half of survey respondents were provided with information designed to educate landowners about forest bioenergy production and harvesting. Specific research questions include the following:

RQ1: What portion of engaged family forest owners in Kentucky intends to harvest energy wood?

RQ2: What characteristics can be used to predict family forest owner intent to harvest energy wood?

RQ3: Does the provision of bioenergy educational materials have an effect on family forest owner intent to harvest energy wood or landowner attitudes, perceived control, or subjective norms?
Chapter Two: Literature Review

Designing and implementing a sustainable biomass and biofuels industry is an elaborate challenge and the body of literature pertaining to this field is equally broad and complex. Research has covered a wide variety of topics including, but certainly not limited to biomass feedstock types and comparisons, maximum yield strategies, transportation costs, sustainability concerns, and market analyses. Many researchers have studied the feasibility of a sustainable bioenergy through exploration of the associated challenges and opportunities of these systems (Benjamin et. al, 2009; Guo et. al, 2007). While there are challenges to producing bioenergy, the opportunities, specifically for family forests owners are not to be overlooked. Munsell and Germain (2007) reasoned that demand from a growing bioenergy industry might lead to lower rates of selective and premature harvest and improved silvicultural practices on private landowners. Although the body of literature covering biomass and biofuels is vast and varied, there are still considerable unknowns about private landowner's intent to participate in woody biomass harvesting, especially in Kentucky. This thesis seeks to fill that void.

This literature review will be organized in the following way. First, relevant research on the physical and economical availability of biomass is reviewed. Then an overview of stakeholder perspectives is provided. Then, relevant research on landowners and the theory of planned behavior is included. The term non-industrial private forest (NIPF) is often used to describe family forests in scientific literature, and the terms can be used interchangeably. In this section, the term NIPF
is used when citing research that used specifically refers to these ownerships as NIPF's.

**Biomass Availability**

The amount of biomass available is constrained by three factors: physical, economic and social. Physical availability is the *actual location* and quantification of biomass materials. Economic availability is based on market values and is often confounded by extraneous factors. The following sections review relevant literature on these two factors.

*Physical Availability* - Many studies have attempted to quantify the volume of biomass available on differing scales and regions using various methods. Parikka (2004) estimated the global supply of biomass available for biofuel production and indicated that forest biomass holds significant potential for renewable energy production. On a smaller scale, Blackard et al. (2008) mapped and estimated the biomass available across the entire United States using FIA data combined with satellite imagery. His study revealed that Kentucky and other states in the Southeast have large amounts of biomass available due to their climate and precipitation. The biomass resources of the region have been the subject of other availability studies. Galik et al. (2009) aimed to quantify the biomass available in North Carolina, South Carolina, and Virginia based on harvesting records, and hypothetical biomass values, including the effect of increased demand and prices on timber and pulpwood markets. Specific data regarding the volume of resources in Kentucky are available based on FIA data (Turner et al. 2008). Most exploration of the physical availability of biomass does not focus on the social or economic
availability of these resources, but this is an extremely important aspect of
determining potential supply that has received considerable attention in the
literature.

Economic Availability – The economic availability of biomass is another well-
documented area of study with data available for many methods and locations.
These types of analyses have been present in the literature for quite some time.
Young et al. (1991) explored the economic availability of woody biomass in the
Southeast, including the state of Kentucky. Unfortunately, changing economies and
resource prices make these findings essentially obsolete today. Economic analyses
have been used to examine many aspects of bioenergy programs. Infrastructure
location has a strong effect on economic availability of biomass, due to the high cost
of transporting feedstock to those facilities. Estimates of costs and factors affecting
costs were used by Wu et al. (2011) to determine ideal locations of biofuel facilities
in central Appalachia, and economics have been combined with GIS data to
determine the ideal location of biomass facilities in Michigan (Zhange et al. 2011).
More relevant studies examine the economics of forest biomass specifically, such as
material derived from thinning of overstocked forests (Polagye et al. 2007).
Langholz et al. (2009) provides an analysis of the economic availability of two
specific Kentucky counties, Laurel and Trimble, suggesting that sufficient material is
available to pursue continued bioenergy development. Both the physical and
economic availability of biomass for bioenergy production are quite intricate
factors, but they do not account for all of the necessary assessment of biomass
attainability. Butler et al. (2010) compared social and physical availability and
concluded that social constraints reduce the attainability of biomass more than physical factors. Clearly, an understanding of stakeholder perspectives on biomass and bioenergy are important to measuring and conceptualizing landowner supply.

**Stakeholder Perspectives on Biomass and Bioenergy**

In addition to the study of the systems, economic and physical factors of the biomass industry, some researchers have investigated various perspectives of biomass stakeholders. Aguilar and Garrett (2009) surveyed professionals in the forestry, biomass, and energy fields concerning the appropriate definitions, sources, and opportunities for bioenergy development. Participants recognized that efforts to promote woody biomass should consider local resources as well as social and economic conditions. Dwivedi and Alavalapati (2009) conducted focus groups to analyze perceptions of strengths and weaknesses among stakeholders from NGO’s, government, industry, and academia. Positive perspectives included implications for rural development and advantages over feedstock sources that compete with food. Stakeholders perceived major weaknesses as competition with alternative renewable sources and the state of conversion technology. The University of Kentucky is conducting a similar study to analyze stakeholder perceptions within the state.

Stidham and Simon-Brown (2011) have explored statewide stakeholder opinions in Oregon, and Plate et al. (2010) surveyed public perception of woody biomass for energy in Florida. Despite the geographical differences between the states, generally these groups held a favorable view of biomass for energy. While understanding the perspectives of stakeholders, including the public, are critical to
exploring the success of sustainable bioenergy, these studies largely ignore the perspectives of private landowners, who own and exert control over this resource and ultimately decide whether or not to supply the feedstock necessary to produce bioenergy in states like Kentucky where family ownership of forest land dominates. Fewer studies have concentrated on the general perspectives of private landowners towards biomass and bioenergy, but often identify characteristics of landowners that affect their perspectives and preferences.

Janota and Broussard (2008) examined perspectives of NIPF owners regarding biomass related policies in Indiana and found that attitudes, motivations for owning land, absentee ownership and riparian areas had a significant effect on policy preferences, but socio-demographic and land characteristics mattered little. In another survey of NIPF owner policy preferences toward biomass, Shivan and Mehmood (2010) showed that landowners generally prefer tax-based policies compared to direct subsidies. Factors that affected preference were income, age, residence patterns, size of ownership, objectives, size of trees on land, and previous experience with assistance programs. In this case socio-demographic factors and land characteristics did play a role. It is clear that there is a complex set of interactions that affect landowner decision-making and preferences regarding biomass. Learning more about family forest owners and the characteristics that affect their behavior will lead to better understanding of landowner intent to supply biomass.
Conceptualizing Family Forest Owners

Previous research involving private landowners has occurred in various geographical regions across the U.S., but not yet in Kentucky. This thesis will be one of the first studies to survey landowners in Kentucky on their willingness to participate in biomass harvesting. The use of surveys is beneficial in understanding how large groups of people think, feel, and act; surveys have been widely used in research involving family forest owners.

Butler and Leatherberry (2004) used data from the USFS annual National Woodland Owner Survey has to compile statistics about family forest owners across the United States. Many studies have aimed to understand and even characterize private woodland owners and how those types affect decisions and management. Kluender and Walkingstick (2000) developed a typology of NIPF owners in Arkansas using results from a mail survey and Ross-Davis and Broussard (2007) surveyed Indiana landowners to differentiate types of owners and implications for management in their state. Individual reasons for owning land further develop our understanding of private forest owners. Kendra and Hull (2005) surveyed new forest owners in Virginia to determine groups of owners by their motivation for forest ownership and discuss methods of appealing to these individuals, which has important implications for extension workers. Landowner motivations can also be influenced heavily by attitudes. Majumdar et al. (2008) analyzed family forest owners in Alabama, Georgia, and South Carolina and determined three groups based on attitudinal ownership types; multiple-objective, non-timber, and timber. Each of these groups would likely have different preferences or perspectives on providing
biomass for energy. Understanding how attitudes, characteristics, and other factors affect landowner decisions and behavior is critical to development of a bioenergy system based on supply from private forests.

*Landowner characteristics significant to attitudes and behavior –*

Understanding the factors that affect landowner decision-making can inform policymakers attempting to predict behavior. A review of work in this area is beneficial to predicting factors that will affect decisions regarding supply of biomass. Gramman et al. (1985) suggests that landowner beliefs and past management plans are important factors affecting management on NIPF’s. Bourke and Luloff (1994) found that the attitudes of Pennsylvania landowners are closely aligned to those of the public and are not generally affected by socio-demographics, intended uses, or ownership patterns. Past behavior may also have an effect on cognitive intent of woodland owners (Trafimow and Borrie 1999). Additional factors that have been shown to affect landowner decisions and behavior are land characteristics (Conway et al. 2003) and whether or not the land was inherited. Majumdar et al. (2009) found that inheritors are more likely to be active managers than those that purchased their land. The results of these studies demonstrate the types of factors that may influence the intentions of family forest owners in Kentucky. Examining the intentions of woodland owners is possible through the use of surveys and the method has been applied previously.

*Surveying Family Forest Landowner Intentions/Willingness –* The literature contains many examples of attempts to measure the intent, or willingness of landowners to engage in specific activities. Parker (1986) conducted a survey of
intent to sell fuelwood among Michigan landowners in 1980 and enjoyed a
tremendously high response rate (75%). Fletcher (2009) explored NIPF owner
intent to sell carbon credits based on six different regulatory schemes. More
relevant to this study is research on intent to supply biomass for bioenergy
specifically. Gruchy et al. (2011) used a mail survey to assess willingness to harvest
biomass among family forest owners in Mississippi, paying special attention to the
preferences for harvest type compared to clear cutting. An effective way to analyze
intended behavior is to employ psychosocial theories of behavioral intention. These
theories can be incorporated to design surveys that measure intent and include
specific factors that behavioral scientists have identified as significant in shaping
intentions.

**Theory of Planned Behavior**

The theory of planned behavior (TPB) was first proposed in 1985 by Icek
Ajzen (Ajzen 1985). TPB is a behavioral model designed to predict human behavior
and is a logical extension of the theory of reasoned action (Fishbein and Ajzen
1975). The central idea behind TPB is that intent to perform a specific behavior is
the best predictor of future behavior, and that intent is a function of an individual’s
attitude, subjective norms, and perceived behavioral control. Attitude toward the
behavior refers to how favorably or unfavorably the individual perceives the action.
A subjective norm is defined as the individual’s perception of the social pressures to
perform or not perform that action. Finally, perceived behavioral control represents
the individual’s perception of how easy or difficult it is to perform the action (Ajzen
1991). The theory of planned behavior is possibly the most widely researched
behavioral model (Armitage and Connor 2001) and has been used in many disciplines, including the measurement of intent among private forestland owners.

*Natural Resource Surveys based on Theory of Planned Behavior* – There is scientific precedence for designing natural resource surveys using the theory of planned behavior. Karpinnen (2005) used the theory of planned behavior to model the intentions of NIPF owners regarding their choice of forest restoration methods and also found that attitude was the strongest predictor of behavioral intent. Munsell et al. (2009) used TPB to explore the intent of woodland owners to engage in sustained yield management practices. Additionally, it is acceptable to include additional predictors in the model if they account for significant variance (Ajzen 1991). Thompson (2009) used an expanded TPB model that included measures for innovativeness, environmental orientation, perceived risk, and knowledge of activity in question to examine private landowner intent to participate in carbon markets across the United States. Lastly, Pouta and Rekola (2001) used the theory of planned behavior to examine the intent of the community to pay for forest regeneration in Finland. Although this study did not measure intent among private forestland owners, it is relevant to the present study because it included experimental information factor. Some participants received treatment information regarding the behavior in questions while other did not. However, the treatment effect did not significantly affect reported intent. The following studies are most similar to the project presented in this research study.

Campbell (1988) explored the characteristics, attitudes, and perceived barriers to biomass harvesting among landowners in the Great Lakes states over
two decades ago. Price was the most important factor, along with availability of technical advice and equipment as barriers. In a survey of Alabama NIPF owner’s willingness to supply biomass, Paula et al. (2011) found significant factors included size of woodland, active management, and price. Additionally, 61% were willing to supply timber for biofuel production and 73% were willing to supply timber harvest residues. Joshi and Mehmood (2011) surveyed family forest owners’ willingness to supply biomass in Florida, Arkansas, and Virginia. Significant factors were woodland size, species composition, management objectives, age and education. Most recently, Markowski et al. (2012) conducted a similar survey of Massachusetts’s family forest owners’ willingness to harvest biomass and found a lower probability than the researchers expected and suggested that inter-region results vary.

**Research Rationale**

Although the body of literature covering biomass and biofuels is vast and varied, there are still considerable unknowns concerning the social availability of bioenergy feedstock from family forests, specifically private landowner’s intent to participate in harvests that include energy wood and the factors that influence those decisions. Recent research has successfully provided willingness predictions and probabilities for other states, along with several key factors influencing those decisions. Although those results are useful for comparison, no data is currently available concerning social availability of energy wood in Kentucky. Additionally, this study will determine the factors that matter to Kentucky landowners through the use of a well-established behavioral intention model with proven success in
natural resource surveys. The results of the study will contribute to the current scientific literature by expanding estimates of social availability into unexplored populations using cross-disciplinary methods. Additionally, these results will help policymakers and stakeholders estimate the supply of biomass obtainable from private landowners while planning the future of renewable energy production in Kentucky, as well as provide insight into effective topics and strategies for targeting outreach programs regarding the bioenergy industry.
Literature Cited


Chapter Three: Manuscript

Private Landowner Intent to Supply Forest Biomass for Energy in Kentucky

Zachary J. Leitch

Introduction

Demand for clean renewable energy sources has increased in the last decade due to heightened awareness of global climate change caused by atmospheric greenhouse gas accumulation and the desire to achieve energy independence from petroleum exporting nations. In response the federal government has issued regulations requiring increased use of renewable fuels. The Renewable Fuels Standards, originally established by the Energy Policy Act of 2005, were updated in 2007 with the passage of the American Security and Independence Act (United States Environmental protection Agency 2012). This standard requires that states continually increase use of renewable fuels through the year 2025 and limit the amount of corn-based ethanol that can contribute to the total renewable fuel goals.

Many states in the Southeastern US have the potential to meet renewable energy production goals through the use of biomass. Approximately 89% of the biomass on Earth exists in standing forests (Petrou and Pappis 2009) therefore, energy wood from forest resources will likely contribute significantly to the supply of bioenergy feedstock. This material will most often be collected together with traditional timber products during commercial harvest operations, at least until dedicated bioenergy crops, such as switchgrass or short-rotation plantations are widely established. In this paper, energy wood harvest will refer to a harvest that
removes traditional products together with low-value material appropriate for bioenergy production.

Establishing a wood energy supply chain in the Southeast will presumably require participation from family forest owners who own 59% of the forestland in the South (Butler and Leatherberry 2004). This is especially true in Kentucky where 78% of the forestland belongs to private families (Thomas et al. 2007). A crucial step in determining the availability of feedstock is to understand whether or not forest landowners intend to harvest energy wood from their property. Estimates of landowner intent and an increased understanding of factors affecting landowner decisions will be valuable for policymakers working to design and implement an effective statewide supply chain strategy, industry professionals planning the construction of conversion facilities, logging companies investing in specialized harvesting equipment, organizations that work with private landowners and state agencies planning future energy production strategies.

Although the body of literature covering biomass and biofuels is vast and varied, there are still considerable unknowns concerning the supply of bioenergy feedstock from family forests, specifically private landowner’s intent to participate in harvests that include the extraction of energy wood and the factors that influence those decisions. Recent research has successfully provided willingness predictions and probabilities for some states in the Eastern US, along with several key factors influencing those decisions. In a survey of Alabama non-industrial private forest owner’s willingness to supply biomass, Paula et al. (2011) found significant factors included size of woodland, active management, and price. Additionally, 73% of
respondents were willing to supply timber harvest residues for biofuel production. Joshi and Mehmood (2011) surveyed family forest owners’ willingness to supply biomass in Florida, Arkansas, and Virginia. Significant factors were woodland size, species composition, management objectives, age and education. Most recently, Markowski et al. (2012) conducted a similar survey of Massachusetts’s family forest owners’ willingness to harvest biomass and found a lower probability than the researchers expected and suggested that inter-region results vary. Although these results lay a foundation for understanding the social availability of forest biomass, this research should be extended into additional states and populations.

The research presented here aims to further analyze the social availability of energy wood using a survey of private forest owners across the Commonwealth of Kentucky. Kentucky is an interesting case study due to its unusually high private ownership of forest resources and its geographical position at the border of the Northern and Southern regions of the Eastern US. Kentucky’s forests are 78% owned by families (Thomas et al. 2007), compared to 59% in the Southeast, 55% in the Northeast and 42% nationwide (Butler and Leatherberry 2004). The results will strengthen our understanding of family forest owner intent to harvest energy wood in the central hardwood region of the Eastern US. Results of factors that affect intent to harvest energy wood may apply to family forest owners nationwide. This survey was designed to quantify current intent to include energy wood in future harvests among private landowners and determine what influences those intentions using a widely accepted theoretical framework of behavioral intent, called the Theory of Planned Behavior (Ajzen, 1991).
This research also contains an experimental factor, designed to test the effect of extension type outreach information on intent to harvest energy wood.

Treatment materials were developed to educate landowners about forest bioenergy production and harvesting. The results of the study will contribute to the current scientific literature by expanding estimates of social availability into unexplored populations using cross-disciplinary methods. Additionally, these results will help policymakers and stakeholders estimate the supply of biomass obtainable from private landowners while planning the future of renewable energy production and determine what factors affect intent, providing insight into effective topics and strategies for targeting outreach programs regarding the bioenergy industry.

Methods

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is a behavioral model designed to predict human behavior and is a logical extension of the theory of reasoned action (Fishbein and Ajzen 1975). The central idea behind TPB is that intent to perform a specific behavior is the best predictor of future behavior, and that intent is a function of an individual’s attitude, subjective norms, and perceived behavioral control (Ajzen 1985). Attitude toward the behavior refers to how favorably or unfavorably the individual perceives the action. A subjective norm is defined as the individual’s perception of the social pressures to perform or not perform that action and their motivation to comply. Finally, perceived behavioral control represents the individual’s perception of how easy or difficult it is to perform the action (Ajzen 1991). Figure 3.1 provides a graphical representation of the TPB construct.
There is scientific precedence for designing natural resource surveys using the theory of planned behavior. Karpinnen (2005) used the TPB to model the intentions of family forest owners regarding their choice of forest restoration methods and found that attitude was the strongest predictor of behavioral intent. Munsell et al (2009) used TPB to explore the intent of woodland owners to engage in sustained yield management practices and Thompson (2010) used an expanded TPB model to examine private landowner intent to participate in carbon markets across the United States. Lastly, Pouta and Rekola (2001) used the theory of planned behavior to examine the intent of the community to pay for forest regeneration in Finland. Although this study did not measure intent among private forestland owners, it is relevant to the present study because it included an experimental information factor, in which some subjects received treatment information regarding the behavior in questions while others did not. In this case, the treatment effect did not significantly affect reported intent.
Experimental Treatment

Harvesting forest biomass for bioenergy production may be an unfamiliar topic among many woodland owners, and lack of knowledge may inhibit their intent to include energy wood in future harvests. Previous studies have suggested that print materials are an effective medium for communicating with many family forest owners (Kuhns et al. 1998; Salmon et al. 2006). Therefore, this study included an experimental component designed to test the effect of extension-type educational materials on behavioral intent. Half of participants were randomly selected to receive the information treatment along with their survey, while the control group received the survey only. The information packet was created together with the University of Kentucky Cooperative Forestry Extension Service to educate landowners about bioenergy in general, appropriate feedstock material, harvesting information, and potential consequences. Full color photographs demonstrated post harvest effects at various removal intensities.

Survey Development

To examine the intent of family forest owners to harvest forest biomass for bioenergy a self-administered survey consisting of 55 questions was developed. It was designed to measure family forest owner intent to harvest energy wood and the effect of the theory of planned behavior predictors on those intentions. These predictors are attitude, subjective norms and perceived control, and the model was extended to include prior knowledge. The survey included additional questions regarding land characteristics and prior harvest activity adapted from the Kentucky National Woodland Owner Survey, and standard demographic questions from
Qualtrics Survey Software. The TPB measures were developed in the following ways:

Attitude was assessed using a six-question measure consisting of four questions concerning individual's feelings and possible outcomes of energy wood harvesting. Two additional outcome evaluation questions measured the perceived value of those possible outcomes of the activity. Each item used a six-point Likert-type response scale. Many confounding thoughts, feelings and perspectives shape attitudes, so an additional question asking respondents to indicate their overall attitude on a seven-point positivity scale was included to measure attitude apart from the composite measure.

Subjective norms were assessed using an eight-question measure with four questions regarding perceptions of forestry professionals, county extension workers, family, and other forest owners’ beliefs that the individual should harvest energy wood. Four additional questions asked respondents to measure their motivation to comply with their perceptions of social pressure from each of these groups. Each item used a six-point response scale ranging from *Strongly Disagree* to *Strongly Agree*.

Perceived control was assessed using a three-question measure containing questions about the possibility of biomass harvesting on the individual's land, the ease/difficulty of doing so, and the ease/difficulty of overcoming any barriers the individual listed in a previous open-ended question. Each item was measured using a six-point response scale.
Prior knowledge was assessed using a four-question measure consisting of two questions about the subject’s knowledge of energy wood harvesting measured on six-point response scales and two questions regarding the perceived prevalence of energy wood harvesting among other forest owners, measured using seven-point response scales. In this case a neutral response was included to accommodate subjects that were completely unaware of the prevalence of wood energy harvesting.

Behavioral Intent was assessed using two questions that capture intent through different wording and response types. Subjects were asked to respond yes/no to the statement “I intend to include energy wood in future harvests on my land.” Respondents were only provided with a yes or no choice to force a positive or negative response and eliminate neutral reporting, which provides insight into general intentions regarding wood energy harvest rates among survey participants. The other question asked the individual to report their agreement with the following statement: “Future harvests on my land will only remove timber products such as commercial sawlogs and/or veneer. I do NOT want any energy wood harvested. All of the branches, leaves, and low value trees will remain on site.” Participants were provided with a seven-point Likert response scale, including a neutral option to capture indecisiveness. These questions provide two dependent variable types, dichotomous and continuous, for a more robust analysis of intent. Table 3.1 provides a list of the survey questions used to measure attitude and subjective norms. Table 3.2 provides a list of the survey questions used to measure perceived control, prior knowledge and intent.
### Table 3.1 Attitude and Subjective Norms Survey Questions

#### Attitude

I feel positively about the idea of creating energy from trees growing in my forest.

*Strongly Disagree - Strongly Agree*

Electricity and fuel made from wood, rather than fossil fuels, will lead to a healthier planet.

*Very Unlikely - Very Likely*

Taking steps to improve the environment is _________.

*Very Bad - Very Good*

Using domestic energy sources, such as wood energy, will reduce the nation’s dependence on foreign energy sources.

*Very Unlikely - Very Likely*

Reducing our country’s dependence on energy from foreign nations is _________.

*Not at all Important - Extremely Important*

Harvesting energy wood will improve the health of my forest land.

*Very Unlikely - Very Likely*

#### Overall Attitude

Below, please indicate your overall attitude about energy wood harvesting in Kentucky.

*Extremely Negative - Extremely Positive*

#### Subjective Norms

Forester and other forestry professionals believe that I should harvest energy wood from my land.

*Strongly Disagree - Strongly Agree*

When it comes to my forestland, I want to do what forestry professionals think I should do.

*Strongly Disagree - Strongly Agree*

County extension agents believe that I should harvest energy wood from my land.

*Strongly Disagree - Strongly Agree*

When it comes to my forestland, I want to do what county extension agents think I should do.

*Strongly Disagree - Strongly Agree*

My family believes that I should harvest energy wood from my land.

*Strongly Disagree - Strongly Agree*

When it comes to my forestland, I want to do what my family thinks I should do.

*Strongly Disagree - Strongly Agree*

Other forest owners I know believe that I should harvest energy wood from my land.

*Strongly Disagree - Strongly Agree*

When it comes to my forestland, I want to do what other forest owners think I should do.

*Strongly Disagree - Strongly Agree*
Table 3.2 Perceived Control, Prior Knowledge and Intent Survey Questions

<table>
<thead>
<tr>
<th>Perceived Control</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>It is possible for me to conduct harvest that include energy wood in my forests.</td>
<td>Strongly Agree - Strongly Disagree</td>
</tr>
<tr>
<td>Conducting a forest harvest that includes energy wood is</td>
<td></td>
</tr>
<tr>
<td>Very Easy - Very Difficult</td>
<td></td>
</tr>
<tr>
<td>If you listed any barriers, how easy or difficult is it to overcome these barriers.</td>
<td>Very Easy - Very Difficult</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prior Knowledge</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I have an in-depth understanding of energy wood harvesting.</td>
<td>Strongly Disagree - Strongly Agree</td>
</tr>
<tr>
<td>I understand how wood energy harvests are different from traditional timber harvests.</td>
<td>Strongly Disagree - Strongly Agree</td>
</tr>
<tr>
<td>Other forest owners in Kentucky have harvested energy wood from their land.</td>
<td>Strongly Disagree - Strongly Agree</td>
</tr>
<tr>
<td>I hear people discussing the potential of using wood for energy creation.</td>
<td>Strongly Disagree - Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Future harvests on my land will only remove timber products such as commercial sawlogs and/or veneer. I do NOT want any energy wood harvested. All of the branches, leaves and low value trees will remain on the site.</td>
<td>Strongly Disagree - Strongly Agree</td>
</tr>
<tr>
<td>I intend to include energy wood in future harvests on my land.</td>
<td>Yes or No</td>
</tr>
</tbody>
</table>

Population Sample

The target population of this study is active family forest owners with a degree of interest in management who own at least 15 acres of woodland in the state of Kentucky. These are the individuals most likely to engage in future harvest activity and be faced with the decision whether or not to include energy wood. This acreage minimum is consistent with similar studies that have used 10 (Markowski et al. 2012) and 20 (Joshi & Mehmood 2011; Paula et al. 2011) acres as a minimum ownership cutoff. The population sample was drawn from a list of family forest owners obtained from the University of Kentucky Cooperative Forestry Extension
Service. The list included individuals from across the state that had completed UK Forestry Extension woodland owner courses and owners of American Tree Farm certified forests as examples of landowners exhibiting engaged behavior and interest in management activities. Previous studies similar to this have used a variety of methods to acquire population samples. Paula et al. (2011) mailed surveys to all family forest owners with minimum acreage in a specific Alabama county and Markowski et al. (2012) chose landowners randomly based on property tax information. Joshi and Mehmood (2011) used a combination of information from the Arkansas Forestry Commission, a commercial vendor, and county tax assessors to compose a population sample for their three-state analysis.

During October and November 2011, individuals with contact information and a qualifying amount of land were phoned and asked if they were willing to participate in the study. When applicable, landowners who could not be reached after the second attempt were left a message describing the project and explaining that a survey was being sent to them. A small number of surveys sent out (12) were mailed to individuals that heard of the study from a woodland owner group and were recruited through email correspondence.

**Data Collection**

Surveys were mailed to individuals that agreed to participate, or that had been left a message explaining the study, on the next business day following contact. Included with the survey was an informed consent form explaining the purpose and details of the study, as required by the Institutional Review Board, and a pre-addressed prepaid return envelope to ease response. Approximately half of the
subjects were randomly included in the treatment group that received the seven-page energy wood information packet along with the survey. A total of 341 surveys were sent out – 172 control and 169 treatment. Subjects were directed to return the signed consent form along with their survey using the provided envelope. Data from returned surveys were manually entered into a project database in December 2011.

**Statistical Analysis**

All statistical analyses were conducted using IBM’s SPSS Statistics version 20. Data handling and analyses were adapted from operational protocols provided by Francis et al. (2004). Responses to questions regarding each of the TPB predictors (see Tables 3.1 and 3.2 above) were combined to form a single composite continuous variable for that predictor measure by summing the subject’s response values and dividing by the number of response choices. Cronbach’s alpha measure of internal reliability was computed for each of the composite measures. Given the variety of composite scale compositions, composite scores were then standardized to simplify analysis of results. In addition, differences in spread between scale items are nullified through standardization. A small percentage of subjects (9%) avoided reporting yes or no regarding intent to harvest energy wood in the future, reporting in some way that they were unsure. These responses were categorized as no for analysis purposes, because the subject was unwilling to say yes, and because an analysis of these subjects’ responses to the continuous intention question showed low intent.
TPB predictors were tested on both the dichotomous and continuous measures of intent, because they were both designed to analyze behavioral intent, albeit in different ways. Multiple linear regression was used for continuous intent, with the equation: \( y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_k x_k + \varepsilon \). Multiple logistic regression was used for the dichotomous yes/no measure, with the equation: 

\[
\log(\text{odds intent}) = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_k x_k + \varepsilon,
\]

where independent variable coefficients are the log odds ratios, versus slope in the linear model. In each equation the independent variables are the theory of planned behavior predictors attitude, subjective norms, and perceived control, extended in this study to include prior knowledge, and where epsilon is the residual error of the model. Both analyses used backward elimination, producing a parsimonious model. Other variables not included in the theoretical model were tested on both measures of behavioral intention and these intention measures were compared to one another. Dichotomous variables, including experimental condition, were tested on dichotomous intent using chi-square cross tabulation and tested on continuous intent using independent samples t-tests. Continuous variables were tested on dichotomous intent using logistic regression and tested on continuous intent with correlation.

**Results**

A total of 341 surveys were mailed to individuals across the state of Kentucky. Two were returned undeliverable, six were returned post-analysis, and nine were returned but did not qualify due to a missing signature on the consent form or because the individual had provided a reason not to participate. The final
analysis included surveys from 144 individuals for an adjusted response rate of 42%. 84 responses were from subjects in the control group and 59 in the treatment group. Table 3.3 provides descriptive statistics for survey respondents.

Landowners in this study owned forestland in 75 of Kentucky’s 120 counties, and represented all regions of the state. Figure 3.2 provides a representation of the participants’ woodlands by county.

Table 3.3 Descriptive Statistics of Survey Participants

<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>Percentage of all respondents (n = 144)</th>
<th>cont.</th>
<th>cont.</th>
<th>cont.</th>
<th>cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 - 34</td>
<td>1.4</td>
<td>9</td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>35 - 44</td>
<td>5.6</td>
<td>4.9</td>
<td>4.9</td>
<td>4.9</td>
<td>4.9</td>
</tr>
<tr>
<td>45 - 54</td>
<td>13.9</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>55 - 64</td>
<td>37.5</td>
<td>9.7</td>
<td>9.7</td>
<td>9.7</td>
<td>9.7</td>
</tr>
<tr>
<td>65 - 74</td>
<td>28.5</td>
<td>9.7</td>
<td>9.7</td>
<td>9.7</td>
<td>9.7</td>
</tr>
<tr>
<td>75 - 84</td>
<td>10.4</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>85 or over</td>
<td>2.1</td>
<td>7.6</td>
<td>7.6</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>100,000 or more</td>
<td>29.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>84.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>15.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>94.4</td>
<td>20.8</td>
<td>20.8</td>
<td>20.8</td>
<td>20.8</td>
</tr>
<tr>
<td>Native American</td>
<td>1.4</td>
<td>27.1</td>
<td>27.1</td>
<td>27.1</td>
<td>27.1</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than High School</td>
<td>0.7</td>
<td>12.5</td>
<td>12.5</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>High School</td>
<td>6.9</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Some College</td>
<td>20.1</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Associate’s</td>
<td>4.9</td>
<td>17.4</td>
<td>17.4</td>
<td>17.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Bachelor’s</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master’s</td>
<td>29.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctoral</td>
<td>5.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional (JD, MD)</td>
<td>6.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intent to harvest forest biomass for bioenergy was moderately high among survey respondents. 67% answered yes to the statement “I intend to include energy wood in future harvests on my land.” Only 16.7% answered no, and 6.3% did not provide an answer. Another 14 individuals (9.7%) did not answer the yes or no question, but provided hand-written answers, such as “not sure”, “maybe”, or “don’t know”. Similarly, 70.8% of subjects responded positively – Strongly Agree, Agree, or Somewhat Agree - to the continuous intention question. The results of the dichotomous measure of intent corresponded significantly with responses to this continuous intention measure (p= <.001), providing validity to each measure and justification for the parallel analysis.

Attitude was the strongest predictor of intent to harvest energy wood. It was significant in both dichotomous and continuous regression models. Both the self-reported overall attitude and the composite attitude measures were significant in the linear regression model, however only overall attitude was significant in the
logistic model. Subjective norms was significant in the dichotomous model only and perceived control in the continuous model only. Lastly, prior knowledge as an extension of the theory of planned behavior model was not significant in either the dichotomous or continuous model. Table 3.4 provides TPB variables and coefficients for each of the final intention regression models. Table 3.5 provides results of Cronbach’s alpha measure of internal reliability for the TPB predictor measures. Higher alphas represent greater reliability ranging from zero to one, with 0.6 as a minimum for acceptable reliability (Francis et al. 2004). There was no significant difference in reported intent to harvest energy wood between individuals in the control group and those who received the wood energy information packet along with their survey. However, the inclusion of educational materials did have a positive effect on the reported prior knowledge (p = .002) of individuals in the treatment group. The information treatment did not have an effect on the TPB predictors attitude, subjective norms, or perceived control. Additionally, subjects’ perceptions of forester and county extension worker's beliefs about energy wood harvesting, and preferences for harvest intensity were not affected by receiving the bioenergy information.

Table 3.4 Significant Regression Variables and Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>β (log odds ratio)</th>
<th>Odds Ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall attitude</td>
<td>1.533</td>
<td>4.361</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Subjective norms</td>
<td>1.184</td>
<td>3.267</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Nagelkerke R² = 0.546

<table>
<thead>
<tr>
<th>Variable</th>
<th>β (slope)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>-0.306</td>
<td>0.011</td>
</tr>
<tr>
<td>Overall attitude</td>
<td>-0.308</td>
<td>0.011</td>
</tr>
<tr>
<td>Perceived control</td>
<td>-0.165</td>
<td>0.032</td>
</tr>
</tbody>
</table>

R² = 0.428
Adjusted R² = 0.415
Table 3.5 Internal Reliability of Composite Measures

<table>
<thead>
<tr>
<th>Composite Measure</th>
<th>Cronbach's alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>0.765</td>
</tr>
<tr>
<td>Subjective Norms</td>
<td>0.879</td>
</tr>
<tr>
<td>Perceived Control</td>
<td>0.603</td>
</tr>
<tr>
<td>Prior Knowledge</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Very few of the demographic, prior harvest, or land characteristic factors outside of the theory of planned behavior that were analyzed had an effect on behavioral intent. Individuals who were aware that wood could be used as a renewable energy source before taking the survey showed greater intent for the dichotomous (p = .002) measure. Additionally, subjects that had harvested pulpwood from their forest in the past showed higher intent on the composite measure (p = .012). Lastly, landowners provided a broad and insightful list of potential barriers when asked to report what may prevent them from harvesting energy wood on their property. Lack of market and woodland access were the most frequently reported categories. Figure 3.3 provides the frequency of barriers reported by category.
Two-thirds of respondents reported that they intend to harvest energy wood in the future. This level of intent is consistent with the 65% willingness predicted by Joshi and Mehmood (2011) in their analysis of Arkansas, Florida, and Virginia landowners; it is also consistent with the recent study that reported 73% of Alabama family forest owners were willing to provide forest residues for energy
(Paula et al. 2011). The high rate of reported intent to include energy wood in future forest harvests provides positive implications regarding the supply of feedstock available for bioenergy production in Kentucky. Combined with political support from state and federal government, these results could provide the justification necessary to stimulate investment in conversion facilities and specialized harvesting equipment. Development of the necessary infrastructure and success of the industry may shift demand, leading to increased enthusiasm among private landowners that are hesitant to supply feedstock. Although a relatively high number of landowners intend to harvest energy wood, ten percent of individuals surveyed indicated that they were unsure of their energy wood harvest intentions. Understanding the intentions of this group of landowners may lead to outreach that assists them in making the decision that is right for them and their land.

This study used the theory of planned behavior (TPB) to understand why landowners are or are not willing to take part in a biomass industry in the state. TPB proposes that behavioral intention is the best predictor of behavior, and that intent is a product of an individual’s attitude, perceived subjective norms, and perceived control. Each of these factors played a significant role in predicting landowner intentions. Attitude is often the most important predictor of intent. Not surprisingly, attitude was the most important factor in this analysis. Both the composite and overall measures of attitude were significant. Individual outcomes included in the attitude measure of the survey were also tested against intent. Individuals who believe that bioenergy rather than fossil fuels will lead to a
healthier planet, that domestic bioenergy will reduce dependence on foreign energy sources, or that harvesting energy wood will improve the health of their forest were significantly more likely to intend to include energy wood in future harvests.

The influence of attitude in shaping intent to harvest energy wood should not be overlooked, because attitudes likely evolve over time. For example, corn ethanol as an energy source has led to questions regarding its competition with food production (Naylor et al. 2007) and the federal government chose not to renew subsidies for corn ethanol in December of 2011. This may contribute to a negative perception of bioenergy in general. Negative attitudes may become increasingly positive—over time—if non-corn bioenergy production becomes more prevalent, more cost effective or legally imperative.

In addition to attitude, the influence of subjective norms has important ramifications for the supply of feedstock from private landowners. Other studies found that subjective norms had a significant effect on willingness in other landowners studies based on TPB (Munsell et al 2009; Thompson 2010). This analysis reveals that individuals with higher intent often perceive that others believe they should supply wood energy and the study participants want to conform to those beliefs. Participants provided various responses regarding perceptions of social pressure to harvest energy wood. The accuracy of these perceptions and motivations to conform remain unclear and are beyond the scope of this study. However, it is clear that gaining wide support for the bioenergy industry and fostering positive trusting relationships with family forest owners will maximize supply. Designing an efficient and cost-effective statewide supply and production
system with broad political support will likely produce positive beliefs from the widest range of Kentuckians.

The final TPB predictor, perceived control, had a significant effect on the continuous measure of intent, which is consistent with other TPB studies mentioned above. Internal reliability of the perceived control question set was lower than expected. This is possibly due to two things: some respondents did not list any barriers, (or the associated difficulty of overcoming them) and the small number of items in the scale. Conducting a pilot test of the survey and making the necessary corrections to questions could have prevented this minor limitation.

Obviously, landowners do not intend to supply biomass if they feel that doing so is out of their control. As a result, policymakers should consider making the knowledge, methods, and tools necessary for harvest easily available to those woodland owners who need them. Based on an open-ended survey question, the forest owners revealed their awareness of the barriers preventing them from harvesting energy wood. Frequently cited challenges (i.e. markets, ecological damages, conversion facilities) were also identified as weaknesses and threats by professional stakeholders in the Southeast (Dwivedi & Alavalapati 2009). While not all of these challenges can be overcome, policymakers and forestry professionals may be able to develop strategies and solutions that make it possible for otherwise enthusiastic landowners to conduct harvests.

The characteristics outside the TPB theoretical construct that affected reported intent were fewer than expected, but each of them withstands logical scrutiny. The landowners familiar with the capacity to create renewable energy
from wood before taking the survey were more likely to report intent to harvest. Landowners unfamiliar with wood energy are unlikely to intend to supply forest biomass for an industry, which they have not yet formed attitudes, perceptions of social pressure and motivation to comply, or feelings of control. Study participants who harvested pulpwood during prior harvests were more likely to report positive intent. The species and types of material commonly harvested for pulpwood are similar to those harvested and chipped for energy production. These individuals likely have more of those species on their property or they are familiar with the process of removing residues during traditional harvests. 

Surprisingly, other factors such as primary forest use did not affect intent in this study. It was expected that individuals whose reported primary use of forestland is recreation would be less willing to harvest energy wood. Previous research has shown that recreational owners are less likely to conduct a harvest (Kuuluvainen et al. 1996; Young & Reichenbach 1987). Other important and interesting characteristics that were insignificant were whether or not the individual had harvested in the past and the amount of woodland owned. Although 67% of respondents had conducted harvested previously, this group was no more likely to intent to include energy wood in future harvests. Larger woodland ownership is often associated with positive intent or willingness to harvest forest biomass as in each of the similar studies mentioned above (Joshi and Mehmood 2011; Paula et al. 2011; Markowski et al. 2012).

The inclusion of the experimental information treatment did not affect intent to harvest wood energy among participants in this survey. This does not diminish
the value of communication products and materials created by extension offices for private landowners. Since this study used a mail survey format, it is impossible to know if subjects in the treatment group actually read the provided packet let alone, if the information provided may not have been new and useful to them. The factors that did affect intent, such as attitude and perceived subjective norms, are the culmination of information received over time and from multiple sources (e.g., extension office, friends, neighbors, media sources, etc.). Some landowners also reported not having enough information to make a decision, and others cited their lack of knowledge as a barrier to energy wood harvesting. Clear and useful information from multiple sources should help landowners make decisions that are right for them.

The 42% survey response rate for this study is comparable to two similar studies Paula et al. 2011 (41% response rate) and Markowski et al. 2012 (49% response rate). Mail-based surveys are often susceptible to low response rates, with an average around 18% (Fowler 2009), but the moderately high response rate in this study is likely due to the three factors: participant recruitment strategy, the connection of the population to the subject matter, and ease of returning the survey materials (e.g., inclusion of prestamped return envelopes). These three factors are also limitations because of experimental bias and participant bias.

For example, the author personally phoned each study participant to inform them of the study; based on that conversation, study participants decided if they wanted to participate in the study or not. Those who had a favorable interaction with the author were more likely to compete the survey. Additionally, landowners
who participated in woodland owner courses or who own ATF certified forests may have more interest in forestry related activities than the average family forest owner in Kentucky and were more likely to participate in the study. It should be noted that landowners from all over Kentucky provided these responses. As a result, the distribution of woodland representation across the state enhances validity of the population sample and many demographic results were similar to those available for family forest owners in the entire southeast, who are older and better educated than average adults in the US (Butler & Leatherberry 2004). A few centrally located counties had more representation than others; this is likely due to woodland owner courses that were held relatively close to the start of participant recruitment for this study. Contact information for those individuals was likely more up-to-date, resulting in greater likelihood of contact and recruitment.

**Conclusion**

The research presented here explores the social availability of forest biomass for energy production in Kentucky. The success of this industry will be greatly impacted by the supply of feedstock from private individuals who own a majority of forest resources in the state. The methods and theoretical constructs employed in this study successfully answered the research questions presented. Further, this study provides an initial evaluation of landowners’ intent to harvest energy wood and also outlines the factors, barriers, and characteristics that shape those intentions. Based on this study’s findings, general intent was favorable, with two-thirds of landowners reporting their intent to harvest energy wood. The study also reveals how these intentions are shaped by attitudes about biomass and bioenergy,
perceived subjective norms, feelings of control, and prior knowledge of wood
energy harvesting.

Knowing family forest owner’s intentions is critical to furthering the forest
biomass industry in Kentucky, but landowners also reported many challenges that
prevent them from harvesting energy wood. These challenges are vital
informational inputs that policymakers need to consider while creating an effective
statewide supply chain strategy. Design and implementation of the forest biomass
industry should take into account the interests and abilities of suppliers at all stages.
Although the informational packet provided to woodland owners in this study did
not affect intent, the role of communication and community outreach should not be
overlooked. This study provides stakeholders at all levels with the valuable
information that can enhance the creation of a sustainable forest biomass industry
in Kentucky; however, continued communication with and outreach to landowners
is needed to ensure the success of the biomass and bioenergy industry in Kentucky.
Literature Cited


Chapter Four: General Conclusions

The development of a viable biomass and bioenergy industry in Kentucky will help the Commonwealth meet its renewable energy goals in accordance with federally mandated fuel standards. The success of this industry will be greatly impacted by the supply of energy wood from Kentucky’s family forest owners. This study was conducted to answer the following research questions concerning the social availability of forest biomass:

RQ1: What portion of engaged family forest owners in Kentucky intends to harvest energy wood?

RQ2: What characteristics can be used to predict family forest owner intent to harvest energy wood?

RQ3: Does the provision of bioenergy educational materials have an effect on family forest owner intent to harvest energy wood or landowner attitudes, perceived control, or subjective norms?

The survey tool and methodology, the Theory of Planned Behavior construct, and the landowner information packet developed with the University of Kentucky Cooperative Forestry Extension Service allowed each of these questions to be answered. Landowner intent to harvest energy wood in the future is generally high, at 67%, and is shaped by individuals' attitudes, subjective norms, and perceived control. While information materials in this study did not affect reported intentions, communication and education between all stakeholders are no doubt vital to the success of the bioenergy industry in the state.
Contributions

This research contributes to the scientific literature concerning the social availability of biomass for bioenergy production. Rates of intent are comparable to those of previous studies, substantiating the field’s current understanding and ability to make accurate future predictions. For example, this study extends current scientific knowledge by studying a new population (i.e., Kentucky landowners) and revealing that, despite geographic location, this population has similar intentions and barriers, to participating in the forest biomass industry, to landowners in other states. Additionally, this study validates the theoretical constructs of TPB and provides evidence of the successful use of interdisciplinary methods in forestry research. Finally, the study's findings on the information treatment provide insight on how community outreach and public education efforts may or may not affect landowner intentions.

This study's findings can be used by multiple stakeholders involved in the development of Kentucky's bioenergy industry as evidence to suggest there is sufficient supply necessary to spur further development of markets and infrastructure. Not only will this study impact state agencies that develop and implement bioenergy policy, but also stakeholders the private sector, such as industry professionals and investors and even logging companies, involved in the construction of collection and conversion facilities or the procurement of specialized harvest equipment and training of employees. This information is also beneficial to professional foresters and forest extension agents who assist family forest owners with the management of their resources. Knowing which barriers
Kentucky landowners feel prevent them from harvesting wood energy provides foresters and extension agents with an opportunity to develop a strategic plan that will make harvesting easier for family forest owners. Finally, even Kentucky family forest owners will be able to glean some useful information from this study. Perceived subjective norms play a significant role in shaping intent and these results will help landowners understand how other family forest owners in the state view wood energy harvesting.

**Limitations**

There are four limitations of this research study. First, the use of a survey method limits the external validity of the study’s findings, because it is not possible to generalize the data to the population as a whole. Since the survey was mailed to the study participants, it is unknown who actually filled out the information. Additionally, experimenter bias could have impacted the survey response rate; those study participants who had a favorable interaction with the author may have been more likely to participate in the research study. The second limitation is the study sample. Although responses were collected from across the state, it cannot be assumed that the subjects surveyed provide an exact representation of the average Kentucky family forest owner. Subjects were likely more active managers as they had previously attended woodland owner courses or completed the American Tree Farm certification process. Additionally, a larger sample size would better represent the population and provide more power to the analysis. The larger sample could have been achieved by acquiring assistance in the time-consuming subject recruitment process. The third limitation of this study is lack of a pilot test
to ensure the reliability and validity of the survey instrument. Conducting a pilot study would provide an opportunity to conduct a factor analysis before hand and ensure the survey instrument had internal validity. The factor analysis would have revealed if the survey instrument was an accurate predictor of the variables under study. The fourth limitation is the lack of a formative research on the type of information included in the experimental information treatment. Conducting basic formative research, such as holding focus group sessions, would have provided needed insight on what information to include in the treatment. Identification of the type of information that woodland owners lack prior to development may have led to a significant treatment affect.

**Future Research**

The study of the social availability of forest biomass for bioenergy is an understudied area in the forestry discipline. Based on this study’s findings, there are four future studies that could be undertaken. First is the further examination of the factors and considerations that shape individual’s attitudes concerning energy wood harvesting. Attitude is the most important determinant of intent and it is the product of many complex and confounding concepts. Inquiry could analyze attitude as a function of economics, land ethics, environmental philosophy, and geopolitical ideology.

The second study could focus on perceived subjective norms. The accuracy and formation process of landowner perceptions concerning professional forester and extension worker beliefs and what motivates them to comply with those perceptions are unknown at this time. Analysis of this process would assist these
professionals in developing and fostering positive relationships that lead to satisfied woodland owners and increased supply. Research might include a comparison between past experiences of landowners and assistance from forest professionals in various Kentucky counties.

The third study could provide further analysis of the barriers landowners feel prevent them from harvesting energy wood. The complexity of these barriers is unknown; future studies could analyze these obstacles and determine the feasibility of overcoming them. The fourth study could analyze landowner’s willingness to participate in biomass supply cooperatives, another suggestion formulated by Governor’s Executive Task Force on Biomass and Biofuels. Energy wood cooperatives that share equipment, expertise, and labor may be the most effective organizational strategy for supply of bioenergy feedstock. Analysis of landowner willingness to participate in cooperatives and the feasibility of aggregating biomass harvests on small parcels of land may be useful in the formation of regional bioenergy cooperatives.
Appendix

5.1 Survey Instrument

University of Kentucky Department of Forestry
Wood Energy Survey

When we say wood energy in this survey we are talking about bioenergy made from forest material, such as low-value trees and branches. We refer to this type of material as energy wood. This material is typically harvested together with traditional forest products, such as sawlogs, veneer logs, and pulpwood.

Directions: Please answer each question as honestly as possible. When you are finished place the survey inside the supplied envelope and drop in an outgoing mailbox.

1. I feel positively about the idea of creating energy from trees growing in my forest.
   - Strongly Disagree
   - Disagree
   - Somewhat Disagree
   - Somewhat Agree
   - Agree
   - Strongly Agree

2. Electricity and fuel made from wood, rather than fossil fuels, will lead to a healthier planet.
   - Very Unlikely
   - Unlikely
   - Somewhat Unlikely
   - Somewhat Likely
   - Likely
   - Very Likely

3. Taking steps to improve the environment is ____________.
   - Very Bad
   - Bad
   - Poor
   - Fair
   - Good
   - Very Good

4. Using domestic energy sources, such as wood energy, will reduce the nation's dependence on foreign energy sources.
   - Very Unlikely
   - Unlikely
   - Somewhat Unlikely
   - Somewhat Likely
   - Likely
   - Very Likely

5. Reducing our country's dependence on energy from foreign nations is ____________.
   - Not at all Important
   - Very Unimportant
   - Somewhat Unimportant
   - Somewhat Important
   - Very Important
   - Extremely Important

6. Harvesting energy wood will improve the health of my forest land.
   - Very Unlikely
   - Unlikely
   - Somewhat Unlikely
   - Somewhat Likely
   - Likely
   - Very Likely

7. Below, please indicate your overall attitude about energy wood harvesting in Kentucky.
   - Extremely Negative
   - Negative
   - Somewhat Negative
   - Neutral
   - Somewhat Positive
   - Positive
   - Extremely Positive
8. Foresters and other forestry professionals believe that I should harvest energy wood from my forestland.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

9. When it comes to my forestland, I want to do what forestry professionals think I should do.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
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<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

10. County extension agents believe that I should harvest energy wood from my forestland.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

11. When it comes to my forestland, I want to do what county extension agents think I should do.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

12. My family believes that I should harvest energy wood from my forestland.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

13. When it comes to my forestland, I want to do what my family thinks I should do.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

14. Other forest owners I know believe that I should harvest energy wood from my forestland.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

15. When it comes to my forestland, I want to do what other forest owners think I should do.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
16. It is possible for me to conduct harvests that include energy wood in my forests.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

17. Conducting a forest harvest that includes energy wood is ____________.

<table>
<thead>
<tr>
<th>Very Easy</th>
<th>Easy</th>
<th>Somewhat Easy</th>
<th>Somewhat Difficult</th>
<th>Difficult</th>
<th>Very Difficult</th>
</tr>
</thead>
</table>

18. I know how to go about conducting a harvest on my land.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

19. What barriers may prevent you from harvesting energy wood on your forest land?

[Blank space for answer]

20. If you listed any barriers, how easy or difficult is it to overcome these barriers?

<table>
<thead>
<tr>
<th>Very Easy</th>
<th>Easy</th>
<th>Somewhat Easy</th>
<th>Somewhat Difficult</th>
<th>Difficult</th>
<th>Very Difficult</th>
</tr>
</thead>
</table>

21. I have an in-depth understanding of wood energy harvesting.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

22. I understand how wood energy harvests are different from traditional timber harvests.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

23. Other forest owners in Kentucky have harvested energy wood from their land.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

55
24. I hear people discussing the potential of using wood for energy creation.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

25. Before taking this survey, were you aware that wood can be used as a renewable energy source?

- Yes ☐
- No ☐

26. How many acres of land do you own in Kentucky?

- 20 to 50 ☐
- 51-100 ☐
- 101-150 ☐
- 151-200 ☐
- 201-250 ☐
- More than 250 ☐

27. How many acres of forest land do you own in Kentucky?

- 20-50 ☐
- 51-100 ☐
- 101-150 ☐
- 151-200 ☐
- 201-250 ☐
- More than 250 ☐

28. In which counties do you own forest land in Kentucky?

- [ ]

29. Do you live on the property where you own forest land?

- Yes ☐
- No ☐

30. How did you acquire your forest land?

- Purchased it ☐
- Inherited it ☐
- Other, please specify [ ]

31. How long have you owned your forest land?

- Less than 5 years ☐
- 5-10 years ☐
- 11-15 years ☐
- 16-20 years ☐
- More than 20 years ☐

32. What is the primary use of your forest land?

- Hunting ☐
- Sawtimber Production ☐
- Recreation ☐
- Cultivating/collection non-timber forest products ☐
- Grazing/pasture ☐
- Other [ ]
33. What are your plans for your forest land in Kentucky in the next five years?

<table>
<thead>
<tr>
<th>Plan Description</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leave it as is - no activity</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Minimum activity to maintain woodland</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Harvest firewood</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Harvest sawlogs or pulpwood</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Collect non-timber forest products</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sell some or all of my woodland</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Give some or all of my woodland to my children or other heirs</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Divide all or part of my woodland and sell the subdivisions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Buy more woodland</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Convert some or all of my woodland to another use</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Convert another land use to woodland</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>No plans at this time</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

34. Do you currently have a management plan for your forestland in Kentucky?

   Yes ○
   No ○

35. Cost-share programs provide landowners with money to help plant trees or manage their woodland. Examples include the Conservation Reserve Program, Stewardship Incentive program, and Forestry Incentives Program. Have you ever used a state or federal cost-share program to help you manage your forest land in Kentucky?

   ○ Yes, I used:
   ○ No

36. Have trees ever been harvested from any of the forest land that you own in Kentucky since you have owned it?

   ○ Yes
   ○ No

37. If yes, what types of products were harvested? (Check all that apply)

   ○ Veneer logs
   ○ Firewood, cords per year
   ○ Sawlogs
   ○ Post or poles
   ○ Pulpwood
   ○ Other
38. **Why have you conducted harvests in the past?**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>To achieve objectives in my management plan</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Trees were mature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>To clear land for conversion to another use</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Needed the money</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Needed wood for own use</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Price was right</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>To improve hunting opportunities</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>To improve scenic and recreational opportunities</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>To remove trees damaged by a natural catastrophe</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>To improve quality of remaining trees</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

39. **During the most recent harvest, did a professional forester help plan, mark, or contract the harvest?**

○ Yes  
○ Don't remember  
○ No

40. **Have trees been harvested or removed in the last five years?**

○ Yes  
○ Don't remember  
○ No

41. **If you have never harvested your forest, how much have you considered harvesting?**

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</table>

42. **Do you currently have any planned or ongoing commercial harvests?**

○ Yes  
○ No
43. How likely are you to allow a commercial harvest on your forestland in the next five years?

Very Unlikely  Unlikely  Somewhat Unlikely  Somewhat Likely  Likely  Very Likely

44. How likely are you to allow a commercial harvest that also removes energy wood, meaning low value trees, small branches, and brush?

Very Unlikely  Unlikely  Somewhat Unlikely  Somewhat Likely  Likely  Very Likely

45. I never want to have energy wood harvested from my land.

Strongly Disagree  Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Agree  Strongly Agree

46. Future harvests on my land will only remove timber products such as commercial sawlogs and/or veneer. I do NOT want any energy wood harvested. All of the branches, leaves, and low value trees will remain on the site.

Strongly Disagree  Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Agree  Strongly Agree

47. Future harvests on my land will include timber products such as commercial sawlogs and/or veneer, as well as energy wood. Energy wood can be harvested, but I want SOME material to remain on the site. Approximately half of the branches, leaves, and low value trees will remain on the site.

Strongly Disagree  Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Agree  Strongly Agree

48. Future harvests on my land will include timber products such as sawlogs and/or veneer, as well as energy wood. I want as much material harvested from the site as economically possible. I do NOT want merchantable branches, leaves, or low value trees left on the site.

Strongly Disagree  Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Agree  Strongly Agree

49. I intend to include energy wood in future harvests on my land.

Yes  No
50. **What is your current age?**

- [ ] 18 to 19
- [ ] 20 to 24
- [ ] 25 to 34
- [ ] 35 to 44
- [ ] 45 to 54
- [ ] 55 to 64
- [ ] 65 to 74
- [ ] 75-84
- [ ] 85 or over

51. **Are you male or Female?**

- [ ] Male
- [ ] Female

52. **What is your race?**

- [ ] White/Caucasian
- [ ] African American
- [ ] Hispanic
- [ ] Asian
- [ ] Native American
- [ ] Pacific Islander
- [ ] Other

53. **What is the highest level of education you have completed?**

- [ ] Less than High School
- [ ] High School / GED
- [ ] Some College
- [ ] 2-year College Degree
- [ ] 4-year College Degree
- [ ] Masters Degree
- [ ] Doctoral Degree
- [ ] Professional Degree (JD, MD)

54. **In which industry are you employed?**

- [ ] Forestry, fishing, hunting or agriculture support
- [ ] Mining
- [ ] Utilities
- [ ] Construction
- [ ] Manufacturing
- [ ] Wholesale trade
- [ ] Retail trade
- [ ] Transportation or warehousing
- [ ] Information
- [ ] Finance or insurance
- [ ] Real estate or rental and leasing
- [ ] Professional, scientific or technical services
- [ ] Management of companies or enterprises
- [ ] Admin, support, waste management or remediation services
- [ ] Educational services
- [ ] Health care or social assistance
- [ ] Arts, entertainment or recreation
- [ ] Accommodation or food services
- [ ] Other services (except public administration)
- [ ] Unclassified establishments
- [ ] Other

55. **What is your combined annual household income?**

- [ ] Less than 30,000
- [ ] 30,000 – 39,999
- [ ] 40,000 – 49,999
- [ ] 50,000 – 59,999
- [ ] 60,000 – 69,999
- [ ] 70,000 – 79,999
- [ ] 80,000 – 89,999
- [ ] 90,000 – 99,999
- [ ] 100,000 or more
5.2 Bioenergy Education Packet

Stakeholder Introduction to Energy Wood

Jeff Stringer, John Lhotka, Billy Thomas, Zach Leitch

Bioenergy is energy derived from biological material. This material is often referred to as biomass. Many types of biomass can be used in energy production, including corn, wood, and even algae. Energy wood refers to bioenergy made specifically from trees and woody debris. Sources of energy wood include saw and paper mill residues or urban wood waste, but the most abundant source is from standing forests. This makes Kentucky an ideal candidate for wood energy harvesting, because of our tremendous forest resources. Approximately half of Kentucky is forestland, and 78% of our forests are owned by family forest owners.

The most common forms of energy produced from wood are electricity and liquid fuels. Wood can be used to produce electricity when it is burned in power plants. Wood can be burned together with coal in traditional power plants, a process known as co-firing. There is also a new generation of power plants emerging across the United States designed to produce electricity from wood alone. Wood can also be used to produce liquid fuel. Liquid fuels made from plant biomass are known as biofuels and the most common is cellulosic ethanol; cellulosic ethanol is similar to ethanol produced from corn. Cellulosic ethanol is produced in special refineries that convert materials in wood into liquid fuel. The cellulosic ethanol industry is growing rapidly, with a number of operational plants across the US and more being built every day.

Wood is an excellent choice for alternative energy production, because of the advantages it offers in comparison to energy from fossil fuels or ethanol from corn and other agricultural crops. Making use of local, alternative energy sources, such as wood, reduces our tremendous reliance on fossil fuels. Fossil fuels are a non-renewable resource, and they are often subject to market fluctuation and political instability. In addition to providing a reliable and renewable energy source in state, wood energy is a much cleaner alternative to fossil fuels. Energy produced from wood results in drastically lower air pollution and greenhouse gas emissions.

Wood is also more suitable for ethanol production than corn. Growing corn for ethanol takes valuable agricultural land out of food production, which creates competition with the food industry that results in a volatile market and higher food prices. Wood removed from forests for energy production can create a new income source for Kentucky landowners. Cellulosic ethanol from wood is also cheaper than corn ethanol, because it does not require establishment costs or expensive fertilizer and pesticide applications.

Wood has the potential to become a clean, versatile, and reliable source of energy. This potential has resulted in a growing market for wood to be used in energy production. Wood energy is a smart choice for Kentucky. Creating a renewable energy industry in Kentucky will help keep more money and jobs in our state.
Energy Wood

Harvesting trees for wood energy can take on a number of different forms. The types of trees, or portions of trees harvested for energy and what a harvest looks like where energy wood is sold depends upon markets. Currently the price projected for energy wood is lower than traditional products such as sawlogs, railway ties, and pulpwood. This means that only trees or parts of the trees that could NOT be used for other products would be harvested and sold for energy wood. In some cases whole trees can be harvested for wood energy if they are hollow, crooked, have very bad wood quality, or are too small to be sold as sawlogs or pulpwood. In some cases only the branches would be used for wood energy because the rest of the tree can be harvested for veneer, sawlogs, railway ties, or pulpwood.

The figure at right provides an example of the portions of the tree that could be harvested for energy wood. In this case the tree contains wood that could be cut into logs for sawtimber as well as limbs that could be sold for pulpwood generally down to about 3 inches in diameter. The limbs at the top of the tree that are less than three inches can be sold for energy wood. Markets for sawtimber exist everywhere. But there are areas in Kentucky where there are no markets for pulpwood. In these areas the pulpwood can also be sold as energy wood. It should be noted that federal programs developed to encourage the use of trees for fuel require that energy wood not compete with other traditional products such as sawlogs or pulpwood. In these cases loggers can only sell trees or portions of trees that for energy wood that they cannot sell to other markets.
Logging and Wood Energy Harvesting

Historically, timber harvests in Kentucky have focused on the removal of commercial sawlogs to make products such as dimensional lumber and veneer. These harvests are normally completed by removing the sawlogs from the woods and leaving small diameter trees and woody residues (e.g., tree tops and foliage) in the woods. Unlike sawlog production, commercial wood energy harvests can utilize all the parts of a tree and potentially all of the trees in a woodland. Therefore, the amount of woody material removed in an energy harvest would be greater than a sawlog harvest because woodland owners would have the ability to sell small diameter trees and woody residues. Harvests that include the removal of energy wood would likely be done with a different combination of logging equipment than would be used for a sawlog only harvest. Whereas traditional sawlog logging involves the use of chainsaws and wheeled skidders, logging operations that harvest energy wood must be mechanized. This normally means that machinery like feller-bunchers or harvesters are used to cut trees down.

Also in many instances a logger might chip the energy wood on-site and would need to have a chipper on the property and have the ability to get semi-trucks to the site.

The increase in machinery on a site, the larger area needed for chippers and the movement of semi-trucks all require more space and more planning. The increased use of equipment must be planned for (see below).

What does Wood Energy Harvesting Look Like?

Economics, woodland owner objectives, and the factors discussed above factor into what a woodland will look like after a harvest that involves the removal of energy wood. In some cases energy wood could be a part of a selective harvest where only a portion of the trees are removed and the tops are used for wood energy. In other cases all of, or a majority of, the trees could be cut and all the tops and trees removed from the woods.

Economics does play a part in determining if energy wood can be harvested from a woodland. There is a minimum amount of energy wood that must be harvested per acre and over the entire logging job to allow a logger to profitably harvest energy wood. It is important to realize that in many cases at least one-half of all the trees must be cut and tops removed for a wood energy
harvest to make economic sense. Further, there are woodlands where a very high percentage of all the trees must be cut and tops removed to make the economics work.

The picture at the right shows woods that are being thinned. Note the wood and tops that are piled in the foreground. All of this material will be removed as energy wood in this harvest. There was enough energy wood obtained from this thinning that a number of good quality trees were able to be left. The poorly formed and low value species were removed improving the long-term value of this woodland. Having a market for energy wood helps make this possible.

These two pictures show what a logging site might look like where energy wood was harvested. In the upper photo some of the tree tops were able to be left because there was no pulpwood market. This allowed the harvest of energy wood to come from the pulpwood section of the tree and the tree tops could be left to conserve nutrients contained in the leaves, buds and small branches. However, the logger might have also removed these tops for energy. In this case the landowner and logger may have made a little more money on the harvest.

The lower picture shows what woods might look like after a harvest where the entire tree was removed from the woods for energy. This is very common in areas where there is a pulpwood market. Since the sawlogs were removed (greater than 10 inches in diameter) and the pulpwood (stems and branches from about 10 to 3 inches in size) were removed the only material left for energy wood was the tops. In this case the tops were harvested and chipped for energy wood, leaving little leaves, buds and small branches on the site.
- Even with energy wood removed woodlands will quickly and naturally regenerate. Regeneration comes from hardwood seed that has built up in the duff layer as well as from the growth of seedlings and saplings left after the harvest and most importantly from stump and root sprouts. If stumps are cut low these sprouts can produce very good quality trees. This rapid regrowth covers the ground quickly and abates much of the initial look of an energy wood harvest after the first year or two. The photograph shows three-year-old natural regeneration from a site that where all trees were harvested.

- One eye sore that commonly happens when energy wood is not removed are piles of unused branches. This is common in areas where there are no markets for energy wood as was the case where this picture was taken. If energy wood was removed from the site there would be no piles of discarded branches and tops left.

- Because of the need to harvest a large volume of tree tops a logging job that removes energy wood generally requires the mechanical felling of trees. This normally means that machinery like feller-bunchers or harvesters are used. Also in many instances a logger might chip the energy wood on-site and would need to have a chipper on the property and have the ability to get semi-trucks to the site.
Is harvesting energy wood right for my land?
The harvesting of energy wood is not inherently good or bad but instead should be considered as a tool to help woodland owners achieve their management objectives. Woodland owners can determine if a wood-energy harvest is appropriate for their land by considering factors such as woodland owner objectives, current status of the woodlands in question, and market availability. Regardless, the decision should be discussed with a professional forester and be part of a woodland management plan.

Woodland Health and Residual Stand Improvement
Harvesting energy wood can provide an opportunity to remove unacceptable growing stock (trees that are not helping a woodland owner meet his objectives) such as invasive species, low grade trees, or trees of commercially inferior species. The removal of this material can result in an improvement to the residual woodland and the reduction in forest fuels that could lessen the potential damage of wildfires.

Starting a New Woodland (Regeneration)
Because of past practices (such as significant fire damage or repeated high-grading) or other degrading impacts (such as storm or insect damage) that have left virtually no acceptable growing stock on a woodland it may be appropriate to restart the woodland. By clearing the woodland of standing competition an even-aged stand can be initiated, and with management cultivated into a woodland that will more likely meet woodland owner objectives.

Aesthetic Considerations
Many woodland owners may be interested in having their timber harvested but are concerned with how the area will look following the harvest. The thought of tree tops, cut-offs, and large branches spread out or congregated across the woodland may not be acceptable to some woodland owners. A wood-energy harvest would allow this material to be removed leaving a more park-like appearance, which may be more appealing to some woodland owners.

Maximizing Revenue
In most hardwood stands the majority of value is concentrated in the saw log portion of the trees. In the absence of pulp markets, traditional hardwood harvests leave the tree tops, cut-offs, and branches on site. A wood-energy harvest removes this material and increases the revenue returned to the woodland owner and in marginal situations it may be enough to justify the harvest. If the land is being converted from a woodland then a wood-energy harvest will capture the value as opposed to expenses associated with clearing the site.
Potential Consequences of Energy Wood Harvests

Because wood energy harvests use a different type of logging approach and remove far more woody material, it is important to consider the potential impact of harvest that extract energy wood in comparison to traditional sawlog harvests. While all forest harvesting operations have the potential to impact the forest and its soils, scientific studies have shown that increased wood removal and the use of whole-tree harvesting can have a larger negative impact than do sawlog only harvests. Impacts include changes to forest soils and productivity, water cycles, forest composition, biodiversity, and wildlife habitat.

Increased equipment traffic and woody material removal in mechanized whole-tree harvests can increase soil rutting, erosion, and compaction. Skid trails, log decks, and haul roads are often larger and subjected to more use. While controlling erosion of these areas of exposed soil is an important part of protecting the environment for any type of harvest it is certainly important for harvests were energy wood is removed. This erosion is not controlled can impact water quality due to increased sedimentation and the leaching of nutrients into the waterways.

Impacts associated with forest harvesting may also affect long-term forest productivity. By removing more woody material, wood energy harvests would also remove more nutrients from the forest. This is because trees use nutrients to grow and a portion of those nutrients are “trapped” in the wood being harvested. Repeated wood energy harvest could potentially reduce the nutrient availability on a site and thereby reducing the productivity of the forest. Fortunately, scientific data suggest that if harvests are done on long rotations (> 70 years) the risk of nutrient depletion and decreased productivity of the region’s forests is minimized.

Soil disturbance associated with whole-tree harvesting may also affect the regeneration of important commercial species such as oaks by creating conditions that are more favorable to less desirable native and invasive exotics plants. Widespread changes in regeneration patterns could result in species compositional shifts that could impact biodiversity and have economic ramifications for the region.

Proper forest management planning, such as the development of a forest stewardship plan, can help ensure proper forest management techniques are used to aid with regeneration of trees species desirable for timber production and wildlife habitat. Proper planning of logging and the appropriate use of Best Management Practices (BMPs) designed to protect water quality is required to ensure that water quality is protected. Readers should note that BMP’s are mandatory in Kentucky as part of the Kentucky Forest Conservation Act that requires a training logger on-site and the use of BMPs to protect water quality. Woodland owners should ensure that loggers follow all BMPs. There have also been guidelines developed in other states for logging operations that remove energy wood. These guidelines stipulate that a certain percentage of tree tops be left to minimize the loss of nutrients and to provide wildlife habitat. Guidelines are also being developed for Kentucky. In summary the potential negative impacts of harvests where energy wood is removed are understood and logging can be managed so that these impacts are addressed.
5.3 Response Frequencies

1. I feel positively about the idea of creating energy from trees growing in my forest.

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<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
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2. Electricity and fuel made from wood, rather than fossil fuels, will lead to a healthier planet.

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3. Taking steps to improve the environment is ____________.

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4. Using domestic energy sources, such as wood energy, will reduce the nation’s dependence on foreign energy sources

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5. Reducing our country's dependence on energy from foreign nations is ____________________.

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6. Harvesting energy wood will improve the health of my forest land.

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7. Below, please indicate your overall attitude about energy wood harvesting in Kentucky.

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8. Foresters and other forestry professionals believe that I should harvest energy wood from my forestland.

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9. When it comes to my forestland, I want to do what forestry professionals think I should do.

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10. County extension agents believe that I should harvest energy wood from my forestland.

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11. When it comes to my forestland, I want to do what county extension agents think I should do.

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12. My family believes that I should harvest energy wood from my forestland.

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13. When it comes to my forestland, I want to do what my family thinks I should do.

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14. Other forest owners I know believe that I should harvest energy wood from my forestland.

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15. When it comes to my forestland, I want to do what other forest owners think I should do.

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16. It is possible for me to conduct harvests that include energy wood in my forests.

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17. Conducting a forest harvest that includes energy wood is _______________.

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18. I know how to go about conducting a harvest on my land.

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20. If you listed any barriers, how easy or difficult is it to overcome these barriers?

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21. I have an in-depth understanding of wood energy harvesting.

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22. I understand how wood energy harvests are different from traditional timber harvests.

<table>
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<tr>
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<td>17</td>
<td>11.8</td>
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<td>16.7</td>
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<tr>
<td>Somewhat Disagree</td>
<td>15</td>
<td>10.4</td>
<td>10.4</td>
<td>27.1</td>
</tr>
<tr>
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<td>54.9</td>
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<tr>
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<td>55</td>
<td>38.2</td>
<td>38.2</td>
<td>93.1</td>
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<tr>
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<td>6.9</td>
<td>6.9</td>
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<tr>
<td>Total</td>
<td>144</td>
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23. Other forest owners in Kentucky have harvested energy wood from their land.

<table>
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<td>4.2</td>
<td>4.5</td>
<td>8.2</td>
</tr>
<tr>
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<td>70</td>
<td>48.6</td>
<td>52.2</td>
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<tr>
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<td>12.5</td>
<td>13.4</td>
<td>73.9</td>
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<tr>
<td>Agree</td>
<td>33</td>
<td>22.9</td>
<td>24.6</td>
<td>98.5</td>
</tr>
<tr>
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<td>2</td>
<td>1.4</td>
<td>1.5</td>
<td>100.0</td>
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<tr>
<td>Total</td>
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<td>93.1</td>
<td>100.0</td>
<td></td>
</tr>
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<td>10</td>
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<td>6.9</td>
<td></td>
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<td>Total</td>
<td>144</td>
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24. I hear people discussing the potential of using wood for energy creation.

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<td>7.9</td>
<td>7.9</td>
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<tr>
<td>Disagree</td>
<td>28</td>
<td>19.4</td>
<td>20.0</td>
<td>27.9</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>7</td>
<td>4.9</td>
<td>5.0</td>
<td>32.9</td>
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<tr>
<td>Neither Agree nor Disagree</td>
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<tr>
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<td>80.7</td>
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<td>18.1</td>
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<td>99.3</td>
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<td>.7</td>
<td>.7</td>
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<tr>
<td>Total</td>
<td>140</td>
<td>97.2</td>
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25. Before taking this survey, were you aware that wood can be used as a renewable energy source?

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<td>91.5</td>
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<td>8.3</td>
<td>8.5</td>
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<td>97.9</td>
<td>100.0</td>
<td>100.0</td>
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<td>2.1</td>
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<tr>
<td>Total</td>
<td>144</td>
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26. How many acres of land do you own in Kentucky?

<table>
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<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
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<td>Valid</td>
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<td>20 to 50</td>
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<td>51-100</td>
<td>30</td>
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<td>33.6</td>
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<td>101-150</td>
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<td>15.0</td>
<td>48.6</td>
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<td>151-200</td>
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<td>10.7</td>
<td>59.3</td>
</tr>
<tr>
<td>201-250</td>
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<td>9.7</td>
<td>10.0</td>
<td>69.3</td>
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<tr>
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<td>97.2</td>
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<tr>
<td>Total</td>
<td>144</td>
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27. How many acres of forest land do you own in Kentucky?

<table>
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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<td>12.9</td>
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<td>Total</td>
<td>144</td>
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</table>

29. Do you live on the property where you own forest land?

<table>
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<tr>
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<td>2.1</td>
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<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

30-1. How did you acquire your forest land?-Purchased it

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<th>Percent</th>
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</table>
30-2. How did you acquire your forest land?-Inherited it

<table>
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<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<tr>
<td>Total</td>
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</table>

31. How long have you owned your forest land?

<table>
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<th>Percent</th>
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<th>Cumulative Percent</th>
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<td>Less than 5 years</td>
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<td>7.1</td>
</tr>
<tr>
<td>5-10 years</td>
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<td>11-15 years</td>
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<td>16-20 years</td>
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<tr>
<td>More than 20 years</td>
<td>62</td>
<td>43.1</td>
<td>44.0</td>
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<tr>
<td>Total</td>
<td>141</td>
<td>97.9</td>
<td>100.0</td>
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<tr>
<td><strong>Missing</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>3</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
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32-1. What is the primary use of your forest land?-Hunting

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32-2. What is the primary use of your forest land?-Recreation

<table>
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<tr>
<td>Total</td>
<td></td>
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32-3. What is the primary use of your forest land?-Grazing/pasture

<table>
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<th>Cumulative Percent</th>
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</thead>
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<td>11</td>
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<td>Missing</td>
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<td>92.4</td>
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<tr>
<td>Total</td>
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32-4. What is the primary use of your forest land?-Sawtimber Production

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<td>Total</td>
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32-5. What is the primary use of your forest land?-Cultivating/collecting non-timber forest products

<table>
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<tr>
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### 32-6. What is the primary use of your forest land? - Other

<table>
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### 33-1. What are your plans for your forest land in Kentucky in the next five years? - Leave it as is - no activity

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<td>14.0</td>
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<tr>
<td>Disagree</td>
<td>28</td>
<td>19.4</td>
<td>21.7</td>
<td>35.7</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>18</td>
<td>12.5</td>
<td>14.0</td>
<td>49.6</td>
</tr>
<tr>
<td>Agree</td>
<td>35</td>
<td>24.3</td>
<td>27.1</td>
<td>76.7</td>
</tr>
<tr>
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<td>20.8</td>
<td>23.3</td>
<td>100.0</td>
</tr>
<tr>
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<td>89.6</td>
<td>100.0</td>
<td></td>
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<tr>
<td>Missing</td>
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### 33-2. What are your plans for your forest land in Kentucky in the next five years? - Minimum activity to maintain woodland

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<td>14.2</td>
</tr>
<tr>
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<td>45.8</td>
<td>49.3</td>
<td>63.4</td>
</tr>
<tr>
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<td>9.7</td>
<td>73.1</td>
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<tr>
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<td>90.3</td>
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<td>100.0</td>
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<td>Missing</td>
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### 33-3. What are your plans for your forest land in Kentucky in the next five years? - Harvest firewood

<table>
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<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<td>5.4</td>
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<tr>
<td>Disagree</td>
<td>19</td>
<td>13.2</td>
<td>14.6</td>
<td>20.0</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>20</td>
<td>13.9</td>
<td>15.4</td>
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<tr>
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<td>43.8</td>
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<td>83.8</td>
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33-4. What are your plans for your forest land in Kentucky in the next five years?-Harvest sawlogs or pulpwood

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33-5. What are your plans for your forest land in Kentucky in the next five years?-Collect non-timber forest products

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33-6. What are your plans for your forest land in Kentucky in the next five years?-Sell some or all of my woodland

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33-7. What are your plans for your forest land in Kentucky in the next five years?-Give some or all of my woodland to my children or other heirs

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### 33-8. What are your plans for your forest land in Kentucky in the next five years?-Divide all or part of my woodland and sell the subdivisions

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### 33-9. What are your plans for your forest land in Kentucky in the next five years?-Buy more woodland

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### 33-10. What are your plans for your forest land in Kentucky in the next five years?-Convert some or all of my woodland to another use

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### 33-11. What are your plans for your forest land in Kentucky in the next five years?-Convert another land use to woodland

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**33-12. What are your plans for your forest land in Kentucky in the next five years? - No plans at this time**

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**33-13. What are your plans for your forest land in Kentucky in the next five years? - Other**

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**33-14. What are your plans for your forest land in Kentucky in the next five years? - Don’t know**

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**34. Do you currently have a management plan for your forestland in Kentucky?**

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35. Cost-share programs provide landowners with money to help plant trees or manage their woodland. Exam...

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36. Have trees ever been harvested from any of the forest land that you own in Kentucky since you have o...

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37. If yes, what types of products were harvested? (Check all that apply)

37-1. Veneer logs

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37-2. Sawlogs

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37-3. Pulpwood

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37-4. Firewood, cords per year

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37-5. Post or poles

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<tr>
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37-6. If yes, what types of products were harvested? (Check all that apply) - Other

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38-1. Why have you conducted harvests in the past? - To achieve objectives in my management plan

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38-2. Why have you conducted harvests in the past? - Trees were mature

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<td>5.6</td>
<td>8.8</td>
<td>15.4</td>
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38-3. Why have you conducted harvests in the past? - To clear land for conversion to another use

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<td>10.4</td>
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<td>62.5</td>
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38-4. Why have you conducted harvests in the past? - Needed the money

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<th>Cumulative Percent</th>
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<td>20.7</td>
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<tr>
<td>Disagree</td>
<td>23</td>
<td>16.0</td>
<td>25.0</td>
<td>45.7</td>
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</table>

81
Neither Agree nor Disagree | 20 | 13.9 | 21.7 | 67.4  
Agree | 22 | 15.3 | 23.9 | 91.3  
Strongly Agree | 8 | 5.6 | 8.7 | 100.0  
Total | 92 | 63.9 | 100.0 |  
Missing System | 52 | 36.1 |  
Total | 144 | 100.0 |  

38-5. Why have you conducted harvests in the past?-Needed wood for own use

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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<tr>
<td>Valid</td>
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</table>
| Strongly Disagree | 17 | 11.8 | 18.7 | 18.7  
| Disagree | 17 | 11.8 | 18.7 | 37.4  
| Neither Agree nor Disagree | 12 | 8.3 | 13.2 | 50.5  
| Agree | 39 | 27.1 | 42.9 | 93.4  
| Strongly Agree | 6 | 4.2 | 6.6 | 100.0  
| Total | 91 | 63.2 | 100.0 |  
| Missing System | 53 | 36.8 |  
| Total | 144 | 100.0 |  

38-6. Why have you conducted harvests in the past?-Price was right

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<th>Cumulative Percent</th>
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<tr>
<td>Valid</td>
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<td></td>
</tr>
</tbody>
</table>
| Strongly Disagree | 16 | 11.1 | 18.8 | 18.8  
| Disagree | 15 | 10.4 | 17.6 | 36.5  
| Neither Agree nor Disagree | 24 | 16.7 | 28.2 | 64.7  
| Agree | 27 | 18.8 | 31.8 | 96.5  
| Strongly Agree | 3 | 2.1 | 3.5 | 100.0  
| Total | 85 | 59.0 | 100.0 |  
| Missing System | 59 | 41.0 |  
| Total | 144 | 100.0 |  

38-7. Why have you conducted harvests in the past?-To improve hunting opportunities

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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<tr>
<td>Valid</td>
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<td></td>
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</tr>
</tbody>
</table>
| Strongly Disagree | 4 | 2.8 | 4.6 | 4.6  
| Disagree | 11 | 7.6 | 12.6 | 17.2  
| Neither Agree nor Disagree | 23 | 16.0 | 26.4 | 43.7  
| Agree | 34 | 23.6 | 39.1 | 82.8  
| Strongly Agree | 15 | 10.4 | 17.2 | 100.0  
| Total | 87 | 60.4 | 100.0 |  
| Missing System | 57 | 39.6 |  
| Total | 144 | 100.0 |  

38-8. Why have you conducted harvests in the past?-To improve scenic and recreational opportunities

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<th>Cumulative Percent</th>
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<tr>
<td>Valid</td>
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<td></td>
<td></td>
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</table>
| Strongly Disagree | 3 | 2.1 | 3.4 | 3.4  
| Disagree | 23 | 16.0 | 25.8 | 29.2  

82
<table>
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<td>83.1</td>
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38-9. Why have you conducted harvests in the past? - To remove trees damaged by a natural catastrophe

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38-10. Why have you conducted harvests in the past? - To improve quality of remaining trees

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<td></td>
<td></td>
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<tr>
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38-11. Why have you conducted harvests in the past? - Other

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39. During the most recent harvest, did a professional forester help plan, mark, or contract the harvest...

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<td>Valid Percent</td>
<td>Cumulative Percent</td>
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<td>---------</td>
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40. Have trees been harvested or removed in the last five years?

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<td>Total</td>
<td>134</td>
<td>93.1</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing System</td>
<td>10</td>
<td>6.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

41. If you have never harvested your forest, how much have you considered harvesting?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Considered</td>
<td>13</td>
<td>9.0</td>
<td>17.6</td>
<td>17.6</td>
</tr>
<tr>
<td>Considered</td>
<td>22</td>
<td>15.3</td>
<td>29.7</td>
<td>47.3</td>
</tr>
<tr>
<td>Considered a little</td>
<td>23</td>
<td>16.0</td>
<td>31.1</td>
<td>78.4</td>
</tr>
<tr>
<td>Never Considered</td>
<td>16</td>
<td>11.1</td>
<td>21.6</td>
<td>100.0</td>
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<td>Total</td>
<td>74</td>
<td>51.4</td>
<td>100.0</td>
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<td>Missing System</td>
<td>70</td>
<td>48.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

42. Do you currently have any planned or ongoing commercial harvests?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
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<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15</td>
<td>10.4</td>
<td>10.8</td>
<td>10.8</td>
</tr>
<tr>
<td>No</td>
<td>124</td>
<td>86.1</td>
<td>89.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>96.5</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing System</td>
<td>5</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

43. How likely are you to allow a commercial harvest on your forestland in the next five years?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Unlikely</td>
<td>37</td>
<td>25.7</td>
<td>26.4</td>
<td>26.4</td>
</tr>
<tr>
<td>Unlikely</td>
<td>33</td>
<td>22.9</td>
<td>23.6</td>
<td>50.0</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>21</td>
<td>14.6</td>
<td>15.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>25</td>
<td>17.4</td>
<td>17.9</td>
<td>82.9</td>
</tr>
<tr>
<td>Likely</td>
<td>16</td>
<td>11.1</td>
<td>11.4</td>
<td>94.3</td>
</tr>
<tr>
<td>Very Likely</td>
<td>8</td>
<td>5.6</td>
<td>5.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>97.2</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing System</td>
<td>4</td>
<td>2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
44. How likely are you to allow a commercial harvest that also removes energy wood, meaning low value trees, small branches, and brush?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>17</td>
<td>11.8</td>
<td>12.2</td>
<td>12.2</td>
</tr>
<tr>
<td>Unlikely</td>
<td>23</td>
<td>16.0</td>
<td>16.5</td>
<td>28.8</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>21</td>
<td>14.6</td>
<td>15.1</td>
<td>43.9</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>31</td>
<td>21.5</td>
<td>22.3</td>
<td>66.2</td>
</tr>
<tr>
<td>Likely</td>
<td>30</td>
<td>20.8</td>
<td>21.6</td>
<td>87.8</td>
</tr>
<tr>
<td>Very Likely</td>
<td>17</td>
<td>11.8</td>
<td>12.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>96.5</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

45. I never want to have energy wood harvested from my land.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree</td>
<td>6</td>
<td>4.2</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>9</td>
<td>6.3</td>
<td>6.4</td>
<td>10.7</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>27</td>
<td>18.8</td>
<td>19.3</td>
<td>30.0</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>12</td>
<td>8.3</td>
<td>8.6</td>
<td>38.6</td>
</tr>
<tr>
<td>Agree</td>
<td>57</td>
<td>39.6</td>
<td>40.7</td>
<td>79.3</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>29</td>
<td>20.1</td>
<td>20.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>97.2</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

46. Future harvests on my land will only remove timber products such as commercial sawlogs and/or veneer. I do NOT want any energy wood harvested. All of the leaves, branches, and low value trees will remain on the site.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>35</td>
<td>24.3</td>
<td>25.2</td>
<td>25.2</td>
</tr>
<tr>
<td>Disagree</td>
<td>46</td>
<td>31.9</td>
<td>33.1</td>
<td>58.3</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>21</td>
<td>14.6</td>
<td>15.1</td>
<td>73.4</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>21</td>
<td>14.6</td>
<td>15.1</td>
<td>88.5</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>11</td>
<td>7.6</td>
<td>7.9</td>
<td>96.4</td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
<td>2.8</td>
<td>2.9</td>
<td>99.3</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>1</td>
<td>.7</td>
<td>.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>96.5</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

47. Future harvests on my land will include timber products such as commercial sawlogs and/or veneer, as well as energy wood. Energy wood can be harvested, but I want SOME material to remain on the site. Approximately half of the branches, leaves, and low value trees will remain on the site.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>11</td>
<td>7.6</td>
<td>7.9</td>
<td>7.9</td>
</tr>
<tr>
<td>Disagree</td>
<td>14</td>
<td>9.7</td>
<td>10.1</td>
<td>18.0</td>
</tr>
<tr>
<td>-----------------</td>
<td>----</td>
<td>-----</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>10</td>
<td>6.9</td>
<td>7.2</td>
<td>25.2</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>41</td>
<td>28.5</td>
<td>29.5</td>
<td>54.7</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>32</td>
<td>22.2</td>
<td>23.0</td>
<td>77.7</td>
</tr>
<tr>
<td>Agree</td>
<td>28</td>
<td>19.4</td>
<td>20.1</td>
<td>97.8</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>3</td>
<td>2.1</td>
<td>2.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>96.5</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

| Missing System  | 5  | 3.5 |      |      |
| Total           | 144| 100.0|     |      |

48. Future harvests on my land will include timber products such as sawlogs and/or veneer, as well as energy wood. I want as much material harvested from the site as economically possible. I do NOT want merchantable branches, leaves, or low value trees left on the site.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>15</td>
<td>10.4</td>
<td>10.9</td>
</tr>
<tr>
<td>Disagree</td>
<td>27</td>
<td>18.8</td>
<td>19.7</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>18</td>
<td>12.5</td>
<td>13.1</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>33</td>
<td>22.9</td>
<td>24.1</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>21</td>
<td>14.6</td>
<td>15.3</td>
</tr>
<tr>
<td>Agree</td>
<td>15</td>
<td>10.4</td>
<td>10.9</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>8</td>
<td>5.6</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>137</td>
<td>95.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

| Missing System | 7  | 4.9 |      |      |
| Total | 144 | 100.0|     |      |

49. I intend to include energy wood in future harvests on my land.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>97</td>
<td>67.4</td>
<td>71.9</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>16.7</td>
<td>17.8</td>
</tr>
<tr>
<td>Write in NOT INCLUDED IN ORIGINAL SURVEY</td>
<td>14</td>
<td>9.7</td>
<td>10.4</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>93.8</td>
<td>100.0</td>
</tr>
</tbody>
</table>

| Missing System | 9 | 6.3 | 100.0 |      |
| Total | 144 | 100.0| |      |

Control or Treatment Group (Not a survey Question)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>84</td>
<td>58.3</td>
<td>58.7</td>
</tr>
<tr>
<td>Treatment</td>
<td>59</td>
<td>41.0</td>
<td>41.3</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>99.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

| Missing System | 1 | .7 | 100.0 |      |
| Total | 144 | 100.0| |      |
50. What is your current age?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 to 34</td>
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<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>35 to 44</td>
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<td>5.6</td>
<td>5.6</td>
<td>7.0</td>
</tr>
<tr>
<td>45 to 54</td>
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<td>13.9</td>
<td>14.0</td>
<td>21.0</td>
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<tr>
<td>55 to 64</td>
<td>54</td>
<td>37.5</td>
<td>37.8</td>
<td>58.7</td>
</tr>
<tr>
<td>65 to 74</td>
<td>41</td>
<td>28.5</td>
<td>28.7</td>
<td>87.4</td>
</tr>
<tr>
<td>75-84</td>
<td>15</td>
<td>10.4</td>
<td>10.5</td>
<td>97.9</td>
</tr>
<tr>
<td>85 or over</td>
<td>3</td>
<td>2.1</td>
<td>2.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>99.3</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

51. Are you male or Female?

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>122</td>
<td>84.7</td>
<td>84.7</td>
<td>84.7</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>15.3</td>
<td>15.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

52. What is your race?

<table>
<thead>
<tr>
<th>Race</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>White/Caucasian</td>
<td>136</td>
<td>94.4</td>
<td>98.6</td>
<td>98.6</td>
</tr>
<tr>
<td>Native American</td>
<td>2</td>
<td>1.4</td>
<td>1.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>138</td>
<td>95.8</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>6</td>
<td>4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

53. What is the highest level of education you have completed?

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than High School</td>
<td>1</td>
<td>.7</td>
<td>.7</td>
<td>.7</td>
</tr>
<tr>
<td>High School / GED</td>
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<td>6.9</td>
<td>7.0</td>
<td>7.7</td>
</tr>
<tr>
<td>Some College</td>
<td>29</td>
<td>20.1</td>
<td>20.3</td>
<td>28.0</td>
</tr>
<tr>
<td>2-year College Degree</td>
<td>7</td>
<td>4.9</td>
<td>4.9</td>
<td>32.9</td>
</tr>
<tr>
<td>4-year College Degree</td>
<td>36</td>
<td>25.0</td>
<td>25.2</td>
<td>58.0</td>
</tr>
<tr>
<td>Masters Degree</td>
<td>42</td>
<td>29.2</td>
<td>29.4</td>
<td>87.4</td>
</tr>
<tr>
<td>Doctoral Degree</td>
<td>8</td>
<td>5.6</td>
<td>5.6</td>
<td>93.0</td>
</tr>
<tr>
<td>Professional Degree (JD, MD)</td>
<td>10</td>
<td>6.9</td>
<td>7.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>99.3</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>1</td>
<td>.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

54. In which industry are you employed?
<table>
<thead>
<tr>
<th>Industry</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry, fishing, hunting or agriculture support</td>
<td>13</td>
<td>9.0</td>
<td>10.1</td>
<td>10.1</td>
</tr>
<tr>
<td>Utilities</td>
<td>1</td>
<td>.7</td>
<td>.7</td>
<td>15.5</td>
</tr>
<tr>
<td>Construction</td>
<td>3</td>
<td>2.1</td>
<td>3.9</td>
<td>19.4</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>9</td>
<td>6.4</td>
<td>10.9</td>
<td>30.2</td>
</tr>
<tr>
<td>Retail trade</td>
<td>3</td>
<td>2.1</td>
<td>10.9</td>
<td>41.1</td>
</tr>
<tr>
<td>Finance or insurance</td>
<td>5</td>
<td>3.5</td>
<td>3.9</td>
<td>51.2</td>
</tr>
<tr>
<td>Real estate or rental and leasing</td>
<td>5</td>
<td>3.5</td>
<td>5.4</td>
<td>56.6</td>
</tr>
<tr>
<td>Professional, scientific or technical services</td>
<td>10</td>
<td>6.9</td>
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<td>Educational services</td>
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<td>6.4</td>
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<td>Arts, entertainment or recreation</td>
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<td>.7</td>
<td>61.9</td>
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<tr>
<td>Accommodation or food services</td>
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<td>.7</td>
<td>.7</td>
<td>62.6</td>
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<td>Other services (except public administration)</td>
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<td>Total</td>
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<tr>
<td>Total</td>
<td>144</td>
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</table>

55. What is your combined annual household income?

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<th>Income Range</th>
<th>Frequency</th>
<th>Percent</th>
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<th>Cumulative Percent</th>
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<td>System</td>
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<td>Total</td>
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### 5.4 Multiple Regression Results

#### Multiple Logistic Regression - Variables in the Equation

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<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
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<td>.762</td>
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<td>1.565</td>
<td>.573</td>
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<sup>a</sup> Significance levels for each step are compared to the previous step.
### Multiple Linear Regression - Variables in the Equation

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<th>Model</th>
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<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
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<tr>
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<td>-.141</td>
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<td>Zscore: Positive Attitude Toward Wood Kentucky (n=6, a=.765; 1-6 mean composite scale)</td>
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<td>-.317</td>
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<td>.121</td>
<td>-.292</td>
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<td>.876</td>
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<td>Zscore: Positive Attitude Toward Wood Kentucky (n=6, a=.765; 1-6 mean composite scale)</td>
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<td>-.304</td>
<td>2.650</td>
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## 5.5 Variable Analysis Results

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<th>Variable (Question #, Variable code)</th>
<th>Dichotomous Intent</th>
<th>Continuous Intent</th>
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<td>Healthier Planet (2, a2)</td>
<td>Sig.002</td>
<td>Sig.002</td>
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<tr>
<td>Reduce Dependence (4, a4)</td>
<td>Sig.002</td>
<td>Sig.002</td>
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<tr>
<td>Improve Forest Health (6, a6)</td>
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<td>Sig.002</td>
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<tr>
<td>Reported Barrier (19, pc4)</td>
<td>NS.626</td>
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<tr>
<td>Basic Prior Knowledge (25, pk5)</td>
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<tr>
<td>Acres Forestland Owned (27, lc2)</td>
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<td>NS.157</td>
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<tr>
<td>Reside on Forest Land (29, lc4)</td>
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<td>NS.433</td>
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<td>Purchased Land (30, lc5, 1)</td>
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<td>Inherited Land (30, lc5, 2)</td>
<td>NS.226</td>
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<td>Years Forestland owned (31, lc6)</td>
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<td>Primary Use Hunting (32, lc7, 1)</td>
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<td>Primary Use Recreation (32, lc7, 2)</td>
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<td>Primary Use Pasture (32, lc7, 3)</td>
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<td>Used Cost Share (35, lc10)</td>
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<td>Have Harvested Pulpwood (37, ha2, 3)</td>
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<td>Have Harvested Firewood (37, ha2, 4)</td>
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<td>Have Harvested Poles (37, ha2, 5)</td>
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### TPB Composite Variables

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Literature Cited


Vita

Zachary John Leitch
Born October 6, 1983 - Cooperstown, North Dakota

Educational Background:

North Dakota State University, Fargo, ND
Bachelor of Science in Social Science Education, May 2008
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University of Kentucky, Lexington, KY
Part-time Instructor, Basics of Public Speaking
August-December 2008

Richfield High School, Richfield, MN
Student Teacher, World History
January-April 2008

Professional Positions Held:

Assistant Director of Research and Instructional Technology
University of Kentucky, Lexington, KY
July 2008-January 2012

________________________
Zachary J. Leitch

________________________
March 9, 2012