PRIVATE FOREST LANDOWNER WILLINGNESS, COMMUNITY IMPACTS
AND CONCERNS, AND THE DEVELOPMENT OF A WOOD-BASED
BIOFUELS INDUSTRY

A Dissertation in
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by

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ABSTRACT

The technical/economic aspects of using wood-based biomass as an alternative source of fuel have been well represented in current academic literature. However, currently very few studies have examined the concerns of private forest landowners (PFLs) and communities toward increased harvesting rates to support a wood-based biofuels industry. Further, few studies have tried to study or to determine what factors might impact such willingness. The absence of studies that focus on understanding PFLs and community concerns as well as PFLs willingness to participate in harvesting biofuels for energy is in part traceable to two basic, but untested, assumptions regarding communities and forest landowners: (1) PFLs are able and willing to participate in the production of raw materials with few obstacles; and (2) they will make the transition because of the opportunity to increase profits. While the technical/economic aspects are clearly important, little attention has been paid to those social and cultural factors that may impact the viability of such activity. To address this issue, the present study focused on three questions. (1) What are the opportunities and concerns of PFLs, communities, residents, and existing wood-based industries regarding the development of a wood-based biofuel industry? (2) Will PFLs be willing to harvest raw materials for a wood-based biofuel industry? (2a) What sociocultural and sociodemographic dimensions influence PFLs’ willingness to harvest raw materials for a wood-based biofuel industry? Data was collected using a mixed methods approach including using secondary data, key informant interviews and a phone survey of both the general public and PFLs in the Eastern forest region.
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Chapter 1

Introduction

Sources of biomass products include cellulosic crops such as switchgrass, hybrid poplar, and willow, as well as natural forests (Perlack et al. 2005). Biomass is used to create bioenergy in several ways. It can be a source of cellulosic ethanol, where the biomass material is turned into a liquid fuel for use in transportation or bioelectric facilities (Zhu and Pan 2010). Biomass can also be turned into pellets for use in heat plants or bioelectric facilities (Mendell and Lang 2012). Both of these represent ways biomass is used to produce bioenergy.

The development and promotion of biomass energy from these sources has been pursued for several reasons. At the state and national levels, enacted policies have encouraged the development of biomass energy to address our increasing energy demand, while promoting energy security as a renewable energy source and reducing greenhouse gas emissions associated with burning fossil fuels. At the local level it has been suggested that a biofuels industry could help address rural economic diversification and development. At the national level President Bush, in his 2007 State of the Union address, set a national goal of producing 35 billion gallons of renewable and alternative fuels by 2022 (Maness 2008). This would replace approximately 15 percent of the nation’s projected fuel consumption (Maness 2008). Many states also enacted policies and goals to try and reduce greenhouses by replacing fossil fuels with non-fossil fuel options such as wind, solar, or biomass. Shortly after President Bush’s address, some states created Renewable Portfolio Standards outlining strategies to meet energy demands and reduce greenhouse gas emissions with alternative renewable energy supplies (Wiser
and Barbose 2008). Energy biomass production was identified as a key element of these strategies.

A move towards increasing renewable resources as a means for meeting the nation’s energy needs led many to look at timber-based biofuel as an option. This spurred many studies and reports on biofuels. Within these studies the economics of using wood-based biomass as an alternative source of fuel is well represented in current academic literature. However, less studied has been the impact of increased harvesting associated with the newly emerging biofuel industry on both communities and existing wood-based industries within geographic regions. Shifts that increase wood withdrawals from forests involve more than just economic considerations. Many rural communities, which often depend on timber as their primary industry, typically face myriad social, cultural, and biophysical issues when considering changes to existing timber harvesting levels.

One of the critical aspects of using wood resources to meet biofuel needs is the need to gauge the willingness of private forest landowners (PFLs) to increase harvesting rates. To date, few studies have examined landowner willingness to participate. Nor have there been many studies that investigated the opportunities, threats, and concerns associated with such a shift on local communities. The absence of studies which focus on understanding PFLs willingness to participate in harvesting biofuels for energy is in part traceable to two basic, but untested, assumptions regarding forest landowners: (1) PFLs are able and willing to participate in the production of raw materials with few obstacles; and (2) they will make the transition because of the opportunity to increase profits. Moreover, the extant literature has tended to focus on the technical/economic aspects of energy biomass production. While the technical/economic aspects are clearly important,
little attention has been paid to the social and cultural factors that may impact the viability of such activity.

To address these issues, this study uses two broad questions and one analytic question to guide and organize the research effort:

1) What are the opportunities and concerns of PFLs, communities, and residents regarding the development of a wood-based biofuel industry?

2) Will PFLs be willing to harvest raw materials for a wood-based biofuel industry?

2a) What sociocultural and sociodemographic dimensions impact PFLs’ willingness to harvest raw materials for a wood-based biofuel industry?

Not only does this study identify PFLs willingness to participate, it also assesses whether this willingness varies across sociocultural and sociodemographic dimensions. Further, this study moves beyond previous work by assessing the opportunities and concerns PFLs and communities have concerning the development of a biofuels industry. My examination of the complexities of the development of a woody biofuels industry is motivated by the premise that a sociological understanding of this study’s research questions complements and augments current knowledge while helping to determine the efficacy of such an industry. It does this by discovering the social acceptability of such development.

In the following chapters, I first discuss the scholarly literature that focuses on topics within or connected to the woody biofuels industry and development. This chapter includes discussions of what is meant by PFLs; the main drivers of the biofuels industry at the national, state, and community levels; and sociocultural aspects such as variation in
PFLs values in connection with their forestland. This chapter ends with a discussion of my theoretical research model. In Chapter 3, I discuss the research design and methodology, as well as measurement procedures. The next two analytic chapters look at the results from the qualitative (Chapter 4) and quantitative (Chapter 5) data collected for the study. The final chapter provides a summary and conclusion to the study with a combined discussion of findings from both collection methods, and advances possible implications drawn from this study.
Chapter 2

Literature Review

The purpose of this chapter is to introduce and review relevant literature related to the efficacy of a wood-based biomass industry in the Eastern forest region. Topics covered here provide a broad overview of the complex nature of this issue and the importance of understanding the myriad social factors which can influence the outcome.

Why Biomass? Creating Demand and Assessing Supply

A review of the literature on biomass makes it clear that the development and promotion of biomass energy has been pursued for several specific reasons: (1) to address our nation’s energy demand (Cook and Beyea 2000; Mendell and Lang 2012; Walsh et al. 2003); (2) to promote energy security through the use of sustainable renewable energy sources (Cook and Beyea 2000; Evans, Strezov, and Evans 2010; Ragauskas et al. 2006; Walsh et al. 2003); (3) to reduce greenhouse gas emissions from fossil fuels (Gan and Smith 2006; Hudiburg et al. 2011; Johnson 2009); and (4) to promote economic development opportunities for rural communities (Domac, Richards, and Risovic 2005; Joshi and Mehmood 2011; Mayfield et al. 2007; Perez-Verdin et al. 2008). These reasons, and the policies that back them, have strong ties to green energy and renewable energy movements, both of which root to the earlier environmental movement in the United States (Bies 2006; Demirbas, Balat, and Balat 2009; Midilli, Dincer, and Ay 2006). Renewable energy and biofuels have moved into the mainstream and now policy acts as the major mechanism to promote the achievement of these four main goals.
Policy: Creating demand for biofuels

Bioenergy has been influenced both through legislation regulating electric utilities and by efforts to increase renewable energy generation in the United States. Most of these policy efforts can be grouped into three general areas: renewable energy targets, emissions, and biomass production (Mendell and Lang 2012).

Specific policy efforts encouraging biomass and bioenergy production include federal and state bills establishing renewable portfolio standards, renewable electricity standards, and/or renewable fuel standards (Mendell and Lang 2012). A major example of these efforts is the Energy Independence and Security Act of 2007. In that year, President Bush’s State of the Union address set a national goal of producing 35 billion gallons of renewable and alternative fuels by 2017 (Maness 2008). Achieving this goal would mean replacing 15 percent of the nation’s projected fuel consumption from these alternative fuels (Maness 2008). In response, the Energy Independence Security Act was passed in 2007; it called for 36 billion gallons of renewable biofuels to be produced annually by 2022 (Mendell and Lang 2012).

Many states also enacted policies and goals to try and reduce greenhouses by replacing fossil fuels with non-fossil fuel options such as wind, solar, or biomass. Shortly after President Bush’s address, some of these states created Renewable Portfolio Standards outlining strategies to meet energy demands, increase renewable energy production, and reduce greenhouse gas emissions (Wiser and Barbose 2008). Within these strategies was energy biomass production. For example, Pennsylvania’s Governor Rendell announced his plan entitled the PennSecurity Fuel Initiative. This initiative had the goal of replacing 900 million gallons of the state’s transportation fuels by 2016 with
alternative sources, such as ethanol and biodiesel. Further, Pennsylvania and other eastern states commissioned task forces to conduct raw material inventories.

Another policy that encouraged the use of bioenergy revolved around regulations of greenhouse gas emissions. Indeed, biomass was encouraged as a means to reduce overall greenhouse gas emissions. This reflected the fact biomass was seen as being carbon neutral.

Regulatory efforts of emissions began with the Clean Air Act of 1970. One recent effort derived from the Clean Air Act was the Greenhouse Gas Tailoring Rule (Mendell and Lang 2012). The Tailoring Rule covered facilities that exceeded certain thresholds for emissions of carbon dioxide and other greenhouse gases. Because the carbon neutrality of biomass remains under consideration, the EPA announced that Greenhouse Gas Tailoring permitting requirements for facilities using biomass to make electricity would be deferred until further information confirming or refuting its neutrality (Mendell and Lang 2012).

Legislative efforts to increase the supply and availability of biomass for energy uses included the Biomass Crop Assistance Program, part of the Food, Conservation, and Energy Act of 2008 (Mendell and Lang 2012). Mendell and Lang (2012) explained the purpose of the program was:

… to assist agricultural and forestland owners and operators with the establishment and production of eligible crops for conversion to bioenergy, and the collection, harvest, storage, and transportation of eligible materials for use in a biomass conversion facility (p.49).

This legislation provided incentives that encouraged the production and use of biomass for energy production. These policies effectively formed the foundation
that promoted the development of a market for wood harvesting for a biofuels industry.

*The idea behind carbon neutrality*

The use of biomass as a way to reduce greenhouse gas emissions has been a source of controversy for many years. Some agencies, organizations, and stakeholders raised questions about the carbon neutrality of biomass to reduce carbon emissions. Carbon neutrality referred to the natural role trees played in the biogenic carbon cycle (Mendell and Lang 2012). The biogenic carbon cycle is the process of removing carbon from the atmosphere through photosynthesis, storing it, and emitting it into the atmosphere through respiration and decay (Mendell and Lang 2012; Mitchell, Harmon, and O'Connell 2012; Schulze et al. 2012). When biomass is burned to make electricity, heat, or power for vehicles, it releases stored carbon into the atmosphere. The general premise was that carbon emissions from biomass were part of a natural cycle in which growing forests over time would re-capture (sequester) the carbon emitted through car emissions and energy facilities burning biomass (Lamers and Junginger 2013).

However, the carbon neutrality associated with burning biofuels for energy remains under question. One of the basic arguments against biomass carbon neutrality dealt with the time lag between the release of carbon from burning and its recapture by a single stand of trees (Mendell and Lang 2012; Zanchi, Pena, and Bird 2012). Other issues involved in the neutrality debate include the method of measurement and the variables included in measurement (carbon stocks versus carbon debt).

The extant literature indicated that whether forest bioenergy is carbon neutral has depended largely on which carbon accounting method is used (Mendell and Lang 2012).
Two basic ways to measure a system’s carbon flows are used: the carbon stocks approach and the carbon debt approach (Johnson 2009; Schulze et al. 2012). The carbon stocks method provided a landscape-level view that considered several forest stands in a landscape (Johnson 2009). Carbon losses from harvesting any particular stand were offset by the carbon uptake of growing trees in neighboring stands. There were several limitations to this approach. First, the growing trees in neighboring stands were already going to capture carbon whether the nearby stand was harvested or not. The introduction of increased carbon from burning the harvested stand did not mean the growing trees in the neighboring stands were going to sequester carbon above and beyond what they were already collecting. A second limitation to the carbon stocks approach was the failure of those employing it to account for the lost carbon sequestering that occurred from normal growth in the absence of bioenergy production (Johnson 2009; Schulze et al. 2012).

The carbon debt approach focused on a single stand (Johnson 2009; Mendell and Lang 2012). Carbon released through burning biomass needed to be regained through the regrowth of the harvested stand (Mendell and Lang 2012). Under the carbon debt approach, bioenergy was not inherently carbon neutral because it took a certain amount of time for the stand to re-capture the carbon, leaving a carbon deficit (Lamers and Junginger 2013). It is called a carbon debt because biomass, at least forest biomass, generally emits more carbon than fossil fuels per unit of energy produced (Walker et al. 2010). Moreover, each approach employs different criteria/variables when calculating the carbon neutrality associated with using biomass for energy production.

Excess emissions from biomass are viewed as a carbon debt. Over time, re-growth of the harvested forest removes such carbon from the atmosphere, reducing carbon debt.
This is described as the time lag between burning and recapture. After the debt has been paid in full, biomass begins yielding carbon dividends in the form of atmospheric greenhouse gas levels lower than what would have occurred from the use of fossil fuels to produce the same amount of energy (Hudiburg et al. 2011; Mendell and Lang 2012; Walker et al. 2010). The greenhouse gas implications of burning biomass for energy and the length of the time lag varied depending on the characteristics of the bioenergy combustion technology, the fossil fuel technology it replaced, and the biophysical and forest management characteristics of the forests from which the biomass was harvested (Mendell and Lang 2012). It should be noted that neither of these two methods would be considered a full life cycle analysis, as neither approach accounts for all the variables which have carbon output. For example, neither approach deals with the carbon produced from transportation.

Researchers at the Monomet Center for Conservation Sciences, using the carbon debt approach, analyzed greenhouse gas emissions in Massachusetts (Walker et al. 2010). This study found significant differences in the length of time needed to pay off the carbon debt depending on the type of fossil fuel replaced and forest management actions taken (Walker et al. 2010). For example, they found that it took an estimated 21 years to pay of the carbon debt when replacing coal used to produce electricity (Walker et al. 2010). However, when biomass was used to replace natural gas to produce electricity, it could take more than 90 years to pay off the debt. Other studies found similar results (Gan and Smith 2006; Mitchell et al. 2012; Zanchi et al. 2012). The differences in payoff times have to deal with the amount of carbon released by each source of fuel. This is
related to how the carbon is chemically bonded to the other molecules and the reaction it undergoes during the burning process (Walker et al. 2010).

*Economic development for rural communities*

The harvesting of biomass and its subsequent production into energy or fuel is believed to have the potential to provide economic benefits to those areas that participate. The development of biomass and biofuels could potentially provide revenue to communities and counties in the form of taxes (Buchholz, Canham, and Hamburg 2011) and job creation (Gan and Smith 2007; Manley and Richardson 1995). Further, increased harvesting for biomass was seen as a way to increase profits for PFLs. Energy biomass production held potential to recharge rural economies hard hit hard by job losses in manufacturing and agriculture over the past several decades (Gan and Smith 2007). Gan and Smith (2007), in a study of eastern Texas, estimated that together, harvesting and power generation would create nearly 1,340 jobs, accounting for almost one-third of the total current employment in the study region’s logging sector. Further, they estimated the total impact on the value added to the logging industry alone would be around $216 million (Gan and Smith 2007). Given these possible opportunities, it was easy to understand why there is increased interest in developing this industry.

However, it should be cautioned that such development – that is, development focused exclusively on resource extraction – might not result in economic stability or sustainability. Many rural communities that could see benefits from the development of a wood-based biofuels industry have long histories of forest resource extraction. Promoting the continuation of such dependency may not lead to the desired economic outcomes. Rural communities dependent on resources often cycle through periods of growth and
decline which are a major barrier to community stability (Krannich and Greider 1984; Krannich and Luloff 1991).

Analyses focusing on economic aspects in resource-dependent communities have often found a number of issues that resulted from these fluctuations and declines in extraction-based employment including high rates of unemployment, underemployment, and high levels of poverty (Freudenburg 1992; Krannich et al. 2014). Additionally, extralocal control and outside market forces often rendered rural communities powerless to address economic fluctuations (Krannich and Luloff 1991). While economic opportunities offered by such development may be appealing, the consequences associated with reliance on resource-based economies appear to be more accurately characterized by a range of long-term threats that outweigh the benefits of employment growth and other economic opportunities (Krannich et al. 2014).

Offering an alternative market for forest resources and harvesting may indeed help, at least in the short-term, bolster struggling rural communities. However, research showed there was an almost-inevitable downturn in resource-based economic activity. Even with policies geared toward the sustainable and renewable nature of forest harvesting, pursuing continued resource extraction to support a wood-based biofuels industry may just merely strengthen resource dependency and exacerbate the many social and economic issues associated with it.

*Estimating supply: Is there enough to meet larger goals?*

Do we have the supply necessary for biomass to significantly help meet current and future energy demands? Many studies focused on trying to quantify the supply of woody biomass, as well as its potential to produce cellulosic ethanol (Galik, Abt, and Wu
2009; Maness 2008; Perlack et al. 2005; PHDC 2007). For example, in 2005 the Oak Ridge National Laboratory estimated United States’ forests could produce 142 million dry tons of wood products and had the capacity to yield an additional 226 million dry tons (Perlack et al. 2005). Further, Maness (2008) estimated the nation’s supply of woody biomass yield could contribute between 3.6% and 4.9% of the nation’s annual demand for gasoline, which is approximately 13.6 billion gallons. As a state example, in 2007 Pennsylvania’s Secretary of Agriculture commissioned a task force to conduct a raw material inventory of the state’s forest for biofuel production to evaluate the sustainability of this supply (PHDC 2007). The task force reported high volumes of low quality and small diameter woody biomass that were readily available from the state’s 17 million acres of forestland (PHDC 2007).

It would seem that based on supply, energy, and fuel biomass had the potential to achieve the goals of helping meet current and future energy demands. However, supply was only part of the issue. Nowhere in these reports – national or state – was there mention of how willing PFLs, who control the majority of the forested land, were to contribute their wood to this effort (Metcalf et al. 2011). Those who were encouraging biomass energy development seemed to simply assume PFLs would respond to increased markets and/or price and act to help meet market demand (Joshi and Mehmood 2011). Additionally, even studies focused on the sustainability nature of electricity generation from biomass tended to focus on price, efficiency, greenhouse gas emissions, and availability of supply (Cook and Beyea 2000; Evans et al. 2010).
Why the focus on technical/economics aspects and the idea of sustainability

It is not the goal of this study to refute the importance of technical/supply and economic aspects in determining the efficacy of a wood-based biofuels industry. Rather, it is to provide an understanding of how sociocultural and sociodemographic elements contribute/constrain the possible development of such an industry. The common assumptions mentioned earlier, that PFLs will participate in harvesting for a biofuels industry with limited obstacles and for increased profits, are largely tied to concepts found in neoliberal development perspectives.

The connections between the promotion of woody biomass for bioenergy and biofuels to sustainability and development are easily identified. Even though the goals promoted by policy were guided by the desire to attain sustainability in energy production, a large portion of the studies of energy biomass production focused on the technical/economic side of the question. This was a typical neoliberal approach to natural resource issues. Neoliberalism is an economic theory often associated with development (Peet and Hartwick 2015). Among other things, neoliberalism promotes the use of rational economics and markets as the driving force behind development and development decisions (Harvey 2005). In the study of woody biomass harvesting and promotion of bioenergy we found that neoliberal tendencies (letting the market promote the achievement of desired outcome) were present. This was interesting considering the sustainable nature of the driving goals.

In contrast, a sustainable development approach to research and the development of strategies to meet goals was based on the notion that we needed to understand social, environmental, as well as economic implications to the study and development of a
woody biomass energy industry (Leach, Scoones, and Stirling 2010). With the introduction of the concept of sustainability from the Brundtland report (Brundtland 1987), increased attention was placed on the role of sustainability in development plans.

My work in this project continues to open the dialogue of possible alternatives to neoliberal policies and practices as drivers of development. Further, it points out that economics was just one part of development. In order to promote sustainability and sustainable energy development we must consider other factors, including social and environmental factors. In the study of woody biomass harvesting and biofuels development, acknowledging the social constraints of achieving sustainability based goals would be key. Employing only a strong economics/markets approach, common in much neoliberalism-based studies, would not account for the social constraints of woody biomass harvesting and biofuels development. Many of these constraints revolve around PFLs and communities.

**What is a Private Forest Landowner?**

Forest ownership in the United States is often broadly defined as being public or private. Public ownership includes forest land owned by federal, state, or local governments. Private forests are typically divided into forests owned by forest industry and those owned by non-industrial owners (Longmire 2012). Forest industry ownership is made up of private entities that owned forest land, as well as those that owned and operated wood processing facilities (Longmire 2012). Those private owners who did not fit into the industry ownership category were typically placed into the category of non-industrial private forestland owner (NIPF) (Butler 2008). Butler (2008) explained that
NIPF owners were defined as owning at least one acre of contiguous forestland at least 10 percent stocked, who do not own wood processing facilities.

However, categorizing these ownership types in such a manner has several problems. Such a categorization or typology of private forest ownership has limited application within a sociological analysis of private forest owners because we are defining them not for what they are, but rather what they are not. Further, such a categorization is based solely on one specific type of use – economic. By defining private forest landowners as either industrial or non-industrial we create a description that failed to acknowledge the many reasons and uses PFLs have for owning their land. Further, the NIPF name also implied that forest industry was the ideal private ownership from the perspectives of both forestry professionals and researchers (Finley et al. 2001; Longmire 2012).

Due to the issues of such a typology, Finley et al. (2001) called for a new and more positive name to be given to these forest landowners. Finley et al. (2001) explained that NIPF lacked sensitivity to a large portion of forest landowners who did not own industrial forests. They proposed the term private forest landowner. The intent of this name change was to move toward a positive descriptor for this class of forest landowners (Finley et al. 2001; Longmire 2012). PFL was used throughout this dissertation because it was both an inclusive and positive term for defining forest landowners. Defining landowners as PFL described who they were and did not limit discussion to only economic terms.
Why Focus on PFLs?

*Forest fragmentation, parcelization, and harvesting*

The Eastern forest region contains significant stocks of forest resources, approximately 384 million acres of timberland. Of those 384 million acres, 318 million acres (82%) was in private ownership, which included forest industry. Individual private forest landowners controlled 276 million acres of the Eastern forest (86%). These acres were held by an estimated 9.9 million landowners (Butler 2008). The majority of PFLs (about 60%) were estimated to own less than 10 acres of forestland (Butler 2008). At the individual level, PFLs appeared to have a seemingly small impact on overall forest management and use. However, given their sheer numbers and combined forest resources, PFLs, in fact, have a large collective impact (Butler 2008; Kuhns, Brunson, and Roberts 1998).

Private forests generate economic value and provide aesthetics, recreational, ecologic, and resource protection benefits. While the forestland base has remained fairly stable, forestland per capita declined indicating greater numbers of landowners owning smaller parcels of forest (Butler 2008; Longmire 2012). The movement away from a smaller number of owners with larger acreages toward a larger number of owners with smaller tracts of land resulted in a much more diverse group of owners with a variety of management approaches, reasons for ownership, and landowner characteristics.

Fragmentation (the division of forests into smaller noncontiguous patches) and parcelization (the division of forests among larger numbers of owners) may impact the efficacy of a wood-based biofuels industry. Several studies found that small ownerships, defined as those less than 20 acres, dominated the landscape (Buchholz et al. 2011; Butler
and Ma 2011). Other studies found that below certain size thresholds access to wood products became more limited by owner interests and economies of scale (McDonald et al. 2006). Tract size has long been considered an important factor in explaining PFLs’ forest management decisions (Cleaves and Bennett 1994; Longmire 2012; Row 1978). Typically, owners of larger tracts of forestland were more likely to have a written management plan, received professional advice, conducted a commercial timber harvest, and owned their forest primarily for timber production (Longmire 2012; Metcalf 2010). In contrast, PFLs who owned smaller parcels were less likely to engage in forest management practices and harvesting (Metcalf 2010). For example, Metcalf (2010) found that only 5 percent of PFLs with one to ten acres had conducted commercial harvests in the past ten years. Such patterns were likely to continue and would be problematic for biomass harvesting as parcelization continued (Buchholz et al. 2011).

Clearly forest parcelization remains a growing concern and could provide significant constraints to the forestland area available for commercial harvests. Knowing the amount of forest land owned by each PFL is clearly important for determining its relationship to PFL willingness to participate in harvesting for a biofuels industry. Further, such parcelization may impact the ability of biofuels industry to harvest tracks of land large enough to be profitable.

**PFLs: Use values versus exchange values**

Research undertaken to identify important drivers of PFL harvesting and management practices were often rooted in two basic economic principles – profit and utility maximization (Gregory, Conway, and Sullivan 2003). This is not surprising given the common assumption that profit was the primary motivator in PFLs’ harvesting and
management decisions. However, studies undertaken based on the assumption of profit maximization treated PFLs similar to forest industry, where landowners were seen as firms and their forests as resources of production (Gregory et al. 2003). This produced the further assumption that PFLs were rational timber producers with predictable harvesting behavior (Newman and Wear 1993).

Given the context of an increasing number and diversity of forest owners, PFLs cannot be treated as a homogenous group (Kittredge 2004; Salmon, Brunson, and Kuhns 2006). The assumption that PFLs made harvesting decisions, including harvesting for a biofuels industry, due to increased profit ignored the fact PFLs used and valued their land for many different reasons – and not necessarily harvesting for profit. Scholars have recognized property owners made a distinction between exchange value and use value (Logan and Molotch 1987). Privately held forest land provides a good example of such value distinctions.

Buchholz et al. (2011) emphasized landowner values played an important role in the availability or access to product for harvesting. They suggested this social constraint might be more important in gaining access to supply than other physical or economic constraints (Buchholz et al. 2011). Research indicated PFLs had a variety of reasons and several different sets of values associated with forest land ownership (Finley, Luloff, and Jones 2005; Silver et al. 2015). While some PFLs value the forest primarily for its economic opportunities, for many others the value of forestland lied in the pleasure it provided as a place for hiking, hunting, fishing, and/or bird watching. In fact, research suggested PFLs generally had little interest in timber harvesting or forest management activities (Butler and Ma 2011; Finley et al. 2005; Metcalf 2006; Metcalf 2010). Such
findings could be problematic for the emergence of this industry as it impacts access to a reliable and sustainable source of biomass for energy production. Buchholz et al. (2011) explained that while there was not enough known on this subject, they believed this was likely to be the single greatest source of concern and constraint in the forests resources available for biomass energy.

It is important to gain an understanding of how PFLs values toward and uses of their forest land may influence their willingness to harvest for a wood-based biomass industry. The fact that many PFLs owned and valued their land for a variety of reasons stands as a stark contradiction to the commonly held assumption that PFLs would harvest for a wood-based biofuels industry solely based on opportunities to increase profits. While this might be the case for some PFLs, it might not be for a growing number of PFLs who could impact the development of such an industry.

Past behavior/future plans

When it comes to PFLs’ forest management decisions, some evidence suggested that both past management behavior and management plans impacted current and future PFL harvesting decisions (Joshi and Arano 2009; Longmire 2012; Silver et al. 2015). In the social sciences it is often said that behavior predicts behavior. Put more fully, past behavior predicts future actions (Aarts, Verplanken, and Knippenberg 1998; Ouellette and Wood 1998; Stern 2000). Several theories of behavior, such as the theory of planned behavior, suggested previous behavior played a significant role on behavioral intentions (Ajzen 1985; Ajzen 1991; Fishbein and Ajzen 1977). Applied to forest management, this would suggest that past forest management decisions and harvesting behavior could predict future decisions. Given that many PFLs – particularly those with small tracts of
forest land – have not harvested in the past (Metcalf 2010); past forest management behavior may prove to be a concern and a barrier to biomass energy development in relation to PFLs’ willingness to harvest. It is important to understand if and how engaging in one type of forest management activity was related to their decisions to engage in other types of forest management activities.

The theory of planned behavior connects past actions with plans or intentions for future action (Ajzen 1991). To a great extent the idea that future plans, or intended future actions, influenced future action was intuitive. People often do the things they planned to do, assuming their actions are not constrained in some way (Ajzen 1991; Ouellette and Wood 1998). Further, such plans were often based on experiences and outcomes of past actions (Ouellette and Wood 1998). However, Joshi and Arano (2009) suggested that to understand forest landowner management decisions each decision could not be studied in isolation. Instead, these decisions needed to be studied in relation to plans these PFLs made concerning different types of management decisions, including harvesting (Joshi and Arano 2009). It is therefore important to understand how past management actions and future forest management plans may influence PFLs willingness to harvest biomass for a biofuels industry.

Knowledge concerning the biofuels/forest industry and level of consulting

The theory of planned behavior, as well as other research efforts, identified knowledge as a precursor to behavior, including harvesting behavior (Ajzen 1985; Ajzen 1991; Joshi et al. 2013; Silver et al. 2015). It was widely assumed PFLs lacked information and knowledge about forest management practices and markets, and that enhancing their knowledge would increase the likelihood of active management of their
private forests (Longmire 2012). Several studies found that knowledge concerning forests, forest management, and the biofuels/forest industry impacted forest management decisions and willingness to harvest (Joshi et al. 2013; Poudyal et al. 2014; Young et al. 2015). For example, Joshi et al. (2013) concluded that knowledge of wood-based energy significantly influenced Mississippi forest landowners willingness to harvest to support a biofuels industry. Silver et al. (2015) found PFLs wanted additional knowledge concerning ecosystem impacts before deciding to participate in harvesting biomass for a biofuels industry.

Whether PFLs actively sought knowledge concerning a biofuels industry may also influence their willingness to participate in harvesting biomass for energy. Longmire (2012) found that where PFLs got their information and to what degree they sought out the information on their own influenced whether they participated in information programs and had an active forest management plan. Similarly, Dolisca et al. (2006) found that farmers who actively sought information concerning forest management were more willing to participate in forestry management programs and consult with forest manager experts concerning their forest management decisions. Because it is likely that a PFL who has sought out knowledge concerning a biofuels industry would have more knowledge, it is important to control for such differences among PFLs to determine if levels of knowledge and consulting concerning the biofuels/forest industry had a relationship with PFLs’ willingness to harvest to support that industry.

*How might PFLs impact the achievement of larger goals?*

Bioenergy produced from biomass is considered a renewable source of energy because it could be replenished as forests naturally regenerated or were replanted to
speed up the process (Mendell and Lang 2012). Bioenergy produced from biomass was therefore theoretically able to help meet energy demands and achieve energy security and promote sustainability. However, when considering the goal of energy security and the use of sustainable renewable energy resources we encounter issues of supply versus access.

Woody biomass can be a sustainable and renewable energy source with proper forest management practices. At the same time, the idea of sustainability and energy security require consistent access to a renewable fuel source. This means that issues such as access to PFLs supply will impact the potential of biomass to help achieve energy security in the future and current demands now. Studies indicated PFLs willingness to harvest could change as life situations changed (Butler 2008). Supplies that had previously been counted on to be harvested could become inaccessible as PFLs decided not to harvest, chose to supply different markets, or forestland was sold or inherited and the new owners chose not to harvest. When added to the fact that many PFLs already did not own or value their forests for purposes of making profit further constrained access to adequate supplies. The potential for achieving the goals of helping meet energy demands and energy security, while being sustainable is seriously constrained by PFLs willingness to grant access to the biomass supply on their land and forest parcelization. It is therefore necessary to understand what factors might influence PFLs willingness to harvest biomass for a biofuels industry.

What is a Community?

Theories are explanations that help us understand particular phenomenon. A range of theories have been proposed to explain the role, structure, and emergence of community
and its related concepts. In particular, the field theoretical/interactional perspective emphasized the central roles social interaction and local capacity played in the emergence of community among people sharing a common territory (Bridger, Brennan, and Luloff 2010; Wilkinson 1991). This perspective provided a frame to understand the processes that shaped individual level responses to local needs shaping local life.

According to the interactional perspective, the community consisted of three properties: (1) a local ecology – an organization of social life for meeting day-to-day needs and adapting to changes in a particular territorial and social environment; (2) social organization; and (3) community action (Wilkinson 1991). Social interaction provided the associations that comprised the local society and gave structure and direction to processes of collective action.

The term field has been widely used within both social and natural sciences. Wilkinson (1970a) provided a working definition of the term field that was used in this dissertation. He explained that a field was an unbounded nexus of interactions which was both dynamic, in that it was in a continuous state of change, and emergent, reflecting the outcome of the interaction that took place within it (Wilkinson 1970a). Within the field theoretical/interactional perspective, community was seen as a social field, one which had the attributes described above. Because community was an emergent process, it was logical to conceive of it in dynamic terms (Bridger et al. 2010). Community represented a complex, social, economic, and psychological entity reflective of a place, its people, and their various relationships (Bridger et al. 2010; Kaufman 1959; Wilkinson 1991). As a field of social interactions, community emerged from the collective actions of its members.
The process of emergence was unique to the interactional approach to community. From the interactional perspective, community was not a given. Instead, it was developed, created, and recreated through the process of social interaction (Bridger et al. 2010; Bridger and Luloff 1999b; Wilkinson 1991). Community was dependent upon a wide range of interactions. When barriers existed to limit or constrain these interactions, the emergence of community was hindered (Luloff and Swanson 1995; Wilkinson 1970b; Wilkinson 1991).

The emergence and maintenance of community within a local society was therefore dependent upon a local capacity or potential for community action (Bridger et al. 2010; Wilkinson 1963; Wilkinson 1991). Such action had direct linkages to local wellbeing, as it provided a platform for local citizens to address the needs, wants, and unique opportunities of their communities. Social interaction was essential to this process, as it created awareness of local needs and opportunities among local residents, while at the same time providing opportunities for citizens to be invited to take part in action activities.

Community action reflected the interaction of local actors and groups that focused on the creation of social relationships, problem solving, and/or the achievement of goals shaped by and found in their locality (Kaufman 1959; Wilkinson 1963; Wilkinson 1991). From a field theoretical perspective, community action was the foundation of the community development process because it included purposive and positive efforts designed to meet the shared needs of the locality (Brennan and Israel 2009; Bridger et al. 2010; Wilkinson 1979). The ability of local action to emerge and be sustained was the key factor in determining community development.
Another important element of community within the field theoretical perspective was community agency. The community was a constantly changing environment consisting of community action and social interaction (Wilkinson 1991). As the various social fields adapted to and acted in response to changes in the environment, groups and organizations exhibited agency (Luloff and Swanson 1995). Agency reflected not only the motives of people to act together, but their capacity to do so (Brennan and Israel 2009; Bridger et al. 2010; Luloff and Swanson 1995; Swanson 2001). The ability to adapt was reflected in how people came together to address local issues (Brennan and Israel 2009; Bridger et al. 2010; Bridger and Luloff 1999b). Thus, community agency could be seen as the process of building relationships that increased the capacity of local people to come together to act (Brennan and Luloff 2007; Luloff and Wilkinson 1979). In the field theoretical approach: “As long as people care about each other and the place in which they live, there is potential for agency and development of community” (Bridger et al. 2010: 90; Flint, Luloff and Finley 2008; Wilkinson 1991; Flint and Luloff, 2005, 2007). The key component to this process was the creation and maintenance of linkages and channels of interaction across local social fields that would otherwise be directed toward the limited interests of each (Brennan, Flint, and Luloff 2009; Brennan and Israel 2009; Bridger et al. 2010; Luloff and Bridger 2003; Theodori 2005). This was accomplished through the development of the community field.

In each community, groups existed that were organized around various specific/special interests and goals (Bridger et al. 2010; Wilkinson 1968). From the interactional perspective, such groups were viewed as relatively unbounded fields of interaction (Bridger et al. 2010; Wilkinson 1970a). Every local society must have a
mechanism or process capable of connecting the interactions occurring in these various special interest fields into a collective whole (Bridger et al. 2010; Wilkinson 1970a; Wilkinson 1970b). This mechanism, in the interactional perspective, was provided by the community field. Unlike other special interest social fields, the community field does not pursue a single set of interests. Instead, it created linkages and lines of communication between and among the actions and interests of other social fields (Brennan and Israel 2009; Brennan and Luloff 2007; Bridger et al. 2010; Wilkinson 1968; Wilkinson 1970a). The community field thus provided linkages that highlighted and brought into focus common interests in local aspects of social life. Such a focus, and related community agency and action, directly shaped local quality of life and wellbeing (McGrath et al. 2009).

Why Focus on Communities?

The impact to and influence of communities on the efficacy of a wood-based biomass industry has largely been ignored within the extant literature, even more so than PFLs. There are several possible reasons for this. Because the majority of the Eastern forests were owned by PFLs and access to their forest stocks were subject to their decisions, communities and their support could simply have been overlooked. As explained, a major driver and justification for the development of a wood-based bioenergy industry was the possible economic benefits to rural communities (Buchholz et al. 2011; Gan and Smith 2007; Mayfield et al. 2007). Due to such possible economic benefits, a similar set of assumptions may have been applied to communities as those being extended to PFLs – namely, communities would be supportive and accept the
development of a wood-based bioenergy with few obstacles for increased economic benefits and opportunities.

Economic benefits and opportunities were not the only things that could come from the development of a wood-based biofuels industry. There were a number of other possible impacts which communities may have needed to address. Even though the majority of forests were owned by PFLs, the possible negative impacts associated with increased harvesting – erosion, harm to wildlife and habitat, forest aesthetics, and water and air quality – were likely experienced by the larger community. Further, a biofuels industry would not just include increased forest product harvesting. It also included possible impacts from increased truck traffic, road damage and construction, and possible construction of new facilities for wood processing and energy development. Each of these events are commonly tied to energy development projects and often resulted in local opposition from communities (Devine-Wright 2008; Elliott 2003).

Community support for or opposition to various developments is a complex phenomenon. Community support was often not given without qualification (Bell et al. 2013; Walker 1995). Even where communities supported a particular development they often believed there were general limits and controls that needed to be placed on it (Wüstenhagen, Wolsink, and Bürer 2007). If a large number of community residents had qualifications for development, in this case the development of a biofuels industry, these qualifications could account for variation in support and opposition within the community. Often qualifications pertained to the impact of developments on the landscape, environment, wildlife, and community residents (Bell, Gray, and Haggett 2005).
Trying to address differing priorities, interests, and qualifications among groups of people within the community can be difficult (Bohon and Humphrey 2000). Further, communities often lacked the capacity to come together in ways that allowed them to address these types of issues in a way beneficial for the community as a whole (Wilkinson 1991). However, when community residents did have the capacity to come together and work across interests and priorities to address issues and problems they could determine the outcomes of local development within their community (Wilkinson 1991). This community capacity included the ability to oppose or support any kind of development within their locality, often in the face of outside forces and policy demands (Wilkinson 1991). For these reasons it was important to understand community support and opposition to the development including understanding the opportunities and concerns communities perceived regarding a wood-based biofuels industry. Additionally, because communities could have the capacity to oppose or promote development within their community, development might better be pursued at a community level.

**Sustainability and community**

Several studies focused on the importance of sustainability for rural community development (Brennan, Luloff, and Finley 2005b; Bridger and Luloff 1999a; Bridger and Luloff 2001; Dale, Ling, and Newman 2008; Maser 1997). Community development has always been an important part of community theory (Wilkinson 1991). Finding a way to sustain development was also an important part of natural resource dependent/based community research.

This fact was salient in the boomtown literature, which described the boom/bust cycles that rural communities went through when they were dependent on natural
resource extractive industries (Brown, Dorins, and Krannich 2005; Krannich and Greider 1984; Putz, Finken, and Goreham 2011). Many of these studies focused specifically on economic impacts, while others focused on social consequences. Very few looked at social, economic, and environmental impacts simultaneously. Similarly, studies on woody biomass harvesting impacts typically focused on economic impacts (positive and negative). Wilkinson (1991) explained that while economics was a part of development there was much more to community development. Focusing on economic development without understanding how it impacted individual, social, and ecological wellbeing could lead to increased economic gains, but also economic determinism and loss of community (Swanson and Luloff 1988; Wilkinson 1991).

The theory of sustainable development was based on the premise that development only occurred when equal effort was exerted to increase and improve conditions in social, socioeconomic, and environmental areas (Leach et al. 2010). Bridger and Luloff (2001) explained these types of efforts to achieve sustainability could be difficult when sustainability was pursued above the local level. They suggested that by focusing on sustainability at the local level, changes could be seen and felt more immediately while placing sustainability within a context from which it can be validated as a process (Bridger and Luloff 2001).

In the study of PFLs willingness and community and PFLs concerns, I am engaging in a broader theoretical discussion concerning community development and the theoretically appropriate scale from which to pursue sustainability. The study of biomass harvesting highlights issues raised by Bridger and Luloff (1991, 2001). Sustainability goals, and the role biomass can play in meeting them, are currently being pursued from a
national/state level through the enactment of policy. At such macro levels, the scale of change required to pursue these goals at the local level was large enough that problems of coordination across political and action units caused a disconnect (Bridger and Luloff 2001).

In the case of my project there was a divide between the focus on technical/economic factors and the importance of social factors such as community impacts and concerns, as well as PFLs values and how they impacted the feasibility of a biofuels industry. Sustainability would, therefore, be better pursued at the local/community level where it can account for these many social issues. From the community field perspective, when local people care about each other and the place they live, community and sustainable development can emerge (Brennan et al. 2005b; Bridger et al. 2010; Flint and Luloff 2005; Flint and Luloff 2007; Flint, Luloff, and Finley 2008).

**Perceived Impacts: Positive or Negative**

PFLs’ willingness to participate in and communities’ support for a wood-based biofuels industry may be connected to perceived impacts to a variety of important issues. Gramling and Freudenburg (1992) provided a simple framework that addressed individual and group perceptions concerning impacts or outcomes of development and development projects. They explained that within the human realm, measurable impacts began as soon as there were changes in social conditions – often from the time when information about a project or development first became available. Even before any physical disturbances took place, an area could experience what they called opportunity-threat impacts.
These perceptions resulted from the efforts of individuals, groups, and communities to identify, define, and respond to the ongoing and the anticipated implications of development, whether as opportunities (to those who see the changes as positive) and/or as threats (to those who see the changes as negative) (Gramling and Freudenburg 1992). Impacts occurred not just when individuals and communities were faced with threats over which they had little effective control, but also when they had to decide the extent to which a proposed development would have positive or negative impacts to multiple aspects of concern. Gramling and Freudenburg (1992) explained that perceptions concerning the outcomes of a development might be more important to the overall acceptance of or opposition to a proposed development than other possible determinates of support or opposition. When considering the willingness of PFLs to participate in and communities’ support for a wood-based biofuels industry, individual and community perception of the possible impacts, both positive and negative, could impact the outcome of such development.

*Perceived impacts to the environment and forest health*

Community, from a community field theory perspective, included both people and the natural environment (Wilkinson 1991). This suggested members of the community were attached to and concerned for the local environment. For instance, Brehm, Eisenhaure and Krannich (2004) found that at the ecological level, overall community attachment was associated with greater concern for the environment and was more useful for understanding environmental attitudes than many sociodemographic variables (Brehm, Eisenhauer, and Krannich 2006). While attitudes and behaviors are not the same, the latter finding supported Wilkinson’s proposition (1974, 1991) that community and its related concepts led to the
development of an ecological consciousness. An ecological consciousness, or a concern for the environment, included exhibiting behaviors that promoted ecological well-being and the maintenance of the biosphere.

The natural environment played a significant role in healthy and successful social lives by providing shared and structured symbols (Elmendorf 2008). These symbols helped ground people in their everyday lives, and as change occurred, they provided residents with a consistent sense of place and comfort (Elmendorf, 2008). According to Greider and Garkovich (1994), symbols were developed through social interaction and were held and preserved within a community. Greider and Garkovich (1994) explained that the symbols people used to create landscapes from the natural environment were reflections of how they defined and viewed themselves. People constructed the natural environment into landscapes using different symbols that conferred different meanings on the physical objects and conditions present in that environment. It is possible that the introduction of increased harvesting or a new biofuels energy production facility could come into direct conflict with symbolic meanings ascribed to the physical environment and the landscapes created. This could lead to negative beliefs and decreased support when proposed developments challenged established meanings.

Forest landowners and community residents have been found to hold similar views regarding the natural environment, environmental issues, forestry practices, and policies (Bourke and Luloff 1994). Forestry practices viewed as being environmentally beneficial and promoting forest health were more likely to receive wide support than those practices perceived to have negative impacts to the environment (Longmire 2012). Like other energy-related topics, there are always concerns over the environment. However, biomass
does also have potential to benefit the environment, at least from a forest management standpoint. Many were concerned that increased harvesting for biofuels could be harmful to the environment and wildlife (Bies 2006; Dwivedi and Alavalapati 2009; Schulze et al. 2012). For those who voiced such concerns, they often focused on the possibility that increased harvesting would modify vegetation, soil, and hydrologic conditions, lead to increase erosion rates and flooding, and decreased water quality (Schulze et al. 2012). Others suggested that with proper forest management, harvesting/thinning for biomass would increase the health and value of forests by increasing regeneration, increase the value of stands, remove invasive species, and protect against fire by acting as a fuel treatment (Manley and Richardson 1995; Sabourin, Puttock, and Richardson 1992).

To be of use in further studies and advise future policies concerning the development of a wood-based biomass industry, it was important to understand how perceived impacts to the environment and forest health influenced willingness to support and participate in such development. Because perceived environmental impacts had a relationship to the degree of an individual’s connection to nature/environment (Baldassare and Katz 1992; Klineberg, McKeever, and Rothenbach 1998; Silver et al. 2015), it was important this connection be understood along with its relationship to management and harvesting decisions concerning biofuels.

*Perceived impacts to forest aesthetics*

Research attempting to identify possible reasons for opposition to energy and other development projects often focused on physical and environmental characteristics. A common focus in this area has been on the visual/aesthetic impacts a particular development may have surrounding landscapes (Elliott 2003). Not only were there threats
to forest aesthetics from harvesting, there could also be visual impacts to surrounding landscapes from constructed facilities, new roads, and electricity transmission lines and grids that accompanied the development of a biofuels industry. Like perceived impacts to the environment, impacts to the visual landscape could come into contrast with symbolic meanings and social constructions of the community. Further, if PFLs owned and valued their land for visual/aesthetic reasons, perceived negative impacts could well conflict with those values. In both cases we could find negative beliefs and decreased community support and PFLs willingness to harvest.

One study found PFLs who thought harvesting biomass for bioenergy would impact their forest aesthetics were less willing to participate in such harvesting (Joshi and Mehmood 2011). It was unclear if this was the case throughout the Eastern forest region. As such, it was important that this study provide insight into understanding how perceived impacts on forest aesthetics and landscapes influenced community support and PFLs willingness to participate in harvesting biomass for a biofuels industry.

*Perceived impacts to the economy*

The development of a wood-based biofuels industry has been tied to the provision of local economic benefits. For PFLs, these benefits came in the form of increased profits from harvesting trees to sale to this industry (Domac et al. 2005). For communities, these benefits could come in the form of taxes and employment (Buchholz et al. 2011; Remedio 2003). Despite these potential economic benefits in the development of a biomass and bioenergy industry, there were also concerns over possible impacts to current forest harvesting and products (Dwivedi and Alavalapati 2009; Perez-Verdin et al. 2008). Little research on how a biofuel market would impact traditional forest industry
and markets exists. It was possible that with the development of a competitive industry seeking the same raw material, prices would increase, reducing the profit margins for current industries (Mendell and Lang 2012). This would seriously threaten an established and important industry in many of the communities where biomass would be harvested. As such perceived economic outcomes could play a role in woody biomass development efforts. If PFLs and communities perceived the economic benefits to be lacking or that such development would negatively impact current economic conditions and industry, community support for and PFLs’ willingness to harvest for a biofuels industry may be decreased.

**Sociodemographic Variables**

Multiple studies suggested several sociodemographic variables had a relationship with forest landowner’s management decisions (Butler and Ma 2011; Butler et al. 2010; Joshi and Mehmood 2011; Metcalf 2010). This study was concerned with six sociodemographic variables often used in social science research, either as determinants or as controls. Variables of interest included age, gender, education, length of residence, political ideology, and income.

As PFLs life circumstances changed, so too could forest management decisions. Life circumstances and outlooks often changed overtime and as PFLs aged. Age has been found to be related to forest management decisions (Joshi and Mehmood 2011; Susaeta et al. 2012). For example, Joshi and Mehmood (2011) found in their study in Arkansas, Florida, and Virginia that younger landowners were more likely to harvest to supply biomass for bioenergy than older landowners. Further, age has long been used in studies concerning proposed development projects. One study looking at support for renewable
energy development found that younger respondents showed higher levels of support toward having renewable energy development take place within their community and near their place of residence than older respondents (Larson 2013). Age has also been a strong and consistent predictor of environmental concern and feelings of connection to nature (Jones and Dunlap 1992). This meant adding age to the analysis was necessary when examining the relationship between respondents’ connection to nature and willingness to harvest for biofuels.

Gender has often been used as a control and/or determinant in social science research on development. This was also the case in studies looking at forest management decisions, though not to the same degree as other social research. This may be because the majority of forest owners, PFLs in particular, are male (Longmire 2012). Gender can be an important determinant of support for a particular development. One reason for this may be tied to levels of concern and perceived risk. Several studies examined support for particular development projects and found women tended to have higher levels of concern and perceived risk of negative impacts than men (Davidson and Freudenburg 1996; Kasperson, Golding, and Tuler 1992). These higher levels of concern and risk perception impacted their views of development projects and resulted in lower levels of support and acceptance when there was any sort of risk (Davidson and Freudenburg 1996). Further, women were generally found to have higher levels of concern for the environment than men (Davidson and Freudenburg 1996; Jones and Dunlap 1992; Van Liere and Dunlap 1980). Such findings suggest it is important to understand the relationship of gender with PFLs’ willingness to participate in harvesting for a biofuels
industry, as well as control for its relationship with concern of negative impacts to the
environment.

Education has been an important determinant in forest management behavior
(Butler et al. 2010; Joshi and Mehmood 2011; McDonald et al. 2006), support for
development projects (Bergmann, Colombo, and Hanley 2008), and concern for the
environment (Jones and Dunlap 1992; Klineberg et al. 1998). Several studies found a
relationship between education and forest management decisions. However, this
relationship was not always predictable. For example, Joshi and Mehmood (2011) found
that higher levels of education influenced harvesting decisions, including harvesting for
biomass. Other studies, such as Dennis (1989) and McDonald et al. (2006), found forest
landowners with higher levels of education were least likely to harvest. Further,
education was one of the most consistent predictors of concern over environmental
impacts of development projects, including energy development; it influenced
landowners perception toward environmental and energy issues (Jones and Dunlap 1992;
Joshi and Mehmood 2011). Such influences on perceptions may shape PFLs’ willingness
to harvest, especially if they determined such activity to negatively impact the
environment or many other possible aspects.

Length of residence and PFLs forest management decision making have been
studied together fairly often. How long a person has owned and resided in an area may
relate to how one feels toward forest harvesting and development in the area. The length
of time one has lived in a place may also relate to how they feel about the area itself.
According to Feldman (1990), the difference may be due to the bonds and place
attachments that development during residency. Beckley (2003) found that length of
residence was an important variable as it related to an individual’s bond to an area. Beckley (2003) found length of residence produced differences in how residents responded to potential development. He concluded that longer-term residents were more worried about social outcomes, while newcomers were more concerned about impacts to the landscape and its aesthetic features. This may influence how one feels and reacts toward increased harvesting on their land and the surrounding area. Further it may be associated with harvesting decisions. For example, how long someone has owned the land and how long they have lived on it have been shown to impact the likelihood of harvesting (Butler et al. 2010; Vokoun, Amacher, and Wear 2006). Vokoun et al. (2006) found the longer one owned and lived on their land increased their likelihood of harvesting.

Political ideology has been an important variable in social science research and in understanding PFLs management decisions. Political ideologies are useful because those who identified with a specific ideology often held similar ideals about environmental, social, and political issues. Jones and Dunlap (1992) explained those who were more liberal in their political ideology were more likely to be concerned for the environment. When looking at possible impacts to whether PFLs had harvested or not, Longmire (2012) found that those who considered themselves in some way conservative indicated they had harvested in higher percentages than those who described themselves as being more liberal. How this plays out when considering willingness to participate in forest product harvesting for a biofuels industry is still unclear. Because it may influence management decisions and perceived impacts, political ideology is also an important control variable.
Income has been found to impact forest management and harvesting decisions. Owners who had higher incomes and were wealthier were found to be less likely to harvest than those who had lower incomes (Becker et al. 2013; Dennis 1989; McDonald et al. 2006). Aside from forest management and harvesting, income was found to be related to the belief that environmental protection should be given priority over the creations of jobs (Klineberg et al. 1998). In this case, those with higher incomes were more likely to give priority to environmental protections (Klineberg et al. 1998). This could prove to hinder the development of a biofuels industry, especially if PFLs place importance on the goal of rural community economic development through job creation. In both situations, level of income could impact the availability and access to large enough and sustainable supplies of biomass.

**Analytic Model**

![Analytic Model for PFLs' Willingness to Participate in Harvesting for a Biofuels Industry](image-url)
Based on the literature review an analytic model was developed. This analytic model was used to determine if the findings and theories discussed in the literature review provided an accurate understanding of PFL willingness to harvest biomass for energy. Figure 1 shows five main variable concepts which may be related to PFLs’ willingness to participate in forest product harvesting for energy. Sets of variables were used to measure multiple facets contained in these broader concepts. The literature suggested that how PFLs use and value their land and nature, their forest management and harvesting plans and past actions, their knowledge concerning biofuels and forest industries, their perceptions concerning the impacts and outcomes to themselves and their community, and sociodemographic characteristics are related to PFL willingness to harvest biomass for bioenergy.

**Conclusion**

The assumptions that PFLs were able and willing to harvest biomass to support a biofuel industry and will do so with few obstacles and for opportunities to increase profits had several consequences. These same assumptions have been extended to communities who stood to receive economic benefits associated with biofuels development, and these assumptions have, until recently, not been challenged. This has resulted in limited research on PFLs and communities who stood to be impacted both positively and negatively from this development. Further, the almost exclusive focus on technical/economic/supply issues ignored many social, cultural, and environmental concerns that could impact the efficacy of a wood-based biofuels industry.

PFLs do not own and value their land exclusively as an investment or way to make a profit. Many owned their land for intrinsic values and uses that did not include
harvesting trees for sale. Research indicated that PFLs maintained their property for a variety of reasons reflecting a complex assortment of both use and exchange values. How these values and perceived impacts to these values influenced PFLs’ willingness to harvest biomass for energy has yet to be extensively studied; however, research indicated that such values do influence PFLs’ forest management decisions.

Research has also indicated the use of biomass to produce energy and fuel has several benefits including helping to meet current and future energy demands, and energy security. Its potential in these two areas rests on being able to work with PFLs and gain access to large stable supplies of biomass as well as gaining larger community support for such development. Biomass also has the potential to provide positive economic benefits in the form of tax revenues and job creation. It is not understood how this could impact current economies and forest product industries. Nor is it understood how PFLs and communities would react to potential threats and opportunities presented by a biofuels industry.

The purpose of this study is to provide detailed analysis of PFLs’ willingness to participate in forest product harvesting for a wood-based biofuels industry. This included analyzing what sociocultural and sociodemographic dimensions impacted this willingness. The following chapters provide details concerning the perceived opportunities and concerns of communities and PFLS regarding a wood-based biofuels industry.
CHAPTER 3

RESEARCH METHODS

This chapter has two main parts. The first outlines the data collection methods used in the project. The second provides details on the construction and measurement of the dependent and independent variables used in the statistical analysis.

Data Collection Methods

This project utilized a mixed method (qualitative and quantitative) approach to provide a better understanding of community impacts, concerns, and influences on willingness of PFLs to participate in the biofuels industry. The mixed method design included analyzing secondary data, conducting key informant (KI) interviews and a phone survey of both PFLs and the general public in the Eastern forest region.\(^1\) The Eastern forest region is defined as all states east of or contiguous to the Mississippi River.

The use of multiple methods has been suggested and used as a way to deal with the weaknesses of each method while benefiting from their combined and complementary benefits (Sechrest and Sidani 1995). Social science research has increasingly combined multiple methods such as in-depth case studies and surveys (Egan et al. 1995; Luloff 1999; Sechrest and Sidani 1995). One benefit to using multiple methods was tied to the concept of triangulation. Triangulation is the use of multiple sources of information to enhance the reliability and validity of the findings (Jick 1979; Morse 1991). Denzin (1970) explained the purpose of using multiple methods was “to forge valid propositions that carefully consider relevant rival causal factors” (p.27).

\(^1\) Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, Wisconsin.
Study site selection/secondary data analysis

A longitudinal database consisting of social and environmental data for all counties in the Eastern forest region was developed. Then, using this database, a cluster analysis was used to identify similar counties. These clusters served as representative study sites. From these clusters, sites were selected that helped understand the variance in forest, social, and demographic conditions across the Eastern forest region.

Figure 2 Forest Cover in the Eastern Forest Region
The database was created using a process developed in an earlier study conducted for the USDA Forest Service Northern Research Station (Brennan, Luloff, and Finley 2005a; Steele, Luloff, and Finley 2004). For my dissertation project, a longitudinal database was created for counties in the Eastern region for the years 1970-2010, using existing computerized files from censuses, business directories, and state agency directories. The analysis for my study empirically classified the counties for 1970, 1980, 1990, 2000, and 2010 using indicators of employment at the 2 digit SIC level to differentiate among extractive, manufacturing, and service sector industries; industrial diversification as measured through indices of employment and industrial differentiation; income; income inequality (GINI index); service availability (health, education, municipal, and others, all measured on a per capita basis and compared with regional norms); population size, composition, and change; and net-migration. In addition, we included information from the USDA Forest Service Forest Inventory and Assessment (FIA) for comparable periods identifying forest cover, biomass and volumes, and management.

Cluster analysis was employed and assisted in the development of an overview of forest conditions in the region. This analytical method classified units into maximally similar categories while minimizing internal categorical differences. Cluster analysis has been described as a “multivariate statistical procedure that starts with a data set containing information about a sample of entities and attempts to reorganize these entities into relatively homogeneous groups” (Aldenderfer and Blashfield 1984:7). Cluster analysis allowed the identification of several types of counties that varied according to such characteristics as percent of land in forest, percent of workforce employed in
forestry-related occupation, income, education, sociodemographic composition, and
population change. Other categories of independent variables, drawn from the literature
on economic development, included types of physical and/or natural resources,
infrastructure, spatial relationships with growth centers, initial economic base, patterns of
structural change, spending on or availability of social services, public and higher
education and training, and other public investments measured with secondary data. In
the end, this process identified clusters of counties throughout the region, from which
representative counties were selected for the KI interviews.

This process identified clusters within the Eastern forest region based on specific
forest variables. These variables included the percent of forested land and the percent of
private ownership of that forested land. Using these variables, four clusters were
identified. The clusters were as follows: 1) 16 percent forested with an average of 93
percent private forestland ownership; 2) 54 percent forested with an average of 83
percent private forestland ownership; 3) 13 percent forested with an average of 44
percent private forestland ownership; and 4) 75 percent forested with an average of 60
percent private forestland ownership. States were selected across both the north and south
areas of the Eastern forest region across the cluster categories. Two counties were then
selected in each state. A metropolitan county was selected first, followed by an adjacent
rural county. This allowed maximum variation across the clusters, the Eastern forest
region, and metropolitan status.

Figure 2 identifies the states and counties of the study sites. Interviews were
undertaken in Stone and Pearl River Counties in Mississippi; Lawrence County,
Tennessee; Clinton and Centre Counties, Pennsylvania; Marathon and Clark Counties,
Wisconsin; and Fairfield and Lancaster Counties, South Carolina. In each case study site, data related to forest resources and economic development actions was gathered from editorials, reports, policy documents, and other archival sources. Relevant aggregations of secondary data coupled to findings drawn from the key informant data enables the ability to systematically describe the relationship between PFLs and the public’s willingness to support biomass extraction (PHDC 2007).

Figure 3 Study site states and counties
Key informant interviews

Key informant interviews are an important, time-intensive research element in case studies (Neuman 2005). Such interviews allow researchers to explore in-depth how local leaders and residents perceive and conceptualize issues. These community experts, with their particular knowledge and understanding, can provide insights on the nature of problems and give recommendations for solutions (Creswell 2012). These KIs were invaluable sources of information that provided a detailed context often lacking in other forms of data collection (Creswell 2012; Neuman 2005). Further, this information was essential to the design of relevant survey questions. Working within five states and approximately 10-25 informants in each study site provided an important comparative component and enabled my ability to determine if there were variations in how people in distinct areas viewed issues.

KIs were conducted with PFLs, local community leaders, community residents, and forest industry representatives. These KIs helped determine perceptions of PFLs willingness to participate in harvesting for the biofuel industry and identify those opportunities and concerns communities had concerning a biofuels industry. Further, these interviews were used to determine potential obstacles associated with forest-based biofuel production particularly as it related to local economic development, well-being, and interests and concerns related to biomass extraction from private forests. The data collected in these interviews provided diverse perspectives on issues related to biomass-based energy development, community and resident concerns, and the roles of PFLs in this emerging industry.
This project sought information from a broad set of similar respondents. This was done for two reasons. First, it provided an opportunity for the researchers to gain as wide a set of opinions, ideas, and knowledge from as many stakeholder groups as possible. Second, it allowed for comparisons across sites among similar group representatives. To facilitate this, key informants were identified through state and organizational directories and included: (1) individual PFLs; (2) PFL groups; (3) state resource management agencies; (4) a senior local government official; (5) a local planning agency; (6) a local economic development agency; (7) a local environmental group; (8) a regional and/or national environmental group; (9) local media; (10) business community; (11) local forest industry; (12) nongovernmental organizations; (13) local school district; and (14) underrepresented or marginalized segment of local society (Wilson 1987; Wilson 1996)².

As well, additional interviews were conducted when key informants recommended meeting with other people with important insights not on the original list (also known as “snowball” sampling). Interviewing ceased when information gathered from interviews became redundant. Responses were aggregated following a procedure that eliminated idiosyncratic answers and respondent error (see Schwartz, Bridger, and Hyman. 2001).

² The underrepresented/marginalized members of society have been characterized as those who are economically disadvantaged and whose opinions generally are ignored. Involving them in this process is a deliberate attempt to broaden the data gathering process to make it more representative of each community.
Table 1 Key informant interviews by state and category

<table>
<thead>
<tr>
<th></th>
<th>TN</th>
<th>MS</th>
<th>PA</th>
<th>WI</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Interviews</td>
<td>10</td>
<td>21</td>
<td>17</td>
<td>24</td>
<td>23</td>
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<tr>
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<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Forest landowner</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Extension</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Media</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
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<tr>
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<td>2</td>
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<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Federal resource manager</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Environmental NGO</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Local service organization</td>
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<td>3</td>
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<td>3</td>
<td>6</td>
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<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1 provides details concerning the total number of KIs conducted in each area, as well as the pre-determined category they were interviewed for. It should be noted many of the key informants actually filled multiple categories. For example, the elected president of the school board in South Carolina also represented a minority population. Further, many of the key informants were also PFLs in addition to the category for which they were interviewed. While there were 16 KIs who were interviewed as PFLs, an additional 27 of KIs were PFLs (43 PFLs total).

All interviews included 11 primary open-ended question that covered the following topics: (1) major changes in the local economy and efforts to increase and/or retain jobs and income; (2) changes in forest management on ownerships and local quality of life; (3) interest and willingness to use biomass harvesting as a sustainable rural economic development strategy in the area; (4) impacts of such usage on primary and secondary manufacturing as well as support industries and occupations; (5) efforts to
preserve habitat and other environmental resources; (6) perceived strengths, weaknesses, opportunities, and threats associated with biofuel production; (7) conflicts over the use and exchange values of natural resources for economic development; and (8) perceptions of understanding by various stakeholders about biomass related issues and energy development and conceptual approaches for informing community members. Although the same interview guide was used for each interview, follow-up questions were asked to pursue unique insights specific informants offer (see Appendix A) for the KI interview guide.

A content analysis of the KIs was conducted. Content analysis is a process for systematically coding and analyzing data (Bernard 2013). The purpose of using this method was to identify key themes and patterns. Further, content analysis is used to analyze data while taking into account the specific context it was collected in (Krippendorff 2013). Using the global search command in Microsoft Word, key words were used to search the text of each KI. Key words or codes were developed based on information gained in the review of the literature. This procedure identified the relationship of biomass harvesting to social and economic conditions and the potential impact of the biofuels industry on communities and existing wood-based industries. These findings were essential to the development of the larger region-wide survey. Thus, the approached employed here utilized in-depth studies of a subject in a particular context, and a survey component to facilitate the ability to determine the generalizability of the findings.
Regional phone survey

To assess community receptivity to the biofuels industry and understand influences to PFL willingness to participate in harvesting for a biofuels industry, a region-wide phone survey of PFLs and the general public was developed and conducted in the Spring/Summer of 2015. The regional phone survey was conducted by the Opinion America Group. The group used a blended random digit dial and random cell samples for the overall Eastern forest region. In addition, they also used a random targeted sample (targeted at counties east of or contiguous to the Mississippi River with higher density of forestland). They also introduced a random replicate sample of 1,000 of those random targeted forest landowners to gauge the incidence of qualification and make projections on how much of that random targeted forestland sample was needed to meet the quota N of 900 for PFLs.

The survey helped to determine perceived strengths, weaknesses, opportunities, and threats associated with the development of biofuel facilities and their impact on local communities, residents, and PFLs. The survey instrument was separated into two sets of questions. The first set included those questions asked of both PFLs and the general public providing a comparative base for these two groups. The second set included questions directed specifically to PFLs (See Appendix B). During the process of the phone survey there were a total of 6,290 valid numbers contacted. In total, 1,829 surveys were completed, 920 by the general public and 909 by PFLs. This resulted in a total response rate of 29 percent. However, this study specifically focused on the subgroup of 909 PFLs.
Determining the interests and concerns of PFLs is important since they can have an immediate impact on and, as a result, significantly affect the emerging biofuel industry. Further, such issues have implications for community economic development and well-being across the larger Eastern forest region where PFLs with diverse non-consumptive objectives (e.g., recreation, aesthetics, solitude, and legacy being more important than income from harvesting) dominate.

**Variable Measurement**

**Dependent Variable**

This study used as its dependent variable PFLs willingness to harvest for a biomass industry. It was measured using the responses to the question “If possible, I would harvest biomass for energy from my land.” The responses were based on a five-category Likert-type scale with choices ranging from 1= “strongly disagree” to 5= “strongly agree.” Respondent scores ranged from a low of 1 to a high of 5, with a mean of 2.6.

**Independent Variables**

*Acres of Forest Land Owned*

Because tract size has long been considered an important factor in explaining PFLs’ forest management decisions, this study included a measure of acres of forest land owned (Cleaves and Bennett 1994; Longmire 2012; Row 1978). The variable acres of forest land owned, was measured using the survey question “In total, about how many forested acres do you own?” Respondents were then given a list of nine different acre range options to choose from. The categories were 1= “1 acre but less than 5 acres”; 2=...
“5 acres to less than 10 acres”; 3= “10 acres to less than 25 acres”; 4= “25 acres to less than 50 acres”; 5= “50 acres to less than 100 acres”; 6= “100 acres to less than 250 acres”; 7= “250 acres to less than 1,000 acres”; 8= “1,000 acres to less than 5,000 acres”; and 9= “5,000 acres or more.” Responses ranged from 1 to 9 with a mean of 3.5.

*Use Values and Exchange values*

PFLs valued and owned their land for a variety of reasons, and these values may play an important role in PFLs’ decisions to harvest for a biofuels industry (Buchholz et al. 2011; Finley et al. 2005). I measured the importance respondents’ placed on use and exchange values from responses to the statement “please tell me if the reason is an important or unimportant reason to you for owning your forestland.” The respondents were then read a list of thirteen reasons. The level of importance for each reason was measured using a Likert scale where 1= “very unimportant” and 5= “very important.” To determine if the measure of values should be one measure or more, an exploratory factor analysis was conducted to discover if there were any latent variables. Factor analysis is based on information gained from a correlation matrix and is used to discover patterns of relationships among a number of variables and to determine the consistency of such relationships (Warner 2012). Factor analysis was employed here as a data reduction technique, to help understand the structure of a set of variables, and as a means to identify common themes from within a large number of variables. The latter element was essential in constructing a measure of an underlying variable and assessing whether there were one or more latent factors being measured by this set of variables (Warner 2012).

As a means for data reduction, factor analysis is routinely applied to situations where there is a need to evaluate whether the scores on a set of individually measured
variables can be explained by a smaller set of the variables (Field and Miles 2010). An example of this is when a researcher wants to remove redundant measures, or to measure a concept as parsimoniously as possible. By reducing a data set from a group of related variables to a smaller set of factors, factor analysis achieves parsimony by explaining the maximum amount of related variance in a correlation matrix using the smallest number of constructs (Field and Miles 2010). When trying to discover themes from within groups of variables (exploratory factor analysis), the researcher will perform a factor analysis to discover the existence of multiple factors or latent variables (Akaike 1987; Briggs and Cheek 1986). For example, a researcher has a set of questions measuring beliefs concerning the perceived opportunities or threats large-scale renewable energy facilities pose to the community. While the large set of questions taken as a whole might measure overall beliefs, a factor analysis can be performed to determine if there were multiple beliefs or latent variables being measured by the group of questions. The research might find that there were several distinct themes or beliefs being measured such as economic, environmental, and social opportunities or threats.

The results indicated there were two distinct underlying groupings, with eigenvalues of 2.6 and 1.1 respectively. The first measure used the first grouping to create a scale measuring use values. The second measure used the second grouping to create a scale measuring exchange values. The use values scale was created using the following items: hunting, camping, personal uses of wood, enjoyment, to enjoy wildlife, and solitude. A reliability analysis of this scale yielded a Cronbach’s alpha coefficient of .71, indicating an acceptable alpha level (Warner 2012). The resulting measure had a potential range of range 6-30, where use 6= “use values are very unimportant” and 30= 
“use values are very important.” Actual scores ranged from 6 to 30 and had a mean of 24.9.

I measured the importance respondents’ placed on exchange values as a reason they owned their land from responses from question based on the second grouping identified in the factor analysis. The exchange values scale was created using the following items: land investment, to sell land for profit, growing trees for sale, and income other than from selling timber. A reliability analysis of this scale yielded a Cronbach’s alpha coefficient of .70, indicating an acceptable alpha level (Warner 2012). The resulting measure had a potential range of range 3-15, where use 3= “exchange values are very unimportant” and 15= “exchange values are very important.” Actual scores ranged from 6 to 15 and had a mean of 7.1.

*Past Actions and Future Plans*

Previous research indicated prior behavior and actions had some bearing on future behavior, actions, and plans (Aarts et al. 1998; Ajzen 1991; Joshi and Arano 2009). Further, future plans or intentions also had an influence on actual future actions and decisions (Ajzen 1991; Ouellette and Wood 1998). For this reason this study included measures of both past actions and future plans.

To measure past action concerning harvesting trees for sale, respondents were asked whether or not they had ever harvested trees for sale. Respondents indicated, 1= “yes” or 0= “no”, to whether they had ever “Cut and/or removed trees for sale.” A frequency distribution of responses indicated that 59.8 percent had never cut and/or removed trees for sale, while 40.2 percent had done so.
To measure the influence of future plans to harvest trees for sale, respondents were asked if they “Plan to harvest trees for sale in the future.” This reflected the idea that those who were already planning on harvesting trees could be more open to the idea of doing so for a biofuels industry (Ajzen 1985). Responses were measured using a Likert type scale where 1 = “very unlikely” to 5 = “very likely.” This measure had a mean of 2.3.

Management plans and decisions should not be studied in isolation. Rather, decisions and plans should be studied in relation to all different types of management decisions (Joshi and Arano 2009). To accomplish this, my study included variables measuring other management plans. Respondents were asked to “please tell me if you agree or disagree that the item is in your plans for your forest land in the next ten years.”

A factor analysis was run on the eight items concerning whether PFLs had plans to conduct a specific management activity to determine if there were groupings among the items. The factor analysis confirmed there were two specific groupings with eigenvalues of 2.57 and 1.11. The factors were divided between plans focused on cutting trees (the first factor) and those that did not (the second factor). The scale for plans that focused on cutting was created from the following items: harvest dead trees, reduce fossil fuels use, remove low value trees, generate income, and support local renewable energy. A reliability analysis of these factor items resulted in a Cronbach’s alpha coefficient of .74, indicating an acceptable alpha level (Warner 2012). The items had original responses measured on a Likert type scale where 1 = strongly disagree to 5 = strongly agree. The resulting scale had a range of 5-25 where 5 = “strongly disagree about having such plans” to 25 = “strongly agree about having such plans.” Actual scores ranged from 5 to 25 and had a mean of 16.5.
The scale for plans that did not focus on cutting was created from the following items: improve wildlife habitat, clean up the forest, and aid forest regeneration. A reliability analysis was run on the second factor grouping and resulted in a Cronbach’s alpha coefficient of .63. I choose to include this measure in the analysis because it approached the common acceptable alpha level .65 or higher (Warner 2012). The resulting scale had a range of 3-15 where 3 = “strongly disagree about having such plans” to 15 = “strongly agree about having such plans.” Actual scores ranged from 3 to 15 and had a mean of 12.3.

Knowledge concerning biomass and forest industry

Research indicated knowledge may act as a precursor to behavior, including harvesting behavior (Ajzen 1985; Joshi et al. 2013; Silver et al. 2015). It was therefore important to understand how PFLs’ knowledge concerning the biomass and forest industries might impact their willingness to harvest for a biofuel industry. The variable measuring respondent knowledge concerning biomass and the forest industry was created from 7 yes or no questions (see appendix # for full list of items). A factor analysis was conducted to determine if there were groupings of items. All items loaded on a single factor with an eigenvalue of 2.58. A reliability analysis was conducted and resulted in a Cronbach’s alpha coefficient of .71, indicating an acceptable alpha level (Warner 2012). The items were measured so that 1=yes and 0=no. This resulted in a scale which had a possible score range of 0-7. Actual scores ranged from 0 to 7 with a mean of 5.5.

Level of consulting regarding energy biomass

Some research found that where PFLs got their information and to what degree they sought out the information on their own influenced management decisions and plans
Dolisca et al. 2006; Longmire 2012). Because of this, my study included a measure of PFLs’ level of consulting about energy biomass. Respondents were asked “How often they consulted with” county extension agents, forestry consultants, loggers, agency personnel (local state, or federal), forest industry personnel, news media, and friends or family about energy biomass. Responses were coded as 1= “never”, 2= “once”, and 3= “more than once.” A factor analysis was conducted to determine if there were groupings among the seven items. The factor analysis indicated that all seven items loaded onto one factor with an eigenvalue of 2.24. The seven items were combined into a scale measuring the total level of consulting for energy biomass. A reliability analysis was conducted which resulted in a Cronbach’s alpha coefficient of .86, indicating an acceptable alpha level (Warner 2012). The resulting scale ranged from 7-21 where 7= “low level of consulting” and 21= “high level of consulting.” Actual scores ranged from 7 to 21 and had a mean of 10.5.

*Perceived impacts from harvesting for a biofuels industry*

PFLs’ willingness to participate in and a communities’ support for a wood-based biofuels industry may be connected to perceived impacts to a variety of important aspects – most typically visual, economic, and environmental factors (Gramling and Freudenburg 1992). Additionally, PFLs may perceive harvesting-related impacts associated with forest aesthetics, forest health, and their recreational activities (Metcalf 2010).

Survey respondents were asked to indicate whether they “think biomass harvesting for energy will have a positive or negative impact on” five items including the health of their forest, the environment, forest aesthetics, their recreational activities, and
surrounding communities’ economies. Responses were coded 1= “negative” impact and 0= “positive” impact. A factor analysis was conducted to discover if there were groupings among the items. The factor analysis indicated there were 5 factors with eigenvalues of 4.2, 2.29, 2.01, 1.45, and 1.13. While all the items loaded highly onto the first factor, they also all loaded on their own factors. This indicated that each item could be assessed individually. This study chose to look at their individual contribution to provide a more nuanced analysis of how perceptions regarding each of items impacted PFLs’ willingness to harvest biomass for energy.

A frequency of responses for the item forest health indicated 39.5 percent believed harvesting biomass for energy would have a negative impact on their forest’s health and 60.5 percent believed such harvesting would have a positive impact. A frequency of responses for whether they thought biomass harvesting for energy would have a positive or negative impact on the environment indicated 42.5 percent believed harvesting biomass for energy would have a negative impact on the environment while 57.5 percent believed such harvesting would have a positive impact. A frequency of responses for perceived impacts on forest aesthetics indicated 50.4 percent believed harvesting biomass for energy would have a negative impact on their forest’s aesthetics and 49.6 percent believed such harvesting would have a positive impact. The frequency of responses for perceived impacts to PFLs recreation activities indicated 51.8 percent believed harvesting biomass for energy would have a negative impact on their recreation activities and 48.2 percent believed such harvesting would have a positive impact. A frequency of responses for perceived economic impact on surrounding communities indicated 36.5 percent believed harvesting biomass for energy would have a negative
impact on surrounding communities’ economies and 63.5 percent believed such harvesting would have a positive impact.

Connection with nature

A person’s connection to nature has been found to influence both perceptions of impacts from development, values, and possibly environmental oriented behavior (Baldassare and Katz 1992; Dutcher et al. 2007; Klineberg et al. 1998; Nisbet, Zelenski, and Murphy 2008). Further, one’s connection to the surrounding environment could influence their willingness to harvest biomass (Silver et al. 2015). Respondents’ connection to nature was measured through the question, “I want to get a sense of how closely you believe that you overlap with nature.” Responses ranged from 1 to 3 where 1= “not at all”, 2= “partially”, and 3= “nearly completely” and had a mean of 2.5, indicating that most respondents felt some connection with nature.

Sociodemographic variables

Six commonly used sociodemographic variables were included in this study. Sociodemographic variables were used because past literature suggested important associations between these variables and harvesting behavior and other behavior (Butler and Ma 2011; Butler et al. 2010; Joshi and Mehmood 2011; Metcalf 2010; Susaeta et al. 2012). For this study, I wanted to assess the overall relationship that the sociodemographic variables of age, gender, education, length of residence, political ideology, and income had with PFLs willingness to participate in harvesting biomass for a bioenergy industry.

Age has been found to be a determinate of forest management behavior (Davidson and Freudenburg 1996; Joshi and Mehmood 2011; Susaeta et al. 2012).
age was determined by asking the respondent to indicate the year of their birth. I then subtracted the year the respondents said they were born from 2015, the year the survey was administered. The mean age for respondents was 50.9.

Gender was a commonly used variable in studies examining sociodemographic differences for a specific phenomenon, including forest management and harvesting decisions (Longmire 2012). The measurement of gender in this study was straightforward; the respondents were asked to identify themselves as female or male. In this study, Female was coded as “0” and male was coded as “1.” A frequency distribution of gender indicated 43.2 percent of PFL respondents were female and 56.8 were male.

Education has also been an important determinant of forest management behavior (Butler et al. 2010; McDonald et al. 2006). A respondent’s education was measured by asking them to indicate the highest grade of school they completed. The responses were separated into eight categories. The categories included 1= “none”, 2= “grade school”, 3= “some high school”, 4= “high school grad or GED or vocational school”, 5= “some college”, 6= “technical school”, 7= “completed college”, and 8= “graduate/professional school.” The average grade of school completed was some college.

Lengths of residence and PFLs forestland harvesting and management practices have been studied together fairly often (Beckley 2003; Feldman 1990; Vokoun et al. 2006). However, length of residence has received only limited attention in research concerning bioenergy. How long a person has resided in an area may be related to how one feels toward harvesting biomass for energy as opposed to harvesting for other more traditional purposes. For this reason, it was important to learn of any impacts length of residence might have on the dependent variable during analysis. Length of residence was
measured by the question “how long have you lived in your present community.” This was a continuous variable with a range of 1 to 44 and the mean length of residence was 36.5 years.

Political ideology has been found to have an influence on a number of behaviors (Jones and Dunlap 1992; Longmire 2012). Political ideologies are useful because those who identified as having a specific ideology often had similar ideals about environmental, social, and political issues. I measured political ideology by asking the respondents to self-identify with one of five ideological categories where 1= “liberal”, 2= “moderate liberal”, 3= “moderate”, 4= “moderate conservative”, and 5= “conservative.” The mean for the measure political ideology was 3.7, indicating a conservative leaning among respondents.

Income has been used as a predictor of many different types of behaviors, attitudes, values, and plans (Becker et al. 2013; Dennis 1989; Klineberg et al. 1998). However, income has often been found to be an inconsistent predictor depending on the specific phenomenon in question. Regardless, it is important to see if income had a relationship with willingness to participate in forest product harvesting for a biofuels industry. I measured income through an eight-category question on the survey. These categories were less than $15,000, $15,000 to under $25,000, $25,000 to under $35,000, $35,000 to under $50,000, $50,000 to under $75,000, $75,000 to under $100,000, $100,000 to under $150,000, and $150,000 or more. The mean, 4.9, indicated the average respondent made between $50,000 and $75,000.
Conclusion

The mixed method design is specifically used to provide an effective method to gather the relevant data in a reliable and valid manner. This design facilitated triangulation of findings across places (five study sites), people (PFLs and the general public in these places and at a regional level), and levels of analysis (local communities and Eastern region). The case study approach enabled the ability to conduct in-depth studies of a burgeoning biofuels sector in a particular context. Using multiple case studies helped to determine if findings are replicable (Yin 1989:53). The survey component enabled the ability to determine the generalizability of findings. Redundancy was built into the framework by using the results from the KIs to drive a region wide survey. This provided a way to gauge the generalizability of the findings and experiences drawn from the five case studies in the region.

Biofuel issues are complex – their resolution requires more than simple assessments of raw material supply and exchange value of biomass. Concerns about soil conditions, water quality and quantity, harvesting practices, land parcelization and fragmentation, transportation related issues, local governmental decision making, and their interactions – all of which have been highlighted in recent studies surrounding biofuels – also need to be understood. The intersection and resolution of these issues has substantial political and economic implications. Recognizing the connection among biophysical, sociodemographic/socioeconomic, and sociocultural dimensions of natural resources is critical to assessing the viability of woody biomass production. This mixed-method approach revolves around the development of an understanding of ecosystem-level planning which helps create innovative approaches acceptable to stakeholders.
involved in or effecting natural resource management. Further, it leads to better decision making. The following chapters provide an analysis using the data collected through these methods.
Chapter 4

Qualitative Analysis

Using forest resources to create bioenergy, either as ethanol for transportation or to burn for electricity and heat, has the potential to be a renewable and sustainable energy source (Perlack et al. 2005; Zhu and Pan 2010). Wood-based fuels could be a significant source of energy to help meet current and future energy demands, helping to provide energy independence and security (Cook and Beyea 2000; Evans et al. 2010; Mendell and Lang 2012). Further, wood-based biofuels are seen as a way to reduce greenhouse gas emissions and reinvigorate economies in rural communities (Gan and Smith 2007; Schulze et al. 2012). Because of these reasons, there has been a high level of interest at both the national and state levels to develop a wood-based bioenergy industry to support specified energy goals (Maness 2008; Wiser and Barbose 2008).

One of the critical aspects of using wood resources to meet biofuel industry demands is the need to gauge the willingness of private forest landowners (PFLs) to increase harvesting rates. To date, few studies have examined landowner willingness to participate. Nor have there been many studies that investigated the opportunities, threats, and concerns associated with such a shift on local communities. The extant literature has tended to focus on the technical/economic aspects of energy biomass production. While the technical/economic aspects are clearly important, little attention has been paid to the social and cultural factors that may impact the viability of such activity. The absence of studies which focus on understanding PFLs willingness to participate in harvesting biofuels for energy is in part traceable to two basic, but untested, assumptions regarding forest landowners: (1) PFLs are able and willing to participate in the production of raw
materials with few obstacles; and (2) they will make the transition because of the opportunity to increase profits. Moreover, these assumptions are likely being applied to rural communities who are in need of the possible jobs and tax revenue associated with the development of a wood-based biofuels industry. These assumptions have likely curtailed research efforts to better understand social constraints such as PFLs’ willingness to harvest and the concerns held by communities and PFLs toward the development of a wood-based biofuels industry. To address this absence of important information, this project employed key informant interviews (KIs) to understand the opportunities and concerns of PFLs, residents, and communities regarding the development of a wood-based biofuel industry.

Key informant interviews are an important, time-intensive research element in case studies (Neuman 2005). These interviews allowed me to explore in-depth how PFLs, local leaders, and community residents perceived and conceptualized issues surrounding the development of the biofuels industry. These experts, with their particular knowledge and understanding, provided insights on the nature of problems, issues, opportunities, and concerns as they related to their particular community. They were invaluable sources of information that imparted a detailed context not accessible through other forms of data collection.

This chapter provides an analysis of the information gathered from the key informants during the interview process. I will present and discuss several themes that emerged in aggregate. The main purpose of this chapter to provide further understanding concerning the opportunities and concerns of PFLs, residents, and communities about
existing wood-based industries and efforts to develop and support a wood-based biofuels industry.

**Major Themes**

When taken together, the analysis of the key informant interviews identified several major themes. These included concerns and opportunities over landowner versus public rights, trust, economic opportunities and impacts, knowledge and education, the environment, and broader community context. It should be noted that while these distinct themes emerged, there is often overlap and connection between these themes.

*Landowner versus public rights*

A clear message was delivered by these KIs regarding landowner and public rights concerning forest management decisions. They believed the public should be involved in public land decisions and that there were experts in place to manage those lands. But, when it came to private lands, our KIs indicated individual PFL had the responsibility and final say when making decisions about the use of their land. For example one PFL from Tennessee said “At some level they [the public] should be involved, however I wish there was more deference to experts to hear about the pros and cons of biofuels.” Similarly, a non-PFL KI in South Carolina said:

I think the public should be involved in public decisions. If the forest harvesting is on public land than yes they should be involved. Private land harvesting is very different. It is hard to say. Harvesting almost always impacts those around you. But private property is private and in the end it is their [PFLs] decision what to do, not the publics.

Concerns were also expressed about regulations that limited landowners ability to harvest and the influence of local ordinances imposed by others – especially environmental groups and immigrants who had moved to the community but had little
experience and/or ties there – let alone familiarity with forest practices. A PFL from Wisconsin stated:

"It’s our land isn’t it? I mean we should be able to do what we want with our own land. There are a lot of people moving into the area, in the north part of the county. These people just don’t understand how things work. They do not understand how important forest harvesting is to the community and to landowners. They come in and because they bring money with them, they think that they can stop harvesting. They think it is bad for the environment or something. They don’t know anything about forests and how they work."

Similarly, a respondent in South Carolina said:

"Environmental groups and people moving in try and push us [longtime residents] around. They try to force us to stop harvesting. They are smart about it. They get together and try and get the local and state government behind them. They get laws and regulations made that restrict harvesting."

PFL versus public rights were a concern to both PFLs and other community residents. Both groups appeared to want a voice in such decisions. It was also apparent that environmental and community residents, particularly newer residents, had concerns with harvesting. These concerns had, in some cases, led to the enactment of ordinances, policies, and laws that restricted harvesting activity. Such restriction could impact the efficacy of a wood-based biofuels industry.

Trust

One common thread found across almost all of the interviews was tied to the level of trust and conservatism expressed by the KIs. Simply said, KIs had little faith or interest in the government doing anything for them or their resources. Trust issues were not limited to just the federal level – people wanted to know if their leaders were pushing biofuels development without support of the local community. Further, there were also issues of trust with energy and harvesting companies. Much of this lack of trust seemed
to deal with past experiences. For example, a South Carolina respondent articulated a situation that happened in his community, making him question the motivations behind biofuels development. This respondent said:

Years ago the community discovered the county was bringing in an inter-railway transfer station. The county officials tried to get it approved under the radar. There was less than a week’s notice to try and mount opposition. The word went out to all the churches in the area. Through that network opposition was mounted and we were able to attend the meeting and get a delay on the decision. Eventually through a lot of time and work the community was able to stop the development. It is this type of action by government that makes me question any type of development in the area. It makes me question the motivation behind biofuels development. If experience serves, any development and increased harvesting would be done quietly, without a large/load public announcement. It would be similar to the railroad situation.

As the KIs explained, issues of trust do not only apply to government entities, but also extend to harvesting and energy companies. A respondent from Wisconsin provided an example of this when she said “these different companies, energy companies have deep pockets. They can pretty much buy their way to what they want.” Similarly, a respondent from Tennessee referred to the concern that governments and companies might do what they want because they push locals out. He said “depending on the setup and how involved the government is and owners. There could be an issue if only companies and the wealthy get involved and locals can’t.”

Based on these types of experiences, KIs were conservative about government involvement in harvesting decisions. A PFL from Mississippi stated:

I’d rather [government] not have too much of a role other than using the people who are already in place. The government should depend on [landowners] for being good stewards. Even local government should be hands off.
Trust remains a key concern for the biofuel industry, and it is no small thing when situated in the larger public perception of energy development.

*Economic opportunities and challenges*

The perceived economic opportunities and threats associated with the development of a wood-based biofuels industry was an important area of concern. As with almost all new developments, issues concerning economic opportunities and challenges varied. However, there were several prominent patterns identified in this analysis. As indicated earlier, the existing literature focused on the technical/economic aspects of energy biomass production. In these studies it was often assumed PFLs, and likely their communities, would make the necessary transition because of the opportunity to increase profits, jobs, and tax revenue stemming from the development of a wood-based biofuels industry. While I believe PFLs and communities valued their forest land for a variety of reasons, economic incentives clearly appeared to play an important role in PFLs’ willingness to harvest and a local community’s support for a biofuels industry.

For example, a forest resource manager in Pennsylvania said: People need to pay taxes, they need cash flow. As the price of veneer lumber goes down, people will look to other markets to get the value they want. Economic reasons will drive landowners to participate. If a market would open up they would participate.

Another Pennsylvania respondent substantiated that statement: “I think that if a market was opened, landowners would be happy and it would allow them to earn extra income.” This was common sentiment throughout all study areas. For example, a PFL in South Carolina expressed a similar opinion when she said: “Yes PFL’s will participate. It will provide a new market, new opportunity. Many families use harvesting as a way to keep
land and make money.” One government official in Wisconsin supported these statements in his comment that:

Private forest landowners would be willing to participate in an expanded biofuels market. It is a way to make money, so why not? As long as it is cost effective they would. It would allow them to make a profit off of the waste from their harvests.

Another PFL in South Carolina said:

Sure, I think they [PFLs] would. I a lot of them are cutting trees anyway. I mean I am going to be harvesting part of my land soon, so yeah if there was a chance to make a little extra I would do it.

The general notion that PFLs owned their forestland to make profit was also prevalent in Tennessee. As one Tennessee respondent explained “not specific to biofuels, but many people in West Tennessee view land as a means to make money, so if there was a market for it [biofuels] they would participate.”

It seemed that many believed PFLs would be willing to participate in harvesting to support a biofuels industry because of economic incentives. However, there was also an indication that PFLs owned their land for reasons other than profit. This raised an important question – should this assumed willingness to participate be broadly extended to PFLs generally? For example, a PFL in Wisconsin said “there are many [PFLs] that manage the land for other purposes, such as hunting, while others mange for both hunting and product harvesting.” A PFL from South Carolina provided more detail, and explained that most PFLs owned their land for multiple reasons. He said:

I do not own my land to make profit. My neighbors do not own their land to make profit. I manage my forests for other things, wildlife habitat for example. I know that my neighbors do a lot of hiking and camping on their land. There are a lot of people who own forestland that do not have any desire to make money off of it. A lot of people in the woodland owners association I am in would say the same thing. We own the land for many reasons. It is true that many own their land to try and make money,
but they most likely own it for other reasons as well. Landowners who only own their forests for economic reasons only are few and far between.

Another South Carolina resident made a similar statement, saying:

Converting forest to fuel for electricity depends on value set. If what they [PFLs] value is making money and if they get a good price for the wood, they would be willing to do it. But there are a lot that do not have a value set that includes harvesting wood for sale. Their value set includes hunting, fishing, bird watching, visual beauty, and a number of other things. They probably don’t care about price or making money.

While there some evidence suggested PFLs would participate in harvesting their forests for a biofuels industry for economic incentives, a large body of evidence suggested PFLs owned their land for other reasons. The latter evidence, when coupled to the comments of these KIs, suggested PFLs’ values and uses of their forest land varied, and are far more complex than earlier wood-based biofuels industry studies suggested.

Almost all KIs thought creating jobs was important. In fact, economic opportunities such as jobs seemed to be the primary reason why KIs thought communities would accept and support harvesting for and development of a biofuels industry. For example, one respondent from Mississippi responded, “Creating jobs is most important. In this economy it’s important.” Further, a South Carolina KI said that communities would participate if it made economic sense. She said “Well, as long as they [biofuels industry] can compete then the jobs, money, and markets will all benefit the area. I think the community would support it, but again as long as the economics was right.” Along the same lines, a Wisconsin respondent said:

I think the community would get behind it as well. It could help provide some jobs for those who lost theirs when some of the mills closed down. It makes sense, we have been harvesting for other things, why not biomass. But then again if the mills are already struggling, how would the extra competition impact them?
These respondents highlighted the point that jobs were very important, and communities
would benefit from biofuels harvesting and development. However, the latter respondent
identified an important concern: how will such development impact current forest
industries?

Another large concern was tied to the question – who would survive? This
suggested that PFLs and communities were both concerned about the impact of this new
industry on current/traditional forests industries. Communities were concerned that
increased harvesting for a new biofuels market might have negative impacts on their
economies. For example, a respondent from Pennsylvania said:

I think communities are going to want to know who is going to benefit. Who
is going to get the jobs? They are also going to wonder how many of
those jobs will replace jobs in other forest industries. In some people’s
minds it is a tradeoff. If you gain one job here, you lose one somewhere
else. You know what I mean? How will this impact current jobs in other
areas?

Another KI made a similar comment:

There might be some people that would switch over to harvesting for bio-
fuels if the price was right. But there is enough forest to support both I
think. There could be some issues with competition and prices increasing.
That would be good for the PFL owners, but not for either the current
industry or a bio-fuels industry.

It was clear that economic aspects played a vital role in garnering community support. It
was also clear that perceived negative impacts to current industries could reduce general
community support. The information presented here on the economic opportunism and
impacts added detail and understanding to both the community and PFLs’ support for a
biofuels industry. Further, it provided some added clarity to a neglected area in past
research.
Education, information, and knowledge

As explained in Chapter 2, a person’s knowledge may have impacts on a great number of aspects, including PFLs willingness and community support for a particular development (Ajzen 1991; Joshi et al. 2013). It was possible that a person’s knowledge, as well as their information sources, might influence their perceptions concerning possible outcomes (Joshi et al. 2013; Longmire 2012). A major theme which developed out of the KIs was the need for education, information, and a concern for a lack of knowledge about a variety of forest related topics. KIs suggested two things were critical: (1) education about the forests themselves provided to both PFLs and the community/general public especially in places characterized by large in-migration and declining traditional ties to the land; and (2) people did not understand what biomass and biofuel were about and they were not in a position to make wise decisions about this industry.

A simple response by a respondent in Mississippi demonstrated some of these points when he said “General population has no idea. No one has come in to talk about it [biofuels industry].” This KI suggested that not only does the general population not have any knowledge about biofuels harvesting and development, but also that they have not had adequate information provided to them. One of the earlier quotes from a Wisconsin KI discussing landowner rights also pointed out that many newer residents, without traditional ties to the land, knew nothing about forest management. She said “they [newer residents and environmental groups] think it is bad for the environment or something. They don’t know anything about forests and how they work.” Similarly, another Wisconsin KI said “Education would be needed to inform the public of benefits and
risks.” Further, a KI from Tennessee said this concerning educational needs for PFLs, “Landowners need education and would need answers to several questions. What could be brought in? How much would be cut? What kind of trees? What is the net return?”

The lack of knowledge and information seemed to create anxiety and unrest even in communities relatively focused on forests and forest uses. Communities and PFLs had many questions, which to this point had not been answered. To a certain degree, many felt this was because there had been a lack of effort to provide good information. Further, there was some anxiety that those who lacked traditional ties to the land and harvesting would make efforts to restrict harvesting due to their lack of correct knowledge.

Environmental concerns

Several concerns related to the environment were expressed. These concerns dealt with water and air quality, wildlife, sustainability, clear cutting and forest aesthetics, and truck traffic. While truck traffic was not necessarily always described as an environmental concern, it was often mentioned congruently in KI comments addressing environmental concerns. Because of this, traffic is addressed in this section.

Water and air quality, were almost always mentioned as environmental concerns in connection with increased harvesting and biofuel facility development. For example, a KI from Pennsylvania said:

Forests provide a lot of public value… water and air quality. Landowners don’t get paid to provide that. So there are concerns over what increased harvesting would do to the water.

A Wisconsin PFL said:

People always seem to be working together or are in conflict over jobs and the economy, environmental impacts to air and water. The people would be concerned with environmental impacts to the air and water. Trees help to provide clean air and water. If you cut them down, they are not there to
provide those benefits, it’s that simple. So increased harvesting for any reason, including for biofuels could negatively impact those things. That scares people.

Water and air quality issues were important to communities and were often an area where community residents came together and worked together to address them. KIs suggested that it was important to consider these concerns when making decisions concerning harvesting and biofuels development.

While these concerns were primarily focused on the local community, there was some level of concern that impacts to water could be felt at a much larger level, depending on the degree of harvesting. For example, a South Carolina KI said:

If harvesting is widespread and they do not do it properly, then there could also be impacts to the watershed. Run off, erosion, that sort of thing. It is possible to overcome some of these issues by working with a forester to develop a management plan. I am morally/ethically opposed to do any sort of harvesting without having a way to track what is going on.

This statement represented a concern that if harvesting was excessive, than water quality issues could be felt at a much larger level than just in and around the communities near the harvesting.

There was also concern that increased harvesting for a biofuels industry might impact wildlife, though how and what type of impacts were not always specified. For example a KI in Pennsylvania suggested that “there would be increased impacts on the environment and wildlife.” Further, a KI from South Carolina thought that communities and PFLs would want to know “What type of cutting would they be doing? Clearcut impacts on wildlife and environment. Run off would be a concern.” There was also an indication that economic benefits could place the environment and wildlife at risk. For example a KI in South Carolina said:
I would say that if it gets jobs into the area let it as long as the environment and wildlife are taken into account. I don’t think that the true costs of energy production have ever been taken into account, and that includes environmental impacts. We would need to be smart about how we go about doing it. Taking all precautions to not overly impact the environment and wildlife. But in the end the area needs jobs.

Communities and PFLs were concerned that because the area needed jobs, taxes, and other economic benefits, due diligence would not be undertaken to ensure development did not negatively impact the environment and wildlife.

The sustainable nature of increased harvesting and the biofuels industry was an important concern. However, there seemed to be mixed feelings about whether sustainable forest harvesting standards were in place and being used. For example, a PFL from South Carolina suggested that “sustainability standards are not in place. I think that energy companies are behind this.” However, KIs in Wisconsin had confidence that sustainable harvesting practices were in place. A Wisconsin KI said: “The area is already doing sustainable harvesting. As long as these practices are continued there shouldn’t be a problem with harvesting for biofuels.” Another Wisconsin KI said: “I think that it is already happening [sustainable harvesting]. As long as an expanded harvest was done in a sustainable manner […], there shouldn’t be much opposition.” A KI in Pennsylvania insisted that harvesting biomass was sustainable, explaining:

There are issues and questions of sustainability. Biomass is good for local economies and is sustainable. People do not understand sustainability or sustainable forests. The Secretary at Boalsburg has problem with cutting down trees for biomass. Says we should use coal. They just don’t understand the sustainability of biomass.

It appeared that the mixed feelings concerning whether harvesting could and would be done sustainably was being questioned and could reflect local historical harvesting practices.
A related concern regarding sustainability did not just focus on harvesting, but of the biofuels industry itself. For example, a Tennessee KI expressed this concern in this manner:

My concerns would be with cleanliness and safety. It would have to be cleaner than oil rigs and petroleum-based fuel. I wonder about its effectiveness and lasting power. I would have to have confidence in the scientists that this energy source is sustainable.

This KI raised questions of trust in experts and the information they provided concerning biofuels as a sustainable energy source. A KI in South Carolina said:

It’s not that we don’t have enough trees, we do. It’s not that we can’t harvest them in a renewable and sustainable way. I just don’t think that it can compete with other sources of energy, renewable or otherwise. I guess the government could step in and make it profitable for companies to do business. But I don’t consider that sustainable.

Such concerns bring into question the sustainable nature of both harvesting, harvesting practices, and biofuels as a sustainable development due to competition with other fuel sources.

There was widespread opposition to clear-cutting reflecting KIs concerns with possible overharvesting, and impacts on wildlife and the environment. For example, a PFL from Mississippi said “No one really wants clear cutting. It leads to so many problems including harm to wildlife, forest aesthetics, and other environmental impacts.” This same sentiment was expressed repeatedly in all study areas and is a huge concern for communities and PFLs alike.

A KI from South Carolina discussed community concerns and said “Clear cut issues are always a concern. People do get upset when a place is clear cut.” Further, clear cutting was identified as a concern from the past in many areas. However, in some areas it was a recent issue. For example, in Wisconsin a KI said “some people are concerned
with cutting more trees. In the recent past it was clear cutting, which was a big concern for many in the area.” On the other hand, many KIs also believed clear cutting would not take place. A good example of this can be found in a statement made by a KI from South Carolina. This KI said:

I do not believe they [biofuels and wood harvesting industries] will come in and clear cut the area. They won’t do it, if they want the support of communities and landowners. People won’t stand for it. Plus loggers have too many incentives to follow best management practices. If they don’t the wood they bring in doesn’t get certified, and they could lose buyers.

There was concern that overharvesting might happen depending on the type of harvesting that occurred. While thinning and selective cutting was viewed as more acceptable, clear cutting could lead to over harvesting and other negative outcomes. A KI from South Carolina suggested clear cutting could lead to overharvesting when she said “I think overharvesting is possible but not likely. As long as there isn’t any extreme clear cutting, I am not overly concerned with overharvesting.” Regardless of whether clear cutting was possible or not, it remained a major concern. Communities and PFLs were unsure what was meant by increased harvesting and wanted to know what type of harvesting would take place. They were concerned that increased harvesting might mean clear cutting, which no one wanted.

Whether from clear cutting or harvesting in general, visual impacts were a concern for both PFLs and communities. Aesthetically, clear cutting was seen as an acceptable harvesting practice and increased harvesting brought similar concerns. A KI in Mississippi said “there might also be concern over visual impacts if there was increased harvesting for biofuels.” Further, after a new biofuels facility was built, community
members were concerned that harvesting for the facility would result in negative visual impacts. A Wisconsin KI explained:

At first people were not so sure about it [the facility and harvesting]. People were afraid they would be cutting down a lot more trees. They were afraid they would see visual impacts. The area is known for its forests and for the Wisconsin River. They don’t want those to be impacted too much.

A KI in South Carolina expressed a similar feeling toward increased harvesting for biofuels. He said: “Some people are opposed to expanding biomass because they believe it will lead to more trees being cut. To an extent this is true. We have seen more trees cut.” In Tennessee, a KI said: “There would really only be opposition to an expansion in biomass if they started taking whole trees. People are very concerned with visual impacts from forest harvesting.” Visual impacts from harvesting were a large barrier to the development of a wood-based biofuels industry. As stated by a KI in Wisconsin, “if this [increased harvesting for biofuels] is going to work, problems of visual impacts will need to be addressed.”

As long as harvesting was done in a manner to reduce visual impacts, KIs were confident there would be little opposition. For example, a KI in Pennsylvania said “people perceive that the trees on their drive to work will be the trees that are cut down. They are afraid of the visual impacts. But if managed properly, it won’t be that big of a deal.” A Wisconsin KI made a similar statement: “As long as an expanded harvest was done in a manner to reduce visual impacts, there shouldn’t be much opposition.” Another Pennsylvania KI went further by saying that “Most harvesting is non-visible, so it won’t be a problem. But I guess if the cuts were more visible people would more likely to be upset and concerned.” This KI suggested that it was really only when harvests were
visible that people were concerned. A Mississippi KI made a similar comment, “you really don’t see it [harvesting]. I am pretty sure that is how it would be for biofuels. Most people wouldn’t even know where the harvesting was taking place.” Whether harvesting would be visible or not, perceived visual impacts from harvesting remained a concern to communities and PFLs.

Increased truck traffic was mentioned as another concern. This issue was most often expressed in relation to road damage. A KI from South Carolina pointed out that “there would be increased transportation which causes problems for roads and traffic.” Another South Carolina KI mirrored this statement, “If harvesting increased further, there might be extra damage to roads form trucks.” A KI from Wisconsin also expressed concerns over road damage from increased truck traffic. For example, one KI explained:

Additionally, there is a lot of road damage due to trucks coming in and out. The community is having a hard time to funding the repairs. Roads would be a major concern if wood-based biofuel harvesting was to increase in the area. The community is in a great location but there are lots of roads and lots of damage from trucks. It would only get worse with more trucks out there hauling wood.

Pennsylvania KIs also felt increased truck traffic was a concern. One KI stated: “… with a biomass facility there would be increases in traffic from trucks in and out of town. People already have issues with agricultural trucks hauling stuff through town.”

While road damage from increased truck traffic associated with harvesting for a biofuels market was a concern, there was also mention of increased emissions and air quality issues. Further, there was some concern that increased truck traffic could impact wildlife. For example, a KI from Pennsylvania stated:

I think that the northern area of the county might be more concerned about the harvesting. They might be concerned over how to fix roads from increased traffic. These trucks also don’t have the same standards for
safety and emissions. They could continue to contribute to air quality issues.

Concerning impacts to wildlife, a KI from South Carolina said:

We already have enough trucks hauling wood and other stuff as it is. Some have said it has started to impact a few of the herds around the area. I am not sure if that is true, but more trucks wouldn’t make it better.

Communities and PFLs perceived several effects from increased truck traffic as a result of increased harvesting for a biofuels industry. These perceptions included impacts to roads, wildlife, and air quality. Further, communities and PFLs had concerns about perceived impacts to a number of environmental topics from increased harvesting and biofuels development. While there was some evidence that many of these impacts—visual, water and air quality—could be addressed using specific forest management and harvesting techniques, it did not lessen the fact that communities and PFLs had these perceptions. As explained in Chapter 2, such perceptions are important when it comes to supporting the development of a wood-based biofuels industry.

Community context

In most cases the KIs indicated that harvesting biomass was consistent with local culture and history tied to traditional forest management. A KI in South Carolina indicated this when he said: “We have been harvesting around here for some time. I don’t see a problem if we harvest for biofuels. Harvesting is just a part of who we are and what we do.” A KI from Wisconsin made a similar point:

We have depended on the forest for a long time. I do not see that changing. Because it matches what we have always done, I think you will find that people around here will want to do it [harvest for biofuels].
These KIs indicated that because their forests had traditionally been harvested, harvesting for biofuels was consistent with such use and would likely be supported.

There was also an indication that communities and PFLs have tried to balance harvesting and other traditional forest uses. A KI in South Carolina said “the forest provides. It is a source of income and jobs, but also a source of recreation and cultural heritage.” Many communities and PFLs were concerned with possible losses to uses of the forests for traditional activities such as hunting, and recreation in general from increased harvesting for economic gains. Many communities and PFLs were concerned that traditional harvesting would be restricted. This was discussed to some degree when considering landowner versus public rights. Many PFLs believed their ability to harvest, something seen as a central part of the economic and cultural history of the area, was restricted and challenged. For example, a KI in Wisconsin said:

There has been some conflict between people who have been here a long time and understand the forest has multiple uses. We want to make use of the forest in any way we can. We harvest it for multiple reasons and we use it for recreation. Many new people in the area don’t understand we do both. Historically, we have always done both and they want to stop all harvesting.

While there may be some conflicts between PFLs and other community residents, harvesting has been an important part of these communities both economically and culturally. It is clear those who believed harvesting was a significant part of the community believed it would be supported because it was consistent with that historical use. In areas experiencing high levels of migration this may not be the case, as newcomers view and use the forest differently.

While many believed increased harvesting for biofuel would be supported because it matched traditional uses of the forest, it should also be noted that traditional
uses may not support such harvesting. For example, some KIs mentioned that the use of low quality waste wood has been used by lower income residents for heating purposes. A KI from Mississippi explained “harvesting for a biofuels industry may impact the poor folks in their area who relied on this wood for heating.” This is just one of several indications that forests were used for multiple reasons by PFLs and communities. Historically harvesting has been a part of these communities, and harvesting for biofuels would be supported because it is matches what they have done in the past.

Summary

The KIs indicated there were a wider variety of and more complex attitudes and beliefs about support for a biofuels industry than commonly assumed. As discussed, these assumptions are based on the routine assertion that PFLs and communities have few concerns and face few barriers to their participation in a biofuels industry. In a word, these assumptions tie to the belief that communities and PFLs will do so for economic incentives. While economic aspects—such as jobs, taxes, and profit—appeared to be significant drivers behind community and PFL support for and willingness to participate in harvesting and the development of a wood-based biofuels industry, KIs indicated they were only a few of the many things considered when making the decision to participate and support the biofuels industry. And, many of the latter concerns were not economic in nature. Further, these KIs indicated that many PFLs owned their land for multiple reasons, which may or may not include harvesting wood for profit. It also highlighted the many perceptions held by communities and PFLs. These perceptions, both positive and negative, were the sources of many concerns, which, in the end, may become barriers to
community support for and PFLs willingness to harvest for a wood-based biofuels industry.

While there were other drivers behind forest management and harvesting decisions, there was still a high level of interest in biomass for biofuels to improve rural economies. Many of these communities and PFLs had been harvesting for a long time. They understood that harvesting provided opportunities to gain economic incentives such as jobs, tax revenue, and income. It was also indicated that both communities and PFLs would support the development of a biofuels industry due to these perceived outcomes. This was consistent across all study areas.

In some rural areas, biomass use is consistent with local culture and history tied to traditional forest management. It was interesting and informative that in each of our five states – Pennsylvania, Mississippi, South Carolina, Tennessee, and Wisconsin – tradition seemed to be a key force for accepting and supporting the emerging biomass industry. However, there were traditional forest uses that did not necessarily support such harvesting, especially at increased levels. Communities and PFLs indicated they used their forests for multiple reasons, and some uses – recreation, preservation, and possibly as a heat source – did not support harvesting for biofuels. It seems likely that the tradition of balancing both economic and other uses could lend support for a biofuels industry.

Despite the fact this traditional element exists, there was deep anxiety about what this meant to the community and the environment. Many significant concerns that deal with environmental issues were raised. These issues involved community and PFL perceptions concerning impacts to water and air quality, harvesting practices, the sustainable nature of biofuels and harvesting, and visual impacts from harvesting and development. What
was clear was that stakeholders wanted to ensure that sustainable management and harvesting practices were used so that they could reduce the perceived negative impacts.

Education, information, and engagement were all described as being important concerns. It was clear that PFLs and communities wanted additional information to help answer questions and address their concerns. Further, at this point, the KIs indicated engagement with those who likely had this information was often lacking. What was needed was more attention to the publics and the areas where bioenergy activity was studied, planned, or occurring. Providing communities and PFLs the information they needed to make informed decisions should be a common process with any new development. Doing this would help PFLs and communities become more involved and armed with correct information.

Acceptance and support of the biofuels industry and bioenergy – like any other activity – requires local involvement in all phases of activity. Doing this means involving locals and making them a part of the decision-making process. The decisions then become theirs and they are more likely to reflect the interests of the broader community. This is community agency and reflects the fact that people in this area care about each other and the place they live.
Chapter 5

Quantitative Analysis: PFLs’ Willingness to Participate

This chapter provides an analysis of the information obtained through the phone survey of PFLs. Its purpose is to provide an understanding of PFLs level of willingness to participate in harvesting for a wood-based biofuels industry. Further, it provides an analysis and discussion of the sociocultural and sociodemographic dimensions influence on PFLs’ willingness to participate. Results from bivariate and multivariate are presented and discussed.

Before the bivariate and multivariate results are presented, a short description and discussion of the sociodemographic characteristics of the PFLs from the sample used in this study is needed. This information can be summarized in Table 2. From the information found on Table 2 it can be inferred that the average PFL in this study was male, in his early 50’s, had lived in his community for almost 37 years, was politically moderate or moderately conservative, had completed some college, owned between 25 to 50 acres, and had an income between $50,000 and $75,000. From this data it would seem that the sample used in this data had a high mean age and length of residence in their community. However, based on the literature, the sample of PFLs used in this study had a much higher proportion of female respondents than what would be expected (Longmire 2012).
Table 2 Summary of Sociodemographic Variables by Percent in Category

<table>
<thead>
<tr>
<th>Age (Mean= 51)</th>
<th>Acres of Forestland (Mean= 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29</td>
<td>1 but less than 5</td>
</tr>
<tr>
<td>30-49</td>
<td>5 but less than 10</td>
</tr>
<tr>
<td>50-69</td>
<td>10 but less than 25</td>
</tr>
<tr>
<td>70 and over</td>
<td>25 but less than 50</td>
</tr>
<tr>
<td>Political Ideology (Mean= 4)</td>
<td>50 but less than 100</td>
</tr>
<tr>
<td>Liberal</td>
<td>100 but less than 250</td>
</tr>
<tr>
<td>Moderate Liberal</td>
<td>250 but less than 1000</td>
</tr>
<tr>
<td>Moderate</td>
<td>1000 but less than 5000</td>
</tr>
<tr>
<td>Moderate Conservative</td>
<td>5000 or more</td>
</tr>
<tr>
<td>Conservative</td>
<td>Gender</td>
</tr>
<tr>
<td></td>
<td>% Male</td>
</tr>
<tr>
<td></td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td>% Female</td>
</tr>
<tr>
<td></td>
<td>43%</td>
</tr>
<tr>
<td>Education (Mean= 6)</td>
<td>Income (Mean= 5)</td>
</tr>
<tr>
<td>Grade School</td>
<td>Less than 15k</td>
</tr>
<tr>
<td>Some High School</td>
<td>23%</td>
</tr>
<tr>
<td>Graduate High School/GED</td>
<td>15k to under 25k</td>
</tr>
<tr>
<td>Technical School/Associates</td>
<td>22%</td>
</tr>
<tr>
<td>Some College</td>
<td>25k to under 35k</td>
</tr>
<tr>
<td>Completed College</td>
<td>23%</td>
</tr>
<tr>
<td>Graduate/Professional</td>
<td>35k to under 50k</td>
</tr>
<tr>
<td>Length of Residence (Mean= 36.5)</td>
<td>50k to under 75k</td>
</tr>
<tr>
<td>20 or less</td>
<td>75k to under 100k</td>
</tr>
<tr>
<td>21 or more</td>
<td>29%</td>
</tr>
<tr>
<td></td>
<td>100k to under 150k</td>
</tr>
<tr>
<td></td>
<td>71%</td>
</tr>
<tr>
<td></td>
<td>150k or more</td>
</tr>
</tbody>
</table>

Are PFLs Willing?

To determine whether PFLs were willing to participate in forest product harvesting for biofuels/bioenergy, respondents were asked directly to indicate their level of willingness to harvest biomass for energy from their land. Figure 4 shows the willingness of PFLs to harvest biomass for energy from their forestland. This bar chart represented the percent of respondents in each response category from “strongly disagree” to “strongly agree” for the statement “if possible, I would harvest biomass for energy from my land.”

When asked directly, 29.6 percent of respondents indicated they strongly disagree with the statement. These respondents were very unwilling to harvest biomass for energy.
An additional 21 percent indicated they somewhat disagreed with the statement, suggesting they were unwilling to harvest biomass for energy. Together, these two categories account for just over 50 percent of the responses. Alternatively, many respondents indicated a willingness to harvest biomass for energy. Just under one in five (18.2 percent) responded they strongly agreed with the statement, indicating a high degree of willingness to participate in forest harvesting for energy. An additional 26 percent responded they somewhat agreed that they would harvest biomass for energy from their land. Thus, more than two in five (about 44 percent) indicated some level of willingness to participate in harvesting for energy. While more respondents indicated they were not willing to participate in forest product harvesting for bioenergy, there was still a high degree of variability in willingness to participate. Respondent willingness to participate seemed to be divided.

Figure 4 Willingness of PFLs to harvest biomass for energy by percent
In order to begin to understand how PFLs’ willingness to harvest biomass for energy is related to the number of acres of forestland they own, a crosstab of these two variables was run. The results of this crosstab are represented in Figure 5. The results in Figure 5 are by group or category percentage; meaning that the percentages in each category represent the percent of respondents in each acres owned category who responded in each dependent variable category. The patterns observed, in general, when looking at the strongly disagree and strongly agree categories suggest PFLs who owned 50 acres or less tended to be less willing to harvest biomass for energy than those who owned more than 50 acres. These patterns however, are not necessarily observed in the somewhat disagree and somewhat agree categories. In fact, in most cases it is the opposite.

![Figure 5: Willingness of PFLS to harvest biomass for energy by acres owned](image)

Figure 5: Willingness of PFLS to harvest biomass for energy by acres owned
It is also important to understand alternatives PFLs are considering for their forest products. Respondents were asked to indicate how willing they were to harvest residual material for energy after they had already harvested for other products. The results, indicated in Figure 6 were slightly different than those when respondents were asked directly to indicate their willingness to harvest their timber for energy. While just over 50 percent of respondents indicated they would not harvest biomass for energy, slightly over 50 percent of respondents indicated they would harvest their residual material for bioenergy only after they had harvested for other products. Once again, the division in willingness to harvest for energy after other products are harvested could result in similar issues and constraints. While such harvesting is less extensive and can more easily be undertaken on smaller tracts of land, it still may prove difficult to gain access to and harvest enough material from to support the development of a wood-based biofuels industry.

Figure 6 Willingness of PFLS to harvest residual material for bioenergy after harvesting for other products
Figure 7 Willingness of PFLS to harvest residual material for bioenergy after harvesting for other products

The results of this variable were also cross tabulated with number of acres owned. The results of this crosstab are represented in Figure 7. The results in Figure 7 are also by group or category percentage; meaning that the percentages in each category represent the percent of respondents in each acres owned category who responded in each dependent variable category. Similar to the previous crosstab discussed in Figure 5, the patterns observed, in general, suggested PFLs who owned 50 acres or less tended to be less willing to harvest biomass for energy than those who owned more than 50 acres. These patterns however, are not necessarily observed in the somewhat disagree category.

If nothing else, PFLs’ mixed willingness to participate in harvesting of any kind for a wood-based biofuels industry brought the efficacy of such an industry into question. Further, it raised questions about the common assumptions used by its proponents that PFLs would participate in this industry for economic gains and with few barriers. When
looking at the relationship between willingness to harvest biomass for energy and acres of forestland owned, there seemed to be some patterns that emerged. However, these patterns and differences across acres owned were not always consistent. Given this information, it is difficult to understand why many earlier studies did not extend effort to understand PFLs willingness and what may influence it. In response, the main purpose of this chapter is to provide an analysis of PFLs willingness to participate in harvesting for a wood-based biofuels industry and to understand possible relationships with specific variables. To do this, the results from bivariate and multivariate analysis are presented.

**Bivariate Analysis**

The bivariate and multivariate analysis presented in this chapter was undertaken using clusters or sets of variables. These sets of variables attempted to measure different aspects of particular topics. These variable sets included one that dealt with different types of plans PFLs had (plans for cutting trees, non-cutting, and harvesting trees for sale). There was also a set of variables measuring different beliefs and perceptions concerning outcomes and impacts of harvesting biomass for energy (forest health, the environment, forest aesthetics, recreational activities, and economic impacts). Another set included the way PFLs valued their land (use value vs exchange value). A set of variables dealt with the level of knowledge and consulting PFLs had concerning the forest and biofuels industries. The study also included a set of variables measuring several different sociodemographic characteristics. These variable sets provided a way to understand the data and the relationships these larger themes have with the dependent variable.

Prior to the multivariate regression, a Pearson correlation matrix was analyzed to provide an assessment of the nature of the individual relationships among the
independent variables, as well as their relationships with the dependent variable. The purpose of the Pearson correlation matrix was to assess the strength and direction of the relationship between the independent and dependent variables (Field and Miles 2011; Warner 2008). The matrix also provided preliminary information on whether the relationships between variables were statistically significant (Warner 2008). Correlation does not equal causation. Instead, the purpose here was to determine, when taken together, if any significant linear relationship existed between the two variables. This was the first step in determining if the variable might contribute to PFLs’ willingness when applied in a more complex analysis.

Table 3 provides the bivariate correlation matrix for PFLs’ willingness to harvest biomass for energy. The results indicated several variables had a statistically significant relationship with PFLs’ willingness, at the bivariate level. All statistically significant relationships between independent variables and the dependent variable were indicated with an asterisk. Many of the variables included in the Table 3 had a statistically significant relationship with PFLs’ willingness to participate in harvesting biomass for energy. Most notable, however, was the fact that none of the sociodemographic variables, with the exception of gender, had a statistically significant relationship with the dependent variable. The bivariate correlation between “gender” and “PFL willingness” resulted in a Pearson correlation coefficient of 0.10 that was statistically significant at the .01 level, indicating a negative relationship between these variables. This suggested males had higher levels of willingness to participate in harvesting biomass for energy.
Table 3 Correlation matrix for PFLs’ willingness to harvest biomass for energy with the independent variables

|                      | PFLs willingness | # of acres | Connection with nature | Use values | Exchange values | Have harvested trees for sale in future | Plan to harvest trees for sale in future | Has plans that focus on cutting | Knowledge of biomass/forest industry | Has plans that do not focus on cutting | Level of consulting | Health of your forest | The environment | Forest aesthetics | Recreation activities | Forest recreation activities | Economic impact to communities | My services | Education | Age | Gender | Length of residence | Political ideology | Income | M/SD |
|----------------------|-----------------|------------|------------------------|------------|----------------|----------------------------------------|-------------------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|-------------------|------------------|----------------|---------------|---------------------|-------------------------|-----------------|-----------|------|--------|-------------------|-------------------|--------|--------|
| PFLs willingness      | 1.00            |            |                        |            |                |                                        |                                           |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| # of acres            | **0.11** 1.00    |            |                        |            |                |                                        |                                           |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Connection with nature|                | -0.04     | -0.03                  | 1.00       |                |                                        |                                           |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Use values            |                | **-0.10** 0.03 | 0.14                  | 1.00       |                |                                        |                                           |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Exchange values       |                | **0.18** 0.15 | -0.07                  | 0.16       | 1.00           |                                        |                                           |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Have harvested trees for sale |            | **0.18** 0.35 | -0.07                  | 0.04       | 0.25           | 1.00                                   |                                           |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Plan to harvest trees for sale in future |            | **0.25** 0.34 | -0.05                  | 0.03       | 0.30           | 0.54                                   | 1.00                                      |                                      |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Has plans that focus on cutting |            | **0.26** 0.10 | 0.04                   | 0.24       | 0.39           | 0.20                                   | 0.26                                      | 1.00                                 |                                     |                                    |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Has plans that do not focus on cutting |            | **0.12** 0.03 | 0.11                   | 0.31       | 0.16           | 0.04                                   | 0.12                                      | 0.40                                 | 1.00                                 |                                     |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Knowledge of biomass/forest industry |            | **0.16** 0.12 | 0.03                   | 0.16       | 0.05           | 0.15                                   | 0.14                                      | 0.07                                 | 0.10                                 | 1.00                                 |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Level of consulting   | **0.22** 0.11   | 0.05       | 0.16                   | 0.14       | 0.08           | 0.11                                   | 0.18                                      | 0.20                                 | 0.31                                 | 1.00                                 |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Health of your forest | **0.41** 0.00   | 0.08      | -0.10                  | -0.04      | -0.09          | -0.11                                  | -0.08                                     | -0.11                                | -0.15                                | -0.17                                | 1.00                           |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| The environment       | **0.37** 0.03   | 0.07      | -0.06                  | -0.05      | -0.08          | -0.10                                  | -0.11                                     | -0.10                                | -0.09                                | -0.15                                | 0.56                           | 1.00                           |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Forest aesthetics     | **0.36** 0.06   | 0.10      | -0.04                  | -0.05      | -0.10          | -0.08                                  | -0.11                                     | -0.09                                | -0.13                                | -0.18                                | 0.54                           | 0.55                           | 1.00                      |               |                     |                        |                |           |      |        |                   |                   |        |         |
| Recreation activities | **0.29** 0.00   | 0.07      | -0.04                  | -0.07      | -0.10          | -0.08                                  | -0.06                                     | -0.05                                | -0.14                                | -0.12                                | 0.48                           | 0.48                           | 0.53                      | 1.00          |                     |                        |                |           |      |        |                   |                   |        |         |
| Forest recreation activities |            | **0.29** 0.02 | 0.07                  | -0.05      | -0.02          | -0.11                                  | -0.13                                     | -0.06                                | -0.16                                | -0.15                                | 0.35                           | 0.35                           | 0.34                      | 0.26          | 1.00                  |                        |                |           |      |        |                   |                   |        |         |
| Economic impact to communities |            |          |                       |            |                |                                        |                                           |                                      |                                     |                                     |                                 |                  |                  |              |               |                     |                        |                |           |      |        |                   |                   |        |         |
| My services           |                | 0.06      | -0.07                  | 0.08       | -0.05          | -0.11                                  | 0.00                                      | 0.01                                 | 0.10                                 | -0.02                                | 0.02                           | 0.04                           | 0.07                                      | 0.13                  | -0.10                  | 1.00                     |                |           |      |        |                   |                   |        |         |
| Education             | **0.10** 0.07   | -0.06     | 0.06                   | 0.05       | 0.08           | 0.12                                   | 0.02                                      | 0.03                                 | 0.23                                 | 0.03                                | -0.06                          | -0.06                         | -0.09                                     | -0.08                  | -0.08                  | 0.02                      | 1.00                  |           |      |        |                   |                   |        |         |
| Age                   | 0.04           | 0.02      | 0.08                   | -0.09      | -0.12          | 0.00                                   | 0.05                                      | -0.20                                | -0.06                                | 0.15                                 | 0.09                           | 0.03                           | 0.03                                     | 0.06                                 | 0.09                                | -0.09                  | 0.05                  | -0.06                  | 1.00                  |                |      |        |                   |                   |        |         |
| Gender                | **0.13** 0.01   | 0.12      | -0.03                  | -0.09      | 0.01           | 0.10                                   | 0.11                                      | 0.02                                 | 0.03                                 | -0.03                                | -0.05                          | -0.07                         | -0.06                                     | -0.10                                | 0.05                                | -0.03                  | 0.08                  | -0.12                  | 0.10                  | 1.00                   |   37/21.2 |     37/21.4 |                   |                   |        |         |
| Length of residence   | -0.01          | 0.12      | -0.09                  | -0.01      | 0.10           | 0.11                                   | 0.02                                      | 0.02                                 | -0.03                                | -0.05                                | -0.07                          | -0.06                         | -0.10                                     | 0.05                                | -0.03                  | 0.08                  | -0.12                  | 0.10                  | 1.00                   |           | 37/21.4 |     37/21.4 |                   |                   |        |         |
| Political ideology    | 0.03           | 0.07      | -0.04                  | -0.01      | -0.08          | 0.01                                   | 0.01                                      | -0.18                                | -0.11                                | 0.08                                 | 0.02                           | 0.01                          | 0.04                                     | 0.09                                 | -0.08                  | 0.19                  | 0.13                  | 0.37                  | -0.18                 | 4.7/18   |    4.7/18 |                   |                   |        |         |

* p<.05; **=p<.01; ***=p<.001  M=Mean; SD=Standard Deviation
The “number or acres of land” a respondent had was positively related to willingness to harvest biofuels for energy with a Pearson correlation coefficient of 0.11 that was statistically significant at the .01 level. This finding reflected a positive relationship between these two variables and supported what was found in other studies – namely, those with larger tracts of land tended to be more willing to harvest their land (Longmire 2012; Metcalf 2010). Apparently, this was also the case for harvesting biomass for biofuels.

When considering the relationship between reasons PFLs indicated they owned their forest land and willingness to harvest biofuels for energy, both use values and exchange values were statistically significant. The bivariate correlation between use values and willingness to harvest biomass for energy resulted in a Pearson correlation coefficient of -0.10 that was statistically significant at the .01 level, indicating a negative relationship between these variables. This suggested those who owned their land for many intrinsic (or use) values were less willing to harvest biomass for energy than those that owned their land for fewer intrinsic (or use) values. Alternatively, those who owned their land for its exchange values had higher levels of willingness. The bivariate correlation between exchange values and the dependent variable resulted in a Pearson correlation coefficient of 0.18 that was statistically significant at the .001 level, indicating a positive relationship with PFLs willingness to participate in harvesting biomass for energy.

Both past harvesting action and future plans had statistically significant relationships with willingness to harvest biomass for energy. When considering the individual relationship between the variable “have harvested trees for sale,” the bivariate correlation resulted in a Pearson correlation coefficient of 0.18 that was significant at the .001 level, indicating a positive relationship between it and the dependent variable. The bivariate correlation between “has plans
that focus on cutting” and the dependent variable resulted in Pearson correlation coefficient of 0.26 and was statistically significant at the .001 level, indicating a positive relationship between the two variables. Similarly, the bivariate correlations between “has plans that do not focus on cutting” and willingness to harvest biomass for energy resulted in a Pearson correlation coefficient of 0.12 and was statistically significant at the .001, indicating a positive relationship with the dependent variable. When looking at whether the respondent specifically was planning to cut trees for sale in the future, the bivariate correlation resulted in a Pearson correlation coefficient of 0.25 and was statistically significant at the .001 level. This indicated a positive relationship with willingness to harvest for energy.

PFLs’ levels of knowledge concerning biofuels/forest industry as well as their level of consulting for the biofuels industry both had statistically significant relationships with the dependent variable. The bivariate correlation between levels of knowledge concerning biofuels/forest industry and willingness to harvest for energy resulted in a Pearson correlation coefficient of 0.16 and was statistically significant at the .001 level, indicating a positive relationship with the dependent variable. Level of consulting concerning the biofuels industry also had a positive relationship with the dependent variable. The bivariate correlation resulted in a Pearson correlation coefficient of 0.22 for this relationship.

When taken individually, perceived impacts to the health of their forest, the environment, forest aesthetics, recreational activities, and economic impacts to surrounding communities all had statistically significant relationships with willingness to harvest biomass for energy. The bivariate correlation between perceived impacts to the health of their forest and the dependent variable resulted in a Pearson correlation coefficient of -0.41 and was significant at the .001 level, indicating a negative relationship between the variables. This suggested those PFLs who
believed increased harvesting of biomass for energy would have a negative impact on the health of their forest had lower levels of willingness to harvest for energy than those who believed it would have a positive outcome. The bivariate correlation between perceived impact to the environment and the dependent variable resulted in a Pearson correlation coefficient of -0.37 and was statistically significant at the .001 level, indicating a negative relationship between the two variables. This meant those PFLs who perceived negative impacts from increased harvesting of biomass for energy would have lower levels of willingness to participate in such harvesting compared to those who perceived the impact to be positive. The bivariate correlation between the perceived impact to forest aesthetics and willingness to harvest biomass for energy production resulted in a Pearson correlation coefficient of -0.36 and was statistically significant at the .001 level, indicating a negative relationship between these variables. This suggested PFLs who believed that increased harvesting for a biofuels industry would negatively impact forest aesthetics had lower levels of willingness to harvest biomass for energy than PFLs who perceived the impacts of such harvesting to be positive. The bivariate correlation between perceived impacts to recreational activities and the dependent variable resulted in a Pearson correlation coefficient of -0.29 and was statistically significant at the .001 level, indicating a negative relationship between these variables.

Like the other perceived impact variables, PFLs who perceived negative outcomes to recreational activities from increased harvesting for biofuels had lower levels of willingness to harvest for biomass for energy than those who believed the impacts would be positive. Similarly, the bivariate correlation for perceived economic impacts to surrounding communities and willingness to harvest biomass for energy produced a Pearson correlation coefficient of -0.29 and was statistically significant at the .001 level. This suggested that when PFLs perceived the
economic impact to surrounding communities to be negative they were less willing to harvest biomass for energy than PFLs who believed surrounding communities would gain positive economic outcomes from such harvesting. When examining individual relationships between each independent variable and the dependent variable, those that dealt with perceived impacts and outcomes had the strongest substantive relationships with the dependent variable.

While there were only a few instances where statistically significant relationships existed between independent variables, most had relatively low substantive relationships. There were, however, a few relationships which need to be discussed. Because of moderately strong bivariate correlations between the measures dealing with perceived impacts from increased harvesting for a biofuels industry (health of your forest, environment, forest aesthetics, my recreation activities, and economic impacts to surrounding communities), multicollinearity issues could be of potential concern in assessing the relationships involving these variables when they are included in the logistic regression analysis. When highly correlated variables are included in a regression together they can have an adverse effect on estimates of regression coefficients and their significance by inflating standard errors (Warner 2008). In order to assess these issues, the logistic regression was run separately with only one of these variables included among the list of other independent variables. Additionally, interaction terms were created and regressions were run to determine if the interaction effects were statistically significant.

Results derived from each of these alternative models revealed only small shifts in the size of coefficients for all of the independent variables included in the model. No substantive changes in the nature of relationships or in any changes in levels of significance between the independent variables of interest and the dependent variable were uncovered. Further, the results from the models which included the interaction terms indicated that none were statistically
significant. This suggested that simultaneous inclusion of these variables in the final logistic regression model was appropriate.

**Multivariate Analysis**

**Table 4 Logistic regression with the dependent variable, PFLs' willingness to harvest for energy, and independent variables**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate (Log Odds)</th>
<th>Standard Error</th>
<th>ChiSq</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>-6.52</td>
<td>1.00</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>-4.79</td>
<td>0.98</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>-4.67</td>
<td>0.98</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>-3.51</td>
<td>0.97</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Acres of Forestland</td>
<td>0.05</td>
<td>0.06</td>
<td>0.376</td>
<td>1.05</td>
</tr>
<tr>
<td>Connection with nature</td>
<td>-0.02</td>
<td>0.17</td>
<td>0.924</td>
<td>0.98</td>
</tr>
<tr>
<td>Use Values</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.278</td>
<td>0.96</td>
</tr>
<tr>
<td>Exchange Values</td>
<td>0.02</td>
<td>0.03</td>
<td>0.571</td>
<td>1.02</td>
</tr>
<tr>
<td>Have harvested trees for sale</td>
<td>0.05</td>
<td>0.22</td>
<td>0.806</td>
<td>1.06</td>
</tr>
<tr>
<td>Has plans that focus on cutting</td>
<td>0.06</td>
<td>0.02</td>
<td>0.004</td>
<td>1.06</td>
</tr>
<tr>
<td>Has plans that do not focus on cutting</td>
<td>-0.06</td>
<td>0.04</td>
<td>0.100</td>
<td>0.94</td>
</tr>
<tr>
<td>Plan to harvest trees for sale in future</td>
<td>0.15</td>
<td>0.06</td>
<td>0.018</td>
<td>1.17</td>
</tr>
<tr>
<td>Knowledge of biomass/forest industry</td>
<td>0.05</td>
<td>0.05</td>
<td>0.343</td>
<td>1.05</td>
</tr>
<tr>
<td>Level of consulting</td>
<td>0.05</td>
<td>0.03</td>
<td>0.102</td>
<td>1.05</td>
</tr>
<tr>
<td>Health of your forest</td>
<td>-0.98</td>
<td>0.24</td>
<td>&lt;0.001</td>
<td>0.38</td>
</tr>
<tr>
<td>The environment</td>
<td>-0.24</td>
<td>0.22</td>
<td>0.282</td>
<td>0.79</td>
</tr>
<tr>
<td>Forest aesthetics</td>
<td>-0.58</td>
<td>0.22</td>
<td>0.007</td>
<td>0.56</td>
</tr>
<tr>
<td>My recreation activities</td>
<td>-0.37</td>
<td>0.21</td>
<td>0.049</td>
<td>0.69</td>
</tr>
<tr>
<td>Economic impact to communities</td>
<td>-0.46</td>
<td>0.20</td>
<td>0.024</td>
<td>0.63</td>
</tr>
<tr>
<td>Age</td>
<td>0.01</td>
<td>0.01</td>
<td>0.052</td>
<td>1.01</td>
</tr>
<tr>
<td>Gender</td>
<td>0.17</td>
<td>0.18</td>
<td>0.360</td>
<td>1.18</td>
</tr>
<tr>
<td>Education</td>
<td>0.08</td>
<td>0.06</td>
<td>0.189</td>
<td>1.08</td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.00</td>
<td>0.00</td>
<td>0.377</td>
<td>1.00</td>
</tr>
<tr>
<td>Political ideology</td>
<td>-0.09</td>
<td>0.06</td>
<td>0.140</td>
<td>0.91</td>
</tr>
<tr>
<td>Income</td>
<td>0.00</td>
<td>0.05</td>
<td>0.948</td>
<td>1.00</td>
</tr>
</tbody>
</table>

N=589  C=0.81

---

3 In order test the congruence of the general information from KIs and general survey across the region, I subdivided the survey data between the Northern and Southern regions and added a dummy variable where 1=North and 0=South. In all regression the dummy variable was not significant. As a result, this data was not included in the final model.
A logistic regression analysis approach was employed to test the combined relationships between the independent variables and the dependent variable, PFLs’ willingness to harvest biomass for energy. The results from the logistic regression analysis indicated that six of the independent variables – had plans that focused on cutting, planned to harvest trees for sale in the future, impacted health of their forest, impacted forest aesthetics, impacted their recreational activities, and had an economic impact on surrounding communities – had statistically significant relationships with the dependent variable. The results of the logistic regression are provided in Table 4. Overall, the model had a relatively strong fit, producing a $c$ statistic of 0.81. This meant the model was able to predict the value (log odds) of each variable over 80 percent of the time.

Table 4 also indicated that the index for “had plans that focused on cutting trees” had an estimate of 0.06 and was statistically significant ($p<.01$). This suggested that for every one unit increase in the index for having such plans, we could expect higher odds of being in a higher category of willingness to harvest biofuels for energy. The variable “planned to harvest trees for sale in the future” had an estimate of 0.15 and was statistically significant ($p<.05$). This suggested that respondents who planned to harvest trees for sale in the future had higher odds of being in a higher category of willingness to harvest biomass for energy compared with those who did not have such plans.

Table 4 also indicated that several of the perceptions variables (concerning positive or negative impacts and outcomes from increased harvesting for a biofuels industry) played an important role in willingness to harvest biomass for energy. The variable “perceived impact to the health of your forest” had an estimate of -0.98 and was statistically significant ($p<.001$). This suggested we could expect lower odds of being in a higher category of willingness to harvest
biomass for energy for PFLs who perceived the impact to the health of their forest was negative compared to those who perceived the impact to be positive. The logistic regression indicated the variable “perceived impacts to forest aesthetics” had an estimate of -0.58 and was statistically significant \((p<.01)\). This suggested we could expect lower odds of being in a higher category of willingness to harvest biomass for energy for respondents who perceived negative outcomes to forest aesthetics compared with those who believed such harvesting would have positive outcomes on forest aesthetics. This table also indicated that the variable “perceived impacts to my recreational activities” had an estimate of -0.37 that was statistically significant \((p<.05)\). This meant we could expect lower odds of being in a higher category of willingness to harvest biomass for energy for PFLs who perceived that increased harvesting for a biofuels industry resulted in negative impacts to their recreational activities compared with those who believed such impacts would be positive. Finally, the logistic regression resulted in an estimate of -0.46 for the variable “perceived economic impacts to surrounding communities” and was statistically significant \((p<.05)\). This suggested PFLs who perceived negative economic impacts to the surrounding communities were more likely to have lower odds of being in a higher category of willingness to harvest biomass for energy compared to those who believed such activity would provide positive economic benefits to the surrounding communities.

Table 4 also showed that none of the variables in the set of sociodemographic characteristics were statistically. From these results it was determined that within a multivariate context, sociodemographic variables did not influence PFLs’ willingness to harvest biomass for a biofuels industry. Additionally, while the bivariate results indicate the number of acres a PFL has, influences their willingness to harvest for biofuels, it is not significant in the multivariate context. This is interesting as the literature suggested it influences harvesting decisions.
However, it is not surprising given the inconsistent patterns discussed earlier in the chapter. This is also the case for gender. It was significant when taken in a bivariate relationship. However, its influence is not significant when taken in context with other variables.

In addition to the multivariate logistic regression results, a confusion matrix or classification table was developed. A dichotomous version of the dependent variables of PFL willingness to harvest biomass for energy was created. The categories “strongly disagree” and “somewhat disagree” were combined and coded as 0= not willing. The categories “strongly agree” and “somewhat agree” were combined and coded as 1= willing. The category of “neither agree nor disagree” was removed for this portion of the analysis. The confusion matrix is derived by cross classifying the actual and predicted responses for the dependent variable based on the model used for the logistic regression. The results showed that the model correctly classified approximately 75 percent of the observations based on the final model. This resulted in a misclassification rate of approximately 25 percent. The model was also able to better predict those who would not be willing to harvest biomass for energy compared to those who would be willing. The confusion matrix helped provide a more detailed understanding of how accurately the model was able to predict PFL willingness.

<table>
<thead>
<tr>
<th></th>
<th>Willing</th>
<th>Not Willing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willing</td>
<td>176</td>
<td>64</td>
</tr>
<tr>
<td>Not Willing</td>
<td>59</td>
<td>190</td>
</tr>
<tr>
<td>N=489</td>
<td></td>
<td>Mean=.75</td>
</tr>
</tbody>
</table>

Table 5 Confusion matrix for PFLs' willingness to harvest biomass for energy
When looking at the values for the independent variables for each correctly predicted group (willing and not willing) there are clear patterns. For example, those who are willing to harvest biomass for energy generally are planning on harvesting their trees for various reasons and consistently perceive that such harvesting will have positive impacts. It is suggested here that in order to increase the probability of a PFL being willing to harvest biomass for a biofuels industry, particular focus should be placed on demonstrating the positive outcomes from harvesting. Additional effort should be exerted to understand PFLs harvesting plans.

Discussion

As explained in Chapters 1 and 2, many of the studies examining the efficacy of a wood-based bioenergy industry focused primarily on technical/supply issues. These studies provided information about the potential of the Eastern Forest Region to supply adequate biofuel quantities to meet industry demands and goals. Further, these studies often focused on economic aspects such as the market, profits, investment, and economic development. While all of these concerns are important, alone they are unable to fully explain the complexities and impacts of the development of a wood-based bioenergy industry.

The focus on the technical/supply aspects of a wood-based biofuels industry often excluded other important social, cultural, and biophysical issues, many of which are interconnected in complex ways. As a result, we lacked proper understanding of PFLs’ willingness to participate in harvesting biomass for energy purposes. This, in part, could be traced to assumptions regarding PFLs. It was often assumed PFLs were able and willing to harvest their forests for biomass with few obstacles and because of the opportunities to increase profits. Until recently, due to these assumptions, studies focusing on understanding PFLs willingness to participate were relatively scarce. This chapter tried to address this lack of focus.
on PFLs and provided an analysis of those factors which influenced PFLs’ willingness to harvest and support a wood-based biofuels industry.

As explained the analysis presented in this chapter was undertaken using sets of variables. These sets of variables attempted to measure different aspects of particular topics. For example, there was set of variables that dealt with different types of plans PFLs have (plans for cutting trees, non-cutting, and harvesting trees for sale). There was also a set of variables measuring different beliefs and perceptions concerning outcomes and impacts of harvesting biomass for energy (forest health, economic impacts, etc.). The bivariate results indicated that when taken individually there were many variables, or sets of variables, which had statistically significant relationships with PFLs’ willingness to harvest biomass for energy. For example, the set of variables that dealt with PFLs’ plans, as well as their perceptions concerning possible outcomes and impacts had the largest substantive relationships with the dependent variable. However, the sets of variables concerning PFLs’ values (exchange and use) and their knowledge and information attainment also had significant relationships with PFLs’ willingness. It was interesting that within the set of PFLs values, connection with nature was not statistically significant. Since one’s connection to nature has been found to have a relationship with levels of support for other types of development, it was surprising that no relationship existed in this study.

The set of sociodemographic variables were included because prior research had pointed to their relationships with forest management, support for development, and their ties to environmental connection and concern. It was anticipated that these variables would be related to willingness to harvest biomass for energy as well, making it necessary to understand their influence on the dependent variable. However, with the exception of gender, the set of
sociodemographic variables did not exhibit statistically significant relationships with PFLs’ willingness to harvest biomass for energy when looking at bivariate relationships.

A multivariate analysis is very important when determining how variables contribute to individual or group decision making. Rarely, if ever, in real life are variables considered on an individual/bivariate basis. Variables, topics, and themes are considered within the larger decision making process and come together to inform attitudes, beliefs, values, and behavior. The multivariate analysis showed that two sets of variables had relationships with PFLs’ willingness to harvest biomass for energy. The broader themes of perceived impacts from harvesting for biofuels, and PFLs’ plans concerning their forests influenced PFLs’ willingness. The logistic regression results indicated PFLs’ harvesting and forest management plans had a strong relationship with PFLs’ willingness to harvest biomass for energy. More specifically, PFLs with plans that dealt with cutting trees for any reason, including harvesting trees for sale, were more willing to do so for energy production. This was consistent with research that focused on how future plans related to actions and behaviors. Here, it was likely PFLs did not necessarily plan on harvesting their forest to support a biofuels industry. Instead, because PFLs were already planning on cutting their trees for various reasons – including for sale – they were more open to the possibility of harvesting biomass for energy because it already aligned with their plans. Doing so did not represent a change in their future plans, but merely an adaptation to them. The assumption that PFLs would be willing to increase forest product harvesting to support a wood-based biofuels industry for increased profits may possibly be true for PFLs who were already going to cut or harvest their trees. Such incentives may be enough to sway PFLs who were already going to harvest their trees. However, given the diversity of PFLs, the reasons they might
possibly be harvesting (e.g., timber stand improvement, weed control, etc.) need to be further understood.

While research and theory indicate that past behavior and actions influence future plans and actions, additional effort should be extended to understand what other factors might impact PFLs' future management and harvesting plans. Exploring management patterns could lead to a better understanding of how engaging in one type of forest management activity was related to PFLs’ future plans and decisions to engage in other types of forest management and harvesting activities, including harvesting for a wood-based biofuels industry (Joshi and Arano 2009).

The results produced by the logistic regression indicated PFLs’ perceptions concerning the impacts and outcomes of increased forest product harvesting for a biofuels industry had a strong relationship with PFLs’ willingness to harvest biomass for energy. Those who perceived the impacts and outcomes of increased harvesting for a biofuels industry to be negative to their forests health, aesthetics, recreational activities, and to the economies of surrounding communities were less likely to be willing to harvest for such purposes. This substantiates previous research looking at perceptions and beliefs concerning the introduction of proposed developments, including development tied to energy production. As explained in Chapter 2, perceptions concerning the outcomes of a development may be more important to the overall acceptance of or opposition to the proposed development than other possible determinates of support or opposition (Gramling and Freudenburg 1992). When considering PFLs’ willingness to harvest biomass for energy, perceived impacts influenced their decision to participate in forest product harvesting for biofuels.

The other variable sets did not have a statistical relationship with the dependent variable. Based on previous literature, it was assumed that PFLs’ values concerning their forests and
nature, as well as their knowledge and consulting habits would influence PFLs willingness to harvest. The results indicated that this was not the case in a multivariate context. Further, the set of sociodemographic variables did not have a statistically significant relationship with willingness to harvest biomass for energy, when other variables were taken into account.

In sum, a better understanding of PFLs’ willingness to harvest biomass for energy was obtained through an analysis of what variables were related to and possibly influenced their willingness to participate in such harvesting. This analysis showed that PFLs’ future plans and perceptions of potential impacts and outcomes greatly influenced their likelihood to willingly participate in harvesting biomass for energy. If a wood-based biofuels industry is to be developed, at least at a scale that would help attain many of the goals set by national and state policies, it will be important to gain access to PFLs stocks. Understanding PFLs forest management plans, making efforts to decrease negative impacts, and increasing local economic benefits, would help us understand and facilitate increased PFLs willingness to participate and support increased harvesting and development for a wood-based biofuels industry.
Chapter 6

Conclusion

Discussion and Possible Implications

This dissertation informs efforts to engage PFLs and communities in discussions and efforts to understand their concerns, opportunities, and willingness to participate in and support harvesting and development of a wood-based biofuels industry. The study included concatenation of secondary data, the creation of a longitudinal database, and analysis of that data, and the conduct of key informant interviews, and the design, implementation, and analysis of a region wide phone survey. The data gathered from these sources were very congruent and often the findings in one validated the other. For example both KIs and responses from the phones survey suggested perceived impacts were important determinates of PFL willingness and community support. Together, all of this data helped provided a better understanding of PFLs and community concerns, opportunities, and impacts of increased harvesting for and the development of a wood-based biofuels industry. Further, the data helped highlight the relationships between various sets of sociocultural and sociodemographic variables and PFLs willingness to harvest biomass for energy. Using the finding of this study, policy makers would be able to better design legislation to achieve sustainable forest management associated with biofuels development. The results presented in this dissertation built upon previous research and extended our knowledge concerning the efficacy of a wood-based biofuels industry.

The fact that more than fifty percent of respondents indicated they would not be willing to harvest biomass to support bioenergy production should be cause for reflection about the efficacy of a biofuels industry. This division and variation in willingness to harvest biomass for energy has several implications for the development of such an industry. First, due to the
increasing level of forest parcelization and fragmentation in this broad and important forested region of the nation dominated by PFL ownership of the vast majority of total forested acres, gaining access to enough tracks of land to harvest at a profitable level may be difficult. Second, this difficulty could be exacerbated if those PFLs willing to harvest for a bioenergy industry are scattered among those who are not. If this were the case, it would effectively contribute to the problems associated with increased parcelization and fragmentation of accessible forest stocks. Third, if both of these issues occurred it would severely impede the ability of renewable and sustainable forest resources to meet national and state goals.

One of the key findings from this study was the importance of perceived impacts and outcomes from increased harvesting and the development of a biofuels industry. Both PFLs and communities indicated perceived negative impacts were a source of concern and would likely play a role on the level of community support for and PFLs’ willingness to participate in harvesting for a biofuels industry. Possible impacts identified included water and air quality, forest health, visual impacts, and traditional uses of the forests (e.g., hiking, hunting, and camping). Further, the results produced by the logistic regression indicated the set of variables that dealt with PFLs’ perceptions concerning the impacts and outcomes of increased forest product harvesting for a biofuels industry had a strong relationship with their willingness to harvest biomass for energy. Those who perceived the impacts and outcomes of increased harvesting to be negative to their forests health, aesthetics, recreational activities, and to the economies of surrounding communities were significantly less likely to be willing to harvest for such purposes. Simply said, these perceived impacts influenced PFLs’ willingness to harvest biomass for energy and the development of a biofuels industry.
Several implications are tied to the fact that perceptions concerning potential outcomes and impacts are developed prior to any actual activity. If harvesting for and the development of a wood-based biofuels industry is perceived as having multiple negative impacts, a foundation for opposition and rejection is already laid. When the lack of focus on PFLs and communities in previous studies is combined with the lack of efforts to provide education and information to both groups serious questions arise about the real potential for a biofuels industry to gain traction or support.

Another key finding dealt with the fact decisions to harvest biomass for energy was based on more than just economic factors. The KIs, as well the findings of the bivariate and multivariate analyses, indicated there was a wider variety of complex values and beliefs about support for a biofuels industry than commonly assumed. As discussed, the common assumptions discussed throughout this study are based on the routine assertion that PFLs and communities have few concerns and face few barriers to their participation in a biofuels industry. In a word, these assumptions tie to the belief that communities and PFLs will do so for economic incentives. Economic aspects – such as jobs, taxes, and profit – appeared to be significant drivers behind PFL and community support for and willingness to participate in harvesting and the development of a wood-based biofuels industry. However, the findings from this study suggest they were only a few of the many things considered when making the decision to participate and support the biofuels industry. Further, the results indicated that most PFLs owned their land for multiple reasons, which may or may not include harvesting wood for profit, highlighting the many perceptions held by communities and PFLs.

In light of this it is interesting that the set of measures concerning the reasons why PFLs owned and valued their land (exchange value vs. use value) were not statistically significant.
Earlier research indicated such values could impact harvesting and forest management activities (Butler and Ma 2011). KIs indicated that PFLs valued their land for multiple reasons, and PFLs take into account these multiple values when making harvesting decisions, including harvesting for biofuels. If this was the case, why were these variables not significantly related to PFLs’ willingness? It can be inferred from the results of both the KIs and survey that while PFLs and communities value their forests for multiple reasons, these values are not a contributing factor when they consider harvesting for and supporting a biofuels industry. Instead, PFLs and communities’ perceptions concerning how harvesting or development will impact these values were important when determining willingness to participate and support such activity. For example, while the scale measuring use values did not have a statistically significant relationship with PFLs’ willingness, the variable measuring perceived impact to forest aesthetics did. Forest aesthetics would be considered an intrinsic or use value and if PFLs perceived negative outcomes to this value they were less likely to harvest for a biofuels.

As indicated from this analysis, a better understand of how PFLs’ valuation of their forestland and other variables has impacted perceived outcomes from harvesting for a biofuels industry is needed. For example, we could better understand PFLs’ willingness to participate in increased forest product harvesting by exerting effort to better understand how they developed their perceptions concerning the impacts and outcomes of harvesting and development. It will also be important to proceed in a way to reduce negative impacts particularly as they relate to forest health and aesthetics and recreational activities, while also increasing socioeconomic benefits of community economies. Doing so may help improve the willingness of PFLs to participate in harvesting for a biofuels industry.
In some rural areas, biomass use is consistent with local culture and history tied to traditional forest management. It was interesting and informative that in each of our five states—Pennsylvania, Mississippi, South Carolina, Tennessee, and Wisconsin—tradition seemed to be a key force for accepting and supporting the emerging biofuels industry. However, there were traditional forest uses that did not necessarily align with increased support for harvesting, especially at increased levels. PFLs and communities indicated they used their forests for multiple reasons, and some uses—recreation, preservation, and possibly as a heat source—did not support harvesting for biofuels. It seems likely that the tradition of balancing both economic and other uses could lend support for a biofuels industry.

Despite the fact these traditional element exist, there was deep anxiety about what this all meant for the community and environment. It was clear that stakeholders wanted to ensure sustainable management and harvesting practices were used so that they could reduce negative impacts.

PFLs with plans that dealt with cutting trees for any reason, including harvesting trees for sale, were more willing to do so for energy production. This was consistent with research that focused on how future plans related to actions and behaviors. Here, it was likely PFLs did not necessarily plan on harvesting their forest to support a biofuels industry. Instead, because PFLs were already planning on cutting their trees for various reasons— including for sale— they were more open to the possibility of harvesting biomass for energy because it already aligned with their plans. Doing so did not represent a change in their future plans, but merely an adaptation of them. In this case, the assumption PFLs would be willing to increase forest product harvesting to support a wood-based biofuels industry for increased profits may possibly be true for PFLs.
already planning on cutting or harvesting their trees. Such incentives may be enough to sway those PFLs already committed to harvesting.

While research and theory indicate that past behavior and actions influence future plans and actions, additional effort should be extended to understand what other factors might impact PFLs future management and harvesting plans. Exploring management patterns could lead to a better understanding of how engaging in one type of forest management activity was related to PFLs’ future plans and decisions to engage in other types of forest management and harvesting activities, including harvesting for a wood-based biofuels industry (Joshi and Arano 2009).

There were some indications in previous studies that given the diversity of PFLs, the variety of reasons they possibly harvest, broad economic differences, forest composition and regional differences might impact how PFLs and communities view and think about the development of a biofuels industry. What this study has shown, is that there are not statistical or substantial differences in the way PFLs and communities understand and view such development. The analysis of both the KIs and the phone survey showed that PFLs and communities have similar concerns and perceptions regarding impacts from increased harvesting and development for a biofuels industry.

Education, information, and engagement were all described as being important concerns. It was clear PFLs and communities wanted additional information to help answer questions and address their concerns. Further, at this point, the KIs indicated engagement with those who likely had this information was often lacking. What was needed was more attention to the publics and the areas where bioenergy activity was studied, planned, or occurring. Providing communities and PFLs the information they needed to make informed decisions should be a common process
with any new development. Doing this would help PFLs and communities become more involved and armed with correct information.

**Conclusion**

There are several things that have been made clear through this study. Significant social barriers to the development of a biofuels industry existed. These social barriers included numerous concerns including perceived impacts from increased harvesting and development to water and air quality, forest health, forest aesthetics, recreational activities, and other traditional uses. Because past research has focused almost exclusively on issues of supply and demand, it did not identify these social barriers. Even perceived economic opportunities were more complex than have been assumed, with the possibility of impacting current forest product industries. PFLs and communities are more than just economic actors with patterns of predictable forest management behavior. My study identified that these social barriers, such as negative perceptions, variation in forest management plans, forest values, trust, and lack of information and knowledge had significant influence on community support and access to PFLs’ forests. Engagement with PFLs and communities is essential if access to PFLs’ forests and community support for a biofuels industry is to be achieved.

There are also several policy and real world implications that have been derived from this study. The findings suggested policies and practices created to increase PFLs and communities’ economic opportunities, while reducing negative impacts, would likely increase support for harvesting and development. One way to avoid this would be to promote sustainable development policies that inherently included PFLs and communities in the development process. Current development processes typically exclude residents and communities from the decision making process. Today the process has typically followed the principles of decide-
propose-defend – meaning that developers, policy makers, and states decide. Only after the decision has been made is the public involved. Acceptance and support of the biofuels industry and bioenergy – like any other activity – requires local involvement in all phases of activity. Doing this means involving locals and making them part of the decision making process. The decisions then become theirs and they are more likely to reflect the interests of the broader community. This is community agency and reflects the fact that people in these areas care about each other and the place they live.

**Limitations and Suggestions for Further Research**

An important limitation of this research was the use of a phone survey. The use of a phone survey has often resulted in limited sample size and a shorter questionnaire compared to other survey data collection methods such as mail surveys. Because of the limited sample size, there is a question regarding the generalizability of survey-based findings to the larger Eastern forest region population. In a study that has been designed to only take advantage of one method of data collection, this would have been cause for significant concern. However, this study was designed and effort was extended to reduce this possible issue.

This study utilized a mixed methods design to collect and analyze multiple sources of data. Doing this facilitated triangulation of findings across places (five study sites) and people (PFLs and the general public in these places and at a regional level). The case study approach enabled the ability to conduct in-depth studies of a burgeoning biofuels sector in a particular context. Using multiple case studies helped to determine if findings were replicable (Yin 1989:53). The survey component enabled the ability to determine the generalizability of findings. Redundancy was built into the framework by using the results from the KIs to drive a region wide survey. This allowed me to compare information gained through the KIs and surveys and
determine the extent to which they agreed with each other. A fact represented by the many areas of agreement between the data sources. This promoted a high level of confidence in both the validity and generalizability of the findings, at least within the Eastern forest region.

This study attempted to build on earlier research, especially those studies focusing on economic aspects. However, this study was, in fact, limited. It focused primarily on sociodemographic and sociocultural aspects associated with biofuels development. While there were some economic aspects included, by and large it was undertaken independently from economic and supply evaluations found in previous studies. Development of a biofuels industry is a complex topic which really required all of these different evaluations (social, economic, and supply/technical) to be undertaken simultaneously to provide a more complete understanding of the context of the development of a wood-based biofuels industry. By design, and reflecting limitations of time and resources, this study focused on an aspect largely missing from the extant literature – the social focus. However, this provides an opportunity for further research.

The insights derived from this study highlighted several possibilities for future research. A study where social, economic, and supply evaluations are undertaken together in a way that included multiple disciplines is recommended. This study took steps to begin this process, and has benefited and provided information previously lacking in previous studies. However, a more integrated and combined study of these important aspects would move the study of the developing biofuel industry forward.

Current studies would benefit from efforts extended to understand the development of perceptions concerning development, and in this case harvesting and other development associated with a biofuels industry. This study provided some insight on this topic. However, there is still much needed effort to provide a detailed and nuanced examination of these
variables, how they develop, how they change, and how they differ across the community all in relation to biofuels development and harvesting.

In sum, this dissertation informs efforts to engage communities and PFLs in discussions and efforts to understand the concerns, opportunities, and willingness to participate in and support harvesting and development of a wood-based biofuels industry. This study helped provided an understanding of community and PFLs concerns, opportunities, and impacts of increased harvesting for and development of a wood-based biofuels industry. Further, it has helped provide a better understanding of the relationships between various sets of sociocultural and sociodemographic variables and PFLs and communities willingness to harvest and support a biofuels industry. Using the finding of this study, policy makers would be able to better design legislation to achieve sustainable forest management related to biofuels development. It is hoped that those involved in the development of the biofuels industry will take seriously the fact that the social barriers, concerns, and opportunities identified in this study have already likely impacted such development.
References


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Appendix A

Key Informant Questions

Name:______________________________________ Title______________________

Time in Position:______(yrs.) Length of time in community: __________________(yrs)

Address:_______________________________________________________________

City:________________State:____________ZipCode:__________County:_________

Phone:________________________Interview Location:__________________________

Interviewer:___________________________

1. (a) How would you describe your community and its people, particularly over the past 10 or so years?
   (b) What are its core set of values and/or what do you think makes the community viable as a place to live?
   (c) Describe how people work together in the community.
   (d) Where do residents learn about community happenings? [local paper/radio, word of mouth, meetings?]
   (e) How is the community changing?
   (f) What are its special places and what makes them special? (Are there special natural areas? How do people interact with the natural areas?)

2. What conditions or events bring community members together and what drives them apart?

3. (a) What are the major issues and concerns in your community?
   (b) Is forest product harvesting (prices, mill closures, lack of consultants and loggers, bond-related forest road issues, water quality, wildlife habitat, or other environmental issues) a concern? (Why or why not?)
   (c) IF A CONCERN: What occurred to raise forest product harvesting as a concern?
   (d) What event(s) brought forest product harvesting to the community’s attention?
   (e) How long has the community had these concerns?

4. (a) Are you familiar with wood-based biofuel production?
   (b) What concerns, if any, might you have about wood-based biofuel harvesting, production, and distribution in the community? [What are/were your sources of information on this?]
(c) Have there been any developments related to woody biomass in the community (e.g., new facilities or industry interest/movement)?
(d) Are federal and state agencies, including extension, communicating with residents about wood-based biofuel?

5. (a) If there was a proposal to have a wood-based biomass facility in your community, how concerned would you be about the potential impact of increased forest product harvesting there?
   (b) In the past, what has been the public’s response to forest product harvesting?

6. (a) What roles do federal, state, and local governments and local citizens play in decisions related to forest product harvesting?
   (b) Harvesting for wood-based biofuel specifically?
   (c) Are any local or state forest landowner organizations addressing forest products harvesting? If so, how?

7. (a) How concerned are you with the potential of wood-based biofuel production on existing industries (generally and specifically forest-based industries) and employment?
   (b) What do you see as the biggest issues associated with developing a wood-based biofuel production industry in your community? [strengths, opportunities, weaknesses, and threats]

8. (a) Should the public be involved in decisions related to expanding and/or changing wood harvesting?
   (b) In what ways should they be involved?
   (c) Are your responses to the above questions influenced by whether the forests are public or private? Why does this matter? [Who owns the forests in and around your community?]

9. (a) How willing do you think the private forest landowners in your community are to participate in an expanded forest products industry in general, and specifically a wood-based biofuel industry?
   (b) How willing do you think community residents, government agencies, NGOs, and forest landowner organizations in general would be to do this on public land?
   (c) What kind of information do landowners and communities need to make responsible decisions about woody biofuel development?

10. (a) What general community impacts – positive and negative – might be associated with an expanded wood-based biofuel industry if one were to develop in your community?

11. Finally, can you think of anyone else I should talk to about forest product harvesting in your community?
INTRODUCTION -- ASK FOR LISTED PERSON
Good (morning/afternoon/evening). My name is _______ and I am calling on behalf of PennStateUniversity and we are conducting a nationwide study for the Bureau of Forestry and would appreciate your opinions. This brief survey focuses on LAND OWNERSHIP. We'd greatly appreciate a few moments of your time. Your opinion is very important. (IF NEEDED SAY) We are not selling anything, and this study is very brief and will only take a few minutes of your time. All information is completely confidential.

S1. First, do you own at least ONE (1) acre of forestland? (INTERVIEWER CLARIFICATION: Forestland is defined as at least one (1) acre of land, not maintained as a lawn, where trees are the predominant vegetation type)

   1. Yes – own at least one (1) acre of forestland (QUALIFIES AS FOREST LAND OWNER SECTIONS)

   2. No – does not own at least one (1) acre of forestland (QUALIFIES AS GENERAL PUBLIC SECTIONS)

(ASK S2 IF YES TO S1)

S2. In total, about how many forested acres do you own? Please include all properties if you own more than one.

   (RECORD NUMBER OF FORESTED ACRES)____________

   (INTERVIEWER, IF UNSURE OR HESITANT – PROMPT AND READ RANGES)

   1 acre but less than 5 acres
   5 acres to less than 10 acres
   10 acres to less than 25 acres
   25 acres to less than 50 acres
   50 acres to less than 100 acres
   100 acres to less than 250 acres
   250 acres to less than 1,000 acres
   1,000 acres to less than 5,000 acres
   5,000 acres or more
Ownership Objectives (FLO) – Section 1

1. I'd like to read you a list of reasons landowners own their forestland. As I read each, please tell me if the reason is an Important or Unimportant reason to you for owning your forestland. (INTERVIEWER PROBE: Is that Very or Somewhat Important/Unimportant?)

1 = Very Unimportant  5 = Very Important
2 = Somewhat Unimportant  9 = (VOL) Don’t Know/No Opinion
3 = (VOL) Neither Important nor Unimportant
4 = Somewhat Important

VU SU N SI VI

- Land investment. Eventually sell all or part of my forestland at a profit
- Hunting opportunities
- Camping, walking, or other recreation
- Growing trees for sale
- Personal uses of wood, such as firewood
- Enjoyment of owning forestland
- As an estate to pass on to my children
- Income other than from selling timber
- To enjoy wildlife
- Solitude
- It came with the property
- Non-timber products (such as; mushrooms, berries, nuts, plants, etc.)
- Reducing our country’s dependence on foreign energy

(ASK LAST) Any Other Reason (Accept One Specify)

SHOW ALL REASONS RATED 5 (VI), INCLUDE OTHER IF RATED 5 (VI). IF ONLY ONE REASON RATED 5 (VI) FORCE PUNCH

2. Which reason is the most important reason?
3. Now, I’d like to read you a list of plans that you may or may not have for your forestland in the next ten years. As I read each, please tell me if you agree or disagree that the item is in your plans for your forest land in the next ten years? (INTERVIEWER PROBE; IS THAT STRONGLY/SOMEWHAT AGREE/DISAGREE)

1 = Strongly Disagree
2 = Somewhat Disagree
3 = (VOL) Neither Agree nor Disagree
4 = Somewhat Agree
5 = Strongly Agree
9 = (VOL) Don’t Know/No Opinion

<table>
<thead>
<tr>
<th>Plan</th>
<th>SD</th>
<th>SWD</th>
<th>N</th>
<th>SWA</th>
<th>SA</th>
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<tr>
<td>Harvest dead trees</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Reduce fossil fuel use</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Remove low value trees</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Improve wildlife habitat</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Generate income</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Clean up the forest</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Support local renewable energy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Aid forest regeneration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

4. How often do you or members of your household visit your forestland? Would you say that you or members of your household (READ LIST – RECORD ONE RESPONSE)....
   a. Live on your forestland/visit daily
   b. At least once per week
   c. Monthly
   d. Several times per year
   e. Once per year
   f. Less than once per year
   g. Never
   h. (VOL) Other response (SPECIFY)
Awareness (FLO& GP) – Section 2

5. I’d like to ask you several "yes" or "no" questions.

(Yes) No

(Before taking this survey,) were you aware that trees, also known as biomass, could be used as a renewable energy resource?
Did you know biomass for energy could come from residual products such as tops and branches as well as whole trees?
Are you aware of any biomass harvesting for energy in your area?
Is there a forest products mill (paper, lumber, pellets) located within 100 miles of your forest property?
I have an in-depth understanding of biomass harvesting.
I am familiar Best Management Practices?
I utilize state Best Management Practices on my land

6. Considering all of the possible uses forests provide, which of the following do you feel is most appropriate for their use? (READ LIST – ROTATE – ACCEPT ALL MENTIONS)

Heating
Saw timber for furniture
Saw timber for construction
Paper/pulp
Biofuel
Aesthetics (EXPLAIN)
Clean water
Wildlife habitat
Quality of life
Recreation
(VOL) None of the above

IF MORE THAN ONE MENTIONED, ASK:
(PROGRAMMER NOTE – IF ONLY ONE MENTIONED, FORCE PUNCH Q6a; IF NONE MENTIONED IN Q6, SKIP 6a AND 6b)

4 Questions/statements in yellow are those that were asked of both PFLs and the general public. Those questions/statements not highlighted in yellow were only asked of PFLs.
6a. Which is the most important? (READ THOSE PREVIOUSLY MENTIONED IN Q6 IF HELPFUL)

6b. (If 6a. NOT Biofuel, ASK), How does this (INSERT Q6a ANSWER) compare in importance to biofuel? __More Important ____Less Important ____Same

Biomass Harvesting – Section 3

7. Now I’d like to read you a list of items. As I read each, please indicate whether you think biomass harvesting for energy will have a positive or negative impact on that item. First, (READ ITEM ONE AT A TIME – ROTATE). Do you think biomass harvesting for energy will have a positive or negative impact on (ITEM).

Positive  Negative

The health of your forest

The environment.

Forest aesthetics.

My recreation activities (such as hunting, hiking, bird watching)

Economic impact on communities located near my forestland

8. Now, I’d like to read you a list of statements. As I read each, please tell me if you agree or disagree with the statement. (INTERVIEWER PROBE; IS THAT STRONGLY/SOMewhat AGREE/DISAGREE)

1 = Strongly Disagree
2 = Somewhat Disagree
3 = Neither Agree nor Disagree
4 = Somewhat Agree
5 = Strongly Agree
9 = Don’t Know/No Opinion

SD  SWD  N  SWA  SA

If possible, I would harvest biomass for energy from my land.

I would only harvest residual material for energy after my timber has been harvested for other products.

I would not harvest biomass if pulpwood is more valuable.

It is possible to simultaneously harvest multiple forest products, including biomass for bioenergy

Some material should remain in the site if biomass is harvested for energy

Best Management Practices can mitigate the potential negative impacts of biomass harvesting on my property
9a. In general, how often do you listen to each of the following when considering management activities for your forestland? Do you “OFTEN”, “SOMETIMES” OR “NEVER” listen to (READ ITEM) when considering management activities for your forestland?
9b. Regarding energy biomass, how often do you listen to (READ ITEM)? Would you say “MORE THAN ONCE”, “ONCE”, OR “NEVER”?

<table>
<thead>
<tr>
<th>Q9a. -- In general</th>
<th>Q9b -- Regarding energy biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>County extension agents</td>
<td>Never</td>
</tr>
<tr>
<td>Forestry consultants</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Loggers</td>
<td>Often</td>
</tr>
<tr>
<td>Agency personnel (local, state, or federal)</td>
<td>Never</td>
</tr>
<tr>
<td>Forest industry personnel</td>
<td>Once</td>
</tr>
<tr>
<td>News media</td>
<td>More than once</td>
</tr>
<tr>
<td>Friends or Family</td>
<td></td>
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</tbody>
</table>

10. Are you a member of a local forest landowner organization? ____ YES  ____ No
Conservation Values (FLO& GP) – Section 5

11. Our next question is an interesting one. I want to get a sense of how closely you believe that “YOU” overlap with “NATURE”. Nature includes animate objects (like plants and animals) and inanimate objects (like streams, the atmosphere, and landscapes). Now, using a scale of ZERO (0) to 100, where ZERO means “not at all” and 100 means “perfectly/totally”; How much do you believe “YOU” and “NATURE” overlap.

12. Now, using a scale of one to ten, where 1 means VERY UNIMPORTANT AND 10 means VERY IMPORTANT, how important are the following issues to you? (READ ITEMS – ROTATE)
ITEM | VERY IMPORTANT | VERY UNIMPORTANT
--- | --- | ---
Access to clean drinking water | 1 2 3 4 5 6 7 8 9 10 |  
Protecting recreation | 1 2 3 4 5 6 7 8 9 10 |  
Forest health | 1 2 3 4 5 6 7 8 9 10 |  
Retirement security | 1 2 3 4 5 6 7 8 9 10 |  
Timber production | 1 2 3 4 5 6 7 8 9 10 |  
College tuition | 1 2 3 4 5 6 7 8 9 10 |  
Protecting hunting opportunities | 1 2 3 4 5 6 7 8 9 10 |  
Wind power generation | 1 2 3 4 5 6 7 8 9 10 |  
Protecting ground water | 1 2 3 4 5 6 7 8 9 10 |  
Health care costs | 1 2 3 4 5 6 7 8 9 10 |  
Renewable wood resources | 1 2 3 4 5 6 7 8 9 10 |  
Gas energy development | 1 2 3 4 5 6 7 8 9 10 |  
Family finances | 1 2 3 4 5 6 7 8 9 10 |  
Green space | 1 2 3 4 5 6 7 8 9 10 |  

**Forestland Transfer (FLO) – Section 6**

13. Which of the following best describes your ownership? (READ LIST -- Check only one)
   ___ Individual
   ___ Joint ownership with spouse
   ___ Other joint ownership
   ___ Family partnership
   ___ Trust or estate
   ___ Corporation or business partnership
   ___ Other (please specify): __________________________

14. In what year did you first acquire your forestland? ___ ___ ___ ___ year
   (GET BEST ESTIMATE IF UNSURE)

15. What generation landowner are you? (READ LIST -- RECORD ONE RESPONSE)
16. Now I'll ask you a few simple yes or no questions….

Do you have a written last will and testament?
Have you created an estate plan?
Have you met with an attorney regarding passing on your land?
Have you met with a tax advisor to discuss passing on your land?
Have you established a trust?
Do you have a revocable trust?
Do you have an irrevocable trust?
Have you talked with your heirs about the future of your forestland?

17. Now I am going to read you a list of activities you may have conducted or plan to conduct on your forested property. First I'll ask you if you have EVER conducted the activity; then I'll ask you to indicate how likely you'll be to conduct the activity in the future. The first activity is (READ ACTIVITY). Have you EVER (READ ACTIVITY)? And how likely are you to (READ ACTIVITY) in the future? Would you say likely or unlikely? (INTERVIEWER PROBE: Is that Very or Somewhat Likely/Unlikely?)

1 = Very Unlikely
2 = Somewhat Unlikely
3 = (VOL) Neither Likely or Unlikely
4 = Somewhat Likely
5 = Very Likely
9 = (VOL) Don’t Know/No Opinion

<table>
<thead>
<tr>
<th>(ROTATE)</th>
<th>Yes</th>
<th>No</th>
<th>VU</th>
<th>SU</th>
<th>N</th>
<th>SL</th>
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<tr>
<td>a. Cut and/or remove(d) trees for sale</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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</tbody>
</table>
b. Cut and/or remove(d) trees for your own use

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

c. Collect(ed) non-timber forest products

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

d. Control(led) for Invasive species

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

e. (Done/Plan to do) Road construction or maintenance

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

f. Improve(d) the wildlife habitat

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

g. Livestock grazing

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

h. (Done/Plan to do) trail construction or trail maintenance

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

i. Insect or disease control

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

j. Controlled burn or prescribed fire

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

k. (Sold/Sell) part of your forested property

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

l. Gift part of your forested property

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

m. (ASK LAST) Any thing else?

(please specify):

(please specify):

Background Questions (FLO& GP) – Section 7

Finally, we’d like to ask you a few questions about yourself and your family. All information will be treated confidentially and will never be linked with your name.

D1. In what year were you born? 19___ (year)

D2. (RECORD/CONFIRM) What is your gender?

| ☐ | Male |

| ☐ | Female |

D3. What was the highest grade of school you completed?

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

A. ___ (VOL) None

B. ___ Grade school (8TH Grade or less)

C. ___ Some high school

D. ___ Completed high school or GED or Vocational School

E. ___ Some college

F. ___ Technical school beyond high school/Associates Degree

G. ___ Completed college

H. ___ Graduate/professional school

D4. How long have you lived in your present community? ___ (RECORD NUMBER OF YEARS IN COMMUNITY)
D5. How do you describe yourself politically? Would you say….(READ CHOICES – ALTERNATE READING L to C and C to L)

<table>
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<tr>
<th>Liberal</th>
<th>Moderate Liberal</th>
<th>Moderate</th>
<th>Moderate Conservative</th>
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<tbody>
<tr>
<td>Liberal</td>
<td>Moderate Liberal</td>
<td>Moderate</td>
<td>Moderate Conservative</td>
<td>Conservative</td>
</tr>
</tbody>
</table>

D6. Currently, how many people, INCLUDING YOURSELF, live in your household who are…..?
(RECORD TOTAL NUMBER OF PEOPLE)

- 18 years old or younger? ______
- 19 to 59 years old? ______
- 60 years or older? ______

D6b. Just to confirm, including yourself, there are (SUM) people living in your household?
(CONFIRM YES, OTHERWISE, REVISIT)

D7. What is your current employment status? Are you…. (READ LIST) (SELECT ONE)

- A. ___ Full-time
- B. ___ Part-time
- C. ___ Retired
- D. ___ Student
- E. ___ Homemaker
- F. ___ Non-employed (looking for work or laid off)

D8. Which of the following are current sources of income in your household? (READ LIST – RECORD ALL THAT APPLY)

- A. ___ Wages and/or salary
- B. ___ Income from business
- C. ___ Interest and/or investments
- D. ___ Income from rental properties
- E. ___ Supplemental security income
- F. ___ Other disability benefits
- G. ___ Social Security payments
- H. ___ Retirement pension payments
- I. ___ Unemployment
- J. ___ Food stamps
- K. ___ Public assistance/welfare
- L. ___ Other, please specify: ______________________________
D9. Finally, please stop me when I read the category that best represents the total income of your household -- before taxes last year (2014)? Was it ….

(RIGHT LIST – RECORD ONE ANSWER)

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<td>A.</td>
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<td>B.</td>
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<td>C.</td>
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<td>D.</td>
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<td>E.</td>
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<tr>
<td>F.</td>
<td>___</td>
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<tr>
<td>G.</td>
<td>___</td>
</tr>
<tr>
<td>H.</td>
<td>___</td>
</tr>
<tr>
<td>I.</td>
<td>(VOL) Prefer Not to answer</td>
</tr>
</tbody>
</table>
VITA

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PUBLICATIONS


RECENT PROFESSIONAL PRESENTATIONS

