The Role of Portable Sawmill Microenterprise Adoption in Promoting Rural Community Development and its Application in Small-Scale Forest Management

by

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Abstract

Changes have taken place in the United States economy over the past several years attributable to the overall global economic environment. As a result of the weakened U.S. economy, there is reduced demand for lumber and other wood-based products utilized within the housing market sector. The forest product industry plays a vital role in economic conditions within forest dependent communities, where few opportunities exist outside of forest industrial employment. The current economic climate makes it now more important than ever to develop new and multi-faceted uses for the natural resources that are readily available in forest dependent areas, allowing individuals an additional means to generate income aside from mainstream industry. One possible means for utilizing available natural resources is through forest microenterprises that incorporate the use of portable sawmills.

This research incorporates a mix of surveys and interviews with portable sawmill owners to understand the structure of portable sawmill ownership and microenterprise existence throughout the United States, how portable sawmills are adopted and information about them diffused, and the application of portable sawmills in a forest management strategy, including forging cooperative agreements between portable sawmill owners and Alabama forestland owners. Results of this research illustrate the ways in which forest based microenterprises that utilize portable sawmills offer a means of income generation utilizing available timber resources, as well the ability to be used as

part of a forest management strategy. As a whole, this research is exploratory in nature as it is currently the first in the United States documenting portable sawmill ownership patterns, regional variations, adoption/diffusion of portable sawmill microenterprises, and general entrepreneurial spirit among owners.

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List of Abbreviations

NE	Northeast
NC	North Central
SE	Southeast
SC	South Central
IM	Intermountain
GP	Great Plains
PNW	Pacific Northwest
PSW	Pacific Southwest
FSC	Forest Stewardship Council
cu.ft.	cubic foot
d.b.h.	diameter at breast height
b.f	board foot
USFS	United States Forest Service
NIPF	Non-Industrial Private Forestland
U.S.	United States

INTRODUCTION

The economic climate in the United States (U.S.) is one that is currently very bleak. The U.S. is crippled with the task of trying to recover from economic conditions measurable to few other times in our U.S. history, notably equivalent to the Recession of the 1980's and in some aspects nearing, for a time, to the Great Depression era of the 1930's (Reuters 2008). The current recession was sparked by several events but is largely attributed to subprime and predatory lending practices that spiked between 2004 and 2006. Attributes of these subprime lending practices included reduced standards for obtaining credit, lower to no down payments required, short term interest rate manipulation, and a change in Wall Street investment leveraging of mortgage backed securities (Gwartney et. al 2009, Mayer et. al 2008). Subsequent rising interest rates resulting in a high loan default rate produced a domino effect throughout the U.S. and world economies resulting in several banking institutional collapses by the end of 2008 (CBCNews 2008, Reuters 2008) . The status of the global economy was greatly affected by this disruption as outlined by New Zealand (2009: 10) which notes

> The rapid escalation of the sub-prime lending crisis in the US led to a significant reappraisal of risk and risk appetites throughout the world's financial markets in September 2008. Wholesale funding in capital markets all but evaporated and a "credit crunch" ensued. World output and trade started to fall dramatically as it became evident the world was in the grip of a global economic crisis. Because it started as a credit crisis, the scale and breadth of this recession is likely to be worse than other recessions, and recovery slower.

Within the U.S., subprime and predatory lending practices leading to the overarching global economic crisis, were heavily concentrated in areas containing a high percentage of poverty and often a proportionally high number of minorities, affecting many rural areas in the Southern region of the U.S (Singleton et al. 2006). Singleton (2006:5) notes, "predatory loans diminish the value of homeownership because they strip equity and undermine families' ability to build assets." This attribute not only affects the economy of rural areas, but also diminishes rural quality of life.

The forest industry, primarily located in rural communities, has been greatly affected by what has become a global economic crisis. In particular, the reduced demand for wood and wood products resulting from this credit crunch, which includes the housing market collapse, had a severe impact on the state of the forest industry and forest management throughout the world (FAO 2009, Pepke 2009, CBCNews 2008). The forest industry plays a vital role in socio-economic development, particularly in rural forest dependent communities where little other opportunities exist and the forest and forest products are large attributes to the communities' economic and social values (Schmincke 2008).

The state of current economic conditions identifies an increasing need for the development of opportunities for individuals in these forest dependent communities, as well as others, to take hold of at least part of their economic condition through diversification of their resources, as well as decrease their reliance on large scale industry, at least to a partial extent. One way individuals are doing this is through the development of microenterprises, reliant on already available resources such as timber. This research project explores the utilization of portable sawmill based forest microenterprises in the creation of local opportunities for socio-economic development throughout various regions of the U.S.

This dissertation begins with an exploration of conceptual foundations including systems theory, ecological modernization, natural resource dependency, community development, the theoretical concept of microenterprises, as well as the use of forest microenterprises as a developmental tool worldwide.

Next, a methodological discussion of the process involved in obtaining primary data through both development of a national portable sawmill owner survey, and interviews with portable sawmill owners/entrepreneurs and landowners who might benefit from portable sawmills. Following this conceptual assessment and methodological discussion an overlay of regional forest timber resources and the state of the forest products industry throughout those regions will be discussed.

Finally, an analysis of results of the primary data obtained on portable sawmill ownership/usage is explored including regional and demographic variations of portable sawmill owners, equipment usage, ownership structure and other business and operational aspects, timber species and harvesting practices, and end products created. The adoption and diffusion of portable sawmills is analyzed to help understand how the innovation process began, rates of adoption among portable sawmill owners, and what communication channels are used to convey information about portable sawmills. The last section explores the use of portable sawmills as a tool in forest management strategies or forest based cooperative agreements in Alabama.

This research project took place during a very unique period in U.S. history. It is now more important than ever to explore alternative economic development opportunities to enable individuals and communities to regain some form of control over their economic state. Beyond gaining an understanding of how and why portable sawmill operators use their mills, the purpose of the study was to lay a foundation for Cooperative Extension and other programs to encourage their more widespread use.

CONCEPTUAL FOUNDATIONS

This chapter provides the conceptual foundations utilized to guide this research project. The first foundation discussed includes the contribution of systems theory to understand the concept of community. Next, a discussion of ecological modernization, natural resource dependency, and community development applies a general understanding of systems theory to how societies function as interrelated parts. Microenterprise/forest microenterprise development will be explored as both a concept and in examples of portable sawmill and other small-scale forest microenterprise research in the United States and internationally. Finally, adoption and diffusion theory and its applicability in terms of the adoption of portable sawmills will be explored.

Systems Theory

The gravity of the current state of the global economic crisis resulting from the U.S. housing market collapse illustrates the way in which our global system is completely interrelated and interdependent on one another, a phenomenon that can be better understood in the context of systems theory. The theory defines systems as “an intricate relationship of parts (that) cannot be treated out of the context of the whole” (Ritzer and Goodman 2004:181). Current global economic changes resulting from a change in one part of the society, from a systems theory perspective as described by Parsons (1951), results from our social system existing as a series of subsystems performing specific functions for the larger system (Waters 1994). This concept, expanded by Habermas (1987) recognizes that "the only real systems are the structural responses to…economy, polity, societal community, and fiduciary….reinterpreted in terms of the system/lifeworld couplet…(where) the economy and polity are steering agencies, focused on system integration and organized along the lines of strategic action" (Waters 1994: 163). As our global society functions as a unit, actions taken within various parts of the system can have a large effect on the structure as a whole.

Systems theory has provided three significant contributions to understanding the concept of community. The interaction field of community developed by Kaufman (1959) utilizes community related actions emphasizing people as individual actors producing a nonterritorial view of community linking people with common social attributes that link them to the larger society (Lyon 1987). Likewise macro system dominance, in terms of a move from *gemeinschaft* (centered on the local community) to *gesellschaft* (centered on society as a whole) relationships, has created distinct horizontal as well as vertical systematic linkages both within and between communities and has led to growing dominance of macro systems over local community subsystems. Promotion of both community autonomy as well as greater identification of individuals within a community can be tools to re-strengthen *gemeinschaft* community relationships (Wise 1998, Lyon 1987).

Natural Resource Dependency

Natural resources dependency can both contribute to societal wellbeing as well as be detrimental to its growth. Taken in its most basic form natural resources allow for the availability of water, fresh air, and sunlight. In a more developed form, trees can provide building material for shelter, plants can be utilized to create food a society consumes, and sun light can be harvested to create solar power to provide electricity and energy. Krannich and Luloff (1991: 6) define resource dependent communities as localities where "economic, social, and cultural conditions of community life are intertwined with, and ultimately dependent upon the production of a natural resource commodity."

All resource dependent communities, however, are not the same (Bliss et al. 1998; Brunelle 1990; Marchuk 1990), and the juxtaposition between dependency and development is debated within the literature. A community can obtain wealth when a natural resource is in abundance in a given area, providing that ownership benefits are widely shared and that resources are managed properly to ensure future use. In many cases an economic dependency occurs as a result of resource extraction coupled with economic incentives offered by industry stakeholders to improve schools, infrastructure, etc. (Kaufman and Kaufman 1990). Likewise a resource dependent community can become poverty stricken if a natural resource is used up, an industry relocates leaving residents without a market for their resource, or if structural obstacles systematically prevent growth. This is often defined in the political economy literature as the resource curse, suggesting "a causal link between the inability of an economy to grow and develop in accordance with classical economic growth theory and the abundance of natural resources it possess" (Goohra 2006: 601). Freudenburg (1992) notes, debatably, that extractive industries, such as the forest products industry, are less likely to lead to economic development then they are to addiction due to the incentives that accompany the industry.

Goohra (2006) defines five observations that can explain the inverse relationship that can happen between natural resource abundance and political economic development. First, the concentration on one resource can often lead to an oligopolistic market structure; second, the motivation of the state to take a direct or indirect involvement in management and functioning; third, the relationship that develops between the state and industry to the point where market forces are unable to direct market activity; fourth, the state then focuses on growth in that one sector which in turn impedes economic growth in another or as a whole; and fifth, the resistance to change in political and economic status quo due to the strong hold of both state and industrial interests.

Several examples of natural resource dependency can be found in literature on the timber industry. Weeks (1990) discussed the economic and social consequences that occur as a result of technological modernization within Oregon's forest products industry. Since the 1970's the number of Oregon mills as well as employment numbers within the remaining mills have been on the decline as the result of increased reliance on second growth timber and the higher operating costs associated with it. The economic and social consequences resulting from these structural changes within the industry include issues surrounding out migration, accelerated aging of the population, and decreased support for community institutions and public services. Weeks (1990) discussed the importance of weighing the sides between the benefits from modernization of the forest products industry and the costs of modernization that are felt by residents of affected communities.

Marchak (1990) explored the political economy of the forest products industry in British Columbia and the resource dependency occurring in several timber communities in the region. Here industry holds a powerful role within the communities where few other economic opportunities exist. The cyclical nature of the timber industry has a great impact on communities dependent on timber and local people are left with little control over issues surrounding the communities.

In the Pacific Northwest, structural changes within the industry and industrial response to such economic and technological forces have transformed the nature of timber dependency throughout the region. Where older technological mills have closed leaving residents with limited options, newer technology mills have increased capacity, employment, and extraction activities. Both older and newer technology mills can yield a timber dependency within the region, however, in different ways and in varying degrees (Brunelle 1990).

Likewise structural variance in forest dependency can occur within one state. Bliss et al. (1998) explored two forest dependent counties within Alabama, their historical patterns of development, resource ownership patterns, social organization, and the structure of the forest sector itself. The importance of this study illustrated the conclusion that all resource dependent areas are not the same This article expanded the argument of Brunelle (1990) to suggest that sustainable development is more than economic growth in that it requires expanding opportunities for residents of a timber dependent area and then protecting the natural resource base that the opportunities are built on (Bliss et al. 1998). This conceptually runs parallel to the ecological modernization argument in that it calls for a need to achieve development through the combination of economic growth and natural resource protection in tandem.

As these studies suggest, it is important to find additional revenue streams within resource dependent areas to ensure diversified means to economic development, while promoting sustainability within these communities. As outlined above, often for those residents of natural resource dependent communities, structural and political obstacles play a major role in the level of development. Bliss et al. (1998) note that site specific development strategies are needed, recognizing the political and social structure of a given resource dependent area. Development strategies that combine environmentally sustainable and economic growth strategies within forestry can be successful, but according to Bliss et al. (1998:30),

> only if we are aware of the impacts our policies and practices have on the economic, social, and environmental wellbeing of rural communities. Whether America's forests foster dependency or development will, in part, reflect our understanding of those impacts and our willingness to address them.

Ecological Modernization

Ecological modernization theory originated in the 1980s with its proponents arguing for "the need to transcend the ecology-economy divide internalizing 'external costs' into the functions of the market and the economy in general" (Mol et al. 2009). Evolving in the mid-1990s into its current form, ecological modernization explores ecological and economic relationships utilizing a global perspective (Mol and Janicke 2009).

Several important contributions come from ecological modernization theory, with the most important described by Spaagaren et al. (2009:503) being "its ability to provide a systematic theoretical framework for integrating social science scholarship and policy perspectives on the ways in which contemporary societies interact and deal with their biophysical environments." The theory views the resolution to ecological crises as being compatible with the advance of technological innovations and industrial development, with political modernization, development of market based instruments, and ecological rationalization in the lead (Fisher and Freudenburg 2001, Spaagaren et al. 2009). Spaagaren and Cohen (2009) note that technology shapes both social systems and their environmental performances in particularly decisive and fundamental ways. Ecological modernization theory brings forth the globalized nature and effect of this on both social systems and subsequently ecological change (Spaagaren 2009).

Two important components of ecological modernization focus on the political and economic feasibility of this process and note the need for adequate market dynamics and entrepreneurial agents to take a leading role in ecological changes, with supporting coalitions brought about through political and economic actors (Fisher and Freudenburg 2001, Mol and Janicke 2009, Huber 2009). Ecological modernization theory works within the modernity paradigm and current market economy without imposing a revolutionary systems ideology (Mol and Janicke 2009). Mol and Janicke (2009:24) note

> Consequently, many mainstream ecological modernization theorists today interpret capitalism neither as an essential precondition for, nor as the key obstruction against, stringent or radical environmental reform. They focus rather on redirecting and transforming 'free market Capitalism' in such a way that it less and less obstructs, and increasingly contributes to, the preservation of society's sustenance base in a fundamental/structural way.

Ecological modernization theory correlates with systems theory in that in order for ecological crises to be resolved, the power structures have to determine that remedying any ecological crisis needs to be a main facet of their technological and industrial development goals. Following the same logic of systems theory, ecologically sound development strategies should have a positive ecological effect at local, national, and international levels.

Fisher and Freudenburg (2001: 704) recognize one component in the theoretical debate on ecological modernization is that it "differ(s) sharply from most established bodies of social thought, claiming that environmental improvement can take place in tandem with economic growth." Critics of ecological modernization theory focus on the need to think in different ways in regard to ecological issues and re-evaluate the production systems as a whole in a more modern and rational manner with an identifiable set of postulates (Giddens 1998, Buttel 2009). Fisher and Freudenburg (2001) present a challenge toward the scientific community in identifying specific conditions where ecological modernization is likely to occur, or not.

An example of a modern technology that is congruent to ecological modernization is a portable sawmill. Portable sawmills represent a type of technology designed to meet certain needs in local communities and throughout the larger society by filling niche markets supplying wood based products often outside of mainstream industry, as well as providing a tool in forest management strategies. They meet these and other needs in an ecologically sustainable manner, in turn meeting human needs.

Community Development

The concept of community development has varied in its ideological foundations since its onset. The original goals of community development initiatives were often to modernize rural and other isolated communities. However, mid 20th century discourse in community development shifted its general ideology to combat the effects of modernization through the organization of localities in pursuit of common goals (Lyon 1987). As defined by Theodori (2005: 665) community development is "a process of building and strengthening the community."

The structure of community development programs can take varying forms. Its application generally follows the path of promoting self-help within a community often in an attempt to re-establish *gemeinschaft* (community-centered social relations), offering technical assistance in a vertically oriented top down development structure increasingly seen in g*esellschaft* (society-wide social relations) or a conflict based community development initiative where the agent initiating change seeks to remedy injustices in the current community structure (Lyon 1987, Tonnies 1957). The extent and approach to community development needs to be based upon the power structure that exists in each locality.

Community power is a multidimensional phenomenon and the structures of communities vary substantially based on the distribution of local power (Lyon 1987). Often in resource dependent communities, much of the power structure is in the hands of local elites including industrial stakeholders. According to Korten (1992), many community development initiatives failed to recognize the development of power in communities and as a result did little to change the power structure, despite an emphasized need to empower local leadership within a community. Likewise the structure of community power will play a large role in ecological modernization, meaning the ability for a community and/or society to move toward ecologically sound sustainability goals is, in large part, dependent upon the goals of the elite power structure engaged in industrial recruitment and other economic development initiatives.

It is important to provide multi-faceted opportunities in resource dependent communities to promote steps toward economic sustainability to shift the power structure back into the hands of rural residents in resource dependent regions. One method is achieving economic sustainability through entrepreneurial activities within the local community. Flora (2006: 2) notes that in the promotion of enterprise development, community based strategies can be effective if they “1) take a systems approach to enterprise and community development, 2) customize the enterprise development for each community, 3) focus on developing entrepreneurs, 4) develop new roles, skills, and tools within the community, 5) operate as a transformational business.”

Despite the inverse relationship previously outlined by Goohra (2006) between natural resource abundance and political economic development, Goohra (2006: 607) also acknowledges the counterargument that natural resources can “provide an impetus for economic growth.” Steps must be taken to increase the versatility of resource dependent communities to allow for multiple uses of both land and materials. By creating local opportunities for rural residents outside of mainstream industry it then becomes possible for residents and community to work toward goals of maintaining ecological sustainability while enhancing or creating new revenue streams to increase or at least maintain their socioeconomic position in the larger market.

Microenterprises

Huber (2009) identifies that there are opportunities available for entrepreneurs to contribute to ecological modernization while increasing their market and competition position. Opportunities exist in opening new market niches and consumer groups, in cost savings by utilizing fewer resources and less energy thereby reducing an environmental burden. Microenterprises can add valuable resources to the larger society by filling important market niches often outside the scope of mainstream industry. In doing so, microenterprises create opportunities for people who are marginalized by conventional labor. There are two schools of thought categorizing people who enter into microenterprises. Orlando and Pollock (2003:3) note

> The first one considers workers in the MIC [microenterprise] sector as either underemployed or surplus labor. These workers cannot find a job in the formal sector due to their low skills and general unemployability (underemployment view). The second view focuses on the fact that some workers *choose* this sector for its flexibility and earnings opportunities (microentrepreneur view).

Microenterprise developers would greatly benefit from any form of policies assisting the creation of their small business ventures. However, Ssewamala, Lombe, and Curley (2006:1) found "that overall there is a considerable level of interest in saving for and investing in small-businesses among poor Americans, including those who are less advantaged in terms of income, poverty, and employment." Therefore micro-entrepreneurial assistance could be beneficial in giving disadvantaged members of society the assistance they need to become successful.

Forest Microenterprises

Salafsky (1997) notes the importance of forest microenterprises in enhancing community development efforts as well as forest conservation goals. As a result empowering local people to enhance their own income as well as manage their resources (Salafsky 1997). In the forest products industry, specifically in small-scale timber harvesting and processing, microenterprises exist throughout the world, often satisfying valuable niches.

Small-scale timber harvesting can serve as a useful operation in areas outside of "mainstream" forestry operations, in niche market areas, at the urban interface, or in areas where large machinery would have the potential to diminish the integrity of the forest. Wooded lots can also be developed using small-scale equipment to create room for housing at minimal cost to both the landowner and developer, causing minimal environmental damage (Updegraff and Blinn 2000). In addition, often landowners are also interested in land improvements for recreation and wildlife purposes and for improving aesthetics (Updegraff and Blinn 2000).

Portable Sawmill and Other Small-Scale Forest Microenterprise Research in the United States

One potential opportunity to develop a microenterprise is through utilizing portable sawmills both to sell lumber as well as to build finished products utilizing that lumber. Portable sawmills are relatively inexpensive in the larger scheme of harvesting and processing technologies and can be purchased for use on a small-scale level. Small-scale equipment is sometimes seen by landowners as more environmentally friendly, and is often the only type of operation that is economically feasible to harvest small tract sizes due to lower operating costs compared to conventional, larger-scale technologies (Updegraff and Blinn 2000). In addition, utilizing small-scale forestry equipment offers advantages over larger scale machinery on uneven-aged managed forestland, on smaller tracts, in specialized markets, as well as offering lower levels of residual soil damage

(Updegraff and Blinn 2000). Other small-scale harvesting equipment that can be utilized with portable sawmills include tractors, boom harvesters, cable yarding systems, small excavators, and others (Updegraff and Blinn 2000).

Portable sawmills can benefit both operator and landowner. Landowners can purchase their own portable sawmill for use on their own land. Likewise, a portable sawmill can be used as a tool to forge a partnership between operator and landowner providing an entrepreneurial opportunity for the portable sawmill owner, and an additional forest management opportunity for the landowner.

Under certain conditions, portable sawmills are relatively inexpensive and cost effective ways for processing harvested logs. There are several models, brands and designs of portable sawmills currently on the market. They can be purchased used or new, and pricing ranges from a couple hundred dollars for portable sawmills using chainsaws as the blade of the mill, to over forty thousand dollars for more complex designs that contain computerized systems or hydraulics. Portable sawmills are very popular in developing countries. Venn et al. (2004: 163) note,

> Portable sawmills are considered to have several advantages over fixed-site mills, including reducing or eliminating log transport costs, being capable of handling small and odd-shaped logs with minimal re-setting of equipment, increasing sawn timber recovery from the log, allowing milling to be undertaken by small teams or even a single person, and offering a low setup cost and low-technology entry point into the timber industry.

In the past, issues such as high insurance costs, as well as safety hazards and rising labor costs had lead to a decline in small-scale operations around the United States (Updegraff and Blinn 2000). Currently small-scale harvesting operations are more prevalent on the east coast of the U.S. as opposed to the mid-west or west coast

(Updegraff and Blinn 2000). Several states offer a list of portable sawmill owners and some potential opportunities utilizing portable sawmills through their respective Extension programs. However, there is currently no published research documenting portable sawmill ownership as a whole throughout the U.S., or regional variation among ownership.

People who use portable sawmills seem to share a common set of interests and values and interact through online portable sawmilling forums. Portable sawmills owners often state that "*saw dust gets into your blood and becomes a part of who you are*." Utilizing a portable sawmill to develop a microenterprise can not only provide individuals with increased income potential, it can enable an increased sense of pride and self identity.

There is little research documenting small-scale harvesting and processing operations in the U.S. and no research documenting portable sawmill operations as a whole throughout the U.S. Research has begun at the Shenandoah Valley Agricultural Research and Extension Center, the Maryland Forest Service, Alaska's Kenai Peninsula, Alabama, and Vermont. Jensen and Visser (n.d.) created a research trial at the Shenandoah Valley Agricultural Research and Extension Center mimicking a small-scale timber harvesting operation on an Appalachian hardwood stand. They note the importance of pre-harvest planning with skid trails as well as directional felling. Their research found that small forestland owners value factors such as wildlife, aesthetics, and providing a low ecological impact much more than they value timber production. Jensen and Visser (n.d: 6) state

> Focusing on meeting the landowner's objectives and adjusting the fee structure accordingly, helps to take some of the pressure for high production off of the harvesting system. With the incentive to increase production removed, the operator can focus on reducing residual stand damage and the overall impact of the harvesting operation.

Oftentimes when a forest is managed for recreation and wildlife, recreational trails are cut and cabins are built. The timber that is cleared typically goes unused. A portable sawmill can be utilized to process timber from cutting trails or other small-scale thinning and either generate revenue to fund further land improvements or actually build a cabin or other outbuilding.

The Maryland Forest Service recently tested the feasibility of small-scale harvesting systems and their potential benefits in U.S. markets. Their project was called the Working Woodlot Initiative (2006) and had the primary objective of gathering information about the marketability of forest products from small parcels. They are also focusing on the social acceptance and economic feasibility of small-scale harvesting.

In Alaska, the Kenai Peninsula's harvesting activities focus mainly on small-scale production for local use. With the increase of spruce bark beetle infestations, beetle-killed timber has been used to produce house logs as well as dimensional lumber. However, larger operations have now followed small-scale systems to chip and export the infested wood, limiting future small-scale opportunities (State of Alaska 2007).

Parts of Alabama utilize animal powered logging to fill important harvesting niches (Toms et al. 1998). Successful horse and mule logging operations were found ranging from one acre to several hundred acres producing about 6500 tons of wood per year (Toms et al. 1998). In 1998 there were 33 successful animal logging operations in Alabama. Trees are initially felled with a chainsaw and animals take the place of a mechanized skidding operation (Toms et al. 1998). Animal logging is used in Alabama not to compete with mechanized harvesting, rather to fill a niche in areas where mechanized harvesting would either be considered too dangerous due to steep terrain, or where mechanized operations would not be economical (Toms et al. 1998).

Vermont has about 800 small-scale independent logging businesses and more than 95% of the Vermont forest products industry is made up of small businesses having a large impact on the economy of the state (Bosquet 2002). Although small-scale forestry makes up a large part of the forest product economy in Vermont, literature examining these successful enterprises was not available.

International Small-scale Forestry Operations and their Applicability to Successful Portable Sawmill Microenterprise Development in the U.S.

To augment the limited amount of research focusing on small-scale timber harvesting and processing trends and their application in the U.S., we also have access to international case studies. This literature has tended to focus on socio-economic impacts. Some international programs take place in impoverished areas similar to areas around the U.S., especially in the southeastern U.S, and have the potential to promote socioeconomic improvements in those areas through the implementation of extension services to promote small-scale microenterprise opportunities. International trends in small-scale forestry demonstrate the need for government to play an instrumental role in facilitating both the initial and continued success of small-scale forestry operations through subsidies and various other programs.

In Papua New Guinea, the European Union set up a support network to encourage small business ventures in the forest products industry, offering a step by step program to walk residents through the process of starting a forest based microenterprise (Salafsky et al. 1997). The overall program's main goals were to promote village based eco-forestry involving sawmilling and harvesting, marketing their processed forest products, manage activities such as insect farming and ecotourism, and promote environmental awareness and conservation (Salafsky et al. 1997). In this case, the government actually provides chainsaws as well as a portable sawmill for local landowners to share as well as training and assistance in purchasing additional equipment needed. There currently are six successful small-scale timber harvesting programs in the area (Salafsky et al. 1997).

Under the same program, a project in West Kalimantan, Indonesia has been able to develop successful community based timber harvesting programs. Salafsky et al. (1997) notes the introduction of a small-scale harvesting enterprise "to combat the threat posed by illegal industrial and hand logging, and to create a more equitable system of resource use." The program began in 1998, taking over an 8000 hectare government owned swamp forest site (Salafsky et al. 1997). The trees were cut and rafted down the river to the local village where it is processed, loaded on ships, and exported to both domestic markets and to international "green markets" throughout Europe (Salafsky et al. 1997). Currently, two of the enterprises are certified by the Forest Stewardship Council allowing them to obtain a premium price for their wood. People in this area are willing to work harder for less money due to limited employment opportunities in the area, which also contributes to its success (Salafsky et al. 1997).

In addition to governmental backing of small-scale forest microenterprises, Alhojarvi (2001) suggests international funding of such enterprises through organizations like the World Bank, branches of the United Nations and the International Labor Organization can be of great value. Hermelin (2001) suggests that small-scale harvesting operations need to be viewed from the perspective of being a Rural Business Enterprise with three main resources at its disposal human resources, business and stewardship resources, and natural resources. Although there is a completely different economic and social structure in these two areas when compared to the U.S., if local or national governments would get involved to offer assistance similar to that seen in Papua New Guinea or West Kalimantan, Indonesia, to resource dependent areas within the U.S., more entrepreneurial activities could be established both for selling harvested timber, as well as for utilizing harvested timber to create better housing and other infrastructure in these areas. Financial support for small-scale forest microenterprises, would help small-scale enterprises enter niche markets largely ignored by large corporations, such as becoming certified through the Forest Stewardship Council (FSC) for entrance into the "green market" similar to what was done in Indonesia (Salafsky et al. 1997). Harvesting and wood processing microenterprises could be established in the U.S. striving for a similar goal of breaking into the "green market" through FSC certification, or entering other potential niche markets needed in the region.

Alternative models, such as the concept of farm forests are very popular in many Scandinavian countries and some are owned through local farm forest cooperatives which both supply timber to industry as well as local roadside timber markets. Russell and Mortimer (2005: 7-8), note that

> forestry is part of the culture in Scandinavian countries, with owner involvement in all aspects of silviculture, from planting to weeding, tending and pruning, as well as harvesting…. [and] demonstrates the ability of small-scale forestry to supply internationally competitive industries with large volumes of wood using highly developed harvesting transport and marketing systems.

Similar to Scandinavian countries, Australia also has forest farms both on a large monocultural level and also on a small-scale level. Herbohn (2001:16) notes that "the past dominance of the state as a major timber supplier also led to perceptions in some sections of the rural community that forestry is only an activity appropriate for governments and corporations." Small-scale harvesting in Australia is in a very early stage of development as the majority of harvesting operations there have always focused on industrial sized projects.

Venn et al. (2004) conducted studies in Western Queensland of local portable sawmill trials in hopes to estimate costs associated with the process as well as its viability. They found that portable sawmill operations can help to diversify a farm business with little initial capital investment, increasing the overall value of lands owned by farmers especially in high value niche markets. They note "however, high costs of production mean that the financial viability of portable sawmilling operations is likely to depend on development of low-volume, high-value niche markets, where buyers are willing to pay a premium for the unique properties of these timbers" (Venn et al. 2004:173).

There are several options for small-scale entrepreneurs utilizing the concept of forest farms. In the U.S., small-scale enterprises can own and operate their own private woodlots as is also the case in many Scandinavian countries and throughout parts of Australia (Russell and Mortimer 2005). Similar to Scandinavian and Australian forest farms, parts of Canada have developed programs in support of forest tenant farming. A small-scale entrepreneur can become a tenant forest farmer if they do not have their own forest land to harvest (Russell and Mortimer 2005). Masse (2001:120) notes that forest tenant farming is the "allocation of a unit of land to an individual, called a forest tenant farmer, who agrees to manage it in a sustainable manner and to share the ensuing revenues with the landowner." Masse (2001) outlined the main objectives under the forest tenant farming system which includes fostering entrepreneurial opportunities, create wealth in rural communities, developing an exportable model, and place a greater value on forest work. Often there is a contract established between the landowner and the tenant, where stumpage fees may serve as rent, and can include other aspects in addition to logging, such as recreational management, etc. (Masse 2001). Several government agencies and forest consultants have developed publications offering assistance in small-scale harvesting and most published literature focuses on appropriate equipment use (Small Woodlands Program of BC 2002, Williams 2002). Mitchell-Banks (2001:48) notes, "small-scale operators are beginning to discover that there is strength in numbers, so associations are growing in both size and number."

Tenant forest farming in Canada has generated a substantial savings by engaging a workforce equivalent in the U.S. to those on welfare or unemployment insurance. There 88% of the tenant farmers were drawing government subsidies before starting the program. Masse (2001:124) notes a high job satisfaction rate among the tenant farmers and "especially appreciated the opportunity to work near their homes, their relations with their employer, the safety of their jobs, and the training opportunities offered to them. As a general rule, they considered their jobs superior to other forest jobs that were available in their region." Tenant forest farming also offers several advantages such as diversification of public land tenure, flexibility of application, a combination of community based and entrepreneurial approaches, as well as improved social atmosphere (Masse 2001:126). Masse (2001:127) explores the socio-economic viability of this program and concludes,

> Tenant farms are viable enterprises that will continue to derive their profits primarily from wood production in the medium term. General supervision and technical support costs reflect the characteristic of the model and are similar to those incurred by forest group ventures operating in Quebec private forests. The socio-economic benefits of tenant farming are tangible and are concentrated at the local and regional levels. The potential for extending the model is good, particularly to public forests located near municipalities.

There appears to be great potential in adopting portable sawmilling as a microenterprise opportunity if market conditions and government intervention, either through proper Cooperative Extension programming or rural small business development opportunities, could enable its success. The next step is to understand the concept of adoption/diffusion within the literature as a basis for understanding how technologies are adopted and later diffused throughout a community.

Adoption and Diffusion

When attempting to introduce any new technology or process into a community, it is important to understand how people obtain information about, respond to, and adopt or reject the innovation. This is known as the adoption and diffusion of innovations. Rogers (1995:11) defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption." There is little importance given to whether the innovation is actually or objectively new, it matters only if the innovation is perceived as new to the individual. Rogers (1995: 11) continues in describing that "newness in an innovation need not just involve new knowledge. Someone may have known about an innovation for some time but not yet developed a favorable or unfavorable attitude toward it, nor have adopted or rejected it. "Newness" of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt."

Therefore a new technology or innovation need not be actually new, instead the technology can be new in the eyes of the adopter, but not necessarily new to society. It is in this sense that adoption theory is applicable to this study of portable sawmill microenterprises and adds to the literature on the adoption/diffusion model. Portable sawmills are not a new technology, instead the implementation of the use of portable sawmills or other small-scale harvesting and processing technologies to diversify the economies of forest dependent communities might be new to residents who have few other options available to them. Downs and Mohr (1976) note the importance of postulating multiple theories of the adoption and diffusion of innovations based on the varying attributes of the innovations themselves. Korsching et al. (2003: 390) note "the key is to identify types of innovations that are on some characteristic theoretically distinct."

Historical Significance of Adoption/Diffusion Research

Adoption/diffusion research has historical origins as an independent multi-disciplinary effort undertaken originally in the early 1900s by European social science research, specifically with the work of Gabriel Tarde (1903) who found that the rate of adoption followed the S-shaped curve, where individuals learn a new innovation by imitating or copying someone else's adoption behavior and do so slowly at first, with more and more following after the first adopters (Rogers 1995).

Beginning in the 1920s American anthropologists began to investigate the ideas behind the adoption/diffusion of innovations, shortly followed by early sociologists, rural sociologists, as well as researchers from education, public health fields, communications, marketing and management, geography, general sociologists, economists, as well as other disciplines (Rogers 1995). Interestingly, even the adoption/diffusion of adoption/diffusion research itself followed an S shaped curve based on the cumulative number of diffusion publications from 1940 to 1996, with the field of rural sociology producing the largest number of diffusion studies.

Rogers (1995: 53) notes, "diffusion research (in rural sociology) provided helpful leads to agricultural researchers about how to get their scientific results put into use by farmers. Diffusion research was greatly appreciated by extension service workers, who depend on the agricultural diffusion model as the main theory guiding their efforts to transfer new agricultural technologies to farmers." The application of current adoption/diffusion theory is rooted in the results of one of the most influential adoption/diffusion studies in rural sociology- the Ryan and Gross (1943) hybrid corn study, followed by an Iowa Extension publication in 1950.

As a result of this influential adoption diffusion study, four main aspects of the adoption/diffusion paradigm emerged (Rogers 1995):

1) how the innovation process begins for an individual farmer,
2) the role and channels of communication to convey the new innovation,
3) time, as defined by the S shaped rate of adoption,
4) the socioeconomic characteristics of various adopter categories

Ryan and Gross (1943) found that while original sources of knowledge on the innovation were primarily from salespeople, it was personal contact with neighbors that were the most influential sources of knowledge. In addition, they found the major hindrance to adoption of new innovation as lack of economic resources to do so. Ryan and Gross (1943: 17) noted "the preliminary stages of diffusion were somewhat slower in terms of adoption than in knowledge." They noted that the average length of time between the diffusion of knowledge to its actual adoption is approximately five years.

> In addition to structuring the diffusion paradigm theoretically, the Ryan and Gross hybrid corn study also established a prototypical methodology for conducting diffusion investigations: one shot survey interviews with the adopter of innovation, who are asked to recall their behavior and decisions regarding the innovation. Thus, the typical research design for studying diffusion was established in 1941. It has lived on, with only certain modifications, to the present day (Rogers 1995:55).

Ryan and Gross's (1943) study on the adoption and diffusion of hybrid corn reflects the adoption of a new technology that fundamentally changed farming practices. This is conceptually very different than the adoption and diffusion of small-scale forest technologies, such as portable sawmills, in that there is not an expectation that all, or even a majority, of people will adopt this technology. The fundamental objective in utilizing adoption/diffusion theory in this research is to try to identify both adoption and diffusion characteristics of portable sawmill adopters using the traditional framework developed by Ryan and Gross and expanded by others in the contemporary adoption literature, in order to identify and subsequently target appropriate extension services to those who might benefit from utilizing this technology.

Contemporary Diffusion and Adoption Research

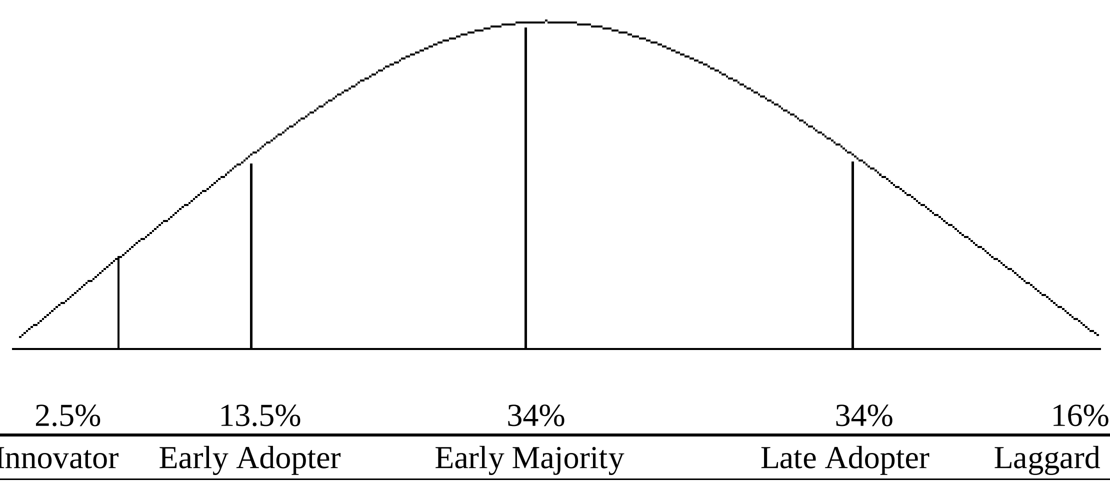
Eight main types of diffusion research that have emerged as a result of the multidisciplinary efforts on adoption diffusion studies are 1) timing of innovation knowledge, 2) rate of adoption of various innovations in a social system, 3) innovativeness, 4) opinion leadership, 5) diffusion networks, 6) rate of adoption in different social systems, 7) communication channels that are used, and 8) the consequences of adopting the innovation (Rogers 1995). Contemporary adoption/diffusion research focused on identifying specific variables describing innovation adopters, categorizing those adopter variables, as well as socioeconomic differences in various adopter groups. The innovative ability of an individual is a large contributing factor in explaining the adoption of new technologies, it does not explain the technology's diffusion throughout societies (Wozniak 1984). Rogers (1995:5-6) defines diffusion as

> the process by which an innovation is communicated through certain channels over time among the members of a social system….diffusion is a kind of social change, defined as the process by which alteration occurs in the structure and function of the social system. When new ideas are invented, diffused, and are adopted or rejected, leading to certain consequences, social change occurs.

Rogers (1995) identified five categories of adopters within the innovation design process defined as innovators, early adopters, early majority, late majority, and laggards. Each of these categories of adopters undergoes a process of obtaining knowledge about an innovation, forming a favorable or unfavorable attitude toward it, a decision to actually adopt or reject the innovation, implementing the innovation into their lives, and confirmation seeking to reinforce their decision to adopt the innovation.

Regarding the rate of adoption, Rogers (1995) notes that innovators who can be characterized as venturesome and/or even obsessed with innovation make up 2.5% of the population, early adopters who serve as a role model for other members of a social system account for 13.5%, early majority who often deliberate adoption of new ideas comprised 34%, late majority who are often skeptical of adopting new ideas make up 34%, and laggards who are last in the social system to adopt and innovation and possess almost no opinion leadership make up 16% of adopters [Figure 2.1]. Regarding personality variables, Rogers (1995) notes that early adopters have greater rationality, less dogmatism, greater empathy, less fatalism, and a more favorable attitude toward change than later adopter categories. Finally, early adopters have different communicative behaviors such as more social participation, more highly connected interpersonal networks, have a greater knowledge of innovations, and engage in more active information seeking behaviors (Rogers 1995).

Figure 2.1: Rogers (1995) Rate of Adoption Model



In addition to their rate of adoption, early adopters differ in socioeconomic status. They normally have higher levels of formal education than later adopters, have a higher socioeconomic status, a greater degree of upward social mobility, but are not different in age as compared to later adopters. In addition, Wozniak (1984) found that the more education an individual has, the more likely they are to be adopters. In addition, Fliegel and Kivlin (1966) note that "for populations characterized by lower levels of education and less contact with urban society, the complexity of innovations would be a more important factor in adoption decisions. To the extent that portable sawmills are a technology with rural roots, this finding may be of importance to the current study.

Rogers (1995:94) noted that "the paradigm also imposes and standardizes a set of assumptions and conceptual biases that, once begun, are difficult to recognize and overcome. That is the challenge for the next generation of diffusion scholars." In this regard, Wozniak (1984) found that larger scale producers are more likely to be adopters than smaller scales of producers. An interesting variable in Wozniak's (1984) study was the frequency of contact with agricultural extension information sources in adopting new technologies. The study found that increases in contact with extension information about new sources of innovation increased the probability of adoption to a larger extent than other sources of information. Likewise, those who have previously adopted innovations in a given area are more likely to adopt a new innovation, suggesting that "innovations that can be implemented along with currently utilized inputs are more likely to be adopted than those innovations which would displace currently utilized inputs" (Wozniak 1984: 77). This point is an important connection in the introduction of alternative means of income generation, portable sawmill based microenterprises, utilizing a resource familiar and integrated into rural forest dependent communities, in this case timber.

The conceptual framework outlining the adoption/diffusion theory has applicability in the innovation, development, and implementation of portable sawmill microenterprises insofar as it can define criteria and develop the schematic framework for introducing microenterprise development initiatives to the societal subgroup with which it hopes to invoke change. This literature also suggests the important role that Extension can play in promoting adoption of a technology such as portable sawmills.

Summary

Systems theory details the ways in which society can be analyzed as a system. Through a systems theory approach, changes in one part of the system have subsequent effects on other parts. This in turn affects the structure of the whole given the interrelated nature of the system.

The dynamic nature of our social systems leads to an abundance of needs. In meeting those needs we often generate waste and subsequently new problems emerge. Additional problems evolve from technological and organizational structures driven by large corporations dominated by cultural forces driving to expand production and profits.

Ecological modernization theory suggests that technological and cultural shifts can help to address these problems. Smaller scale technologies are designed to meet local needs rather than corporate needs and often have a smaller ecological footprint. Portable sawmills are an example of a small-scale technology. Resource dependency is often described as a pathology, but it need not always be so. While dependency can occur from a community's reliance on a natural resource for its livelihood, development can occur if that resource is managed properly in a de-centralized power structure where multiple opportunities to generate development exist. Ecological modernization theory suggests that development can occur in tandem with positive ecological changes, provided the power structures place a value on sustainability.

Community development involves positive change. Small-scale forest microenterprises can serve as a means to community development by offering an additional income generating opportunity for residents in forest dependent communities. Forest microenterprises utilizing portable sawmills can contribute to both community development and can be utilized as a tool in forest management objectives. Examples of its success suggest that extension and other program efforts can be helpful in developing forest microenterprises incorporating the use of portable sawmills.

Adopting forest based technologies, such as portable sawmills, can benefit microenterprises, entrepreneurs, and increase opportunities for community development by increasing opportunities for those in forest dependent communities. In addition, residents of those communities can take an active entrepreneurial role in sustainable development of both their economic welfare as well as the ecological state of their forest resources, as described in ecological modernization theory. If the innovation is then diffused through a community or the larger society and social change occurs then the benefits of those changes can been felt throughout the larger local social structure due to its interrelated parts as described through systems theory. Adoption and diffusion research provides the basis for understanding the process by which a new technology is accepted. Understanding the way in which portable sawmill microenterprises are adopted and diffused is helpful in implementing extension or other program efforts within communities to aid in development efforts.

METHODS

This research explores the idea of utilizing portable sawmills as a potential microenterprise opportunity based on a national survey of portable sawmill owners and follow up interviews with portable sawmill owners to explore methods of adoption and diffusion of portable sawmill microenterprises. Alabama landowners were also surveyed and interviewed to explore the application of portable sawmills into a cooperative agreement among landowners and portable sawmill owners. As a whole, this research is exploratory in nature as it is currently the first in the U.S. documenting portable sawmill ownership patterns, regional variations, adoption/diffusion of portable sawmill microenterprises, and general entrepreneurial spirit among owners.

The methodology of this project combined a mix of surveys and personal interviews beginning with exploratory interviews with portable sawmill manufacturers to obtain basic information about portable sawmills such as how they operate, who their customers are, expertise involved in running a mill, among other things detailed below. Upon completion of these exploratory interviews, an exploratory web survey was conducted to obtain information on portable sawmill owners, ownership structure, products created and other information. The data obtained during the web survey were used as a basis for developing a national portable sawmill mail survey distributed on a much larger scale throughout the U.S. Once the mail survey was completed, personal interviews were conducted with portable sawmill operators as both a follow-up to the mail survey as well as a way to obtain information on the adoption of portable sawmills and the means in which information about portable sawmills are diffused. A separate set of exploratory interviews were also conducted with Alabama landowners to understand their interest in utilizing portable sawmills as a land management tool, either alone or within the structure of a cooperative agreement. An additional Alabama landowner survey was conducted at the same time by others in the School of Forestry and Wildlife Sciences at Auburn University (Zhou 2010). Information gathered in the exploratory interviews with Alabama landowners were used to develop two questions added to the Alabama landowner survey, and used in this project, regarding the utilization of portable sawmills as a land management tool and landowners' interest in cooperative agreements involving portable sawmills.

Preliminary Research

Preliminary data was collected in the Fall 2007 with a portable sawmill company (Logosol) at their Madison, Mississippi headquarters, and through the Joseph W. Jones Ecological Research Center in Newton, Georgia. The goals of the preliminary research were to gain an understanding of how portable sawmills operate, including the level of skill and expertise involved, an estimation of resources associated with operating a portable sawmill, as well as to gauge the motivations of a few portable sawmill owners.

Valuable information was obtained through these preliminary interviews regarding the "language" of portable sawmill owners, the types of equipment used in conjunction with portable sawmills, as well as the issues that are most pertinent to portable sawmill owners/operators and the industry as a whole. Connections made on these trips also allowed us to obtain valuable informant lists of portable sawmill owners/operators that allowed us to continue with the national survey goal.

Development and Distribution of a National Portable Sawmill Survey

After obtaining the necessary preliminary data, an exploratory web-based national portable sawmill owner/operator survey was developed. The survey was initially conducted as a self-administered questionnaire to be sent via an internet survey to approximately 1800 respondents throughout the U.S.

The overall goal of the survey was to understand what is happening in the portable sawmill world, how owners operate their businesses, and whether this could potentially become a viable economic option for others. The results obtained had the potential to yield very important information for both industry as well as for potential new and existing portable sawmill owners and can serve as a basis for additional research to develop a program to promote and enhance portable sawmill use, either through Extension services, local community development initiatives, or through cooperative programs.

Survey Themes

Several themes were evaluated in the web-based national survey including, equipment use, business aspects, land ownership, and demographics of owners/operators. The first theme to be explored was based on equipment, looking at the types of portable sawmills and other equipment most commonly used, length of ownership, and safety. The second theme explored the business aspect of owning a portable sawmill, including costs associated with operating the portable sawmill, contracts, and what types of products are created using the mills. An important element explored in this theme is whether operators use portable sawmilling as a hobby, full-time or part-time employment, if their intended use has changed since ownership, and if they have found it to be a viable economic option.

The third theme looked at land ownership, including how much land is owned by portable sawmill owners, the types and age of timber most often milled, where the timber comes from (storm damage, thinning, etc.), as well as whether respondents mill timber from their own land or from others' land and their willingness to do so. The final theme gauges an understanding of demographic characteristics of the survey respondents including where in the U.S. they are located, their age, rage, level of education, gender, ethnicity, and income level, and how much of their income comes from portable sawmilling.

Unit of Analysis

To address concerns regarding the unit of analysis, or who should be included in the web-based portable sawmill owner/operator survey, I first made the decision to focus on the portable sawmill owners themselves- either independent owners, or owners that share a portable sawmill, as opposed to friends, relatives, or landowners, etc. This decision was made because getting a firsthand account of business related details of portable sawmill operations can only be thoroughly conveyed from the owners/operators themselves- a relative, landowner, friend, etc of the operation would not know every single detail of the operation, firsthand. By focusing on the unit of analysis, portable sawmill owners/operators, I was able to incorporate specific demographic questions (age, race, sex, income, etc.) to obtain an overall picture of who these portable sawmill owners are, specific business related questions regarding specific costs associated with the operation of their portable sawmill, and specific forestry/land based questions to obtain an understanding of both the types, age, and size of timber harvested, as well as *their* knowledge of the types, age and size of timber they are harvesting.

Question Wording and Placement

There were several important issues to consider when asking questions about income, revenue, profits, etc. Moyer et.al (1998) found that respondents are significantly less confident in reporting income of their spouse (60%) or other friends/relatives (30%) than of themselves (83%). Therefore it was important to keep the unit of analysis limited to the actual owner of the portable sawmill. It is important, however, to note that the results of this study indicated that people are only 83% confident in reporting their own income, which leaves a fairly large margin of error especially considering they are reporting information about themselves. If respondents lack some level of confidence in income reporting, it seems logical to assume that they would be even less confident in actual revenue or profits associated with their businesses, something important to keep in mind when analyzing the results.

Specific questions regarding profit numbers were avoided since people might be weary of answering questions about profit, fearing potential IRS repercussions. Instead I asked simple questions like “I made more than I spent” or “I made less than I spent”, or “I produce more than I sell” “I produce less than I sell.” This enabled an assessment regarding the profitability of the microenterprise without pushing away any potential respondents. I did, however, address issues concerning the costs of various facets of their operations, such as labor, repairs, fuel, etc. Although this does not provide for a full economic picture in some terms, especially regarding exactly how much money within each specific facet of the operation, it does enable a determination of whether this could potentially be a viable microenterprise *in general*.

Although studies have addressed how question formats and placement can influence the ability to extract information (Babbie 2001, Dillman 1998, Redline et al. 1999), little to no research addresses the ability to extract income, revenue, or profit information specifically. Gunn (2002) notes that some respondents of web surveys may be concerned with privacy issues, but gives no indication that respondents of web surveys are more concerned with privacy then respondents to paper surveys. Dillman et al. (1998) note the importance of placing income questions near the end of a survey so respondents are not dissuaded from completing the rest of the survey.

The main challenge faced in developing and administering the business part of the survey was being as delicate as possible when asking cost/profit/income related questions. This issue was addressed by, first, offering very general answer choices such as "I produce more/less/etc. than what I sell," or "I lose more than what I make," for example, to at the very least be able to gauge whether respondents are in some type of a viable enterprise, and then trying to get into the specifics of how much they spend on certain expenses. Also, by utilizing this strategy, of asking general then specific questions, I was able to first gauge if respondents keep track of expenses, and then whether they are willing to share this information.

Choosing a Respondent List

After making the decision to survey portable sawmill owners/operators, we then needed to decide where we would obtain the list of respondents. We were offered an owner list from both Logosol and Woodmizer (two portable sawmill companies), but felt that this was not necessarily the best option because Logosol makes mainly smaller scale chainsaw based portable sawmills geared more toward hobby or personal use, whereas Woodmizer makes larger commercial based portable sawmills. Although this would provide a good comparison, we would have been systematically excluding the owners of all other portable sawmill brands and their potentially unique portable sawmill microenterprise. We were also offered a subscriber list of email addresses from *Independent Sawmill and Woodlot Management* magazine and decided to utilize this option.

The National Portable Sawmill Internet-Based Survey

The initial e-mailing was sent to 1800 recipients. Approximately 532 email addresses bounced back or recipients opted out of the study. Of the 1268 active email accounts, 123 responded by completing the survey, resulting in approximately a 10% response rate. Three e-mailings were completed. On September 10, 2008, initial contact consisted of a letter and attached ink to the survey. Follow-up contact was made on September 24, 2008 and October 27, 2008, by e-mail, containing the information letter and survey link. The first survey response was received on September 10, 2008 and the final response was received on January 11, 2009.

There were many set-backs and obstacles uncovered during this process. First, the mail list we received was supposed to contain only portable sawmill owners, but it also included people who did not own a mill. Also, some recipients were extremely wary that we were a “government conspiracy” or that surveymonkey.com did not appear to be a legitimate website. A thread on a forestry forum website was actually set-up and dedicated by concerned survey recipients to “try to uncover the alleged conspiracy.” Those portable sawmill owners who answered the survey offered valuable information about the world of portable sawmilling, as well as brought out a few areas of inaccuracies or confusion in the questions’ wording that were later revised.

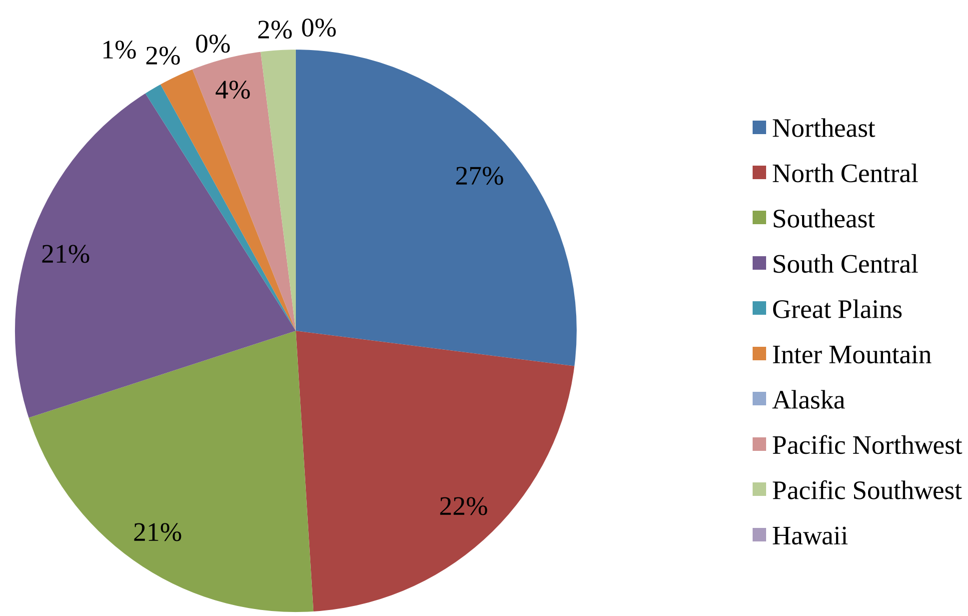
It was originally anticipated that the web survey would be a sufficient methodology for obtaining information for this study. However, upon completion of the web survey it became evident that, while this topic was still worthwhile in pursuing and valuable information had been obtained in limited form, it needed to be approached in a different manner to obtain more comprehensive information from this population. It was then decided to utilize a mail survey approach in hopes of reaching a larger percentage of the portable sawmilling population. By altering the method of distribution to a mail survey and utilizing the *Independent Sawmill and Woodlot Management* mailing list, much better results were obtained.

The National Portable Sawmill U.S. Mail Based Survey

In order to understand the potential for forest based microenterprise development utilizing portable sawmills, a national portable sawmill survey was developed and distributed to portable sawmill owners throughout the U.S. Based on lessons learned in the web based survey, the original mailing list was utilized incorporating all individuals, as opposed to the web survey which only used those who had web addresses listed.

As a result of our low response rate coupled with feedback from several respondents from our mailing list who did not own a portable sawmill, a postcard was developed and distributed prior to the actual mail survey, inquiring as to whether potential recipients owned a portable sawmill and would be willing to participate. Utilizing the approximately 15,000 addresses on the entire mailing list, every 3rd address was sent the mail based survey invitation postcard, totaling 4947 recipients. This number was chosen with the goal of receiving enough responses to be able to make regional comparisons with the survey data, while weighing the cost and time involved with various survey sizes. These initial postcards were mailed in May 2009, to 4947 subscribers throughout the U.S. [Figure 3.1].

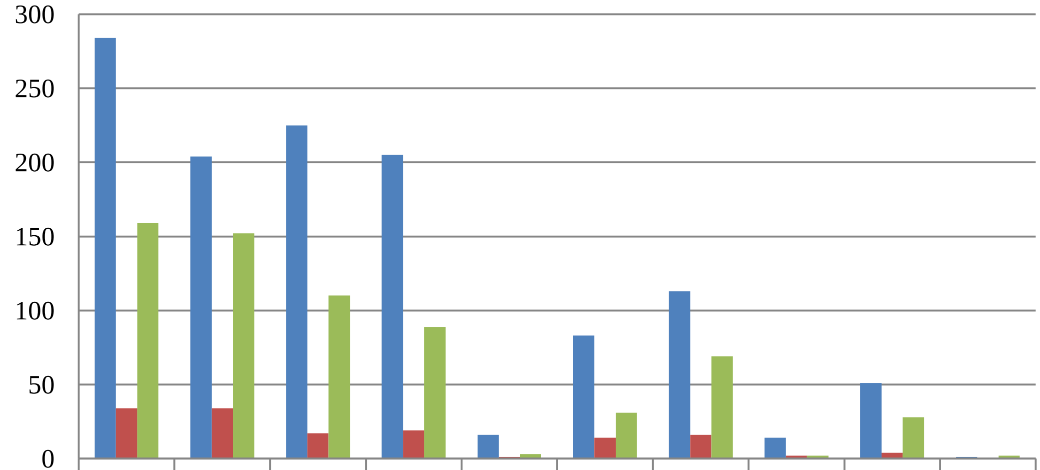
Figure 3.1:Postcard Distribution by Region



The initial mailing explained the study and included a response postcard containing three important statements, and respondents were instructed to check one. The first statement was “yes, I am interested in participating in the national portable sawmill survey and do own a portable sawmill,” the second was “no, I am not interested in participating at this time and I do own a portable sawmill,” and the third was “no, I am not interested in participating at this time and I do <u>not</u> own a portable sawmill.” This postcard response was extremely important in determining whether or not respondents owned a sawmill, and thus subsequently would receive a survey in the mail.

Several return mail envelopes were received from areas in the Pacific Northwest and Southwest marked by the post office as “vacant” or “abandoned,” meaning the respondent had abandoned their residence, a trend in the western U.S. that began as a result of the housing market crash and subsequent economic recession. After cataloging several of the postcard responses as well as the returned mail it became evident that there was a lack in responses from the Western U.S. and that area needed to be oversampled. Therefore, additional survey postcard invitation needed to be sent to those areas in the hopes of achieving a high enough response rate to be able to make valid regional comparisons in portable sawmill usage. In July 2009, this oversample was sent to an additional 840 recipients throughout the Western U.S. including the Intermountain, Pacific Northwest, and Pacific Southwest regions. This oversample yielded a total of 175 additional “yes” respondents- 53 in the Intermountain region, 10 in Alaska, 73 in the Pacific Northwest, 32 in the Pacific Southwest, and 1 in Hawaii. Figure 3.2 below shows the total postcard response by region including the oversamples.

Figure 3.2:Total Postcard Response By Region



	NE	NC	SE	SC	GP	IM	PNW	AK	PSW	HI
Yes	284	204	225	205	16	83	113	14	51	1
No	34	34	17	19	1	14	16	2	4	0
No Mill	159	152	110	89	3	31	69	2	28	2

In July 2009, the national portable sawmill ownership survey was sent to 1196 recipients. A follow up postcard reminder was sent in early August 2009, and a second survey was sent in late August 2009. We received 949 completed surveys which yielded a response rate of 79%.

Mail Survey Analysis

The survey results were analyzed both quantitatively using STATA and Excel, to make several determinations. The first goal was to obtain an overall picture of a "typical" portable sawmill operator and how their business/hobby operates in the U.S. Following this analysis, regional similarities and differences among survey respondents' data were analyzed to determine whether portable sawmill microenterprises are more successful in one area of the U.S. over another, if timber/forestland characteristic differences affect the success and/or ability of a portable sawmill operation, and if socioeconomic differences in respondents and/or their region of residence affects the ability to operate a successful portable sawmill operation. Finally, the survey responses should be able to uncover potentially valuable niche markets that exist throughout the U.S. and their potential application in other areas, and would potentially offer a supply of respondents to be interviewed in a follow up study.

Detailed Interviews with Portable Sawmill Owners

Following the completion of the national mail survey, respondents were asked to indicate whether they would be willing to participate in follow-up semi-structured interviews to obtain a more detailed understanding of the ability of portable sawmill owners to begin and maintain a successful portable sawmill microenterprise.

Interview questions primarily focused on 1) adoption diffusion variables in order to understand how the innovation process began for the individual, 2) the channels of communication to both learn about portable sawmills as well as to convey learned information with other potential investors, 3) the S-shaped rate of adoption among owners, and 4) the socio-economic characteristics of the adopters. If respondents were part of a niche market, additional questions attempted to uncover how the entrepreneur was able to identify this market and what steps needed to be taken to enter into it.

Initial contact with interview respondents was made via the telephone, email, or U.S. mail depending on the information they provided on the survey. The form of these interviews was most often telephone conversations due to the fact that respondents were geographically located throughout the U.S. However a few respondents preferred to be contacted through email due to scheduling conflicts. Regardless of the mode of interview (telephone or email) the interview questions, question order, and follow-up clarifications, remained the same to ensure uniformity in the responses. A total of 46 respondents initially agreed to be interviewed, of those 14 provided me with a telephone number, 17 provided an email address, and 15 only provided a U.S. mail address. A total of 30 respondents actually responded to attempts to contact them, resulting in a 65% response rate of potential respondents. All interviews were completed between August and October 2009. Each interview lasted between 20 minutes and two hours with the average length of an interview taking approximately 45 minutes.

The interview responses were qualitatively and quantitatively analyzed in STATA to understand how their use of portable sawmills was adopted and later diffused throughout their communities. Qualitative analysis was used to understand portable sawmill owners' innovation processes and later categorize them into common themes. Interview responses regarding general adoption rates as well as portable sawmill adoption were coded and matched with the attributes within the categories of the traditional adoption model to obtain an understanding of portable sawmill microenterprise owners' rates of adoption. Diffusion data was categorized based similar attributes to understand how information about portable sawmills was diffused. Demographic data was quantitatively analyzed in STATA to understand the socio-economic characteristics of portable sawmill microenterprise owners.

Other Sources of Data

The main objectives when gathering data for this aspect of the research was to assess both portable sawmill owners' and landowners' willingness to adopt portable sawmills as a tool in their forest management strategies based on their current knowledge of portable sawmilling, and to evaluate both landowner and portable sawmill owner interests in entering into cooperative agreements that incorporate the use of portable sawmills as a forest management strategy.

Alabama Landowner Interviews

Interviews were conducted with approximately 34 Alabama landowners in May 2009. These respondents were participants of a forestry field day located at the Escambia Experimental Station in Brewton, AL. Participants were prompted with a short questionnaire inquiring about their portable sawmill usage, and/or interest in joining into a cooperative agreement utilizing portable sawmills as one of their land management strategies, and followed up with face to face semi-structured brief interviews during a rest break along the Escambia Experimental Station Field Day Forest tour, and during the Field Day lunch break. Each interview lasted an average of 5 minutes, and interviews were sometimes were conducted in groups of 2-3 participants. The objective of these interviews was to gauge Alabama landowner's interest in joining cooperative agreements with portable sawmill owners.

Alabama Timberland Value Survey

The "Alabama Timberland Value Survey" (Zhou 2010) was distributed to Alabama landowners in July 2009, with follow up postcards sent in August 2009. Among other data being collected for various projects, this survey also contained two questions regarding current portable sawmill usage by Alabama landowners to meet their land management objectives and whether they had interest in joining a cooperative agreement to utilize portable sawmilling as an additional land management strategy. The survey was sent to 2500 landowners who owned between 10-500 acres of timberland throughout 6 counties in Alabama (Marshall, Blount, Greene, Hale, Butler, and Conecuh). A total of 405 completed surveys were returned yielding a 16% response rate.

Summary

The overall methodology with this research project utilized a multi-faceted approach, collecting and analyzing survey and interview data, both qualitatively and quantitatively using STATA and MS Excel, to understand several aspects of portable sawmill operations. These aspects include ownership characteristics, equipment usage, microenterprise development, adoption/diffusion of portable sawmill microenterprises, issues pertaining to forest health and the utilization of portable sawmills, and cooperative agreements between portable sawmill owners and Alabama landowners that could incorporate the use of portable sawmills to improve quality of life through economic and community development, and well as increase forest health on small parcels of land in the state.

U.S. REGIONAL FORESTLAND COMPOSITION AND FOREST BASED PRODUCTION

Forestland in the United States encapsulates approximately 33% of its total land area (Smith et al. 2004). Historically, the total forestland area throughout the U.S. had been in decline since the late 17th century, mainly due to the conversion of forest to agricultural land and urbanization throughout the Eastern U.S. Since the early 1900s this decreasing trend had stabilized and currently the U.S. has been experiencing an increasingly upward trend in forestland since the late 1980s, increasing about 4% nationally since 1987 (Smith et. al. 2004, 2010).

Forest growth and production is an integral part of U.S. socio-economic wellbeing supplying employment, goods, and ecological services. However recent changes within the forest products industry resulting from the current U.S. economic crisis has played a major role in the forest products economy.

This chapter explores the current forestland composition throughout the U.S., including regional forest types, land area composition, major forest types and tree species, timber volumes, growth, mortality, and harvesting/removal on both large and small-scale forestland, followed by a detailed look at forest products and production trends in the U.S.

U.S. Regional Forest Types

A relatively common regional subdivision of the U.S. utilized by parts of the US Forest Service (USFS) divides forest regions in the U.S. between the North (characterized by the Northeast and North Central), the South (characterized by the Southeast and South Central), Rocky Mountain (characterized by the Intermountain and Great Plains), the Pacific Coast/West (characterized by the Pacific Northwest, Pacific Southwest, including Hawaii), and Alaska [Figure 5.16.1] (Smith et. al. 2004).

Figure 5.1: Map of United States Regional Forest Divisions as Defined by the USFS

Source: Smith, W. Brad, Patrick D. Miles, John S.Vissage, Scott A Pugh. 2004. Forest Resources of the United States, 2002. Gen. Tech. Rep. NC-241. St Paul, MN: USDA Forest Service, North Central Research Station.

The regional division of the U.S. displayed above will also be utilized throughout this project. The major categorical separations of North, South, Rocky Mountains, and Pacific Coast/West will be referred to throughout this project as condensed regions.

Likewise, the areas within each of the condensed regions (for example, the Northeast and North Central) will be referred to as expanded regions or regions [Figure 5.1].

Forestland Composition throughout the United States

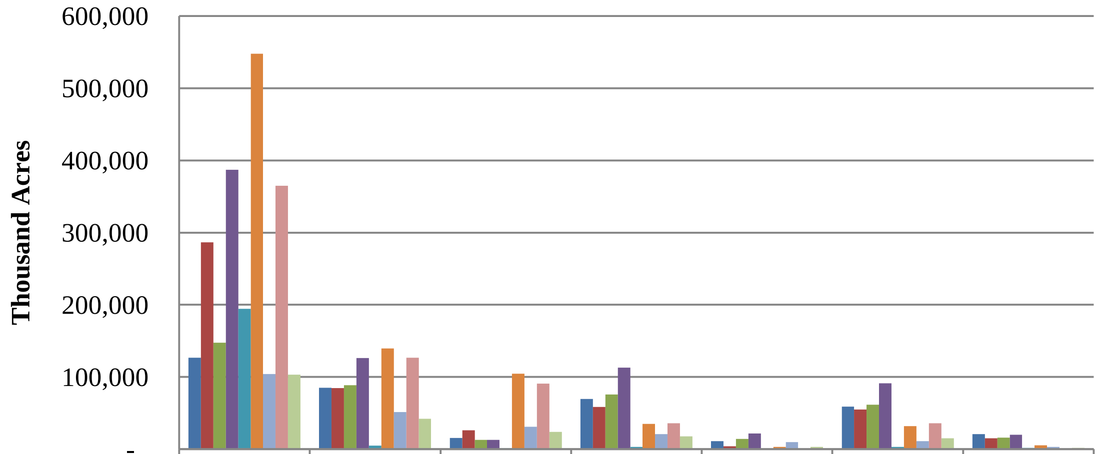
Forested land composition varies throughout the U.S. regions. The Northeast contains the highest percentage of forested land in relation to the total land area within each region, whereas the Intermountain region hold the largest number of forested acres of any region in the U.S. Likewise, the Northeast contains the largest number of acres owned in small acre holdings (≤50 acre tracts), with the South Central region containing the second largest number of small acre holdings. However, the Great Plains contains the highest percentage of non-industrial private acreage in small land holdings. A detailed description of the land composition throughout the U.S. forest regions is described throughout this section.

Northern Land Composition

The total land area in the Northeast region is about 126.8 million acres, containing 85 million acres, or 67% of forestland. Of those acres, approximately 20% are publicly owned and 80% acres are privately owned. Of those private lands, 31% are owned by the forest industry and 69% are owned by non-industrial private land owners. Approximately 20.8 million of these acres (44%) are owned in small holdings of 50 acre tracts or less [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

In the North Central region, there are about 286.8 million acres of total land area with approximately 30% or 84.8 million acres of forestland. Approximately 31% of the forestland in the North Central region is public lands and 69% is private. About 12% of the private forestland in this region is owned by the forest industry, with the other 88% owned by non-industrial private land owners. Small forestland holdings in the North Central region make up 28%, or 14.9 million acres of non-industrial private forestland in the region [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

Figure 5.2: ACRES OF U.S. LAND AREA BY REGION, (thousand acres)



	Total Land Area	Total Forest-land	Total Public	Total Private	Forest Industry	Non-Industrial Private	Small Forest land Holdings (≤50 acres)
NE	126,815	85,031	15,315	69,716	11,017	58,700	20,894
NC	286,677	84,653	26,053	58,600	3,811	54,789	14,914
SE	147,383	88,561	12,761	75,798	14,180	61,618	16,128
SC	387,107	126,044	12,996	113,047	21,735	91,311	20,099
GP	194,298	4,783	1,533	3,251	-	3,251	1,631
IM	547,920	139,560	104,601	34,959	2,926	32,032	5,356
PNW	104,054	51,411	30,835	20,606	9,643	10,963	2,891
---AK	365,041	126,869	90,994	35,875	-	35,875	108
PNW	103,030	41,981	24,073	17,909	3,068	14,840	1,648

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

Southern Land Composition

The total land area in the Southeast region is 148 million acres with 87.9 million acres of total forestland, occupying 59% of the total land area. Approximately 16% of the total forestland in the Southeast is publicly owned and 84% is private. Of the privately owned land in this region, 34% are owned by the forest industry and 66% are owned by non-industrial private land owners, with 16 million acres (33%) owned in small forestland holdings of 50 acres or less [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

The South Central region contains a total of about 387 million acres of land, which is made up of approximately 127 million acres of total forestland or 33% of the total land area in this region. Of the total forestland in this region, only 11% is public with the other 89% being privately owned. Of the total private forestland in the South Central region, 29% is owned by the forest industry and 71% is owned by non-industrial private land owners. Approximately 20 million acres or 25% of the non-industrial private forestland is owned in small tracts of 50 acres or less [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

Rocky Mountain Land Composition

The total land area in the Intermountain region is 548 million acres which are made up of about 144.9 million acres of total forestland, representing 26% of the total land area of the region. Of the existing forestland, 77% are public and 23% are private. This represents is a vast difference in land ownership structure as compared to the North and South. Of the private lands about 15% are owned by the forest industry and 85% are owned by non-industrial private land owners, with 19% or 5.3 million acres owned in small landholdings of 50 acres or less [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

The Great Plains region contains 194.5 million acres of total land area, made up of 5.8 million acres of total forestland, representing only 3% of the total land area in this region. Of that forestland, about 29% is publicly owned and 71% is private. Almost all, 98%, of private forestland in this region is owned by non-industrial private landowners with about 41% owned in 50 acre or smaller tracts [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

Pacific Coast/Western Land Composition

The total land area in the Pacific Northwest region is 105 million acres which are made up of 52.4 million acres of total forestland, representing about 50% of the total land area. Approximately 60% of the total forestland in this region is publicly owned and 40% are private lands. Of those private lands 52% are still owned by the forest industry and 48% are owned by non-industrial private land owners. About 29%, or 2.9 million acres of the non-industrial forestland holdings in this region are in tracts of 50 acres or less [Figure 5.2] (Smith et al. 2010).

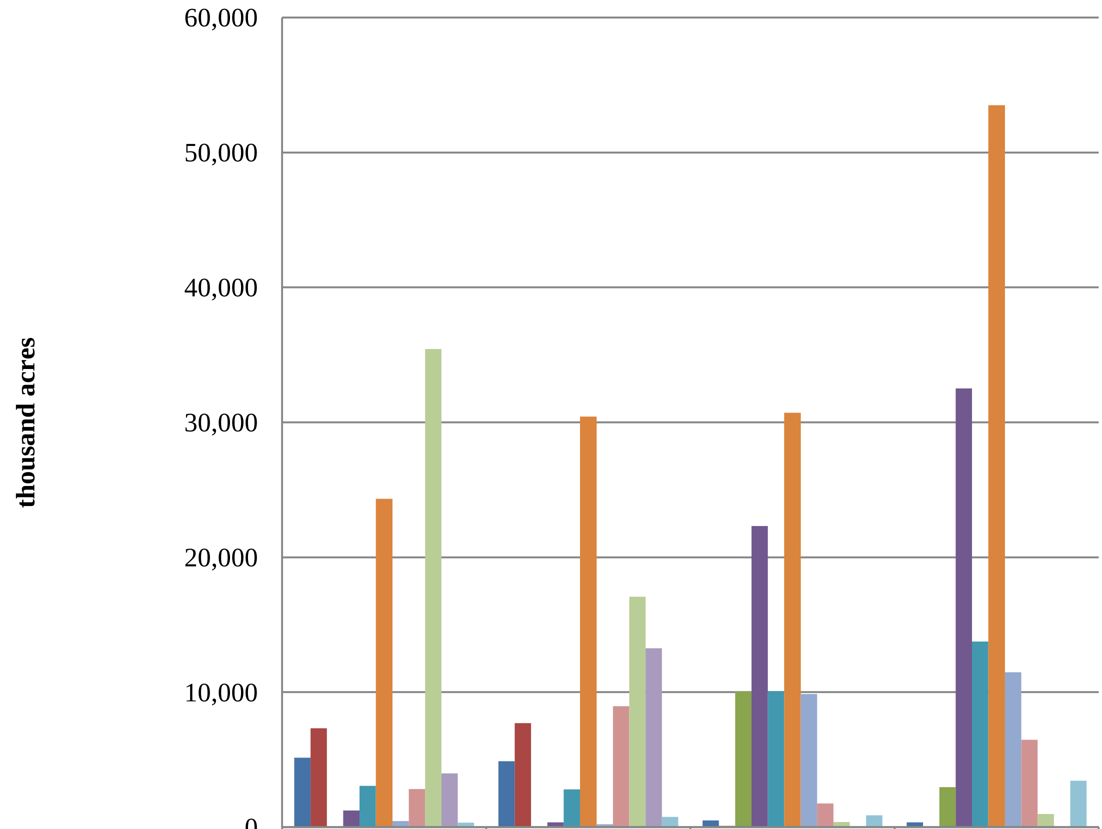
Within this region the total land area of Alaska is 365 million acres including 126.9 million acres of forestland, or 35% of the total land area. Of that forestland, 72% are public and 28% are private. All of the private land in this region is owned by non-industrial private landowners, with less than 1% owned in small acre tracts [Figure 5.2] (Smith et al. 2010).

In the Pacific Southwest region there are almost 104 million acres of total land area, which contains almost 35 million acres of total forestland, or 34% of the total land area. Of the existing forestland, 58% is public and 42% is private. About 33% of the private forestland is owned by the forest industry and 67% are owned by non-industrial private land owners. Approximately 1.6 million acres or 17% of the non-industrial private forestland in the Pacific Southwest is owned by small landholdings or 50 acres or less [Figure 5.2] (Smith et al. 2010; USDA Forest Service 2006).

Major Forest Types and Tree Species

A variety of forest types exist throughout the U.S. Each of these forest types contains multiple tree species; with the dominant species reflective in the name of the forest type themselves [Figures 5.3 and 5.4]. This section will explore these various forest types that exist throughout the U.S. regions, as well as the dominant species within each forest type.

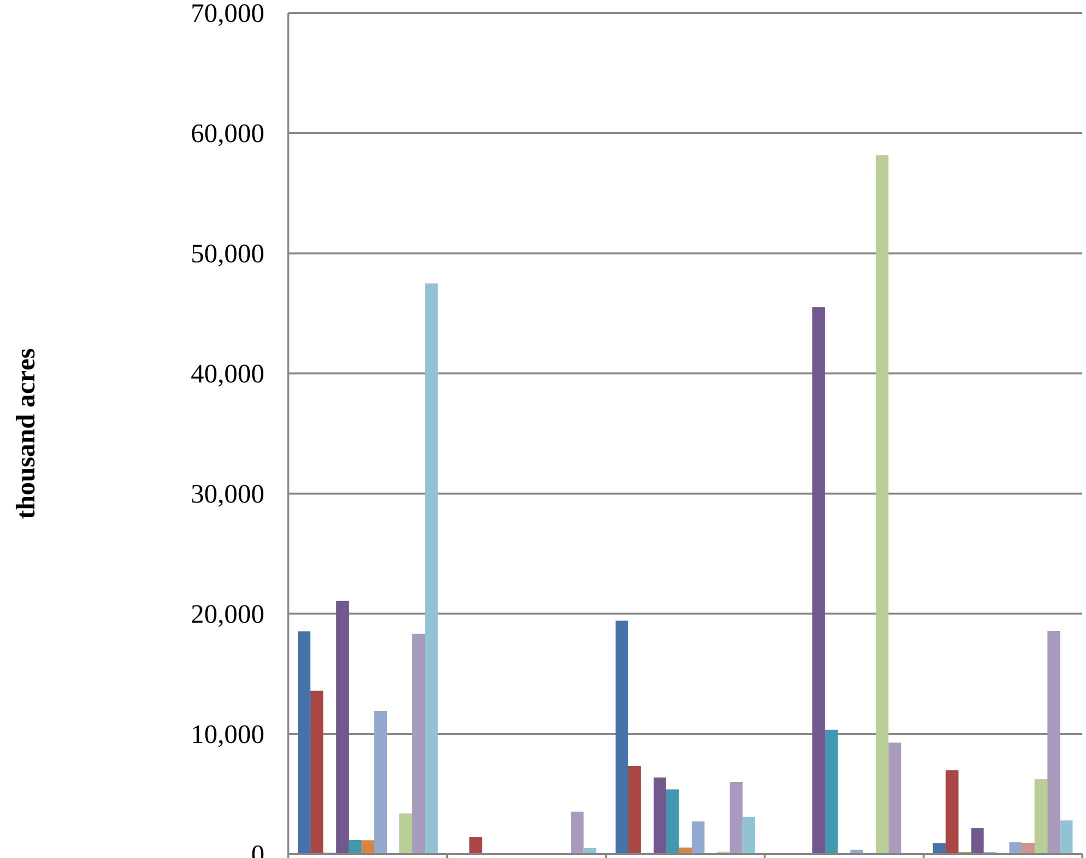
Figure 5.3: Acres of U.S. Forestland by Forest Type, North and South (thousand acres)



	Northeast	North Central	Southeast	South Central
white-red-jack pine	5,154	4,876	500	356
spruce-fir	7,348	7,722	119	13
longleaf-slash pine	0	0	10,065	2,958
loblolly shortleaf	1,230	361	22,314	32,512
oak-pine	3,070	2,788	10,076	13,753
oak-hickory	24,339	30,426	30,712	53,504
oak-gum-cypress	460	225	9,866	11,478
elm-ash- cottonwood	2,826	8,964	1,760	6,482
maple-beech-birch	35,433	17,071	371	978
aspen-birch	3,998	13,264	0	4
other	334	748	884	3,449

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Figure 5.4: Acres of U.S. Forestland by Forest Type, Rocky Mountain and Pacific Coast (thousand acres)



	Intermountain	Great Plains	Pacific Northwest	ALASKA	Pacific Southwest
douglas fir	18,546	0	19,411	0	904
ponderosa pine	13,585	1,421	7,330	0	6,975
western white pine	102	0	63	0	152
fir/ spruce	21,058	56	6,355	45,528	2,150
hemlock/ sitka spruce	1,166	0	5,371	10,341	141
larch	1,153	0	533	0	0
lodge-pole pine	11,906	0	2,711	342	992
redwood	0	0	0	0	916
other softwoods	3,395	0	198	58,170	6,226
western hardwoods	18,339	3,523	5,999	9,280	18,558
pinyon/ juniper	47,482	500	3,095	0	2,805

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

North (Northeast and North Central Regions)

Several important forest types exist, however four major types account for 89% of the Northeast region. These include Northern Hardwood Forests which include sugar maple *(Acer saccharum),* American beech *(Fagus grandifolia),* yellow birch- *(Betula alleghaniensis),* black cherry *(Prunus serotina),* maple *(Acer spp.),* early successional aspen *(Populus spp.),* and paper birch *(Betula papyrifera)*; spruce/ fir forests including the major species of red spruce *(Picea rubens),* and balsam fir- *(Abies balsamea)*; white pine/ hemlock forests including the eastern white pine *(Pinus strobes),* and eastern hemlock *(Tsuga canadensis)*; and oak forests which include a variety of oak *(Quercus spp.)* [Figure 5.3] (Dirr 1998, Smith et al. 2010).

The North Central region is made up of 24 different forest types, however the main types include jack pine *(Pinus banksiana),* forests; red pine (*Pinus resinosa),* forests; eastern white pine *(Pinus strobus)* forests; aspen *(Populus spp).* forests; northern hardwood forests including the American beech *(Fagus grandifolia),* birch *(Betula spp.),* and maple *(Acer spp).*; black spruce *(Acer spp.)* forests, and spruce/fir/hardwood forests including the following tree major species, red spruce (*Picea rubens),* fraser fir *(Abies fraseri),* yellow birch *(Betula allegheniensis),* American beech *(Fagus grandifolia),* mountain ash *(sorbus Americana),* mountain maple *(Acer spicatum),* and fire cherry *(Prunus pensylvanica)* [Figure 5.3] (Dirr 1998, Pearson 2008, Smith et al. 2010).

South (Southeast and South Central Regions)

Within the Southern Region there is a vast abundance of tree species. The major forest type in the South Central area is the Southern Appalachian Hardwood Forests which represents the largest contiguous temperate forest in the world (The American Land Alliance 2005). The American Land Alliance (2005:1) notes that "The Smoky Mountains in the Southern Appalachians alone has more tree species than that occur in all of Europe." While there are several important tree species in the Southern Appalachian Forests, four main groups can be categorized based on their topographic features. At the highest elevations the chestnut oak *(Quercus prinus)*, and scarlet oak *(Quercus coccinea)* thrive, although repeat fires can cause this topographic region to contain large amounts of pine trees *(Pinus spp.)*. At slightly lower elevation the most widespread group of tree species contain the white oak *(Quercus alba)*, and the black oak *(Quercus velutina)*. At lower mid-level elevations there is the largest range of species but can be predominately defined by the red oak *(Quercus rubra)* and sugar maple *(Acer saccharinum)*. At the lowest elevations the main tree species are yellow poplar *(Liriodendron tulipifera)* and other mixed hardwoods [Figure 5.3] (Dirr 1998, Smith et al. 2010).

The Southeast area contains forest types ranging from Atlantic white cedar swamps, and upland to bottomland forests (American Lands Alliance 2005). Some of the major tree species in this area are white cedar *(Thuja occidentalis)*, bald cyprus *(Taxodium distichum)*, sweetgum *(Liquidambar styraciflua)*, varieties of pine including the loblolly *(Pinus taeda)*, slash *(Pinus elliottii)*, shortleaf *(Pinus echinata)*, and longleaf *(Pinus palustris)*, as well as cottonwood *(Populus deltoids)*, hickory *(Carya spp.)*, pecan *(Carya illinoinensis)*, and willow *(Salix spp.)* [Figure 5.3] (Dirr 1998, Appalachian Wood n.d., Smith et al. 2010).

Rocky Mountains (Great Plains and Intermountain Regions)

The Great Plains region contains mainly hardwoods, with oak/hickory forests making up 72% of the forestland contain a variety of tree species including various oaks: white oak *(Quercus alba)*, post oak *(Quercus stellata)*, bur oak *(Quercus macrocarpa)*, chestnut oak *(Quercus muhlenbergii)*, red oak *(Quercus borealis)*, pin oak *(Quercus palustris)*, shumard's oak *(Quercus shumardii)*, black oak *(Quercus velutina)*, black jack oak *(Quercus marilandica)*, shingle oak *(Quercus imbricaria)*. Other species include hickory *(Carya spp.)*, cottonwood *(Populus deltoides)*, eastern red cedar *(Juniperus virginiana)*, red bud *(Cercis spp.)*, and sycamore *(Platanus occidentalis* [Figure 5.4] (Dirr 1998, Manson n.d., Smith et al. 2010).

The Intermountain region can be subdivided further into the Southern and Central Rockies and the Northern Rockies. The Southern and Central Rockies contain Ponderosa pine forests, aspen forests, engelmann spruce/subalpine forests, and pinyon/juniper forests. Within the ponderosa pine forests the major tree species is ponderosa pine *(Pinus ponderosa)*, in mainly pure stands but at higher elevations there is also a mix of southwestern white pine *(Pinus strobiformis)*, Rocky Mountain douglas-fir *(Pseudotsuga menziesii)*, Rocky Mountain white fir *(Abies concolor)*, and quaking aspen *(Populus tremuloides)* [Figure 5.4] (Dirr 1998, Idaho Forest Products Commission 2008, Smith et al. 2010).

At lower elevations there is also a mix of gambel oak *(Quercus gambelii)* (Grahame and Sisk 2002). Aspen forests are found on high plateaus and mountain ranges on nearly pure stands of aspen *(Populus spp.)*. The engelmann spruce/ subalpine forests, also known as subalpine conifer forests contain engelmann spruce *(Picea engelmannii)*, and subalpine fir *(Abies lasiocarpa),* at higher elevations with quaking aspen *(Populus tremuloides)*, often found after a fire disturbance (Grahame and Sisk 2002). Pinyon/ juniper forests occur on the driest environments of any major forest type. The major tree species in this type of forests include the Colorado pinyon pine *(Pinus edulis),* and Utah juniper *(Juniperus osteosperma)* [Figure 5.4] (Dirr 1998, Grahame and Sisk 2002, Smith et al. 2010).

The Northern Rockies area contains the largest unbroken expanse of forestland in the U.S. (Idaho Forest Products Commission 2008). The major forest types in this area include the western white pine forests, douglas fir forests, and lodgepole forests. The western white pine forests are dominated by the tree species of western white pines *(Pinus monticola)*, however in the absence of fire western red cedar *(Juniperus scopulorum)*, western hemlock *(Tsuga heterophylla),* or grand fir *(Abies grandis),* species will dominate these forests [Figure 5.4] (Dirr 1998, Idaho Forest Products Commission 2008, Smith et al. 2010).

Douglas Fir Forests contain mainly pure stands of douglas fir *(Pseudotsuga menziesii)*, however in the absence of management to maintain pure stands, western hemlock *(Tsuga heterophylla)*, western red cedar *(Juniperus scopulorum)*, noble fir *(Abies procera)*, big leaf maple *(Acer macrophyllum),* and red alder *(Alnus rubra)*, tree species are within these forests west of the Cascades. East of the Cascades douglas firs are found mixed with incense-cedar *(Libocedrus decurrens)*, sugar pine *(Pinus lambertiana)*, western white pine *(Pinus monticola)*, ponderosa pine *(Pinus ponderosa)*, grand fir *(Abies grandis)*, white fir *(Abies concolor)*, and western larch *(Larix occidentalis)* (Oregon Forest Resources Institute 2005). Lodgepole pine forests occur in pure stands containing the tree species lodgepole pine *(Pinus contorta)* [Figure 5.4] (Dirr 1998, Idaho Forest Products Commission 2008, Smith et al. 2010).

Pacific Coast/ West (Pacific Northwest and Pacific Southwest Regions-including the states of Alaska and Hawaii)

The Pacific Northwest area includes the major forest types western hemlock/ sitka spruce forests and true fir/mountain hemlock forests. The western hemlock/ sitka spruce forests include the major tree species western hemlock *(Tsuga heterophylla)*, douglas fir *(Pseudotsuga menziesii)*, western red cedar *(Juniperus scopulorum)* and sitka spruce *(Picea sitchensis)* (Washington State Department of Natural Resources n.d.). The true fir/ mountain hemlock forests contain the tree species pacific silver fir *(Abies amabilis)*, mountain hemlock *(Tsuga mertensiana)*, and at lower elevations douglas fir *(Pseudotsuga menziesii)* [Figure 5.4] (Dirr 1998, USDA Forest Service 2006, Smith et al. 2010).

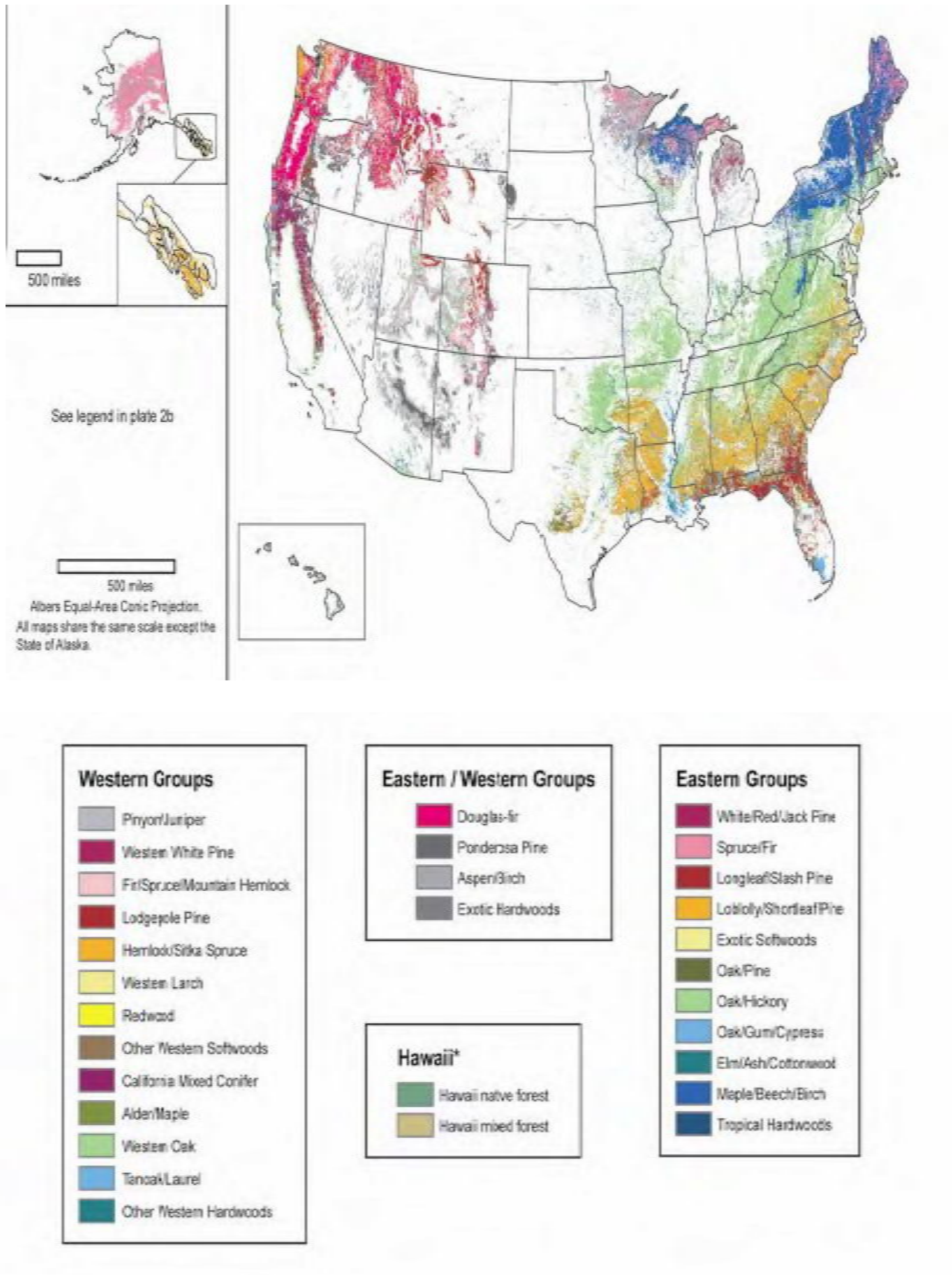
The major forest type in California is the Redwood Forests, however other forests exist where Douglas fir *(Pseudostuga menziesii)*, ponderosa pine *(Pinus ponderosa)*, and in higher-elevation red fir *(Abies magnifica)*, and mountain hemlock *(Tsuga mertensiana)* tree species dominate (American Lands Alliance 2005). The Redwood Forests also contain a variety of tree species in addition to coast redwood *(Sequoia sempervirens)*, douglas fir *(Pseudotsuga menziesii)*, California rose-bay *(Rhododendron macrophyllum)*, Western Azalea *(Rhododendron occidentale)*, and Tanbark Oak *(Lithocarpus densiflora)* [Figure 5.4] (Dirr 1998, U.S. Department of the Interior 2008, Smith et al. 2010).

Hawaii's forests are comprised of nine major forest types with their respective tree species including Ohia/Hapuu *(Metrosideros polymorpha/Cibotium glaucum),* koa/ohia *(Acacia koa/ Metrosideros polymorpha),* mamane/naio (*Sophora chrysophylla/ Myoporum sandwicense)*, native dry land forest of mixed species, eucalyptus *(Eucalyptus spp.),* mixed introduced hardwood forests, guava *(Psidium catleianum),* kiawe *(Prosopis pallida/Leucaena)*; and mixed conifer plantations (Martin and Nakamura 2001, State of Hawaii n.d).

Two large national forests, The Tongass and The Chugach, make up the coastal region of Alaska with the Boreal Forests occupying much of interior Alaska. Within the Tongass Forest the primary tree species are sitka spruce *(Picea sitchensis),* western hemlock- *(Tsuga heterophylla),* western red cedar *(Juniperus scopulorum),* and Alaska (yellow) cedar *(Chamaecyparis nootkatensis)*. The primary tree species in the Chugach Forest are sitka spruce *(Picea sitchensis),* and white spruce *(Picea glauca),* however cottonwood *(Populus deltoids),* hemlock *(Tsuga spp.),* black spruce *(Picea mariana),* and Lutz spruce can also be found. The Boreal Forests contain several tree species including white spruce *(Picea glauca)*, quaking aspen *(Populus tremuloides)*, and paper birch *(Betula papyrifera)*. Other species include black spruce *(Picea mariana)*, balsam poplar *(Populus balsamifera)*, and larch *(Larix spp.)* [Figure 5.4] (Alaska Forest Association 2003, Dirr 1998, Smith et al. 2010).

Figure 5.5 below displays a map of the various forest types described above throughout the U.S.

Figure 5.5: Map of U.S. Forest Types as Described by the USFS

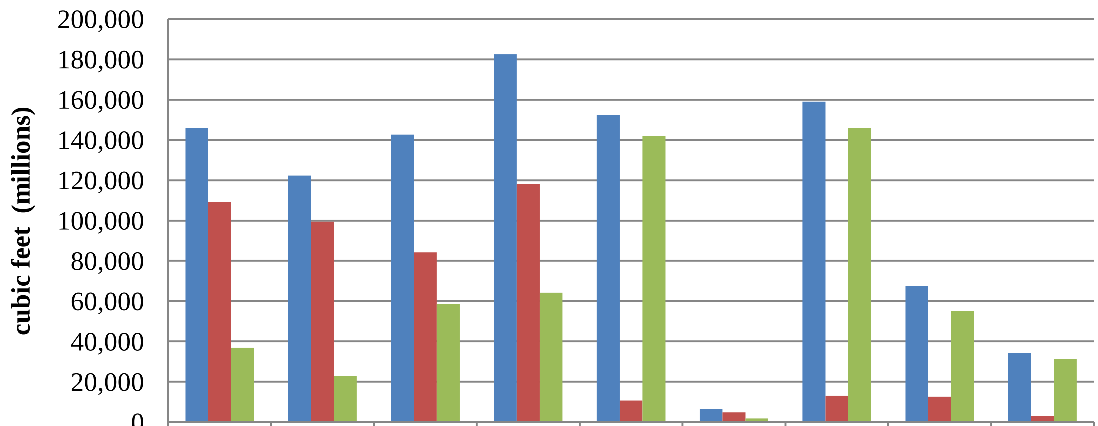


Source: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

U.S. Regional Timber Volumes

The net timber volumes described in this section are displayed in Figure 5.6 below. The South Central region contains the largest net volume of cubic feet of timber, with the Pacific Northwest leading in net volume of softwood throughout the U.S., and South Central holds the highest net volume of hardwood throughout the U.S.

Figure 5.6: Net Volume of Timber on Timberland, by U.S. Region (cubic feet per million)



	NE	NC	SE	SC	IM	GP	PNW	PSW	AK
total	145,97	122,32	142,58	182,48	152,55	6,591	159,04	67,580	34,267
hardwoods	109,17	99,432	84,120	118,26	10,680	4,779	12,999	12,597	3,076
softwoods	36,805	22,896	58,462	64,226	141,86	1,812	146,04	54,983	31,191

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

In the Pacific Northwest and Pacific Southwest, larger tree sizes may affect the availability of certain tree species processed with a portable sawmill regardless of the available net volume of timber due to size restrictions of the mills themselves.

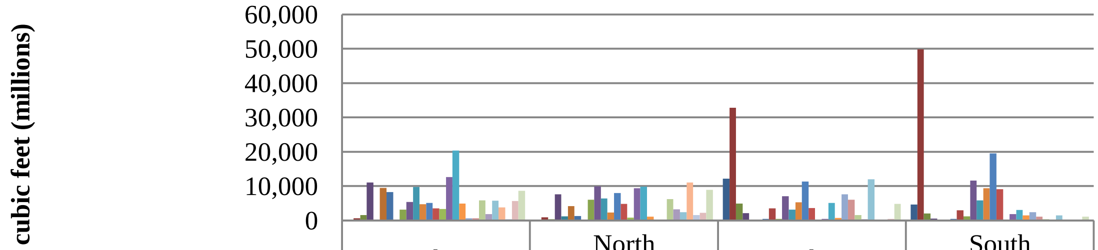
The net volume of growing stock by tree species for the various expanded U.S. regions is illustrated in Figures 5.7 and 5.8 below. In the Northeast, hardwoods make up a large portion of the net volume of timberland contained in this region. In the North

Central region, cottonwood and aspen hold the largest cubic feet of growing stock of timber in the region (Smith et al. 2010).

Loblolly and shortleaf pines dominate the net volume of growing stock of timberland in the Southeast and South Central regions. Pine is an optimal lumber producing species due to its abundance, availability, and has the highest density and strength of a structural lumber species (Southern Forest Products Association 2009).

Douglas Fir is the largest net volume of growing stock of timberland in the Intermountain, Pacific Northwest, and Pacific Southwest regions, with Alaska's largest net volume of growing stock in western hemlock. The Great Plains' largest net volume of growing stock on timberland is in the other softwood category (Smith et al. 2010).

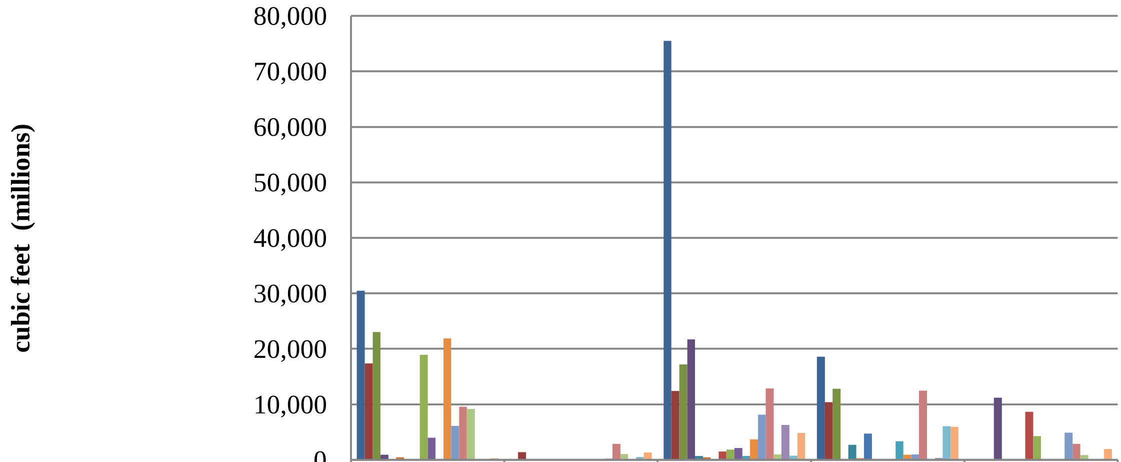
Figure 5.7: Net Volume of Growing Stock on U.S.Timberland, North and South (cubic feet per million)



	Northeast	North Central	Southeast	South Central
longleaf and slash pines	0	0	12,212	4,618
loblolly and shortleaf pines	658	926	32,873	49,856
other yellow pines	1,605	379	4,907	2,088
white and red pines	11,093	7,666	2,180	517
jack pines	3	1,169	0	0
spruce and balsam fir	9,413	4,141	45	0
eastern hemlock	8,281	1,277	502	449
cypress	6	7	3,529	3,001
other softwoods	3,193	6,047	474	1,214
select white oaks	5,395	9,980	7,056	11,619
select red oaks	9,775	6,461	3,190	5,815
other white oaks	4,785	2,290	5,300	9,384
other red oaks	5,141	8,008	11,338	19,542
hickory	3,499	4,835	3,591	9,098
yellow birch	3,355	807	58	11
hard maple	12,696	9,404	470	1,839
soft maple	20,418	9,821	5,149	3,092
beech	4,922	1,153	770	1,505
sweetgum	658	219	7,637	2,441
tupelo and black gum	697	288	6,005	1,093
ash	5,881	6,205	1,545	357
basswood	1,846	3,185	316	49
yellow poplar	5,780	2,438	12,009	1,482
cottonwood and aspen	3,740	11,004	99	36
black walnut	358	1,554	196	16
black cherry	5,688	2,193	427	79
other hardwoods	8,696	8,964	4,866	1,095

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Figure 5.8: Net Volume of Growing Stock on U.S. Timberland, Rocky Mountain and Pacific Coast Regions (cubic feet per million)



	Inter mountain	Great Plains	Pacific Northwest	Pacific Southwest	ALASKA
douglas fir	30,504	0	75,516	18,608	0
ponderosa and jeffery pine	17,383	1,407	12,420	10,379	0
true fir	23,024	0	17,213	12,803	6
western hemlock	941	0	21,697	78	11,224
sugar pine	0	0	677	2,717	0
western white pine	443	0	436	283	0
redwood	0	0	1	4,710	0
sitka spruce	0	0	1,486	106	8,641
englemann and other spruce	18,934	0	1,889	18	4,287
western larch	3,961	0	2,135	0	3
incense cedar	0	0	695	3,336	0
lodgepole pin	21,855	0	3,678	923	81
western red cedar	6,123	234	8,164	964	4,884
other softwoods	9,556	2,898	12,889	12,482	2,876
cottonwood and aspen	9,198	1,029	969	124	843
red alder	68	0	6,317	333	73
oak	18	564	777	6,068	0
other hardwoods	272	1,305	4,826	5,957	1,957

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Growth, Removal, and Mortality

Growth is typically defined as the average annual growth when taking into account the timber lost through mortality (Smith et al. 2010). In regard to removal and mortality, removal is physically removing the trees through harvesting and other activities, whereas Smith et al. (2010:64) defines mortality as "the average annual net volume of timber dying over a given time period due to natural causes." Tree mortality is often predictable due to advanced age of trees, overstory suppression, and problems with insects and disease (Smith et al. 2010). The following section describes the yearly growth, removal, and mortality for the U.S. regions in 2007. It is important for regions to maintain a growth level that is equal to or greater than removals to ensure sustainable forestry practices.

The Northeast currently had a yearly net growth of 3.2 billion cubic ft. There were 1.2 billion cubic ft. of removals, and 935 million cubic ft. of mortality [Figure 5.9] (Smith et al. 2010). The North Central has a similar yearly net growth of 3.3 billion cubic ft, with 1.7 billion cubic ft. of removals, and almost 1.1 billion cubic ft. of mortality [Figure 5.9] (Smith et al. 2010).

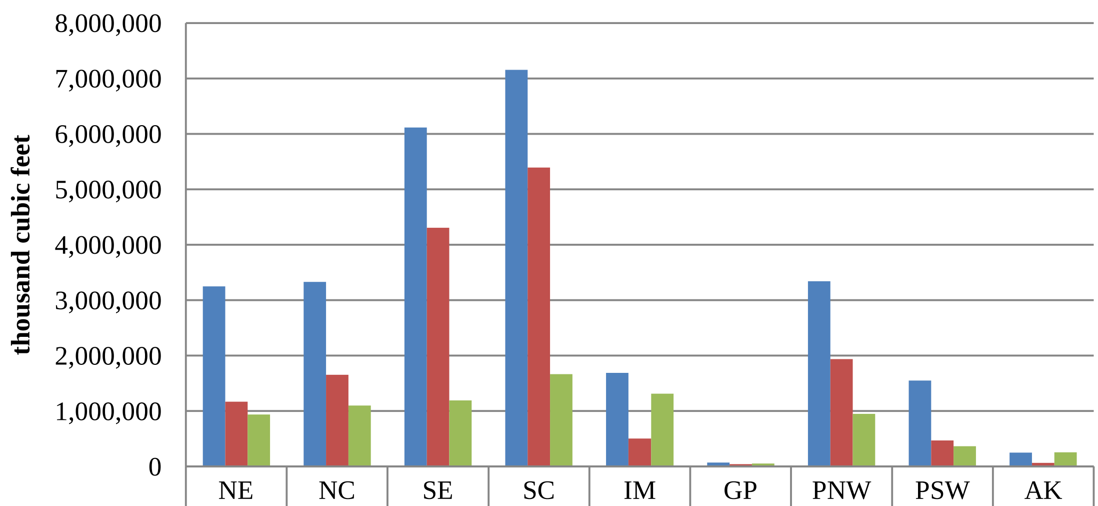
In the Southeast there is a yearly net growth of 6.1 billion cubic ft. There were 4.3 billion cubic ft. of removals, and 1.2 billion cubic ft. of mortality [Figure 5.9] (Smith et al. 2010). The South Central region has a yearly net growth of nearly 7.2 billion cubic ft., with almost 5.4 billion cubic ft. of removals, and 1.7 billion cubic ft. of mortality [Figure 5.9] (Smith et al. 2010).

The Intermountain currently has a yearly net growth of over 1.7 billion cubic ft. with 501.6 million cubic ft. of removals, and 1.3 billion cubic ft. of mortality [Figure 5.9]

(Smith et al. 2010). Whereas, the Great Plains currently has a yearly net growth of 71.6 million cubic ft., with 41 million cubic ft. of removals, and 54 million cubic ft. of mortality [Figure 5.9] (Smith et al. 2010).

Finally, the Pacific Northwest currently has a yearly net growth of about 3.3 billion cubic ft. There were approximately 1.9 billion cubic ft. of removals, and 950 million cubic ft. of mortality [Figure 5.9] (Smith et al. 2010). The Pacific Southwest has a yearly net growth of 1.5 billion cubic ft. There were 469 million cubic ft. of removals, and 363 million cubic ft. of mortality [Figure 5.9] (Smith et al. 2010).

Figure 5.9: Net Growth, Removal, and Mortality, by U.S. Region (cubic feet per thousand)

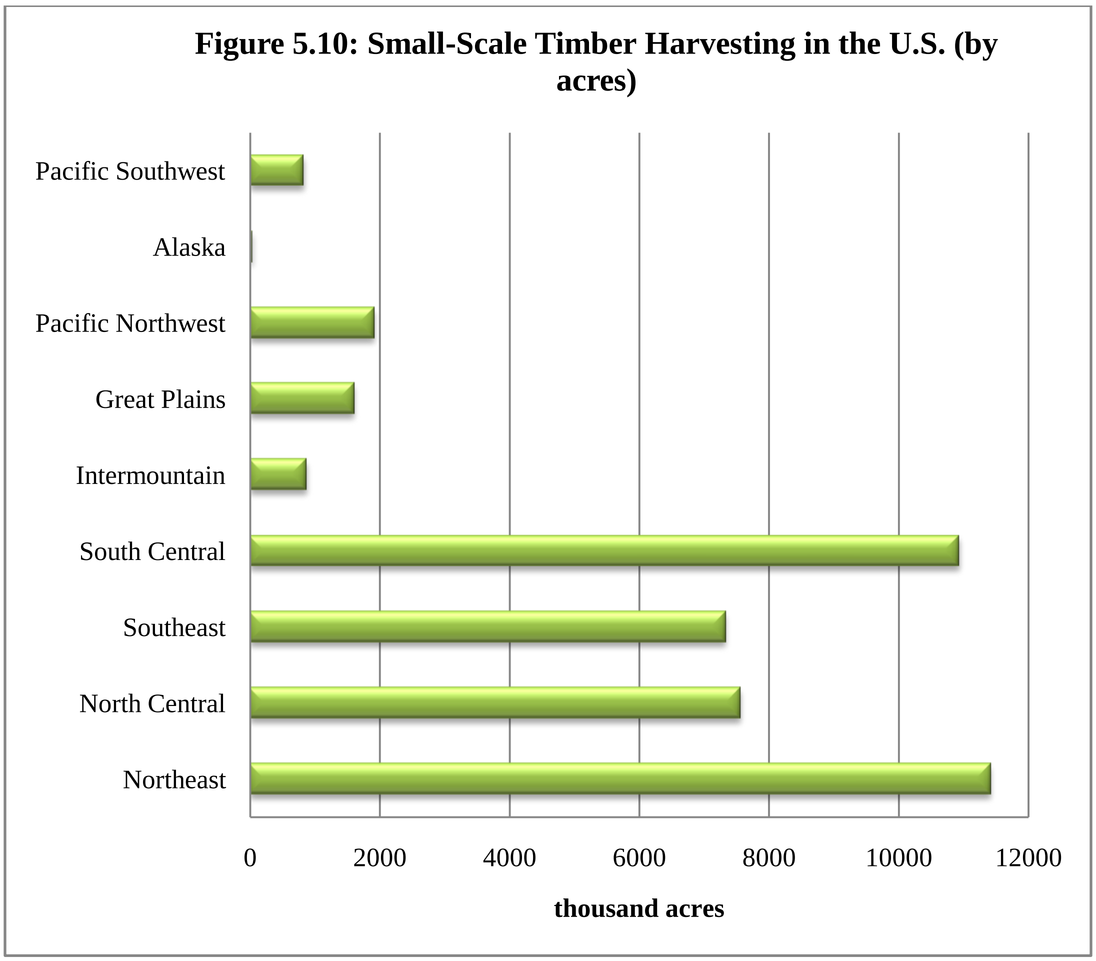


	NE	NC	SE	SC	IM	GP	PNW	PSW	AK
Net growth	3,248,	3,326,	6,115,	7,157,	1,689,	71,625	3,339,	1,547,	247,76
removals	1,168,	1,651,	4,305,	5,390,	501,59	41,164	1,938,	469,23	66,144
mortality	935,28	1,098,	1,191,	1,667,	1,309,	54,208	949,76	363,03	256,30

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Removals/Harvesting on Small-Scale Forestland in the U.S.

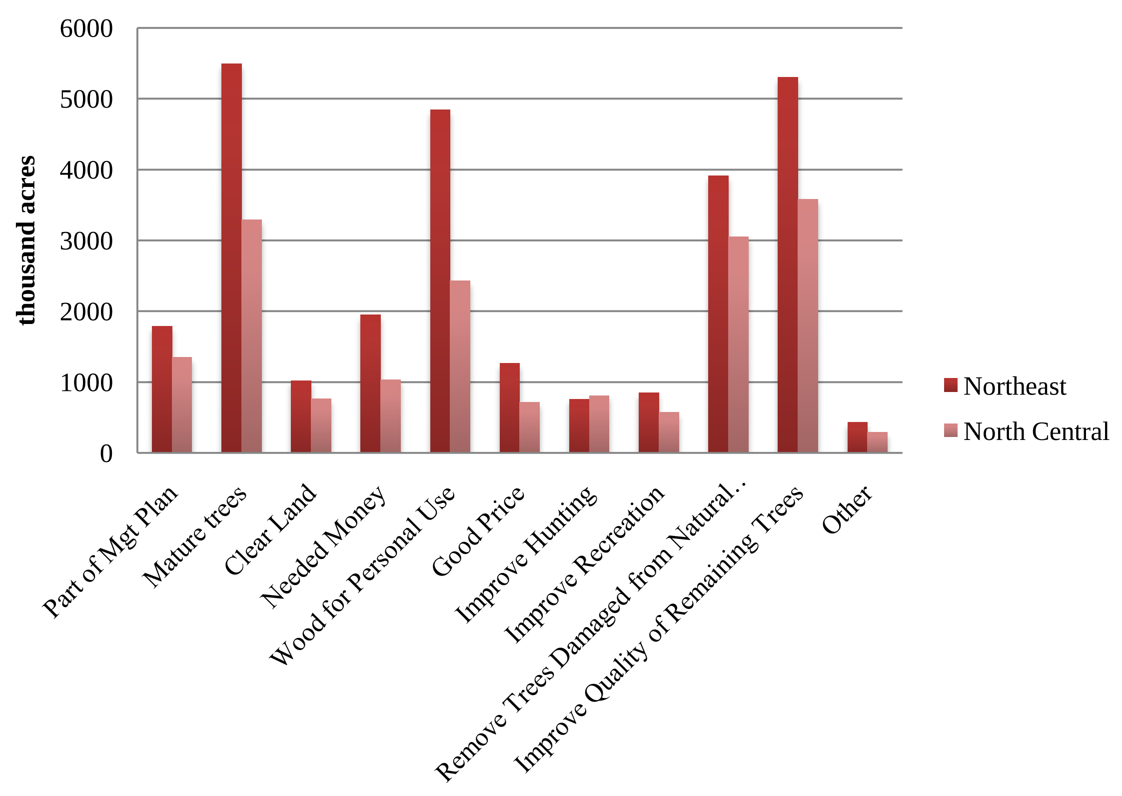
Harvesting timber on small-scale tracts containing 50 acres or less occurs primarily in the Northeast and South Central regions of the U.S. (USDA Forest Service, National Woodland Owner Survey 2006). This makes sense given there are the most acres of small landholding in these areas. Figure 5.10 below illustrates the acres of small-scale timber harvesting currently taking place in the U.S. (USDA Forest Service, National Woodland Owner Survey 2006).



Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

Currently, over 11 million acres of small-scale forestland is harvested in the Northeast, and over 7 million acres is harvested in the North Central regions (USDA Forest Service, National Woodland Owner Survey 2006). Small-scale landowners offered various reasons for harvesting timber from their forestland. In the Northeast, small-scale timber tracts were most prominently harvested due to the abundance of mature trees, to improve the quality of remaining trees, and to use the wood for personal reasons. In the North Central region, trees were most prominently harvested on small-scale tracts to improve the quality of remaining trees, and as a means of storm damage cleanup [Figure 5.11] (USDA Forest Service, National Woodland Owner Survey 2006).

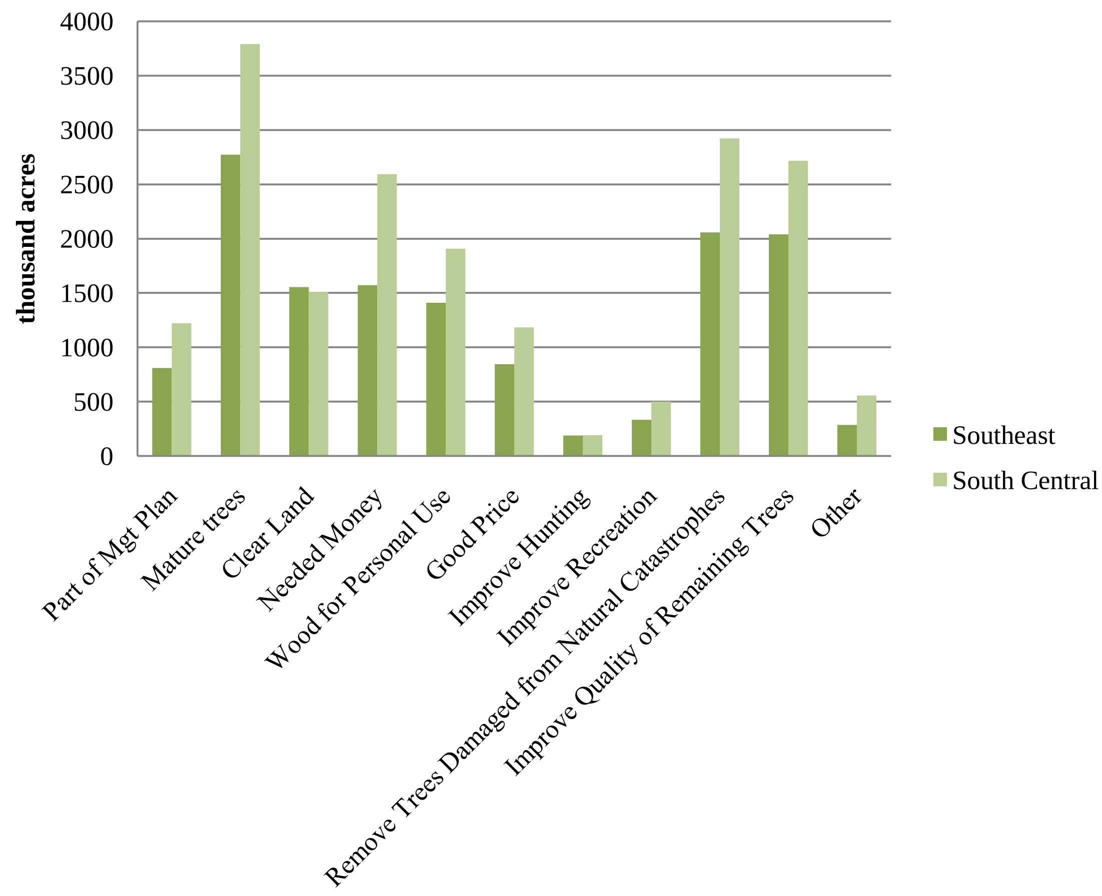
Figure 5.11: Reasons Small-Scale Landowners in the Northern U.S. have Timber Harvested on their Land (in thousand acres)



Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

Of the Southern U.S. small-scale forestland holdings, currently over 7 million acres in the Southeast and over 10 million acres in the South Central regions are harvested (USDA Forest Service, National Woodland Owner Survey 2006). The reason for small-scale timber harvests in the South mimic the North in that their primary harvest reasons are the prevalence of mature trees, storm cleanup, and to improve the quality of remaining trees. However, unlike in the Northern U.S., a major reason for harvesting timber in both the Southeast as well as the South Central regions is the need for money [Figure 5.12] (USDA Forest Service, National Woodland Owner Survey 2006).

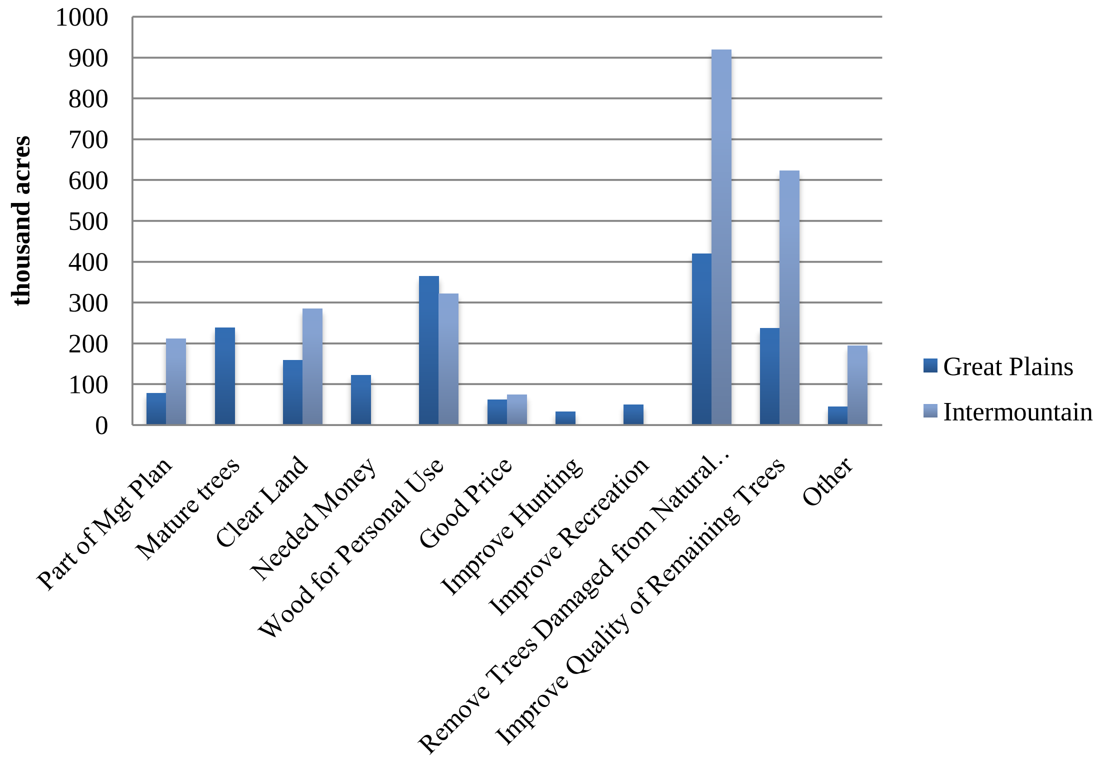
Figure 5.12: Reasons Small-Scale Landowners in the Southern U.S. have Timber Harvested on their Land (in thousand acres)



Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

Over 800 thousand acres of small-scale forestland is harvested in the Great Plains and over 1.6 million acres is harvested in the Intermountain region (USDA Forest Service, National Woodland Owner Survey 2006). The majority of reasons for small-scale harvesting in the Great Plains is for storm damage clean-up and to improve the quality of the remaining trees. Likewise in the Intermountain region, timber is also harvested primarily in storm clean-up efforts on small-scale forest tracts. A large number of small-scale forestland owners in the Intermountain area also harvest to obtain wood for personal use [Figure 5.13] (USDA Forest Service 2006).

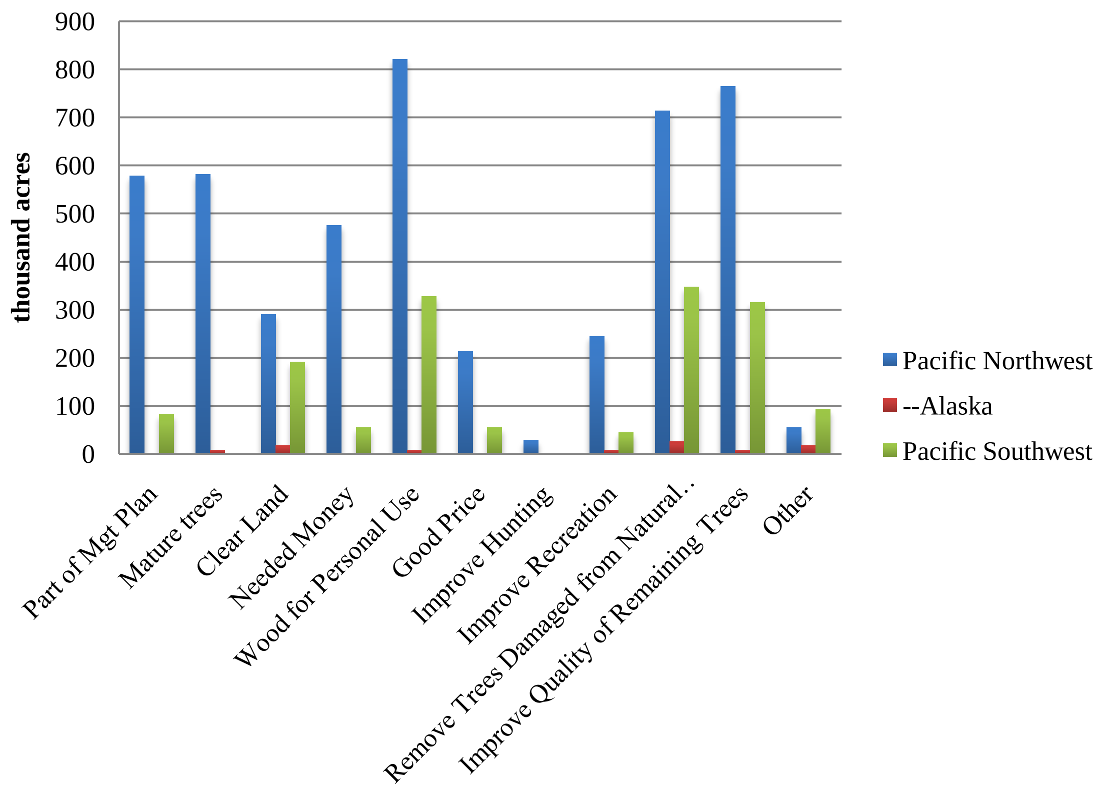
Figure 5.13: Reasons Small-Scale Landowners in the Rocky Mountain U.S. have Timber Harvested on their Land (in thousand acres)



Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

On small-scale forestland tracts, over 1.9 million acres are harvested in the Pacific Northwest, with over 42 thousand acres harvested from small tracts in coastal Alaska(USDA Forest Service, National Woodland Owner Survey 2006). In the Pacific Southwest 829 thousand acres are harvested from small-scale forestland holdings. Unique to the Pacific Northwest, the most prominent reason for harvesting timber from small tracts is for personal use of the wood. Whereas in Alaska as well as the Pacific Southwest, the main reason for harvesting small tracts of timber is for storm damage cleanup [Figure 5.14] (USDA Forest Service, National Woodland Owner Survey 2006).

Figure 5.14: Reasons Small-Scale Landowners in the West/Pacific Coast U.S. have Timber Harvested on their Land (in thousand acres)



Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results

In various regions throughout the U.S., small-scale non-industrial private forestland (NIPF) owners specified their several primary reasons for harvesting. The most commons reasons were to harvest as an income generating activity, to remove trees after a natural disaster, in thinning regimes, as well as a general part of their overall forest management regimen. As discussed in later chapters, these reasons are similar to forest management goals of portable sawmills as well as the landowners described above. Steps should be taken to network these two groups throughout the U.S. to give landowners an additional means to achieve the above mentioned goals. In addition, discovering and utilizing a niche in the overall market can help small-scale forestland owners to generate revenue from their land since current production throughout the U.S. often excludes small-scale forestland owners from mainstream industrial activities due to cost ineffectiveness of harvesting from small tracts of land. The following section describes what industry is currently doing in terms of forest production throughout the U.S. and how small-scale forestry fits into overall U.S. forest production.

U.S. Forest Products and Production Trends

Over the past couple of decades, several changes have taken place within the forest products industry as a whole. In the light of a global economy, coupled with lowered international trade barriers, foreign competition has led to a 31% increase in forest product imports to the U.S. between 1996 and 2004 (Collins et al. 2008). The overall U.S. share of the domestic forest products market decreased by 29% between 1995 and 2001, having an effect on the pulp, paper, and paperboard, softwood lumber, plywood, and household furniture markets (Collins et al. 2008). Within the U.S., the demand for various smaller diameter timber has led to regional shifts in production increasing the Southern U.S.'s portion of U.S. production from 40% in the 1970's to more than 60% in 2002, while at the same time decreasing demand in the western U.S. which held more than 40% of the domestic market to less than 20% today (Collins et al. 2008). Despite these changes, the U.S. generates as well as consumes more wood based products than any other country, and while certain sectors of the U.S. forest economy have declined, regions such as the South, Upper Midwest, and the Westside Cascades have remained strong (Collins et al. 2008, Howard and Westby 2008).

According to the American Forest and Paper Association (AFPC), the current economic crisis in the U.S. has had crushing effects on the U.S. forest products industry as a whole. This sector of the economy has lost over 300,000 jobs since 2006, many of these jobs located in rural resource dependent areas with few other options available. In addition, economic conditions have led to a decreased demand for consumer goods across the board resulting in a compounding effect on the paper and packaging sectors of the forest products industry resulting in the largest one year decline recorded in this industry (American Forest and Paper Association 2009).

Declines in the housing industry, as previously mentioned, have also greatly affected the wood sector of the forest products industry, and the abundance of vacant housing inventory leads to a reduced probability for a quick recovery in this area (AFPC n.d., Howard and Westby 2008). Within the first 5 months of 2008 production of sawn softwood decreased by over 15%, and imports of this product decreased by over 30%, with other sectors experiencing similarly crushing effects of the economic crisis (Howard and Westby 2008). The AFPC (n.d.: 1) notes "together, the decline in paper and wood products sectors threatens the sustainable forestry practices that the industry makes possible, as well as raises the risk of unproductive forestland being sold for development and lost forever."

Changes toward a predominantly large scale global structure of the wood products economy, have resulted in the development and strengthening of smaller scale industrial niches for small-scale forest operations in the U.S. Small-scale production in both timber and non-timber products continue to hold a viable sector of the forest products industry, for example, within the furniture and millwork sectors firm sizes are decreasing while as a whole growth potential for niche markets offering value added products (Collins et al 2008). Collins et al. (2008:5) notes,

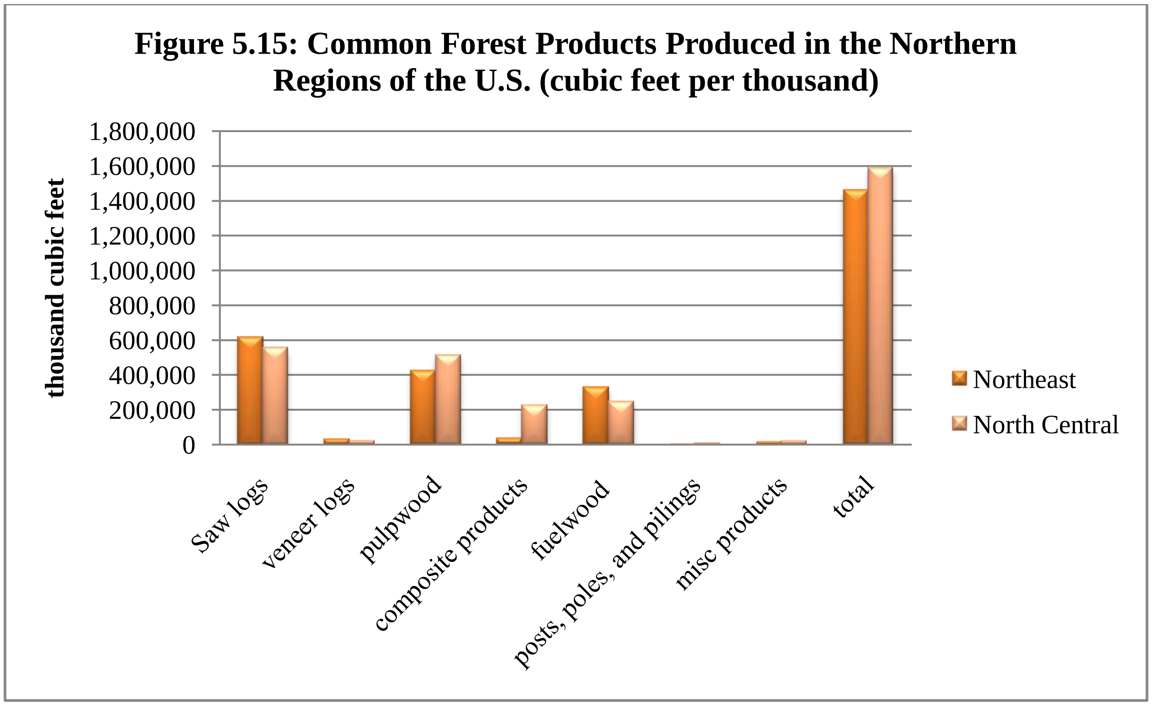
> High-value-added operations might play a role in sustaining a wood products sector in regions such as the Intermountain West or the Northeast, which do not have comparative advantage in the major commodity markets. Rooted in small communities, successful firms in these regions are closely tied to suppliers of raw materials such as the Forest Service. They can tailor operations to meet local or regional demand for services and "niche" products from natural forests, such as custom-made furniture or specialty woods (such as alder, cherry, or walnut). In such markets, producers can capitalize on the unique attributes of local resources and proximity to markets, giving local firms a distinct advantage.

Portable sawmills are a valuable tool that can be utilized throughout the small-scale forest production. They offer the relative advantage of being usable on both small and large tracts of land and serve an especially valuable role in various niche markets throughout the U.S. The next part of this chapter explores the current status of both large and small-scale forest products industries throughout the U.S. as well as overall regional changes in production trends over the past few decades. Unfortunately, data is currently not available for a direct comparison of small-scale forest landowner production trends, due to sampling system changes between past data collection in the U.S. Forest Service (USDA Forest Service 2009). Understanding the nature of both large and small-scale forest production throughout the U.S. is important in recognizing what forest landowners are doing with their land in terms of production as a whole then to later understand the context in which niches within the industry that utilize portable sawmills fit.

The following section describes 2007 U.S. regional forest production for large and small-scale forest products. Overall production trends will also be assessed to understand the changing nature of the forest products industry over the past several years.

Northern Region Forest Products

The forest products industry in the North is mainly concentrated in the production of saw logs, pulp wood, and fuel wood (Smith et.al. 2010). The Northeast's saw log production is the most prominent large scale market in the region producing over 42% of the yearly production in this region in 2007, or 613 million cu.ft., per year. Pulpwood production is also a dominant wood products market producing 29% of the total cubic feet of yearly production. Likewise, fuel wood production occupies 23% of the annual production in the Northeast. In the North Central region, saw log production is also the most prominent forest product producing about 35%, or 555 million cu.ft. per year. The region's pulpwood production was also a large part of the overall cubic feet produced per year totaling 512 million cu.ft., or 32% of overall production. Fuel wood production and composite products also occupied a large amount of the region's overall production at 16% and 14% respectively [Figure 5.15] (Smith et.al. 2010).

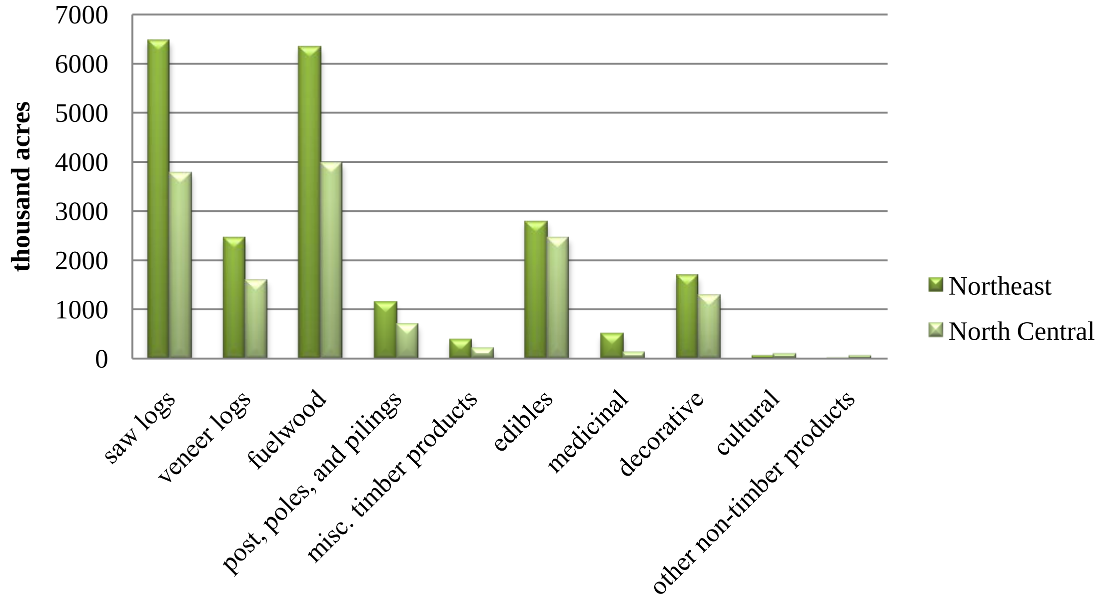


Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Small-scale production in both the Northeast and North Central regions are also primarily based in fuel wood and saw logs (Smith et.al. 2010). In the Northeast, fuel wood was produced on approximately 6.3 million acres, representing 38% of the total timber production acres, and saw logs were produced on approximately 6.5 million acres or 39% of the total timber production acres. In the North Central region, fuel wood represented 39%, or almost 4 million acres of total timber production, and saw logs represented 37%, or 3.8 million acres of total timber production.

Small-scale production data also included non-timber based forest products. Edible and decorative products are currently the most prominent non-timber based forest products in both the Northeast and North Central regions. Over 55% of the non-timber production in the Northeast, and 61% in the North Central region is in edibles. Likewise, decorative products represent 33% of the Northeast, and 32% of the North Central region's non-timber production acres (USDA Forest Service, National Woodland Owner Survey 2006) [Figure 5.16].

Figure 5.16: Forest Products Produced from Small Forestland (≤50 acre tracts) in the Northern Regions of the U.S. (thousand acres)



Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

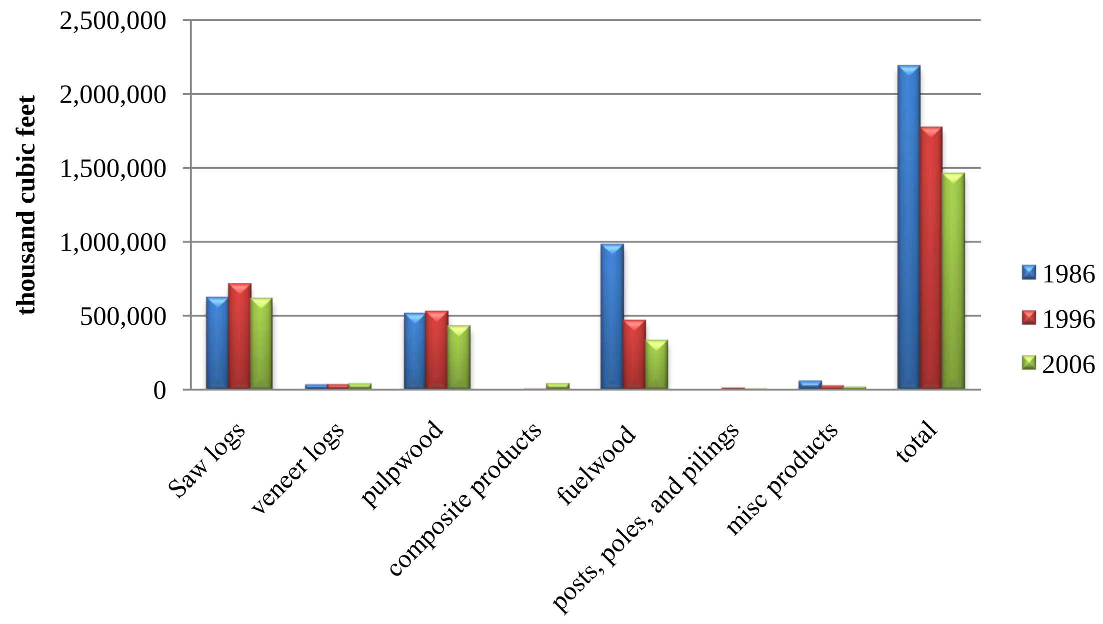
Northern Production Trends

Overall, the total production of forest products in the Northeast has continued to decrease since 1986 dropping from 2.2 billion cu.ft., to 1.8 billion cu.ft. in 1996, to less than 1.5 billion cu.ft. in 2006 [Figure 5.17] (Smith et al. 1997, 2010; Waddell et al. 1987). There was an increase in saw log production from 621.5 million cu.ft. in 1986, 714.1 million cu.ft. in 1996, with a decrease to 613.3 million cu.ft. in 2006. Veneer logs production is also following a very slight increase with production at 27.7 million cu.ft. in1986, 32.7 cu.ft. in 1996, to 34.1 million cu.ft. in 2006. Pulpwood experienced a slight increase in production from 1986 to 1996, with an increase from 510.1 million cu.ft. to

523.9 million cu.ft. respectively, but then production decreased in 2006 to 512 million cu.ft. [Figure 5.17] (Smith et al. 1997, 2010; Waddell et. al. 1987).

Composite production trends were not recorded in 1986, but increased between 1996 and 2006 from 2.1 million cu.ft. to 38.5 million cu.ft. Fuel wood production saw a major decrease from 1986 to 1996 dropping from 976.9 million cu.ft. to 466.9 million cu.ft., and experienced another decrease in production by 2006 to 325.5 million cu.ft. Posts, poles, and pilings production was not recorded in 1986, but from 1996 to 2006 remained at about 8.1 million cu.ft. Miscellaneous production also decreased from 1986 to 1996 to 2006 producing 53.1 million cu. ft., to 24.5 million cu. ft., to 14.5 million cu. ft., respectively [Figure 5.17] (Smith et al. 1997, 2010; Waddell et. al. 1987).

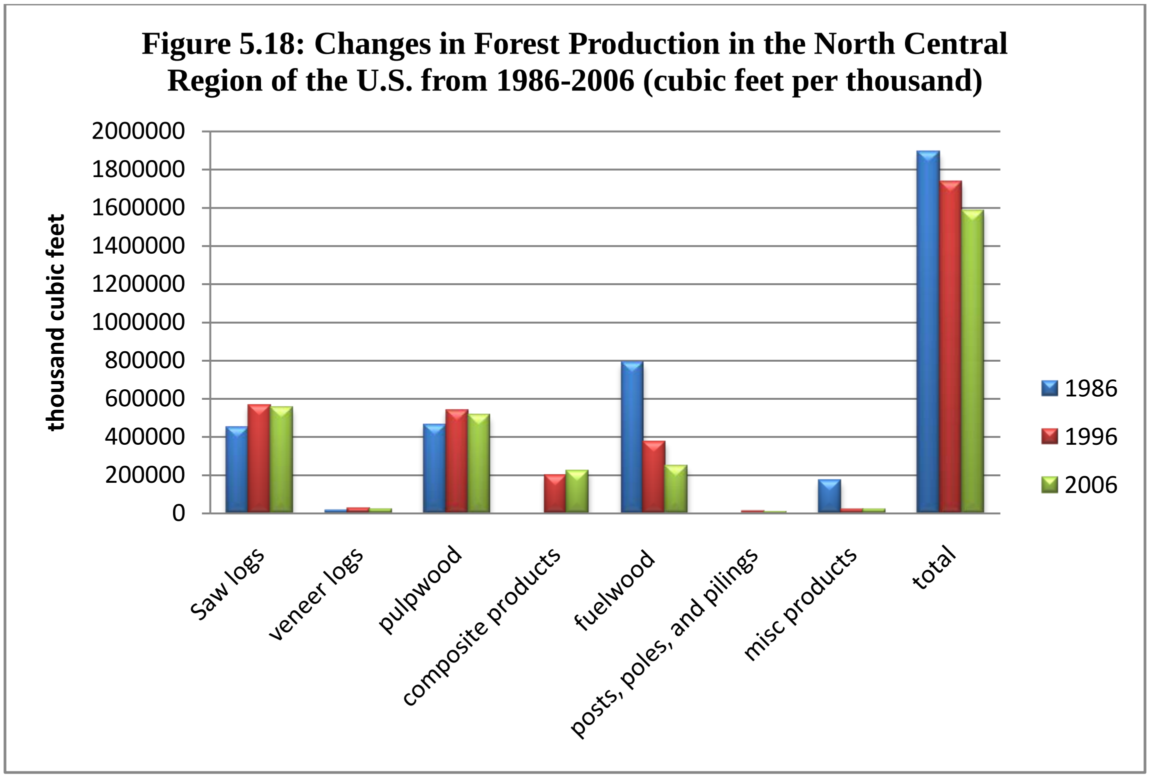
Figure 5.17: Changes in Forest Production in the Northeast Region of the U.S. from 1986-2006 (cubic feet per thousand)



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

The production trends for the North Central area during the previously recorded 20 year period has continued to decrease since 1986 dropping from 1.9 billion cu.ft., to 1.7 billion cu.ft. in 1996, to 1.6 billion cu.ft. in 2006 [Figure 5.18] (Smith et al. 1997, 2010; Waddell et al. 1989). Saw log production increased from 447.7 million cu.ft. in1986, to 565.6 million cu.ft. in 1996, with a slight decrease to 554.8 million cu.ft. in 2006. Veneer logs production is also following a very slight increase with production at 15.2 million cu.ft. in 1986, to 27.4 million cu.ft. in 1996, decreasing to 21.5 million cu. ft. in 2006. Pulpwood experienced a slight increase in production from 1986 to 1996, with an increase from 465.9 million cu.ft. to 539.8 million cu.ft. respectively, but then production decreased in 2006 to 512.1 million cu.ft.

Composite production trends were not recorded in 1986, but retained a slight increase from 199.4 million cu.ft. in1986 to 222.6 million cu. ft. in 2006. Fuel wood production again saw a major decrease in this region from 1986 to 1996 dropping from 788.5 million cu.ft. to 375.2 million cu.ft., and experienced another decrease in production to 247.1 million cu.ft. in 2006. Posts, poles, and pilings production was not recorded in 1986, but decreased from 9.1 million cu.ft. in 1996 to under 8.2 million cu.ft. in 2006. Miscellaneous production decreased drastically from 172.2 million cu.ft. in 1986, to 20.1 million cu.ft. in 1996, increasing production to 20.3 million cu.ft. by 2006 [Figure 5.18] (Smith et al. 1997, 2010; Waddell et al 1989).

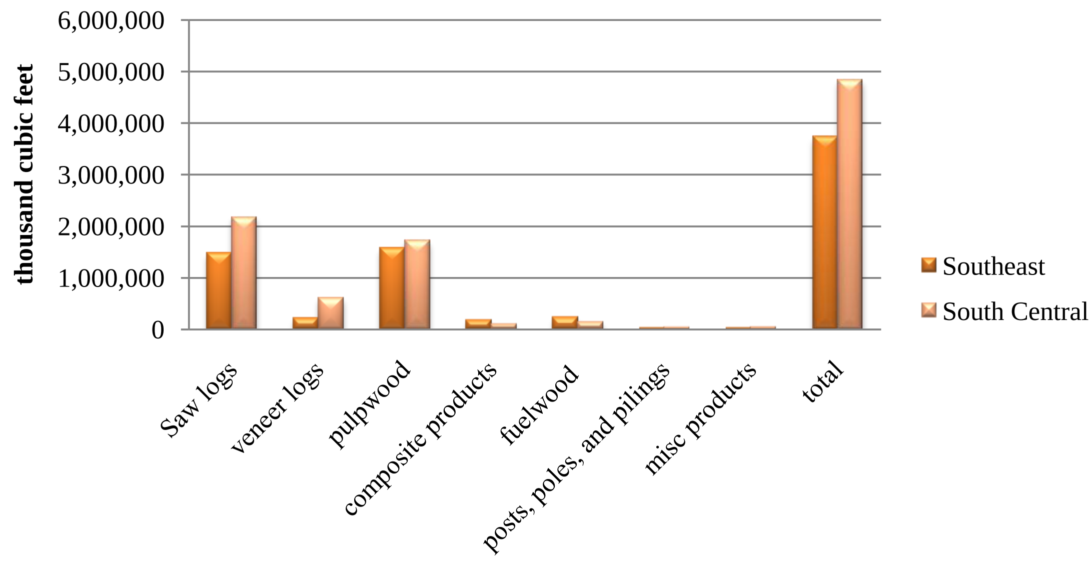


Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007.Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Southern Region Forest Products

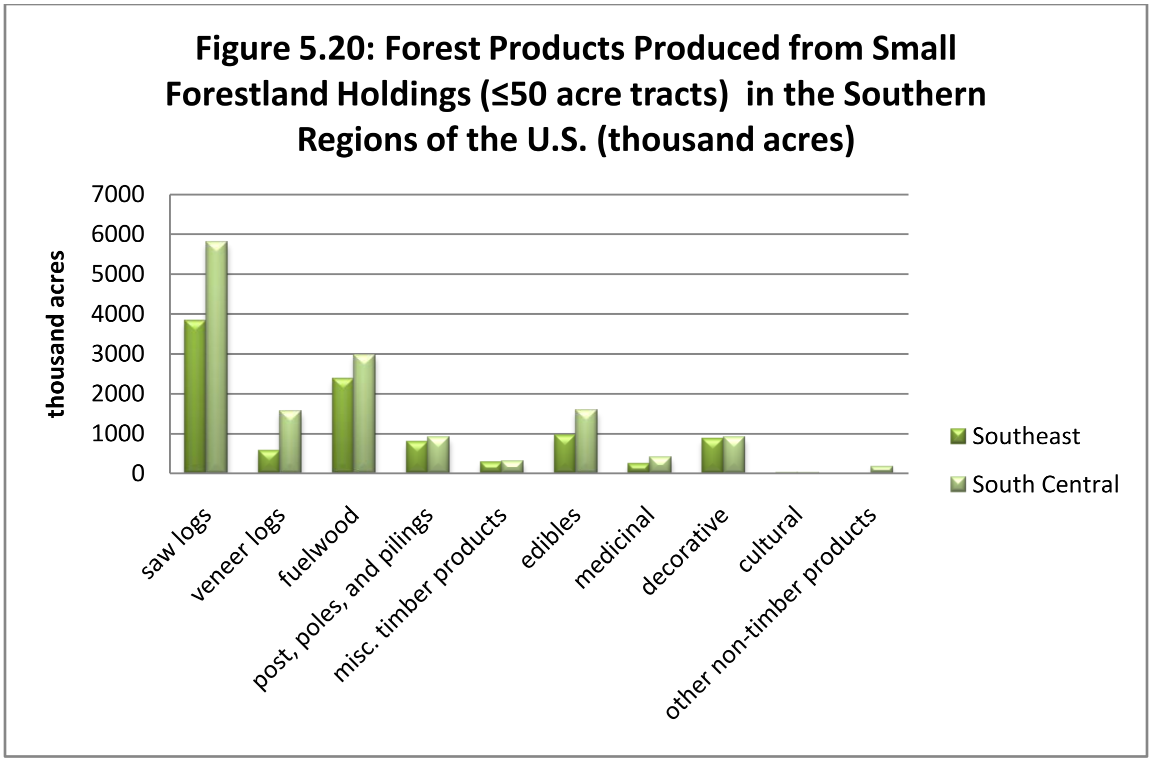
The forest products industry in the South is mainly concentrated in the production of saw logs and pulp wood (Smith et.al. 2010). The Southeast's pulpwood and saw log production is 1.6 billion cu.ft. each per year, representing 84% of the region's total forest production. In the South Central region, saw log production is 2.2 billion cu.ft. per year, with its pulpwood production at 1.7 billion cu.ft, also representing 81% of the region's total forest production. [Figure 5.19] (Smith et al. 2010).

Figure 5.19 : Common Forest Products Produced in the Southern Regions of the U.S. (cubic feet per thousand)



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007.Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

The most prominent forest products created from small forestland tracts were saw logs in both the Southeast and South Central regions, representing about 49% of the total small-scale timber products in the Southeast and 44% of the small-scale timber products in the South Central. Edibles were the most prominent non-timber based product in both the Southeast and South Central regions [Figure 5.20] (USDA Forest Service, National Woodland Owner Survey 2006).



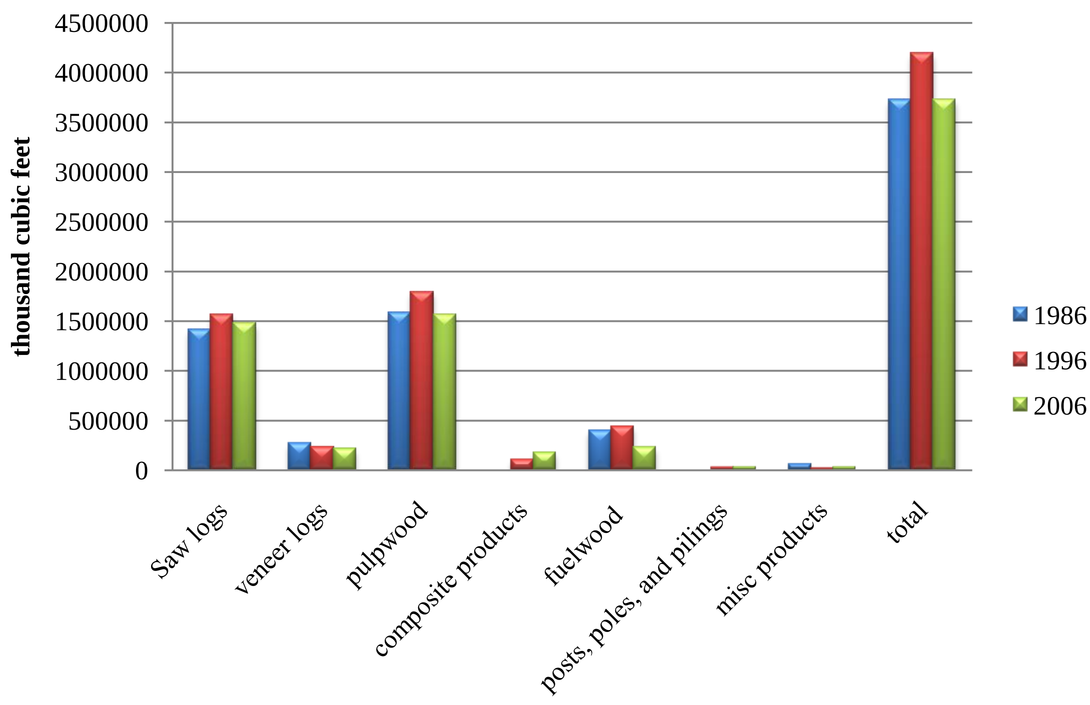
Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

Southern Production Trends

The total production in the forest products industry within the Southeast has increased from 1986 producing 3.7 billion cu.ft., to 1996 producing over 4.1 billion cu.ft., but then experienced an overall decrease in production by 2006 producing 3.7 billion cu.ft.). [Figure 5.21] (Smith et al., 1996, 2010, Waddell et al. 1989). Saw log production increased from 1.4 billion cu.ft. in 1986, to 1.5 billion by 1996, then remaining relatively steady through 2006. Veneer logs production is also following a slight decrease with production from 1986 at 270 million cu.ft. to 238 million cu.ft. by 1996, and continued to decrease to 215 million cu. ft. by 2006. Pulpwood, on the other hand, experienced a slight increase in production from 1986 to 1996, from 1.6 billion cu.ft. to 1.8 billion cu.ft., respectively, but in 2006 production decreased to 1.6 billion cu.ft.

Composite production trends were not recorded in 1986, but showed an increase from 106 million in 1996 to 180 million cu.ft. in 2006. Fuel wood production saw a slight increase from 1986 to 1996 from 401 million cu.ft. to 439 million cu.ft., but experienced a decrease in production by 2006 to a little over 230 million cu.ft. Posts, poles, and pilings production was not recorded in 1986, but increased between 1996 and 2006 from 27 million cu.ft. to over 30 million cu.ft. Miscellaneous production experienced a major decreased from 1986 to 1996 dropping from over 62 million cu.ft. to just under 21 million cu.ft., then experienced a slight increase by 2006 producing over 30 million cu.ft. [Figure 5.21] (Smith et al., 1996, 2010, Waddell et al. 1989)

Figure 5.21: Changes in Forest Production in the Southeast Region of the U.S. from 1986-2006 (cubic feet per thousand)

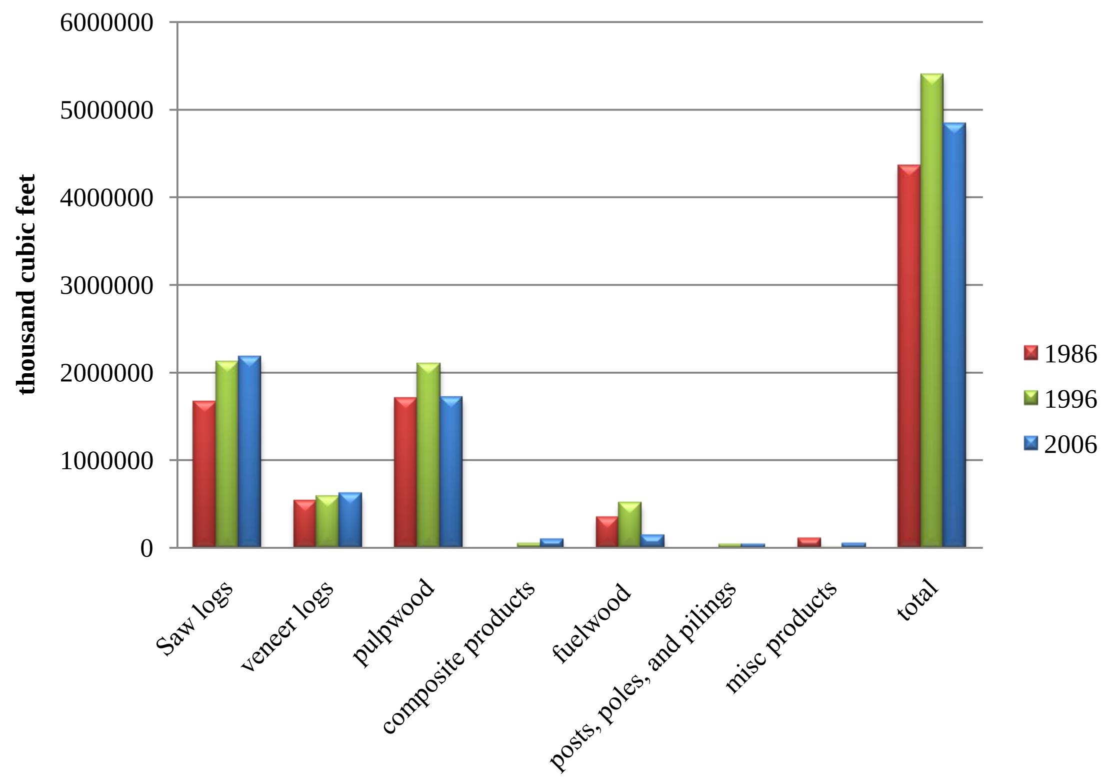


Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

The production trends for the South Central region increased from 4.3 billion cu.ft. in 1986 to 5.4 billion in 1996, but then experienced an overall decrease in production to 4.8 billion cu.ft. by 2006 [Figure 5.22] (Smith et al. 1997, 2010; Waddell 1989). There was an increase in saw log production from almost 1.7 billion cu.ft. in 1986, to 2.1 billion cu.ft. by 1996, and remaining relatively steady through 2006. Veneer logs production followed a steady increase with production at 537 million cu.ft. in 1986, to 586 million cu.ft. in 1996, to 614 million cu. ft. by 2006. Pulpwood experienced a decrease in production from 1986 to 1996, from 1.7 billion cu.ft. to, 2.1 billion cu.ft., and decreased to 1.7 by 2006.

Although composite production trends were not recorded in 1986, they showed a large increase from 1996 to 2001, increasing from almost 46 million cu.ft. to almost 98 million cu.ft. Fuel wood production increased from 1986 to 1996 from 345 million cu.ft to 509 million cu.ft., but experienced a large decrease in production between 1996 and 2001 decreasing to just under 142 million cu.ft. by 2006. Posts, poles, and pilings production was not recorded in 1986, but decreased from over 40 million cu.ft. in1996 to about 38 million cu.ft. by 2006. Miscellaneous production experienced a major decreased from 1986 to 1996 when production went from almost 104 million cu.ft. to only 2.2 million cu.ft. and then increased to 50.8 million cu.ft. by 2006 [Figure 5.22] (Smith et al. 1997, 2010; Waddell 1989).

Figure 5.22: Changes in Forest Production in the South Central Region of the U.S. from 1986-2006 (cubic feet per thousand)

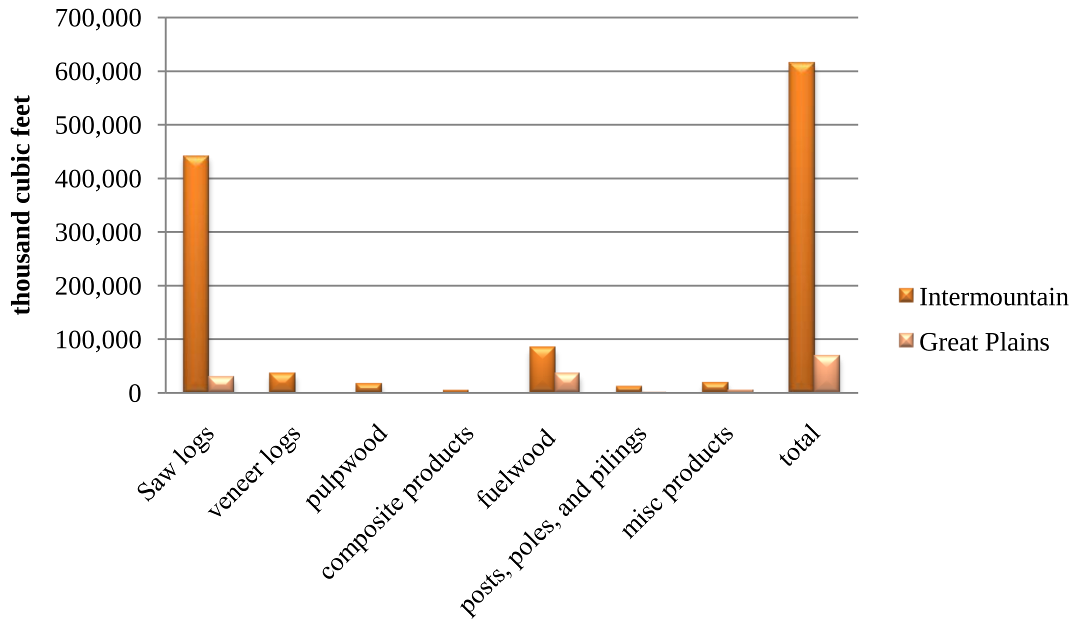


Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Rocky Mountain Region Forest Products

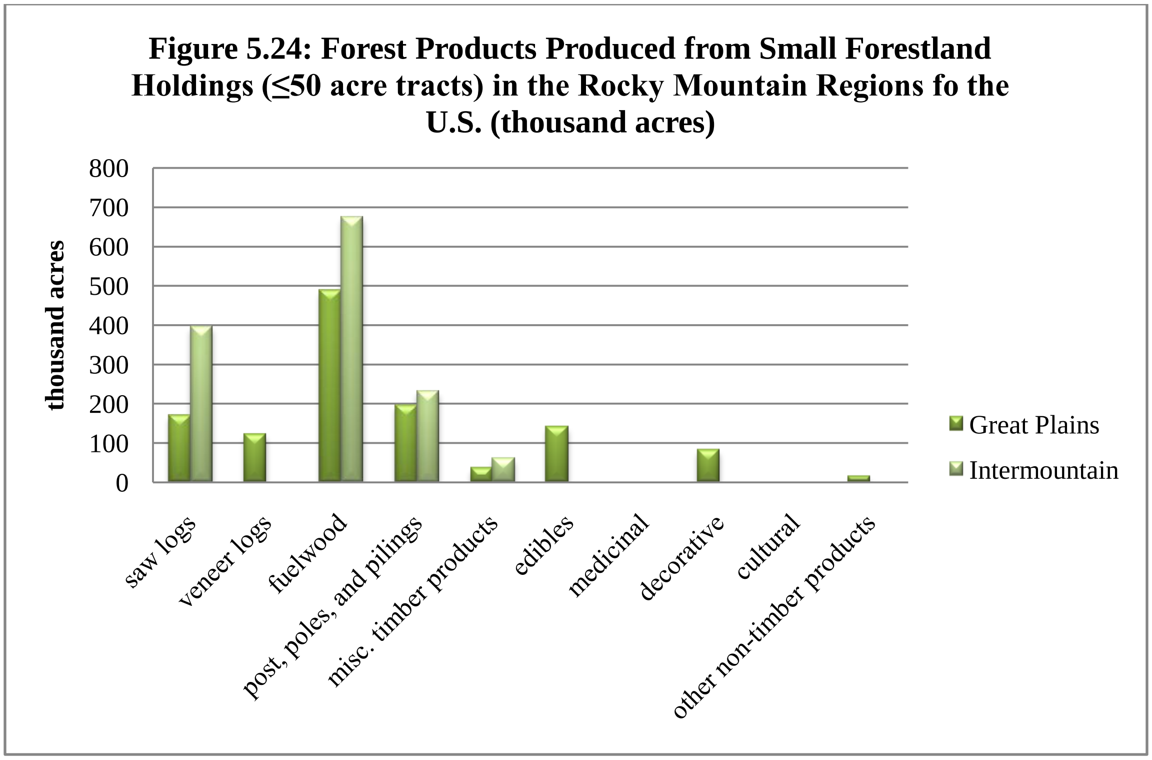
The Intermountain region’s saw log production is 441.7 million cu.ft. per year, with its fuel wood production at 84.3 million cu.ft. representing 72% and 14% of the region’s total forest products respectively [Figure 5.23] (Smith et al. 2010). The Great Plains’ saw log production is 28.6 million cu.ft. per year, representing 41% of the region’s total forest production per year. Fuel wood production is also popular in the region making up 35.5 million cu.ft., or 51% of the total forest production in the region [Figure 5.23] (Smith et al. 2010).

Figure 5.23: Common Forest Products Produced in the Rocky Mountain Regions of the U.S. (cubic feet per thousand)



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Unlike overall forest production in the Intermountain region that focuses a great deal on saw logs, forest products obtained from small-scale holdings in the Great Plains region focus primarily on fuel wood production representing about 50% of the total small-scale timber production. In addition to fuel wood, small-scale holdings in the Great Plains focused on harvesting primarily for posts, poles, and pilings making up 19% of the total timber production in the region, whereas in terms of overall large scale production in this region, that facet remains relatively low representing only 1% of the overall forest production. Non-timber based forest products do not tend to be as popular in these regions however there is some activity harvesting for edible and decorative products in the Great Plains region [Figure 5.24] (USDA Forest Service, National Woodland Owner Survey 2006).



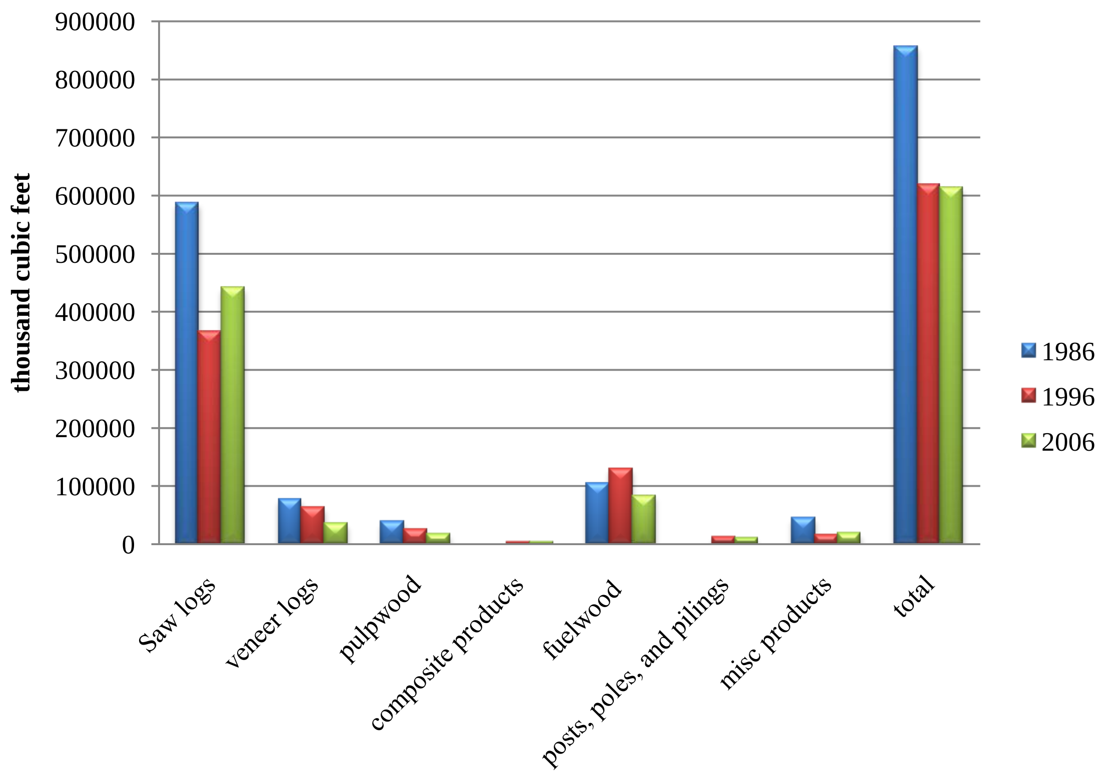
Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

Production Trends in the Rocky Mountains

The total production of forest products in the Intermountain region has continued to decrease since 1986 dropping from 856 million cu.ft., to 619 million cu.ft. in 1996, to 613 million cu.ft. by 2006 [Figure 5.25] (Smith et al.1997, 2010; Waddell 1989). The region has experienced a decrease in saw log production from just less than 588 million cu.ft. in 1986 to under 366 million cu.ft. in 1996, and then increasing to almost 442 million cu.ft. in 2006. Veneer logs production experienced a decrease with production at almost 78 million cu.ft. in 1986, to 63 million cu.ft. in 1996, to 36 million cu. ft. by 2006. Pulpwood experienced a decrease in production from 1986 to 1996, going from 39 million cu.ft. to 26 million cu.ft. respectively, and continued to decrease through 2006 to 17 million cu.ft.

Composite production trends were not recorded in 1986, but decreased from 4.6 million in 1996 to just under 4.5 million by 2006. Fuel wood production increased from 1986 to 1996 going from under 106 million cu.ft. to over 130 million cu.ft., followed by a decrease in production to under 85 million by 2006. Posts, poles, and pilings production was not recorded in 1986, but decreased from 1996 to 2006 falling from over 13 million to a under 11 million cu.ft. Miscellaneous production also decreased from 1986 to 2001 producing over 45 million cu.ft. in 1986, over 16 million cu.ft. in 1996, to 18.9 million cu.ft. by 2006 [Figure 5.25] (Smith et al.1997, 2010; Waddell 1989).

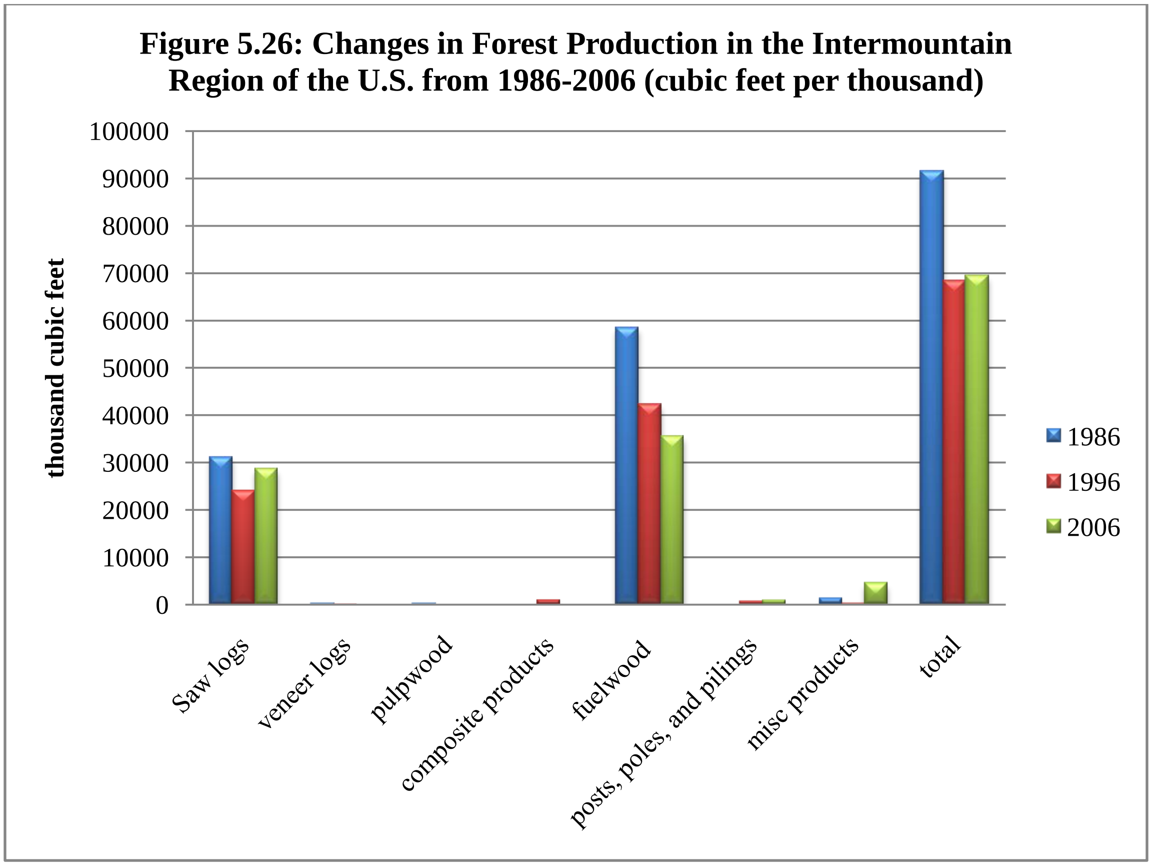
Figure 5.25: Changes in Forest Production in the Intermountain Region of the U.S. from 1986-2006 (cubic feet per thousand)



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Production in the Great Plains region decreased from1986 dropping from over 91 million cu.ft. in 1986, to 68 million cu.ft. in 1996, but regained strength increasing production to over 69 million cu.ft. in 2006 [Figure 5.26] (Smith et al. 1997, 2010; Waddell 1989). Saw log production decreased from just less than 32 million cu.ft. in 1986, to 24 million in 1996, then increased to almost 29 million cu.ft. in 2006. Veneer logs production decreased from 193,000 cu.ft. in 1986, to 102,000 cu.ft. in 1996, to nothing by 2006. Pulpwood experienced a decrease in production from 1986 to 2001, dropping from 223,000 cu.ft. in 1986, to nothing by 1996.

Composite production trends were not recorded in 1986, but decreased from 985,000 cu.ft. in 1996 to almost nothing by 2006. Fuel wood production decreased from 1986 to 2001 dropping from over 58 million cu.ft. in 1986, to 42 million cu.ft. in 1996, to 35 million cu.ft. by 2006. Although posts, poles, and pilings production was not recorded in 1986, production increased between 1996 and 2001 from 667,000 cu.ft. to 849,000 cu.ft. Miscellaneous production decreased from 1.3 million cu.ft. in 1986 to only 203,000 cu.ft. in 1996 then increased to 4.4 million cu.ft. in 2006 [Figure 5.26] (Smith et al. 1997, 2010; Waddell 1989).

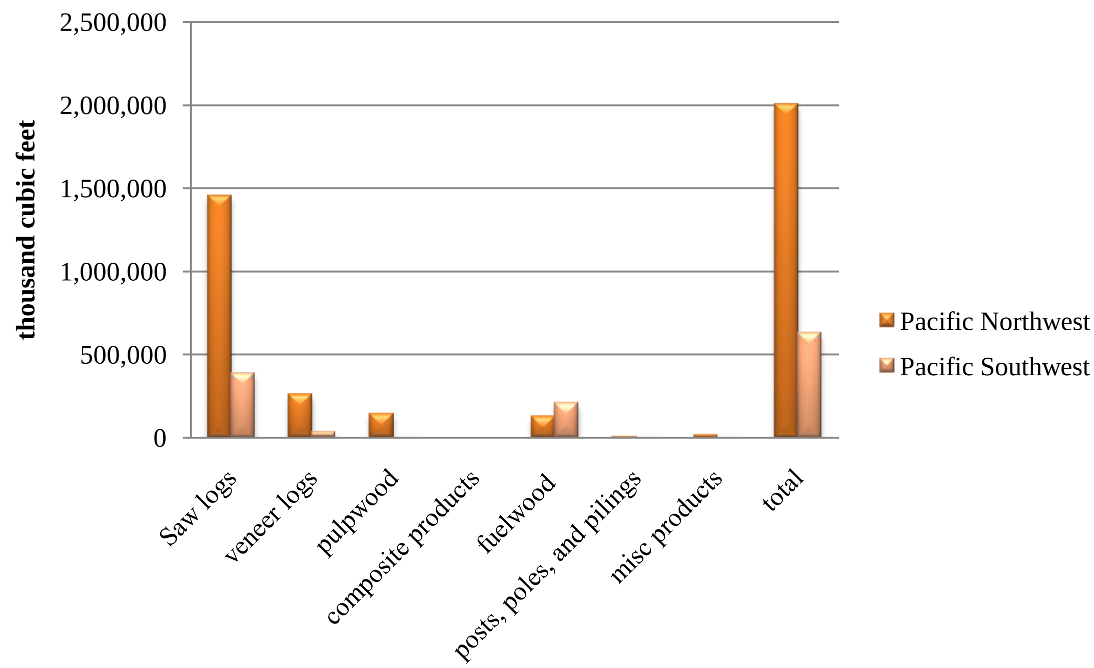


Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Forest Products in the West/Pacific Coast Regions

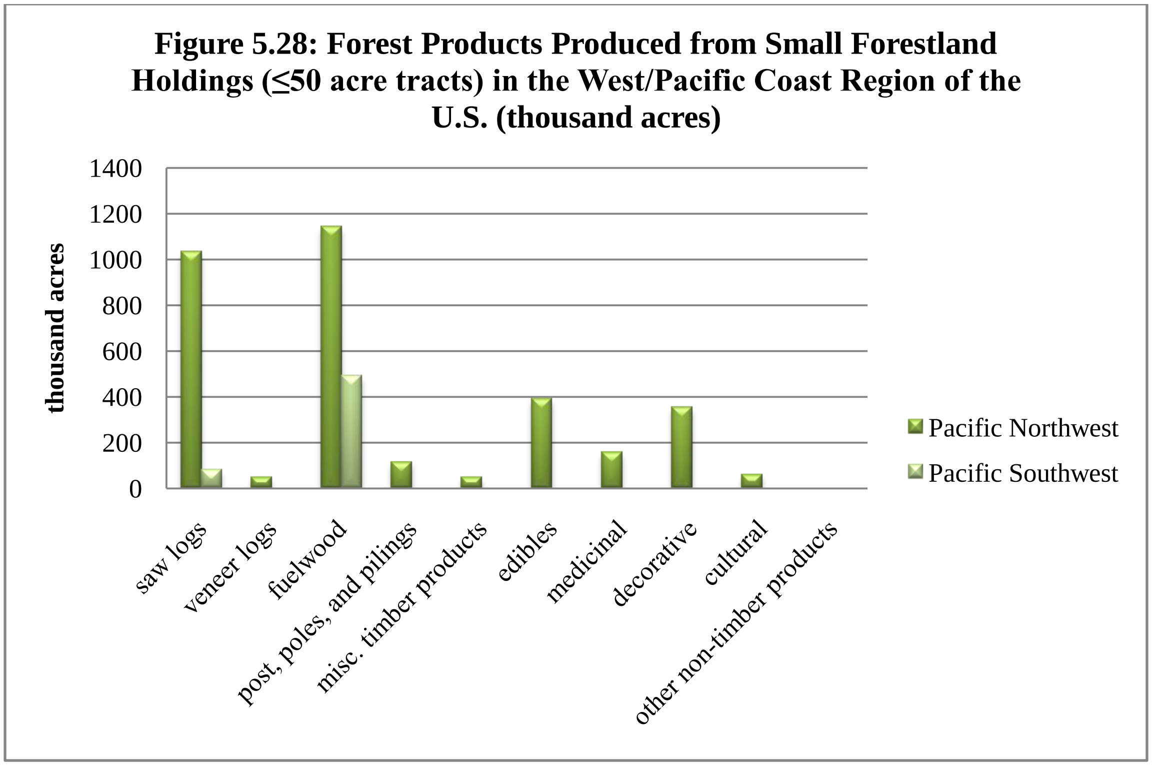
In the Pacific Northwest, saw log and veneer log production are the most prominent forest products representing 1.5 billion cu.ft., or 73% per year, and 257.7 million cu.ft. or 13% per year, respectively [Figure 5.27] (Smith et al. 2010). In the Pacific Southwest, saw log production is 386.8 million cu.ft. representing 62% of the total forest production in this region per year, with its fuel wood production at 206.1 million cu.ft. or 33% of the region's overall forest production[Figure 5.27] (Smith et al. 2010).

Figure 5.27: Common Forest Products Produced in the West/Pacific Coast Regions of the U.S. (cubic feet per thousand)



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

On small-scale tracts in the Pacific Coast, the forest products obtained were primarily fuel wood and saw logs in both the Pacific Northwest and all of the small-scale production in the Pacific Southwest. In the Pacific Northwest various non-timber based forest products such as edibles and decorative products, as well as some medicinal products were created [Figure 5.28] (USDA Forest Service, National Woodland Owner Survey 2006).



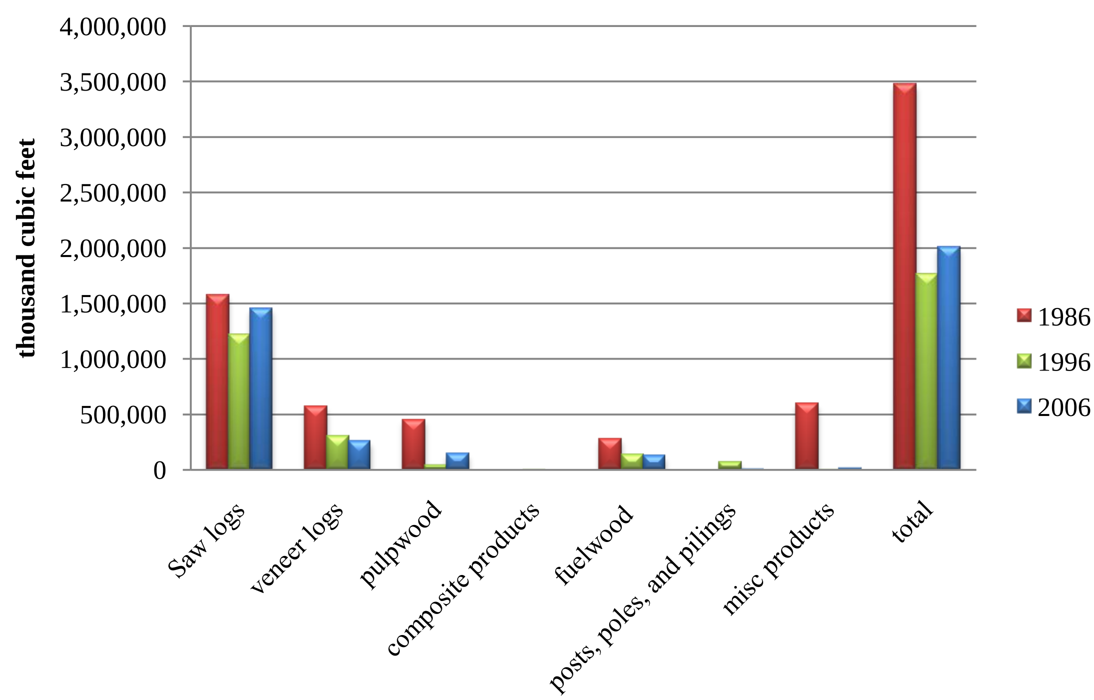
Data: U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

West/Pacific Coast Production Trends

The total production in the Pacific Northwest in the forest products industry has continually decreased since 1986 dropping from over 3.4 billion cu.ft., to under 1.8 billion cu.ft. by 1996 and increased to 2.0 billion cu.ft. in 2006 [Figure 5.29] (Smith et al.1997, 2010; Waddell 1989). Saw log production has decreased from over 1.5 billion cu.ft. in 1986, to 1.2 billion in 1996 and increased to 1.5 billion cu.ft. in 2006. Veneer logs production decreased from 573 million in1986, to 297 million in 1996, and continued to decrease to 258 million cu.ft. by 2006. Pulpwood experienced a significant decrease in production from 1986 to 1996, from over 450 million cu.ft. to only 40 million cu.ft., then increased dramatically to almost144 million cu.ft. by 2006.

Composite production trends were not recorded in 1986, but increased from 1.4 million cu.ft. in 1996 to almost nothing by 2001. Fuel wood production decreased from 1986 to 1996 from 278 million cu.ft. to under 138 million cu.ft. and continued to decrease through 2006 to 125 million cu.ft. Posts, poles, and pilings production was not recorded in 1986, but decreased dramatically between 1996 and 2006 going from 68.6 million cu.ft. to only 7.6 million cu.ft. Miscellaneous production experienced a major decrease from 1986 to 1996 dropping from 596 million cu.ft. in 1986 to under 3 million cu.ft. by 1996 increased to 14.8 million cu.ft in 2006 [Figure 5.29] (Smith et al.1997, 2010; Waddell 1989)..

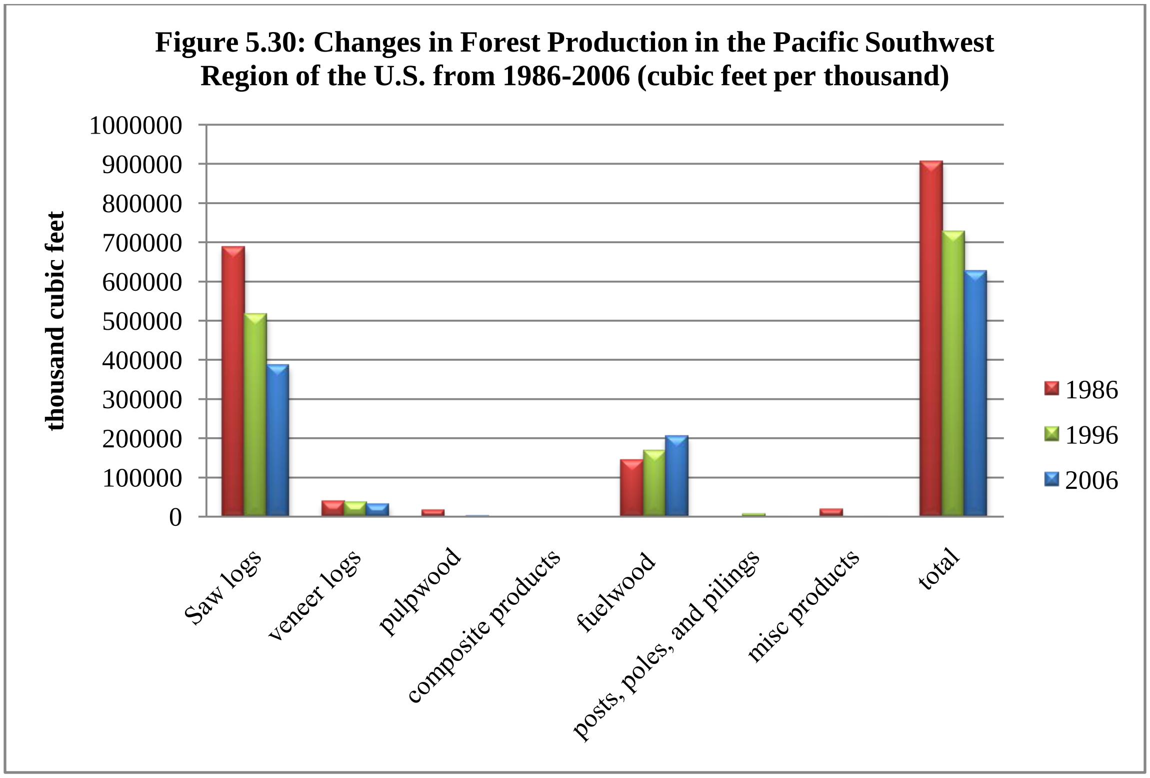
Figure 5.29: Changes in Forest Production in the Pacific Northwest Region of the U.S. from 1986-2006 (cubic feet per thousand)



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

The production trends for the Pacific Southwest have continued to decrease since 1986 from almost 907 million cu.ft., to less than 728 million cu.ft. by 1996, and has continued to decrease through 2006 to only 628 million cu.ft. [Figure 5.30] (Smith et al. 1997, 2010; Waddell 1989). Saw log production has decreased from almost 688 million cu.ft. in 1986, to 515 million cu.ft. in 1996, then continued to decrease to under 387 million cu.ft. by 2006. Veneer logs production decreased with production at 38 million cu.ft. in 1986, to 35 million cu.ft. in 1996, to 32 million cu. ft. in 2006. Pulpwood experienced a significant decrease in production from 1986 to 2001, dropping from 17 million cu.ft. in 1986 to 0 in 1996 and increased to 2.4 million in 2006.

Composite production trends were not recorded in 1986, and were recorded at 0 for 1996 and 2001. Fuel wood production increased from 145 million in 1986 to almost 170 million in 1996 and continued to increase to 206 million cu.ft. in 2006. Posts, poles, and pilings production was not recorded in 1986, but decreased from 7 million cu.ft. to only 405,000 million cu.ft. between 1996 and 2006. Miscellaneous production decreased from 18 million cu.ft. to 245,000 between 1986 and 1996, and continued to decrease to 124,000 by 2006 [Figure 5.30] (Smith et al. 1997, 2010; Waddell 1989)..



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007.Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Discussion

The U.S. forest products industry has altered production levels of various timber products both between regions and within the regions themselves as evidenced through the overall production trends throughout the U.S. during the previous 20 year recorded period. Within the overall forest products industry, small-scale production continues to retain a small portion of income generation within the overall scheme of the industry. However, with changes in automation and increasing technologies that are capable of driving production to a whole new level, small-scale production becomes increasingly less capable of competing with larger forest production. Likewise, with the current economic status in the U.S. it becomes increasingly important that small-scale forestland holders are able find new multi-faceted uses for both the timber on their land and as an additional income generation stream. One way small-scale forest production has been able to remain competitive is through the development of niche markets utilizing the timber they have available that would not be utilized or is not economical for large-scale industrial operations.

One particular forest production technology, portable sawmills, can be utilized on small tracts of land, within market niches, and can become a useful part of a small-scale forest management plan, as well as a way of generating income, and improve forest health. Portable sawmills are relatively inexpensive when compared to other harvesting and processing technologies. Small-scale equipment, in general, is sometimes seen by landowners as more environmentally friendly, and is often the only type of operation that will harvest on small tract sizes due to reduced operating costs associated with smaller tracts (Updegraff and Blinn 2000), and portable sawmills fit this criteria. They can often be pulled on a trailer behind a pick-up truck or ATV and cause minimal site damage or soil disturbance. These small-scale technologies have the advantage on uneven-aged managed activities as well as on sensitive sites. Likewise, on a small-scale level as well as in the specialized thinning market, there is a competitive advantage of utilizing smaller scaled equipment which often come at a reduced capital investment as well as reduced subsequent operating costs (Updegraff and Blinn 2000).

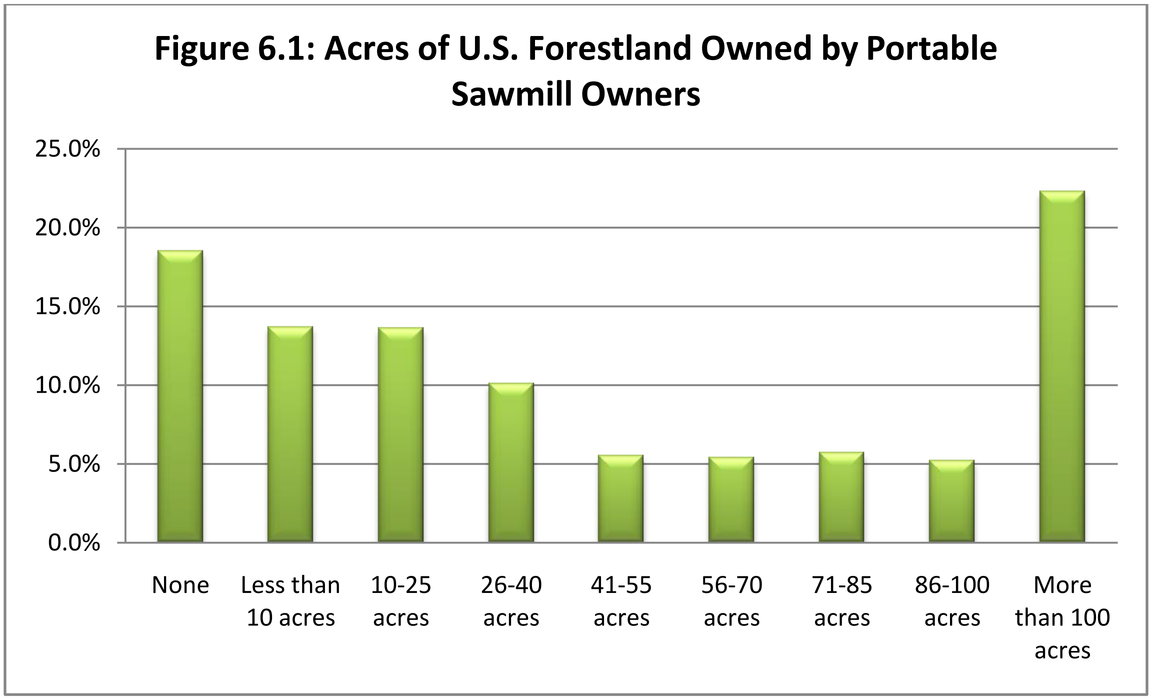
The following chapters reveal the results from the national portable sawmill survey in terms of an exploration of forestland ownership characteristics of portable sawmill owners and timber species used in portable sawmilling; harvesting/removal practices of portable sawmill owners; portable sawmills as a forest management and/or small-scale production tool; demographic and other ownership characteristics of portable sawmill owners including equipment used, and microenterprise characteristics- including the adoption/diffusion characteristics accompanying their microenterprise development; as well as a potential application of portable sawmills in the Southern U.S. as a land management strategy in cooperation with forestland owners.

PORTABLE SAWMILL OWNERS’ FORESTLAND AND TIMBER SPECIES UTILIZATION CHARACTERISTICS AND PORTABLE SAWMILLS AS A SMALL-SCALE FOREST PRODUCTION TOOL

This chapter will report on the forest based results from the national portable sawmill survey. Various characteristics of portable sawmill owners’ land ownership composition, timber species used in portable sawmills, and timber removal/harvesting for use in their portable sawmill, as well as their accompanying land management objectives will be explored followed by the application of portable sawmills as a small-scale forest production tool.

Forestland Ownership Characteristics of Portable Sawmill Owners

The forestland ownership characteristics varied among portable sawmill owners, ranging from owning no land to owning more than 100 acres. Figure 6.1 illustrates the acres of forestland owned by survey respondents throughout the U.S. There was no statistically significant relationship between the acres of forestland a portable sawmill owner owned and the U.S. region they live in. Likewise there was no statistically significant relationship between the acres of forestland a portable sawmill owner owned and their age, education, reported income, or percent of household income generated from portable sawmill work. However Figure 6.1 does show a “U” shaped curve. Many respondents own no land, while others own over 100 acres. These data show that owners of small tracts (41-100 acres) are unlikely adapters.



Timber Species used in Portable Sawmills Compared with Available Species Timber Volumes

A variety of timber species are milled with portable sawmills. Throughout the U.S. as a whole, maple, oak, pine, cedar, and cherry are the most popular species of tree milled with a portable sawmill.

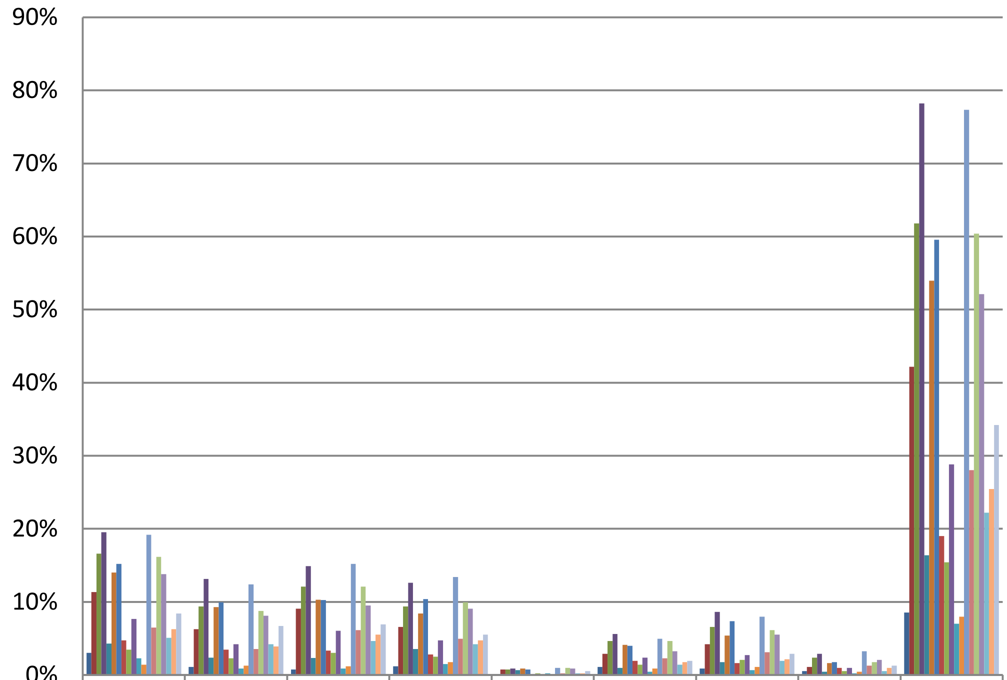
In the Northeast, oak, pine, and maple are the three most popular species used in a portable sawmill and soft and hard maple, white and red pine, and select red oaks were the most prevalent species located in this region. In the North Central region, oak, pine, and cedar are the most popularly milled species and cottonwood and aspen, hard and soft maple, and select white oaks were the most made up the most volume of growing stock in this region. In the Southeast, oak, pine, cherry, and maple are the most popularly milled species whereas loblolly and shortleaf pine, longleaf and slash pine, and yellow poplar had the highest volume of growing stock in this region. In the South Central region, oak, cedar, and cherry are the most popular species milled whereas loblolly and shortleaf pine were by far the most prevalent species in the region followed by other red oaks [Figures 5.7, 5.8, and 6.2].

In the Great Plains, there was a variety of species milled at the same percentage and few available abundant species in the region including softwoods, ponderosa and Jeffery pine. In the Intermountain region, oak, maple, pine, and cherry were again the most popularly milled species despite the abundant availability of Douglas fir, true fir, and lodgepole pine. In the Pacific Northwest, oak, pine, and maple were milled the most with portable sawmills, despite the abundance of douglas fir, western hemlock, and true fir. In the Pacific Southwest, pine and oak were the most popularly species milled with portable sawmills as compared to the abundant net volume of Douglas fir, true fir, and other softwoods [Figures 5.7, 5.8, and 6.2].

Throughout the U.S., timber species utilized in portable sawmills tended to often correlate with the timber species that are available in abundance within those regions. However in some cases although there is an abundance of available species as was the case with Douglas fir in the Intermountain, Pacific Northwest, and Pacific Southwest, a very small percentage of the timber milled in that region with a portable sawmill includes that species, most likely due to the large d.b.h. of the trees themselves.

Timber species that are milled throughout U.S. offers an indication of what species residents of that region value as a productive lumber species. Some species, like cherry, tend to transcend regional abundance throughout the east coast, and are one of the most popularly milled species despite the fact that other species in those regions might be more readily available [Figures 5.5 and 5.6]. Timber utilized on a small-scale level with a portable sawmill should barely affect the overall abundance of growing stock throughout the U.S., therefore it is not necessary for small-scale producers to avoid less abundant species. In addition, timber could be utilized in a portable mill that has very recently died, or been removed for thinning, or other forest maintenance purposes, minimizing any additional harm to the forest structure while maximizing current forest management techniques.

Figure 6.2: Timber Species Used in Portable Sawmills by Expanded U.S. Region (n=949)



	NE	NC	SE	SC	GP	IM	PNW	PSW	TOTAL
Alder	3%	1%	1%	1%	0%	1%	1%	1%	9%
Hickory	11%	6%	9%	7%	1%	3%	4%	1%	42%
Maple	17%	9%	12%	9%	1%	5%	7%	2%	62%
Oak	20%	13%	15%	13%	1%	6%	9%	3%	78%
Sweetgum	4%	2%	2%	4%	1%	1%	2%	0%	16%
Walnut	14%	9%	10%	8%	1%	4%	5%	2%	54%
Cedar	15%	10%	10%	10%	1%	4%	7%	2%	60%
Douglas Fir	5%	3%	3%	3%	0%	2%	2%	1%	19%
Fir	3%	2%	3%	2%	0%	1%	2%	1%	15%
Hemlock	8%	4%	6%	5%	0%	2%	3%	1%	29%
Juniper	2%	1%	1%	2%	0%	0%	1%	0%	7%
Larch	1%	1%	1%	2%	0%	1%	1%	0%	8%
Pine	19%	12%	15%	13%	1%	5%	8%	3%	77%
Spruce	6%	4%	6%	5%	0%	2%	3%	1%	28%
Cherry	16%	9%	12%	10%	1%	5%	6%	2%	60%
Poplar	14%	8%	9%	9%	1%	3%	6%	2%	52%
Beech	5%	4%	5%	4%	0%	1%	2%	1%	22%
Birch	6%	4%	6%	5%	0%	2%	2%	1%	25%
Other	8%	7%	7%	6%	1%	2%	3%	1%	34%

There was a statistically significant relationship between certain species of timber milled with portable sawmills and whether owners operated their portable sawmill as a business or hobby [Table 6.1]. Those who processed alder with their mill were more likely to operate as a part-time business and hobby than any other business structure in the Northeast (χ^2=11.68, p=.05), South Central (χ^2=13.30, p=.05), and Pacific Northwest regions (χ^2=9.59, p=.05).

Portable sawmill owners who processed hickory were more likely to operate as a hobby only than any other business structure in the Northeast (χ^2=12.00, p=.05), Southeast (χ^2=10.58, p=.05), and South Central regions (χ^2=14.10, p=.05). Those who processed oak were more likely to operate as a part-time business and hobby than any other business structure in the North Central region (χ^2=13.95, p=.05), and as a hobby only in the Southeast region (χ^2=13.03, p=.05). Of those portable sawmill owners who processed Douglas fir, they were more likely to operate their mill as a part-time business and hobby than any other business structure in the Northeast (χ^2=28.77, p=<.001), South Central (χ^2=18.12, p=<.001), and Pacific Northwest regions (χ^2=9.68, p=.05), but as a part-time business only in the Pacific Southwest region (χ^2=10.36, p=.05) [Figure 6.1].

Those who processed fir were more likely to operate as a part-time business and hobby than any other business structure in the Northeast (χ^2=10.03, p=.05), and as a part-time business only than any other business structure in the Intermountain region (χ^2=16.08, p=.05). Portable sawmill owners who processed hemlock were more likely to operate as a hobby only than any other business structure in the Southeast region (χ^2=10.6, p=.05). Those who processed juniper with their mill was equally as likely to operate as a full-time business, part-time business, or part-time business and hobby in the

Southeast (χ^2=15.42, p=.05), and as a full-time business in the Intermountain region (χ^2=9.45, p=.05) [Figure 6.1].

Portable sawmill owners who processed larch in the Intermountain region were more likely to operate as a full-time business than any other business structure (χ^2=12.17, p=.05). Those who processed pine in the Southeast were more likely to operate as a hobby only than any other business structure (χ^2=11.84, p=.05). Those who processed spruce in the Intermountain region were more likely to operate as a part-time business than any other business structure (χ^2=12.28, p=.05), whereas in the Pacific Northwest they were more likely to operate as a hobby only than any other business structure (χ^2=10.06, p=.05). Portable sawmill owners who processed cherry were most likely to operate as part-time business and hobby than any other business structure in the Northeast (χ^2=10.72, p=.05), and as a hobby only as compared to any other business structure in the South Central region (χ^2=8.50, p=.05). Finally, those who processed poplar were more likely to operate as a hobby only than any other business structure in the Pacific Northwest (χ^2=10.72, p=.05). There was no variation in the operational usage of portable sawmill owners when processing the following species in any region of the U.S. Those species include maple, beech, sweet gum, birch, cedar, or miscellaneous other species [Figure 6.1].

The variation in timber species based on whether a portable sawmill owner operated as part of a business or hobby illustrates offers an indication of profitability and demand for certain species in a region over others. Those who operate as a hobby would be more likely to utilize timber they prefer or those that were more readily available, whereas if someone is operating as a business, it is presumed that they would try to mill timber that they could sell.

Table 6.1: Variation in the Species of Timber Milled in a Portable Sawmill Depending on How the Mill is Used, by Expanded Region

Timber Species	Region	Full Time Business	FT Business and Hobby	Part Time Business	PT Business and Hobby	Hobby Only	TOTAL	χ2	Fisher's Exact
Alder	*NE*	2.2%	0.4%	1.8%	4.4%	3.1%	12%	11.68*	.029
	SC	2.0%	0.0%	0.0%	4.1%	1.4%	7%	13.30*	.009
	PNW	0.0%	1.1%	3.2%	4.3%	0.0%	9%	9.59*	.018
Hickory	*NE*	0.4%	0.0%	4.9%	18.5%	19.4%	43%	12.00*	.010
	SE	1.2%	0.6%	6.9%	15.5%	23.6%	48%	10.58*	.020
	SC	0.0%	0.0%	7.5%	10.9%	23.1%	42%	14.10*	.002
Oak	*NC*	0.6%	0.0%	8.3%	34.4%	33.1%	76%	13.95*	.005
	SE	3.5%	1.2%	13.2%	21.3%	38.5%	78%	13.03*	.011
Walnut	*SE*	3.5%	0.6%	6.9%	13.8%	28.7%	53%	9.51*	.032
	SC	1.4%	0.0%	6.1%	17.7%	27.2%	52%	8.80*	.032
Douglas Fir	*NE*	3.5%	0.9%	3.5%	6.2%	4.0%	18%	28.77**	.000
	SC	4.1%	0.0%	0.7%	6.8%	6.1%	18%	18.12**	.002
	PNW	3.2%	2.2%	2.2%	4.3%	4.3%	16%	9.68*	.050
	PSW	2.9%	0.0%	14.3%	5.7%	2.9%	26%	10.36*	.013
Fir	*NE*	1.8%	0.0%	0.9%	7.5%	3.1%	14%	10.03*	.030
	IM	3.1%	0.0%	10.8%	4.6%	1.5%	20%	16.08*	.003
Hemlock	*SE*	2.3%	0.0%	2.3%	10.9%	16.1%	32%	10.6*	.018
Juniper	*SE*	1.2%	0.6%	1.2%	1.2%	0.6%	5%	15.42*	.012
	IM	3.1%	0.0%	1.5%	1.5%	0.0%	6%	9.45*	.073
Larch	*IM*	4.6%	1.5%	1.5%	3.1%	1.5%	12%	12.17*	.027
Pine	*SE*	4.6%	0.0%	16.7%	23.6%	34.5%	79%	11.84*	.030
Spruce	*IM*	6.2%	3.1%	9.2%	7.7%	6.2%	32%	12.28*	.014
	PNW	3.2%	0.0%	0.0%	10.8%	16.1%	30%	10.06*	.020
Cherry	*NE*	2.6%	0.0%	6.6%	27.3%	26.4%	63%	10.72*	.028
	SC	1.4%	0.0%	8.8%	21.8%	29.9%	62%	8.5*	.039
Poplar	*PSW*	8.6%	0.0%	2.9%	8.6%	31.4%	51%	10.72*	.010
Maple	*No variation in any region based on how sawmill is used*								
Beech	*No variation in any region based on how sawmill is used*								
Sweet gum	*No variation in any region based on how sawmill is used*								
Birch	*No variation in any region based on how sawmill is used*								
Cedar	*No variation in any region based on how sawmill is used*								
Other	*No variation in any region based on how sawmill is used*								

*p=.05**, *p=<.001*** (Less than 20% of expected freq= <5, 0% of expected freq=<.05)

Portable Sawmill Owners' Timber Removals/Harvests

Approximately 73% of respondents indicated that they harvest timber from their own land. There was a statistically significant positive relationship between the number of acres owned by a portable sawmill owner and whether they harvest from their own land (coef.=.30, p=<.001), therefore the more land a portable sawmill owner owned, the more likely they are to be harvesting timber from their land than from the land of others.

There was a statistically significant positive relationship between harvesting from a portable sawmill owner's own land and income levels (coef.=.01, p=.05), meaning those who harvested from their own land often had higher income levels than those who did not. This can be attributable to the fact that those with higher incomes would be more likely to own more land than those with lower incomes. However there was no statistically significant correlation between the percent of income a portable sawmill owner obtained from milling and whether they harvest timber on their own land.

There also was no statistically significant relationship between whether a portable sawmill owner harvested timber from their own land and the portable sawmill owner's age or education. Likewise there was no statistically significant association between harvesting timber on their own land and what region of the U.S. they live in. Finally, the relationship between a portable sawmill owner's operating expenses in relation to the revenue they generate from their portable sawmill is not statistically correlated to whether or not they harvest timber from their own land.

About 61% of portable sawmill owners own forestland that is adjacent to their home. Approximately 16% of portable sawmill owners do not own forestland at all, and rely on getting timber from someone else's land, purchasing logs, or through salvage activities. There was a statistically significant relationship between the proximity of a portable sawmill owner's forestland to their home and whether they harvest timber from their land (χ^2= 431.46, p=<.001) [Table 6.2]. In general, the close proximity a portable sawmill owner's forestland was to their home the more likely they were to harvest timber from their home, except when the forestland was over fifty miles away. Those with forestland over fifty miles away were almost as likely to harvest from their own land as compared with an owner with land less than ten miles from their home. However, the proximity of forestland to a respondent's home was not correlated with any statistical significance to their region, what their expenses are compared to revenue generated from their mill, or by costs or charges incurred per board foot while operating their mill. The "No" column represents those who do not harvest from their own land, but may harvest timber from someone else's land or may instead purchase timber to use in their mill.

Table 6.2: Whether Respondents Harvest Timber from their Own Land in Relation to the Forestland Proximity to Home

	Harvest from Own Land		
	Yes	No	Total
Do not own forestland	7 0.8%	132 15.1%	139 15.9%
Adjacent to home	477 54.5%	53 6.1%	530 60.6%
Less than 10 miles from my home	74 8.5%	17 1.9%	91 10.4%
11-20 miles from my home	20 2.3%	4 0.5%	24 2.7%
21-30 miles from my home	9 1.0%	1 0.1%	10 1.1%
31-40 miles from my home	4 0.5%	2 0.2%	6 0.7%
41-50 miles from my home	4 0.5%	3 0.3%	7 0.8%
Over 50 miles from my home	58 6.6%	10 1.1%	68 7.8%
Total	653 74.6%	222 25.4%	875 100.0%

χ^2= 431.46, p=<.001 (Less than 20% of expected freq= <5, 0% of expected freq=<.05)

There was a statistically significant positive relationship between the percent of time a portable sawmill owner harvested from their own land and the amount of forestland they owned, meaning the more forestland owned the higher the percentage of time they will harvest timber from their own land for use in their mill (coef.=.31, p=<.001). The larger amount of forestland owned, the more time would need to be spent on forest management, so it would make sense that those owning larger tracts of land would harvest timber from their land more often and in turn have a harvested supply of timber from their own land more often than those owning smaller tracts.

There is also a statistically significant relationship between the percent of time timber is harvested from their own land to use with their portable sawmill and the proximity of that forestland to their home (χ^2=379.91, p=<.001). Approximately 20% of respondents whose forestland was adjacent to their homes were likely to harvest from their own land 100% of the time as compared to the 2.3% of respondents whose forestland was over 50 miles from their home. Although even with forestland adjacent to their home, over 24% of respondents actually milled timber from their own land a quarter of the time or less [Table 6.3].

Individuals own forestland for a wide variety of reasons as indicated in a previous chapter. It seems likely that those who own forestland that is adjacent to their home would do so, not only for timber strategies, but also for privacy, aesthetics, recreation, and various other reasons, and while those owning land a distance from their home would do so for several of the same reasons, timber may be a larger part of that overall forest management strategy. Future research is needed to address this hypothesis.

Table 6.3: Percent of the Time Timber is Harvested from a Respondent's Own Land to Process with Portable Sawmill Compared to Distance of Forestland from Home

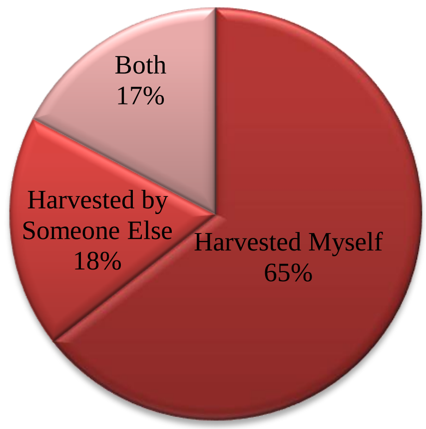
	100%	75%	50%	25%	0%	Total
Do not own forestland	1 0.1%	0 0	0 0	2 0.2%	134 15.4%	137 15.7%
Adjacent to home	174 20.0%	93 10.7%	53 6.1%	134 15.4%	77 8.8%	531 61.0%
Less than 10 miles from my home	19 2.2%	15 1.7%	7 0.8%	25 2.9%	23 2.6%	89 10.2%
11-20 miles from my home	9 1.0%	5 0.6%	2 0.2%	4 0.5%	4 0.5%	24 2.8%
21-30 miles from my home	3 0.3%	3 0.3%	1 0.1%	1 0.1%	2 0.2%	10 1.2%
31-40 miles from my home	2 0.2%	2 0.2%	0 0	0 0	2 0.2%	6 0.7%
41-50 miles from my home	3 0.3%	0 0	1 0.1%	1 0.1%	2 0.2%	7 0.8%
Over 50 miles from my home	20 2.3%	5 0.6%	7 0.8%	17 2.0%	18 2.1%	67 7.7%
Total	231 26.5%	123 14.1%	71 8.2%	184 21.1%	262 30.1%	871 100%

χ^2=379.91, p=<.001 (37% of expected freq= <5, 0% of expected freq=<0.5)

There was no statistically significant relationship between the percent of time a portable sawmill owner harvested timber from their own land to use in their mill and their region of residence. Likewise there was no statistically significant relationship between the percent of time a portable sawmill owner harvested timber from their own land to use in their mill, and the portable sawmill owner’s age, education, income, income from portable sawmill, or their general expenses incurred from using their mill in relation to the revenue generated from it.

About 65% of portable sawmill owners surveyed harvest timber themselves for use with their mill, and about 18% have the timber they use with their mill harvested by someone else, while 17% do a little of both [Figure 6.3]. There was no statistically significant relationship between who harvests the timber used in a portable sawmill and a respondent’s age, education, income, income from their portable sawmill work, or the region of the U.S. that they live in.

Figure 6.3: Who Harvests the Timber a Portable Samwill Owner Uses in their Mill



There was a statistically significant relationship between whether a portable sawmill owner harvested timber themselves for use in their mill and the acres of forestland they owned, regions except in the North Central and Great Plains. In every region, those who owned more than 100 acres were much more likely to harvest timber themselves that they use in their portable sawmill than have someone else harvest it for them. That makes sense given that if an individual owns land with standing timber, they would not have to utilize additional funds to obtain timber through purchasing it from someone else's land or having someone else harvest the timber from their land. Also those with large acreages of forestland may be more familiar with harvesting techniques and therefore would be capable of harvesting themselves.

In the Pacific Southwest, portable sawmill owners were the most likely to use timber harvested themselves in their mill, with 74% harvesting timber themselves for use in their mill (χ^2=29.33, p=.05). Portable sawmill owners in the South Central region had the lowest percentage of timber only harvested themselves for use in their mill at 58%, the other 42% was split evenly between timber harvested by someone else or both (χ^2=31.75, p=.05). In the Pacific Northwest, portable sawmill owners were more likely to use timber harvested by someone else (24%) then in any other region of the U.S. (χ^2=38.56, p=.05) [Table 6.4]. These differences could be due to several factors such as climate differences in the various regions, landownership types, industry structure, and how readily available harvested timber is in the different regions.

Figure 6.4: Whether Portable Sawmill Owners Harvests Timber Themselves in Relation to Acres of Forestland Owned by Region

Northeast*	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	6.3%	6.3%	9.4%	9.4%	4.0%	4.0%	4.9%	4.9%	17.9%	67%
Harvested by Someone Else	5.8%	2.2%	1.8%	0.9%	1.8%	0.5%	0.5%	0.5%	1.8%	16%
Both	1.4%	3.6%	3.1%	2.7%	0.0%	0.0%	1.8%	0.0%	4.5%	17%

χ2=38.02, p=.005* (30% of expected freq= <5, 0% of expected freq=<0.5)

North Central	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	9.8%	9.2%	9.2%	7.2%	7.2%	3.9%	3.3%	3.3%	15.7%	69%
Harvested by Someone Else	3.9%	4.6%	2.6%	1.3%	0.7%	0.7%	2.0%	0.0%	1.3%	17%
Both	2.6%	2.6%	2.0%	0.7%	0.7%	2.0%	2.0%	0.7%	1.3%	14%

Southeast*	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	6.6%	7.1%	5.4%	7.1%	3.6%	4.2%	2.4%	5.4%	20.2%	62%
Harvested by Someone Else	11.3%	2.4%	0.6%	0.6%	1.2%	1.2%	1.8%	0.0%	0.0%	19%
Both	5.4%	0.6%	5.4%	0.6%	0.6%	0.6%	1.8%	0.6%	3.6%	19%

χ2=59.33, p=<.001* (59% of expected freq= <5, 0% of expected freq=<0.5)

Figure 6.4 *continued*.: Whether Portable Sawmill Owners Harvests Timber Themselves in Relation to Acres of Forestland Owned by Region

South Central*	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	3.5%	10.3%	7.6%	6.2%	4.1%	4.8%	1.4%	4.1%	15.9%	58%
Harvested by Someone Else	9.0%	3.5%	3.5%	1.4%	0.7%	0.7%	0.7%	0.7%	1.4%	21%
Both	5.5%	3.5%	3.5%	1.4%	0.7%	1.4%	2.1%	0.7%	2.1%	21%

χ2=31.75, p=.05* (44% of expected freq= <5, 0% of expected freq=<0.5)

Great Plains	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	27.3%	18.2%	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	64%
Harvested by Someone Else	18.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18%
Both	0.0%	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	18%

Intermountain*	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	6.4%	4.8%	9.5%	7.9%	1.6%	4.8%	6.4%	4.8%	19.1%	65%
Harvested by Someone Else	11.1%	3.2%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	19%
Both	4.8%	6.4%	0.0%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%	16%

χ2=32.01, p=.01*(96% of expected freq= <5, 7% of expected freq=<0.5) interpret results with caution

Pacific Northwest*	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	2.1%	5.2%	9.4%	8.3%	6.3%	5.2%	1.0%	6.3%	18.8%	63%
Harvested by Someone Else	12.5%	2.1%	3.1%	1.0%	1.0%	0.0%	2.1%	1.0%	1.0%	24%
Both	2.1%	2.1%	2.1%	2.1%	0.0%	1.0%	1.0%	0.0%	3.1%	14%

χ2=38.56, p=.001* (93% of expected freq= <5, 0% of expected freq=<0.5)

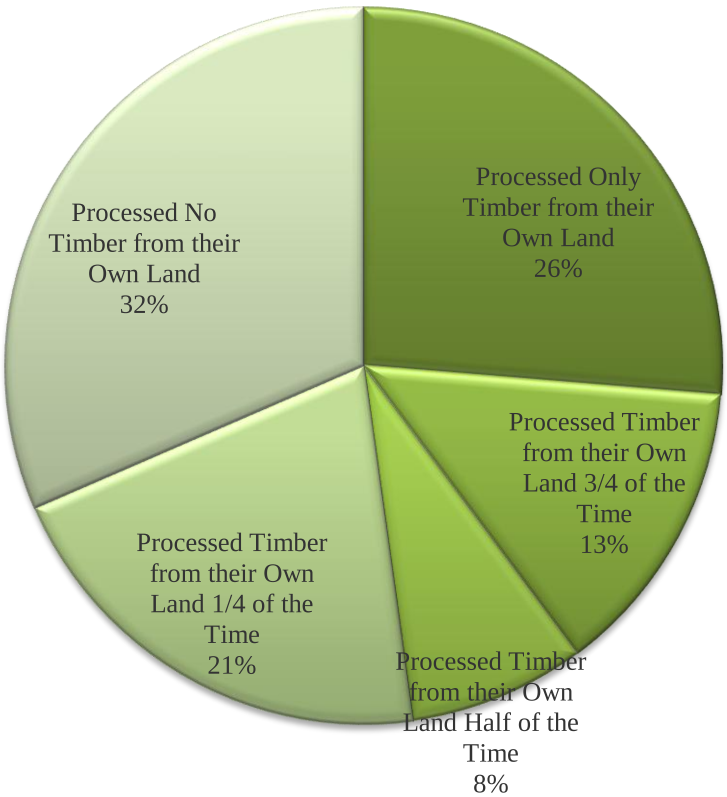
Figure 6.4 *continued*: Whether Portable Sawmill Owners Harvests Timber Themselves in Relation to Acres of Forestland Owned by Region

Pacific Southwest*	None	Less than 10 acres	10-25	26-40	41-55	56-70	71-85	86-100	More than 100	TOTAL
Harvested Themselves	5.7%	11.4%	14.3 %	8.6%	2.9%	0.0%	0.0%	8.6%	22.9%	74%
Harvested by Someone Else	0.0%	0.0%	2.9%	0.0%	0.0%	0.0%	2.9%	0.0%	0.0%	6%
Both	5.7%	5.7%	0.0%	0.0%	0.0%	2.9%	0.0%	0.0%	5.7%	20%

$\chi 2$=29.33, p=.05* * (96% of expected freq= <5, 26% of expected freq=<0.5) interpret results with caution

Overall, approximately 30% of portable sawmill owners indicated that they do not process with their portable sawmill timber that was harvested from their own land. On the opposite end, about 27% of portable sawmill owners only process timber harvested on their own land with their portable sawmill. Likewise, 21% of those surveyed processed harvested timber from their own land about a quarter of the time, 8% processed from their own land half of the time, and 14% processed harvested timber from their own land three fourths of the time [Figure 6.4].

Figure 6.4: Percent of Time Portable Sawmill Owners Processed Timber that was Harvested on their Own Land



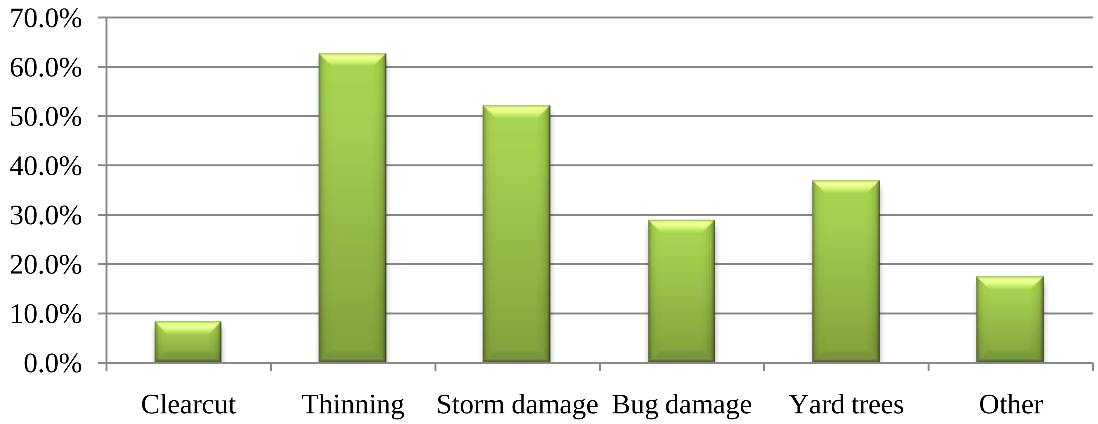
Overall processing timber that was harvested from a portable sawmill owner's land is attributable to several factors including proximity of forestland to a respondent's home and the size of forestland holdings. In each region of the U.S., the size of their landholding as well as the distance of that land from their home determined whether a portable sawmill owner actually harvests timber themselves for use in their mill, or whether the timber is harvested by someone else. In general, demographic data such as age, education, and region of residence played little role in whether a portable sawmill owner harvested timber from their own land, or the percent of time they did so.

Portable Sawmills used in Removals/Harvesting as Part of a Forest Management Strategy

Forest landowners may use timber harvesting and processing as either an income generating activity, or to improve forest health, increasing biodiversity, or creating trails, or other recreational activities (Heiligmann and Bratkovich 2007). In creating new single or mixed species forest stands, harvesting remains an essential factor in creating appropriate site conditions for seedling establishment and growth (Long 2006:1). Small-scale timber harvesting is also utilized in salvage activities after a storm, insect damage, after a fire, etc. (Heiligmann and Bratkovich 2007, Long 2006). Small-scale timber harvesting can also be used for thinning or to clear an area for a house or other structure (Heiligmann and Bratkovich 2007). The increased popularity of residential forested housing and utilization of these forms of harvested timber would reduce both timber waste and decrease fuels build up on the forest floor, at the same time being used to create a value added product (Jensen and Visser 2004).

Portable sawmills can be utilized as part of a forest management strategy not only as an aid in a thinning prescription, but also can be used to mill trees from storm or bug damage, fallen yard trees, and various other harvesting and/or removal forest management strategies. Figure 6.5 illustrates the multiple places that portable sawmill owners indicated that the timber comes from when used in their portable sawmill. The "other" places (indicated in the figure below) that timber was acquired from by portable sawmill owners includes new construction lot clearing, city trees that need to be removed, newly dead trees, select harvesting, general timber stand improvement, fire, flood or river logs, and many other sources. Interestingly there is no statistically significant association between the region a portable sawmill owner resided in and the source of the timber they used in their portable sawmill, meaning similar land management strategies are used to supply timber utilized in portable sawmills throughout the U.S. Portable sawmill owners are clearly not competing with industry to obtain their timber, rather the sources of timber utilized in portable sawmills throughout the U.S. demonstrates the use of resources that would otherwise not be used. This provides not only a use for otherwise unused timber, but also a means for using timber as part of forest and land management.

Figure 6.5: Source of Timber Milled with Portable Sawmills



Portable sawmill owners are often utilizing their mills for the same reasons that landowners offer as reasons for harvesting their land when comparing portable sawmill owners' utilization of timber obtained from thinning, storm damage, yard trees, and bug damage, to landowners' primary reasons for harvesting/removing timber from their land, detailed in a previous chapter, including income generating activities, removing trees after a natural disaster, in thinning regimes, as well as a general part of their overall forest management regimen. Additional information on potential value added benefits to harvesting/removal should be conveyed to landowners so they could have a potentially new use for timber is removed from their land. The following section outlines the use of portable sawmills as a forest production tool, specifically in the lumber and various end product niches created with timber species utilized throughout the U.S. regions. Utilizing portable sawmills as a production tool could offer a value added benefit to harvesting and removals for landowners outside of timber sales.

Portable Sawmills as a Small-Scale Forest Production Tool

In analyzing the survey data on portable sawmill operations throughout various regions of the U.S., existing niches emerged utilizing lumber milled in a portable sawmills to create various end products. Lumber niche markets as well as end product niche markets were revealed that utilize available timber resources in the given regions. This research is unique in that it analyzes portable sawmill usage and application as a forest based microenterprise niche as well as in terms of the production of specific timber species to create specific finished products as outlined in this chapter.

Portable sawmills offer the relative advantage of being utilized within several existing niche markets including lumber production, furniture and other millwork, and in the home building sectors of the small-scale forest production economy, adding versatility to compete within various sectors of the forest products industry to their previously specified advantages.

Lumber Production

Lumber production with portable sawmills varied throughout the U.S. Portable sawmill owners were asked to indicate what species of timber they used in their mills and that data was then compared with what they indicated they did with the lumber sawn from their portable mills. An important point to note here is that some portable sawmill owners indicated that they buy timber to process with their mill. One respondent in particular indicated in a follow-up interview that they purchase timber via the internet, therefore timber species used in portable sawmills may be harvested locally or purchased from another area of the U.S.

As shown in Table 6.5, Douglas fir and fir tended to be positively correlated with lumber sales by portable sawmill owners (p=.05). In the Great Plains region, portable sawmill produced lumber sales were positively correlated with the walnut species (p=05). Likewise in the Intermountain region, the sweet gum species was positively correlated with selling lumber produced with a portable sawmill (p=.05). Finally in the Pacific Northwest, the fir species was positively correlated with selling lumber produced from a portable sawmill (p=.05). There were also several negatively correlated timber species with lumber production sales from portable sawmills in both in the U.S. as a whole, as well as in specific regions identified below, meaning that those who processed certain species of timber were likely to do something else besides selling the lumber created [Table 6.5]. Throughout regions of the U.S. portable sawmill owners tended to produce and sell lumber that was somewhat unique to the region, with the exception of fir in the Pacific Northwest which is readily available.

Table 6.5: Statistically Significant Correlations between Selling Lumber Made from a Portable Sawmill and Timber Species Used, by Region

	TOTAL U.S.	NE	NC	SE	SC	GP	IM	PNW	PSW
hickory	-0.13 **	-0.14 *							-0.43 *
maple	-0.06 *		-0.24 *						
oak	-0.10 **	-0.13 *		-0.15 *					
sweet gum	-0.09 *			-0.15 *			0.26 *		
walnut	-0.11 **	-0.17 *			-0.25 *	0.67 *			
Douglas fir	0.08 *								
fir	0.10 *							0.26 *	
cherry	-0.11 **				-0.16 *				
poplar	-0.08 *								-0.39 *
birch				-0.16 *					

p=.05*, p=≤.001**

In addition to selling lumber produced with a portable sawmill, many portable sawmill owners utilized lumber produced with their portable mill in trade for other goods and services throughout their communities. Lumber trading is an interesting aspect of portable sawmill culture and is often used as a way to avoid setting up a formal business structure. Lumber is processed and traded for other goods and/or services throughout the community. In the Southeast, the Douglas fir species of lumber sawn with a portable sawmill was positively correlated to trading that lumber for other goods and services (p=.05). While it is unlikely that this species would be available in natural stands in the Southeast, it could be available in tree farms, especially those that grow Christmas trees, or respondents may have purchased the lumber from an outside source. An interesting trend revealed in the follow-up interviews with portable sawmill owners showed that portable sawmill owners who produce specialty lumber or products have the ability to purchase a variety of log species on the internet.

In the Pacific Southwest, trading lumber produced with a portable sawmill was positively correlated to juniper timber (p=.05). Similar to lumber sales, there are also statistically significant negative correlations between certain species of lumber produced with a portable sawmill and trading that lumber for other goods and/or services outlined below [Table 6.6]. Those who produced cherry, normally did not trade lumber. This could be due to the higher value of cherry lumber. Pine was also not likely to be a traded lumber species. This, on the other hand, is most likely due to the availability and low cost of pine lumber. Its lack of uniqueness coupled with low cost in hardware stores makes pine unlikely to be traded. Overall when lumber is used in trade, it tends to be somewhat unique to the region it is being traded in, yet without the high inherent value of a species like cherry.

Table 6.6: Statistically Significant Correlations between Trading Lumber Made with a Portable Sawmill for other Goods/Services and Timber Species Used, by Region

	TOTAL U.S.	NE	NC	SE	SC	GP	IM	PNW	PSW
maple									-0.46 *
Douglas fir				0.18 *					
juniper									0.37 *
pine				-0.16 *		-0.62 *			
cherry	-0.1 *		-0.2 *						-0.47 *
poplar									-0.58 **
beech	-0.08 *					0.62 *			

p=.05*, p=<.001**

The average cost to operate a portable sawmill per board foot is displayed below [Table 6.7]. Most portable sawmill owners noted an average cost of $.15 or less per board foot to process lumber. This compares to the current retail cost of at least $.25-.$.50 per board foot for a basic pine 2x4 ft board to over $2.00 a board foot for more specialty sizes and wood varieties (Lowes 2010). This variable cost data was provided by portable sawmill owners and included all aspects including time and materials. There may be other fixed costs or opportunity costs associated with portable sawmill operating, however this was not clarified in the data. Often in both the survey and follow-up interviews, portable sawmill owners were reluctant to share too much financial information about their portable sawmill operations. This was a large limiting factor of the cost benefit analysis of this research.

Table 6.7: Portable Sawmill Owners' Costs to Operate a Portable Sawmill (per b.f.)

Cost	Percent of Respondents
$.01- $.05	15%
$.06- $.10	27%
$.11- $.15	15%
$.16- $.20	9%
$.21- $.25	9%
$.26- $.30	9%
$.31- $.35	1%
$.36- $.40	3%
$.41- $.45	2%
$.46- $.50	4%
more than $.50	7%

The correlations between a portable sawmill owner’s cost to process timber and the species of timber used is listed below by region [Table 6.8]. There were several statistically significant correlations between a portable sawmill owner’s cost per board foot to process timber with their mill and the species of timber that was used. In the Northeast, respondents who harvested maple or larch had a higher cost per board foot to process timber as compared to not processing maple or larch (p=.05), and respondents who harvested walnut as one of their species had a lower cost per board foot to process the timber (p=.05). In the North Central region, respondents who processed hemlock had a lower cost per board foot to process timber with their mill as compared to not processing hemlock (p=.05), and those who used birch indicated a higher cost per board foot to process timber (p=.05). In the South Central region, those who processed juniper as one of their timber species indicated a higher cost per board foot to process timber with their mill as compared to not processing juniper (p=.05). A limited number of respondents answered survey questions regarding operating costs, and when dividing these responses by regions the response rate was even less. Subsequently the lack of data regarding operation costs per board foot prevented an accurate cost per board foot to process timber with various species in the Great Plains, Intermountain, Pacific Northwest, and Pacific Southwest regions, and this data was dropped from statistical analysis.

Table 6.8: Correlations between Portable Sawmill Owners' Costs (per b.f.) to Process Timber and Species of Timber Used, by Region

	Northeast	North Central	Southeast	South Central	GP/ IM/ PNW/ PSW
alder	-0.07	0.03	-0.03	(dropped)	(dropped)
hickory	-0.11	-0.42	-0.02	0.14	(dropped)
maple	**0.48** *	0.24	-0.09	0.00	(dropped)
oak	-0.35	-0.11	0.01	-0.42	(dropped)
sweet gum	-0.05	0.19	-0.08	0.18	(dropped)
walnut	**-0.46** *	0.24	0.04	-0.22	(dropped)
cedar	0.12	0.10	0.12	-0.29	(dropped)
Douglas fir	-0.12	-0.18	-0.16	0.05	(dropped)
fir	-0.19	0.37	0.26	-0.38	(dropped)
hemlock	0.16	**-0.48** *	-0.23	-0.05	(dropped)
juniper	0.07	-0.07	-0.23	**0.58** *	(dropped)
larch	**0.44** *	-0.03	0.30	-0.10	(dropped)
pine	0.01	-0.17	-0.20	0.37	(dropped)
spruce	0.07	-0.22	0.21	0.17	(dropped)
cherry	0.30	-0.09	0.04	0.11	(dropped)
poplar	-0.09	0.30	-0.08	-0.40	(dropped)
beech	0.00	-0.33	0.02	-0.45	(dropped)
birch	-0.26	**0.59** *	0.21	0.12	(dropped)
other species	0.03	0.30	-0.03	0.13	(dropped)

p=.05*

Likewise, there were several statistically significant correlations between what a portable sawmill owner charged their customers per board foot, and the species of timber they processed with their mill. The average cost per board foot that portable sawmill owners charged their customers was $.21-$.30 per board foot [Table 6.9].

Table 6.9: Amount Portable Sawmill Owners Charged their Customers (per b.f.)

Charge per b.f.	Percent of Respondents
$.01- $.10	1%
$.11-$.20	23%
$.21-$.30	41%
$.31-$.40	16%
$.41-$.50	5%
$.51-$.60	2%
$.61-$.70	3%
$.71-$.80	3%
$.81-$.90	1%
$.91-$1.00	2%
More than $1.00	4%

The correlations between what portable sawmill owners charged per board foot to process timber with their portable sawmill and the species of timber used is detailed below, by region [Table 6.10]. In the North Central region, portable sawmill owners indicated that they charged more per board foot for timber processed with their mill if they processed cherry as one of their timber species (p=.05). Cherry has a high intrinsic value in the Northern regions and is often more expensive than other timber species. In the Southeast, respondents charged less per board foot if they processed alder or fir with their mill, and charged more per board foot if they processed Douglas fir as one of their timber species (p=.05), most likely due to its limited availability. In the South Central region, those who processed juniper indicated that they charged more per board foot (p=.05). In the Intermountain region, respondents who processed sweet gum, walnut, Douglas fir, hemlock, juniper, cherry, poplar, birch, and other species charged a higher amount (p=.05), and those who processed alder, maple, oak, cedar, larch, pine, spruce, and beech charged a lower dollar amount per board foot (p=.05). However, due to the limited response rate to this question from respondents in the Intermountain region, the results appear to be slightly skewed. In the Pacific Northwest those who processed birch as one of their species indicated a higher charge per board foot to their customers (p=.05). Like described in the previous section on costs to process timber, a low response rate to this question resulted in a lack of data, preventing an accurate analysis of customer charges for processed timber in the Great Plains and Pacific Southwest regions. Overall, the higher value of a species or the more specialty species for the region the lumber was, the higher charge was passed to the customer.

Table 6.10: Correlations between Customer Charge (per b.f.) to Process Timber and the Species of Timber Used, by Region

	NE	NC	SE	SC	GP	IM	PNW	PSW
alder	-0.04	0.05	**-0.30** *	-0.04	n/a	**-0.999** *	0.20	n/a
hickory	-0.03	-0.13	0.01	-0.17	n/a	-0.901	0.03	n/a
maple	0.06	-0.29	0.08	0.13	n/a	**-0.999** *	-0.05	n/a
oak	-0.04	0.06	-0.21	-0.08	n/a	**-1.000** *	-0.08	n/a
sweet gum	-0.13	-0.07	0.01	0.01	n/a	**0.999** *	-0.04	n/a
walnut	0.07	0.07	-0.05	0.16	n/a	**0.999** *	-0.29	n/a
cedar	0.15	0.12	-0.16	0.05	n/a	**-0.997** *	0.17	n/a
Douglas fir	-0.07	-0.03	**0.45** *	-0.09	n/a	**0.999** *	0.48	n/a
fir	0.03	-0.04	**-0.32** *	0.02	n/a	0.901	-0.32	n/a
hemlock	-0.01	-0.06	0.02	0.04	n/a	**0.999** *	-0.32	n/a
juniper	-0.01	-0.04	0.01	**0.36** *	n/a	**0.999** *	-0.05	n/a
larch	0.03	0.00	-0.18	-0.11	n/a	**-0.999** *	-0.14	n/a
pine	-0.04	-0.06	0.10	0.05	n/a	**-0.999** *	0.05	n/a
spruce	-0.10	0.02	-0.12	0.12	n/a	**-0.999** *	0.18	n/a
cherry	0.06	**0.33** *	-0.11	-0.16	n/a	**0.999** *	-0.11	n/a
poplar	-0.12	-0.23	0.02	-0.21	n/a	**0.999** *	0.22	n/a
beech	-0.05	-0.01	0.04	0.00	n/a	**-1.000** *	-0.32	n/a
birch	-0.02	0.04	-0.01	0.02	n/a	**0.999** *	**0.63** *	n/a
other species	0.07	-0.11	-0.09	0.18	n/a	**1.000** *	0.45	n/a

p=.05*

Various assumptions arise from this data on costs and charges to mill lumber. It is unknown whether the portable sawmill operators received the timber to be milled from the customers or if the operators provided the timber, the assumption is that the portable sawmill operator provided the timber and the costs and charges associated include the cost of the timber. There is probably a mix of both operator provided as well as customer provided timber in this data. Likewise this data most likely includes a combination of wood delivered to the portable sawmill owner as well as the portable sawmill owner going to the location of the timber. Based on additional data provided by portable sawmill owners, the assumption is that while there is most likely a combination of both, many portable sawmill owners pick up timber or have timber delivered to the site of their mill, rather than traveling with their mill.

Relationship between the Types of End Products Created Utilizing Wood Processed with a Portable Sawmill and Various Tree Species in U.S. Regions

There were also several statistically significant correlations throughout the U.S. between different products created from wood sawn in a portable sawmill and timber species utilized. Table 6.11 below illustrates the statistically significant correlations between timber species and various end products created using lumber sawn in a portable sawmill.

In the Northeast, there was a statistically significant correlation between making furniture with lumber sawn from a portable sawmill and utilizing the timber species hickory, oak, and cherry ($p=.05$). This means that portable sawmill owners who are furniture makers in the Northeast are more likely to process hickory, oak, and cherry as opposed to other timber species. Fence production was positive correlated to processing beech lumber in the Northeast region (p=.05) Also in the Northeast, shelf production was correlated with birch (p=.05) whereas in the North Central region it was positively correlated with fir, juniper, and spruce (p=.05).

In cabinetry, there was a positive correlation among cabinet making and processing larch species in the Northeast (p=.05), whereas in the North Central region cabinet production was positively correlated with maple (p=.05) and hemlock (p=<.001). There was a positive correlation in the Northeast between wooden toy production and utilizing hemlock and spruce to process with their portable sawmill (p=.05). Finally in the North Central region, processing alder with a portable sawmill was positively correlated with house or other building production (p=.05).

Table 6.11: Statistically Significant Correlations between Timber Species and Various End Products Created from Lumber Sawn in a Portable Sawmill, Northern Regions

Northeast	furniture	fence	shelves	cabinets	toys
hickory	0.16 *				
oak	0.13 *				
hemlock					0.14 *
larch				0.16 *	
spruce					0.15 *
cherry	0.13 *				
beech		0.19 *			
birch			0.16 *		

North Central	misc products	tables/ benches	shelves	cabinets	house or other building
alder					0.18 *
maple				0.17 *	
Douglas fir		0.23 *			
fir			0.22 *		
hemlock				0.3 **	
juniper			0.18 *		
pine	0.26 **	-0.25 *			
spruce			0.16 *		
poplar		-0.19 *			

p=.05*, p=<.001**

Table 6.12 below illustrates the statistically significant correlations in the Southeast and South Central regions between timber species utilized in a portable sawmill and the subsequent finished products that are produced with that lumber. The production of fence material utilizing lumber sawn with a portable sawmill was positively correlated to processing juniper/eastern red cedar in the Southeast (p=.05) and birch in both the Southeast (p=.05) and South Central regions (p=.05). Pine was negatively correlated with the production of miscellaneous wood products as well as building material in the South Central regions (p=.05). This is interesting given the abundance of pine in the area as most likely reflects the abundant availability and low cost of pine lumber in a store.

Table 6.12: Statistically Significant Correlations between Timber Species and Various End Products Created from Lumber Sawn in a Portable Sawmill, South

Southeast	misc. products	fence	shelves	cabinets	house or other building
alder			0.16 *		
juniper		0.23 *			
spruce					-0.15 *
beech				-0.17 *	
birch		0.17 *			
other species	0.17 *				

South Central	misc. products	tables/ benches	shelves	cabinets	house or other building	building material	flooring
sweet gum			0.21 *				
cedar				0.19 *			
juniper					0.17 *		0.17 *
pine	-0.02 *					-0.19 *	
poplar				-0.18 *			
birch		0.21 *		-0.17 *			

p=.05*, p=<.001**

The statistically significant correlations found in the Intermountain region are shown in Table 6.13 below. Furniture production was positively correlated to processing the walnut species of timber in their portable sawmill (p=.05). Processing the Douglas fir species was positively correlated to building a house or other building from timber sawn in a portable mill (p=.05), and beech was positively correlated with producing general building material from timber sawn in their portable sawmill (p=.05). The Great Plains region did not have any statistically significant correlations between the production of various finish products from lumber produced with a portable sawmill and the timber species utilized, this is likely due to the limited data obtained from the Great Plains.

Table 6.13: Statistically Significant Correlations between Timber Species and Various End Products Created from Lumber Sawn in a Portable Sawmill, Rocky Mountain

Intermountain	furniture	house or other building	building material
walnut	0.24 *		
Douglas fir		0.29 *	
beech			0.26 *

p=.05*, p=<.001**

Lastly on the West/Pacific Coast, processing birch was positively correlated with producing furniture with lumber sawn in a portable sawmill in the Pacific Southwest (p=.05), and with various other species in the Pacific Northwest (p=.05). Processing Douglas fir with a portable sawmill was positively correlated with subsequent fence production utilizing the lumber processed with a portable mill in the Pacific Northwest (p=.05). In the Pacific Southwest there were statistically significant positive correlations between processing both cedar (p=.05) and larch (p=<.001) to produce tables and/or benches. The production of building material with lumber sawn in a portable sawmill was positively correlated with hickory in the Pacific Northwest and with Douglas fir in the Pacific Southwest (p=.05), and negatively correlated with the production of oak in the Pacific Southwest (p=.05). Finally, processing cherry in a portable sawmill was positively correlated with the production of wood flooring in the Pacific Southwest (p=.05) [Table 6.14].

Table 6.14: Statistically Significant Correlations between Timber Species and Various End Products Created from Lumber Sawn in a Portable Sawmill, West/Pacific Coast

Pacific Northwest	furniture	fence	building material
hickory			0.31 *
sweet gum	-0.2 *		
Douglas fir		0.24 *	
other species	0.21 *		

Pacific Southwest	furniture	tables/ benches	toys	building material	flooring
oak				-0.42 *	
cedar		0.34 *			
Douglas fir				0.42 *	
larch		0.53 **			
pine	-0.35 *		-0.38 *		
cherry					0.34 *
birch	0.37 *				

p=.05*, p=<.001**

Of those portable sawmill owners who created an end product with lumber produced with their mill, many sold those products. The statistically significant correlations between selling end products with lumber produced with their portable sawmill and specific timber species that were used in the mill are detailed below [Table 6.15]. Throughout the U.S. as a whole, there were not any positive correlations between any particular species and selling end products with any kind of statistical significance, however, those who utilized maple, oak, and cherry in their mill were negatively correlated with selling end products (p=.≤001, p=.05, p=.05, respectively), although the reason why is unknown, especially since cherry lumber produced in a portable sawmill was a widely sold species in certain regions. In the North Central region, portable sawmill owners who used fir were positively correlated with selling end products (p=.05). In the Great Plains, there was a positive correlation between utilizing beech timber in a portable sawmill and selling end products from lumber produced with that mill (p=.05). Likewise, in the Intermountain region, there was a positive correlation between utilizing sweet gum in a portable sawmill and selling end products from lumber produced in their mill (p=.05).

Table 6.15: Statistically Significant Correlations between Selling End Products made from Portable Sawmill Lumber and Timber Species Used, by Region

	Total U.S.	NE	NC	SE	SC	GP	IM	PNW	PSW
hickory								-0.2 *	
maple	-0.11 **		-0.2 *	-0.17 *					
oak	-0.08 *		-0.2 *						
sweet gum							0.26 *		
fir			0.2 *						
hemlock				-0.18 *					
spruce		-0.17 *							
cherry	-0.09 *			-0.17 *					
poplar				-0.22 *					
beech				-0.17 *		0.77 *			

p=.05*, p=≤.001**

In addition to selling end products created from lumber produced in their mill, portable sawmill owners also traded those end products for various goods and services throughout their communities. Follow-up interviews with portable sawmill owners revealed that in some cases portable sawmill owners would “trade” end products created with a portable sawmill for “gifts of money” to avoid needing a structured business enterprise to distribute their products. In most cases, however, portable sawmill owners would trade quantities of addition timber in exchange for their millwork. Table 6.16 below outlines the statistically significant correlations between specific species of timber utilized in their portable sawmill and trading end products created with lumber produced in their mill.

Table 6.16: Statistically Significant Correlations between Trading End Products Made with Lumber from a Portable Sawmill for other Goods/Services and Timber Species Used, by Region

	TOTAL U.S.	NE	NC	SE	SC	GP	IM	PNW	NSW
hickory							0.3 *		
hemlock	-0.07 *								
juniper			0.26 **						
birch		-0.13 *							

p=.05*, p=≤.001**

Other portable sawmill owners created end products to keep for themselves utilizing various species of timber [Table 6.17]. In the Northeast, portable sawmill owners who utilized alder, walnut, and/or cherry in their mill were positively correlated with creating various end products to keep for themselves (p=.05). In the South Central region, utilizing Douglas fir in their mill was positively correlated with creating end products to keep utilizing lumber from their portable sawmill (p=.05). Utilizing juniper was positively correlated to creating end products to keep from lumber sawn in their portable sawmill, for owners in the Pacific Northwest. Finally in the Pacific Southwest, using poplar and/or beech in a portable sawmill was positively correlated with creating end products to keep (p=≤.001, p=.05).

Table 6.17: Statistically Significant Correlations between Creating End Products to Keep with Lumber from a Portable Sawmill and Timber Species Used, by Region

	TOTAL U.S.	NE	NC	SE	SC	GP	IM	PNW	PSW
alder		0.17 *							
oak						-0.67 *			
walnut		0.16 *							
Douglas fir					0.17 *				-0.33 *
juniper								0.21 *	
cherry		0.15 *							
poplar									0.64 **
beech									0.34 *
other species	0.07 *								

p=.05*, p=≤.001**

Besides creating smaller scale finished products such as furniture, cabinets, etc. some portable sawmill owners created larger structures such as a house or barn using lumber sawn in their portable sawmill. Throughout the U.S. as a whole, sawing the fir species of timber in their portable sawmill was positively correlated with building a home with lumber sawn from their mill (p=.05).

Specifically in the Northeast and Pacific Northwest, fir was positively correlated with building a home with lumber sawn from their portable sawmill (p=.05), and in the Pacific Northwest, Douglas fir was also positively correlated to building a home with lumber sawn from a portable sawmill (p=.05). In the North Central and Great Plains, sawing hemlock with their portable sawmill was positively correlated with building their home using lumber sawn from their portable sawmill. In the South Central region, building a home utilizing lumber sawn with a portable sawmill was positively correlated with hickory, sweet gum, and/or beech (p=.05) [Table 6.18].

Table 6.18: Statistically Significant Correlations between Building a Home with Lumber from a Portable Sawmill and Timber Species Used, by Region

	TOTAL U.S.	NE	NC	SE	SC	GP	IM	PNW	PSW
hickory					0.16 *				
maple				-0.19 *					
oak	-0.07 *								
sweet gum				-0.15 *	0.16 *				
Douglas fir								0.23 *	
fir	0.09 *	0.15 *						0.21 *	
hemlock			0.17 *			0.67 *			
beech					0.2 *			-0.21 *	

p=.05*, p=≤.001**

Likewise, in building a barn or other outbuilding on their property, portable sawmill owners in the South Central region were positively correlated with utilizing hickory, sweet gum, walnut, and/or pine in their portable sawmill (p=.05). Finally in the Pacific Southwest, there was a positive correlation between sawing walnut and/or other miscellaneous species and building a barn with lumber sawn with their portable sawmill [Table 6.19].

Table 6.19: Statistically Significant Correlations between Building a Barn with Lumber from a Portable Sawmill and Timber Species Used, by Region

	TOTAL U.S.	NE	NC	SE	SC	GP	IM	PNW	PSW
hickory					0.17 *				
sweet gum					0.16 *				
walnut					0.17 *			-0.26 *	0.37 *
pine					0.2 *				
poplar						-0.67 *			
other species									0.36 *

p=.05*, p=≤.001**

Discussion

This chapter offered a means to illustrate how portable sawmill operations fit into the overall forest structure in terms of landownership, how timber species are utilized in relation to their availability, and how forest production can be affected by utilizing portable sawmills.

Portable sawmill owners tended to process timber from their own land if it was in close proximity to their home. However once the owned forestland was over fifty miles away from a portable sawmill owner's home, they were almost as likely to harvest timber from that land as if it were less than ten miles from their home. Likewise those who have larger tracts of land were more likely to harvest from their own land rather than someone else's land. Therefore Extension programs should be aimed at targeting landowners' adoption of portable sawmills as a forest management strategy for those owning larger tracts of land (over 100 acres). The distance of forestland to their home may be of secondary consideration. Extension programs should also target portable sawmill owners who own little to no forestland and provide opportunities to create networks between landowners and portable sawmill owners to generate an additional opportunity for portable sawmill owners to obtain timber, as well providing an additional tool for landowners in their forest management strategy and to generate new revenue streams using their land.

Portable sawmill utilization can be used in conjunction with many small-scale forest management strategies with minimal site disturbance to generate income or a value added product, especially in situations where timber would have otherwise been wasted, such as in the cases of storm and bug damage, removal of newly dead trees, or other salvage activities. Portable sawmills can also serve as a useful tool to enable landowners to meet some of their forest management goals. Portable sawmill owners and landowners alike share similar primary forest management objectives and Extension programs should be aimed at forging networks between the two groups.

The types of species processed in portable sawmills differed based on region of residence. In general, portable sawmill owners tended to use timber that was both readily available in a given region as well as those which have a higher value, such as certain hardwoods like cherry.

An option for landowners and portable sawmill owners outlined within this chapter is to compete in smaller niche markets apart from large scale competition. In different regions of the U.S. portable sawmill owners are producing lumber that tends to be unique to the region they are operating in, creating a specialty lumber niche. When lumber is traded as opposed to sold, it tends to also be unique to the region, however, it is often a lower economically valued species. The higher the value a species, the higher the charge passed on to customers per board foot to process those species with a portable sawmill. Likewise, specialty lumber species warranted a higher charge to customers. Although the data on processing costs and customer charges is limited in this study, it provides a basis for understanding what is currently happening in portable sawmill lumber production in terms of what types of lumber are being produced and sold within specialty niche markets. Extension programs should target programs focused on the importance of competing within a niche market to optimize portable sawmill owners’ chances to run a successful microenterprise producing higher quality lumber and specialty lumber that is not readily available in common markets

In addition to processing specialty lumber within niche markets, in different regions of the U.S., species that are unique to an area are more likely to be used to create various end products as opposed to using species that are more commonly sold in larger stores. However, processing certain species with a traditionally higher value, such as cherry, are more likely to be sold as lumber rather than selling products created with that lumber. This perhaps suggests a higher value of the actual lumber itself as opposed to the finished products created with that lumber. Future research should address this anomaly.

Information regarding the uses of portable sawmills and other small-scale harvesting and processing forest technologies within niche markets needs to be conveyed to small-scale forest landowners as well as rural residents who might have more limited employment opportunities in a largely resource depended community, so they have a range of possibilities for utilizing the timber available to them. Options utilizing specialty timber unique to an area should be explored over competition within the larger lumber producing market. Extension programs should familiarize both landowners and portable sawmill owners with uniqueness of various timber species in their given region to ensure that sawyers do not waste their talents producing products, especially lumber, from species that will not allow them a competitive advantage in the larger market. Extension programs should educate both landowners and portable sawmill owners on timber species, resulting wood values, uses of silvics/silviculture of these species. Programming should educate portable sawmill owners on the potential of partnerships with landowners who have specialty timber potential and offer cost-share programs to help fund landowners who are interested in managing timber stands with specialty timber.

PORTABLE SAWMILL OWNERSHIP CHARACTERISTICS AND MICROENTERPRISE DEVELOPMENT IN THE U.S.

This chapter explores results from the national portable sawmill owner survey as it pertains to demographic characteristics of owners, equipment usage, ownership characteristics and microenterprise operations throughout the U.S. Many of the results were analyzed on both a national and regional level. Two units of analysis, region and expanded region, are used throughout this section to explore regional data. This is similar to defined regions within "Forest Resources of the U.S." (Smith et.al 2004).

The expanded regions of the U.S. include the Northeast, North Central, Southeast, South Central, Great Plains, Intermountain, Pacific Northwest, and Pacific Southwest. These regions are also offered in condensed form as the North (includes the Northeast and North Central), the South (includes the Southeast and South Central), the Rocky Mountains (includes the Great Plains and Intermountain), and the West (includes the Pacific Northwest and Pacific Southwest) and are referred to as "condensed regions" for the purposes of this paper. Table 7.1 displays the states included in each condensed and expanded region of the U.S.

Table 7.1:U.S. Regional Classification as Defined by the USFS

NORTH		**SOUTH**		**ROCKY MOUNTAIN**		**WEST**	
Northeast	**North Central**	**South east**	**South Central**	**Great Plains**	**Inter mountain**	**Pacific Northwest**	**Pacific South west**
Maine	Illinois	Virginia	Kentucky	North Dakota	Montana	Washington	California
Vermont	Indiana	North Carolina	Tennessee	South Dakota	Idaho	Oregon	Hawaii
New Hampshire	Wisconsin	South Carolina	Alabama	Nebraska	Wyoming	Alaska	
Massachusetts	Michigan	Georgia	Louisiana	Kansas	Colorado		
Connecticut	Missouri	Florida	Arkansas		Arizona		
Rhode Island	Iowa		Oklahoma		Utah		
New York	Minnesota		Texas		New Mexico		
Pennsylvania					Nevada		
New Jersey							
Maryland							
West Virginia							
Ohio							

Source: Smith, W. Brad, Patrick D. Miles, John S.Vissage, Scott A Pugh. 2004. Forest Resources of the United States, 2002. Gen. Tech. Rep. NC-241. St Paul, MN: USDA Forest Service, North Central Research Station.

Table 7.2 displays the respondents indicating portable sawmill ownership for both the condensed and expanded regions of the U.S. The highest portable sawmill ownership was in the North making up 43% of the survey respondents. Likewise the Rocky Mountain region had the lowest number of portable sawmill ownership encompassing only 8% of the survey respondents.

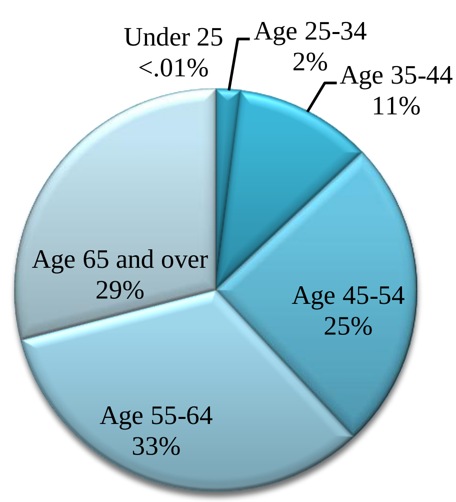
Table 7.2: Portable Sawmill Owner Survey Respondents by Condensed and Expanded Region

Condensed Region			Expanded Region		
	Number	Percent		Number	Percent
North	394	43%	Northeast	235	25%
			North Central	159	17%
South	325	35%	Southeast	177	19%
			South Central	148	16%
Rocky Mountain	76	8%	Great Plains	11	1%
			Inter Mountain	65	7%
West	132	14%	Pacific Northwest	96	10%
			Pacific Southwest	36	4%
TOTAL	927	100%	TOTAL	927	100%

Demographic Characteristics of Portable Sawmill Owner Survey Respondents

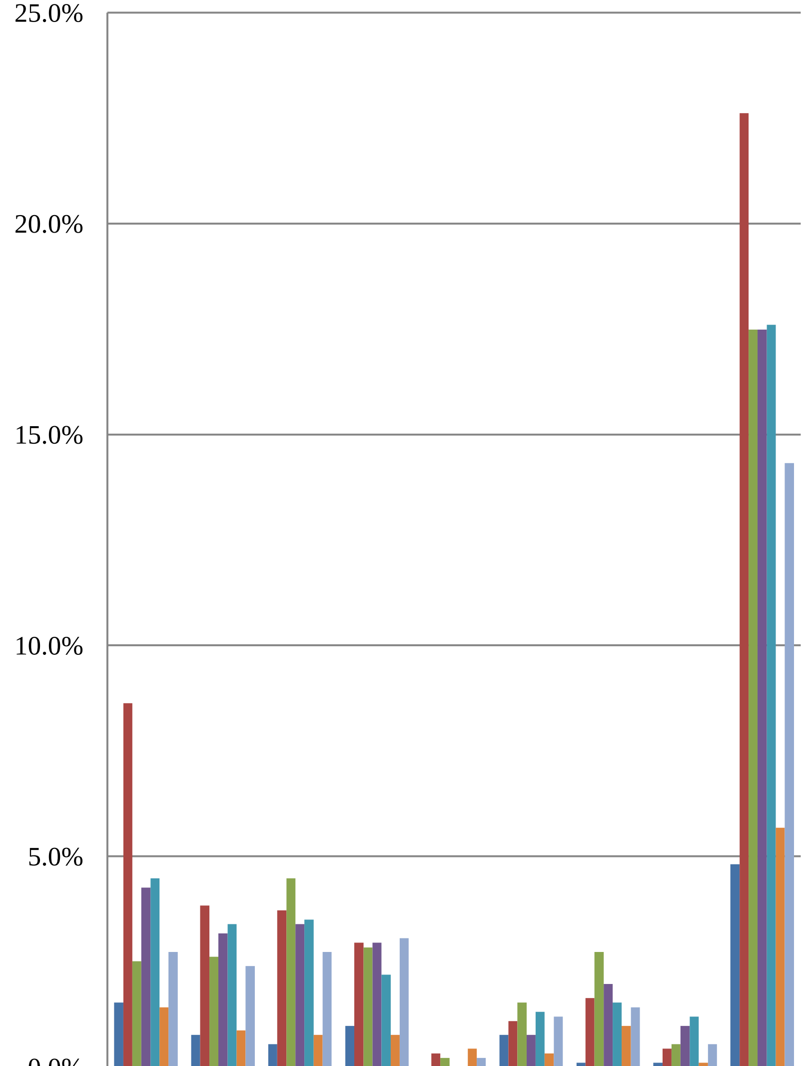
General demographic characteristic of portable sawmill owner survey respondents included age, gender, education level, state of residence, ethnicity, and income. There was a fairly even distribution of ages among survey respondents, with the smallest number of respondents being under the age of 44 [Figure 7.1]. There was no statistically significant difference in respondent ages among the various regions.

Figure 7.1: Respondent Age Distribution



Similarly, there was a relatively even distribution of education levels among respondents, with the smallest percentage of those surveyed having less than a high school degree and the largest percent completing a high school degree [Figure 7.2]. There was a statistically significant difference in education between expanded regions (χ^2=88.81, p=<.001). In the Northeast and North Central regions the most prominent educational attainment category for respondents was "graduated high school." In the Southeast, Intermountain, and Pacific Northwest regions, respondents tended to have some college, whereas in the Pacific Southwest, respondents were more likely to have bachelor degrees than other education levels. In the Great Plains, respondents were slightly more likely to have completed some graduate school than other education levels. In the South Central region respondents were very slightly more likely to hold a graduate or professional degree than any other educational level.

Figure 7.2: Portable Sawmill Owners' Educational Attainment by Expanded Region (n=949)

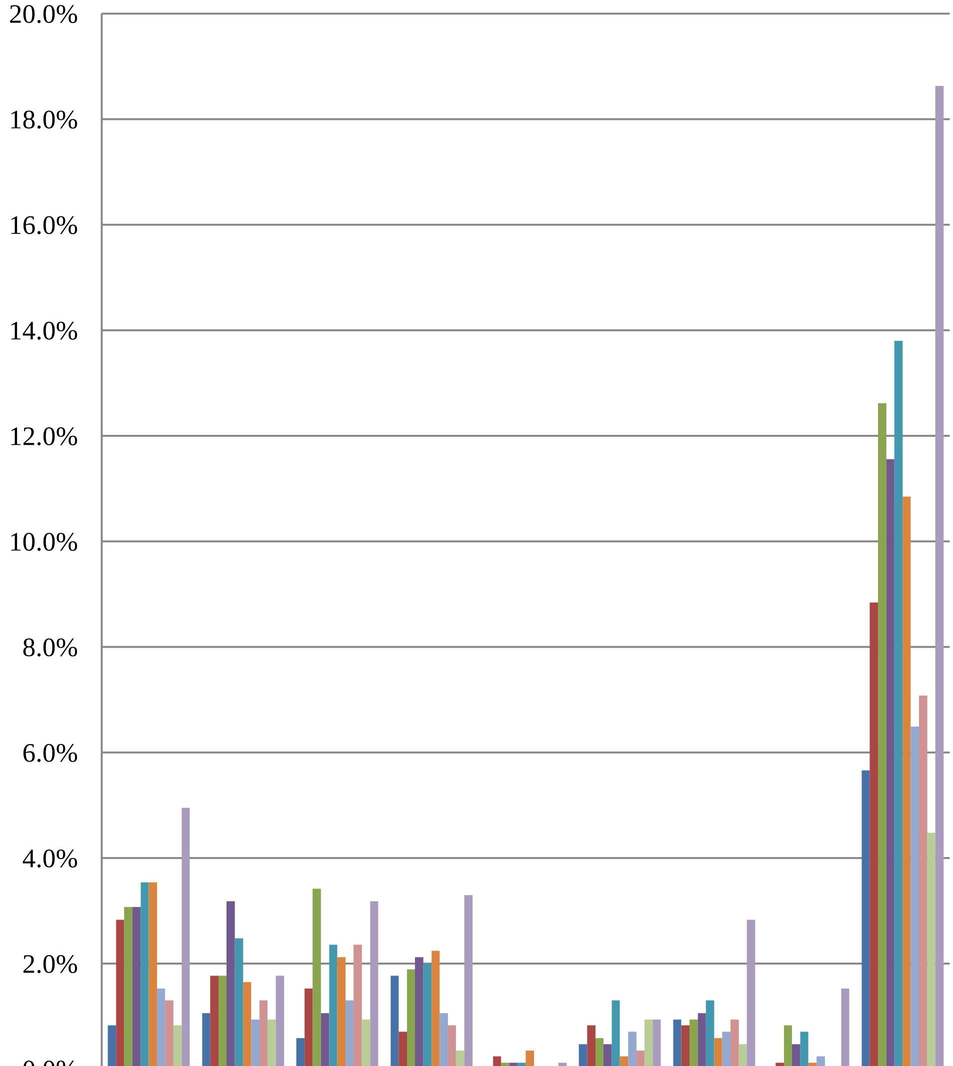


	NE	NC	SE	SC	GP	IM	PNW	PSW	TOTAL
Some High School	1.5%	0.8%	0.6%	1.0%	0.0%	0.8%	0.1%	0.1%	5%
Graduated High School	8.6%	3.8%	3.7%	3.0%	0.3%	1.1%	1.6%	0.4%	23%
Some College	2.5%	2.6%	4.5%	2.8%	0.2%	1.5%	2.7%	0.6%	17%
2 Year or Technical Degree	4.3%	3.2%	3.4%	3.0%	0.0%	0.8%	2.0%	1.0%	17%
Bachelor Degree	4.5%	3.4%	3.5%	2.2%	0.0%	1.3%	1.5%	1.2%	18%
Some Graduate School	1.4%	0.9%	0.8%	0.8%	0.4%	0.3%	1.0%	0.1%	6%
Graduate or Professional Degree	2.7%	2.4%	2.7%	3.1%	0.2%	1.2%	1.4%	0.6%	14%

Over 99% of those who responded to the survey were male, and over 97% were Caucasian. Due to a limited number of female and minority survey respondents, there was no data analysis included with these variables.

The annual household income reported by respondents was a bell shaped distribution for those with a household income of under $100,000 per year. Approximately 18% of those surveyed indicated that their annual household income was over $100,000 per year. The median household income for those surveyed was $50K-$59,000 per year. Those respondents who lived in the Northeast, South Central, and Pacific Northwest had the highest percentage of portable sawmill owners earning $100,000 or more per year. The South Central and North Central regions also had the highest percentage of portable sawmill owners earning a household income of less than $20,000 per year. Overall, there was a statistically significant relationship between income levels and expanded region of the U.S. (χ^2=109.18, p=<.001) [Figure 7.3]. However, given the correlation between income and education levels, if the model holds education levels constant, the income differences between regions does not maintain statistical significance at p=.05. Therefore most likely any income differences observed between expanded regions can be explained by regional variation in educational levels.

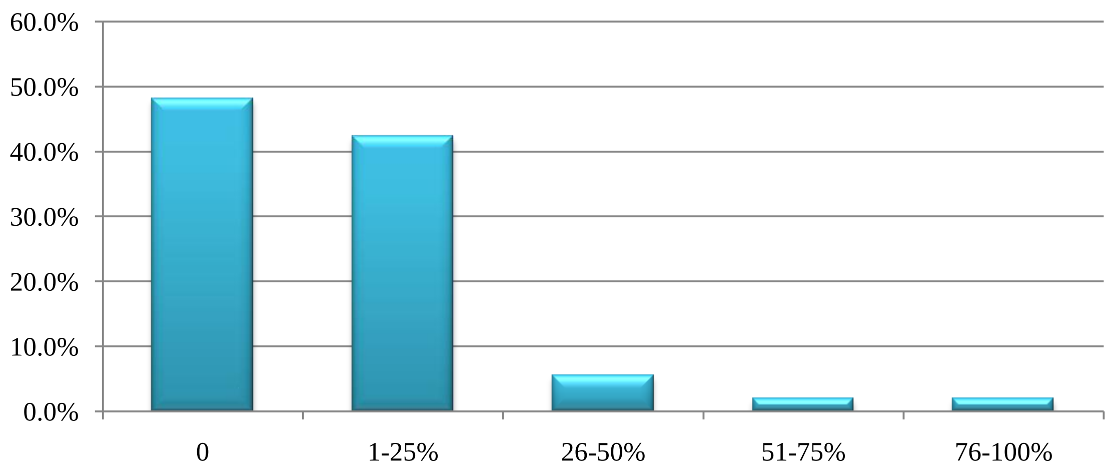
Figure 7.3: Portable Sawmill Owners' Household Income by Expanded Region (n=949)



	NE	NC	SE	SC	GP	IM	PNW	PSW	TOTAL
Less than $20,000	0.8%	1.1%	0.6%	1.8%	0.0%	0.5%	0.9%	0.0%	6%
$20K- $29,999	2.8%	1.8%	1.5%	0.7%	0.2%	0.8%	0.8%	0.1%	9%
$30K- $39,999	3.1%	1.8%	3.4%	1.9%	0.1%	0.6%	0.9%	0.8%	13%
$40K- $49,999	3.1%	3.2%	1.1%	2.1%	0.1%	0.5%	1.1%	0.5%	12%
$50K- $59,999	3.5%	2.5%	2.4%	2.0%	0.1%	1.3%	1.3%	0.7%	14%
$60K- $69,999	3.5%	1.7%	2.1%	2.2%	0.4%	0.2%	0.6%	0.1%	11%
$70K- $79,999	1.5%	0.9%	1.3%	1.1%	0.0%	0.7%	0.7%	0.2%	6%
$80K- $89,999	1.3%	1.3%	2.4%	0.8%	0.0%	0.4%	0.9%	0.0%	7%
$90K- $99,999	0.8%	0.9%	0.9%	0.4%	0.0%	0.9%	0.5%	0.0%	4%
$100,000 or more	5.0%	1.8%	3.2%	3.3%	0.1%	0.9%	2.8%	1.5%	19%

About 48% of respondents indicated that they do not make any income utilizing their portable sawmill. Follow-up interviews revealed that respondents often had undocumented income generating “hobbies” that were not reported as taxable income. As a result of obtaining this information, it is believed that this number is slightly misrepresented. About 42% of those surveyed indicated that 1-25% of their household income is from portable sawmilling, 6% of those surveyed indicated that 26-50% of their household income is from portable sawmilling, 2% indicated that 51-75% of their household income is from sawmilling, and 2% indicated that 76-100% of their income is from sawmilling [Figure 7.4].

Figure 7.4: Percent of Respondents' Household Income Reported to be from Portable Sawmill Microenterprise



There is no statistically significant difference between respondents’ regions of residence and the percentage of household income they obtain from work with their portable sawmill. However, a significant finding is revealed when comparing percentage of household income from sawmilling to educational attainment on a national level reveals a statistically significant relationship in that the higher percent of a portable sawmill owner’s household income comes from sawmilling, the lower their educational attainment (coef.=-.08, p=<.001). When breaking the U.S. into expanded regions, the following regions maintain the same negative relationship between educational attainment and percent of household income that come from sawmilling: Northeast (coef.=-.09, p=.05), South Central (coef.=-.10, p=.05), Great Plains (coef.=-.29, p=.05), and Pacific Southwest (coef.=-.32, p=.05).

Likewise, on a national scale, a lower household income level is associated with having a higher percentage of that income from sawmilling while holding education levels constant (coef.=-.05, p=<.001). This means that individuals with the same education will generally earn less income from a portable sawmill microenterprise as compared to other full time employment. However, when broken down by expanded U.S. region, only the Northeast (coef.=.09, p=.001), and Southeast (coef.=-.07, p=.05) maintain that same negative relationship.

Finally, when comparing a portable sawmill owner's age to their percentage of household income that comes from sawmilling, a negative relationship is observed in that the younger a portable sawmill owner is, the higher percentage of their household income is likely to come from sawmilling, holding both total household income and educational attainment constant (coef.=.-16, p=<.001). Similarly when this model is sorted by expanded U.S. region, the Northeast (coef.=.-12, p=.05), North Central (coef.=.-14, p=.05), Southeast (coef.=.-29, p=<.001), and Intermountain (coef.=.-.30, p=.05), maintain this statistically significant negative relationship between age and percent of household income from sawmilling.

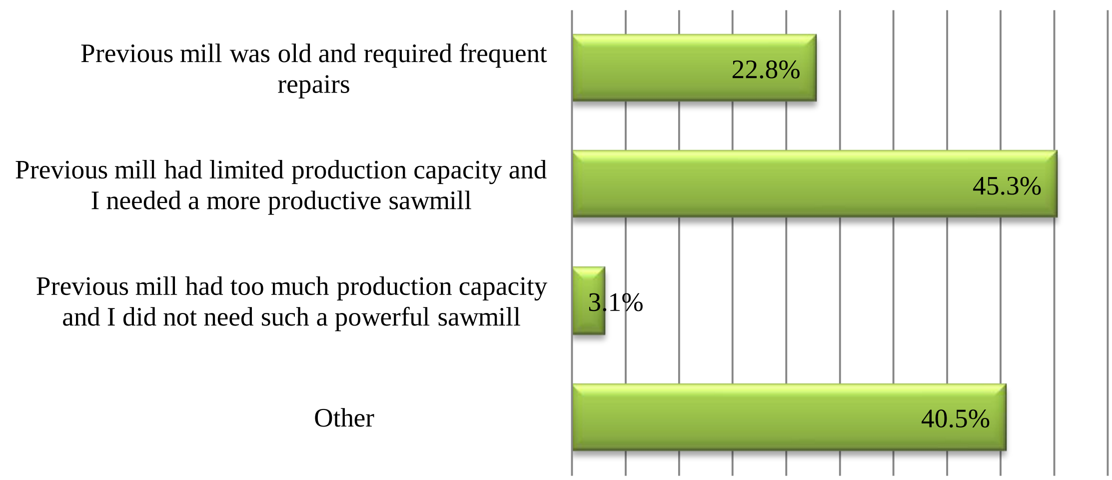
Equipment

This section will discuss portable sawmill equipment as well as accompanying and safety equipment used with a portable mill. Portable sawmill owners had a variety of reasons for purchasing a new mill, with broad range of portable sawmill ages and length of ownership. In addition there are several brands and varieties of portable sawmills that owners possess, with a range of costs that will be discussed. Finally a variety of additional equipment and safety equipment usage among portable sawmill owners will be explored.

Portable Sawmill Purchase

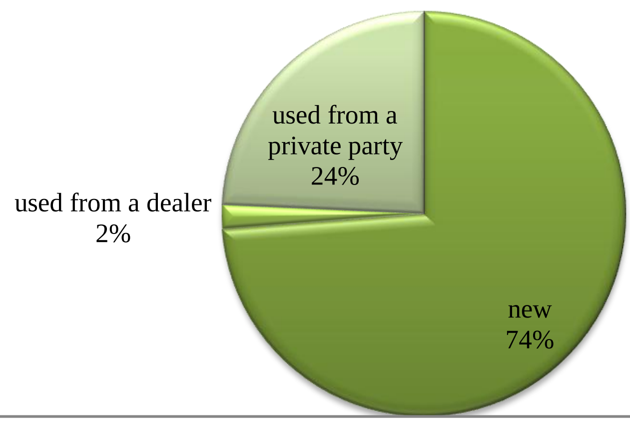
For the majority of respondents, 73%, their current portable sawmill is the first one they have ever owned, and 27% indicated that they have previously owned a portable sawmill. When respondents did previously own a different mill they offered various reasons why they purchased their newer mill. The majority of responses purchased a new mill because a previous mill had limited production capacity and they required a more productive sawmill. Various “other” responses included selling their original mill for more than what they paid for it, indicating that the resale on portable mills is quite high, or desiring new updated features. These responses often were accompanied by statements about older mills wasting a lot of potentially useable wood. Finally, many others upgraded from a chainsaw or circular mill to a bandsaw mill for various reasons including a smoother cut and less waste with a bandsaw [Figure 7.5].

Figure 7.5: Reasons for Current Portable Sawmill Purchase



Overall, approximately 74% of all owners purchased their mill new, 24% used from a private party, and 2% used from a dealer [Figure 7.6]. This could be due to the cost involved in purchasing most mills coupled with the high resale value of mills. Follow-up interviews revealed that in many cases respondents were able to re-sell their mills for almost as much as what they originally paid for it. However, there was no statistically significant relationship between whether this was the first portable sawmill purchased by the owner and whether or not they bought it new or used. Similarly, there was no statistically significant relationship between the reason for their current mill purchase, and whether they bought their current mill new or used, except where the respondent purchased a different mill because the original mill had too much production capacity and they did not need such a powerful mill. In that case the respondent was more likely to purchase a used mill from a private party (p=.05) than a new or used mill from a dealer.

Figure 7.6: Current Portable Sawmill Purchase New or Used



Time: Ages of Portable Sawmills and Length of Ownership

Approximately 61% of respondents indicated that their portable sawmills were first put into service between 2000-2009, but a couple of manual mills were more than 100 years old. Several respondents indicated that using an older mill tended to be dangerous, since newer mills often possessed various updated safety features. Figure 6 below indicates the various years respondents' portable sawmills were first put into service.

Table 7.3: Year Portable Sawmill Was First Put Into Service

Year	Percent
1900-1909	0.11%
1910-1919	0.00%
1920-1929	0.00%
1930-1939	0.11%
1940-1949	0.11%
1950-1959	0.33%
1960-1969	0.22%
1970-1979	2.00%
1980-1989	7.21%
1990-1999	29.38%
2000-2009	60.53%

The average number of years of portable sawmill ownership varied among respondents Table 7.4 indicates that most portable sawmill owners surveyed have owned their current portable sawmill for approximately 8 years and the total length of portable sawmill ownership including previously owned mills is about 10 years. There was a statistically significant relationship (p=.05) between the length of *total* portable sawmill ownership and residing in the South, meaning respondents residing in the South owned mills for less time than those from the North or Western U.S.

Table 7.4: Years of Portable Sawmill Ownership in the U.S.

Average Length of Current Portable Sawmill Ownership	7.97 Years
Average Total Length of Portable Sawmill Ownership (including previously owned mills)	10.20 Years

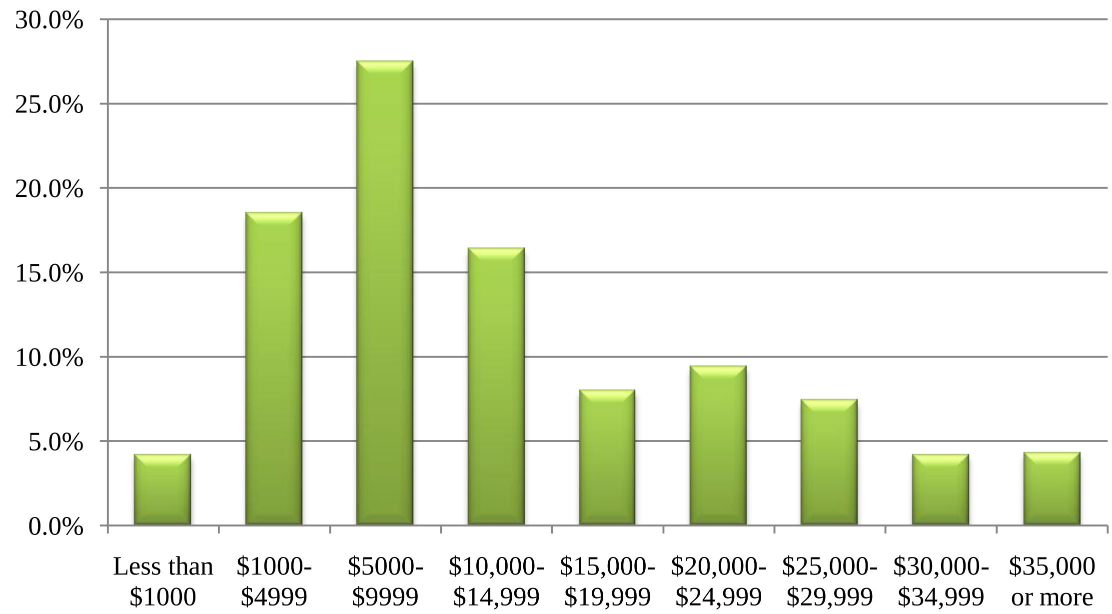
In addition to total length of portable sawmill ownership there was a statistically significant relationship (R^2=.01, p=.05) between the length of *current* portable sawmill ownership and residing in the South, meaning respondents residing in the South owned their current mills for 1.03 fewer years than the North or 1.34 years less than in the Western U.S. There was also a statistically significant difference (R^2=.01, p=.05) between the total years of portable sawmill ownership and region of residence. Southern residents owned a portable sawmill for 1.41 years less than the North, and 2.41 years less than the West.

Portable Sawmill Cost and Mill Brand

There are several models of portable sawmills ranging from very small-scale chainsaw based units that can begin around $150 to larger commercial units costing over

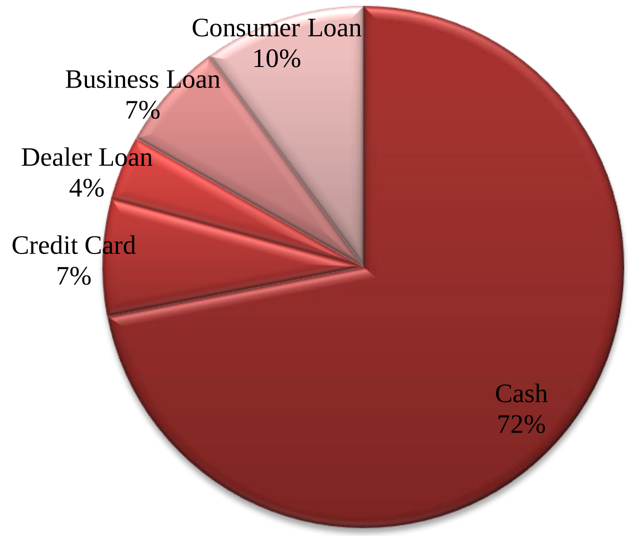
$35,000. Figure 7.7 illustrates the range of prices respondents paid for their portable sawmill. The most common price range for a portable mill was $5000-$9999.

Figure 7.7: Cost of Survey Respondents' Portable Sawmill



The costs of these mills were covered in various ways. Approximately 72% of respondents paid cash for their mills, and 28% used some form of credit. Figure 7.8 illustrates the various forms of payment utilized to finance the purchase of a portable sawmill. Financing option should be explored within the context of an extension program promoting portable sawmills, so that would-be portable sawmill owners and landowners understand the cost investment with portable sawmills as well as the options available to them in terms of buying a mill new or used, and whether to pay cash, credit, or obtain a dealer or consumer loan.

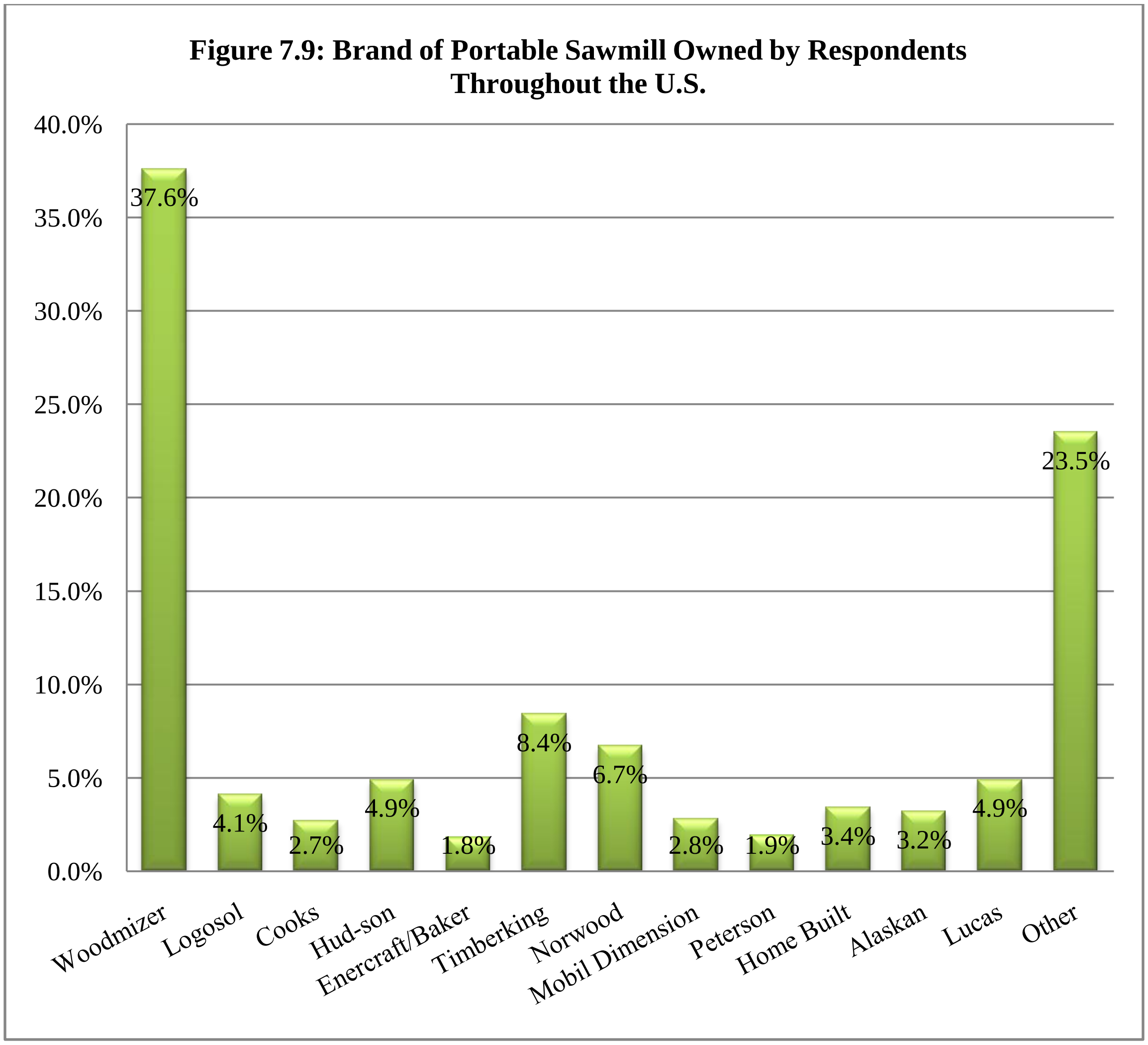
Figure 7.8: How Survey Respondents Financed the Portable Sawmill Purchase



The method of payment was converted into dummy variables representing cash and credit purchases and regression analysis was used to uncover any potential relationship between how a an owner financed their mill purchase and what region of the U.S. they lived in, the cost of the mill itself, whether they used their mill as part of a business, their household income, and the percentage of their household income generated from their mill, taking into account each other. There was no statistically significant relationship between regions and financing, but there was a statistically significant relationship (R^2=.01, p=.05) between how a respondent financed the purchase of their mill and if they lived in the South compared to the West. Residents in the South were about 10% more likely to use credit instead of cash to finance the purchase of their mill compared to residents in the West. In general, the higher the cost the more likely the respondent was to use credit to finance the purchase of the mill (R^2=.09, p=<.001).

Respondents who purchased their mill as part of a full time business were 47% more likely to have used credit instead of cash to finance the purchase of their mill than someone who bought it to use as a hobby (R^2=.08, p=<.001).Those who bought their mill to use as a part time business were 23% more likely to have used credit instead of cash to purchase their mill than someone who bought it for use as a hobby only (R^2=.08, p=<.001). There was no statistically significant relationship between household income and whether they used cash or credit to finance the purchase of their mill. There was however, a statistically significant relationship between whether they used credit to finance their mill purchase and the percentage of a respondents household income that came from portable sawmilling, even when holding the actual cost of the mill constant (coef.=.04, p=.05), meaning those with a higher percentage of household income from sawmilling were more likely to use credit instead of cash to finance the purchase of their mill.

The most popular brand of portable sawmill among survey respondents is the Woodmizer brand. The “Other” category combines several smaller brands such as Mity Mite, Timber Harvester, Turner, etc. and was the second most popular category [Figure 7.9].



There was a statistically significant relationship between mill brand and the respondents' regions of residence (χ^2=98.9, p=<.001). Figure 7.10 below illustrates the various brand of portable sawmill concentration in different regions of the country. The heaviest concentration of mill ownership is in the North, with the most commonly used brand as Woodmizer. The Rocky Mountain and West had a variety of the other types of portable mills listed above.

Figure 7.10: Brands of Portable Sawmill Ownership by Condensed Region

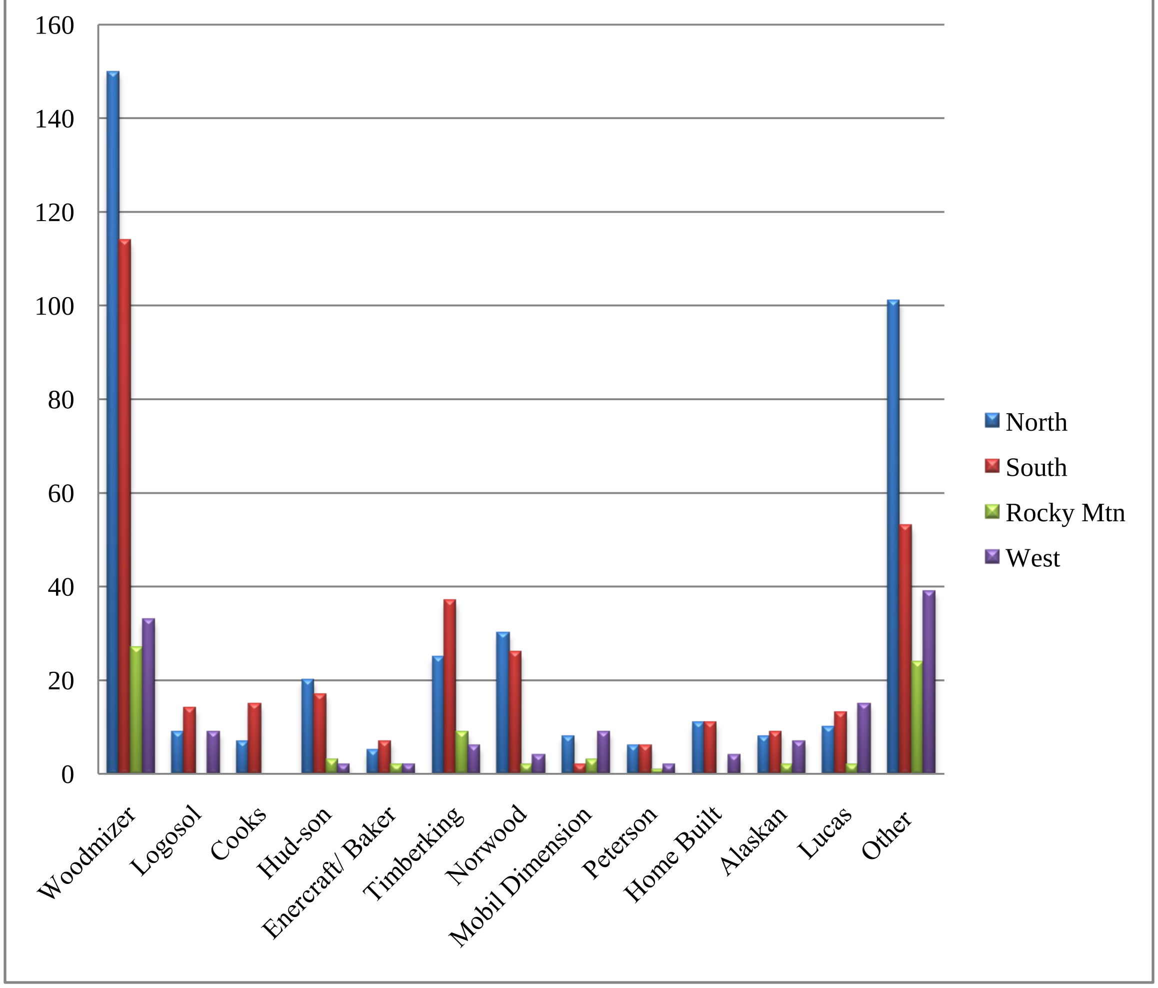


Table 7.5 below shows the average cost range that survey respondents paid for their mill based on the brand they purchased. The Woodmizer brand, while the most popular, also had the highest average cost range. Home built units had the lowest cost, often under $1000. There was a statistically significant relationship between mill cost and brand (χ^2=661.01, p=.001).

Table 7.5: Average Purchase Price by Mill Brand

Woodmizer	$15,000-$19,999
Logosol	$1000-$4999
Cooks	$10,000-$14,999
Hud-son	$1000-$4999
Enercraft/ Baker	$15,000-$19,999
Timberking	$10,000-$14,999
Norwood	$1000-$4999
Mobil Dimension	$5000-$9999
Peterson	$10,000-$14,999
Homebuilt	Less than $1000
Alaskan	$1000-$4999
Lucas	$5000-$9999
Other	$5000-$9999

Additional Equipment Used with a Portable Sawmill

There are several types of small-scale equipment that can be used together with a portable sawmill. The benefits of small-scale harvesting equipment includes lower capital costs, lower operating costs, equipment can have multiple uses, and it is easier to transport (Nova Scotia: 2007, Updegraff and Blinn 2000). Small-scale equipment often requires more skid trails, and could require more operator skills. The operations are often more labor intensive, with lower productivity, therefore utilizing niche markets for small-scale harvesting is imperative to a successful operation (Nova Scotia: 2007). Updegraff and Blinn (2000:5) note, however, that “the lower fixed costs of small-scale equipment can more than compensate for its lower productivity, resulting in increased net revenues per harvesting unit.”

Some of the most basic equipment used in small-scale harvesting are chainsaws, fetching arches, skidding cones, pedestrianized skidder, a motorized winch, and horse logging (Russell and Mortimer 2005). Russell and Mortimer (2005:15) note that “in spite of major efforts and progress by regulators and manufacturers to improve chainsaws, they remain the single most dangerous piece of machinery in forestry." Over 99% of respondents use a chainsaw.

Fetching arches are manually operated arches used to take down trees that get stuck during the thinning process as well as for skidding full poles or logs in early thinning (Russell and Mortimer 2005). About 11% of respondents use a fetching arch. Skidding cones reduce ground friction and assist the extraction of trees or logs without getting stuck on stumps, etc. (Russell and Mortimer 205). Just over 1% of respondents use skidding cones. Pedestrian skidders are used by an individual operator that pulls a log guided by a handle. The disadvantage is that the use of this machine is a completely manual process where the wood is logged with a chainsaw and then lifted onto the skidder (Russell and Mortimer 2005). Similarly just over 1% of respondents use a pedestrian skidder. A motorized winch is another low cost option where the winch can be tied to a tree or other central location. However, this process is very labor intensive and the winches tend to be quite heavy (Russell and Mortimer 2005). About 38% of respondents use a winch.

Horse logging is also one of the more basic forms of small-scale logging. Russell and Mortimer (2005: 31) note "As the forest size decreases and landowners' concerns about environmental issues and aesthetics increase, horse logging may have a niche, working small and sensitive areas, which would not be feasible for mechanized logging." Accessories that can accompany horse logging include a wheeled logging arch, forwarder, wire crane loader, and a grapple loader (Russell and Mortimer 2005). The advantages of horse logging are there is very limited investment and overhead, little to no damage to the surrounding soil and areas being logged, beneficial in pulling down trees that get stuck, and horse logging has a high level of acceptability with the public (Russell and Mortimer 2005). The disadvantages of using horses is the limited size of the timber that can be logged, limited extraction distances, and it takes longer to log an area (Russell and Mortimer 2005). Only about 2% of respondents use animals (a horse, mule, etc.) in their operation.

All terrain vehicles (ATVs) are versatile, relatively inexpensive, and useful for very small operations focusing on 1-20 cords of wood per year (Department of Natural Resources, Nova Scotia: 2007). ATVs are mainly utilized for skidding and hauling and are not necessarily practical for pulling for a distance exceeding a half mile (Updegraff and Blinn 2000). There are several advantages in the use of ATVs. They can be towed behind a car and transported to and from a site, are relatively inexpensive and can also be used for recreation. However, as Russell and Mortimer (2005: 34) note "safety and training are major considerations when using ATVs particularly in forestry conditions. There have been numerous accidents involving ATVs on public roads. Russell and Mortimer (2005:33) note, "timber extraction is one of the most demanding forestry operations undertaken by ATVs and their limitations must be taken into account when deciding on the job to be done and the choice of equipment." About 23% of respondents use an ATV as part of their portable sawmill operation.

Several attachments can be added to ATVs such as a skidding arch, wire crane loader, grapple loader, and a trailer (Russell and Mortimer 2005). A skidding arch is relatively low cost but the load size is limited to the capabilities of the ATV (Russell and Mortimer 2005). A wire crane loader has good maneuverability but requires some manual handling (Russell and Mortimer 2005). A grapple loader has the advantage of clean extraction but it needs a separate power source (Russell and Mortimer 2005). Finally a trailer can be useful for extracting longer distances and provides for clean extraction but has the disadvantage of only being able to handle a small payload (Russell and Mortimer 2005).

Mini tractors can also be used for very small operations. They are small like ATVs and therefore can be transported just as easily (Russell and Mortimer 2005). Accessories for mini tractors include a grapple loader, trailer, and harvesting head (Russell and Mortimer 2005). The grapple loader has the advantage of supplying efficient and speedy loading and unloading, as well as not requiring manual handling, however the design of the tractor is such that operators have to kneel on the seat to operate the loader which can get very uncomfortable after a while and also causes some degree of safety concern (Russell and Mortimer 2005). The trailer offers similar advantages and disadvantages as with its use with the ATV. Finally the harvesting head has the advantage of eliminating work with a chainsaw (Russell and Mortimer 2005).

A medium sized operation, 20-100 cords per year, would call for machinery such as a regular sized tractor which is also versatile in that many harvesting attachments can be added to the original machine, and they also have other uses (Department of Natural Resources, Nova Scotia: 2007). Tractors are the most commonly adapted for timber harvesting because of their versatility. Farm tractors are multi-purpose, have a relatively low price given all of its uses, have well proven technology and parts and service is readily available, not to mention its good resale value (Updegraff and Blinn 2000). Jensen and Visser (n.d.) found that tractors used for extraction are typically not high production systems, they are maneuverable as well as lightweight resulting in minimal residual and soil damage for situation where a landowner is concerned with environmental impact and aesthetics.

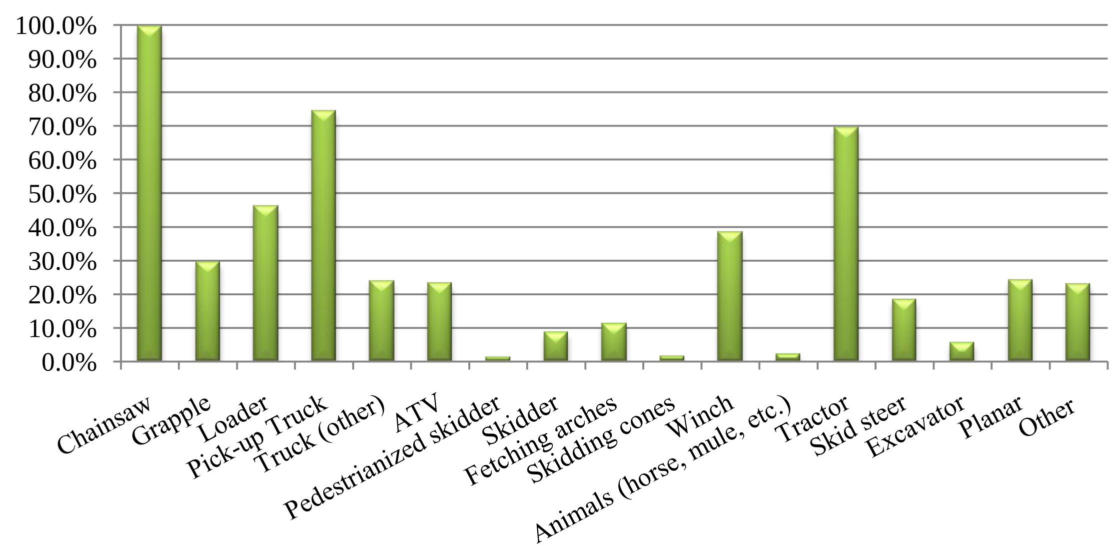
One of the major disadvantages of the use of a farm tractor though is the cab orientation, which is forward facing, and many forestry attachment to a tractor require the operator to be rear facing (Russell and Mortimer 2005). There are tractors that are made specifically for forestry, as opposed to farm tractors, and in Nordic countries people have the ability to purchase “dual role” tractors (Russell and Mortimer 2005). Over 69% of respondents use some kind of tractor in their portable sawmill operation.

Other forms of equipment can be used along with tractors to move logs to the desired locality. Transporting operations utilizing tractors also incorporate the use of skid bars and plates, winches, back fork, a grapple, wire-crane loader, a grapple loader, and a forestry trailer (Russell and Mortimer 2005). Skidder bar and plates have the advantage of being a low cost alternative, however productivity is low and it has limited application in wet or difficult areas, and is not appropriate for thinning (Russell and Mortimer 2005). Winches have the advantage of having the ability to drop a load in a difficult location and, move to safer ground and log from a distance (Russell and Mortimer 2005). The back fork, another low cost option, has the advantage of holding logs off the ground so they stay clean, however it requires manual loading (Russell and Mortimer 2005). A grapple is slightly more expensive, yet has the advantage of operation from within the tractor, but does not have the versatility or flexibility of skidders and winches (Russell and Mortimer 2005). About 30% of respondents use a grapple. Wire crane loaders are the least expensive mechanical accessory however requires extensive walking in that the operator has to attach each bundle and walk along side as it is winched back to the tractor (Russell and Mortimer 2005). A grapple loader is a very efficient and fact accessory in that it eliminates manual handling of the logs, however its main disadvantage lies in its high cost (Russell and Mortimer 2005). Finally the forestry trailer can handle a large log capacity and offers clean log extraction, however it is very costly and can be difficult to maneuver in tight areas (Russell and Mortimer 2005).

Skid steers and excavators can be used together to both load logs and fell logs with tree cutting attachments (Updegraff and Blinn 2000: 5). However this type of operation borders on the capital intensive side and may not be practical for some small-scale operators. About 18% of respondents actually use a skid steer and 6% use an excavator.

Figure 7.11 below illustrates the various equipment that respondents normally used with their portable sawmills. There was no statistically significant relationship between using safety equipment and region of residents, or between the specific types of safety equipment used and region of residents.

Figure 7.11: Equipment Normally Used with Portable Sawmill



Portable sawmill owners also utilize some kind of mechanism for drying the wood that they harvest. Almost half of the respondents air dry their lumber in an open area, and another 28% air dry their lumber some form of enclosed area. Often times respondents indicated building a shelter with wood sawn from their portable sawmill to make an enclosure to house both lumber as well as their mill. About 8% of those surveyed did not dry the lumber at all. There is a statistically significant relationship between the drying mechanism used and the expanded region the portable sawmill owner lived in (χ^2=54.05, p=<.001) [Table 7.6].

Table 7.6: Portable Sawmill Owners' Drying Mechanism by Region

	NORTH		SOUTH		ROCKY MTN		WEST		TOTAL
	NE	NC	SE	SC	GP	IM	PNW	PSW	
Do not dry lumber	1.8%	0.6%	1.2%	1.0%	0.1%	0.6%	1.1%	0.1%	6%
Dry lumber in an open area	12.1%	6.1%	8.6%	6.0%	0.2%	3.8%	5.5%	2.4%	45%
Dry lumber in an enclosed area	8.1%	5.4%	5.4%	6.5%	0.4%	2.0%	2.4%	1.0%	31%
Solar kiln	1.4%	1.6%	1.6%	1.3%	0.2%	0.1%	0.4%	0.1%	7%
Other Kiln	2.1%	3.7%	2.1%	1.2%	0.1%	0.6%	0.9%	0.3%	11%
TOTAL	25%	17%	19%	16%	1%	7%	10%	4%	100%

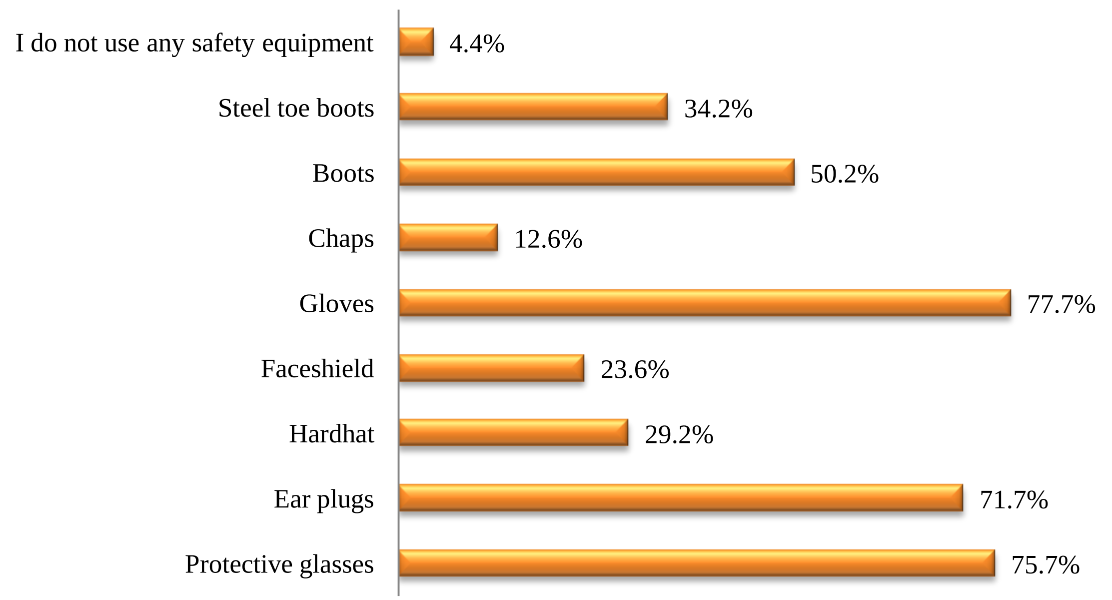
χ^2=54.05, p=<.001 (25% of expected freq.= >5, 0% expected freq.= .0.5)

Safety Equipment

Various types of safety equipment were used with portable sawmills. Almost 96% of portable sawmill owners surveyed use some form of safety equipment. Various equipment used includes protective glasses, gloves, boots, a hardhat, etc. [Figure 7.12]. There was a statistically significant difference between the use of safety equipment and a respondents age (R^2=.01, p=.05). Older respondents tended to be less likely to use safety equipment than a younger operator. Extension programs should promote the use and importance of safety with older portable sawmills. Workshops could be set up hosting equipment vendors who would demonstrate the types of safety equipment available as well as have some available for purchase.

There was no statistically significant difference between the use of safety equipment and their total length of sawmill ownership, the region of the U.S. the portable sawmill owner was located, or their education level.

Figure 7.12: Safety Equipment Normally Used While Operating a Portable Sawmill



There appeared to be a wide variety of equipment utilized as part of a portable sawmill operation. Some basic accessories such as a chainsaw and basic safety equipment were utilized by almost all of our respondents. Those few aside, there are numerous equipment choices that a portable sawmill operator has to complement their operation in a variety of ways using some all, or none of the accompanying equipment to operate their mill. Extension programming could include videos or brochures describing various equipment options available for use with portable sawmills.

Business Aspects of Portable Sawmill Operations

This section explores ownership structures of a portable sawmill, whether owners are in a microenterprise with their mill or use it as a hobby, the uses of timber that is sawn with a portable sawmill, finished products created with timber sawn from their mills, as well as operational aspects such as the demand, contracts, and expenses involved with mill ownership.

Ownership Structure

The majority of those surveyed, 71%, indicated that they owned their portable sawmills alone as an individual, as opposed to the 20% that owned their mills as part of a business. There was a statistically significant relationship between the mill ownership structure and the condensed region of residence (χ^2=31.89, p=.05) [Table 7.7]. However, there was no statistically significant relationship between expanded regions. A small percentage in the South and Rocky Mountain regions own a portable sawmill with several others and part of a co-op, while in the North a small percentage own a portable sawmill with several others as part of a business.

Table 7.7: Portable Sawmill Ownership Structure by Condensed Region of U.S. as Indicated by Respondents to the National Portable Sawmill Survey

	NORTH	SOUTH	ROCKY MTN	WEST	Total
Alone as an individual	29.0%	26.5%	5.6%	10.1%	71.3%
Alone as part of a business	9.0%	5.9%	2.2%	3.0%	20.1%
With another person	2.2%	1.9%	0.3%	0.3%	4.7%
With another person as part of a business	1.2%	0.3%	0.1%	0.8%	2.4%
With several other people	0.9%	0.0%	0.0%	0.1%	1.0%
With several others as part of a business	0.2%	0.0%	0.0%	0.0%	0.2%
With several others as part of a co-op	0.0%	0.1%	0.1%	0.0%	0.2%
Total	42.6%	34.8%	8.4%	14.3%	100.0%

χ^2=31.89, p=.05 (54% of expected freq.= >5, 21% of expected freq.=>0.5) interpret results with caution

There was a statistically significant relationship between ownership structure and the respondents age (χ^2=137.48, p=<.001). Older respondents were more likely to own a mill alone as an individual, whereas middle aged respondents (35-54) were more likely they were to own their mill as part of a business, under 35 tended to be more likely to share their mill with other people as part of a business. Only two respondents shared their mill as part of a co-op and were aged 35-44, and over 65. Extension programs should focus on identifying these age groups and gearing programs to promote cooperative ownership to age groups that are more likely to own their mill as part of a group then as an individual purchase.

The Use of Portable Sawmills as a Microenterprise vs. Using a Mill as a Hobby

Respondents reported various reasons for first purchasing a portable sawmill. Approximately 59% of those surveyed indicated purchasing a portable sawmill either for employment reasons or for a hobby that developed into some form of employment [Figure 7.13]. About 41% indicated purchasing a portable sawmill for a hobby only, and 37% purchased their mill for a hobby that turned into either full-time or part-time employment. Another 22% purchased their mill for strictly employment purposes. A statistically significant relationship was observed in that those who purchased their mill to use as full time employment tended to have a lower income than the other categories, holding education constant (p=<.001). This is most likely due to the fact that those earning lower wages may be more interested and/or willing to embark on something to earn additional income.

Figure 7.13: Reason for First Purchasing a Portable Sawmill

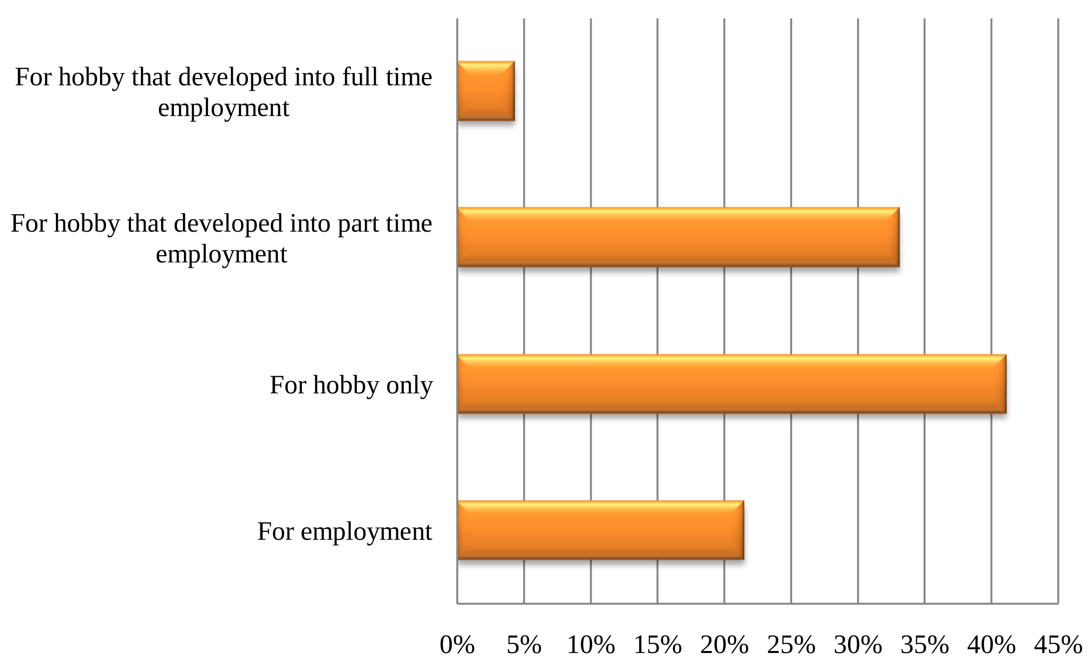


Table 7.8 indicates respondents' current use of portable sawmills. Approximately 40% of those surveyed indicated currently using their portable sawmills for hobby only, with the other 52% utilizing their mills for part time employment, and 7% as full time employment. Those in the South were most likely to engage in full time employment utilizing their portable sawmill, than in any other region. The most prominent category indicated in Table 7.9, were those in the North who utilized their mill as a part time business as well as a hobby. There was a statistically significant relationship between a mill owner's current use of their portable sawmill and the condensed region they live in (χ^2=23.08, p=.05).

Table 7.8: How Portable Sawmills are Currently Used by Condensed Region

	NORTH	SOUTH	ROCKY MTN	WEST	Total
Full-Time Business	19 2.1%	21 2.3%	6 0.7%	10 1.1%	56 6.2%
FT Business and Hobby	2 0.2%	2 0.2%	2 0.2%	4 0.4%	10 1.1%
Part-Time Business	52 5.7%	59 6.5%	14 1.5%	20 2.2%	145 16.0%
PT Business and Hobby	164 18.1%	99 10.9%	29 3.2%	42 4.6%	334 36.8%
Hobby Only	147 16.2%	140 15.4%	24 2.6%	52 5.7%	363 40.0%
Total	384 42.3%	321 35.4%	75 8.3%	128 14.1%	908 100.0%

model: χ^2=23.08, p=.05 (20% of cells =<5 expected freq.)

The Uses of Timber Sawn with a Portable Sawmill

There are various uses for lumber sawn from a portable sawmill ranging from selling or using the lumber, to building a structure, to creating a finished product within a niche market. Respondents' indicated building a barn or other outbuilding with wood from their mill (68%), selling the lumber (51%), trading lumber (31%), and creating various products to sell (25%), keep (32%), or trade (5%). A number of respondents indicated building a barn or other outbuilding (66%), and 25% built their home with wood from their portable sawmill.

Table 7.9 indicates the expanded U.S. region that a respondent lived in compared to what they did with the lumber sawn from their portable sawmill. There were only statistically significant regional variations in the uses of sawn timber when the lumber was used to build a house (χ^2=21.97, p=.05) or a barn/outbuilding (χ^2=27.18, p=<.001). This difference could be in large part due to state and city ordinance laws that restrict the use of non-graded lumber for use in structures. Several survey respondents indicated the inability to build a structure due to the local ordinances prohibiting the use of non-graded lumber. One way to utilize portable sawmilled lumber in a building structure is to obtain a grading stamp, although many respondents found this cost prohibitive due to the limited use they could get from it, coupled with the annual recertification requirements, which vary by state. Extension programs should develop material explaining the building laws and ordinance requirements for their area, as well as provide information on getting their lumber graded/stamped so that portable sawmill owners in various locales will be able to utilize resources available to them in terms of building materials. Programming could assess the interest of obtaining a lumber stamp and if warranted combine the resources of multiple portable sawmill owners to obtain a grade for their lumber.

Table 7.9: Use of Timber Sawn with Portable Sawmill by Expanded U.S. Region

	NORTH		SOUTH		ROCKY MTN		WEST		
	NE	NC	SE	SC	GP	IM	PNW	PSW	TOTAL
Sell Lumber	119 -12.80%	97 -10.50%	84 -9.10%	69 -7.40%	6 -0.70%	30 -3.20%	51 -5.50%	16 -1.70%	472 -51%
Trade/ Exchange Lumber	79 -8.50%	48 -5.20%	49 -5.30%	46 -5.00%	4 -0.40%	19 -2.10%	32 -3.50%	11 -1.20%	288 -31%
Sell a Finished Product	56 -6.00%	47 -5.10%	38 -4.10%	33 -3.60%	3 -0.30%	23 -2.50%	22 -2.40%	8 -0.90%	230 -25%
Trade/ Exchange a Finished Product	12 -1.30%	6 -0.70%	11 -1.20%	13 -1.40%	0 0.00%	4 -0.40%	4 -0.40%	0 0.00%	50 -5%
Build Home*	52 -5.60%	34 -3.70%	37 -4.00%	59 -6.40%	2 -0.20%	18 -1.90%	23 -2.50%	11 -1.20%	236 -25%
Build Barn or Other Out building**	163 -17.60%	82 -8.90%	119 -12.80%	105 -11.30%	5 -0.50%	41 -4.40%	75 -8.10%	21 -2.30%	611 -66%
Keep Finished Product	68 -7.30%	50 -5.40%	64 -6.90%	48 -5.20%	5 -0.50%	18 -1.90%	29 -3.10%	14 -1.50%	296 -32%

$\chi 2$=21.97 p=.05* (6% expected freq.=>5, 0% expected freq. =>0.5)

$\chi 2$=27.18 p=<.001** (0% expected freq.= >5)

The various uses for timber sawn with a portable mill had a statistically significant effect on the percent of household income that was generated from a mill. In general, those who sold or traded lumber or a finished product tended to earn more of their household income from sawmilling, and those who built a barn/outbuilding and those who created items to keep were more likely to earn less of their household income from sawmilling then those who sold or traded items.

Table 7.10 illustrates this variation. Differences in the relationship between percentage of household income from sawmilling and the end product from processed timber was statistically significant when the portable sawmill owner sold lumber (χ^2=269.78, p=<.001), traded/exchanged lumber (χ^2=26.01, p=<.001), sold a finished product (χ^2=107.36, p=<.001), built a barn (χ^2=16.68, p=.05), or kept a finished product (χ^2=29.6, p=<.001). Extension material should reflect the fact that 100% of a household income could be obtained from utilizing a portable sawmill to produce lumber or selling finished products, including outbuildings, however it is more likely that a portable sawmill owner would earn a percentage of their household income from portable sawmilling.

Table 7.10: Relationship Between the Percent of Household Income that Came from Sawmilling and End Product from Processed Timber

	Percent of Household Income from Portable Sawmill						
	0	1-25%	26-50%	51-75%	76-100%	TOTAL	χ^2
Sell Lumber	100 11.0%	285 31.3%	45 5.0%	15 1.7%	16 1.8%	461 51%	269.78**
Trade/Exchange Lumber	107 11.8%	152 16.7%	16 1.8%	2 0.2%	4 0.4%	281 31%	26.01**
Sell a Finished Product	42 4.6%	144 15.8%	22 2.4%	8 0.9%	9 1.0%	225 25%	107.36**
Trade/Exchange a Finished Product	27 3.0%	16 1.8%	5 0.6%	1 0.1%	1 0.1%	50 5%	
Build Home	100 11.0%	104 11.4%	17 1.9%	5 0.6%	4 0.4%	230 25%	
Build Barn or Other Outbuilding	302 33.2%	252 27.7%	30 3.3%	7 0.8%	6 0.7%	597 66%	16.68*
Keep Finished Product	176 19.3%	107 11.8%	8 0.9%	3 0.3%	1 0.1%	295 32%	29.6**

p=.05*,p=<.001** (0% expected freq.=>5)

Finished Products Created Utilizing Timber Sawn with a Portable Sawmill

A variety of finished products were created utilizing their portable sawmill. Many respondents, 39%, indicated that they make furniture with the wood from their sawmill. About 24% indicated a wide variety of miscellaneous items created such as chicken coups, custom sawing, crafts, gifts, cedar chests, picture frames, beehive products, hay wagons, surfboard blanks, guitar blanks, turning blanks, carvings, mantles, etc. Another 14% built homes or generated housing materials from wood run through their mill. Approximately 7% used wood from their mill to build cabinets, 5% made tables and/or benches, and 6% made flooring. Table 7.11 outlines the different finished products constructed from wood milled in a portable sawmill by expanded region of the country (χ^2=51.08, p=.05).

In the North the highest percentage of respondents created various miscellaneous products, followed by furniture, and building supplies. In the South the highest percentages were also furniture makers, followed by miscellaneous products, and cabinets. In the Rocky Mountain region, the highest percentage made furniture and various miscellaneous products. In the West the highest percentage of respondents made furniture, followed by various miscellaneous products.

Table 7.11: Finished Products Using Portable Sawmill by Region

	North	South	Rocky Mtn	West	TOTAL
Various/ Misc.	12%	7%	2%	3%	24%
Furniture	15%	17%	3%	5%	40%
Tables/Benches	3%	2%	0%	1%	6%
Fences	0%	1%	0%	1%	2%
Shelves	1%	0%	0%	0%	1%
Cabinets	2%	4%	1%	1%	8%
Toys	1%	1%	1%	0%	3%
House/Building for Others	1%	1%	0%	0%	2%
Sustainable Products	0%	0%	0%	0%	<1%
Misc. Building	6%	3%	2%	1%	12%
Flooring	3%	3%	0%	1%	7%

χ^2=51.08, p=.05 (30% expected freq= >5, 4% expected freq.=>0.5)

There was also a statistically significant relationship between finished products created and how the mill was currently used. Those who used their mill as a hobby only tended to make a variety of finished products including furniture, whereas those involved in some form of employment with their mill were more likely to make flooring, cabinets, furniture, and various other products (χ^2=94.33, p=<.001). When observing on a regional scale, differences between created products and current use of the mill were statistically significant in North Central (χ^2=34.88, p=.05) and South Central (χ^2=44.46, p=.05) regions.

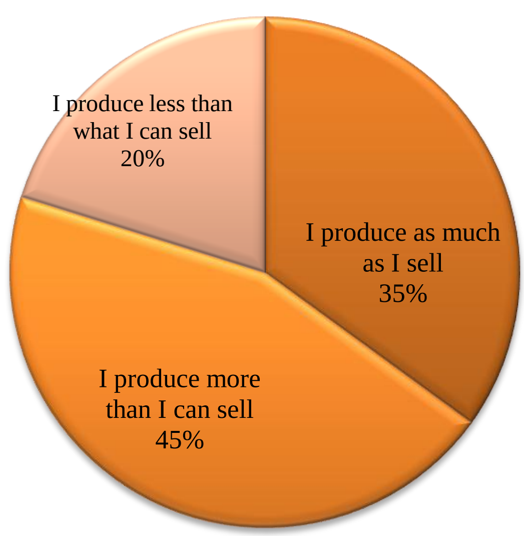
In the North Central region, those who were involved in full time employment with their mill created more miscellaneous buildings and/or building material, and those involved in a part time business or part time business and hobby using their mill more likely to create flooring, building material, cabinets, furniture, and various miscellaneous products, then those operating as a full time business or hobby, whereas those who used their mill as a hobby only tended to create a variety of miscellaneous products, tables and benches, and furniture. In the South Central region, those involved in a full time business with their mill tended to make flooring, or furniture, those involved in a part time business and/or hobby with their mill tended to create furniture and various miscellaneous products. There is no statistically significant difference between the age of respondents and what finished products they created.

Various finished products are created with lumber sawn with a portable mill. Many of those products are sold to earn additional income. Extension programs should outline the range of possibilities for portable sawmilled lumber including finished products that are produced around the U.S., along with information on what individuals are able to sell as compared to what they produce as a hobby.

Operational Aspects: Demand, Contracts, Itemized Expensing

There was also no statistically significant difference between the products respondents created and the perceived demand for their products, whether they utilized contracts for their customers to sign, and whether they itemized their expenses. Figure 7.14 illustrates respondents' perceived demand for their products. Approximately 55% of respondents indicated that they can produce equal to, or less than, what is needed to meet a demand in their market. Overall there is no statistically significant relationship between the perceived demand for their product and the uses of their sawn timber, except wherein the respondent sold the lumber, in that case the respondent was more likely to perceive that they produced more than they could sell (χ^2=7.01, p=.05) as compared to those who sold a finished product who normally believed they produced equal to or less than what they could sell. This could be indicative of portable sawmill owners' production of ordinary lumber obtainable at any local retail outlet, supported by a comment written on the back of one of the portable sawmill surveys that stated their abundance of pine sitting in their shed without a market to sell. This refers to a point made early that portable sawmill owners need to understand the value of various species of lumber and it is insufficient to produce lumber competing within the larger market. Extension programs need to educate portable sawmill owners on not only the difference timber species available in their area, but also the value and rarity of various timber species.

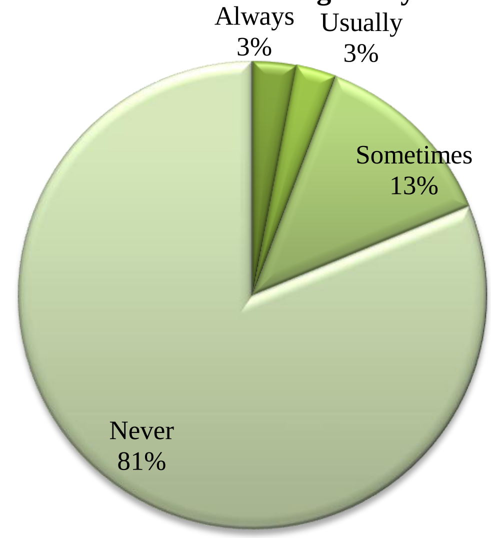
Figure 7.14: Respondents' Perceived Demand for their Products



Interestingly the differences in perceived demand were not statistically significant when comparing it to whether the respondents itemized their expenses. Therefore, as a whole, the demand for their products is based solely on their perception of whether their products are selling, not based on any concrete dollar figures. There was also no statistically significant relationship between the types of finished product a respondent created and the perceived demand of their products, by the U.S. as a whole or by region. Finally, there was no statistically significant relationship between a respondent's perceived demand and their education level, age, or the percentage of household income they generate from their mill.

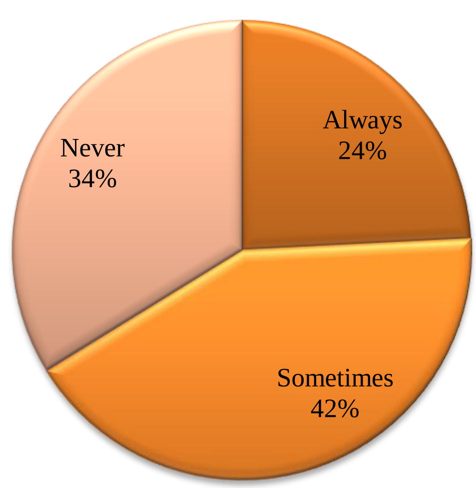
Approximately 81% of respondent who sell or trade products indicated never drafting a contract for their clients to sign, 13% sometimes have their clients sign contracts, 3% usually, and 3% always have their clients sign contracts [Figure 7.15]. Interestingly, there was no statistically significant relationship between how a respondent used their mill (full time business, part time business, hobby, etc.) and whether or not they drafted contracts for their clients to sign in the U.S. as a whole or by region. There was also no statistically significant relationship between whether a respondent drafted contracts for their clients and their education level, age, or the percentage of household income they generate from their mill.

Figure 7.15: Of Respondents Who Sell or Trade Products, Percent that Draft Contracts to be Signed by Customers



About 24% of portable sawmill owners who were surveyed indicated that they always keep itemized expenses of the costs incurred using their portable sawmills, 42% indicated they sometimes itemizing expenses, and 34% indicated never itemizing expenses for costs incurred using their portable sawmill [Figure 7.16].

Figure 7.16: Keep Itemized Expenses of Costs Incurred With Portable Sawmill



There was no statistically significant relationship between itemizing expenses and a respondents' age, income, percent of household income from portable sawmill, region, or the current use of their business except wherein a respondent used their mill for a "part time business and hobby" (χ^2=15.46, p=.05*)* [Table 7.12].

Table 7.12: Of those who use their mill as "part time employment and hobby," whether a respondent itemized expenses related to their mill compared to the percentage of their household income that comes from milling

	Percent of Income from Portable Sawmill				
	0	**1-25%**	**26-50%**	**51-75%**	**76-100%**
Always Itemize Expenses	8.92%	14.01%	1.59%	0	0
Sometimes Itemize Expenses	14.65%	27.39%	0.64%	0	0
Never Itemize Expenses	7.64%	24.20%	0.32%	0.64%	0

model: χ^2=15.46, p=.05, Fisher's exact= .019

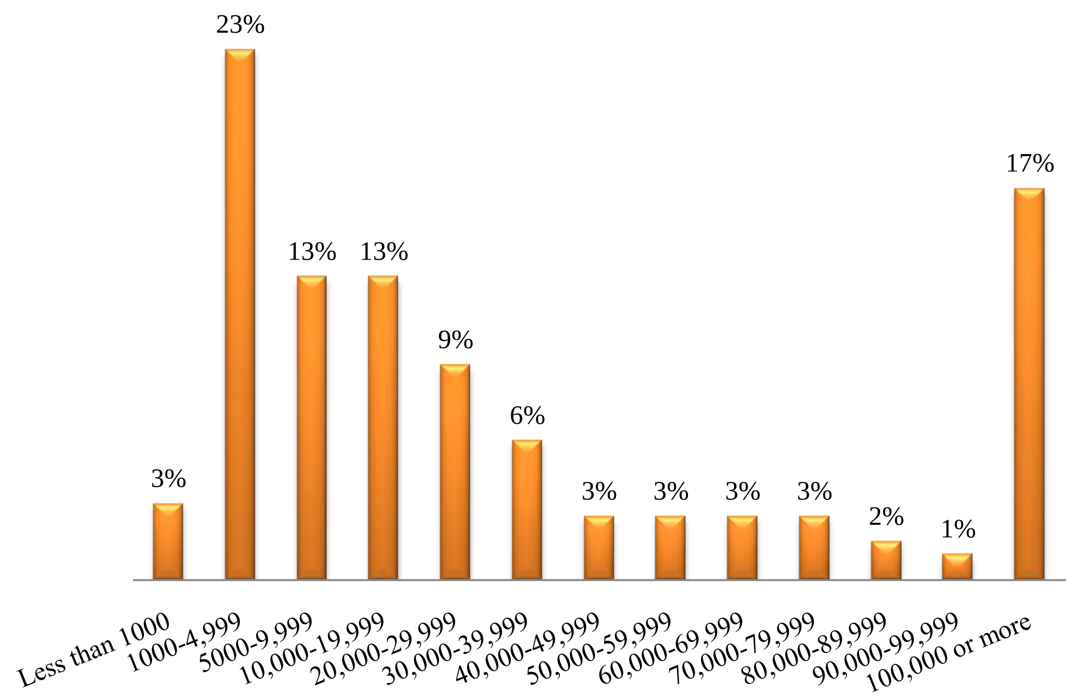
The lack of adequate bookkeeping in portable sawmill microenterprises prevents the entrepreneurs from knowing whether they are actually making a profit or how they can become more profitable. This finding demonstrates a need for educational workshops teaching portable sawmill owners how to budget business expenses and keep accurate itemized expensing to enable them to reach their potential as successful microenterprises.

Operational Costs Associated with Mill Ownership

Respondents were asked to indicate their costs to operate their portable sawmill and what they actually charged customers per board foot. Tables 6.7 and 6.9 indicated the various costs and charges to operate a portable sawmill per board foot. If differentiated in the survey responses, respondents indicated that they charge a range of \$.02-\$.40 more per b.f. for hardwood lumber. Although these numbers varied based on tree species as well as several other factors, they do offer a general idea of charges by portable sawmill owners. In addition, several respondents indicated that they charge on a per hour basis ranging from $30-$100 per hour, with an average of $55 per hour.

Overall there was a wide range of board feet (b.f.) of timber processed by portable sawmill owners ranging from less than 100 b.f. per year to about 17% of respondents processing 100,000 or more b.f. per year [Figure 7.17]. There is no statistically significant relationship between the amount of board feet processed per year and the mill brand or mill cost. One possible explanation for this could be the limited number of respondents (12%) that answered this particular question related to the amount of b.f. processed per year. There was also a slight relationship between those who had a higher percentage of their household income from sawmilling and charging more per board foot (R^2=.01, p=.10)

Figure 7.17: Board Feet of Timber Processed per Year With Respondents' Portable Sawmills



A general model of the variable costs incurred per year using a portable sawmill are indicated in Table 7.13. A variety of costs were indicted such as labor, repair and replacement parts, routine maintenance, fuel and lubricants, insurance, transportation costs, and log purchase costs. The average costs are approximately $7080 per year, however this figure is skewed due to a wide range of operating costs involved. After examining the median costs per year incurred by portable sawmill owners, it becomes more evident that there are several respondents who incur very low costs while others incur very high operating costs. Median variable costs are far lower than average variable costs. The interquartile range offers a view of the 25th-75th percentile of respondents, basically eliminating outliers in each direction, and offers a total cost per year of $3470.

Table 7.13: Respondents' Variable Costs Per Year Associated With Their Portable Sawmill

	Average	Median	IQ Range (25-75 percentile)	Min	Max
Labor costs	$1,618	$0	$500	$0	$76,000
Repairs and replacement parts	$411	$200	$300	$0	$10,000
Routine maintenance, including sharpening of blades	$440	$200	$420	$0	$9,500
Fuel and lubricants for the mill itself	$447	$100	$250	$0	$18,000
Insurance (liability, health)	$687	$0	$600	$0	$15,000
Cost of transporting the mill from location to location	$213	$0	$200	$0	$5,000
Purchase of timber or logs for milling	$3,264	$0	$1,200	$0	$80,000
Total Costs	**$7,080**	**$500**	**$3,470**		

Overall 77% of respondents perceive their portable sawmill operation as having expenses similar to, or less than, the revenue that they obtain operating their mills [Figure 7.18]. Interestingly, there was no statistically significant relationship between a respondent’s expenses vs. revenue, and their region, current use of mill (employment, hobby, etc.), age, income, percent of household income from mill, or education.

Figure 7.18: Respondents' Perception of Their Income/ Expense Ratio

Discussion

This chapter explored the various equipment used in portable sawmill operations as well as characteristics of portable sawmill ownership including forest microenterprises that utilize portable sawmills, operational aspects involved with a portable sawmill operation, as well as demographic characteristics of portable sawmill owners.

An important aspect of portable sawmill ownership involves the variety of equipment and safety equipment that are utilized with a mill. The average portable sawmill cost was between $5,000-$9,999, with the modal ranging from $150 to over $35,000. Most portable sawmill owners paid cash for their mill (72%) but multiple financing options should be conveyed to landowners and would-be portable sawmill owners. The higher the cost of the mill the more likely respondents were to use credit to finance their purchase. Extension material could be developed describing the variety of financing options available to potential adopters as well as the availability of small business grants and loans that could potentially be available to them.

Several types of additional equipment can be used with a portable sawmill ranging from chainsaws to various types of heavy equipment, with the most common being a chainsaw and a pick-up truck. Extension brochures or videos could be developed to demonstrate both portable sawmills in operation and accompanying equipment.

Safety was a priority for most sawmill owners as 96% use some form of safety equipment. Younger portable sawmill owners were more likely to use safety equipment than older owners. Extension programs should target older portable sawmill users in particular and set up workshops displaying various safety equipment available as well as offer tutorials on how to use it.

Several characteristics encapsulated a portable sawmill microenterprise. While many of the microenterprises operated on a part time basis, there were some who were able to fully make a living with their mill. Those who reported a higher percentage of their household income from portable sawmilling often had a lower educational level. Additionally, the younger a portable sawmill owner was, the more likely a greater percent of their household income was achieved through portable sawmilling.

Overall, over half of the portable sawmill owners surveyed reported earning some part of their household income from their mill work. Most portable sawmill owners surveyed used their mill as a part time microenterprise. However, there was some apprehension on the microentrepeneur’s part on offering too much information about their businesses. Some respondents even commented that if they were to give out too much financial information about their microenterprise it could potentially jeopardize their monopoly in the niche market they had discovered in their area. Others indicated that although they give finished products as a gift or trade in exchange for another object or monetary "gifts" in return, they do not operate as a "business." Integrating these cost and earnings data is, therefore, difficult and there may be more portable sawmill businesses that are earning additional household income than what respondents actually reported.

These findings do offer a good starting point to understanding basic general income potential and extension programs can utilize these characteristics in developing educational programs. However there is an apparent lack of adequate book keeping by portable sawmill microenterprises demonstrating the need for Extension to develop educational workshops teaching portable sawmill owners how to begin and operate a successful business in terms of the financial aspects, including how to keep accurate records and itemized expenses.

Portable sawmill owners represented in this study are primarily white males, with more than half being over 55 years old. The education levels of portable sawmill owners varied by region, with the South Central region holding the largest percentage of portable sawmill owners with graduate or professional degrees, and the Northeast holding the largest percentage of portable sawmill owners whose education attainment was high school graduate. The income differences observed by portable sawmill owners can in large part be attributable to educational differences between the regions. Extension programs should understand the most likely adopters of portable sawmills in their region and focus their extension programming to serve this community.

Extension programs could promote portable sawmill ownership within the context of the possibility of achieving up to 100% of an owners household income from sawmilling, although it is not an avenue for getting rich. More likely portable sawmills would offer a potential adopter the ability to supplement part of their income by selling specialty lumber or a finished product and Extension programs should focus most of their attention to reaching this market of potential adopters. Various finished products are created and sold from lumber sawn with a portable mill. Extension programs should outline the range of possible finished products that individuals are creating with lumber sawn in their mill, should focus their attention on identifying niche markets that exist throughout the U.S. as well as specialty products they sell.

THE ADOPTION AND DIFFUSION OF PORTABLE SAWMILLS IN FOREST BASED MICROENTERPRISES

Microenterprises can add valuable resources to the larger society both in terms of filling important markets often outside the scope of mainstream industry as well as enhancing a society's wellbeing through reduction of poverty by creating opportunities available to people who are marginalized by the labor force for one reason or another. Orlando and Pollock (2003) categorize those who enter into microenterprises as either the underemployed/ surplus labor sector, or the microentrepeneur sector, who choose this path due to earnings opportunities and flexibility. Forest microenterprises in particular can be beneficial to enhancing community development efforts as well as forest conservation goals, empowering local people to enhance their own income as well as manage their resources (Salafsky 1997).

Ssewamala, Lombe, and Curley (2006:1) found "that overall there is a considerable level of interest in saving for and investing in small-businesses among poor Americans, including those who are less advantaged in terms of income poverty and employment." Micro-entrepreneurial assistance could be beneficial in giving disadvantaged members of society, especially in resource dependent communities where little outside opportunity is available, the assistance they need to become successful. However, in order to invest in forest based small business potential, we need to understand who people are who enter into such endeavors, why they chose this path, and how businesses utilizing this forest based technology, portable sawmills, have adopted and diffused throughout their larger social structure.

Portable sawmill adoption/ diffusion research presented in this study utilizes the traditional adoption/diffusion model, contributing both it its significance, as well as giving the model new application within the forestry field. A significant finding in this research rests not only in the uniqueness of portable sawmill adoption as a whole as compared to the traditional model, but also a bi-modal adoption pattern emerged between those who utilized their portable sawmill as part of a full-time microenterprise and those who used their mill as a part time microenterprise. Given the existence of this bi-modal adoption pattern, extension programs recognize these differences in adoption and develop their programs accordingly.

This chapter begins with a discussion of how the innovation process began for portable sawmill entrepreneurs. This background material is an important piece to understanding the adoption process and answers the question of what motivations individuals have to adopting portable sawmills, or why they are adopting portable sawmills. Understanding why an individual does something, or adopts an innovation or technology, is pivotal to understanding the larger picture regarding development and extension strategies aimed at helping others to realize the same potential. Interestingly, while the pattern of adoption varied between full-time and part-time portable sawmill microenterprise owners, how the innovation process began these two groups did not differ based on their full time or part time status.

How the Innovation Process Began: The Adoption of Portable Sawmilling

Portable sawmills have been around for centuries. Philip (2001) notes that "the new "portable" sawmills of today are only updates of machines that have existed since the days of pyramid building." Philip (2001) notes that the Egyptians developed this technology, which later refined by the Romans, re-invented in the 19^{th} century during the industrial revolution utilizing water and steam, and again modified into gasoline, diesel, and electricity based circular, band, and chainsaw mills of today.

Previous studies on the diffusion of innovation focused on this type of re-invention of an innovation, or adopting an already existing innovation after modifying it in some way to meet the adopter's needs (Rogers 1995). For several of the portable sawmill owners interviewed their innovation process began while attempting to find other income revenue streams for an existing business, or to supplement their regular full time careers. Many respondents had been engaged in forestry/ wood working based interests for many years before becoming interested in portable sawmills. Common themes emerged as portable sawmill owners discussed their primary reasons for entering into a small-scale forest microenterprise utilizing portable sawmills: as a way to expand a farm business, as a conservation effort, and as a way to fill a needed niche market. One of the most interesting aspects of the themes that have emerged, and in portable sawmill culture in general, is that it tends to transcend locality in that portable sawmill owners around the country are doing the same types of things with their mills for the same group of reasons despite regional or other locality differences.

Expanding/ Transforming a Farm Business

A common theme that emerged through interviews with portable sawmill owners was the utilization of mills as a means of expanding or transforming the structure of an existing farm business. Given the current economic climate, farmers as well as others around the U.S. are in many cases financially struggling. Some farmers have farms which are failing, and others had just slowed during the recent economy. The farmers interviewed in particular were looking for ways to diversify their farms in order to generate additional income for those reasons.

As an example of a completely transformed farm business one respondent operated a farm just outside of a couple thousand person town in rural South Carolina. At 56 years old this full time sawyer with a bachelor degree in Mechanical Engineering, and in semi-retirement, was looking to expand opportunities on his farm during the slow times. He began by sawing oak and selling primarily air dried band sawn oak. However he quickly discovered that selling lumber was not particularly profitable, and started to obtain timber headed to local landfills in order to offset some of the costs, at least that way the wood itself was free. A common theme that was recalled throughout a majority of the interviews, including the interview with this farmer, was his desire to expand his portable sawmill experience coupled with his inability to turn down customers and subsequently turn down initial jobs received through word of mouth, which led to expansion of his microenterprise. While exploring options to expand his struggling farm, this farmer recalled his career changing opportunity,

> I have a forester friend who knew a guy with a paulownia plantation with some blow downs that needed to come out, and so I did it then, got to keep the logs. The dried paulownia was so light and eventually I got more and more into it. One big market for paulownia lumber is the surfing industry. I had a customer ask me to make them surfboard blanks out of it because they didn't have the equipment. It all started from there. I think that god had a big hand in that for me because my farm was failing and I needed something and this just fell in my lap. I didn't have a conscious decision along the way to enter this niche it just fell in my lap.

Currently, this farmer has completely transformed his farm into a portable sawmill microenterprise employing two full time employees as well as one part time employee and ships surfboard blanks mainly to residents of Hawaii and California, from his farm in South Carolina. His wife stays involved with the business through bookkeeping, although he admits he does not keep records the way he should.

Two other examples, described below, involve utilizing a portable sawmill as a tool in expanding a farm business. In the first case the respondent owned a farm in Michigan and was looking for a way to make extra money. The second case involved a tree farmer in Louisiana who also used a portable sawmill as a means of expanding his farm, except in this case expanded production utilizing the same resource (trees) as was used in his farm business.

In the first case, in addition to being a farmer this portable sawmill owner in Michigan is also a high school teacher. He lives in a rural township of just over 1000 residents, owning controlling interest in a farm about 5 miles away in a town of about 2000. He originally purchased a portable sawmill to be used as part of the larger farm operation on a part time basis. This respondent notes "I treat the sawmill as part of my farm operation: sale of standing hay, firewood, rent for storage, timber sales, etc. so it was just added to the mix.” This is similar to what used to be called “farming systems,” creating multiple activities within one enterprise equals stability in the overall system.

When recalling how the sawmilling aspect of his farm operation began he recalled three specific reasons for beginning to use a portable sawmill, “1) I had 5 acres or 5000 red pine trees in need of thinning and at 100 per year I could improve my barn/garage, build other outbuildings…. 2) I had hardwood which needed harvesting as well…. 3) Others approached me wanting lumber sawn.” He incorporated both timber sales as well as custom sawing to his existing enterprise as a means of expansion and has thus been successful in generating new revenue streams. When reporting on the success of the portable sawmill aspect of his microenterprise he recalled,

> I haven't turned away business but haven't done as much of my own/for myself as I would have liked. I have a barn full of well-seasoned lumber for a variety of projects awaiting time/energy and I gain experience in milling. I have also been able to maintain/improve my operations by plowing earnings back into the operations. Examples: 6.5' cant hook, shingle/siding maker, 2 2' extensions. I was also able to use the mill's axle receiver and tongue to create a log trailer to move barn timbers.

The second case, this 65 year old veterinarian in a small city (population 23,000) in rural Louisiana runs his vet practice by day and operates as a tree farmer by night. He originally purchased his portable sawmill nine years ago as a means of expanding his farm business through retaining fallen lumber in storm cleanup and bug damage on his farm. Due to the small size of the tree farm (127 acres) larger logging companies were not interested in the work so he needed a tool to make use of the fallen timber. He recalls, “if insects get into pine I can catch it and help with the financial bottom line of the tree farm that way. Anybody can wack a log but you had better do it the right way or you’ll end up with problems.” This respondent originally began making furniture, but did not find it to be very successful which he largely attributes to economic conditions. Instead he decided to create lumber for framing barns or small houses and has found success in this niche. The lumber that was sold from timber milled after one storm was enough to pay for half of the portable sawmill, and has recently added a de-barker to his mill operation and this has saved a great deal of time and money.

As shown through the examples above, a common theme driven by the desire to expand and/or transform a struggling farm business led to the exploration into utilizing portable sawmills as a new revenue stream. Some of the respondents within this category went on to incorporate the use of portable sawmills full time while others kept their portable sawmill work as a part time piece of their entire enterprise. Regardless of the degree of incorporation, respondents in this category are familiar with running a business, due to their existing farming background, and seemed to be very successful in incorporating portable sawmills into their microenterprise by either expanding on their farm business or by transforming their farm business into something entirely new.

Conservation Effort

Efforts to promote sustainability as well as conservation efforts are apparent throughout society in several ways including reducing waste, recycling, and reusing existing materials. In addition, as discussed in previous chapters, one goal of many small-scale forestland owners is to protect and conserve their resources for wildlife, recreational activities, or to pass to their heirs. One way respondents that were interviewed are doing this, is by adopting a portable sawmill microenterprise as a means to achieving a desired conservation effort. Utilizing a portable sawmill as conservation effort came in forms including utilizing salvage timber or those headed for a landfill, in storm cleanup efforts, and to utilize otherwise discarded timber from preconstruction sites.

Three examples of utilizing a portable sawmill as a means salvaging timber, often headed for landfills are detailed as follows. This first example examines a retired engineering tech turned full time tree farmer who decided to invest his innovative conservation and entrepreneurial spirit into utilizing trees destined for a landfill. As a result of declining timber based jobs within the Conservation Reserve Program in the nearby rural Iowa towns this rural tree farmer recalls,

> CRP material jobs were slowing down but wanted to be involved in tree industry so then I noticed a lot of tree going to the landfill and I thought I could do something with that. Tree planting jobs in my area were on the decline so I was looking for something more to diversify my business but stay in the forest industry.

With tree planting on the decline coupled with hating to see trees dumped into the local landfills as waste, this respondent knew he wanted to stay in the forest industry and used a portable sawmill as a way to diversify his business while helping the environment. He began his microenterprise after purchasing a mill seven years ago. All of the logs he saws are in custom lumber jobs, using unplaned wood for an unfinished dimension, and then dried by customers and used to make furniture or outbuildings. He receives much of his work though advertisements as a forestry provider on Iowa DNR website, Woodweb, and the Peterson sawmill site.

The second example involves a respondent who was very knowledgeable regarding forest/wood product attributable to both his bachelor degree in logging engineering as well as his career long experience as an internal consultant for one of the larger industrial mills in the U.S. Internal corporate structural changes within the forest products industry forced an early retirement on this respondent who subsequently relocated to rural Washington State in near a town of about 2500 residents. Shortly thereafter he purchased a portable sawmill and went to the woods. He notes that while he does not have a structured portable sawmill business he does custom sawing in a number of local neighborhoods on a part time basis. He began his endeavor by rehabilitating forestland and utilizing the usable log segments retained in the cases where the value of sawn lumber was higher than the value of the firewood that could be retained. When asked what originally captured his interest in portable sawmilling he recalled,

> I wanted to salvage the maximum value out of all of the timber that I remove from the property. 70% of that timber goes into firewood, a bit goes into fence posts and the rest into lumber. I'm thinning the property to about 200 stems/acre and that will be further reduced to about 130 stems/acre with a commercial thinning -- when the market comes back!

He notes the success of his endeavor is based on rehabilitating the forest land and increasing wildlife habitat as well as his property value. The products he creates are usually determined by the length and diameter of the salvaged log section and notes, "all of my sawn material is Douglas Fir with no clear boards so almost everything is sawn into construction grade 1" and 2" materials."

In the third example, a husband and wife team began a portable sawmill business as second income source after noticing an abundance of wasted wood seen in salvage and decided to put it to use. They purchased their portable sawmill and began their microenterprise 12 years ago a rural Illinois town containing under 1000 residents. The wife recalls how they began as follows, "my husband is a full time firefighter and went to work as a second job for a tree business. He saw how much wasted wood there is in salvage and so we decided to put it to use." At one point there was such a high demand for their sawmilling services that they had to stop advertising and now solely relies on word of mouth. They currently run their business on eBay and as a small retail outlet center at home. The couple notes the success of their full time portable sawmill microenterprise has enabled them to pay off their 25 year mortgage with revenue received in the 12 years since beginning their operation. The timber that they receive is fully dictated by the "waste" they receive from a local tree service that her husband worked at as a second job at the onset of their microenterprise. She notes, "it is great satisfaction to create a product from previously discarded material. We rely 100% on salvage."

The second way portable sawmill owners are contributing to a conservation effort is through utilizing fallen and discarded timber after a storm. Two examples of using storm damage cleanup as a means of creating a portable sawmill microenterprise are discussed below.

The first example involves a portable sawmill owner in a moderately sized South Carolina city of about 67,000 residents, who began his microenterprise after retiring from the South Carolina Forest Commission in the late 1980's, with experience in forest management practices. At currently 82 and 78 years old respectively, he and his wife jointly own and run a successful full time portable sawmill business. This respondent recalled that his portable sawmill microenterprise began as a result of the existing need in the community. In 1989 a major hurricane swept through this small community leaving an abundance of fallen timber. No one in the local area had any means to utilize the fallen timber, so this couple was inspired and shortly thereafter purchased a portable sawmill to utilize otherwise discarded storm trees. There is such a high demand for their portable sawmill services that when asked if they advertise stated, “No, we do not advertise but we haven’t caught up since Hugo!” Hugo was the name of major hurricane that began their microenterprise. Today, the couple primarily sells lumber to be used in a variety of projects such as barn building, decks, trailer floors, etc. In addition to his wife who plays an active part in the business including an instrumental role in the type of mill purchased, they also employ one part time employee to help with their portable sawmill work and learn the trade. In addition to their portable sawmill microenterprise, they also own a small herd of beef cows and a tree farm.

The second example involves a part time microenterprise owner in a rural northwest Ohio about 30 minutes from Akron, in a town of about 3000 residents. This retired respondent’s mix of interesting lifework can be summed up as follows,

> I am retired auto worker. I also retired from other things. I graduated from Law School and did oil and gas research for a local firm that specialized in helping farmers with oil and gas problems. I still do a little research when I am not answering sawmill questions.”

This respondent originally purchased a portable sawmill after notice the abundance of wasted trees that were blown down and discarded after large storms. He never intended to operate as a part time business however as he recalled,

> Now a day's anyone owning a mill ends up in some sort of hobby/business even if you don't want to have a business. The neighbors usually press you into satisfying their needs. It's kind of like having a local root hog. Others pressure you to work when you would rather go fishing.

This indicates a pressing demand in the community for portable sawmill services. He currently utilizes the storm damaged trees to create a variety of products to satisfy the needs of his customers stating, “just about everything I sell goes to some neighbor's immediate needs. I don't need to create a product, local demand does all the creating for me.”

The final way portable sawmill owners interviewed utilized their mills in a conservation effort is through processing logs that would otherwise be discarded from pre-construction sites, two examples of which are detailed below.

Despite the limited availability of large forest structures in the desert region of Arizona, one portable sawmill owner adopted a portable sawmill as a means to process logs from private lands during the preconstruction stage, clearings, fuels-reduction treatments, and during hazard removals. This respondent began his microenterprise within a metropolitan region of Arizona after seeing “a bunch of logs around” and no large mill in the area to process them. He notes,

> I saw an opportunity with available logs and no timber market. My father is a contractor but we are not a sawmill family like many people in the area. I just jumped into cutting and the market. Most portable sawmill owners cut hardwood and enter that niche, there are not that many in softwoods like me…there is higher money in hardwoods but the market is so much smaller.

Given current economic conditions including the slowing availability of pre-construction sites, this respondent recognizes the unsteady nature of his endeavor and notes,

> That instability also stops me from jumping in and putting another $100K into the business because what if the supply dries up or the distribution channels run dry. The level I am at now is more stable. I make $6-$8 bf for flooring, that is where doing value added is better and you also can have a more consistent supply. I am looking at buying a direct fire kiln now but the upfront costs are very high and with the economy where it is right now I am just trying to keep the status quo.

Despite the slowed economy and a temporary dip in sales he does note that his business is still successful. He notes the importance of entering into a niche and the importance of social networks and collaborations in maintaining success.

> I sell a lot of different products, basically anything people ask for. I make table top, slabs, lumber, cut for a furniture maker, mainly custom cutting. My number one product is 1x12" lumber often used in barn siding, and 24" cabinet grade slabs. I can produce and sell a 1x12" for less than the retailers. It is impossible to make money doing 2x4 or 2x6 and compete with the larger chains, you have to look for a niche market to compete in. I can sell 1" lumber for $.20 cheaper per b.f. than a box retailer, and I sell others that you can't find in the stores like natural edge lumber, siding, etc. The last few years I did more value added products like vertical grain hard pine flooring and molding. I collaborate with the molding shop in town, and furniture makers. For example, I give the name of a cabinet maker to someone and then the cabinet maker uses my wood to make the product. I normally produce rough product.

The second example is a 72 year old retired woodworker living in a 200 resident rural Texas town about 45 minutes northwest of San Antonio. This portable sawmill owner purchased a portable sawmill after offered the opportunity to harvest trees headed for a landfill from a preconstruction site. While not particularly a "conservation effort" per se in that the land was eventually bulldozed and burned, it was at least an effort in reducing the waste of otherwise discarded timber. This mill owner currently operates his microenterprise on a part time basis as a hobbyist. He has no employees and describes his situation as follows,

> No employees, a pain in the rear, so the wife and I decided we would live on what we could make using our own two hands…I've always been in some sort of business as an owner, and always successful in my eyes. We would go to a convention, me with some little wooden thing I had made in my pocket and always someone wanted to buy it. We went to craft shows, looked around, saw what was not there and decided to give it a try. I do not buy and resell, I get a real high when someone buys something that I made with my own hands, and then to top it off, they walk away with a large smile on their face. I don't try to get rich all at once, keep the prices down, keeps the folks coming back asking what is new?

While many of the respondents within the theme of operating toward varying degrees of environmental conservation, they all adopted their portable sawmill microenterprises in the hopes of reducing discarded or otherwise wasted timber. The environmental and well as the entrepreneurial spirit of this group was felt since in most cases these were not pre-existing business people, rather they were people who wanted to make a difference in their local communities, while at the same time creating a niche utilizing discarded or otherwise wasted materials.

To Fill a Niche Market

A final theme encompassing portable sawmill adoption was as a means to fill a niche market, where material was either not available or otherwise desired by either their local community and/or the larger society. As previously noted, operating a microenterprise within a niche market is a great way to compete outside of main stream industry and has the potential to yield great success. Four examples below detail the success of portable sawmill microenterprise owners in specific, and very different, niche markets.

The first example is a portable sawmill owner/entrepreneur in rural non-incorporated town of about 100 resident in northern Georgia who initially purchased his portable sawmill 7 years ago after completing 3 years in his furniture business. Once retiring as liquid propulsion engineer, he began his full time microenterprise making rustic furniture after seeing a need in the southern Appalachian area. He recalled how he originally became interested in using portable sawmills,

> My interest first started in wood in 1954 as a tree surgeon, and in 2000 got into furniture. I wanted to create rough sawn dimensional lumber. I originally have leftover lumber from Appalachian trail maintenance and needed something to do in retirement. Started with small things like wishing wells and that led to rough furniture, which led to more refined high end furniture.

He initially bought the rough sawn lumber to make rustic furniture, however the lumber was often too rough in dimension. Instead he decided to mill his own timber utilizing a chainsaw driven portable sawmill. He noted the greater profit in making furniture rather than selling lumber when, for example, you can get $400 for a bed rather than a profit margin of $1.40 a board foot. He also stated the importance of trying to keep up with local demand for various products and described his production method as follows. "It is based on need. I look at retail stores, and wholesale to retail so I follow the trends. For example, a retained bark edge became so popular so now I usually do it. You definitely have to stay up with changing desires." The rustic furniture created by this microenterprise is very beautiful and unlike any other.

The second example, located in a small town of only about 2000 resident in the Piedmont region of South Carolina, this respondent began a full time timber based microenterprise five years ago after noticing a lack of both availability and certain size specifications of the turning blanks they were looking for. A turning blank is a large piece of wood that is used in woodworking. Several of the turning blanks that this respondent came across were glued from multiple pieces of lumber and the lack in availability of the specifications he was looking for led to the creation of this microenterprise. This entrepreneur and his brother began creating and selling the blanks on eBay. Their business grew exponentially and they soon began to cut and process their own wood processed with their portable sawmill, rather than buying timber as they currently were doing. Utilizing their own portable sawmill processed wood allowed them to take their production to a larger scale. They shifted away from eBay to an online website to sell their products. They process several species of timber and currently also supply their turning blanks to several stores around the southeast. Five years into the business both men are able to make a full time living and also hire one part time employee. An interesting part of this example is that there are actually several portable sawmills located in their community, the respondent estimated that there were about 20 portable sawmills in within a 30 mile radius of their microenterprise. Finding a niche market in which to compete in was instrumental to the success of their microenterprise.

In this next example from a rural area on the east coast of North Carolina, one respondent began his microenterprise after realizing a need for custom sawing in the area. He recalled a story of an older portable sawmill owner he met who utilized his lumber in the creation of custom houses in the area. He recalled, "an old man here had a mill and worked for us building a few buildings. He thought I should get a mill and when I did he would help me get going." The respondent currently runs his microenterprise on a part time basis started as a hobby intended to make money. Like many other portable sawmill owners, he was unhappy with the portable sawmill work he was getting through formal advertising, so currently his only form of advertisement comes by word of mouth. He currently supplies sawn lumber to both individuals and local planning mills. He sells the portable sawmill service utilizing lumber brought to him from customers, sells green lumber from locally available timber he obtains, and brokers finished products.

A final example is another husband and wife team located in a coastal town of about 3000 residents in southwest Washington. These respondents operate a part time microenterprise partaking in both custom sawing as well as creating products ranging from sideboards for dump trucks, garden boxes, and a porch on a home. This team utilizes the income they generate from their mill to donate bikes to be used in fundraisers at local schools, operating as an unofficial non-profit microenterprise. The husband is a retired commercial fisherman and attributes much of the success of their microenterprise to the flexibility of his schedule in retirement coupled with the lack of portable sawmills in the area. He notes, “The market is good here for portable sawmills because the big mills have moved out and it is an isolated area… people usually want a log to be removed NOW, and I get more business that way because I am retired so I can just go pick up a log on a minutes notice.” The husband notes the large role his wife plays in the business retaining a customer base as well as furnishing the garden boxes with flowers. This microenterprise operates solely on processing timber given to them by other people and operates part of their business utilizing a trade/barter system. He notes the importance of finding and competing in a local niche adding “You cannot make a living simply selling lumber.”

This group of portable sawmill microenterprise owners truly encapsulates the expression “see a need, fill a need.” The portable sawmill owners in this group saw a niche that was not being filled, either locally or nationally, and decided to give it a try themselves and built a microenterprise based on filling the apparent void.

The Role of Cost

As the Ryan and Gross (1943) study described in a previous chapter indicated, the major hindrance to adoption of new innovation is lack of economic resources to do so (Rogers 1995). Cost played a varying role in micro-entrepreneurs’ decisions on whether to purchase a mill as well as what type of mill to purchase. To some, the cost factor was the most important factor regardless of the actual cost of the mill, which ranged from under $5000 to some within this category to well over $40,000 to others. Likewise, some who purchased mills within this same range did not even consider cost to be a consideration at all. For most, however, cost tended to be a fairly large or very critical part of the actual mill they purchased and there was little difference in the importance of cost between part time sawyers and full time sawyers [Table 8.1].

Table 8.1: The Role of Cost in a Portable Sawmill Owner's Decision to Purchase a Mill

Role of Cost	FT	PT	Total
Not important: the features is the most important factor	2 (6.7%)	3 (10.0%)	5 (17%)
Cost was fairly important	2 (6.7%)	5 (16.7%)	7 (23%)
Cost was a big factor/ this was a major expense	6 (20.0%)	7 (23.3%)	13 (43%)
Cost played a big role and I wish I spent more to get a better mill	0	2 (6.7%)	2 (7%)
Cost was a big factor- I bought the cheapest mill for what I needed	2 (6.7%)	1 (3.3%)	3 (10%)
TOTAL	12 (60%)	18 (40%)	30 (100%)

The role of cost, in general, can have fairly important implications as to the initial commitment of the entrepreneur to the innovation (in this case the portable sawmill). For example, some respondents indicated that they were willing to “jump in with both feet” while others wanted to “test the waters” with a less expensive mill before purchasing a more expensive model. The role of cost is also illustrative of the socio-economic characteristics of portable sawmill. Full time sawyers tended to have a lower household income when compared with part time sawyers, and for those earning less money cost can be an overwhelming factor preventing adoption. Extension programs should target ways to help would-be portable sawmill adopters obtain the funds to purchase a mill. This help could come in the form of education on low interest loans or grants available to help fund their purchase, as well as programs designed to educate adopters and would-be adopters on budgeting, itemizing expenses, and other financial activities to allow the best chance for them to achieve success in their microenterprise.

Time and the S Shaped Rate of Adoption

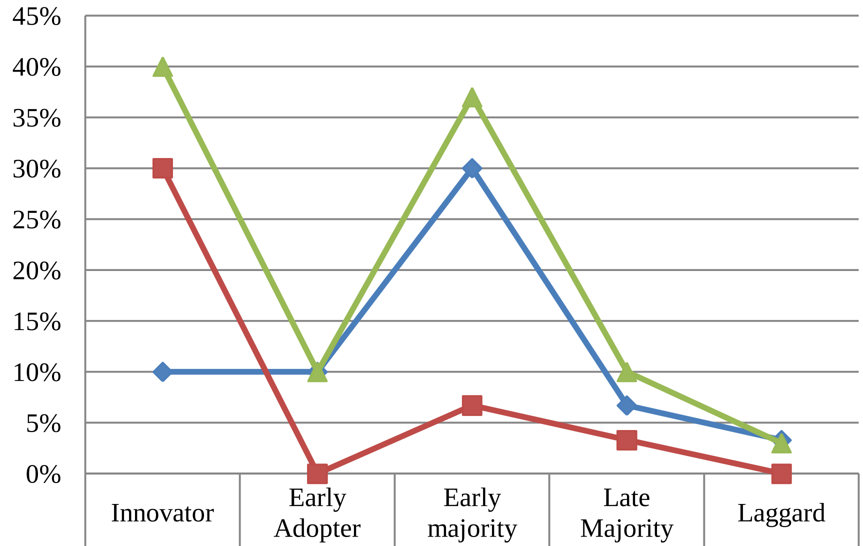
The portable sawmill owners that were interviewed had various perceptions of how innovative they are, in terms of their rate of adopting new technologies in general, as illustrated in Figure 8.1. The portable sawmill owners who were interviewed often considered themselves innovators both in the forest products sector as well as in life.

Respondents noted how they understand that technology improves productivity, and several mentioned that they are innovative in both their home life and careers, “I used to design experimental equipment so I am well skilled in figuring out whether to get on the bandwagon.” Another respondent notes, “I am not skeptical at all. If I am not innovating I'm checking out to see who's innovating-once an engineer, always an engineer." A second respondent with an engineering background offered a similar response, “I have a background in mechanical engineering and aerospace so I am interested in innovations.” Not only was the sense of innovation seen in mechanical fields, but also in service oriented fields such as this high school teacher who stated, “when I see something in a magazine, if I cannot afford to buy it I figure out how I can make it.”

In connecting this with Roger’s adopter model [Figure 2.1], a key difference between traditional adoption models and this study becomes obvious as it is not expected that an entire population, or even a majority of a population for that fact, would adopt portable sawmills. The categorical descriptions of the adoption model is still usable, though in a slightly different way, in describing key sets of characteristics that can help to describe portable sawmill microenterprise owners. In other words, it can help explain and describe characteristics on the type of individuals that portable sawmill microenterprise owners are. The implications of this are important in targeting extension service models to would-be portable sawmill populations.

When looking at the general adoption rates of portable sawmill owners (full time and part time sawyers combined) there appears to be an obvious divergence between Rogers' adoption model and the general adoption rate in this model. However, when analyzing the full time and part time sawyer categories separately a new picture begins to emerge. In this model, part time sawyers tend to be more of a fit with the traditional adoption pattern described in Rogers' model [Figure 2.1], whereas the full time sawyer group is innovatively quite different. The differences in the general perceived adoption rate of full time compared to part time sawyers is significant (χ^2=11.02, p=.05, Fisher's exact=.015). Full time sawyers interviewed tended to have a more innovative general adoption rate as compared with part time sawyers as well as traditional adoption models (p=.05). Hence the significance of extension programs utilizing appropriate adoption models for the particular population subgroup is again evident [Figure 8.1].

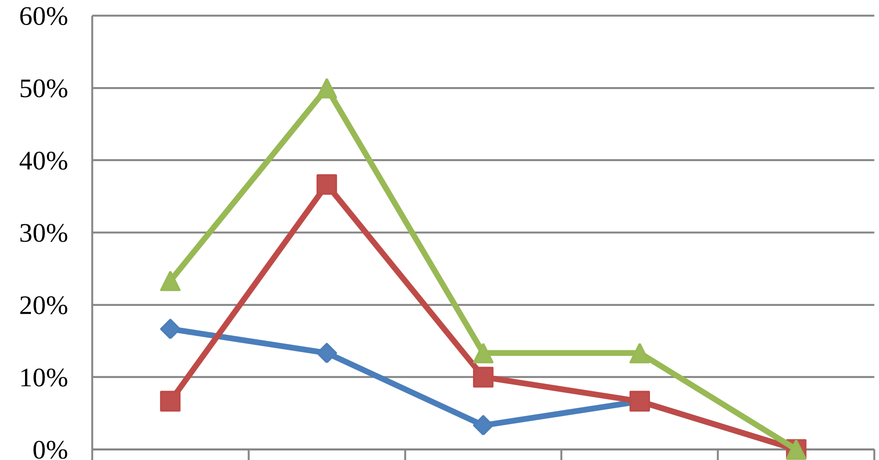
Figure 8.1 Respondents' Perceptions of their Rates of Adoption, or their "General Adoption Rate" (n=30)



	Innovator	Early Adopter	Early majority	Late Majority	Laggard
Part Time Sawyer	10%	10%	30%	7%	3%
Full Time Sawyer	30%	0	7%	3%	0
Combined FT and PT Sawyers	40%	10%	37%	10%	3%

Respondents' perceived innovativeness did not follow the same curve as their actual rate of adoption. The majority of respondents, 64%, were among the first in their local communities to own a portable mill, while another 20% made up the late majority and laggard group within the community of mill owners[Figure 8.2]. Approximately 50% of the respondents belonged to an early adapter group, where the respondent was still one of the first they know to own a mill, but there was one or more people who they knew of that owned a mill before them. This varied from their perception of their rate of adoption above, where only 10% concerned themselves early adopters Likewise, full time sawyers were more representative in the innovator group than any other in both the general adoption model as well as the portable sawmill adoption model. Part-time sawyers were slightly more quick to adopt a portable sawmill than their general adoption rate.

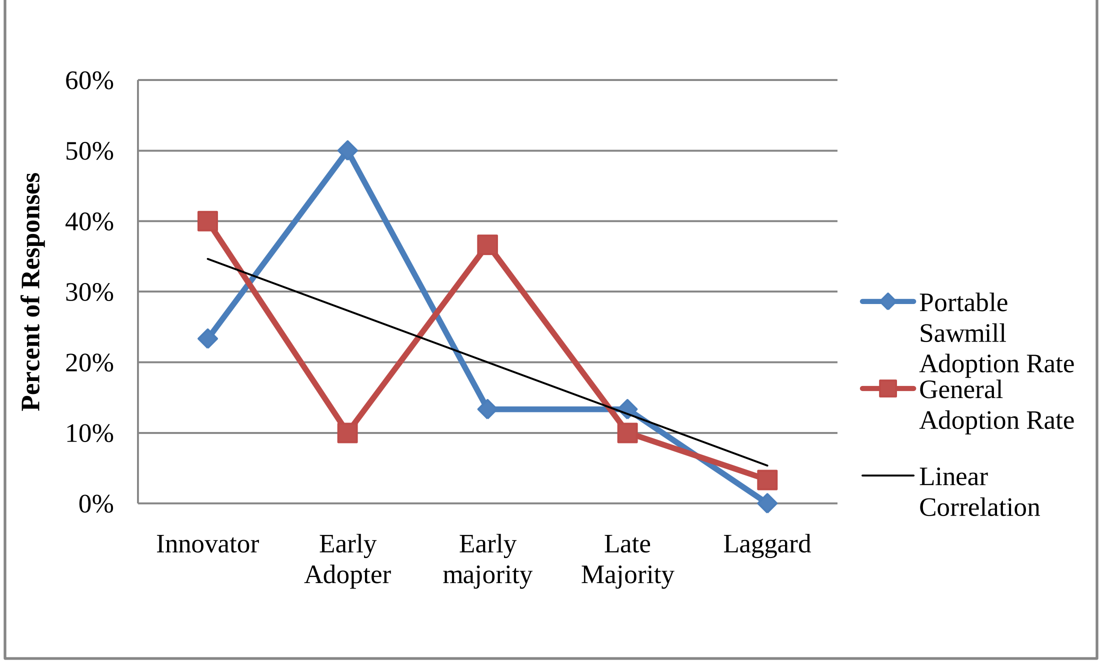
Figure 8.2: Rates of Adoption of Portable Sawmills Based on Presence of Mills Throughout the Respondent's Communities



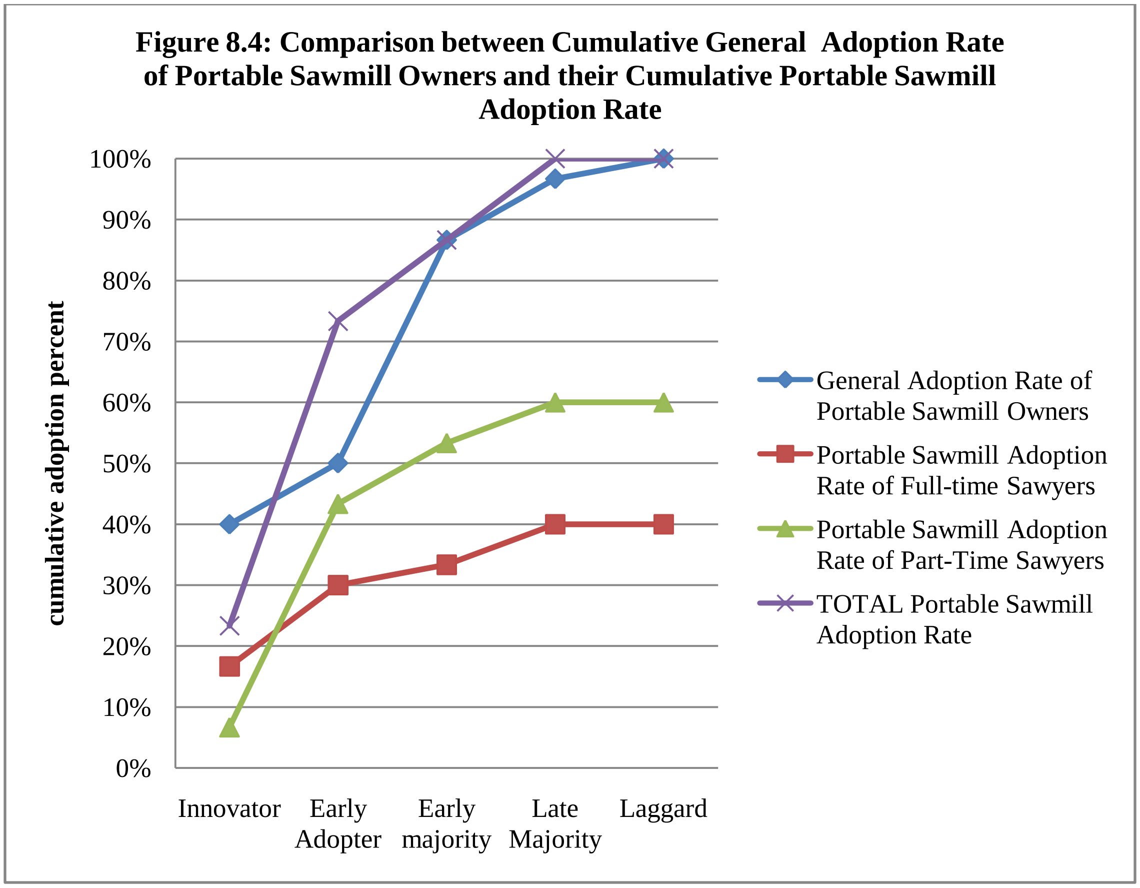
	Innovator: the first person I know to have a mill	Early Adapter: a couple people know had a mill before me	Early Majority: some in the local area owned a mill before I did	Late Majority: several local people owned a mill before me	Laggards: "everyone" owned mill before I did
Full-time Sawyers	17%	13%	3%	7%	0%
Part-Time Sawyers	7%	37%	10%	7%	0%
TOTAL	23%	50%	13%	13%	0%

There was a statistically significant correlation between the rate of adopting a portable sawmill compared with the rate of adopting new technologies in general (p=.01) When comparing portable sawmill owners' perceived general adoption rate to their adoption of portable sawmills a disparity becomes evident, resulting in opposite extremity points within the rates of adoption categories [Figure 8.3]. This disparity contributes to a weakened statistically significant linear relationship between the two.

Figure 8.3: Comparison between General Perceived Adoption Rate and Portable Sawmill Adoption Rate



Rogers (1995) depicted the cumulative length of time it took various populations to adopt an innovation as the S-shaped rates of adoption. Rogers (1995: 23) notes, “most innovations have an S-shaped rate of adoption. But there is variation in the slope of the “S” from innovation to innovation…Innovations that are perceived by individuals as possessing a greater relative advantage, compatibility, and the like, have a more rapid rate of adoption.” Figure 8.4 compares the cumulative adoption rate, or S-shaped rate of adoption of portable sawyers in general, to the cumulative rate of adopting portable sawmills. The respondents’ perceived general adoption rates follow a very clearly defined and steep S-shaped curve. Likewise, full-time sawyers followed a more flatly defined s-shaped adoption curve.



Part time sawyers did not seem to follow an as clearly defined S-shaped curve in their rates of adoption. The reason for this is not fully known, but one hypothesis is that since portable sawmill owners tend to belong to more innovative adopter categories, or perhaps the technology is in its relative early stages of adoption and therefore the late majority and laggard group are not fully represented and perhaps never will be given the specialized and unique nature of a portable sawmill microenterprise. This anomaly in the adoption curve of part time sawyers, in turn, altered the dynamic of the total portable sawmill adoption rate supporting the theories brought forth by Downs and Mohr (1976) who note the importance of postulating multiple theories of the adoption and diffusion of innovations based on the varying attributes of the innovations themselves. An important finding in this data suggests that not only are multiple theories of adoption and diffusion important based on attributes of the innovation but also in the characteristics of the adopters themselves, as seen in the bi-modal adoption patterns of portable sawmill owners.

The Role and Channels of Communication to Convey the Innovation: The Diffusion of Information about Portable Sawmills

Rogers (1995:18) defines communication channels as "the means by which messages get from one individual to another." These can take the form of mass media or interpersonal communication. There were multiple channels of communication used to convey initial information to potential portable sawmill owners.

The majority of respondents, 53%, initially heard of portable sawmills from other people who owned a mill themselves. Others (23%) initially read about portable sawmills in a magazine, catalogue, or other written material. About 10% of respondents initially heard about a portable sawmill on the internet. Respondents who went on to become full-time sawyers, that is respondents who currently use their portable sawmill in a full time microenterprise, were equally as likely to have initially read about portable sawmills in a magazine, catalogue, or other printed form as they were to have heard about portable sawmills from someone who already owned a mill. Those who currently operate their portable sawmill as a part time microenterprise, or as a part time sawyer, were most likely to have initially heard about portable sawmills from someone who already owned a mill [Table 8.2].

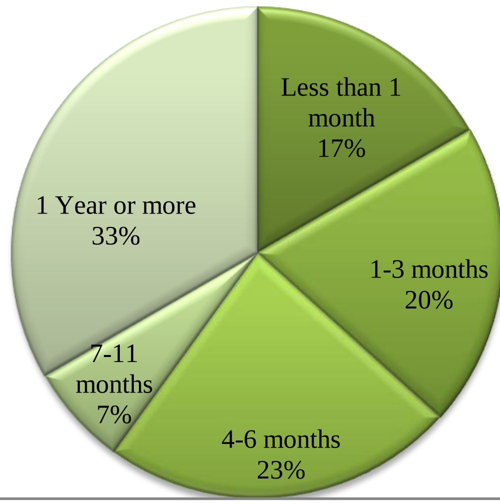
Table 8.2: Diffusion of Portable Sawmill Ownership Information- How Respondent's Initially Heard about Portable Sawmills

	Full-time Sawyers	Part-Time Sawyers	TOTAL
On the Internet	7%	3%	10%
On TV or a watched a video about portable mills	3%	3%	7%
In a magazine, catalogue, or other written material	13%	10%	23%
From Someone else who owned a mill	13%	40%	53%
From Someone else who did not own a mill	3%	3%	7%
TOTAL	40%	60%	100%

Interestingly the decision to purchase a portable sawmill, even when done in a short period of time, seemed to be fairly well researched. Figure 8.5 illustrates the length of time respondent spent researching their portable sawmills before they made the purchase. About 33% of respondents researched portable sawmills for a year or more before purchasing one, 63% researched for 6 months or more, and 83% researched for 1 month or more. This indicates that the decision on which portable sawmill to purchase was fairly well researched with a lot of time invested in choosing the right mill.

Once receiving the initial information about portable sawmills, respondents indicated several means of collecting additional information to research various portable mills. Often respondents would continue to dialogue with other mill owners. They also researched information online or through printed literature either on portable sawmill online forums or through catalogues or other online material directly from the manufacturers. Many respondents indicated calling the portable sawmill companies themselves to gather information and answer any additional questions. Most respondents indicated using many, if not all, of the above methods and there was a large degree of similarity in these methods among all respondents.

Figure 8.5: Time Spent Researching Portable Sawmills Prior to Purchase (n=30)



While respondents indicated various different channels of initial communication regarding portable sawmills, it seems as though subsequent communication channels were similar across the board regardless of how the respondent initially heard of the portable sawmills. Likewise a great deal of time was put into researching mill brands, features, and pricing.

In addition to the adoption categories of portable sawmill owners, an equally important characterization is whether the new technologies they adopt will be diffused throughout their social system and social networks throughout their communities. Often leadership characteristics accompany the rates of diffusion within a society, who is getting the information, how and if they are able to disseminate it throughout their communities, and if anyone is going to listen. Approximately 84% of the portable sawmill owners interviewed tended to consider themselves a leader in not only in terms of forest products but in many facets of life.

Roger's (1995:27) defines opinion leadership as an "earned and maintained by the individual's technical competence, social accessibility, and conformity to the system's norms." Only about 5% of the respondents interviewed did not consider themselves leaders. One respondent in particular noted, "If I thought I was a "leader" I would hurry up and resign." Approximately 25% of the respondents have a long history of public service as a naval officer, teachers, policemen, and emergency medical technicians and consider themselves to be leaders due to those attributes associated with their professions. Others (20%) considered themselves leaders due to their age and family name within their local communities. About half of the respondents consider themselves to be leaders due to their community involvement in politics, coaching children's sports, and other general community development activities/ services.

The portable sawmill owners that were interviewed have not only been influential in their communities but also in terms of their influence in other's decisions to purchase a portable sawmill. 100% of respondents noted talking with others about the benefits of mill ownership and as a result the portable sawmill owners interviewed had an average of 3.8 additional people who purchased a mill as a direct result of their influence with a range of between 1 and 5 additional people, with one respondent indicating that he influenced about 30 purchases. This seems like a remarkable number given the costs associated with purchasing a sawmill and could possibly really demonstrates the strength of these respondents' influences as a whole. When not including the outlier of 30 direct influences in purchasing a portable sawmill the average is lowered to 1.3 additional people who purchased a mill as a direct result of their influence. Full time sawyers tended to play less of a role in influencing someone else to purchase a portable sawmill influencing .75 people, whereas part time sawyers influenced portable sawmill purchases in an average of 1.6 people.

The methods of diffusion that portable sawmill owners used encompassed several types [Table 8.3]. The most prominent way that information about portable sawmills was diffused from the respondent to the local community was by talking with friends and family, neighbors, coworkers and others in the industry. About 23% of respondents also belonged to an online forum about portable sawmills, expanding their influence to both diffuse information as well as to gain new information/influence to a much larger community. Likewise about 3% of those interviewed allowed their name to be listed on a manufacturer's website, so that would-be owners could contact them to gather information in their pursuit to purchase a portable sawmill. Interestingly another 3% were involved with and able to diffuse their portable sawmill information to a local sustainable economic development initiative, a resource based committee, in a surrounding county, as this respondent described, "to influence what people think and in terms of green building. I also try to influence local companies to use local material and try to influence what people buy."

Table 8.3: Primary Diffusion Methods about Portable Sawmills (n=30)

Belong to an online forum	23%
Talk with friends and family	47%
Do local portable sawmill demonstrations	17%
Name listed as a sawyer on website	3%
Talk with neighbors	40%
Talk with Co-workers/Others in the industry	20%
Member of a Trade Association	7%
Involved with a local sustainable economic development initiative	3%

As demonstrated above, various roles and channels of communications were utilized to convey information about portable sawmills. Despite the influx in new technologies used as a means of communication, traditional methods of communication, such as simply talking to someone, is still the most prominent means of conveying information.

Socio-Economic Characteristics of Various Responder Categories

Adoption/diffusion literature specifies certain socio-economic characteristics of various adopter categories. Rogers (1995) notes that early adopters differ in the socioeconomic status- they normally have higher levels of formal education than later adopters, have a higher socioeconomic status, a greater degree of upward social mobility, but are not different in age as compared to later adopters. Regarding personality variables, early adopters have greater rationality, less dogmatism, greater empathy, less fatalism, and a more favorable attitude toward change than later adopter categories. Finally, early adopters have different communicative behaviors such as more social participation, highly connected interpersonal networks, have a greater knowledge of innovations, and engage in more active information seeking behaviors (Rogers 1995).

As noted in an earlier chapter, those with a higher percentage of their income generated through portable sawmilling were those who tended to be at a lower income level, this finding was replicated in the interview data and was most likely not statistically significant due to the small interview sample size, however income levels were not significantly correlated with adoption rates. Incentives often increase the rate of adoption of an innovation, and these incentives will lead to an adoption by individuals who would otherwise possibly not adopt (Rogers 1995). An example of this is how normally those with a higher socio-economic status would adopt a new technology before someone with a lower status, however, when the ability to increase revenue streams comes into the mix, those with a lower income adopt at a similar rate compared to those earning a higher income.

Also replicated in this data is the finding that younger portable sawmill owners are more likely to earn a higher percentage of their household income through portable sawmilling ($p=.05$) compared to older owners, however age was not correlated to the rate of portable sawmill adoption in this study. This finding supports previous literature that states that age is not correlated with adoption rates.

Town size had a statistically significant correlation with the adoption rates of portable sawmill owners. Respondents living in larger communities were more likely to adopt a portable sawmill at a slower rate as compared to those living in a smaller community ($p=.10$). This could be due to several reasons including the availability and access to more forest land in rural communities as well as the lack of options, in general, in rural communities compared to larger cities.

Finally, there was a statistically significant correlation between a portable sawmill owner's general adoption rate and the percentage of their household income that came from their portable sawmill work, meaning the faster general adoption category the respondent belonged to the higher percent of their household income comes from using their portable sawmill ($p=.05$), in other words full-time sawyers adopted faster than part-time sawyers.

Although previous literature has noted a correlation between a higher educational attainment and adoption categories, no statistically significant correlations were found in this study between portable sawmill owners and education. However, if previously mentioned hypotheses are true regarding portable sawyers as a more innovative population than others, perhaps a statistically significant relationship would arise as time goes on.

Discussion

The conceptual framework outlining the adoption/diffusion theory has applicability in the innovation, development, and implementation of forest microenterprises insofar as it can define criteria and help to develop the schematic framework for introducing forest based and/or portable sawmill based microenterprise development initiatives to a societal subgroup. The focus here has been on why people have been interested in adopting portable sawmills, how they began their adoption process, and how that portable sawmill information was diffused.

An important piece to understanding the adoption process is considering what influences individuals to adopt a new technology. Portable sawmill adoption was motivated by three common factors- as a way to expand a farm business, as a conservation effort, and as a way to fill a niche market. Extension programs should focus their attention on groups of individuals who fit these criteria, in the need to expand a farm, have an interest in conservation, and general entrepreneurial energy that could provide the motivation to enter a new niche market.

For the majority of portable sawmill owners (82%), cost was a major factor in their decision to adopt a mill, and which mill they subsequently adopt. Extension should develop programs designed to help potential adopters obtain funds to purchase a mill. These programs could be educational in nature outlining low interest loans or grant availability as well as programs designed around budgeting, expensing, and other financial management activities to enable the best chance for success in their adoption.

When comparing general adoption rates of portable sawmill owners with traditional adoption models, an obvious divergence is evident resulting in opposite extremity points between the traditional adoption model and the general adoption rate of portable sawmill owners. However, when examining part-time and full-time sawyers as separate groups, the innovativeness of part-time sawyers more closely resembles traditional models, whereas, full-time sawyers tend to be, as a group, more innovative. Likewise, regarding the rates of portable sawmill adoption, again part-time sawyers fit a traditional adoption model, whereas full-time sawyers were more innovative in their mill adoption. When examining the s-shaped rate of adoption among portable sawmill owners, full-time sawyers tend to follow a flatly defined s-shape whereas part-time sawyers' cumulative adoption rates do not resemble the traditional s-shaped rate at all, even though an s-shaped adoption rate is evident in their general adoption rates. This finding further supports the need to differentiate theoretically between different types of innovations. This bi-modal adoption pattern is a significant finding in this research and supports the importance of creating multiple adoption theories. Extension programs should take this bi-modal adoption pattern into consideration when creating programs for potential adopters.

Full-time sawyers were most likely to initially hear about portable sawmills from someone else who owned a mill, whereas part-time sawyers were equally likely to have heard about portable sawmills from someone they know as they were to have read about them in a magazine or other written form. This is an important consideration for extension and development programs, that the bi-modal adoption patterns evident in portable sawmill owners also carries over to the methods in which that information was obtained.

A strong sense of leadership was evident with the portable sawmill owners interviewed with about 84% considering themselves leaders in some capacity. These leadership characteristics included involvement in the local community, their age, family name, and career leadership positions. Full-time sawyers tended to be less influential in the mill purchases of others compared to part-time sawyers who tended to influence almost 2 mill purchases each. Despite the influx of new communication technologies, traditional methods of communication, such as simply talking to someone, is still the most common means of communicating information. Extension and other development programs should understand the leadership characteristics evident in portable sawmill owners in order to set up the proper communication channels to diffuse information about portable sawmilling.

Understanding socio-economic characteristics of portable sawmill adapters is important to targeting appropriate extension programs to the suitable audiences. Those living in more rural communities are faster portable sawmill adopters than those in larger cities most likely due to limited opportunities available in many rural areas coupled with abundant timber resources especially found in forest dependent communities. Differences in income did not play a significant role in the adoption of portable sawmills despite the fact that previous literature shows that it should. This may primarily be the result of economic incentives involved with portable sawmill adoption.

As a result of the common themes that have emerged in exploring why and how the innovation process began, the adoption/diffusion characteristics outlined above can be used as a tool to guide extension services in promoting portable sawmill utilization to the appropriate audiences.

UTILIZING PORTABLE SAWMILLS AS A FOREST MANAGEMENT AND COOPERATIVE AGREEMENT TOOL IN ALABAMA

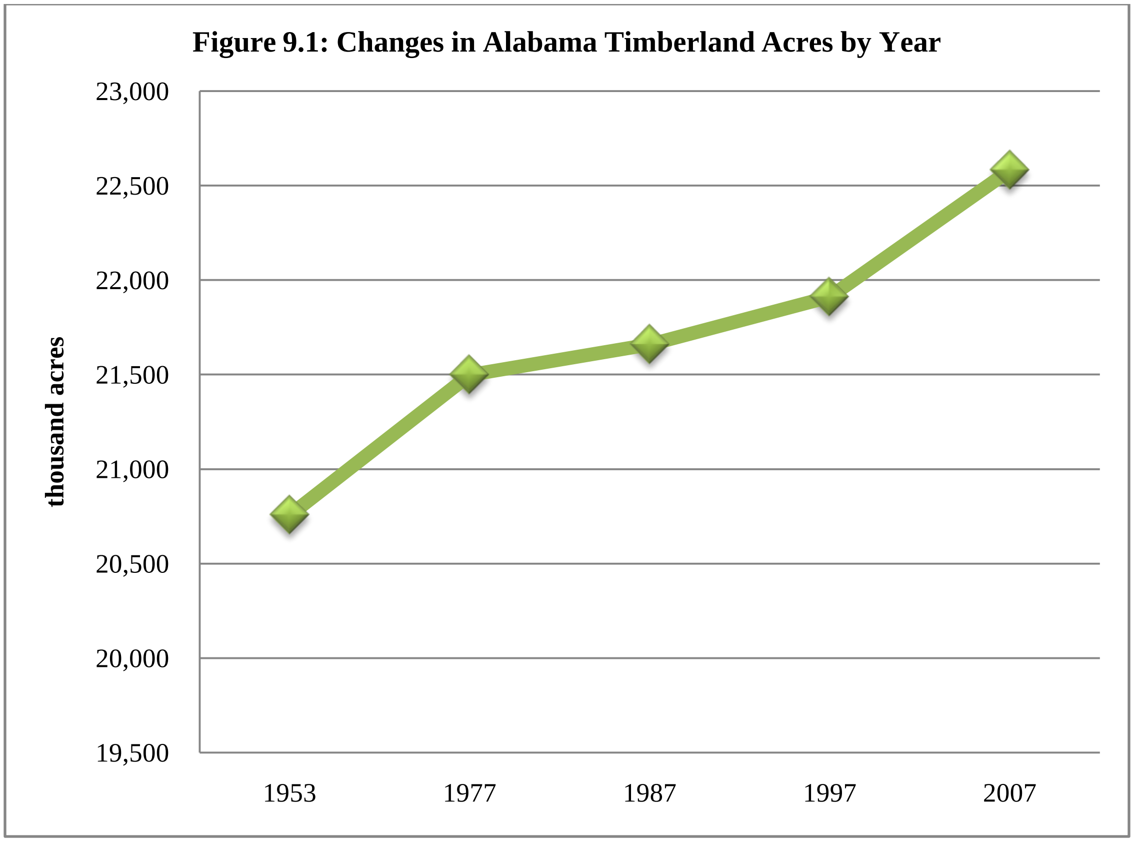
As previously described, forested land occupies over 751 million acres of the U.S., approximately 56% of which is privately owned (Smith et al. 2010). Forested land throughout the U.S. as a whole contains over 800 species of trees and has remained relatively stable for approximately 100 years (Smith et al. 2004). About 29%, or 215 million acres of forestland is located in the Southern region of the U.S., with about 11% of the regional total is located in the state of Alabama (Smith et al. 2010). Within the state of Alabama itself, about 70% of the total land area is forestland, with about 66% of that owned as non-industrial private land. The vast abundance of forested areas throughout Alabama, as well residents' reliance on timber for livelihood, means that some parts of Alabama are considered timber dependent regions (Howze, Robinson, Norton 2003). One characteristic of these timber dependent areas is that residents are often plagued with high rates of poverty among other factors even though the land in the area is often very valuable (Howze, Robinson, Norton 2003).

It is important that timber dependent regions identify new and multi-faceted uses for the resources that are readily available to ensure diversity in economic revenue streams, while limiting further environmental degradation that may have already occurred. Unlike larger harvesting operations that provide limited opportunities for small-scale forest landowners, as well as having the potential to be detrimental to the forest structure, utilizing small-scale harvesting and processing systems has potential as an additional forest land management tool. Likewise utilizing small-scale technologies such as portable sawmills can lead to increased revenue generation, both at an individual level and also filtering throughout local economy and offering potential improvements to local community development.

This chapter will explore how portable sawmills can be utilized as an additional land management tool for forestland owners in general and in terms of cooperative agreements between landowners and portable sawmill owners. Followed by a discussion of why it would be advantageous for extension services to focus on education programs for local forestland owners to use small-scale technologies such as portable sawmills.

Alabama’s Forest Characteristics and Forest Products Industry

Alabama is comprised of approximately 22.7 million acres of forestland equivalent to about 70% of the total land area in the state (Smith et al. 2010). Since the second half of the 20th century, the total amount of timberland in Alabama continued to increase [Figure 9.1].



Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

Alabama has the 3rd most forested acreage in the 48 states (Alabama Forestry Commission 2009). The majority of land in Alabama, approximately 94%, is privately owned and ranks 2nd in private timberland acreage, behind Georgia (Smith et al. 2010, Alabama Forestry Commission 2009). Of Alabama's privately owned land, about 6.3 million acres is owned by the forest industry or other corporate entities, and the other 14.9 million acres, or 70% of all privately owned land, is owned by non-industrial private landowners [Table 9.1] (Smith et al. 2010). Over 22% of the total non-industrial private forestland in Alabama is owned by non-industrial small-scale forestland owners containing tracts that are less than or equal to 50 acres (USDA Forest Service 2006).

Table 9.1: Alabama's Land Ownership Characteristics

TOTAL PUBLIC	TOTAL PRIVATE
1,323,000	21,256,000
total federal	**forest industry/ corporate**
910,000	6,311,000
national forest	**total non-industrial private**
687,000	14,946,000
other	**Small-scale tracts (≤50 acres)**
223,000	3,348,000
state	
301,000	
county and municipal	
113,000	

Data: Smith, W. Brad, Patrick D. Miles, C. Perry, S A Pugh. 2010. Forest Resources of the United States, 2007. Gen. Tech. Rep. WO-78. Washington DC: USDA Forest Service, Washington Office.

U.S.D.A. Forest Service. 2006. National Woodland Owner Survey. Forest Inventory and Analysis Program. Online Data Access http://www.fia.fs.fed.us/nwos/results/

The forest industry is Alabama's largest manufacturing industry and in 2005 produced about $15.39 billion in products (Alabama Forestry Commission 2009). In 2008, approximately $2.27 billion in forest products exported from the state (Economic Development Partnership of Alabama 2009). These products include lumber and wood products, pulp and paper products, and furniture and fixtures.

In 2005, the lumber and wood industry produced about $5.2 billion worth of product, the pulp and paper industry produced about $7.9 billion, and the furniture and fixtures industry produced approximately $2.5 billion (Economic Development Partnership of Alabama 2009). Roughly 48,000 people are directly employed by these industries in Alabama and close to 100,000 people are indirectly dependent on the forest industry in the state (Alabama Forestry Commission 2009).

However, these larger industries often neglect smaller scale tracts of land leaving many small landowners in Alabama without an outlet for their timber, meaning an inability to capitalize from having such a valuable resource. Therefore smaller scale technologies can be useful to enhance small-scale forestland owners' ability to generate revenue and contribute to increased forest management strategies on their land given the substantial amount of forestland owned within the state.

How Portable Sawmills Can Contribute to Small-Scale Forestland Management Objectives

Given the abundance of non-industrial private forestland in Alabama, landowners throughout the state use various tools and strategies to maintain forest health on their land as well as try to meet a variety of land management objectives. Portable sawmills can be used as one tool to help meet a variety of land management objectives and maintain forest health, empowering local people to enhance their own income as well as manage their forest resources, especially on smaller tracts of land where it is often difficult of find outlets for timber (Salafsky 1997, Bailey et al. 2004, Mullins 2007) Updegraff and Blinn (2000: 5) note

> small-scale harvesting technology offers distinct advantages to the owner who expects a majority of his/her work to be in small tracts, on sensitive sites or in uneven-aged management activities. In the specialized market for thinning and small harvest units, operators with appropriately-sized equipment may have a competitive advantage over those with only larger equipment. A primary advantage is reduced capital investment and operating costs. Lower levels of residual stand and soil damage are also important considerations.

Small-scale timber harvesting and processing would be the most profitable outside of "mainstream" forestry operations, in niche market areas, at the urban interface, or in areas where large machinery would have the potential to reduce the integrity of the forest. Updegraff and Blinn (2000:37) note that "many landowners are interested in improving their land for aesthetics, recreation, and wildlife and are interested in hiring small-scale equipment operators to thin stands, develop recreation trails, harvest small areas for wildlife, regeneration, etc. to improve their woodlot." The benefits of utilizing small-scale equipment to achieve these desired management objectives include lower capital costs, lower operating costs, the equipment can have multiple uses, and is easier to transport (Nova Scotia: 2007, Updegraff and Blinn 2000).

Utilizing portable sawmills as a management tool can offer an environmentally friendly use for trees removed from storm damage, bug damage, salvage, dead trees, selective harvest, thinning, and other forest stand improvements. Mullins (2007) notes, "more importantly, the availability of this new technology provided a tool to profitably turn previously 'useless and worthless' trees into valuable lumber with an initial investment less than the cost of a small tractor. The highly portable mills can be operated by a single operator to produce lumber from logs conventional sawmills cannot or will not accept."

In addition Mullins (2007) notes the role portable sawmills contributes to carbon mitigation strategies,

> Portable sawmills often utilize raw materials that otherwise would be left to rot, burned or at best processed into chips, all of which eventually release significant amounts of carbon into the atmosphere. By converting these materials into lumber, the durable wood products sequester the carbon and thereby minimize contributions to atmospheric greenhouse gasses. Additionally, the lumber recovered from this type of material reduces the need for additional harvest from standing forests. The forests allowed to remain standing continue to "scrub" carbon from the air and release oxygen further contributing to atmospheric health, not to mention the reduction in emissions associated with harvesting and processing the trees.

In addition to providing economic motives to increase forest management on small tracts of land, portable sawmills can use used as an aid to enhance community development strategies in rural communities by forging new partnerships among community shareholders through cooperative agreements.

Cooperative Agreements

The traditional definition of a forest cooperative involves state regulation and control combining the resources of various forestland owners to compete against the larger corporate structure (Hull and Ashton 2008). However, a more contemporary definition of forestry cooperative structures, put forward by Hull and Ashton (2008:1) define a forest cooperative as “an enterprise that moves value and control down the supply chain, closer to the landowner and within the local community, so that desired environmental and social qualities may be restored and sustained.”

Hurdles identified in previous literature on forest cooperatives focus on high membership costs, management infrastructure, and maintaining profitability (Blinn et al. 2006, Hull and Ashton 2008). However, assistance should be offered through extension programs or elsewhere so that cooperative structures could be enhanced to remedy these hurdles. In doing so the strengths of forest cooperatives can be fully realized in their ability for individuals to come together focusing on multi-faceted forest management goals and offering “a better structure for meeting absentee forest landowners than traditional assistance programs” (Blinn et al. 2006: 248).

This methodology would enable portable sawmill owners a consistent timber source to create products with as well as providing the landowner with a new source of income generation, because under this cooperative structure, the landowner and portable sawmill owner would each retain a percentage of the resulting income. Alabama landowners and southern portable sawmill owners were surveyed (as described in the methods chapter) to uncover first, if and/or how they currently use a portable sawmill to meet certain land management strategies, and second, whether they would be interested in joining a cooperative agreement that utilized portable sawmills as an additional forest management strategy, or as a way to generate additional revenue either from their own land or from someone else’s land.

Application of Regional Survey Data from the Southern U.S. to Alabama Landowners

In addition to understanding the structure of portable sawmill operations throughout the U.S., this research serves as a gateway to its potential application through the extension services, or other applicable services. One potential program idea that was explored is the potential for a cooperative agreement between a landowner and a portable sawmill owner, where a landowner would allow a portable sawmill owner to utilize wood from their land in exchange for a fee or some other type of arrangement. Portable sawmill owners were asked questions within the survey related to joining into a cooperative agreement as well as land management objectives for milling timber. Within this survey, portable sawmill owners were asked how far they would be willing to travel to obtain timber for their mill.

About 81% of portable sawmill owners who were surveyed in the Southern region of the U.S. indicated that they would be willing to travel over 10 miles for timber, and 21% indicated that they would be willing to travel over 50 miles for timber [Table 9.1]. As a result of portable sawmill owners' willingness to travel for timber, multiple states that are within travel distance of Alabama have been included in portable sawmill owners' interests in collaborating with landowners. These states include Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee and will be defined as the "South" or "Southern" for the purposes of this chapter. A total of 203 respondents were obtained from the South.

Table 9.2: Distance Portable Sawmill Owners are Willing to Travel for Timber

Travel	Percent
Less than 10 miles	19%
11-20 miles	16%
21-30 miles	22%
31-40 miles	8%
41-50 miles	14%
Over 50 miles	21%
Total	100

Portable Sawmilling to Meet Land Management Objectives

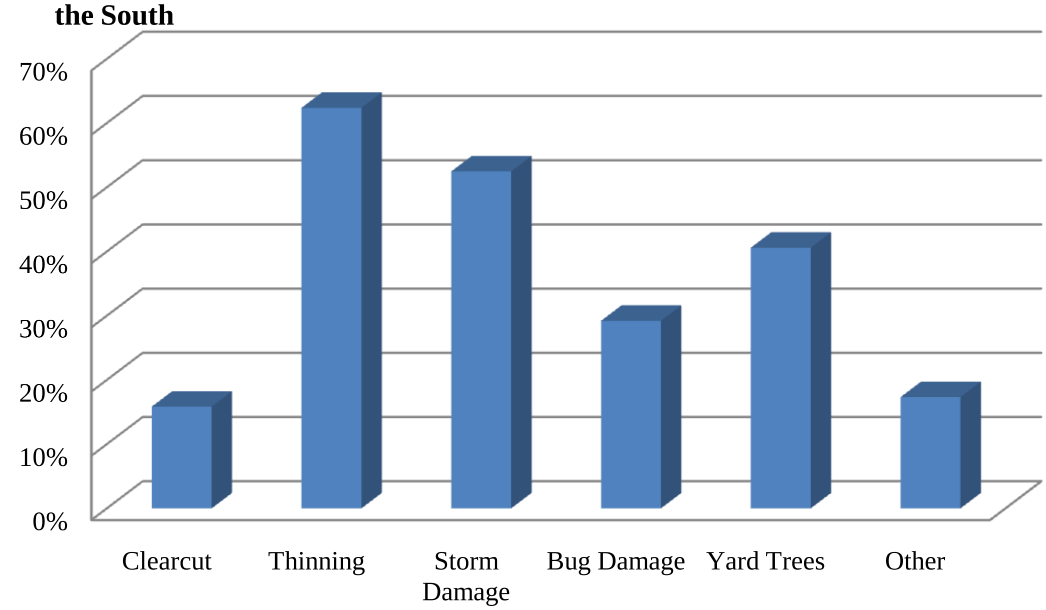
Approximately 64% of respondents from the national portable sawmill owner survey are also small-scale forest landowners, with a total of 83% of those surveyed both large and/or small tracts. Table 9.2 displays the acreage owned by this group.

Table 9.3: Acres Owned by Portable Sawmill Owners in the South

Acres	Frequency	Percent
None	34	17%
<10 acres	25	12%
10-25 acres	37	18%
26-40 acres	18	9%
41-55 acres	15	7%
56-70 acres	13	6%
71-85 acres	7	3%
86-100 acres	8	4%
>100 acres	45	22%

These respondents often use portable sawmills in conjunction with various land management techniques. About 52% used their portable sawmill as part of storm damage cleanup, 29% as part of bug damage cleanup, 41% as part of yard cleanup, 62% with their thinning regime, 16% with clear cutting, and 17% were among various other management techniques [Figure 9.2].

Figure 9.2: Land Management Practices Utilizing Portable Sawmills in the South



Follow-up interviews with portable sawmill owners revealed that they often bought their portable sawmill as a way to decrease the amount of timber waste they were witnessing throughout their communities. Two respondents (a husband and wife team) noted “it is a great satisfaction to create a product from previously discarded material. We rely 100% on salvage.” Another respondent (a building developer/contractor) stated “trees have to come down anyway to build a house and it is nice when the house can be built using part of their own timber. The wood lives on in the house.” One respondent who owns a tree service noted “I love making lumber from logs that would otherwise be chipped for boiler fuel.” Another respondent (owner of a sawmill and lumber company) recounts his business practice as, “logs are taken and milled locally from wood that would be ground for woodchips or cut for firewood.”

Alabama Landowners’ and Portable Sawmill Owners’ Interests in Cooperative Agreements

Forestland owners in Alabama were asked whether they would be interested in participating in a cooperative agreement, involving portable sawmill owners and landowners, as a way of increasing land management strategies with other members of their communities, and as a way to generate a new source of revenue either with their own land, or on others’ land.

The subject of cooperative agreements was initially posed to landowners at the Escambia Experimental Station Forestry Field Day yielded approximately 38% either interested in or already in a co-op agreement with a portable sawmill owner.

Approximately 62% of respondents were not interested in this type of agreement [Table 9.3].

Table 9.4: Alabama Field Day Participants' Interests in Cooperative Agreements with Portable Sawmill Owners

Yes, I am already in an agreement like this	3%
Yes, I am interested in this type of agreement	35%
No, I am not interested	62%

The overwhelming majority of respondents who were not interested, stated so because they either were not familiar with portable sawmilling as an option, 79%, or they stated that it was not a set plan within their timber management strategies and were therefore generally not interested, 9%. Approximately 12% currently owned a mill or knew someone who did and were therefore not interested in an additional arrangement such as a co-op [Table 9.4].

Table 9.5: Alabama Landowner Field Day Participants' Reasons for Not Being Interested in Portable Sawmill Forest Cooperative Agreements

Response	Frequency	Percent
I have a mill	2	6%
I am a friend of a sawmill owner	2	6%
I need more information	27	79%
I am generally not interested	3	9%

After obtaining data from the preliminary interview outlined above, a survey of Alabama landowners was conducted by another research project within the Auburn University School of Forestry and Wildlife Sciences, and questions regarding interest in cooperative agreements were included with that survey. This is described in more detail in the methods chapter.

When asked whether or not they would be interested in joining a forestry based cooperative agreement that specifically involved portable sawmilling, 350 out of the 405 Alabama timberland owners had a survey responses as one of the following; either (1) *yes*

I am already involved in an agreement with a portable sawmill owner, (2) yes I am interested, or (3) *no I am not interested*. If respondents indicated that they were not interested, they were asked to indicate why they were not interested. Of the 350 respondents, approximately 18%, indicated that they were interested in this kind of agreement, and 1 respondent indicated that they were already involved in this time of agreement, and 82% indicated that they were not interested [Table 9.5].

Table 9.6: Alabama Landowner Interest in a Forest Cooperative Agreement Involving Portable Sawmills

Yes, I am already in an agreement like this	<1%
Yes, I am interested in this type of agreement	18%
No, I am not interested	82%

Out of the 286 respondents that indicated that they were not interested in a cooperative agreement, 90 respondents, about 31%, indicated the primary reasons that they were not interested. These reasons were coded 0-11 and responses were grouped accordingly. The table below displays the categories and frequency of each response [Table 9.6].

Table 9.7: Alabama Surveyed Landowners' Primary Reasons for Not Being Interested in Portable Sawmill Forest Cooperative Agreements

Response	Frequency	Percent
I have a mill	3	3%
Too much time involved	4	4%
I am a distant owner	2	2%
I don't want to cut timber/ not interested in timber	52	58%
I am a friend of a sawmill owner	4	4%
I need more information/not sure what to cut	10	11%
I deal with a timber/sawmill company	3	3%
I am generally not interested or see no profit in it	4	4%
I don't want or trust others on my land	6	7%
Other: concern with tree size, timber market, etc	2	2%
	90	100%

More than half of the respondents, 58%, indicated that they are not interested in cutting timber on their land, that they are more interested in preserving wildlife, and want to preserve the integrity of the forest as it is. This group of respondents could benefit from increased education on the utilization techniques of portable sawmills, as it appears that this group is under the impression that it is necessary to physically cut trees to be used in a portable mill. A mill could be used in these cases as a tool to avoid wasting fallen, diseased, or dying trees, which could not necessarily involve cutting down trees for the sake of sawing them. Forest management education regarded the uses of portable sawmills for reasons other than “cutting” are needed. Likewise the approximately 11% of respondents that stated that they would potentially be interested but they would need more information, could also benefit from this education material. About 4% indicted that they are not interested in a cooperative agreement because they have a friend that is a sawmill owner. Another 3% already deal exclusively with a timber or sawmill company, 4% are generally not interested or see no profit potential, 7% do not trust others to be honest with their cutting, or do not want others on their land at all, and another 2% classified as “other” are concerned with tree sizes or the timber market in general.

The disparity between the landowner survey group and the landowner interview group could potentially be explained through variation between the written language as opposed to spoken language where respondents were able to ask questions immediately to clear up any misconceptions or confusion. This variation should be considered when implementing educational materials/workshops on portable sawmills as both a forest management strategies alone and through a cooperative agreement.

Data from portable sawmill owners in several southern states in close traveling proximity to Alabama was analyzed to understand their willingness to travel and mill from others' land. Approximately 56% of those surveyed in this region are willing to mill timber from other landowners' property, and 47% are interested in joining a co-op consisting of some type of collaboration between landowners and sawmill owners. This represents a slightly lower percentage when compared to portable sawmill owners' willingness to join a cooperative agreement throughout the entire U.S. [Table 9.7].

Table 9.8: Portable Sawmill Owners' Interest in a Forest Cooperative Agreement with Landowners

	Interested	Not Interested
U.S.	49.2%	50.8%
South	47.3%	52.7%

Of those respondents that were interested in a cooperative agreement, they were then asked to offer a rough estimate of the percentage of profits they were willing to share with the landowner for the use of their land. The most prominent percentage that portable sawmill owners were willing were share with the landowner was 50% of the profits, with a range of 0-70% [Table 9.8].

Table 9.9: Percent of Profits Portable Sawmill Owners are Willing to Share with Landowners in A Cooperative Structure

Percent of Profits Shared	Number of Respondents	Percentage of Respondents
Less than 10%	3	6%
10-19%	3	6%
20-29%	7	14%
30-39%	8	16%
40-49%	6	12%
50-59%	21	43%
60-69%	1	2%
70-79%	1	2%
80-89%	0	0%
Over 90%	0	0%

Demographic factors such as age, education, and income did not play a statistically significant role in a respondent's interest in joining into a cooperative agreement with a landowner. Interestingly, landownership characteristics of portable sawmill owners, such as acreage of land owned, did not play a statistically significant factor in their interest in joining into a cooperative agreement, so there was basically no difference in attitudes toward joining a cooperative agreement between portable sawmill owners who own several acres of forestland and portable sawmill owners who own no forestland at all.

Follow-up interviews with portable sawmill owners showed the possibility of a very high level of interest in cooperative agreements. All of the respondents were very involved with portable sawmilling and did it for some form of income ranging from "a few dollars on the side" to full time employment. The respondents were asked whether they would be interested in a cooperative agreement as a means of obtaining new avenues to get timber to mill. Over 90% of the respondents were highly interested in joining an agreement like this if one were available in their area. Interestingly, there was a need to explain a scenario of a cooperative agreement, in much more detail than what is allowable in a survey. Often times this section of the interview went on for several minutes. Those respondents who were interested in a cooperative agreement would also like to see meetings with other portable sawmill owners in their local areas to share ideas and timber sources, as well as arrangements with landowners to mill for money or a supply of timber.

Discussion

Portable sawmills are a relatively inexpensive tool ranging in price from a few hundred dollars to $40,000 or more depending on the model and capacity. The modal price range for a portable sawmill that could be used as a hobby or very small business for the “average landowner” is between $3000-$6000, therefore given the right educational tools landowners have the potential to recuperate the cost of their mill relatively quickly.

Based on the results of this study, there appear to be few Alabama landowners that utilize portable sawmills as part of their overall forest management strategy. In general, landowners surveyed/interviewed seemed to have limited knowledge of portable sawmills or how it could potentially benefit their forest management objectives. While both large and smaller scale landowners have the potential to benefit from the use of portable sawmills as an aid in their land management strategy, quite often there are much higher operating costs associated with harvesting timber on smaller tracts of land, and small-scale landowners have limited income generation options available to them. Therefore utilizing a portable sawmill on smaller tracts of land could create an additional forest management and income generating avenue that is not currently available to them in the current market.

Portable sawmills can be used for a variety of functions within the forest in addition to just “cutting timber.” This is an important point that many respondents did not understand. They are unaware that it is not essential to cut living, growing trees in order to supply a portable sawmill. Portable sawmills can be used in forest management as an aid in storm cleanup, to utilize yard trees, and other objectives that would otherwise leave an abundance of timber waste. This “waste” could be transformed to lumber that could be used to build a barn, furniture, and for housing improvements, among other things. The multiple uses of portable sawmills themselves as a forest management tool needs to be fully understood before full interest in a cooperative can be realized.

Many of the portable sawmill owners in the South that were surveyed/interviewed currently utilize their mills with a variety of land management techniques both on their own land and on others’ land, ranging from thinning, to storm cleanup, to utilizing timber that would otherwise be discarded. Their timber uses ranged from classical lumber production to creating finished products within a niche market. These portable sawmill owners, in addition to a great entrepreneurial spirit, also realize the potential of portable sawmills outside of the mainstream of the classical cutting and milling a tree, instead using their mill as an environmental tool to assist in forest management strategies to prevent excess waste of timber that might otherwise be discarded. Landowners could benefit from increased education on the multiple forest management strategies that could be accomplished through the use of a portable sawmill, such as clean up from storm damage, bug damage, and yard tree cleanup in addition to any thinning strategies. Likewise other non-timber strategies should be specified such as environmental mitigation, wildlife and recreation objectives.

The portable sawmill owners who were surveyed also indicated a willingness to travel a fair distance to obtain timber. This willingness coupled with small landowner land availability in a limited market could lead to potential partnership or cooperative agreements that could be forged, even at a greater distance than one might initially suspect. A network of portable sawmill owners and landowners could be created via an internet social networking site, for example, similar to “Woodweb” or other forest based sites. This site could be used as a tool to help locate and pool potential resources and opportunities. Portable sawmill owners and landowners alike could benefit from this partnership economically and could collectively enhance community development through additional revenue circulating through the local economy, new products available to local residents, and new social networks forged within the community.

However, as was the case with respondent interviews, oftentimes a full explanation of portable sawmill usage within a cooperative agreement needed to be provided in detail in order for respondents to understand. This demonstrates that there could be a greater interest in forest/portable sawmill based cooperative agreements, but it appears that a general lack of understanding is hindering respondents’ initial interest. Of those responding to the landowner survey approximately 58% were not interested in a cooperative agreement involving portable sawmilling specifically because they were not interested in cutting timber as a land management strategy. Previous studies have documented how portable sawmilling can be used for several purposes outside of “cutting timber,” including utilization of timber removal for improving land for aesthetics, recreation such as trails and wildlife purposes, turning otherwise useless trees into valuable lumber, and other environmental strategies such as carbon mitigation tactics (Mullins 2007, Updegraff and Blinn 2000). These multiple uses need to be conveyed to landowners to increase interest if this potentially beneficial avenue is to be explored.

CONCLUSION

Systems theory illustrates the way in which societies function as a series of interrelated parts of a whole, and that actions taken to effect part of the system can have a large effect on the structure as a whole (Waters 1994, Ritzer and Goodman 2004, Parsons 1951). Current macro system dominance has shifted societal functions from *gemeinschaft* (community based) to *gesellschaft* (society based) relationships creating distinct horizontal as well as vertical systematic linkages both within and between communities leading to growing dominance of macro systems over local community subsystems (Lyon 1987).

This research project took place during a unique period of U.S., illustrating the effect of macro system dominance to all facets of local subsystems. During this period, weak global economic conditions created an economic recession, resulting from a deep recession in the U.S. economy (Reuters 2008, New Zealand 2009). This recession was largely attributed to subprime and predatory lending practices by several U.S. banking institutions, leading to high default rates and several institutional collapses (Gwartney et. al 2009, Mayer et. al 2008, CBCNews 2008, Reuters 2008, FAO 2009, Pepke 2009, CBCNews 2008). These subprime and predatory lending practices were targeted toward both urban and rural America, with one facet particularly concentrated in the southern U.S., undermining the ability to build assets in many rural families, reducing not only the economy of rural areas, but also quality of life in many rural communities (Singleton et al. 2006).

The forest industry, primarily located in rural areas, has been greatly affected by these changing economic conditions in addition to the compounding cyclical nature of the forest industry to begin with (Marchak 1990). The forest industry plays an important role in the socio-economic development of many forest dependent rural communities. Due to limited opportunities aside from mainstream forest industry employment, forestry and forest products largely shape rural forest dependent communities' social and economic values (Schmincke 2008, Krannich and Luloff 1991).

As a result of these structural forces, it becomes important to identify additional revenue streams within forest dependent areas to ensure diversified means to economic development while promoting sustainability to ensure that these resources are available for future use. The theory of ecological modernization states the needs for adequate opportunities associated with market dynamics and the need for entrepreneurial agents to take the leading role in ecological changes, so that "environmental improvements can take place in tandem with economic growth" (Fisher and Freudenburg 2001:704). Therefore, focusing on additional sources to economic development within rural forest dependent areas which have the ability to contribute to best management practices within the forest should be of utmost importance.

One way of doing so is through microenterprise development utilizing the forest resources that are readily available in these areas. Forest microenterprises have the ability to enhance community development efforts as well as forest sustainability goals, empowering local people to augment their income as well as manage their forest resources (Salafsky 1997). Forestry-based microenterprises utilizing portable sawmills have been documented in the literature in various places around the world (Salafsky 1997, Russell and Mortimer 2005, Venn, McGavin and Leggate 2004, Masse 2001) however, until this point were no systematic studies researching forest microenterprises that utilize portable sawmills in the U.S., nor were there any systematic studies documenting portable sawmill ownership in the U.S.

This research documented various characteristics associated with portable sawmill ownership throughout the U.S. at a national and regional level utilizing primary data obtained through a mix of surveys and personal interviews. The primary data obtained in this research was applied to several topics. The first section explored how portable sawmill operations fit into the overall forest structure in terms of landownership, how timber species are utilized in relation to their availability, and forest production utilizing portable sawmills, followed by information regarding portable sawmill ownership characteristics and operational aspects of portable sawmill based microenterprises.

The next section looked at how portable sawmills are adopted and the adopter categories of portable sawmill owners, followed by a discussion of how information about portable sawmills is diffused. Finally, the idea of utilizing portable sawmills as a forest management tool within the context of portable sawmill based cooperative agreements in Alabama was discussed, in the context that, although there are currently few Alabama small-scale landowners utilizing portable sawmills, given the right information this technology could provide not only an additional land management tool but also a new avenue to generate income that is not currently available to them in the current market.

Dynamic changes in the current economic climate combined with changes to the structure of the forest products industry at the regional level, have led to both the loss of certain timber markets in some regions of U.S., such as the Pacific Northwest, while in other places, such as the southern U.S., have experienced increased production on a large scale level. These structural changes combined with technological changes within the industry have led to larger scale operations dominating the regions, leaving small-scale forestland owners with limited timber markets. A few options exist for landowners in this group to generate income utilizing timber from their forestland. One option for smaller scale forest production in the U.S. is to compete with larger industry, and as illustrated in a previous chapter, there are still several small-scale landowners who take this route. A more common option is to compete in smaller niche markets apart from large scale competition, such as utilizing a portable sawmill to compete in specialty lumber production, furniture making, or in creating a various crafted finished products for income generation or personal satisfaction.

Timber utilized in a portable sawmill often correlated with the availability of timber species in a given region, and mill owners tended to process timber from their own land if it was in close proximity to their home. Extension programs should focus on a dual effort to encourage portable sawmill use in both large and small-scale forestland owners. Extension programs should be aimed toward owners of both very small tracts of forestland, or those owning no forestland at all by creating networks between portable sawmill owners and forest landowners to give mill owners a new opportunity to obtain timber as well as providing an opportunity for landowners to use an additional tool in their land management strategy and earn income from their land. Utilizing portable sawmills with small-scale management strategies offers a way to generate income or a value-added product with minimal site disturbance, especially in situations where timber may not have otherwise been used. Portable sawmill utilization can be used in conjunction with many small-scale forest management strategies to generate income or a value added product, especially in situations where timber would have otherwise been wasted, such as in the cases of storm and bug damage, removal of newly dead trees, or other salvage activities, and can serve as a useful tool to enable landowners to meet some of their forest management goals. Portable sawmill owners and landowners tend to share similar primary forest management objectives and extension programs should be aimed at forging networks between the two groups.

Portable sawmill owners should be encouraged to compete in smaller niche markets to optimize their chance in running a successful microenterprise by producing higher quality and specialty lumber not readily available in common markets. Portable sawmill owners surveyed tended to enter niche markets through specialized lumber sales, or by processing higher value timber to be sold as lumber or used to create finished products. Extension programs need to educate portable sawmill owners about the various species in their areas as well as the values of those species. Certain milled species may have a higher demand as lumber than as a finished product. An example of this was seen in that portable sawmill owners surveyed were more likely to sell cherry lumber and less likely to use cherry lumber to sell a finished product. Extension programs should educate landowners as well as portable sawmill owners about various timber species in their area and encourage the production of specialized products using unique species to give them the competitive advantage in the larger market. Programming should also educate portable sawmill owners and landowners about a potential relationship in growing and processing specialty timber and offer cost-share programs to help fund landowners interested in managing timber stands for this reason. Extension programming should include a written assessment of timber species values for their location and their subsequent economic value as lumber as compared to a product.

The ownership structure of portable sawmills reflects that most portable sawmill microenterprises own their portable sawmill alone, as opposed to in a group, and mills are most often originally purchased for a hobby that, in many cases, developed into an income generating activity where owners were often flooded with more work than they had anticipated. This indicates that the demand for timber processing with a portable sawmill is relatively large. About 7% of portable sawmill owners who completed the survey operate as a full-time microenterprise and 53% operate as a part time business, indicating that about 60% are involved in some form of formal business structure. Out of the other 40% who indicated they use their mill as a hobby only, several indicated generating income from their mill equivalent to a part time business, but without a formal business structure.

Most portable sawmill owners provide their services for others without the use of contracts regardless of the type of business structure they have or whether they operate as a hobby only. Few respondents offered information on their itemized expenses and of those who did, several offered little detail. Most portable sawmill owners did not keep adequate financial records and are therefore unaware of the their microenterprise’s success beyond noticing a physical backlog of processed timber. Extension programs should focus their efforts on educating portable sawmill operators and potential portable sawmill adopters on how to begin and operate a successful business in terms of the financial aspects, including how to keep accurate records and itemized expenses. Without accurate financial record keeping, it is very difficult to fully assess the overall profitability of a portable sawmill based microenterprise. What we do know though, is that many portable sawmill owners appear to make an average living both as a full-time microenterprise, as well as have success in utilizing portable sawmills in a part-time microenterprise. Extension programs should focus their attention on reaching potential adopters interested in developing part-time microenterprises. This study offers a good starting point to understanding basic general income potential of portable sawmill microenterprises and extension programs can utilize these characteristics in developing educational programs.

Portable sawmill owners represented in this study were primarily white males, more than half of which were over 55 years old. Education levels of portable sawmill owners varied by region, with the Northeast holding the highest percentage of portable sawmill owners whose educational attainment was high school graduate, whereas in the South Central region, the largest percentage of portable sawmill owners held graduate or professional degrees. It is important for extension programs to understand the most likely adopters of portable sawmills in their region and focus their programming to serve that community.

There were no significant differences revealed between how portable sawmills are used (i.e., as a type of business or hobby) and a respondent’s region of residence, nor were there significant differences between a respondent’s region of residence and what they did with the lumber sawn with a mill (i.e., sold or traded lumber, built a finished product, etc.) except where the respondent built a home or other structure, namely due to laws regarding the use of stamped (graded) lumber in various states.

An important finding in this research was uncovering under what conditions and motivations portable sawmills were adopted. Three of the major motivations for adopting portable sawmills were to expand or transform a farm business, as conservation effort, and as an attempt to fill a market niche. Extension programs should focus their attention in promoting the adoption of portable sawmills to groups of individuals who fit these criteria, in the need to expand a farm, have an interest in conservation, and general entrepreneurial energy with the resources necessary to enter or create a niche market.

Cost played a moderate role in the adoption of portable sawmills and subsequently which model was chosen, with about 82% stating that cost was a major factor in their decision to purchase a mill as well as which model they bought. Extension programs should educate potential adopters about low interest loans or grants available as well as programs designed around financial book keeping to enable the best chance for success in their adoption.

While key differences between the utilization of traditional adoption models and this study exist, insofar as it is obviously not expected that an entire population, or even a majority of a population would adopt portable sawmills. Overall the categorical descriptions of the adoption model are still usable, though in a slightly different way, in describing key sets of characteristics that can help to describe portable sawmill microenterprise owners. In other words, the adoption model can help explain and describe characteristics on the type of individuals that portable sawmill microenterprise owners are. The implications of this are important in targeting extension service models to would-be portable sawmill populations as well as in supporting the theory suggested by Downs and Mohr (1976) that notes the importance of postulating multiple theories of the adoption and diffusion of innovations based on the varying attributes of the innovations themselves.

An important finding in the adoption rate of portable sawmills in a microenterprise, is that a bi-modal adoption pattern developed between full-time sawyers and part-time sawyers. The innovativeness of part-time sawyers more closely resembles the traditional adoption model, whereas full-time sawyers, as a group, tend to be more innovative. When examining the s-shaped adoption rate among portable sawmill owners, part-time sawyers' cumulative adoption rates do not resemble the traditional model at all, whereas full-time sawyers follow a more flatly defined s-shaped rate of adoption. These findings in the bi-modal adoption patterns of portable sawmill owners further supports the need for multiple theories of adoption.

This bi-modal adoption pattern also carries over to the methods in which information about portable sawmills was diffused. Part-time sawyers were most likely to initially heard about portable sawmills from someone else who owned a mill, whereas full-time sawyers were equally as likely to have heard about portable sawmills from someone they know as they were to have read about them initially in a magazine or some other written form. Likewise, while about 84% of portable sawmill owners considered themselves leaders in some capacity, full-time sawyers tended to be less influential in the mill purchases of others compared to part-time sawyers. The most common diffusion method utilized by portable sawmill owners as a whole is talking to others, despite the influx of new communication technologies. Extension programs should understand and utilize the leadership characteristics evident in portable sawmill owners in order to set up effective communication channels to diffuse information to their communities about portable sawmilling.

It is important for extension programs to understand the socio-economic characteristics of portable sawmill adapters to be able to effectively target appropriate programming to suitable audiences. Portable sawmill adopters who lived in rural communities were faster adopters than those in larger communities. This is most likely due to limited opportunities available in many rural areas coupled with abundant timber resources found in forest dependent communities. Income differences between portable sawmill adopters did not play a significant role in the adoption of portable sawmills despite the fact that previous literature showed it should. This may primarily result from economic incentives involved with portable sawmill adoption.

The final section of this research project applied the idea of utilizing portable sawmills as a forest management and cooperative agreement tool in Alabama. The state of Alabama is the third most forested state in the U.S., containing over 22 million acres forested land, 70% of which is non-industrial private forestland, with over 3.3 million acres owned in 50 acre tracts or less (Alabama Forestry Commission 2009, Smith et al. 2010). Several regions in Alabama are considered to be forest dependent based on the heavy economic reliance on the forest industry. Portable sawmills contribute to forest management objectives by providing a tool to maintain forest health in terms of storm damage removal, bug and storm damage cleanup, salvage, select harvest, thinning, and other forest improvements. Portable sawmills also aid in income generation outside of mainstream forest industrial activities, especially on small tracts of land where it is difficult to find outlets for timber. Given these attributes, there appears to be few Alabama landowners that utilize portable sawmills as part of their overall forest management strategy due to an apparently limited knowledge on these benefits. Portable sawmill owners throughout the South realized the potential of portable sawmills outside of cutting and milling a tree, instead using their mill as an environmental tool to assist in forest management strategies to prevent excess waste of timber that might otherwise be discarded.

Alabama landowners could benefit from increased education on the multiple forest management strategies that could be accomplished through the use of a portable sawmill, such as storm damage, bug damage, and yard tree cleanup in addition to any thinning strategies, and even other non-timber strategies should such as environmental mitigation, wildlife, and recreation objectives. The surveyed portable sawmill owners throughout the South indicated a willingness to travel a fair distance to obtain timber potentially leading to partnerships or cooperative agreements that could be forged, even at a greater distance than one might initially suspect, benefiting portable sawmill owners and landowners economically and could collectively enhance community development, through additional revenue circulating through the local economy, new products available to local residents, and new social networks created.

These previously mentioned purposes would be great avenues for extension programs and small business assistance organizations to focus on. Education could come in the form of pamphlets, articles, and demonstrations describing various options for landowners, such as portable sawmills. Workshops could facilitate activities such as grant writing assistance, among other small business support. An internet based social networking site could be developed to forge partnerships between landowners and portable sawmill owners, providing educational resources for both to succeed.

In addition, a collaborative arrangement through a cooperative agreement could house a small timber market for both lumber, finished products, as well as the sale of actual sawyer services. With the abundance of non industrial private forestland in Alabama coupled with minimal options for small landowners, new forestland management strategies should look to incorporate various techniques, such as utilizing portable sawmills, with these various strategies in mind.

Extension programs need to continue their efforts toward education of various land management strategies available and strive to introduce new and unique avenues for local community development, such as portable sawmilling. Both landowners and portable sawmill owners alike, need to be educated on available resources, programs, and various opportunities available to them, and new opportunities should be developed to forge working relationships among community members that will enhance both the integrity of the forest as well as increase community development.

Overall, the utilization of portable sawmills within a forest based microenterprise has the potential to add an additional sector to local economic opportunities coupled with a decreased level of dependency on mainstream harvesting and processing measures, allowing the entrepreneur to define the "terms of wood." This enables the entrepreneur a greater stake in contributing to his/her environmental responsibility, increase revenue streams, while simultaneously creating a niche market for timber that would otherwise be disposed of. The purchaser of products created through these means can, in turn, feel as though they are contributing to their own environmental responsibilities while helping to foster growth in the local economy. As time progresses and economic prospects continue to appear bleak, adoption of portable sawmill microenterprises to aid in increased income generation could be a viable option to aid in both local economic as well as community development.

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APPENDIX A- WEB-BASED SURVEY

Auburn University Portable Sawmill Survey

1. Auburn University National Portable Sawmill Survey

Dear portable sawmill owner
This survey was developed by a group of researchers and Extension professionals at Auburn University who are interested in learning about people like yourself, who own and use portable sawmills. We were surprised to learn that no national study of portable sawmill owners has been done. That is why we have developed this survey, and why we are asking you to take a few minutes of your time to answer the questions which follow. We estimate it will take you 10 minutes to complete this survey.

Your responses will remain entirely anonymous. If there are questions you prefer not to answer, that is fine – just leave them blank. We have tried not to ask sensitive questions, but knowing something about the economics of sawmilling, and the economic status of sawmill owners, will be helpful to us in developing Extension programming to promote increased use of portable sawmills.

At the end of the survey there is contact information for those who developed and hope to make use of the data from this survey. You can request a copy of our study, if you are interested.

This survey is part of a project funded by the U.S. Department of Agriculture's National Initiative Competitive Grant Program "Enhancing the Prosperity of Small Farms & Rural Agricultural Communities," grant award number 2005-0711.

There are many thousands of portable sawmill operators around the country, but every response is important for our study to have meaning and for the contributions of owner-operators such as yourself to be adequately appreciated. Thank you in advance for participating in this national survey.

If you have any questions feel free to email Dr. Becky Barlow at: rjb0003@auburn.edu

1. What brand of portable sawmill do you own/use?

- ☐ Cooks
- ☐ Enercraft/Baker
- ☐ Hud-son
- ☐ Jonsered
- ☐ Logosol
- ☐ Pro-cut
- ☐ Timberking
- ☐ Woodchuck
- ☐ Woodmizer
- ☐ Other (please specify)

2. What is the model number of your portable sawmill?

3. Is this the first sawmill you have ever owned?

- ○ Yes (Please go to question 5)
- ○ No (Please go to question 4)

Auburn University Portable Sawmill Survey

4. If previously you owned a different sawmill, why did you purchase your current sawmill?

- I have never owned a different mill
- Previous mill was old and required frequent repairs
- Previous mill had limited production capacity and I needed a more productive sawmill
- Previous mill had too much production capacity and I did not need such a powerful sawmill
- Other (please specify)

5. In what year was your portable sawmill first put into service?

6. Did you buy your portable sawmill new or used?

- New
- Used, from a dealer
- Used, from a private party

7. How long have you owned your current portable sawmill? (in years)

8. Do you own your portable sawmill alone, or do you share it with others?

- I own my portable sawmill alone as an individual
- I own my portable sawmill alone as part of my business
- I share my portable sawmill with another person
- I share my portable sawmill with another person as part of a business
- I share my portable sawmill with several other people
- I share my portable sawmill with several other people as part of a business
- I share my portable sawmill with several other people as part of a cooperative

Auburn University Portable Sawmill Survey

9. Please check all equipment that you normally use in conjunction with your portable sawmilling operation.

- [ ] Chainsaw
- [ ] Grapple
- [ ] Loader
- [ ] Pick-up Truck
- [ ] Truck (other)
- [ ] ATV
- [ ] Pedestrianized skidder
- [ ] Skidder
- [ ] Fetching arches
- [ ] Skidding cones
- [ ] Winch
- [ ] Animals (horse, mule, etc.)
- [ ] Tractor
- [ ] Skid steer
- [ ] Excavator
- [ ] Planer
- [ ] Other (please specify)

10. How do you dry the timber that you process?

- [ ] I do not dry the lumber
- [ ] I air dry the lumber in an open area
- [ ] I air dry the lumber in an enclosed area
- [ ] I use a solar kiln
- [ ] I use another type of kiln

Auburn University Portable Sawmill Survey

11. What safety equipment do you normally use while operating your portable sawmill? Check all that apply

- [ ] Protective glasses
- [ ] Ear plugs
- [ ] Hardhat
- [ ] Faceshield
- [ ] Gloves
- [ ] Chaps
- [ ] Boots
- [ ] Steel toe boots
- [ ] I do not use any safety equipment

12. What do you do with the processed timber from your portable sawmill? Check all that apply

- [ ] Sell the lumber
- [ ] Trade or exchange the lumber for other goods and services
- [ ] Create a finished product to sell.
- [ ] Create a finished product to trade/exchange.
- [ ] Build your own home.
- [ ] Build a barn or other outbuildings on your property.
- [ ] Create other finished products to keep.

If you checked that you create a finished product, please specify what you make

13. If you sell or trade, which of the following BEST describes your situation.

- ○ I produce as much as I sell
- ○ I produce more than I can sell
- ○ I produce less that what I can sell

14. If you sell or trade, do you draft contracts to be signed by your client?

- ○ Yes I always make clients sign a contract before starting a job
- ○ I usually make clients sign a contract
- ○ I sometimes make clients sign a contract
- ○ I never have clients sign a contract

Auburn University Portable Sawmill Survey

15. Which of the following best describes how your portable sawmill is currently used?

- full-time employment
- full-time employment AND hobby
- part -time employment
- part-time employment AND hobby
- hobby only

16. Which of the following described the reason why you first purchased a portable sawmill?

- For employment
- For hobby only
- For hobby that developed into part time employment
- For hobby that developed into full time employment

17. Do you keep itemized expenses of the costs that incur using your portable sawmill?

- Yes, I always keep written expenses tracking both time and materials used
- I sometimes track my expenses but not regularly
- No, I never keep track of my expenses

18. How much does it cost per board foot to run your portable sawmill?

19. If you mill wood for others, how much do you charge per board foot? If you trade/exchange milled word for goods and services, what would be the estimated value of your services per board value?

20. Do you keep track of how much timber you process each year with your portable sawmill?

- Yes
- No

If yes, how many board ft do you process per year?

Auburn University Portable Sawmill Survey

21. How much did you pay for your portable sawmill?

- Less than $1000
- $1000-$4999
- $5000-$9999
- $10,000-$14,999
- $15,000-$19,999
- $20,000-$24,999
- $25,000-$29,999
- $30,000-$34,999
- $35,000 or more

22. How did you finance the purchase of your sawmill?

- Personal funds – cash
- Personal funds – credit card
- The dealer provided a loan
- I got a business loan
- I got a consumer loan

23. Over the past 12 months, approximately how much do you spend to operate your portable sawmill:

Labor costs (people you hire to operate the sawmill)	
Repairs and replacement parts	
Routine maintenance, including sharpening of blades	
Fuel and lubricants for the mill itself	
Insurance (liability, health)	
Cost of transporting the mill from location to location	
Purchase of timber or logs for milling	

Auburn University Portable Sawmill Survey

24. Considering the types of costs included in question 23, which of the following statements are true:

- My expenses are larger then the revenue I generate from sales
- My expenses are the same as the revenue I generate from sales
- My expenses are less then the revenue I generate from sales
- I do not sell any products

25. In addition to the costs included in question 23, you have made an investment in the portable sawmill and other equipment, including vehicles and tools. Considering these costs and investments, which of the following statements are true:

- My expenses are larger then the revenue I generate from sales (I "lose" money)
- My expenses are the same as the revenue I generate from sales (I "make" money)
- My expenses are less then the revenue I generate from sales (I break even)
- I do not sell any products

26. What is the primary method used to harvest the timber that you mill into lumber?

- Chainsaw
- Animals (horse, mule)
- Timber harvesting machines/equipment
- Don't know
- Other (please specify)

27. How many acres of forested land do you own?

- I do not own any forested land
- Less than 10 acres
- 10-25 acres
- 26-40 acres
- 41-55 acres
- 56-70 acres
- 71-85 acres
- 86-100 acres
- More than 100 acres

Auburn University Portable Sawmill Survey

28. Do you harvest timber on your own land?

- Yes, always
- Sometimes
- No, never

29. Choose the answer that best describes where the timber is harvested that is processed with your portable sawmill?

- 100% from my own forested land
- 75% from my own forested land, 25% from land owned by others
- 50% from my own forested land, 50% from land owned by others
- 25% from my own forested land, 75% from land owned by others
- 100% from land owned by someone else

30. If you currently process timber from your property only, would you be interested in processing wood from someone else's land with your portable sawmill?

- Yes
- No

31. If you are interested in processing timber from others' land, how far are you willing to travel?

- Less than 10 miles from my home
- 11-20 miles from my home
- 21-30 miles from my home
- 31-40 miles from my home
- 41-50 miles from my home
- Over 50 miles from my home

32. Is your forested land in close proximity to your home?

- I do not own forested land
- My forested land is immediately adjacent to my residence
- Less than 10 miles from my home
- 11-20 miles from my home
- 21-30 miles from my home
- 31-40 miles from my home
- 41-50 miles from my home
- Over 50 miles from my home

Auburn University Portable Sawmill Survey

33. Who harvests the timber that you use with your portable sawmill?

- ○ Harvested myself
- ○ Harvested by someone else
- ○ Both

34. What type of timber do you process with your portable sawmill? (check all that apply)

- ☐ Alder
- ☐ Hickory
- ☐ Maple
- ☐ Oak
- ☐ Sweetgum
- ☐ Walnut
- ☐ Cedar
- ☐ Douglas Fir
- ☐ Fir
- ☐ Hemlock
- ☐ Juniper
- ☐ Larch
- ☐ Pine
- ☐ Spruce
- ☐ Other
- ☐ Other (please specify)

35. What diameter tree do you normally mill?

- ○ Less than 10" DBH
- ○ 10"-24" DBH
- ○ Greater than 24" DBH

36. How long are the logs you normally mill?

In feet

Auburn University Portable Sawmill Survey

37. What age timber do you normally mill?

- Less than age 15
- Age 16-25
- Age 26-35
- Age 36-45
- Age 46-55
- Older than 55
- Don't know

38. Where does the timber primarily come from?

- Clearcut
- Thinning
- Storm damage
- Bug damage
- Yard trees
- Other (please specify)

39. How old are you?

- Under 25
- 25-34
- 35-44
- 45-54
- 55-64
- 65 and over

40. What is your highest education level?

- Some high school or less
- Graduated High school
- Some college
- 2 year or technical degree
- Bachelor degree
- Some graduate school
- Graduate or professional degree

Auburn University Portable Sawmill Survey

41. What is your state of residence?

State:

ZIP/Postal Code:

42. What is your gender?

- Male
- Female

43. What is your ethnicity?

- White or Caucasian
- Black or African American
- Asian or Pacific
- Native American
- Other

44. Which category best describes your 2007 household income?

- Less than $20,000
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 or more

45. What best describes the percentage of your household income that comes from your portable sawmill work?

- 0
- 1-25%
- 26-50%
- 51-75%
- 76-100%

Auburn University Portable Sawmill Survey

Are you interested in providing more detailed information about your portable sawmill experience, either in the form of a more detailed survey or through an interview? If so, please contact Dr. Becky Barlow, Extension Forester in the School of Forestry & Wildlife Sciences at Auburn University at the following email address: rjb0003@auburn.edu. Your name will not be connected to the data provided in this survey.

If you would like to receive a copy of the results from this national survey, please contact Dr. Barlow at the email address listed above. It may take us some time to compile the results, but in appreciation for your help we would be happy to share with you what we have learned.

APPENDIX B- MAIL BASED SURVEY

NATIONAL PORTABLE SAWMILL OWNER/OPERATOR SURVEY

AUBURN UNIVERSITY

3301 FORESTRY AND
WILDLIFE SCIENCES BUILDING
AUBURN, AL 36849-5418

www.auburn.edu

Dear portable sawmill owner:

This survey was developed by a group of researchers and Extension professionals at Auburn University who are interested in learning about people like yourself, who own and use portable sawmills. We were surprised to learn that no national study of portable sawmill owners has been done. That is why we have developed this survey, and why we are asking you to take a few minutes of your time to answer the questions which follow. We estimate it will take you 10 minutes to complete this survey.

Your responses will remain entirely anonymous. If there are questions you prefer not to answer, that is fine – just leave them blank. We have tried not to ask sensitive questions, but knowing something about the economics of sawmilling, and the economic status of sawmill owners, will be helpful to us in developing Extension programming to promote increased use of portable sawmills.

At the end of the survey there is contact information for those who developed and hope to make use of the data from this survey. You can request a copy of our study, if you are interested.

This survey is part of a project funded by the U.S. Department of Agriculture's National Initiative Competitive Grant Progam "Enhancing the Prosperity of Small Farms & Rural Agricultural Communities," grant award number 2005-0711.

There are many thousands of portable sawmill operators around the country, but every response is important for our study to have meaning and for the contributions of owner-operators such as yourself to be adequately appreciated.

The Auburn University Institutional Review Board has approved this document for use from June 25, 2009 to July 18, 2010. Protocol #08-150 EX 0807.
Thank you in advance for participating in this national survey.

1. Do you own a portable sawmill?
   - o Yes
   - o No

2. What brand of portable sawmill do you own/use?
   - o Woodmizer
   - o Logosol
   - o Cooks
   - o Woodchuck
   - o Hud-son
   - o Enercraft/Baker
   - o Timberking
   - o Jonsered
   - o Pro-cut
   - o Norwood
   - o Mobil Dimension
   - o Peterson
   - o Home Built
   - o Alaskan
   - o Lucas
   - o Other____________________

3. What is the model number of your portable sawmill?________________

4. Is this the first sawmill you have ever owned?
   - o Yes
   - o No

5. If previously you owned a different sawmill, why did you purchase your current sawmill?

   - o Previous mill was old and required frequent repairs
   - o Previous mill had limited production capacity and I needed a more productive sawmill
   - o Previous mill had too much production capacity and I did not need such a powerful sawmill
   - o Other (please specify) _____________

6. In what year was your portable sawmill first put into service?____________

7. Did you buy your portable sawmill new or used?
   - o New
   - o Used, from a dealer
   - o Used, from a private party

8. How long have you owned your current portable sawmill?________Years

8a. How long have you owned portable sawmills altogether? ________Years

9. Do you own your portable sawmill alone, or do you share it with others?
   - o I own my portable sawmill alone as an individual
   - o I own my portable sawmill alone as part of my business
   - o I share my portable sawmill with another person
   - o I share my portable sawmill with another person as part of a business
   - o I share my portable sawmill with several other people
   - o I share my portable sawmill with several other people as part of a business
   - o I share my portable sawmill with several other people as part of a cooperative

10. Please check all equipment that you normally use in conjunction with your portable sawmilling operation.
    - o Chainsaw
    - o Grapple
    - o Loader
    - o Pick-up Truck
    - o Truck (other)
    - o ATV
    - o Pedestrianized skidder
    - o Skidder
    - o Fetching arches
    - o Skidding cones
    - o Winch
    - o Animals (horse, mule, etc.)
    - o Tractor
    - o Skid steer
    - o Excavator
    - o Planar
    - o Other ____

11. How do you dry the timber that you process?
- o I do not dry the lumber
- o I air dry the lumber in an open area
- o I air dry the lumber in an enclosed area
- o I use a solar kiln
- o I use another type of kiln

12. What safety equipment do you normally use while operating your portable sawmill?
(Check all that apply)
- o Protective glasses
- o Ear plugs
- o Hardhat
- o Faceshield
- o Gloves
- o Chaps
- o Boots
- o Steel toe boots
- o I do not use any safety equipment

13. What do you do with the processed timber from your portable sawmill?
(Check all that apply)
- o Sell the lumber
- o Trade or exchange the lumber for other goods and services
- o Create a finished product to sell. *Please specify what you make*_________________
- o Create a finished product to trade/exchange. *Please specify what you make*_________________
- o Build your own home.
- o Build a barn or other outbuildings on your property.
- o Create other finished products to keep. *Please specify what you make*_________________

14. If you sell or trade, which of the following describes your situation.
- o I produce as much as I sell
- o I produce more than I can sell
- o I produce less than what I can sell

15. If you sell or trade, do you draft contracts to be signed by your client?
- o Yes I always make clients sign a contract before starting a job
- o I usually make clients sign a contract
- o I sometimes make clients sign a contract
- o I never have clients sign a contract

16. Which of the following best describes how your portable sawmill is currently used.
    - o full-time employment
    - o full-time employment AND hobby
    - o part -time employment
    - o part-time employment AND hobby
    - o hobby only

17. Which of the following described the reason why you first purchased a portable sawmill?
    - o For employment
    - o For hobby only
    - o For hobby that developed into part time employment
    - o For hobby that developed into full time employment

18. Do you keep itemized expenses of the costs that incur using your portable sawmill?
    - o Yes, I always keep written expenses tracking both time and materials used
    - o I sometimes track my expenses but not regularly
    - o No, I never keep track of my expenses

19. If yes, how much does it cost per board foot to run your portable sawmill?______________

20. If you mill wood for others, how much do you charge per board foot? *(If you trade/exchange milled word for goods and services, what would be the estimated value of your services per board value)*____________

21. Do you keep track of how much timber you process each year with your portable sawmill?
    - o Yes
    - o No

21a. If yes, how many board feet do you process each year?______

22. How much did you pay for your portable sawmill?
    - o Less than $1000
    - o $1000-$4999
    - o $5000-$9999
    - o $10,000-$14,999
    - o $15,000-$19,999
    - o $20,000-$24,999
    - o $25,000-$29,999
    - o $30,000-$34,999
    - o $35,000 or more

23. How did you finance the purchase of your sawmill?
- o Personal funds – cash
- o Personal funds – credit card
- o The dealer provided a loan
- o I got a business loan
- o I got a consumer loan

24. Over the past 12 months, approximately how much do you spend to operate your portable sawmill:
- o Labor costs (people you hire to operate the sawmill) $_________
- o Repairs and replacement parts $__ ______
- o Routine maintenance, including sharpening of blades $_________
- o Fuel and lubricants for the mill itself $_________
- o Insurance (liability, health) $_________
- o Cost of transporting the mill from location to location $__________
- o Purchase of timber or logs for milling $______

25. Considering the types of costs included in question 24, which of the following statements are true:
- o My expenses are larger and then the revenue I generate from sales
- o My expenses are the same as the revenue I generate from sales
- o My expenses are less than the revenue I generate from sales
- o I do not sell any products

26. In addition to the costs included in question 24, you have made an investment in the portable sawmill and other equipment, including vehicles and tools. Considering these costs and investments, which of the following statements are true:
- o My expenses are larger and then the revenue I generate from sales (I "lose"money)
- o My expenses are the same as the revenue I generate from sales (I "make"money)
- o My expenses are less than the revenue I generate from sales (I break even)
- o I do not sell any products

27. What is the primary method used to harvest the timber that you mill into lumber?
- o Chainsaw
- o Animals (horse, mule)
- o Timber harvesting machines/equipment
- o Don't know
- o Other (please specify)__________________

28. How many acres of forested land do you own?

- o I do not own any forested land
- o Less than 10 acres
- o 10-25 acres
- o 26-40 acres
- o 41-55 acres
- o 56-70 acres
- o 71-85 acres
- o 86-100 acres
- o More than 100 acres

29. Do you harvest timber on your own land?

- o Yes
- o No

30. Choose the answer that best describes where the timber is harvested that is processed with your portable sawmill?

- o 100% from my own forested land
- o 75% from my own forested land, 25% from land owned by others
- o 50% from my own forested land, 50% from land owned by others
- o 25% from my own forested land, 75% from land owned by others
- o 100% from land owned by someone else

31. If you currently process timber from your property only, would you be interested in processing wood from someone else's land with your portable sawmill?

- o Yes
- o No

31a. If yes, would you be interested in joining a cooperative agreement to mill timber and share profits with a landowner?

- o Yes
- o No

31b. If yes, how much of the profits would you be willing to share with the landowner for use of his/her land? (please enter a percentage between 0%and 100% to the following statement).

I would be willing to give ____% of the profits to the landowner for timber sales obtained using his/her timberland.

32. If you are interested in processing timber from others' land, how far are you willing to travel?
   - o Less than 10 miles from my home
   - o 11-20 miles from my home
   - o 21-30 miles from my home
   - o 31-40 miles from my home
   - o 41-50 miles from my home
   - o Over 50 miles from my home

33. Is your forested land in close proximity to your home?
   - o I do not own forested land
   - o My forested land is immediately adjacent to my residence
   - o Less than 10 miles from my home
   - o 11-20 miles from my home
   - o 21-30 miles from my home
   - o 31-40 miles from my home
   - o 41-50 miles from my home
   - o Over 50 miles from my home

34. Who harvests the timber that you use with your portable sawmill?
   - o Harvested myself
   - o Harvested by someone else

35. What type of timber do you process with your portable sawmill? *(check all the apply)*
   - o Alder
   - o Hickory
   - o Maple
   - o Oak
   - o Sweetgum
   - o Walnut
   - o Cedar
   - o Douglas Fir
   - o Fir
   - o Hemlock
   - o Juniper
   - o Larch
   - o Pine
   - o Spruce
   - o Cherry
   - o Poplar
   - o Beech
   - o Birch
   - o Other____________

36. What diameter tree do you normally mill?
- o Less than 10” DBH
- o 10”-24” DBH
- o Greater than 24” DBH

37. How long are the logs you normally mill? ________ FT

38. What age timber do you normally mill?
- o Less than age 15
- o Age 16-25
- o Age 26-35
- o Age 36-45
- o Age 46-55
- o Older than 55
- o Don’t know

39. Where does the timber primarily come from?
- o Clearcut
- o Thinning
- o Storm damage
- o Bug damage
- o Yard trees
- o Other. Please specify______________

40. How old are you?
- o Under 25
- o 25-34
- o 35-44
- o 45-54
- o 55-64
- o 65 and over

41. What is your education level?
- o Some high school or less
- o Graduated High school
- o Some college
- o 2 year or technical degree
- o Bachelor degree
- o Some graduate school
- o Graduate or professional degree

42. What is your state of residence? ____________

43. What is your gender?

- o Male
- o Female

44. What is your ethnicity?

- o White or Caucasian
- o Black or African American
- o Asian or Pacific
- o Native American
- o Other

45. Which category best describes your 2007 household income?

- o Less than $20,000
- o $20,000 to $29,999
- o $30,000 to $39,999
- o $40,000 to $49,999
- o $50,000 to $59,999
- o $60,000 to $69,999
- o $70,000 to $79,999
- o $80,000 to $89,999
- o $90,000 to $99,999
- o $100,000 or more

46. What best describes the percentage of your household income that comes from your portable sawmill work?

- o 0
- o 1-25%
- o 26-50%
- o 51-75%
- o 76-100%

Are you interested in providing more detailed information about your portable sawmill experience, either in the form of a more detailed survey or through an interview? If so, please contact Dr. Becky Barlow, Extension Forester in the School of Forestry & Wildlife Sciences at Auburn University at (334) 844-1019 or at the following email address: rjb0003@auburn.edu. Your name will not be connected to the data provided in this survey.

If you would like to receive a copy of the results from this national survey, please contact Dr. Barlow at the email address listed above. It may take us some time to compile the results, but in appreciation for your help we would be happy to share with you what we have learned.

Thank you for your participation!

Would you like to add anything that has not been covered in this survey? If so, feel free to write any comments below:

APPENDIX C- ALABAMA LANDOWNER SURVEY QUESTIONS INCLUDED IN A SURVEY CONDUCTION BY ANOTHER RESEARCH GROUP WITHIN THE FORESTRY DEPARTMENT AT AUBURN UNIVERSITY

1) One option for small landowners to generate revenue is to mill timber on their land using a portable sawmill. Do you currently own a portable sawmill?

- yes
- no

2) Would you be interested in joining a cooperative agreement with a portable sawmill owner to operate on your land? In this agreement the portable sawmill owner would mill timber from your property and the profits from the sale of the timber would be shared.

- Yes, I am already in an agreement like this with a portable sawmill owner
- Yes, I am interested in this type of an agreement
- No, I am not interested in joining a cooperative agreement with a portable sawmill owner. The primary reason that I am <u>not</u> interested is ____ ____________________________

APPENDIX D- INTERVIEW GUIDE: PORTABLE SAWMILL OWNERS

1. Why did you buy your first mill?

2. If you have a business using your portable sawmill how did you start it? Was there a need for something and you created it or did you start just making things for yourself and others approached you for services with your mill?

3. Do you advertise or do you create things for others mainly through word of mouth?

4. Is your business successful? What, to you, defines its success?

5. Do you hire others to help you operate your mill or do you do everything alone? If you do hire people are they full time, part time, occasional, etc?

6. If you operate your portable sawmill as a hobby only, have you ever thought about starting a business using your mill? If so, what prevents you from starting one up?

7. How did you decide what products to make and/or sell with your portable sawmill?

8. What is involved in routine maintenance and how often?

9. Have you made any repairs? How often and what are the costs associated with it? Do you make the repairs yourself or does someone else do them? Is it hard to get spare parts?

10. How much of a role did cost play in the time it took you to buy a portable sawmill? How much did yours cost? Do you consider that to be a lot of money or not that much?

11. Do you use your mill portable or stationary (does the wood go to you or do you go to the wood)?

12. What really drew your interest into portable sawmilling?

13. How did you first learn or hear about portable sawmills? Did someone you know have one? Who? In what capacity did they use it (hobby, business, etc)?

14. Once you initially heard about portable sawmills, how did you then proceed? For example, did you ask others about it or talk to others about it, did you read about it online, or in magazines, or did you call a manufacturer for brochures, etc? Did you run right out and buy one or take a lot of time to think about it?\

15. Have others talked to you about your mill?

16. Have any of those who talked to you gone out and bought a mill of their own?

17. Do you tend to influence other people in your community by your actions? Would others consider you a "leader"?

18. Are you skeptical of new innovations or are you one of the first ones to get something new?

19. How much time and thought did you put into portable sawmilling before you actually bought your first mill?

20. Were you interested in it for days, months, years, etc before you actually bought one?

21. Did a lot of people have a mill before you purchased one, did it seem like everyone had one and you were one of the last ones? Or were you one of the first people you knew with one? Or would you say that some people had them and some didn't- you were just in the middle somewhere? Early middle or late middle?

22. Once you had a portable sawmill did you tell a lot of people about it? Or share about your experiences of having one with friends, family, or neighbors? Did you join an online forum dealing with portable sawmilling or something like that?

23. Have you had any issues with wood quality? For example, when building a home there is an inspection process and an additional step needs to be taken in order to ensure the wood quality of "unstamped timber" did you run into any issues like this?

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24. Do you belong to a co-op? Have you ever considered joining a co-op? If something like a forest co-op was available for you to for extra milling or to collaborate with forest landowners that are interested in sawmilling wood from their property, would you be interested? Why or why not? What would it take for you to be interested in something like that?

25. What do you do for a living?

26. What is the size of the city/town you live in?

APPENDIX E- INTERVIEW GUIDE: ALABAMA LANDOWNERS

(Interviews focused on elaborating on these questions handed out prior in the day)

LANDOWNER PORTABLE SAWMILL QUESTIONNAIRE

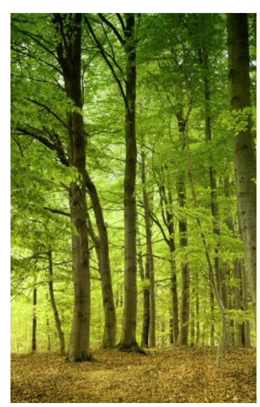
1) One option for small landowners to generate revenue is to mill timber on their land using a portable sawmill. Do you currently own a portable sawmill?

- yes
- no

2) If yes, do you own your portable sawmill as a business or hobby?

- Full time business
- Full time business and hobby
- Part time business
- Part time business and hobby
- Hobby only

3) Would you be interested in joining a cooperative agreement with a portable sawmill owner to operate on your land? In this agreement the portable sawmill owner would mill timber from your property and the profits from the sale of the timber would be shared.



- Yes, I am already in an agreement like this with a portable sawmill owner
- Yes, I am interested in this type of an agreement
- No, I am not interested in joining a cooperative agreement with a portable sawmill owner. The primary reason that I am <u>not</u> interested is ____ ____

4) How many acres of forestland do you own? __________________