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Factors Affecting the Availability of Wood Energy from Nonindustrial Private Forest Lands in the Northeast

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Abstract

The oil embargo of 1973-74 made wood a crisis source of energy. The Northeast was and remains particularly vulnerable to fluctuations in the price of oil. The factors that affect the availability of fuelwood from nonindustrial private forests (NIPF) in the Northeastern United States are described. The availability of market fuelwood depends heavily on tract size. The demand for land to supply the expanding urban fringe may result in a lower supply of market wood but also in more wood being cut to satisfy the owner's need for wood. Eighty-eight percent of the NIPF owners control fewer than 50 acres of forest land; together they control 31 percent of the NIPF resource. Among these owners, fuelwood for personal use is likely to be the product harvested. Studies show that NIPF owners in the Northeast could be persuaded to sell firewood to a regional market, but this supply would not meet the region's total energy needs for more than several years. However, fuelwood could become an important energy supplement to tide over the region until alternative energy sources are developed.

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Introduction

The oil embargo of 1973-74, with its $2 a gallon petroleum prices and long gasoline waiting lines, made wood a crisis source of energy for much of the Nation. The Northeast was and remains particularly vulnerable to fluctuations in the price or reduced imports of foreign oil because: (1) it relies on foreign oil for 89 percent of its energy needs (Palmer and others 1980); (2) much of this region lies outside energy supply routes; and (3) the heating season is long and severe. As a result, energy costs are 30 percent higher in the Northeast than in the rest of the country (Palmer and others 1980).

The central and northern hardwood forests in the Northeast contain deciduous trees with high wood densities (oak, hickory, ash, maple, beech, birch, and others) that yield 8,500 to 9,000 BTU per pound of oven-dry wood, or 35 to 39 million BTU per cord. Using the lower BTU figure, one cord of wood is the energy equivalent of 4.53 barrels of oil. Thus, northeastern forests, whose average annual growth rate is 34 cubic feet (0.43 cord) per acre (Frieswyk and DiGiovanni 1989; Dickson and McAfee 1989a,b,c; Frieswyk and Malley 1985a,b; Powell and Dickson 1984; Considine and Frieswyk 1982; Considine and Powell 1980; Ferguson and Mayer 1974), are capable of producing the equivalent of 1.8 barrels of oil per acre per year. This means that the Northeast's 47.8 million acres of nonindustrial private forest lands (NIPF) yield 516 trillion BTU annually, or the energy equivalent of more than 86 million barrels of oil. This BTU figure represents nearly 19 percent of the 2,781.6 trillion BTU of energy consumed in New England in 1975 (Palmer and others 1980).

As an economically attractive domestic energy supply, wood was the choice of residential and nonresidential users when the price of petroleum, gas, and electric heat began its dramatic rise during the 1973-74 oil embargo, and it remains an important energy source for many consumers. Yet, fuelwood has not become a major supplement to the region's energy needs due to supply and use problems.

This report describes the factors that affect the availability of fuelwood from NIPF lands in the Northeastern United States (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Maryland, New Jersey, New York, and Pennsylvania). It is part of a comprehensive wood-for-energy study entitled "The Production, Consumption, and Marketing of Wood for Energy in the Northeast (Northeast Regional Study 142)." Supported by the U.S. Department of Agriculture and the land-grant universities of cooperating states, this study is designed to:

1. Estimate the demand for wood energy in the Northeast by consuming sectors, state, and region.

2. Analyze the management and supply of wood for energy processing as well as marketing structures.

3. Identify goals and effectiveness of actual and alternative local, state, and Federal forest policies and contrast these with the objectives of forest owners with regard to the use of wood for energy.

The objective of this study is to analyze the supply of wood energy, that is, to identify and describe the factors that influence NIPF owners to harvest, or permit the harvest, of fuelwood from their land.

History

The quality and extent of forest cover in the Northeast has changed dramatically over the past 300 years and continues to undergo rapid change. This is particularly evident among small, private woodlots with their diverse ownership patterns and varied economic circumstances. Consider the impact that the demand for fuelwood has had on our Nation's forests in the last century. In 1870, wood accounted for 75 percent of the Nation's energy budget. By 1900, this demand had dropped to 25 percent, and to 1 percent by 1970. After the 1973 oil embargo, the demand for wood energy rose to 8 percent and was predicted to go as high as 20 percent by the year 2000. Since 1985, fuelwood consumption rates have dropped rapidly due to the renewed availability of cheap oil. Such market fluctuations can have disruptive effects on a forest resource that requires long periods to grow and replenish.

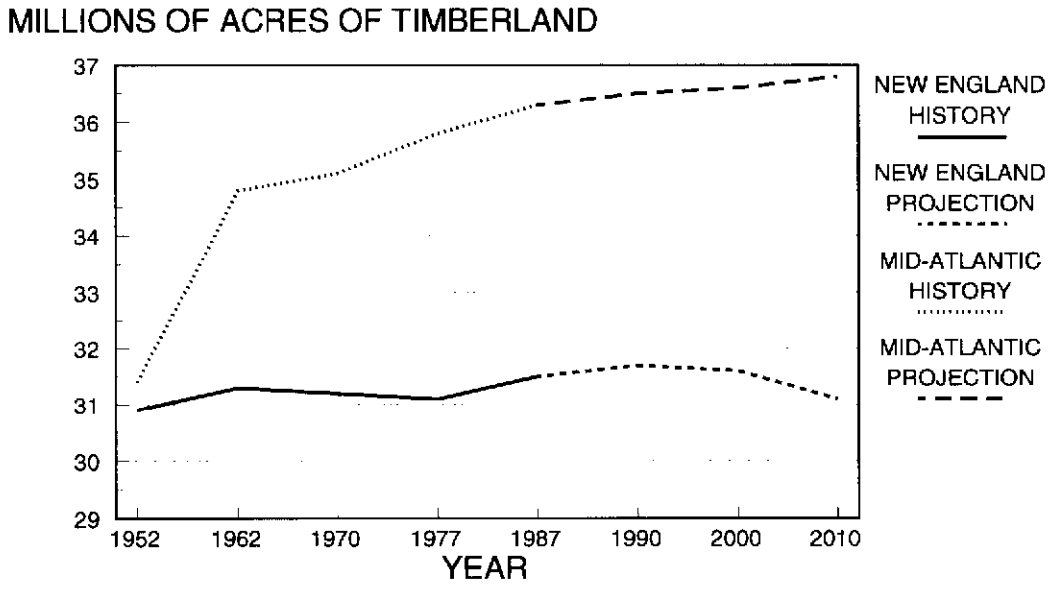

Figure 1.—Trends in timberland area in the Northeast from 1952 to 1987 with projections to 2010 (New England and Mid-Atlantic subregions).

The virgin forests of the East were gradually cut for homesites, building materials, fuel, and agriculture. This cutting continued at an increasing rate as greater numbers of European emigrants arrived. In Vermont, 70 percent of the land was cleared for sheep and cattle pasture by 1885. Competition from midwestern and western agriculture soon reversed this trend. By the late 1800's and early 1900's, forests rapidly reclaimed much of the Northeast. Many of the hill farmers in the Northeast moved west to farm the flat, more productive lands of the midcontinent. The hill farms were abandoned to the encroaching forest. The more productive soils continued to be used by dairy farmers to supply products to growing cities like Boston and New York. As production costs continued to rise faster than milk prices, many of these dairy farms went out of business—a process that continues today as open land is converted to forest (Fig. 1).

Wood-using industries, developed after the initial period of farm abandonment, used the remaining white pine and second-growth forests. For the most part, these new forests were high-graded for their best stems or were clearcut, producing forests of poor quality and low productivity (Kingsley and Barnard 1968; Hewett 1978; Gould and Reidel 1979). Even so, recent forest inventories indicate that New England's resilient woodlands have bounced back to a remarkable state of health and vigor. On average, growth on surviving trees plus ingrowth of new trees to the timber base is about 2.2 percent of inventory per year; removals average 1.2 percent. So growth is nearly double removals and growing-stock volume continues to increase (Gansner and others 1988).

Some forest land in this region continues to be converted from timber production to other uses. Urban and suburban communities use forest land for residential and commercial purposes. The construction of winter and summer recreation resorts, vacation homes, and activity centers also continues to remove land from forest production. Such development pressures may continue in the decades ahead.

Literature Review

There has been a great deal of national concern over the disposition of NIPF lands in the Northeast. Collectively, 7.8 million private owners hold 58 percent of the Nation's timberland, a total of 300 million acres (Birch and others 1982). In the Northeast, where forests cover 66 percent of the region (Table 1), the percentage of forest land in private ownership is especially high, ranging from 75 percent in New Jersey to 97 percent in Maine (Table 2). Most of this private ownership is in NIPF lands (Fig. 2). Maine, Maryland, New York, Pennsylvania, New Hampshire, and Vermont have significant forest industry ownership. Maine has the highest, with forest industry owning 49 percent of the state's timberland (Table 2).

Some believe that industry and government have little control over the supply of forest resources growing on

Table 1.—Forest land in the Northeast (thousands of acres)

State or region	Total land area	Total forest land	Percent or state forested	Timber-land	Percent of forest land in timberland
Connecticut	3,177.8	1,825.7	59	1,777.3	97
Maine	19,836.8	17,607.4	89	17,060.2	97
Massachusetts	5,007.6	3,225.2	64	2,929.4	91
New Hampshire	5,755.5	4,987.2	87	4,812.1	96
Rhode Island	675.1	404.8	60	371.7	92
Vermont	5,934.7	4,544.4	77	4,422.1	97
New England	40,327.5	32,594.7	81	31,372.8	96
Maryland	6,295.5	2,703.3	43	2,424.0	90
New Jersey	4,779.5	2,006.7	42	1,864.3	93
New York	30.234.8	18,506.2	61	15,405.8	83
Pennsylvania	28,778.2	16,825.9	58	15,923.7	95
Mid-Atlantic	70,088.0	40,042.1	57	35,617.8	89
Total or average	110,415.5	72,636.8	66	66,990.6	92

Table 2.—Ownership of private timberland in the Northeast

State or region	Timberland	Privately owned	Forest industry	NIPF owned
	Percent			
Connecticut	57	88	<0.5	100
Maine	86	97	49	51
Massachusetts	58	85	3	97
New Hampshire	84	86	16	84
Rhode Island	55	88	1	99
Vermont	75	90	10	90
New England	78	93	32	68
Maryland	39	90	6	94
New Jersey	39	75	<0.5	100
New York	51	94	7	93
Pennsylvania	55	78	8	72
Mid-Atlantic	51	86	7	93
Regional average	61	89	19	81

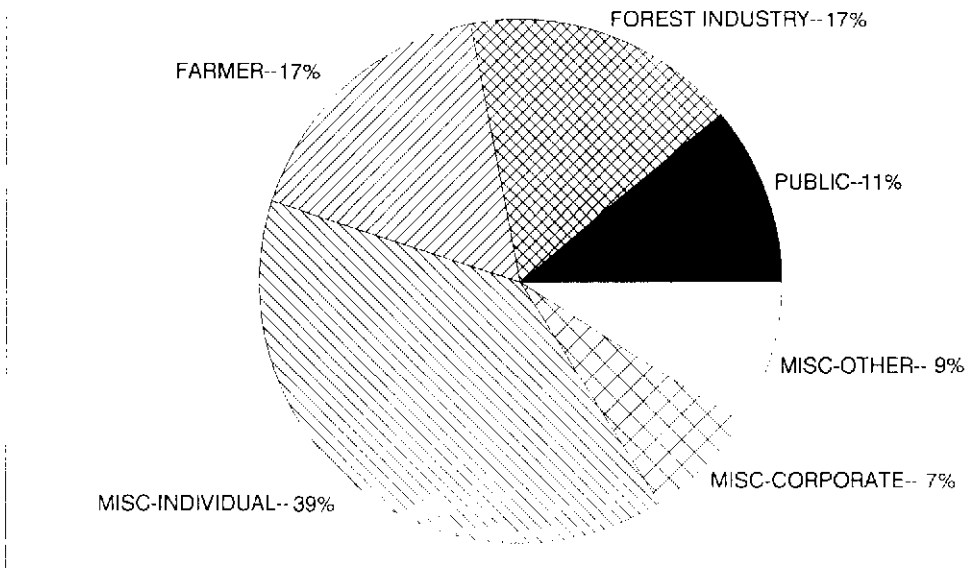

Figure 2.—Timberland area in the Northeast in 1987, by ownership category.

NIPF lands. Some of this stems from a lack of success in persuading NIPF owners to practice sound forest management despite millions of Federal, state, and private dollars spent to encourage these practices. This failure is partially explained by resource factors associated with NIPF holdings: 1) diverse ownership objectives, 2) ambivalent attitudes toward cutting timber, 3) diminished parcel sizes, 4) unfavorable economies of scale for timber production, and 5) short tenure of ownership.

Several researchers have discussed the availability of forest products from NIPF lands. A few have analyzed the availability of fuelwood since the energy crisis of 1973-74. Most make no distinction between forest-products data in general and fuelwood as a specific product. It could be assumed that the landowner will not make a distinction between the removal of one forest product versus another.

In Michigan, the sale of fuelwood was a function of parcel size and the existence of additional nonmonetary incentives to harvest, such as woodlot improvement, wildlife habitat enhancement, and land clearing (Parker 1984). Several authors refer to "parcel size" and "other benefits" as important criteria for fuelwood availability. The most important of these is the size of the woodlot. It is well established in the literature that as the size of the forest ownership decreases, landowner interest in selling fuelwood and other forest products diminishes (Canham 1985). Except for Maine, New Hampshire, and Vermont, the average NIPF parcel size in the Northeast is about 25 acres (Fig. 3). The most common size is fewer than 10 acres while the majority of private timberland is in larger parcels (Fig. 4).

Goals and attitudes toward forest use vary with the type of forest ownership (Fig. 5). Palmer and others (1980) believe that the resulting diverse ownership policies provide a poor basis on which to establish a regional energy supply because the market lacks control over the disposition of NIPF lands. Other studies revealed that a majority of the NIPF owners show a lack of interest in selling wood products from their land. A study of Illinois landowners by Young and others (1985) found that the personal use of fuelwood grown on their lands was the fourth most important reason why landowners hold forest land. Yet, producing income from the sale of timber products was the least important reason. The authors concluded that the personal use fo fuelwood from these lands was certain but that the supply of fuelwood to the market was doubtful.

A study on the availability of biomass in New York by Montieth (1981) found that New York's forests could supply 25 million dry tons a year on a sustained-yield basis for 20 years, but that this volume alone could not meet the energy demands of the state. Additionally, wood was considered a transitional fuel at best and its availability depends on the policies and attitudes of the private landowner. Another biomass-availability study conducted in Vermont's nine northern most counties sought to determine if the availability of wood was adequate to supply a 50-megawatt power plant planned for the City

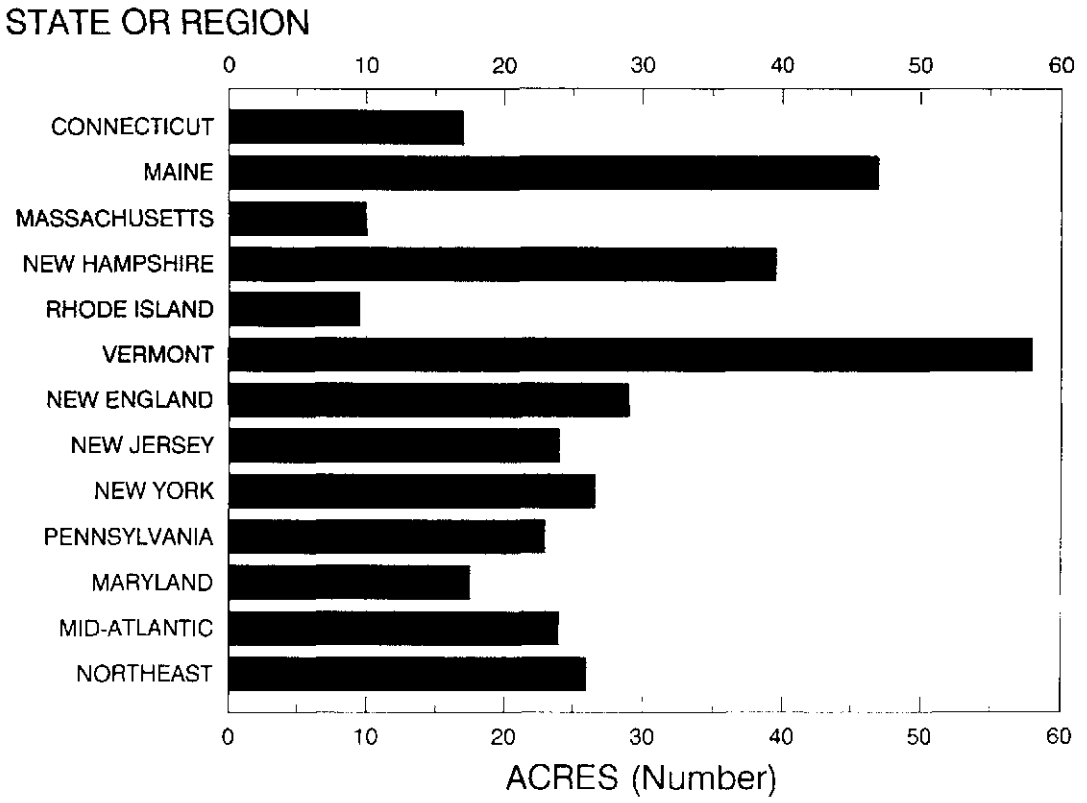

Figure 3.—Average size of NIPF ownership in the Northeast, by state and region.

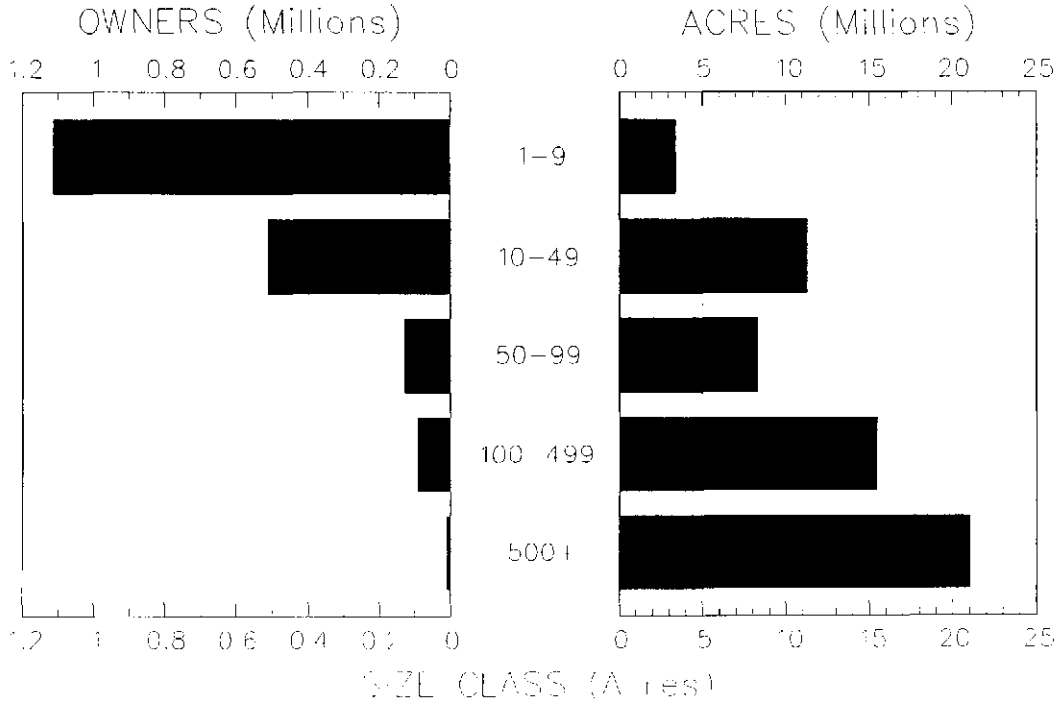

Figure 4.—Distribution of private ownerships in the Northeast, by size class of ownership.

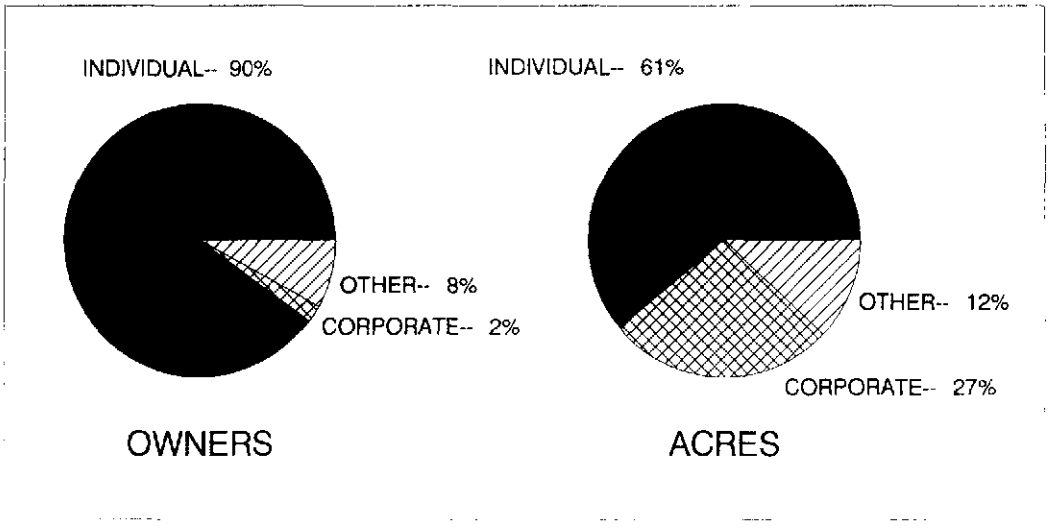

Figure 5.—Distribution of private ownerships in the Northeast, by form of ownership.

of Burlington (Hewett 1978). In the study area, 45 percent of the woodland was found to be economically unavailable for harvest because it is more than one-half mile from a road and its slope is greater than 15 percent. Despite these factors, there still was enough economically and institutionally available wood in the study region to supply the power plant, though the current cutting rate in the area would have to double. Ninety-three percent of the cut would have to come from private lands, and the willingness of the private landowner to sell wood chips to the plant would be critical to its success. Hewett stressed that he had the least confidence in his estimate of the volume of wood chips available from private land to supply this particular outlet.

The availability of fuelwood is affected by a complex system of social, physical, and economic forces that are not necessarily overcome by higher fuelwood prices (Gilbert and others 1987). For example, not all NIPF owners share the same woodland values as foresters. Canham (1985) pointed out that the New York landowners he interviewed hold land as a consumptive good for self-satisfaction rather than as a means of making a profit from selling stumpage. Other than those holding larger units (more than 200 acres), the study participants owned their land for leisure pursuits or for investment or residential purposes. In "Land in America: Commodity or Natural Resource?," Andrews (1979) discusses the economic evolution of land from a resource to a commodity. At some point, he states, when the nonresource values of forest land exceed forest (timber?) resource values, the land is no longer held for resource production but for the commodities associated with urbanization and development. Gould and Reidel (1979) believe that forests in the Northeast are being decimated by changes in agriculture, exploitive logging, and uncontrolled development. They warn that forest land in the region is being fragmented into even smaller tracts as that resouce is being transformed into a commodity. When this occurs over a wide area, it is both physically and economically difficult to practice forestry. Add to this the apparent lack of desire on the part of new landowners to sell forest products and you now must depend on a large number of nonindustrial private forest-land owners holding small tracts to supply fuelwood to the continually urbanizing Northeast.

These and other researchers have expressed the hope that the energy crisis of the 1970's and early 1980's would stimulate NIPF owners to improve their woodlots while producing fuelwood as a byproduct. Some timber stand improvement work was accomplished but not at levels sufficient to improve a significant number of forest acres. The major reason for this is that the energy crisis ended in 1984. Whatever incentives NIPF owners had to improve their woodlands and supply fuelwood were mostly lost to a deflated petroleum market brought on by sharp decreases in the price of foreign oil, which once again became the prime energy source in the Northeast.

Forest Service Survey Data

The Northeastern Forest Experiment Station has conducted landowner and forest surveys in each of the Northeastern States. In the course of this research, information has been obtained about landowner attitudes and forest characteristics, and estimates of timber availability have been made. Recent findings from these surveys are important to this study.

Ownership change in Connecticut, Massachusetts, New Hampshire, Rhode Island, and Vermont between inventories conducted in the early 1970's and 1980's has seen the average size of ownership decrease from 28 to 20 acres. As the forest is subdivided into smaller parcels, the opportunity for using timber harvest to support other ownership objectives is reduced. At the same time, interest in wood for fuel has significantly altered the harvest experience and intention to harvest of forest-land owners. The previous survey showed that 66 percent of the owners never intend to harvest timber. These owners controlled 24 percent of the forest resource. A decade later, 29 percent of the owners did not intend to harvest and they own only 9 percent of the private forest acreage. Owners intending to harvest in the next 10 years rose from 10 to 45 percent of all private owners. The acreage owned by owners intending to cut in the next 10 years rose from 40 to 75 percent (Brooks and Birch 1988; Kingsley 1976; Kingsley and Birch 1977).

New Hampshire and Vermont

The new data from New Hampshire and Vermont show that the owners take an active interest in their forest lands and hold no negative feelings toward timber harvesting. Owners have made an effort to improve the timber quality of their woodlands. The availability of a market for low-grade material or for their own use for fuel has stimulated management activity. Amenity values remain important to these landowners. Advocates of timber management have kept the nontimber objectives of these landowners in mind (Widmann and Birch 1988; Birch 1989).

Maine

With its highly developed forest industry, Maine has nearly 10 million acres of private timberland owned by people with timber production as their primary reason for owning forest land (Birch 1986b). Forest owners in Maine are interested in harvesting trees from their land and are growing more timber than is currently being used. Also, it is estimated that nearly 40 percent of Maine's NIPF land would be under management if the owners of more than 500 acres could be persuaded to manage their woodlands. The 1,500 large NIPF ownerships willing to harvest in the next 10 years control more than 3 million acres of timberland (Birch 1986b):

Size class (acres)	*No. owners who plan to harvest*	*No. acres available*	*Percent of acres available*
1-49	48,000	669,000	10
50-499	22,400	2,450,600	39
500+	1,500	3,234,200	51

New York

In New York, 42 percent of all private forest land is owned by people who intend to harvest in the next 10 years (Birch 1983). NIPF owners with 50 or more acres of forest land control 78 percent of the NIPF land available:

Size class (acres)	*No. owners who plan to harvest*	*No. acres available*	*Percent of acres available*
1-49	97,700	1,131,300	22
50-499	21,000	2,434,500	48
500+	800	1,529,100	30

A significant number of New York landowners, particularly those holding fewer than 50 acres of forest land, will harvest wood products for their own consumption. This personal supply and consumption may significantly reduce total demand but may not contribute energy to the general market. Again, the relatively few owners with more than 500 acres of forest land can contribute significant amounts of wood.

Pennsylvania

The NIPF owners of Pennsylvania, like their counterparts throughout the Northeast, hold forest land for reasons other than timber production (Birch and Dennis 1980). Most seem to receive little monetary benefit from their woodlands but continue to hold them for nontimber values. At the time of the 1978 survey, changing social, economic, and energy demands made it difficult to predict resource availability of industrial timber products from this class of landowner. Timber availability from Pennsylvania's NIPF lands was divided into two classes: more than and fewer than 500 acres of forest land. The 100 NIPF owners with more than 500 acres who intend to harvest in the next 10 years control 44 percent of the available acreage; the remaining acreage is controlled by 38,000 owners:

Size class (acres)	*No. owners who plan to harvest*	*No. acres available*	*Percent of acres available*
1-499	38,000	1,516,800	56
500+	100	1,192,900	44

Maryland

The NIPF owners of Maryland are extremely diverse in supplying forest products to the market. Most of the 95,800 forest-land owners in this highly urbanized state have little interest in harvesting timber (Kingsley and Birch 1980). About 75 percent of them own their forest for residential, farm, investment, or esthetic reasons. By contrast, nearly one-quarter of the private timberland in Maryland is owned primarily for timber production. Owners who indicated a willingness to harvest timber hold 1.6 million acres. Because owners of 805,000 acres have received forest management assistance, there is potential for a significant increase in professional guidance in harvesting operations. Maryland includes areas where timber removal rates were greater than can be sustained from available supply. Therefore, it is important that NIPF owners be involved in forest management to bring about a new balance of supply and demand.

Although 44,900 owners indicated a willingness to harvest timber, only 7,900 planned to harvest in the next 10 years. These 7,900 owners hold 619,200 acres of forest land:

Size class (acres)	*No. owners who plan to harvest*	*No. acres available*	*Percent of acres available*
1-499	7,800	337,500	55
500+	100	281,700	45

Another estimate of availability based on previous harvest experience indicates that 22 percent of the owners have harvested from their woodlots; these owners controlled 1.2 million acres. Of this total, 479,400 acres were owned by those who intend to harvest in the next 10 years. The remaining acreage was owned by people who plan to harvest in the future.

New Jersey

New Jersey's timberland is extremely fragmented. The data collected for this state were gathered before the energy crisis, so owner intentions and objectives might have changed radically. Nearly 50 percent of the timberland was owned by people whose objectives were recreation and investment (Kingsley 1975). Little forest land in New Jersey was held primarily for timber production, though 41 percent of the owners were willing or planned to harvest timber in the future. The acreage owned by those planning to harvest in the next 10 years was nearly equally divided between owners who had harvested in the past and those with no harvest experience:

Harvest experience	*No. owners who plan to harvest*	*No. acres available*	*Percent of acres available*
Have cut	2,000	118,400	48
Have not cut	8,500	127,300	52

One conclusion from the study was that the greatest values of forest lands in suburban and rural areas of New Jersey are the amenities they can bring to a community.

Northeastern Station researchers have made significant attempts to predict NIPF acreages and volumes available for cutting in the Northeast. They acknowledge that many owners are undecided about future harvests despite past harvest experience. In states where follow-up studies have been conducted since the energy crisis, researchers found increased numbers of owners with harvest experience and increased timber availability. How long this positive response will continue without high oil prices remains to be seen. Also, what one landowner plans to do with his or her woodland probably will not be continued by the next owner of that parcel.

The overall conclusion of this literature review is that as urbanization incrases, the availability of commercial wood products from NIPF lands decreases. Some of this is the result of the decrease in parcel size and an increase in fractionalization. In highly urbanized states, private forests become personal, private recreation areas and, eventually, space for urban development.

Problems Associated with Physical Availability of Wood

There is a common misconception that the vast forest acreage in the rural Northeast is biologically, physically, and socially homogeneous, and that one set of economic, legal, and technical rules can govern it all. It is further assumed that access to the fuels market is relatively simple since fuelwood requires no further manufacturing after it is cut to length and split. This erroneous perception quickly changes when one makes serious attempts to utilize wood for energy. Problems develop when one attempts to purchase fuelwood stumpage, harvest the standing trees, transport the raw material to a distribution point, prepare the product in a form for energy consumption, and deliver the product to a customer. When the wood is burned, the consumer must then deal with combustion byproducts for an extended number of heating seasons.

An analysis of the forest lands of the Northeast refutes the assumption of homogeneity. Northeastern forests are made up of the following forest types: northern boreal (spruce-fir), northern hardwood (maple-beech-birch), central hardwoods (oak-hickory), and eastern conifers (pine-hemlock). Density of forest cover ranges from 89 percent in Maine to 43 and 42 percent in Maryland and New Jersey, respectively (Table 1). Most forest lands in the Northeast are fully stocked to overstocked with growing-stock trees. Only 3 percent of New England forests is considered poorly stocked. In Vermont, however, rough and rotten trees comprise 22 percent of the standing timber in trees 5.0 inches in d.b.h and larger (Frieswyk and Malley 1985b).

A typical process for converting growing wood into BTU with no byproducts requires 16 handling operations. The process begins with felling a tree. Its top is removed and the portion useful for fuelwood is skidded to a landing. The topped and limbed portion then is cut for hauling, and the fuelwood log is loaded for transport. At a more convenient location, logs are cut into burnable lengths and the wood is split, loaded, and delivered to the consumer. Next, the consumer stacks the wood for drying, restacks it near a wood-burning appliance, and then feeds the wood into the burning unit. Finally, ashes are removed and stored for disposal.

Site factors such as terrain and location can limit the availability of fuelwood. As much as 25 to 30 percent of the forests in the region's more mountainous states, like New Hampshire and Vermont, are on slopes greater than 15 to 20 percent, which limits the use of some logging equipment (Hewett 1978). Physical obstructions such as cliffs and rock outcrops make other timber stands inaccessible. Forest soils also can be limiting factors by creating erosion and operating hazards (Montieth 1981). And wetlands can affect the cost of fuelwood because they act as physical barriers to harvesting.

The distance from the forest stand to a major haul road is an economic limitation placed on fuelwood availability. The maximum economic skidding distance varies by logging site, region, and the price paid for the delivered product. An optimal skidding distance might be 1,200 to 1,800 feet with a maximum limit of 4,000 feet (Conway 1976). Others maintain that 600 feet is an ideal skidding distance with an economic maximum of one-half mile (Rich and others 1979). The quality, density, and length of roads to market are critical to the profitability of the fuelwood operation (Montieth 1981). After the cut stumpage is skidded to roadside, it must be hauled efficiently to a distribution point or directly to the consumer. Fuelwood stumpage does not command a high price—$5 to $10 per cord (128 cubic feet). It has low value because cutting and removal are labor intensive. Fuelwood is bulky and heavy to transport, and, once split, takes up to a year to dry before it can be burned. Low stumpage prices discourage landowners from placing their fuelwood on the market, limiting overall availability.

Environmental Problems and Use of Wood for Fuel

Several environmental impacts are associated with using wood as a fuel. Steep slopes and certain types of soil can contribute to severe erosion when logging operations are conducted haphazardly. If not drained properly, main haul roads can become water courses that transport soil off the harvest site. Similarly, skid roads that are used to haul trees to landings (accumulation points) severely disturb the forest floor. This can lead to gully erosion. Erosion also can lead to stream siltation that is detrimental to both humans and animals. Most of these impacts can be prevented so long as effective soil erosion and road-building practices are followed.

Fuelwood harvesting also can have adverse impacts on forest esthetics ranging from slight to severe. Fuelwood harvesting generally is acceptable esthetically because harvesters commonly use stems down to 4 inches in diameter. As a result, less visible residue is left in the woods. Yet, many landowners refuse to have their forest cut despite relatively minor disturbances. In fact, logging can be an instrument for enhancing esthetic values by opening dense stands and accenting the pleasing characteristics of residual trees. Large clearcuts that are visible from great distances, are unnecessary and should be avoided (Pecoraro and others 1977; Montieth 1981; Rich and others 1979).

Problems with fuelwood use are experienced at the combustion site. Byproducts from the incomplete combustion of wood include carbon monoxide, particulates, hydrocarbons, and oxidants (Pecoraro and others 1977). Dry wood contains carbon, hydrogen, sulfur, oxygen, nitrogen, and an ash residual (Fernandez 1976). Air pollution associated with burning wood is considered as minimal so long as control devices for particulate pollution are installed in the stack of the wood-burning device (Pecoraro and others 1977) and so long as the device is properly maintained and adjusted (Palmer and others 1980). Wood ash, another byproduct of wood burning, creates a disposal problem not associated with oil, gas, or electric heat. However, wood ash causes little environmental damage when disposed of properly at an appropriate site. Residual ash can be recycled into soil as a plant nutrient. Such use reduces much of the bulk that otherwise must be disposed of at a central location (Palmer and others 1980).

Other combustion problems relate to the bulk and weight of fuelwood and the necessary increased cleanup of dirt and bark. These, along with ash and dust deposits, make wood a disagreeable fuel to many homeowners. Most wood-burning devices also require continual manual filling, kindling, and ash removal, in other words, frequent and inconvenient fuel handling.

Finally, there is a greater risk of structure fires with wood than with most other types of fuel. Improper installation of wood stoves and exhaust pipes, failure to clean creosote buildup, and direct contact with open flames during fueling, ash cleaning, etc., present opportunities for fire to escape a fire box and cause serious structural damage and even loss of life.

Indicators of Social Availability of Fuelwood

The more forest land an individual owns, the more likely he or she is to manage timber actively (Webster and Stoltenberg 1959; Thompson and Jones 1981). Even in the heavily populated Northeast, most owners of more than 500 acres of forest land intend to harvest timber from their land in the future. Other indicators of interest in forest management are length of ownership and numbers of owners who have sought forestry assistance.

Table 3.—NIPF owners who harvest firewood and the acreage they control, by size of ownership

State	Type of use	Size class (no.) 1-49 acres	50-499 acres	500+ acres
		OWNERS (Thousands)		
New York		110.0	11.3	0.2
Maine	Personal	46.4	21.8	1.0
	Sale	3.0	6.2	.8
New Hampshire	Personal	31.2	10.6	.4
	Sale	2.0	3.5	.3
Vermont	Personal	20.0	12.4	.4
	Sale	1.7	4.5	.3
		ACRES (Thousands)		
New York		1,026.6	1,132.4	382.1
Maine	Personal	636.0	2,370.5	673.6
	Sale	84.4	790.2	2,691.8
New Hampshire	Personal	357.4	1,241.2	396.2
	Sale	64.3	441.8	394.4
Vermont	Personal	334.6	1,505.7	355.1
	Sale	52.0	651.4	447.8

Recent studies in the Northeast indicate that size of ownership has a direct influence on what forest products are harvested (Birch 1983, 1986b, 1989; Widmann and Birch 1988). NIPF owners with fewer than 50 acres are most likely to have harvested firewood (Table 3). Many fuelwood harvesters cut firewood in conjunction with the harvest of a commercial product. There also are differences by size class as to whether firewood is cut for personal use or for sale (Birch 1986b; Widmann and Birch 1988; Birch 1989).

The length of NIPF ownership should be considered when discussing management of these lands. In New England, 25 percent of the private forest land has been in the same ownership for more than 40 years. In Vermont, the average length of ownership is about 12 years (Kingsley and Birch 1977; Armstrong 1975; Sinclair and Mayer 1972). Fuelwood provides an opportunity to manage for a product in a short period. Timber stand improvement can now yield a cash return or a product the owner can use.

Another indicator of potential interest in producting wood products is the increased use of professional forest management services. In New Hampshire and Vermont, those using the services of a professional forester increased by 70 percent from 1973 to 1983 (Kingsley and Birch 1977; Widmann and Birch 1988; Birch 1989). Nearly two-thirds of the private forest land in these two states is controlled by people who had professional forestry assistance. But there is still room for improvement. In the Tug Hill region of New York, only 16 percent of the owners who harvested timber had a written management plan prepared by a professional forester (Canham 1985); an additional 16 percent intended to have a forester develop a plan. It should be pointed out that it is the owners of larger tracts who take advantage of professional forestry services.

A final observation on how the knowledge of forest-land owners in New England has changed: in the prior survey, a majority of the owners stated they did not know a source of forestry advice and assistance (Brooks and Birch 1986). Although owners of mostly small acreages, they nevertheless controlled a significant timberland area. About 10 years later, nearly 60 percent of owners are aware of the public agencies that are sources of forestry assistance (Brooks and Birch 1988).

Reasons for Owning Woodland

Ownership studies by Northeastern Station researchers have identified six primary reasons for owning timberland: land investment, recreation, timber production, farm and domestic use, residence (including esthetics), and "other" (Fig 6). In every northeastern state, residence was the most common reason for ownership, followed by land investment (by owners in New Jersey, Connecticut, New Hampshire, and Maryland). Recreation is another popular reason for owning forest land in the Northeast; sport and recreation clubs are an important ownership component in Pennsylvania and New York (Birch and Dennis 1980;

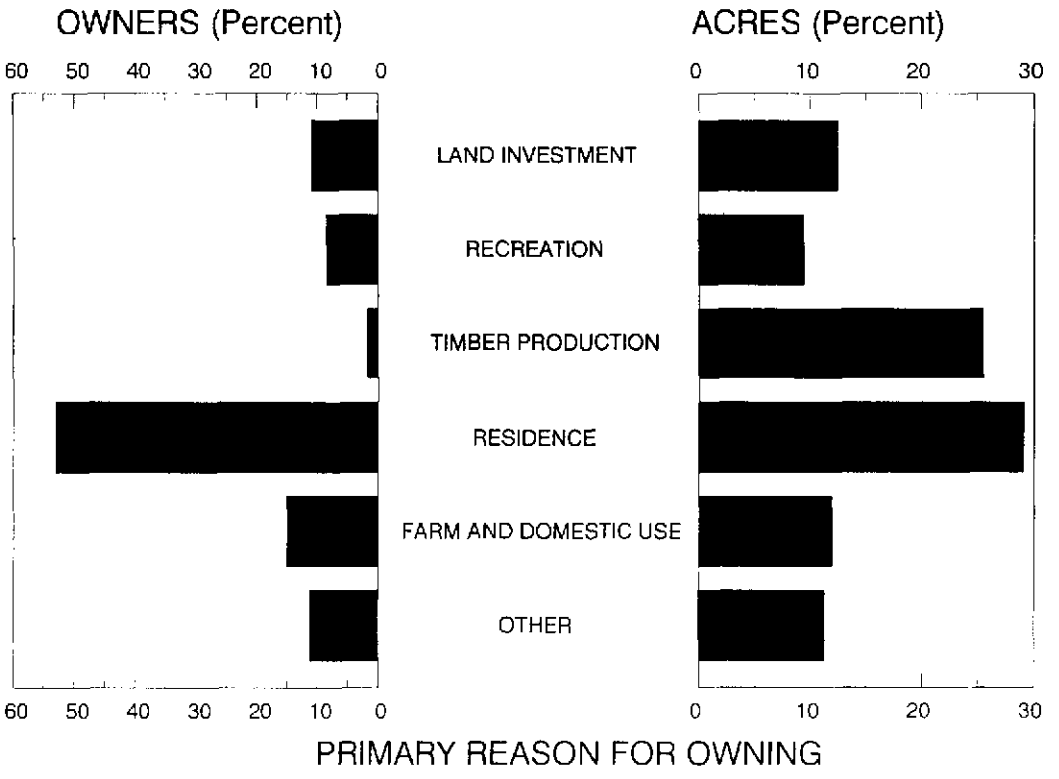

Figure 6.—Distribution of private ownerships in the Northeast, by primary reason for owning forest land.

Birch 1983). In New York, more than 80 percent of the land in this category is owned by people who have harvested timber from their lands. Many owners can be shown that harvesting timber can be an important tool for managing wildlife habitat.

Many owners own their forest land for farm or domestic use (including firewood). Because farming is the primary use of property in many of these ownerships, growing timber for sale is of secondary importance. For example, in New York, 19 percent of the private forest land is held by owners who see timber production as their second objective. If this land is added to the area where timber production is the most important reason for owning, then 5.6 million acres is held by people who show some interest in timber management. Few NIPF owners in the Northeast own forest land primarily for timber production, but a significant amount of private forest land in the Northeast is held with this objective. Corporations owning sizeable acreages of forest land in the region have other objectives, such as subsurface mining (minerals, coal, oil, and natural gas). Under current market conditions, the incentive to sell wood will remain low.

Past and Future Cutting Practices

The past harvesting activities of NIPF owners and their future plans have been investigated to gain a better understanding of timber availability and owner attitudes toward the sale of fuelwood. Their reasons for cutting or not cutting also have been analyzed. The percentage of NIPF owners who have cut wood products from their land varies considerably from state to state. Some of this variation can be attributed to the time when the data were collected, as harvest experience has increased in recent years. For example, in 1973, only 24 percent of the landowners in New Hampshire and Vermont had harvested timber (Birch and Gansner 1989).

The 1983 data for these same states indicate that 58 percent have harvested some trees from their land. Private forest land owned by people who have harvested increased from 65 to 82 percent. In response to energy demands, 86 percent of the owners who have harvested cut some fuelwood for their own use. Across the 10-state region, nearly 40 percent of the landowners have harvested forest

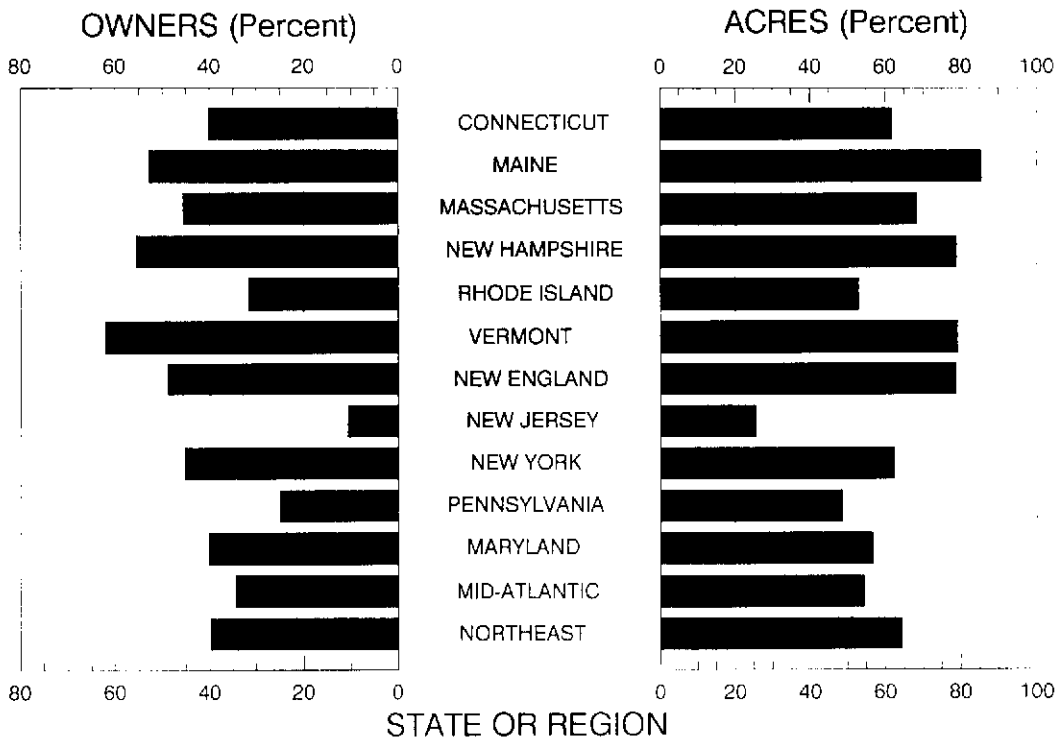

Figure 7.—Distribution of owners in the Northeast who have harvested forest products from their forest land, by state and region.

products from their land (Fig. 7). Collectively, these owners control approximately 64 percent of the NIPF acreage.

Future harvest plans of landowners provide an important insight into the volume of fuelwood that will be available to future markets. Twenty-six percent of the NIPF owners in the Northeast expect to harvest trees from their lands in the next 10 years and 32 percent expect to do so in the future (Fig. 8). Together, these people control nearly 80 percent of the NIPF acreage in the Northeast. New Hampshire and Vermont provide an example of how intentions to harvest can change. In 1973, 10 percent of the owners intended to cut in the next 10 years (Fig. 9). This proportion increased dramatically to 58 percent in 1983 (Birch and Gansner 1989). And an additional 22 percent of the owners may cut in the future. These two groups currently hold 90 percent of the private timberland in the two states.

The consumption of fuelwood by Vermonters is declining. In the winter of 1981-82, 53 percent of Vermont households burned wood for heat, but in the 1983-84 season this percentage fell to 46 while cordwood consumption fell 21 percent (State of Vermont 1980-86). Apparently, the fuelwood market in the Northeast is highly sensitive to the price of alternative fuels.

Landowner reasons for harvesting also provide insight into the availability of fuelwood from NIPF lands. Common reasons for harvesting include woodlot improvement, timber salvage, offered a good price, needed money, needed wood for own or company use, and land clearing. The

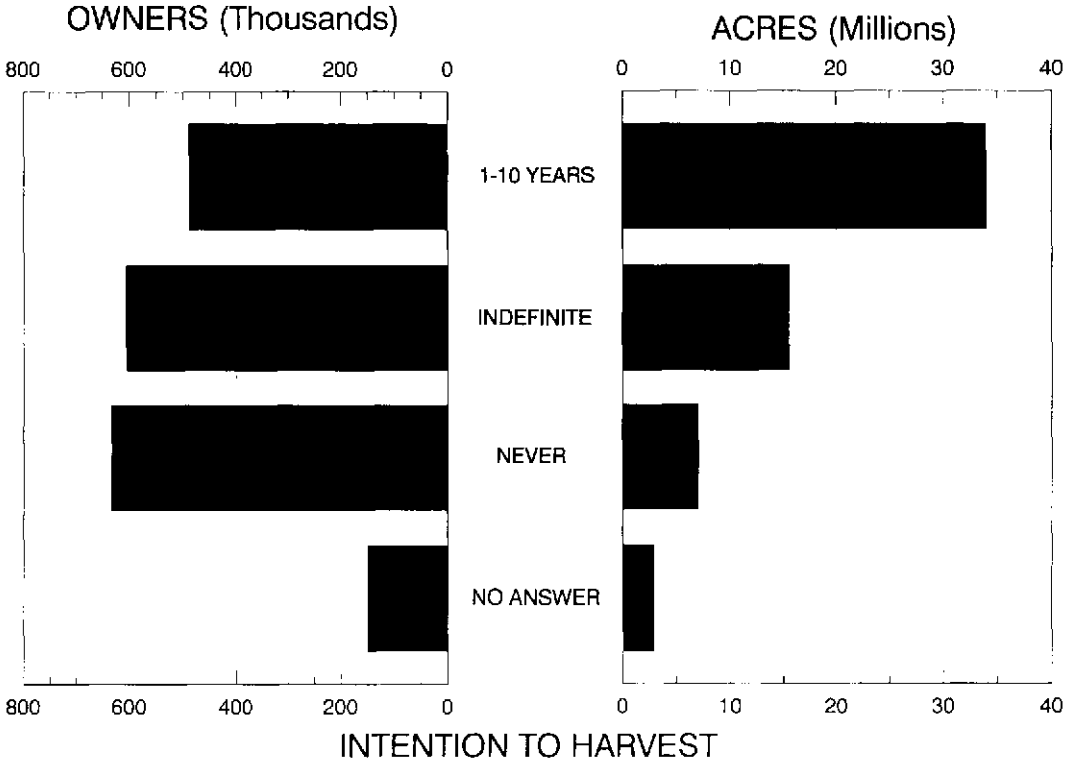

Figure 8.—Distribution of NIPF ownerships in the Northeast, by attitude toward harvesting timber.

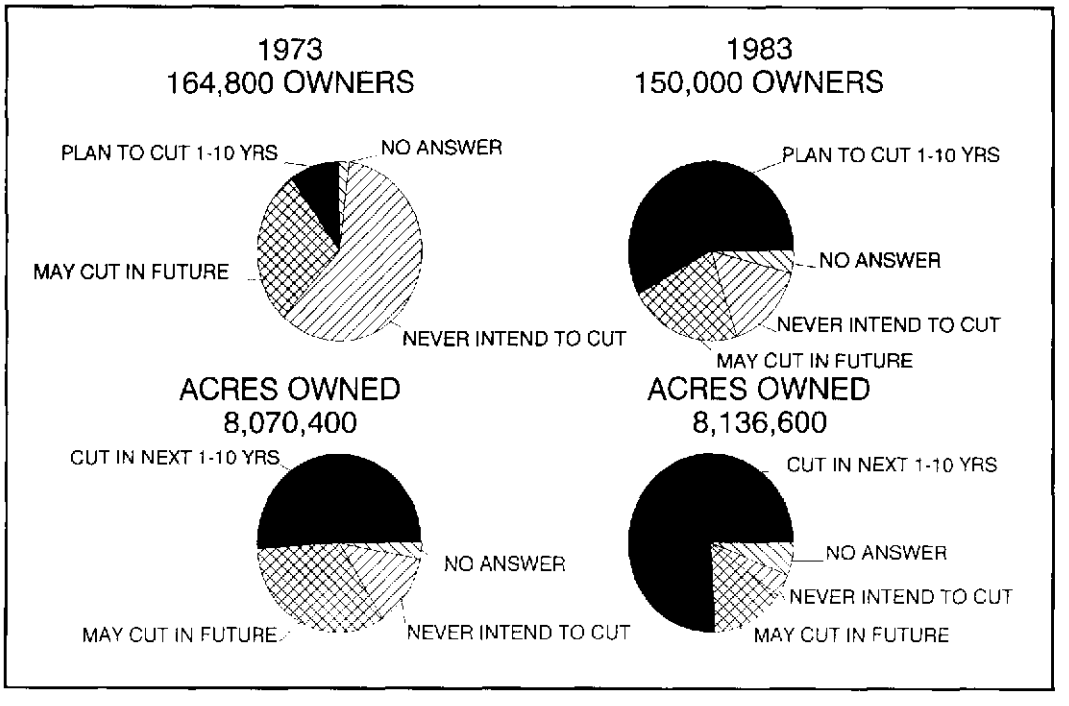

Figure 9—Change in intention of private owners to harvest timber in the future, New Hampshire and Vermont—1973 and 1983.

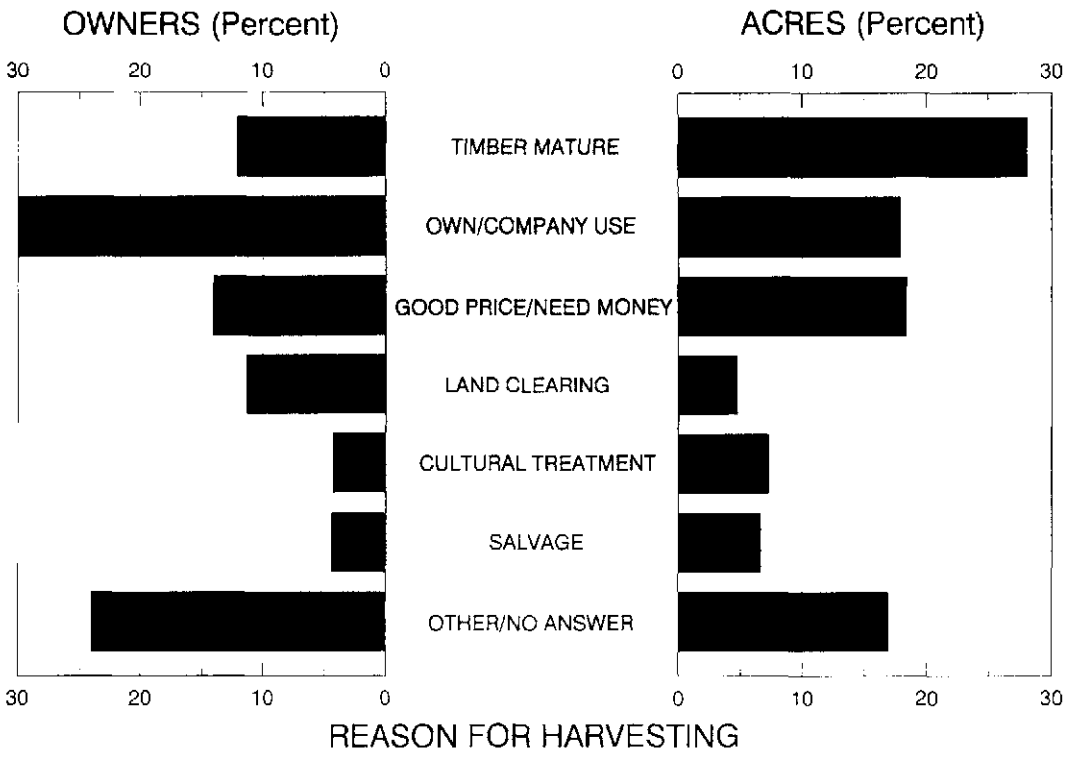

Figure 10.—Distribution of NIPF owners in the Northeast who have harvested timber, by reason for harvesting.

reason given most often by NIPF owners was that the timber was needed for their own use (Fig. 10). Most of these owners hold fewer than 50 acres of forest land, and many are cutting firewood for their own use. Owners who harvested because their timber was mature control the largest percentage of acreage—this reason was given most often by owners with 50 or more acres of forest land. Sawlogs were the product harvested most often by these owners.

Many owners who have harvested indicated they cut because they needed money or they were offered a "good price." These two reasons are similar and often overlap. All of the reasons cited for harvesting produce timber or fuelwood in the Northeast. Cultural treatments and timber salvage may produce fuelwood for sale, but it is important to recognize that even wood that is consumed for personal use reduces the region's need for energy from outside sources. Tree removal for land clearing may result in the sale of harvested products to the market, but this is a one-time event. It is important to note that owners with harvesting experience are more likely to harvest in the future. Therefore, owners should be shown how harvests can be sustainable in the future.

Approximately one-third of the NIPF owners in the Northeast never plan to harvest. These owners control about 12 percent of the private forest land in the region. While the number of owners who do not intend to harvest has declined in the years since the energy crisis, many of those remaining in this group do not intend to harvest for philosophical reasons (Brooks and Birch 1988). Previous surveys indicate that a lack of interest in harvesting was frequently supported by a concern about the maturity of the stand. Today, fears about the scenery being destroyed and a basic opposition to harvesting are becoming dominant concerns.

Northeastern forest-land owners have many reasons for not harvesting trees from their woodland. Some of these may result in the withdrawal of their land from the wood-products market during their tenure of ownership. However, these lands may become the property of another owner with a different objective. The reason given most often

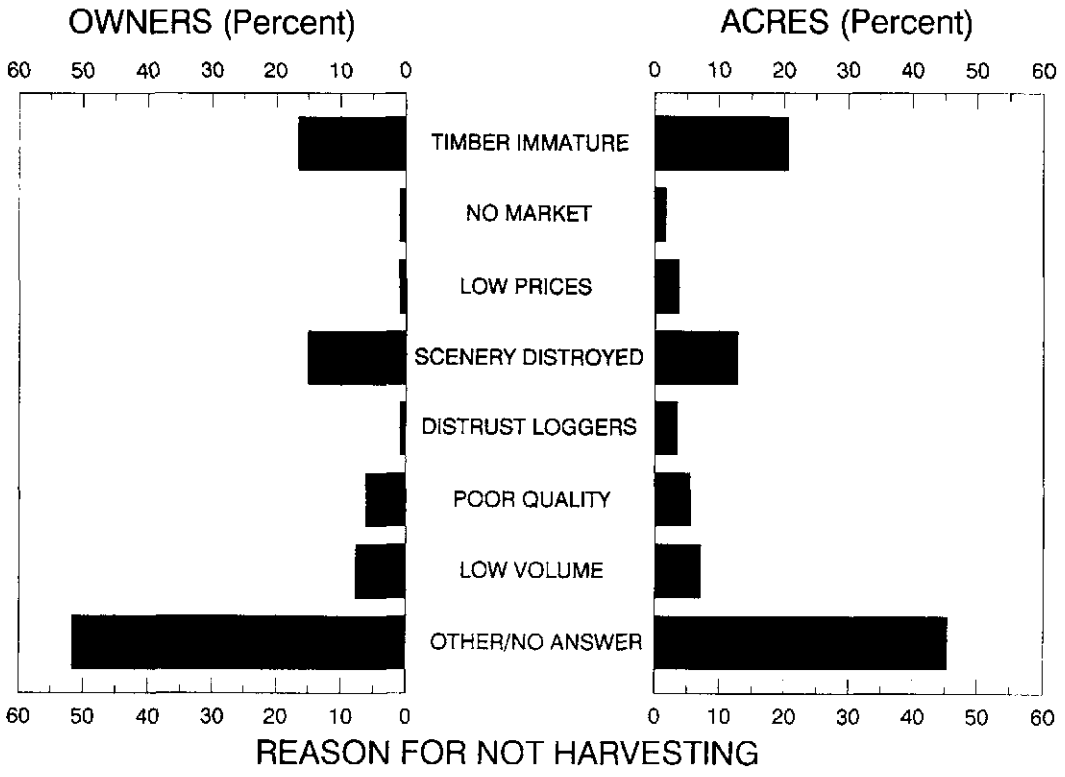

Figure 11.—Distribution of NIPF owners in the Northeast who have not harvested timber, by reason for not harvesting.

for not harvesting was that the timber was immature (Fig. 11). Many of these ownerships afford management opportunities to produce fuelwood and a better conditioned stand for other products in the future.

The next most frequently cited reason for not harvesting was that timber harvesting would ruin the scenery. The owners in this category hold an average of 13 acres of forest land. If the owner's residence is on the property, one can understand the concern that the forest land should retain its pleasant appearance. Owners who have not harvested for other reasons may be convinced by educational programs that managed harvests can be beneficial to wildlife and enhance other values. Similarly, distrust of loggers and lack of information on harvesting could be remedied by the services of a professional forester. Small trees or trees of poor quality generally do not preclude harvesting for fuelwood. Woodlot owners who cite these reasons might be interested in harvesting in the future.

Conclusions

Obtaining commercial (for sale) fuelwood from NIPF lands in the Northeast depends greatly on the following complex, dynamic, and interacting factors.

1. The availability of market fuelwood depends heavily on tract size. Owners of tracts 500 acres and larger have little reluctance to sell fuelwood and other timber products in the regional market. The efficiencies of size and opportunities for forest management tend to place them in the wood marketing business. These circumstances occur considerably less often for NIPF owners who hold 50 or fewer acres of forest land.

2. The demand for land to supply the expanding urban fringe in the densely populated Northeast results in woodland fractionalization and decreased tract size. This may result in a lower availability of market wood but also may result in more wood being cut to satisfy the owner's personal need for wood.

Eighty-eight percent of the NIPF owners each control fewer than 50 acres of forest land. Together, they own 31 percent of the NIPF forest land (Fig. 12). Among these owners, fuelwood for personal use is likely to be the product harvested.

The owner of 50 to 499 acres is the least predictable fuelwood producer. This category of woodland is likely to experience subdivision pressure. The 12 percent of the NIPF owners in this category control nearly half all NIPF

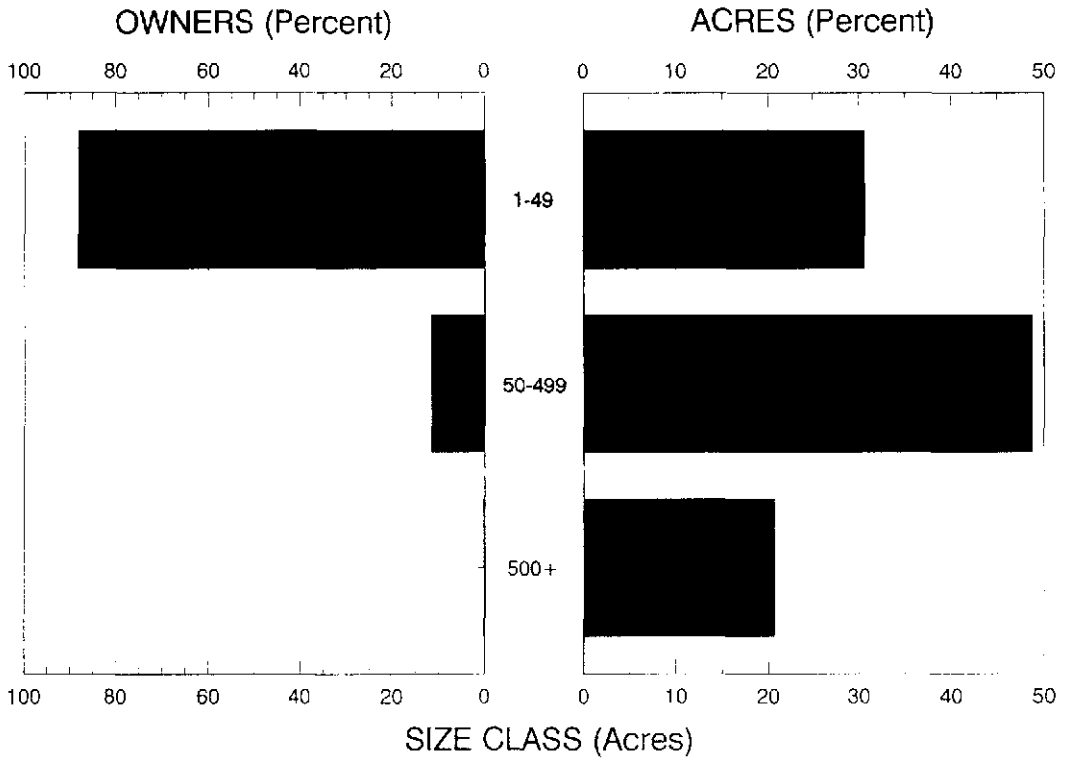

Figure 12.—Distribution of NIPF ownerships in the Northeast, by size class of ownership.

land in the Northeast. These are the owners who were most likely to have harvested fuelwood from their land. Many of these owners who harvested firewood for personal use cut it in conjunction with the harvest of another product such as sawlogs, fuelwood for sale, or another industrial product.

3. Most NIPF owners do not own their woodland primarily for timber production. Rather, the vast majority own woodland for purposes that range from residence to recreation. This does not mean that these people will not cut fuelwood (40 percent of the owners have harvested timber from their land in the past). Future harvesting of fuelwood will depend greatly on the price of alternative fuels. More than 25 percent of the private forest-land owners in the Northeast intend to harvest timber from their land in the next 10 years. These owners control 57 percent of the private forest land in the region. The diversity of owner intentions to harvest and their many objectives make it difficult to formulate a regional wood energy policy.

4. Nearly 40 percent of the Northeast's NIPF owners have held their woodland for fewer than 12 years. Depending on the tree species and forest products desired, this period is far short of the time required for most forest crops to reach maturity. However, the forests of the Northeast are becoming mature. Sawtimber-size stands have become dominant and many stands are fully stocked to overstocked with trees. Fully stocked and overstocked stands result in stagnant tree growth, increased tree mortality, and a poorly stocked understory. This presents an opportunity to get these stands under some form of management, at little or no cost to the owner, during their period of tenure. There is no guarantee that once sound management is initiated the new owner will continue the practice, but this should not prevent us from advocating strong forest management on NIPF lands.

5. Prohibitive logging terrain or excessive wetness may restrict fuelwood availability in some areas. In New Hampshire and Vermont, up to 30 percent of the forest land is on slopes greater than 15 to 20 percent. In these areas, harvesting may not be economically feasible given current logging methods and prices.

6. During the national energy crisis, when demand for fuelwood in the Northeast rose to its highest level in

recent history, fuelwood stumpage prices remained relatively stable at less than $10 per cord. Most NIPF owners were not stimulated to sell cordwood at those prices. Consumers received enough free or inexpensive wood from friends, family, and public woodlands or there were enough competing suppliers with access to ample wood supplies to keep stumpage prices low. The remaining consumers in the region were willing to pay the additional price associated with the convenience of burning oil or gas.

We conclude that before the demand for available wood increased to an unsustainable level and wood energy markets become fully established, the energy crisis of the 1970's dissipated. Cheap foreign oil again was delivered to the Northeast. A fuelwood market in the Northeast based on NIPF growing stock never reached a level to cause substantial increases in stumpage prices. If the price of oil had not declined, it is likely that fuelwood use and prices would have risen at least until the price per BTU for wood approached the price for oil.

7. Several state and regional studies have demonstrated that even if NIPF owners in the Northeast could be persuaded to sell firewood to a regional market, the supply would not meet the region's total energy needs for more than a few years. However, fuelwood could become an important energy supplement to tide over the region until alternative energy sources are developed.

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Describes factors affecting the availability of fuelwood from nonindustrial private forests (NIPF) in the Northeast. The availability of market fuelwood depends heavily on tract size. The demand for land to supply the expanding urban fringe may result in a lower supply of market wood but also in more wood being cut to satisfy the owner's need for wood. NIPF owners in the Northeast might be persuaded to sell firewood to a regional market, but this supply would not meet the region's total energy needs for more than several years. However, fuelwood could become an important energy supplement in the Northeast until alternative energy sources are developed.

Keywords: Available timber, harvesting, forest-land ownership

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