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Status and Potential of Michigan Agriculture Phase II: Timber and Timberland Resources
Michigan State University Agricultural Experiment Station and Cooperative Extension
Service

Special Report

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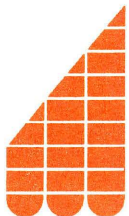
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**SPECIAL
REPORT**

Michigan Agricultural
Experiment Station,
Michigan State University

**Status and Potential
of Michigan
Natural Resources**

**Timber and
Timberland
Resources**



Reports on the Status and Potential of Michigan Natural Resources

This special report is one of a series (listed below) prepared for a project of the Michigan Agricultural Experiment Station (MAES) called the "Status and Potential of Michigan Natural Resources" (SAPMINR).

The project was designed to take an inventory of the current status of Michigan natural resources, identify emerging trends, and appraise future opportunities. The purpose was to assist MAES in establishing priorities and planning programs.

Both overview and focused topic assessments have been made. The overview reports provide background information on the political, economic, and social environments influencing Michigan natural resources. The focus reports examine specific resources, including timberland resources, fisheries and wildlife resources, parks and recreational resources, and land and water resources.

The SAPMINR project began in early 1993. At that time, interdisciplinary teams of MSU faculty members, graduate students, federal and state government officials, and others collaborated to develop preliminary reports. In March 1994, a SAPMINR conference took place during MSU's Agriculture and Natural Resources Week. The objective of the conference was to provide a public forum for discussion of the preliminary reports. Based on interaction with conference participants, the authors prepared the final drafts of the special reports (SR).

This report should not be considered final. Efforts to analyze the past and forecast the future are ongoing. Even so, this report is a base for dialogue on both the status and potential of Michigan natural resources.

To receive any of the reports listed below, contact: MSU Bulletin Office, Room 103 Agriculture Hall, Michigan State University, East Lansing, MI 48824-1039.

Status and Potential of Michigan Natural Resources List of Reports

Overview Reports

- SR 67 --SAPMINR Highlights
- SR 68 --Michigan Natural Resources Policy
- SR 69 --Demographic, Social and Economic Trends
- SR 70 --Integrated Natural Resource Systems

Focus Reports

- SR 71 --Timber and Timberland Resources
- SR 72 --Lumber, Furniture, Composition Panels and Other Solidwood Products
- SR 73 --Pulp, Paper, Allied Products and Wood Energy
- SR 74 --Fisheries
- SR 75 --Wildlife
- SR 76 --Tourism
- SR 77 --Boating and Underwater Recreation
- SR 78 --Camping, Trails and Dispersed Recreation
- SR 79 --Water Resources
- SR 80 --Land Resources
- SR 81 --Nonrenewable Resources
- SR 82 --Natural Resources and Communities

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Timber and Timberland Resources

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Introduction

Michigan's forests and timberland have had a great impact on the growth and development of the state. The late 19th and early 20th centuries were a period of extensive exploitation of the timber resource. The mining of Michigan's forests for timber left millions of acres deforested, with as much as 3.6 million acres still classified as deforested in 1935. Recovery occurred in the mid-20th century as natural reforestation, plantations, and reversion of agricultural land increased timber volumes and acreage. In the late 20th century, Michigan timberland acreage decreased, as residential and transportation development converted forestland. The statewide timber resource grew, however, as productivity, markets and management increased. Use of the timber resource intensified and more uses were found for Michigan's predominantly hardwood fiber timber resource. Industry expansion from new plant locations and increased capital expenditures in the 1980s brought economic development to many areas.



In the last few years of the century, therefore, it is appropriate to review the status of Michigan's timberland resource. The timing of this review is especially

fortunate as preliminary data from the U.S. Forest Service's 1993 Inventory have just become available. These data show that Michigan has 18.6 million acres of timberland—a net increase for the first time since 1955. Timber volumes (26.8 billion cubic feet) and growth rates (830 million cubic feet per year) also increased substantially.

Timberland

More than half of Michigan is forestland – 19.2 million acres (see glossary). Timberland reserved for uses that preclude commercial timber harvest is 3.4 percent of the state. Timberland, defined as forestland capable of producing a commercial timber crop, covers 51 percent of the state. Woodland, defined as forestland incapable of producing commercially important trees because of poor site conditions, is 1.4 percent of the state.

Michigan and the Region

Of the 21 northern states, Michigan is the richest in timberland (Table 1, Powell et al., 1993) and only New York has more forestland. Michigan's timberland dominates the growing stock and sawtimber volumes of the North. It carries more than 10 percent of the growing stock in the North and 24 percent of the growing stock in the North Central region. Michigan's forest-industry lands hold over half the North Central industry's growing stock volume.

Distribution of Timberland

Historically, the northern Lower Peninsula (NLP) has had a higher proportion of forestland than the southern

Table 1. Timberland acreage and timber volumes in the northern United States.

State	Timberland in Thousands of Acres	Growing Stock in Million Cubic Feet
Michigan	17,442 ¹	22,142
Illinois	4,030	5,121
Indiana	4,296	5,435
Iowa	1,944	1,670
Minnesota	14,773	15,146
Missouri	13,377	9,001
Ohio	7,567	10,200
Wisconsin	14,921	16,604
Total North Central Region	78,350	85,319
Total Northeast Region ¹	79,449	121,800
Total North	157,799	207,119

¹ Since these are 1992 estimates for all states, this does not match the new 1993 inventory figure.

Lower Peninsula (SLP) (Figure 1) and the western Upper Peninsula (WUP) has had a higher proportion of forestland than the eastern Upper Peninsula (EUP). There are 3.0 million acres of timberland in the SLP and 7.2 million acres in the NLP. Timberland makes up 21 percent and 63 percent, respectively, of all the land in these regions. The EUP has 3.8 million acres of timberland and the WUP has 4.6 million acres.

Because timberland comprises 77 percent of the eastern half of the Upper Peninsula, 84 percent of the western half of the Upper Peninsula, and 63 percent of the northern Lower Peninsula, it exerts an especially strong influence over the economy of this region (Figure 2).

During the past decade timberland acreage has actually increased, reversing the trend of decline which took place from 1955 through 1980 (Table 2). The U.S. Forest Service's 1993 preliminary inventory figure of 18.6 million acres of timberland is an increase of 6.5 percent since 1980. The largest increase—524,000 acres—has

been in the SLP, with the NLP also showing an increase of 521,000 acres of timberland. The expansion of abandoned agricultural cropland was reforested through tree planting and natural succession.

Forest Types

Common Michigan forest types include oak-hickory, elm-ash-soft maple, maple-birch and aspen-birch (Table 3, Figure 3). Together these four types account for 75 percent of Michigan's timberland. The maple-birch type is the largest, comprising 38 percent of the timberland. Maple-birch acreage has increased steadily since 1938. Aspen-birch, once as abundant as maple-birch, has dropped to 17 percent of Michigan timberland. Jack, red and white pine are the most common softwood types, and together they comprise more than 10 percent of the timberland. The remaining timberland is either in one of six other forest types or is timberland currently without trees.

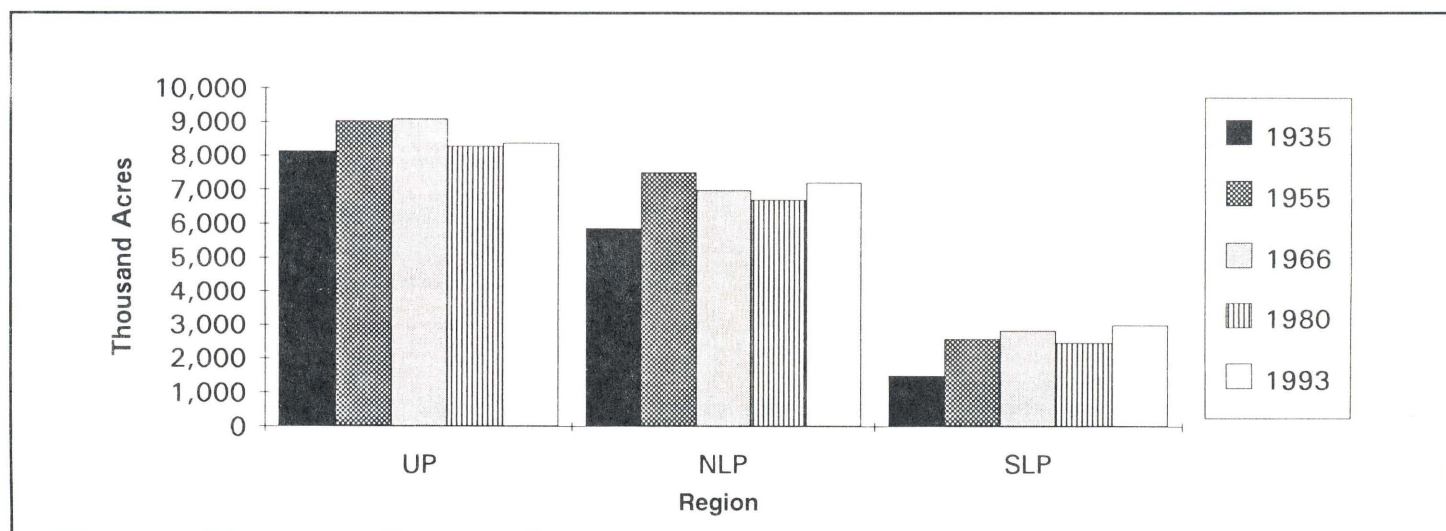


Figure 1. Michigan timberland area by region, 1935-1993, in thousands of acres .

Table 2. Timberland acreage in Michigan, 1935-1993, in thousands of acres.¹

Region	1935	1955	1966	1980	1993 ²
UP	8,132	9,039	9,090	8,290	8,386
NLP	5,862	7,508	6,994	6,702	7,217
SLP	1,497	2,574	2,816	2,477	3,001
State	15,491	19,121	18,900	17,468	18,604

¹ Column totals may not add due to rounding.

² Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

Table 3. Cover type distribution of Michigan timberland, 1935-1993, in thousands of acres.

<u>Cover Type</u>	<u>1935</u>	<u>1955</u>	<u>1966</u>	<u>1980</u>	<u>1993¹</u>
Pine	1,029	1,622	1,766	1,705	1,969
Spruce and fir	1,899	1,122	1,510	1,254	1,170
N. white cedar	639	886	1,188	1,172	1,345
Tamarack	247	130	176	115	149
Oak-hickory	1,307	1,789	2,405	1,779	1,971
Elm-ash-maple	683	974	1,936	1,327	1,620
Maple-birch	4,576	4,651	5,245	6,075	7,146
Aspen-birch	5,045	4,799	4,676	3,782	3,149
Nonstocked	66	3,148	- - - 2	258	82
Total	15,491	19,121	18,900	17,468	18,604

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.
² Nonstocked type was not used in 1966 inventory.

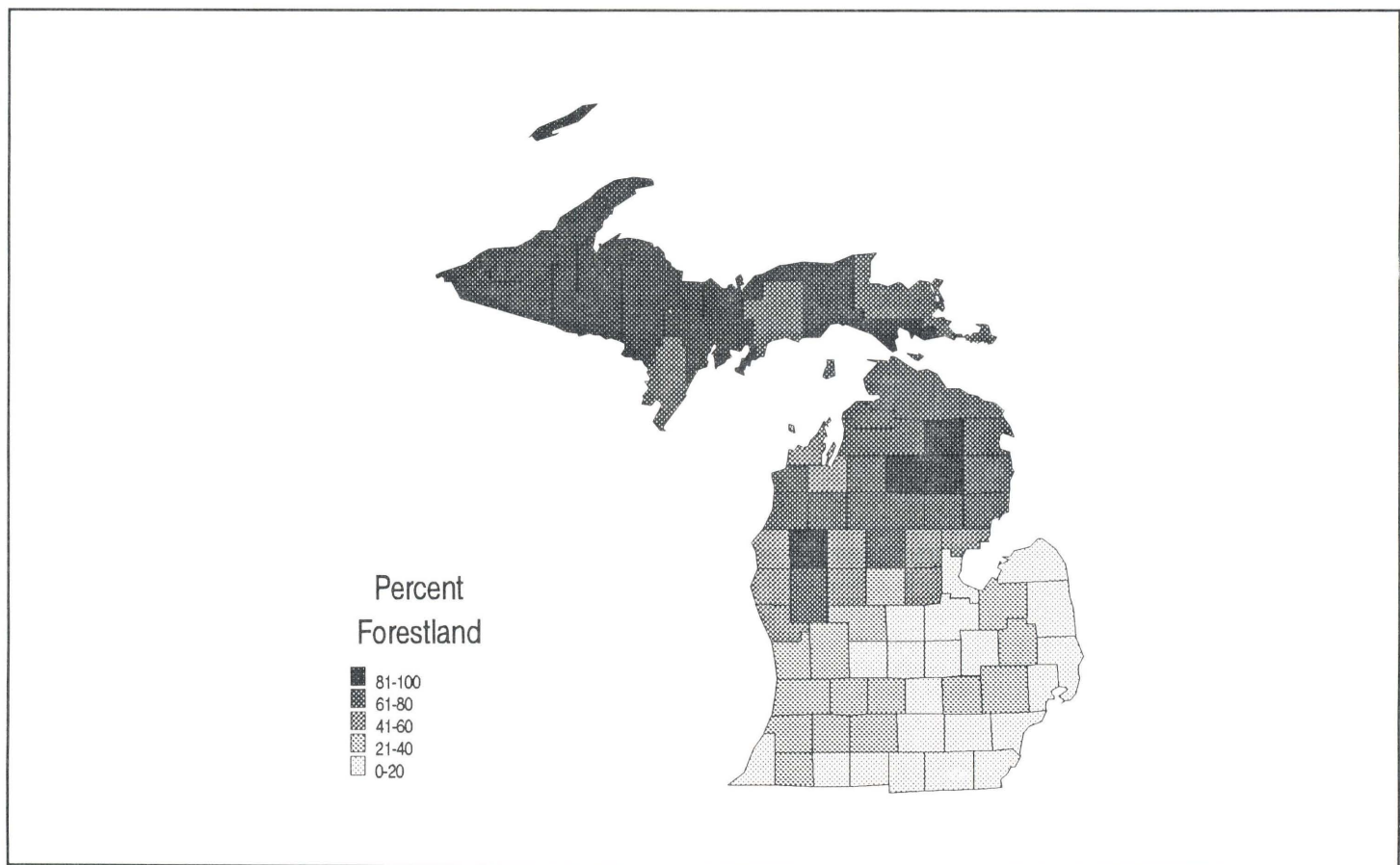


Figure 2. Michigan counties percent forestland.

Table 4. Michigan timberland ownership, 1955 to 1993, in thousands of acres.¹

<u>Ownership</u>	<u>1955</u>	<u>1966</u>	<u>1980</u>	<u>1993²</u>
Local Government	85	109	187	256
Federal	2,530	2,494	2,509	2,530
Industrial	2,851	2,257	1,981	1,514
State	3,695	3,838	3,517	3,734
Private Non-industrial and Farm	9,960	10,203	9,242	10,570
Total	19,121	18,900	17,490	18,604

¹ 1935 ownership data are not available.
² Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

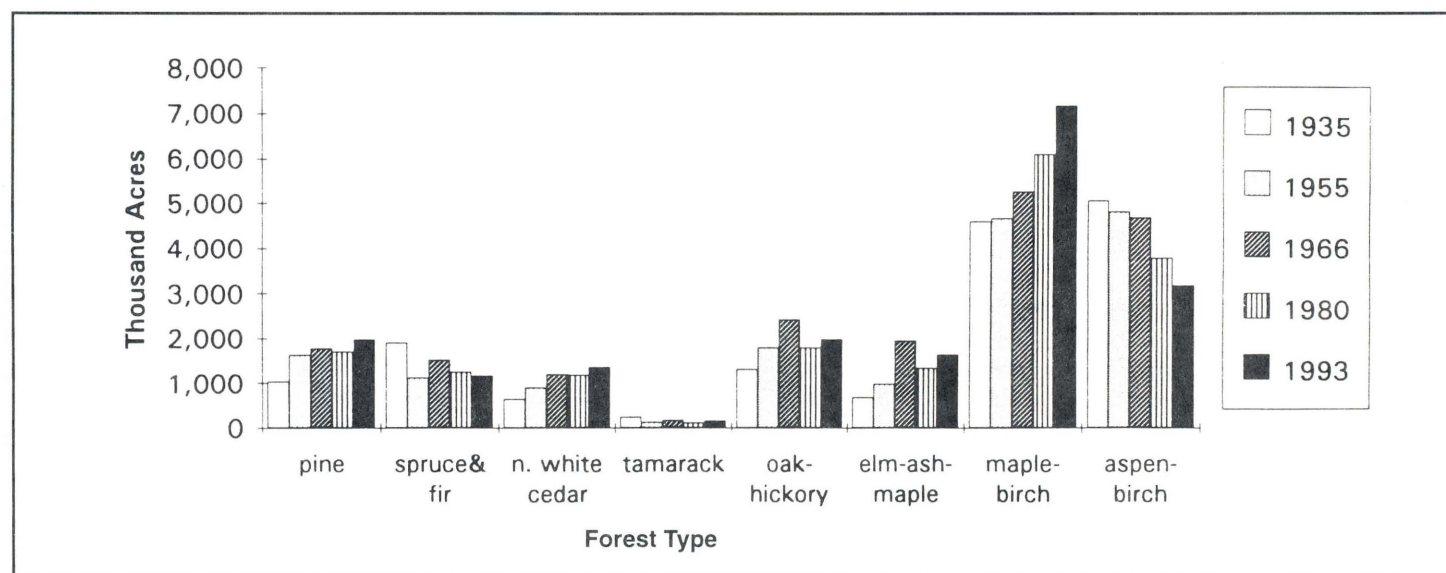


Figure 3. Michigan cover type distribution, 1935-1993, in thousands of acres.

Ownership

Timberland ownership is roughly two-thirds private and one-third public (Table 4, Figure 4). The largest ownership class, private nonindustrial and farm timberland, contains 57 percent of the state's timberland. The private nonindustrial class is composed of land held by private owners other than the forestry industry and farmers. Regionally, private nonindustrial ownership is concentrated in the Lower Peninsula, where it is 61 percent of the timberland, while in the Upper Peninsula it accounts for 41 percent of timberland acreage. Statewide, farmers own only 4 percent of Michigan's timberland, ranging from 1 percent of the Upper Peninsula timberland to 6 percent of Lower Peninsula timberland.

The state of Michigan is the major public timberland owner, with 20 percent of the timberland statewide, 19 percent of Upper Peninsula timberland and 22 percent of Lower Peninsula timberland. This land is administered by the Forest Management and Wildlife Divisions of the Michigan Department of Natural Resources (MDNR). The MDNR administers the 3.9 million-acre State Forest system, 3.6 million acres of which are timberland. The six state forests are in the Upper and northern Lower Peninsulas. Additionally, the MDNR administers 294,000 acres in state game areas, largely in the southern Lower Peninsula.

Federal lands, primarily managed by the U.S. Forest Service, comprise 14 percent of Michigan timberland. The 2.6 million-acre National Forest System makes up

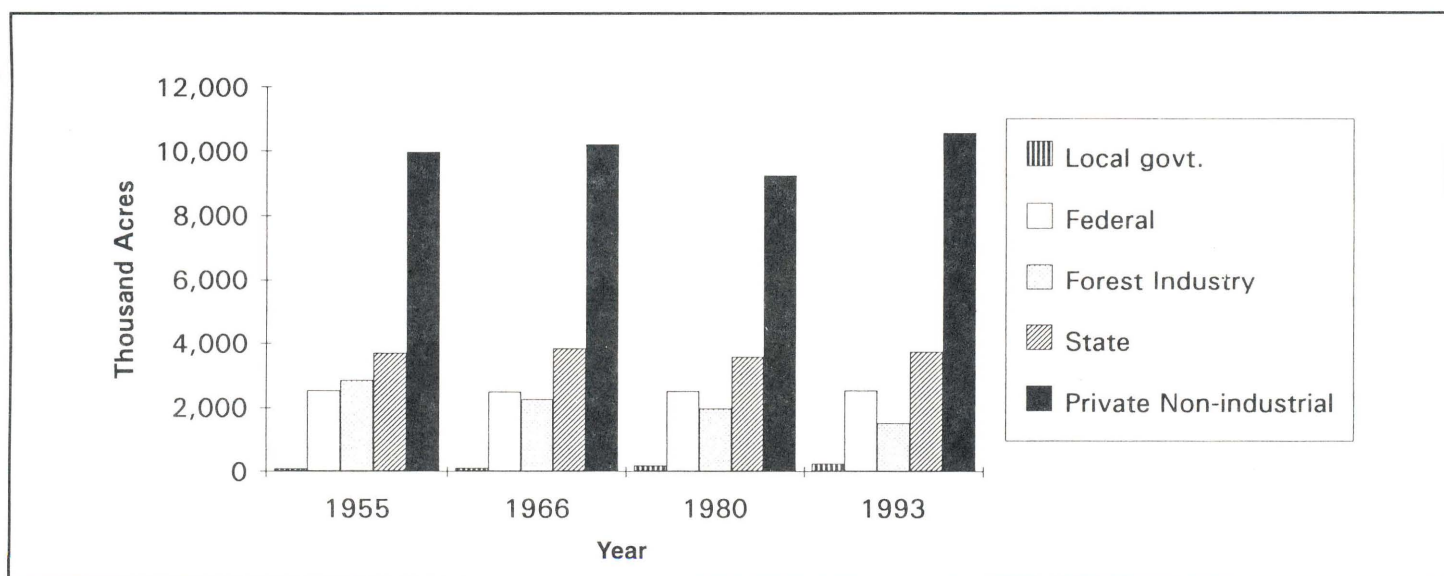


Figure 4. Michigan timberland ownership, 1955-1993, in thousands of acres.

the majority of this ownership. Two national forests, the Ottawa and the Hiawatha, are in the Upper Peninsula; a third, the Huron-Manistee National Forest, spans the northern Lower Peninsula.

Forest industry ownership is 8 percent of timberland and is mostly in the Upper Peninsula, where 18 percent of the timberland is in this ownership class. Mead Corporation and Champion International, the largest industrial owners, are located in the central and western Upper Peninsula, respectively. Forest industry and public ownership have a greater influence there than in the Lower Peninsula—the WUP is 35 percent public, 24 percent forest industry and 41 percent private nonindustrial. The EUP is 46 percent public, 11 percent forest industry and 42 percent private nonindustrial.

Size Class

Timber stand size classes are commonly defined as sawtimber, poletimber, and seedling and sapling. Sawtimber stands are those with an average diameter of 9 inches dbh (diameter at breast height—4.5 feet above the ground) or larger for softwoods, and 11 inches dbh or larger for hardwoods. Michigan's sawtimber stands account for 46 percent of the state's timberland stands, compared with 45 percent nationally. Poletimber stands are smaller than sawtimber stands and have average diameters of at least 5 inches dbh. They account for 30 percent of Michigan's timberland, compared with

28 percent nationally. Seedling and sapling stands are smaller than poles and have an average diameter of at least 1 inch. They account for 24 percent of Michigan's timberland acreage.

Volumes in Growing Stock

Total

The total growing stock of timber is defined as the volume of all trees that are at least 5 inches dbh, with merchantable volume measured from 1 foot above the ground to a top diameter of 4 inches, minus rot or other defects that reduce the yield for timber products. Michigan's 1993 growing stock volume was 26.8 billion cubic feet. This represents a 41 percent increase from the 1980 volume and a 79 percent increase from 1966 (Table 5). Hardwoods dominate the inventory with 71 percent of the volume (Figure 5); this portion is almost evenly split between "soft" hardwoods (e.g., red maple, basswood) and "hard" hardwoods (e.g., oak, sugar maple). The remaining 29 percent of the inventory volume is softwood, primarily pine in the Lower Peninsula and cedar, spruce, fir and other softwoods in the Upper Peninsula.

The NLP has the largest percentage of total growing stock (38 percent) while the SLP has the smallest (16 percent) (Table 6). The EUP and the WUP have 19 percent and 27 percent of Michigan's growing stock, respectively.

Table 5. Growing stock and sawtimber volume, 1935-1993.

Growing stock in thousand cubic feet	1935	1955	1966	1980	1993¹
Softwood	3,848	2,594	3,838	5,356	7,781
Hardwood	7,434	8,119	11,187	13,748	19,070
Total	11,282	10,713	15,025	19,104	26,851
Sawtimber in million board feet					
Softwood	9,584	6,399	9,702	13,946	23,737
Hardwood	18,965	17,358	24,161	33,724	48,267
Total	28,549	23,757	33,863	47,670	72,004

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

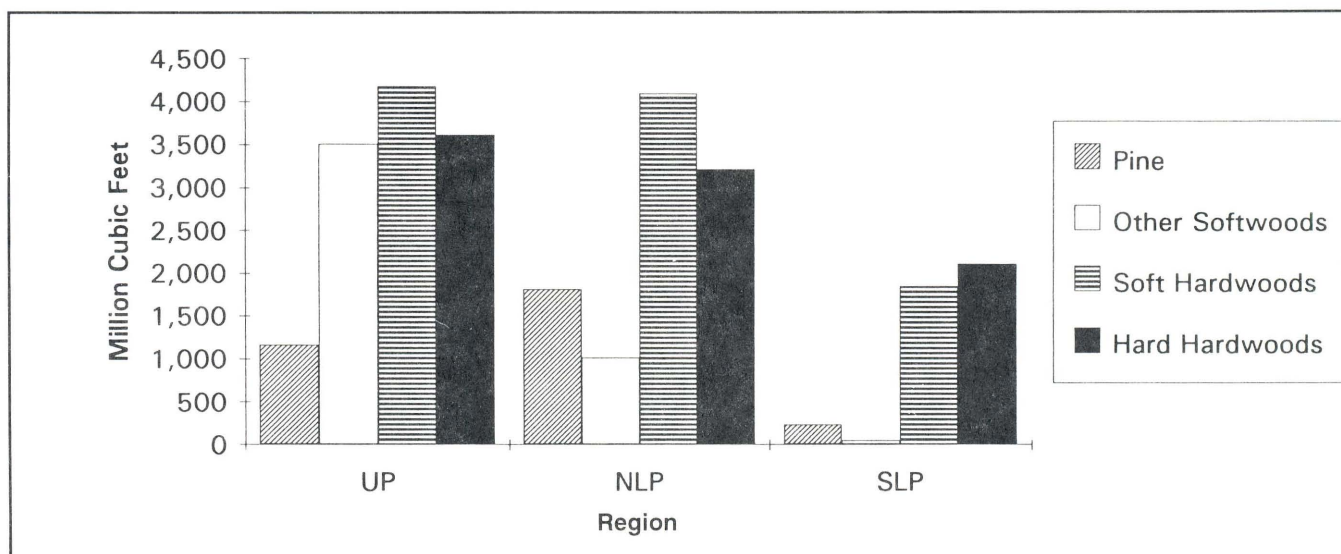


Figure 5. Net volume of growing stock by region and species group, 1993, in million cubic feet.

Table 6. Growing stock volume by region, 1993, in million cubic feet.¹

	UP	NLP	SLP	State
Softwood	4,671	2,828	281	7,776
Hardwood	7,774	7,335	3,962	19,055
Total	12,446	10,163	4,243	26,851
% of state	46%	38%	16%	100%

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

Volumes in Timber Type

Seventy-one percent of Michigan's growing stock volume is in hardwood types (Table 7, Figure 6). The maple-birch type dominates with 45 percent of timber volume. Volume in the aspen-birch type, though increasing absolutely, decreased from 17 percent of Michigan's

Table 7. Growing stock volume by forest type, 1980 and 1993, in million cubic feet.¹

Forest Type	1980	1993
Pine	1,605	2,740
Spruce-fir	1,113	1,118
N. white cedar	1,400	2,032
Tamarack	54	98
Oak-hickory	2,014	2,951
Elm-ash-maple	1,258	2,057
Maple-birch	8,055	11,979
Aspen-birch	3,555	3,867
Nonstocked+exotic	49	8
Total	19,104	26,851

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

volume in 1955 to 14 percent in 1993. Red, white and jack pine types carry 10 percent of timber volume, a percentage which has steadily increased since at least 1955.

Sawtimber Volume

Michigan's 1993 sawtimber volume (board feet in sawlog-sized trees) is 72 billion board feet. Of that, 67 percent is comprised of hardwoods and 33 percent is softwoods. More than one third of Michigan's sawtimber volume is in the NLP (35 percent). Twenty-eight percent is in the WUP and 19 percent is in the EUP (Figure 7).

Sawtimber volume is 57 percent of the 26.8 billion cubic feet of growing stock and has been steadily increasing (Table 8). Sawtimber volume increased by 51 percent between 1980 and 1993 (Figure 7) and the 1993 sawtimber volume is three times that of 1955. Increases in hardwood sawtimber volumes in the NLP and SLP are especially notable. In the EUP, however, softwood species gained dominance over hardwoods.

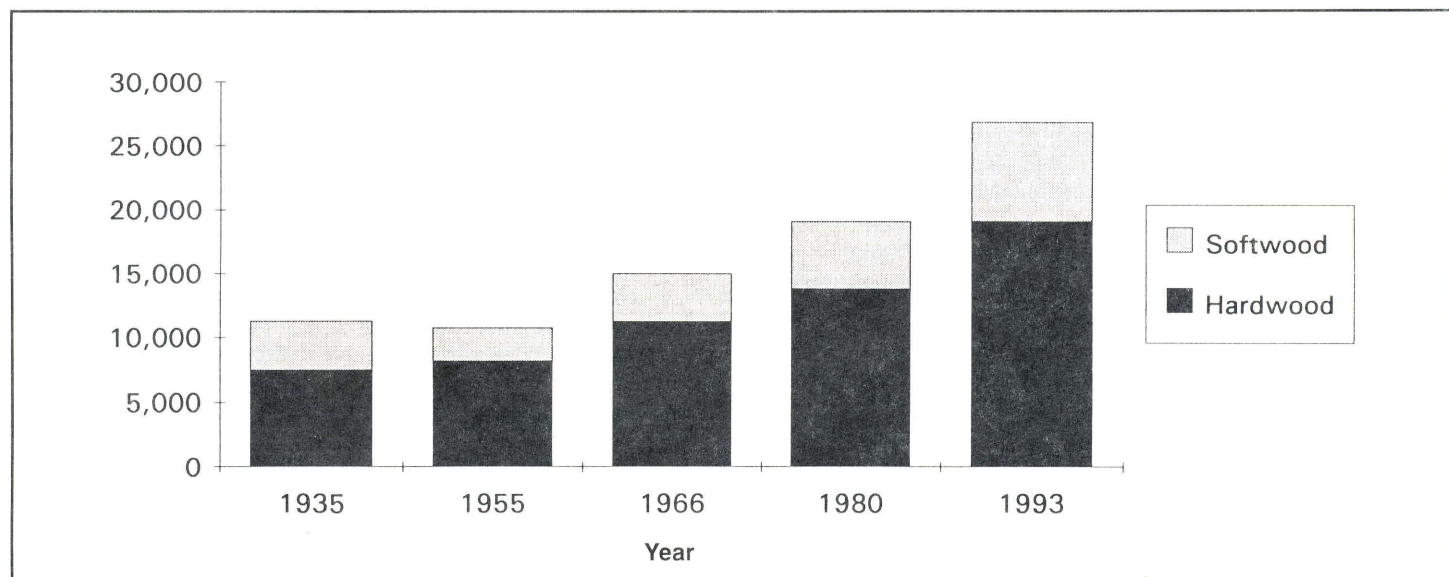


Figure 6. Volume of growing stock, 1935-1993, in million cubic feet .

Table 8. Net volume of sawtimber by region and species group, 1993, in million board feet.¹

	<u>UP</u>	<u>NLP</u>	<u>SLP</u>	<u>State</u>
Softwood	15,311	7,406	994	23,711
Hardwood	18,241	17,936	12,052	48,229
Total	33,552	25,342	13,046	71,941

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

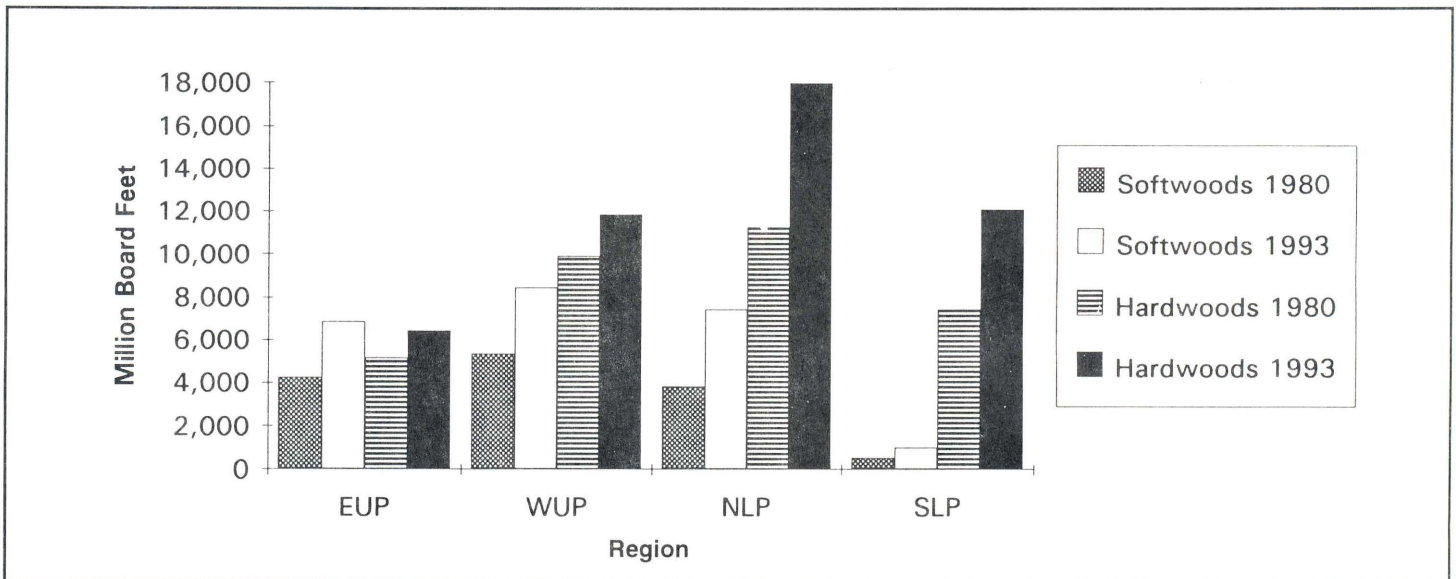


Figure 7. Net volume of sawtimber on timberland by region and species group, 1980 and 1993, in million board feet.

Growth

Current (1993) growth of timber is 830 million cubic feet per year and growth averaged 763 million cubic feet per year from 1980 to 1993. Seventy percent of the growth since the last inventory was in hardwoods (Table 9). Growth rates for pine, soft hardwoods and hard hardwoods increased since the last inventory, but declined for other softwoods. Growth rates differed regionally as well (Table 10). In both parts of the Upper Peninsula, hardwood growth rates declined, as did the softwood growth rate for the western Upper Peninsula.

The opportunity to intensify timber management and increase growth and growing stock volumes within Michigan is significant. Relatively flat terrain, productive soil structure and a good transportation network provide access to the majority of these timberlands. The potential to increase growth is possible through increased stocking of timberland. Thirty-two percent of Michigan's timberland is fully stocked. The annual growth can be enhanced further through stand improvements, tree

species conversion and use of genetically improved species. Red pine, a native species, has the potential to produce as much wood volume per acre as doe slash and loblolly pine in the south (Lundgren, 1982). Use of genetically improved tree varieties could result in productivity gains of 10 to 15 percent (MICHCOTIP, personal communication). Michigan's Forest Development Fund expects to fund investments in these types of intensified management through tax-exempt revenue bonds. Mead Corporation in Escanaba has aggressively planted red pine over the past 16 years to take advantage of improved timber yields.

Timberland Summary

Several key characteristics exert a strong influence over the management of Michigan's forests and the availability of alternative forest products. The maple-birch forest type continues to dominate Michigan and most of the state's timber volume is hardwoods. Growing stock volumes increased from 1980 as did

Table 9. Current net growth, 1993, and average net annual growth of growing stock on timberland by species group, 1965, 1966-1979, and 1980-1993, in million feet per year.

	<u>Pine</u>	<u>Other Softwoods</u>	<u>Soft Hardwoods</u>	<u>Hard Hardwoods</u>	<u>Total</u>
1993	131	123	311	265	830
1980-93 ¹	129	104	285	248	765
1966-79	91	115	246	227	678
1965	60	100	182	238	580

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

Table 10a. Average net annual growth of growing stock on timberland by species group and region, 1966-1979 and 1980-1993, in million cubic feet per year.¹

<u>Region</u>	<u>Softwood Growth 1966-1979</u>	<u>Softwood Growth 1980-1993</u>	<u>Hardwood Growth 1966-1979</u>	<u>Hardwood Growth 1980-1993</u>
UP	120	116	207	184
NLP	76	103	187	211
SLP	9	13	79	135
State	205	232	472	531

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

Table 10b. Average annual removals from growing stock on timberland by species group and region, 1966-1979 and 1980-1993, in million cubic feet per year.¹

<u>Region</u>	<u>Softwood Removals 1966-1979</u>	<u>Softwood Removals 1980-1993</u>	<u>Hardwood Removals 1966-1979</u>	<u>Hardwood Removals 1980-1993</u>
UP	39	45	94	90
NLP	15	24	89	74
SLP	2	5	35	29
State	56	74	218	192

¹ Data for 1993 are **preliminary** data from the 1993 Forest Inventory, USDA Forest Service and are subject to change.

growth rates for pines, soft hardwoods and hard hardwoods (Figure 8).

Michigan's forests continue to be held primarily by private nonindustrial landowners, with farmers, private individual owners and nonforest products industrial owners holding more than half of the state's forestland. Forest industry ownership, for which timber production is the primary objective, has decreased slightly over the last decade.

Both the proportion and absolute volume of Michigan's forests in sawtimber stands increased from 1980 to 1993, with sawtimber volumes 66 percent higher than in 1980. This is despite the perception that Michigan has less sawtimber than it previously did. The balance of poletimber to sawtimber has shifted such that Michigan's forest now carry more volume in sawtimber than in poletimber.

Timber Availability

Since 1980, the forest products industry of Michigan has been a target industry for development by state and regional government. The growth in the industry over the past decade has been well documented (Chappelle and Pedersen, 1991; Potter-Witter and Haraty, 1988). Concurrent with this growth has been increased harvest from Michigan forests and increased utilization of harvests (Manthy and Potter-Witter, 1988; Hackett and Pilon, 1993). Net annual growth of softwood and hardwoods were approximately 2.6 times that of annual removals in 1993. This net annual growth versus removals ratio is cited frequently as a measure of the development potential for the region.

The ratio, however, is a simplistic and static representation of supply and demand relationships. It does

provide a snapshot of timber resource relationships for a given area. A more in-depth analysis is needed based not only on resource growth but on timber type or species conditions, regional conditions, landowner objectives and management behavior, and infrastructure. Growth is calculated for all commercial forestland, only a portion of which is actually available for harvest or is operable given current technology and markets. Current annual mortality is also accepted as a given, though it can be reduced through more intensive management. The growth to removals ratio also represents only a measure of current growth, not potential. Many opportunities exist to increase supply through intensified stocking or growth rates. The MDNR analyzed 143 cases of management opportunities that would increase immediate or future yields and return from 4 to over 25 percent above inflation on investments (Murray, 1994). Rising real prices for many types of stumpage in Michigan are making timber management investments even more attractive.

Other environmental, economic, social and political factors influence the economic availability of existing timber. They include timber management requirements, landowner objectives and ownership patterns, markets, and infrastructure such as roads and timber-producing firms. Approximately 1.5 percent of Michigan's timberland base is accessed each year for commercial harvesting (assuming an average of 15 cords per acre yields with industrial demand at 4 million cords annually). The forest industry primarily owns timberland to furnish its wood-using mills. Michigan's public timberland ownerships have objectives ranging from low-intensity vegetative management on U.S. Forest Service semi-primitive areas to the planned, high-intensity management associated with Forest Development Fund investments on state-owned timberland.

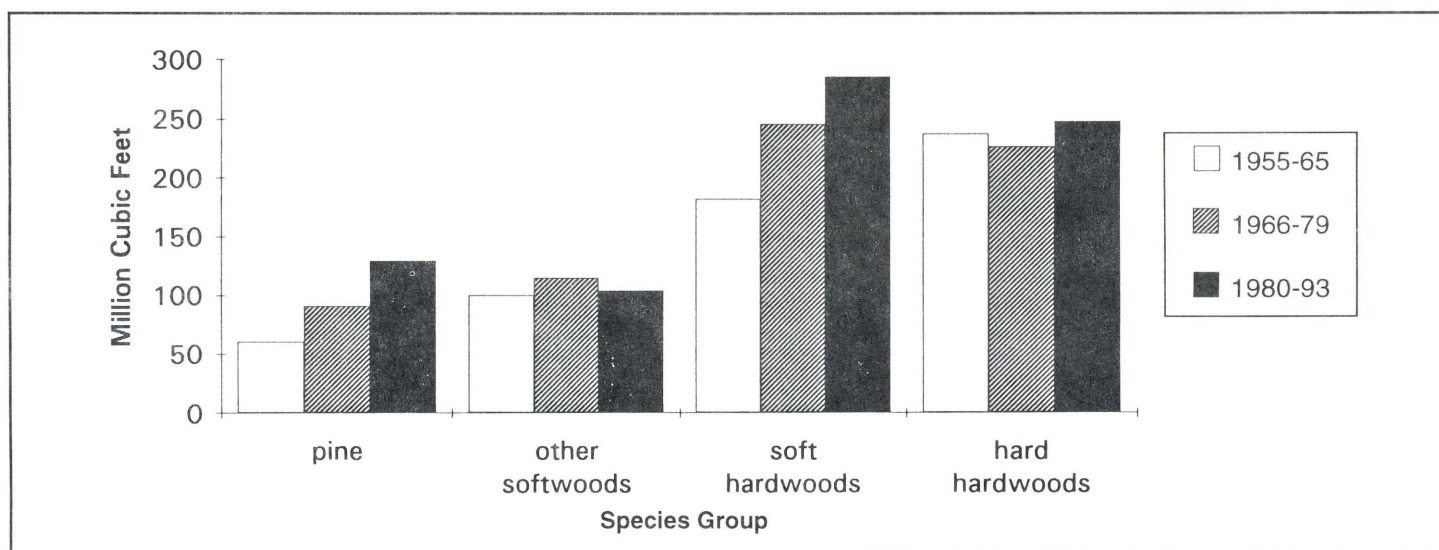


Figure 8. Average annual growth by species group, 1955-65, 1966-79 and 1980-93, in million cubic feet.

Utilization Trends for Species Groups

Maple-Birch

Maple-birch is the dominant forest type in Michigan (38 percent of commercial forestland). Of the primary manufacturers listed in the Michigan Department of Natural Resources' *Directory of Manufactures*, 216 use species from the maple-birch group. The majority of these firms each employ less than 30 people. Of the larger firms employing more than 30 people, most are in the Upper Peninsula. Michigan production of key maple-birch species, primarily hard and soft maple, was valued at \$81 million delivered to mills in 1992. Sawtimber prices for some species in the maple-birch and other hardwood types have experienced rising real prices in some regions of the state. In the Upper Peninsula, hard maple sawtimber stumpage prices for state forest sales increased 1.57 percent annually and soft maple prices increased 3.05 percent annually from 1955 to 1990. (All rates of stumpage price increase are real rates, i.e., above inflation.) There were no significant increases or decreases in prices for sawtimber in the northern Lower Peninsula or for pulpwood in any region of the state from 1955 to 1990 (Potter-Witter and Lacksen, 1993).

Aspen

The aspen and birch types comprise 17 percent of Michigan's timberland. The aspen resource has spurred considerable commercial development interest since the late 1970s. Aspen availability, for example, was a major factor in location of one oriented strandboard mill in the northern Lower Peninsula and two in the Upper Peninsula. Aspen species are used by at least 182 primary and 57 secondary manufacturers in the state. Twenty-five of these are relatively large plants, employing more than 30 people each (Potter-Witter and Ramm, 1992). Aspen's value in production is substantial—equal to \$85 million out of a total hardwood \$217 million delivered to the mill in 1992.

In the northern Lower Peninsula, removals from the aspen type were equal to 85 percent of growth for 1992-93 and 95 percent for 1980-93. Real stumpage prices for state aspen sales are indicative of the intensive utilization of the resource—from 1978 to 1988, real stumpage prices for MDNR aspen pulpwood rose 4 percent to 5 percent annually in the Upper and northern Lower Peninsulas.

Oak-Hickory

Comprising 11 percent of Michigan's commercial forestland in 1993, the oak-hickory type declined between 1966 and 1980, and then rose slightly from 1980 to 1993. Oak stumpage production in 1992 was valued at \$35 million delivered to the mill. In 1988, there were 136 known primary manufacturers in Michigan who processed oak, 56 percent of which were in the northern

Lower Peninsula. Seventy-four percent of the mills employed 15 or fewer people. There were 426 secondary manufacturers in Michigan that processed oak in 1988. Seventy-one percent of these were in the southern Lower Peninsula and most employed 30 or fewer people.

There were significant real price increases for (mixed) oak stumpage from 1954 to 1989—2 percent for oak sawlogs in both northern regions and 5.7 percent for oak pulpwood in the northern Lower Peninsula (Wigler, 1991; Hyldahl and Potter-Witter, 1991). From 1981 to 1989, when price data for red and white oak were available separately, real price increases were 5.8 percent for Lower Peninsula red oak sawlogs, 6.5 percent for Upper Peninsula red oak sawlogs and 11.2 percent for Upper Peninsula red oak pulpwood. White oak showed no significant price changes except for Lower Peninsula pulpwood, which declined 4.8 percent.

Pine

Red, white and jack pines comprise 11 percent of commercial timberland. The 2,735 million cubic feet of pine growing stock is the largest softwood volume in Michigan. Red pine makes up 52 percent of this volume. Total pine volume more than doubled from 1955 to 1980, and increased 70 percent from 1980 to 1993. Red, white and jack pine production in 1992 was valued at \$46 million. Fifty-five percent of this value was in red pine.

The market for red pine sawtimber and utility poles in Michigan has been growing in the northern Lower Peninsula (Grossman and Potter-Witter, 1991a). Red pine sawtimber real stumpage prices increased an average of 2.7 percent from 1980 to 1990. Real prices for pulpwood were constant over the same period. The sustainability of recent red pine harvests has been questioned (Marty and Potter-Witter, 1992). Federal and state forest managers plan harvest levels with labor, administrative and multiple use constraints. As a result, the amount of red pine timber they have offered for sale is much less than timber growth from their lands. Private stumpage offerings are uncertain. Public ownerships are evaluating the opportunity to offer more red pine for harvest. Administrative decisions based on more detailed analysis and recognition of changes may occur.

White Cedar

The northern white cedar type comprises 7 percent of timberland and 8 percent of the growing stock in the state. Cedar is an important timber species, especially in the eastern Upper Peninsula—the EUP produces over 50 percent of Michigan's cedar sawlogs, pulpwood, poles and posts. In 1988, white cedar was used by at least 132 of Michigan's wood products manufacturers, most employing 15 or fewer people. Also using white cedar were several large firms with 50 or more employees, located in both the NLP and the EUP. The value of cedar production delivered to mills was \$6.5 million in 1986 (Grossman and Potter-Witter, 1991b).

Stumpage prices for cedar have been constant in the northern Lower Peninsula but have risen 4.4 percent for pulpwood and 8 percent for sawtimber in the Upper Peninsula (Grossman and Potter-Witter, 1991b). Concerns regarding scarcity, pressure from deer browsing and lack of regeneration are being expressed by federal, state and private resource professionals.

Michigan Compared to Other Regions

Prices for timber commodities have risen in other parts of the United States from 1982 to 1992. Hardwood logs and timber have risen 31 percent since December 1981 (Producer Price Index for the net output of selected industries and their products, 1992). For the same period, softwood prices increased 95 percent, with Douglas fir increasing 118 percent but southern yellow pine decreasing 22 percent.

Michigan's Forest Products Industry

Michigan's forest products industry is comprised of timber managers and stumpage sellers (SIC code 0811), timber producers and lumber and wood products manufacturers (SIC code 24), wood furniture and

fixtures manufacturers (SIC code 25 exclusive of metal furniture), and pulp and paper manufacturers (SIC code 26). In Michigan there are approximately 3,500 timber managers; 1,000 timber producers, truckers and brokers; 430 primary manufacturers; and 1,400 secondary manufacturers. Analysis of the lumber, furniture and composite panels sectors and the pulp and paper sectors are covered in SAPMINR Special Reports 72 and 73).

Volume and Value of Output

Roundwood Production

Michigan produced 348.3 million cubic feet of roundwood in 1992 (Table 11). Fifty-three percent of the production was in the Upper Peninsula and 41 percent was in the northern Lower Peninsula. Michigan produces 60 percent of its total timber volume as pulpwood—raw material for pulp and paper, wafer and particle board, and other products using reconstituted wood or wood fiber. In the southern Lower Peninsula, however, sawlog volume is 81 percent of production. Most of this volume is in high value species, such as red and white oak, which are used by the furniture industry. Roundwood production has steadily increased over the past several decades (Figure 9). Production in 1992 was more than twice that of 1975.

Table 11. Industrial roundwood production by species group and product, 1992, in thousand cubic feet.

Species group	Sawlogs	Veneer Logs	Pulpwood	Industrial Fuelwood	Poles	Posts	Other products
Softwoods	24,958	190	44,740	8,656	145	2,804	1,052
Hardwoods	85,199	6,414	164,534	9,374	—	—	240
Total	110,157	6,604	209,274	18,030	145	2,804	1,292

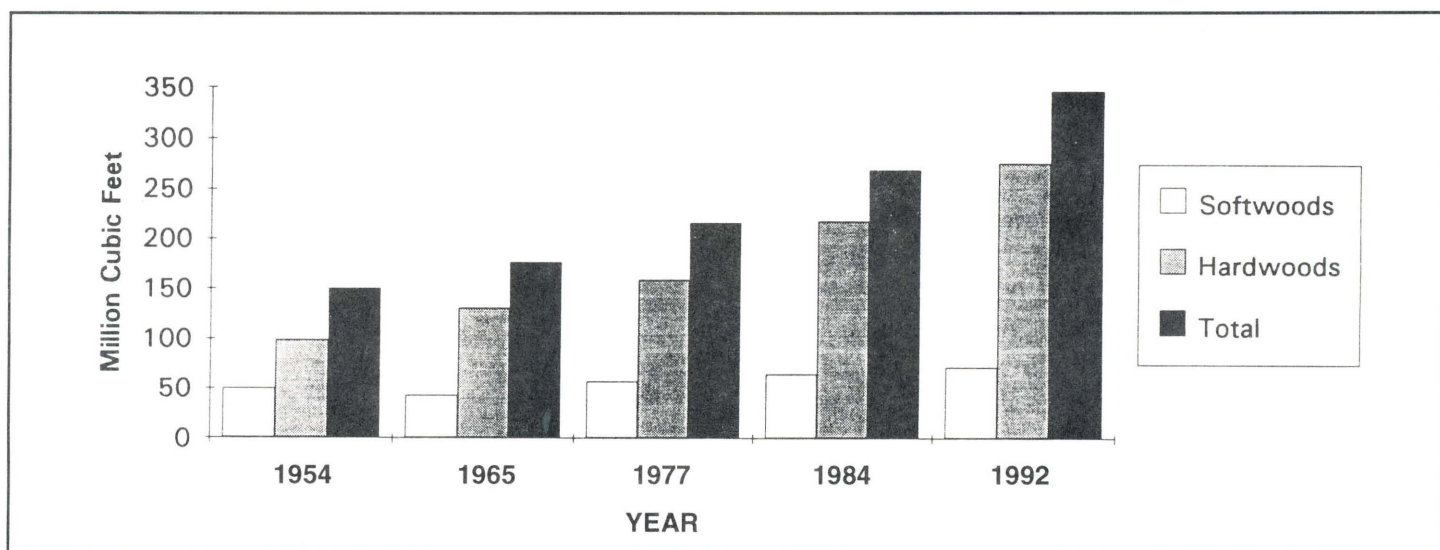


Figure 9. Industrial roundwood production, 1954-1992.

Value

The value of Michigan's 1992 timber production is estimated at \$310.6 million (Table 12). Pulpwood production has a slightly higher value (\$135 million) than does sawlog production (\$116 million). Most of the value is from hardwood production, which makes up 79 percent of the total value. Forty-nine percent of the production value is from the Upper Peninsula and 42 percent is from the northern Lower Peninsula.

Employment

The wood products industry employs more than 60,000 people, based on Michigan Employment Security Commission (MESC) data. Private sector wood products-related employment is approximately distributed as follows: Forestry (SIC 08), 1,000 people; Lumber and Wood Products, except furniture (SIC 24), 16,400 people; Wood Furniture and Fixtures (wood portion of SIC 25), 18,800 people; and Paper and Allied Products (SIC 26), 21,500 people. As these data are based on July 1994 filings with the MESC, they do not include several thousand jobs created through sole proprietors and partnerships, and family-owned businesses that do not employ nonfamily members. A larger number of other workers in trade and transportation sectors, such as truckers and brokers, are also dependent upon the wood products industry. In addition, there are well over 1,000 public sector employees involved in forestry and forest management-related activities.

The majority of forest products manufacturing is concentrated in the southern Lower Peninsula, which has 76 percent of the forest products employees in the state (Figure 10). Most of this employment is in sawmilling and furniture manufacturing. The Upper Peninsula, however, contains the majority of timber producers. Primary manufacturers are spread more evenly throughout the state.

Table 12. Value of industrial roundwood production by product group, 1992, in millions of dollars.

Product	Value Delivered to the Mill
Pulpwood	\$134.8
Sawtimber	\$116.0
Industrial fuel & residential firewood	\$41.7
Veneer logs	\$10.5
Posts and poles	\$6.9
Other products	\$7
Total	\$310.6

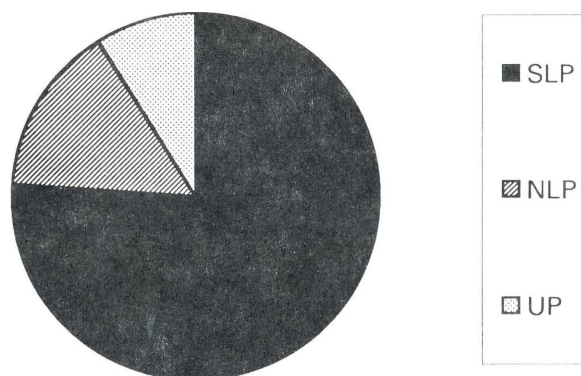


Figure 10. Forest products employment by region, 1993.

Payroll

Wages from direct employment in the forest products industry were \$373.8 million in the first quarter of 1994 (Table 13). Again, these data do not include sole proprietors and partnerships, nor do they include some family-owned businesses that do not employ nonfamily members. Reported wages, therefore, underrepresent total income, especially in the logging camps and contractors category, which contains many sole proprietors, partnerships and family businesses.

Impact of the Timber Industry

The impact of sales, income and employment in the various sectors of Michigan's forest products industry was estimated in a 1986 Michigan State University input-output study (Chappelle et al., 1986). Multiplier values can be used to summarize the economic impact of the industry. They relate the ratio of associated direct, indirect, and induced impacts to direct impacts, thereby representing the ripple effect felt throughout the economy from an initial (direct) stimulus. Overall, the average total (Type II) sales multiplier across all wood products industries was 2.45, the comparable income multiplier was 2.02, and the comparable employment multiplier was 2.31. These values imply that, on average, each wood products job or dollar of sales or income generates more than its equivalent throughout the Michigan economy.

The timber-producing sector of the wood products industry is most closely associated with the logging sector (SIC 2411) and can serve to illustrate the impact estimation process. In the MSU study (Table 14), for each dollar of (direct) sales activity by logging contractors, it was estimated that an additional \$1.60 of "indirect" and "induced" impacts was generated. Specifically, about 50 cents was generated in additional (indirect) industry sales and additional \$1.10 of sales activity was induced through related household spending. Thus, the total sales multiplier for the logging sector was estimated to be \$2.60 (\$1 of direct demand + \$.50 of indirect + \$1.10 of induced). It was also determined that, on average, each dollar of sales in the logging sector generated 33 cents of

Table 14. Sales income and employment multipliers for Michigan's logging sector, 1980.

<u>Multiplier</u>	<u>Direct & indirect effects</u>	<u>Direct, indirect & induced effects</u>
Sales	1.50	2.60
Income	1.41	1.83
Employment	1.69	2.20

direct income and, subsequently, about 28 cents of additional indirect and induced income. Each job in the logging sector was estimated to generate more than one additional job through the multiplier effect. Impacts vary from sector to sector and may be important in evaluating a sector's contribution to a local economy. As these multipliers were developed from a "snapshot" of Michigan's economy and the forest industries in Michigan have grown, relationships, and thus multipliers, may have changed somewhat since the base year of the study.

Implications

Michigan has aggressively promoted forest utilization investments in recent years, and the observed price increases discussed earlier may be associated with increased demand. Rising real stumpage prices are good news for forest landowners. Higher prices will encourage the consideration of long-term investments in timber growth and yields, and infrastructure development. Current timber harvests will be stimulated. Planned timber sales will result in greater revenues and higher prices should make investment in forestry more attractive. At the same time, landowners need to be better informed about forest management opportunities, stumpage market prices, good marketing practices and sales contracts.

Table 13. Michigan forest products industry estimated quarterly wages in millions and number of firms, 1994.

<u>Industry Category</u>	<u>Total Wages 1994 First Quarter</u>	<u>Firms</u>
Logging Camps and Contractors	NA	NA
Lumber and Wood Products	\$84.8	1,125
Wood Furniture and Fixtures	\$111.4	265
Pulp and Paper Industries	\$177.5	235
Total Wood Products	\$373.8	1,625

While rising real stumpage prices may mean greater revenues to the landowner, industry may face increased costs. Industry may respond with substitutions of other species and materials, technological improvements in processing, shifts to processing that adds more value, or intensified forest management by industry landowners. Depending upon the demand for its products, industry may or may not pass increased stumpage costs on to the consumer.

Forest industry, economic development agencies, forest planners and managers should make industry promotion, location, expansion and management decisions with full recognition of the different timber supply and demand relationships in the various regions of the state. Forest researchers should examine the feasibility of increasing timber quality and growth where appropriate and of developing state timber models to monitor and forecast timber availability on a regional and species basis.

Emerging Issues Regarding Timberland

The Commercial Forest Act

The Commercial Forest Act (Act 94, PA 1925 as amended through 1993) now requires each CFA enrollee to have an acceptable forest management plan in place. The impact of this requirement on nonindustrial enrollments is unknown. It is thought that many parcels were enrolled to emphasize management primarily for wildlife and recreation, with timber production secondary. Another unknown is the impact of the recent elimination of property taxes to fund public education. This may influence private landowners' decisions as to whether to remain involved with the CFA or not. If not, what will be the future of those lands currently enrolled?

Forest Practices Act

Legislation has been drafted by an hoc committee that addresses the need for standards regarding harvesting and management practices on forestlands. It would require mandatory certification of logging operators and foresters who engage in or are in charge of these practices. With widespread support from the vested interest groups that cooperated in the design of this act, adoption has been stalled by opposition from the Michigan Farm Bureau and fiscal constraints to implementation.

Forest Fire Protection/Losses

Timber losses due to fire were estimated at 113,000 cubic feet annually from 1966 to 1980, all in softwoods (Raile and Smith, 1983). The data available shows historic losses and may allow a reasonable assumption about future losses. Protection of forested lands surrounded by private lands, and the difficulty of protecting fragmented forests in private ownership, is a

concern. The MDNR predicts the problem will grow as lack of comprehensive land use planning continues to break up large tracts of land into smaller and smaller ownerships, and as the forest-residential interface grows.

Insect/Disease Losses

Like losses to fire, timber loss to insects and diseases may have a significant impact. Annual mortality from insects and disease was estimated at 66.5 million cubic feet from 1966 to 1980, 54.2 million of this in hardwoods (Raile and Smith, 1983). The value of the losses is largely unknown at this point, since research funds are lacking to pursue this issue. Besides information on changes in population densities, very little is known about the long-term impact on the state's forestlands due to defoliation by the gypsy moth. Conceivably, the stress induced in favored hardwood species (oak) could result in changes in stand composition, which would significantly impact wildlife, as well as timber supply. This would change timber and nontimber use.

Non-Point Source Pollution

The federal Water Quality Act (1987 as amended) will have implications for forest management practices on both public and private lands. The federal government currently allows the states to determine whether their programs to address non-point source pollution will be voluntary or regulatory. According to those who have studied the issue, one of the most important issues confronting forestry is striking a reasonable balance between voluntary and regulatory approaches to forest management on private lands.

Ecosystem and Landscape Management

This issue reflects a growing acceptance for comprehensive management of all natural resources within a given ecosystem, with each given equal value. This issue has wide public support but faces resistance from segments of society that see higher direct costs and opportunity costs from changed management practices. Much is to be gained from understanding how Michigan's forest types interact, a first step in landscape management. To accomplish this, inventory data must be tied to geographic location and ownerships. The establishment of a GIS for Michigan's forests would be useful to public and private land managers, but very costly.

Biodiversity

A component of ecosystem management is moving away from an emphasis on single-species to management based on a more natural mix of plants and animals native to a given ecosystem. Forests are being especially targeted, as many perceive that they have become monocrops—emphasizing preferred individual species optimal for timber production over the stability of mixed species. Only a small proportion of Michigan's forests, however, are monocultures—primarily, pine plantations.

Fragmentation

This issue stems from concern for wildlife that rely on contiguous ecosystems of certain minimum size for travel corridors and territorial requirements. The breaking up of large forested parcels into many smaller ones for residences is among the most noticeable type of fragmentation.

Clear-Cutting

At issue are forest management practices, such as clear-cutting, and logging practices, including construction of haul roads that sever wetlands. Clear-cutting is a silvicultural method, as well as a harvesting method, to establish and maintain shade-tolerant species such as aspen and pine. The (temporary) visual impact creates a strong negative perception of this traditionally acceptable practice.

Sustainable Development and Natural Resource Dependent Communities

The role of timber resources in providing income and jobs to communities is substantial in Michigan. This is especially true for the Upper Peninsula and parts of the northern Lower Peninsula. What are the characteristics of communities that depend on timber production and how sustainable is this development? How are natural resource dependent communities different than those with other economic bases, with respect to economic and sociological factors?

Glossary

The following sources were used to compile the glossary:

Raile, G.K. and W.B. Smith. 1983. *Michigan forest statistics*. USDA Forest Service Resource Bulletin NC-67. 101pp.

Smith, W.B. 1991. *Assessing removals from north central inventories*. USDA Forest Service Research Paper NC-299. 48pp.

Average annual removals from growing stock. The average net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses. Average annual removals of growing stock are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots. See Other removals.

Average annual removals from sawtimber. The average net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses. Average annual removals of sawtimber are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots. See Other removals.

Commercial species. Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, osage-orange and redbud.)

Cord. One standard cord is 128 cubic feet of stacked wood, including bark and air space. Cubic feet can be converted to standard cords by dividing by 79.

Farm. Either a place operated as a unit of 10 or more acres from which the sale of agricultural products totals \$50 or more annually, or a place operated as a unit of less than 10 acres from which the sale of agricultural products for a year amounts to at least \$250. Places having less than the \$50 or \$250 minimum estimated sales in a given year are also counted as farms if they can normally be expected to produce goods in sufficient quantity to meet the requirements of the definition.

Forestland. Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover but not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards

with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forestland is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forestland. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide.

Forest industry land. Land owned by companies or individuals that operate a primary wood-using plant.

Forest type. A classification of forestland based upon the species forming a plurality of live tree stocking. Major forest types in Michigan are:

Jack pine. Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch and maple.)

Red pine. Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch and maple.)

White pine. Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch and maple.)

Balsam fir. Forests in which balsam fir and white spruce comprise a plurality of stocking, with balsam fir the most common. (Common associates include white spruce, aspen, maple, birch, northern white-cedar and tamarack.)

White spruce. Forests in which white spruce and balsam fir comprise a plurality of the stocking, with white spruce the most common. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar and tamarack.)

Black spruce. Forests in which swamp conifers comprise a plurality of the stocking, with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar. Forests in which swamp conifers comprise a plurality of the stocking, with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack. Forests in which swamp conifers comprise a plurality of the stocking, with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak-hickory. Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, beech, yellow-poplar, elm and maple.)

Elm-ash-soft maple. Forests in which lowland elm, ash, cottonwood and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include birch, spruce and balsam fir.)

Maple-birch. Forests in which sugar maple, basswood, yellow birch, upland American elm and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine, elm, hemlock and basswood.)

Aspen. Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir and paper birch.)

Paper birch. Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen and balsam fir.)

Exotic. Forests in which species not native to Michigan comprise a plurality of the stocking (mostly Scotch pine plantations).

Growing-stock tree. A live tree of commercial species that meets specified standards of size, quality and merchantability. (Note: Excludes rough, rotten and dead trees.)

Growing-stock volume. Net volume in cubic feet of growing-stock trees 5 inches dbh and over, from 1 foot above the ground to a minimum 4 inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods. Hardwood species with an average specific gravity greater than 0.50, such as oaks, hard maple, hickories and ash.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous. See Soft hardwoods and Hard hardwoods.

Indian land. Tribal lands held in fee but administered by the federal government.

Industrial wood. All roundwood products, except fuelwood.

Local government land. Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Miscellaneous federal land. Federal land other than National Forest, and land administered by the Bureau of Land Management.

Miscellaneous private land. Privately owned land other than forest industry- and farmer-owned land.

National Forest land. Federal land that has been legally designated as National Forest or purchase units, and other land administered by the USDA Forest Service.

Net annual growth of growing stock. The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Net annual growth of sawtimber. The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Net volume. Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Nonforest land. Land that has never supported forest, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1 to 40 acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.)

Nonforest land without trees. Nonforest land with no live trees present.

Nonforest land with trees. Nonforest land with one or more trees per acre at least 5 inches dbh.

North region. Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia, Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin.

North Central region. Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin.

Other removals. Growing-stock trees removed but not utilized for products, or trees left standing but "removed" from the timberland classification by land use change. Examples are removals from cultural operations such as timber stand improvement work, land clearing and changes in land use.

Productive-reserved forest land. Forestland sufficiently productive to qualify as commercial forestland but withdrawn from timber utilization through statute, administration regulation, designation or exclusive use for Christmas tree production, as indicated by annual shearing.

Roundwood products. Logs, bolts or other round sections (including chips from roundwood) cut from trees for industrial or consumer uses. (Note: Includes saw logs, veneer logs and bolts; cooperage logs and bolts; pulpwood; fuelwood; piling; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Sawtimber volume. Net volume of the saw-log portion of live sawtimber in board feet; international 1/4-inch rule (unless specified otherwise) from stump to a minimum 7 inches top diameter outside bark (dob) for softwoods and a minimum 9 inches top dob for hardwoods.

Soft hardwoods. Hardwood species with an average specific gravity less than 0.50, including aspen, basswood, balsam poplar and soft maple.

Softwoods. Coniferous trees, usually evergreen, having needles or scale-like leaves.

State land. Land owned by states or leased to them for 50 years or more.

Timberland. Forestland that is producing or capable of producing in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber utilization, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included.

Timber removals from growing stock. The net volume of growing stock in growing-stock trees removed for forest products (including roundwood products and logging residues) and other uses. Timber removals from growing stock are reported for a single year and are based on information obtained from a survey of primary wood-using mills. See Other removals.

Timber removals from sawtimber. The net board-foot volume of live sawtimber trees removed for forest products (including roundwood products and logging residues) and for other uses. Timber removals from sawtimber are reported for a single year (1988 in this report) and are based on information obtained from a survey of primary wood-using mills. See Other removals.

Timber products output. All timber products cut from roundwood or byproducts of wood manufacturing plants. Roundwood products include logs, bolts, or other round sections cut from growing-stock trees, cull trees, salvable dead trees, trees on nonforestland, noncommercial species, sapling-size trees, and limbwood. By-products from primary manufacturing plants include slabs, edging, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and screenings of pulpmills that are used as pulpwood chips or other products.

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