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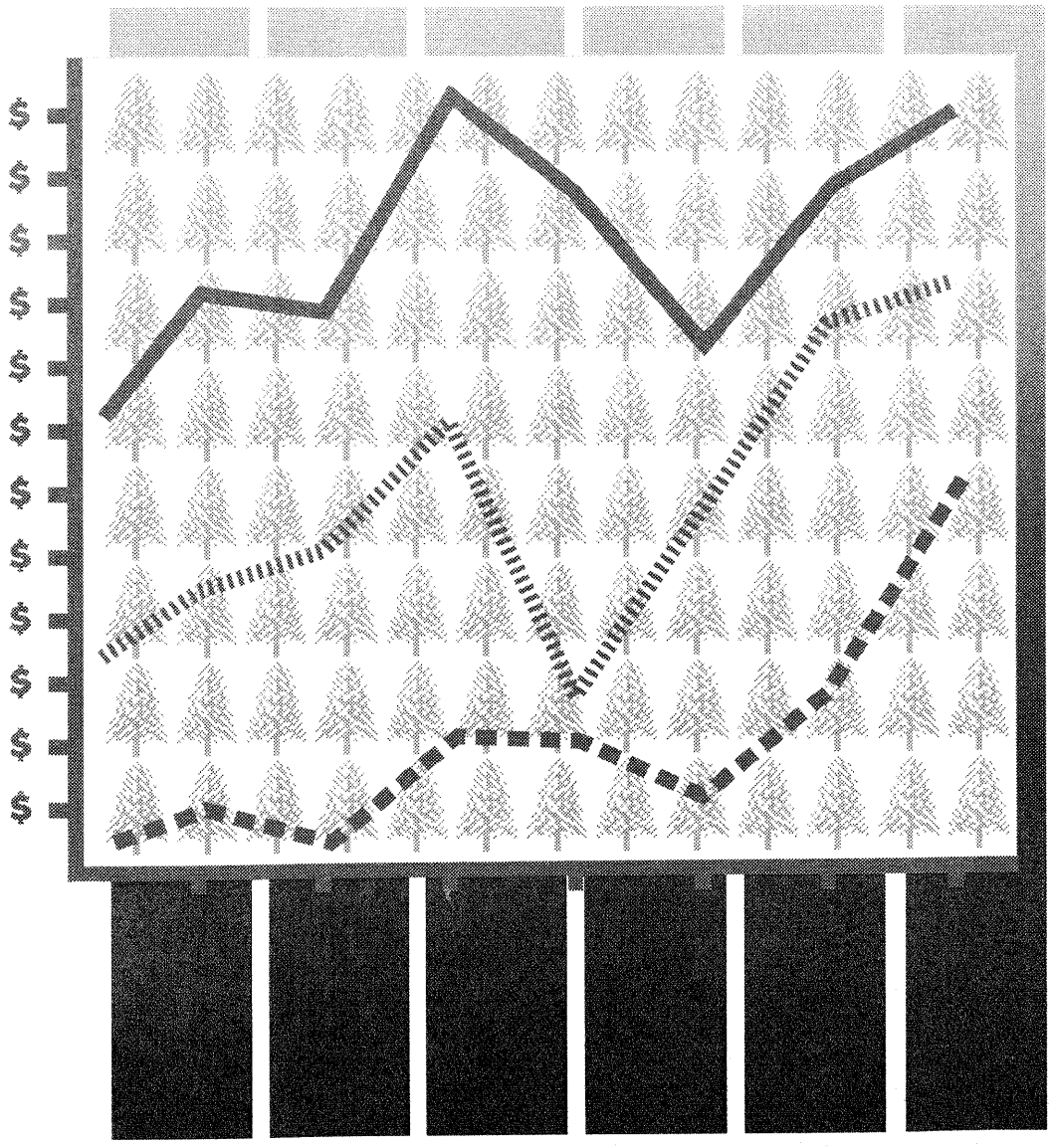
The Economic Impacts of Lake States Forestry: An Input-Output Study

Larry Pedersen, Daniel E. Chappelle and David C. Lothner



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THE ECONOMIC IMPACTS OF LAKE STATES FORESTRY: AN INPUT-OUTPUT STUDY

Larry Pedersen, Daniel E. Chappelle, and David C. Lothner

HIGHLIGHTS

- The forest product industries in the Upper Lake States had sales in excess of $15 billion in 1982, nearly 8 percent of total manufacturing sales in the region.
- The growth rate in forest product sales between 1985 and 1995 is expected to exceed the region's overall economic growth rate by more than 20 percent. By the year 1995, wood product sales are expected to exceed $22 billion in real terms.
- The forest product industries in the Upper Lake States employed more than 150,000 in 1982, with wages and salaries estimated at $3.5 billion. By 1995, the number of employees is expected to grow to 225,000 with wages and salaries at $5 billion.
- The use of wood for energy in the region will produce nearly 10,000 new jobs between 1985 and 1995.
- The use of forested areas for outdoor recreation accounted for more than $2 billion (1982 dollars) of the region's economy in 1985. Adding the multiplier effect, this expenditure generated more than 80,000 jobs and $1.2 billion in personal income. Between 25 and 35 percent of these totals came from nonresidents.
- Although adequate forest resources exist to sustain the economic growth rates projected in this study, continued expansion by wood processing industries could eventually exhaust the surplus timber supplies and raise stumpage prices significantly. Real stumpage price increases are already occurring for some species.
- More intensive forest management could permit higher sustainable harvest levels while improving the timber quality and increasing opportunities for nontimber forest uses.
- Future public and private cooperation on a regional basis could help anticipate potential supply problems and avoid conflicts over forest use.

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INTRODUCTION

This report describes current (1985) and projected (1995) levels of forest-related economic activity in the three-state area of Michigan, Minnesota, and Wisconsin (the Lake States), and their impacts on other economic sectors based on a regional input-output (I/O) model. We analyze direct economic impacts associated with three forms of forest resource uses—forest products, wood energy, and outdoor recreation—as well as the economic multiplier effects. Our goal is to provide Lake States planners, policy makers, and others with data, information, and analytical tools for measuring the economic contributions of Lake States forests. This information will enhance their capability to assess alternative planning strategies in the next round of comprehensive planning.

The Lake States region, with about 41 percent of its total land area forested, is one of the most densely forested areas of our nation. The many resources provided or associated with these forest lands are, once again, gaining recognition for the important role they presently play and the future promise they offer to the region's economy. Although the relative economic contributions of today's Lake States forests will not likely be as important to regional economic development as the forests during the white pine era (1869 to 1900), the contribution will, undoubtedly, be major.

State and Federal forestry agencies within the Lake States have been involved with comprehensive forest

planning activities since the early 1970's. These Lake States planning efforts intensified during the early 1980's in response to the Forest and Rangeland Renewable Resources Planning Act of 1974 as amended by the National Forest Management Act of 1976 (Gray *et al.* 1985). During this period, forest resource managers and planners developed a consensus regarding the quality, quantity, and form of information necessary versus that available for planning purposes (Lewis and Ellefson 1983). The lack of consistent, adequate information was a substantial barrier to the development of long-term forest management strategies and policies necessary for assisting economic development and community stability across the Lake States region.

Measurement of Lake States forest resources is an ongoing process. Recently, the scope of that process has been extended well beyond the traditional USDA Forest Service reports on forest area, the physical availability of standing timber, and wood biomass inventory data, to studies of forest product flow and impacts on the region's economy. These have been promoted by legislation mentioned above, a substantial literature on impact assessment (such as the USDA's Forest Service input-output model IMPLAN), as well as state economic and environmental interests.

Gray *et al.* (1985) assembled data on the production, consumption, and trade of primary wood products in the Lake States. This and similar information is necessary to bridge the gap between inventory data and the sector data in I/O analyses. A series of studies on the timber products economy of Michigan has also recently been published. The final report of this study, "Economic Impacts of Michigan Forest Industries: A Partially Survey-Based Input-Output Study" (Chappelle *et al.* 1986), was a precursor of this regional report.

The economics of nontimber forest resource uses have also been examined, although far less frequently than conventional forest products. Employment Research Associates (1985a and b) estimated the economic impacts stemming from wood energy use in a seven-state Great Lakes region. Proceedings from a May 14-16, 1984 conference, "Assessing the Economic Impacts of Recreation and Tourism," (Propst 1985), contain both theory and applications for a study analyzing the impact of an emerging forest resource use. For a fairly complete listing of forest-related impact assessments, see "Spatial and Regional Analysis Methods in Forestry Economics: An Annotated Bibliography" (Obiya *et al.* 1986).

The benefits from forest resources are often viewed as having fairly localized impacts. While it is true that the economic health of many rural areas in the Lake States is closely tied to the products and services contributed by the surrounding forests, the economic contributions of the forests to one locale will produce ripple effects felt throughout the region.

This report expands the available information base on the Lake States forest resources and their contribution to the region's economy. In it we give an overview of the region's forest resources, describe the methods used in our analysis, present results, and close with a discussion of the results. The appendices provide additional information on methods and interpretation of the results.

LAKE STATES FOREST RESOURCES

The distribution of the 50 million acres of forest land in the Lake States region is fairly evenly divided among the three states—Michigan 18.2 million acres, Minnesota 16.6 million acres, and Wisconsin 15.3 million acres[1]. About 91 percent or about 45.6 million acres are considered timberland (fig.1). Timberland is forest land capable of producing timber for wood products as well as wildlife, water, and recreation. The other 4-1/2 million acres of forest lands are either set aside for wilderness or parks, or are not physically capable of producing commercial timber. The majority of this noncommercial acreage, about 67 percent or 3 million acres, is found in Minnesota.

In total, the Lake States have experienced a 12 percent reduction in timberland between 1952 and 1987. Minnesota has experienced the most significant reduction, about 22 percent, largely as a result of park and wilderness expansions. Michigan's 9 percent decline is due primarily to urban and related development in the southern lower peninsula. In contrast to the other two states, Wisconsin's timberland has remained relatively constant. A modest 1.5 percent increase from 1977 to 1987 has been primarily due to farmland in the southern part of the state reverting back to forest land.

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[1] *Statistics for this section were derived from the USDA Forest Service North Central Forest Experiment Station 1987 RPA data. We wish to thank W. Brad Smith for providing the data.*

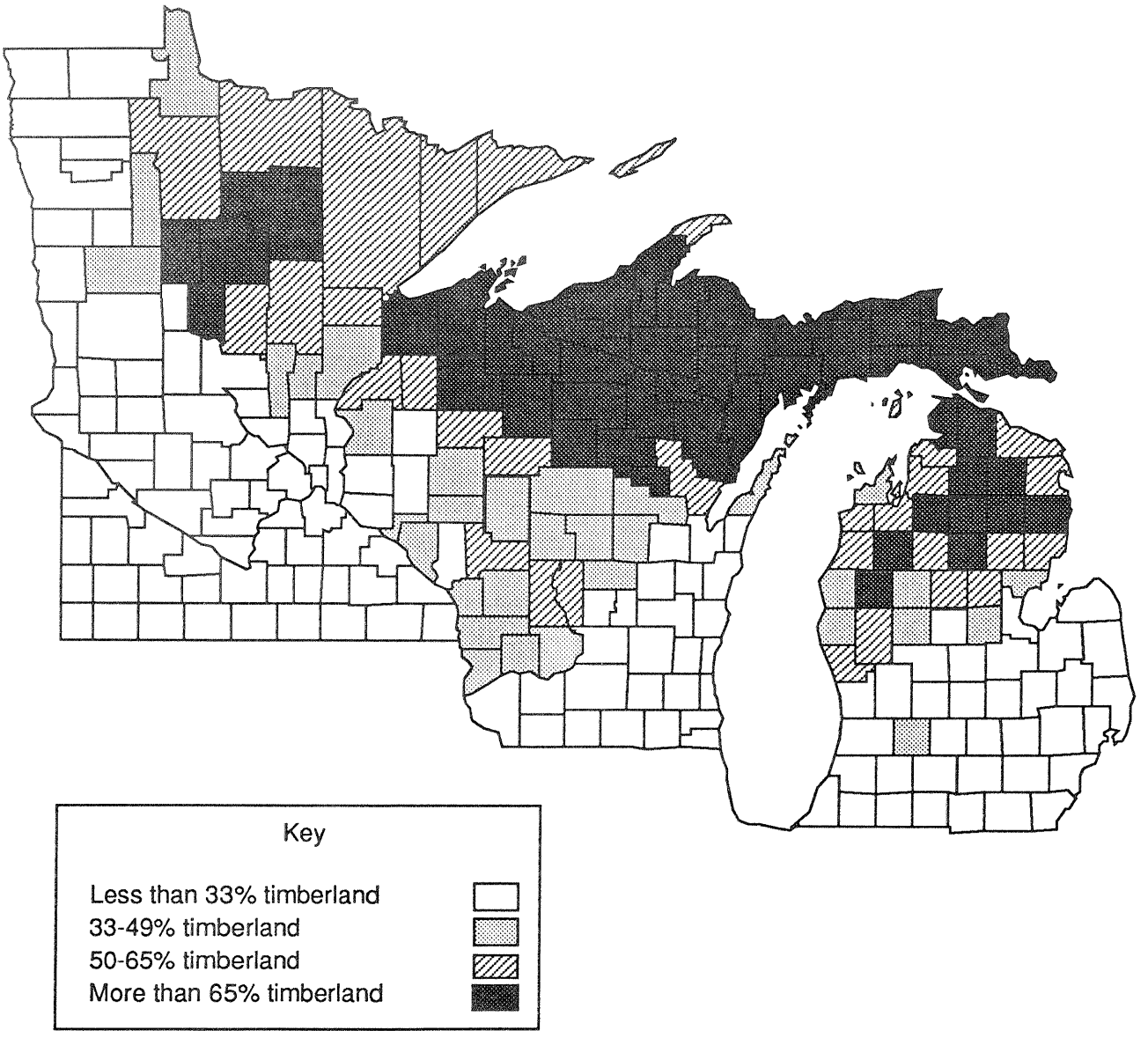

Figure 1.–*Percent of county area classified as timberland, Lake States,*

Nearly 40 percent of timberland in the Lake States is publicly owned, with state and county ownership accounting for over 25 percent of the total (fig.2). Thus, state and county forestry agencies play a major role in providing resources for industrial wood products, fuelwood, and recreation economic development opportunities.

There are presently 6 major forest types in the Lake States. Aspen-birch dominates the region, covering about one-third of the timberland area. This is followed by the maple-beech-birch type which covers another one-quarter. The spruce-fir (15 percent), oak-hickory (12 percent), pine (8 percent), and elm-ash-cottonwood (7 percent) types make up the remaining cover. Only about 1 percent of the timberland is classified as nonstocked. While there are many similarities among the individual states in the region, there are some differences in cover types. Aspen-birch (50 percent) is the dominant cover type in Minnesota whereas maple-beech-birch (36 percent) is the predominant type in Michigan. Wisconsin is dominated by roughly equal proportions of these two forest types.

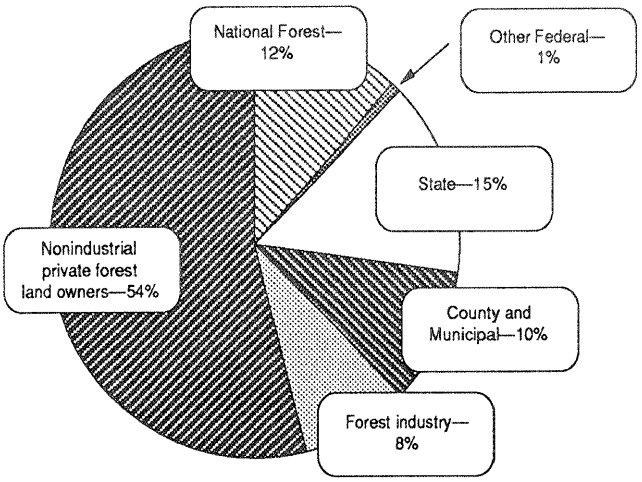

Figure 2.–*Distribution of Lake States timberland among ownership classes.*

In spite of a slight reduction in commercial forest acreage in the Lake States over the past 10 years, total growing-stock volume has continued to increase. The 1987 total growing-stock volume was estimated at 50.8 billion cubic feet. This is an increase of 15 percent over the growing-stock volume estimate in 1977 and a 175 percent increase since 1952 (fig. 3). As in the past, hardwoods still account for nearly three-fourths of the growing-stock volume in the region.

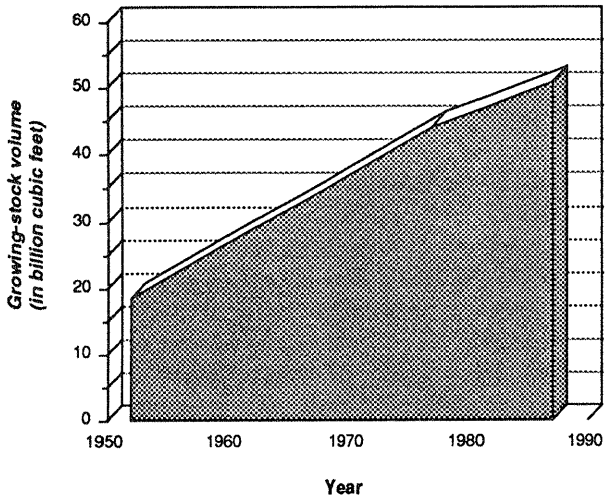

Figure 3.–*Despite a decline in timberland area, growing-stock volume in the Lake States has increased.*

The productivity of Lake States forests has also increased. The regional average for growing-stock volume was estimated at 1,114 cubic feet per acre in 1987. This is about a 21 percent increase from 1977 and results from an increase in timber size as well as more intensive management. The national average for growing-stock volume per acre in 1977 was 1,466 cubic feet, so the Lake States regional average is still likely to be well below the national average. The annual growth of growing-stock volume in the Lake States is 37 cubic feet per acre, an increase of approximately 3 cubic feet per acre over the last 10 years. This is still well below the potential average productivity level in the Lake States which is estimated at 58 cubic feet per acre per year. The average potential site productivity is the volume of timber the average fully-stocked natural stand could produce at culmination of mean annual increment. Thus, there still appear to be significant opportunities to increase timber productivity.

Over 25 percent of timberland in the Lake States is comprised of stands 40 to 60 years old and another 20 percent is 60 to 80 years old. The aspen-birch type, a relatively short-lived forest type, represents nearly 40 percent of the timberland acreage in these two age classes. Thus many of these stands are beginning to deteriorate or are on the verge of deterioration.

Gray *et al.* (1986) describes how this deterioration implies a lost opportunity to utilize these resources and a failure to achieve the physical capability of the land base to produce timber. They go on to address this skewed age class distribution by asking, "how can the wall of wood now occupying the Lake States forest be effectively utilized without entailing a subsequent decline in timber resource availability?" Assumptions used in long-range projection models about future species composition and increased growth rates after harvesting the relatively slow-growing, mature timber can carry significant implications. However, no explicit assumption regarding species composition or growth rates were adopted for this study's forecasts.

As with growing-stock volume, growing-stock growth has steadily increased. Throughout the period, growth has exceeded removals. In 1987, total Lake States net annual growth was 1.7 billion cubic feet whereas removals were 0.9 billion cubic feet. Net annual growth of hardwoods and softwoods were about 1.2 and 0.5 billion cubic feet respectively. These compare to hardwood and softwood removals

of 0.7 and 0.2 billion cubic feet respectively. The difference between growth and removals has been reduced. Removals have increased substantially over the past 10 years, with expansions in both the pulp and paper industry, the structural particleboard industry, and the use of wood for energy. However, both hardwood and softwood growing-stock growth has increased. Thus, there still appear to be opportunities for further industrial expansion.

METHODS

Existing estimates of forest-related activity were integrated with economic forecasts for use with the USDA Forest Service's I/O model IMPLAN[2]. No primary data were collected, rather secondary data sources were used to estimate current and projected economic activity with the three types of forest resource use considered in this study (wood products, energy production, and outdoor recreation). Because of differences in data availability, the methods used to prepare the IMPLAN input varied by forest resource use. In the following we discuss I/O models in general, then IMPLAN specifically, and finally the preparation of input for each sector.

Input-Output Analysis

Input-output analysis describes the interdependence among sectors (industries) in a region, and is used to measure effects felt throughout an economy when demand or supply changes in one or more sectors. In this analysis, effects on the regional economy as a consequence of demand changes were studied. This type of input-output model is driven by final demand, and quantifies the effects of changes in the level of final demand on final payments, sales (gross output), and employment by sector. Final demand refers to household and government purchases, business investments, inventories, and exports. Final payments refer to the value added components of production costs, including wages and salaries (personal income); rents, royalties, and interest (property income); and indirect business taxes.

Virtually any change in final demand will cause a series of transactions to ripple through an economy. Generally, to use an I/O model, we must first estimate final demands for all sectors of an economy for a given year. Using these estimates as inputs, the model forecasts output levels necessary from all industries to meet the forecasted levels of final demand. As a result, we can measure the direct, indirect, and induced effects associated with our estimates of changes in final demand. Direct impacts refer to economic effects in the sector from which the purchase is initially made. Indirect economic impacts occur from the transactions which must take place to provide the output purchased. Indirect impacts include a whole series of backward production linkages that are also referred to as intermediate purchases. Intermediate purchases are diminished by imports that result in transactions and impacts outside the region. Induced impacts stem from increased consumption by households made possible by the increased earnings from meeting the changes in new final and new intermediate demands.[3]

In most I/O analysis, impacts are assumed to occur within a year's time and can be measured in several economic dimensions in addition to sales, such as personal income and employment. These other measures are based on the ratios of these variables to output for each sector in the model's base year.

In addition, "multipliers" may be calculated for each of these economic variables, representing the analogous ripples from the initial increase in final demand. The model employed in this analysis calculates two types of multipliers, a Type I and a Type III, for sales, employment, and personal income. The Type I multiplier is the ratio of the direct and indirect impacts to the direct impact. The Type III multiplier is the ratio of all impacts (direct plus indirect plus induced impact) to the direct impact.[4]

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[2] *Input-output modeling dates back to Leontief's pioneering work in the 1930's. For more detail on Input-output analysis, see Miller and Blair (1985).*

[3] *The induced impact calculated by IMPLAN is different from traditional estimates of induced spending associated with a Type II multiplier. The IMPLAN induced effect is based on direct and indirect impacts causing changes in employment. These changes are used with ratios of employment to population to estimate population changes which are, in turn, multiplied by estimates of average per capita consumption to generate induced estimates. These induced estimates are then fed back through IMPLAN as final demands.*

[4] *The calculation and interpretation of multipliers is explained in Appendix A.*

For our I/O model, we used the USDA Forest Service's IMPLAN Model,Version 2.0 (USDA Forest Service 1983, 1985), maintained by the Forest Service at the U.S. Department of Agriculture's Fort Collins, Colorado Computer Center. IMPLAN's data base contains a detailed national interindustry table and estimates of final demand, final payments, sales, and employment by sector for each county in the U.S. In IMPLAN Version 2.0 these estimates are provided in terms of 1982 economic relationships. The model's economic sectors generally follow commonly used Standard Industrial Classification (SIC) codes. We used the model to develop economic impact estimates for a 48 sector three-state model.

The IMPLAN model is a nonsurvey I/O model. As such, it has to employ data reduction techniques to develop regional models from national data. Version 2.0 of IMPLAN adopts an approach pioneered by Benjamin Stevens and George Treyz, and incorporated in Regional Economic Modelling, Inc. (REMI) models. Regional purchase coefficients (RPCs), representing the proportion of local output purchased to meet local demand, are determined econometrically. Independent variables used to estimate the RPCs include the size of the region, regional wage levels, location quotients based on employment, and transportation costs. Primary data collected on forest product trade flows could be used to check the accuracy of IMPLAN's RPC estimates for forest product industries—thus indicating the extent to which forest product industries rely on indigenous material sources—but such primary data were not yet available for this analysis. In addition, the RAS method, which is an iterative balancing process, is used with Version 2.0 to reconcile inconsistent or incomplete data.

Estimating Economic Impacts

Forest Products Industry

The following steps were used to develop economic impact estimates for the forest products industry:

Step 1. Select forest products industries to incorporate into analysis—IMPLAN allows the user to select the level of industry aggregation and, thereby, the amount of sectoral detail in the model's results. The user is, however, somewhat constrained by the initial level of detail in IMPLAN's data base. For example, the IMPLAN data base does not adequately differentiate forestry services from agricultural and fishery services to permit distinguishing their economic impacts from each other. Another example is that IMPLAN's data base does not distinguish between hardwood and softwood veneer and plywood (SIC 2435 and 2436).

We selected 17 forest product industries to include as separate sectors in our 48-sector regional IMPLAN model (table 1). The selection of industries was based on several factors, including the size of the industry (smaller industries were combined with relatively similar industries to form an aggregate industry) and interest expressed by the three states' Department of Natural Resources and the USDA

Step 2. Estimate growth in final demands for forest product industries, 1982-1995—IMPLAN used 1982 as its base year. For our analyses we wanted to estimate the change in final demands between 1982 and 1985 and between 1982 and 1995 for use as inputs to IMPLAN. We drew on data from three sources: REMI (Treyz 1986), *County Business Patterns* (CBP) (U.S. Department of Commence 1981-1986), and Data Resources Inc. (DRI) (Data Resources Interindustry Service 1985). Each source could give us only a portion of what we needed as inputs for IMPLAN. For each state, we had REMI forecasts of 1984, 1985, and 1995 intermediate and final demands for output and employment, but for only 3 aggregated (SIC 2-digit) forest product industry sectors. The DRI study forecasted output and consumption trends in 39 disaggregated (SIC 4-digit) forest product sectors between the years 1984 and 2000, but only include secondary wood processing industries (i.e., the logging sector was not included). The DRI study also lacked state trend data from Minnesota and Wisconsin—these two states were included in a six-state region which also included Michigan, Illinois, Indiana, and Ohio. CBP for each state provided employment data.

By combining and massaging these data, we were able to estimate the rates of change we needed. The DRI data were used to allocate the REMI final demand estimates for the 3 aggregated forest product sectors in each state to the 17 forest product sectors of interest in this study. The REMI/DRI final demand estimates for 1984, 1985, and 1995 were used to calculate change in final demand between 1984 and 1985 and between 1984 and 1995. To move from IMPLAN's 1982 base year to 1984, we used CBP estimates of employment change between

1982 and 1984, and multiplied the estimated employment change by ratios of employment to final demand, calculated using REMI and DRI data, to derive changes in final demands between 1982 and 1985 and 1982 and 1995.

Step 3. Estimate growth in final demands for other sectors in the model—Estimates of final demand for sectors not involving forest products were required to complete the picture of the interaction between the forest product sectors and other sectors of the region's economy. For private, nonfarm, nonforest industries, IMPLAN 1982 base year final demand values were multiplied by REMI-derived growth ratios to estimate projected 1985 and 1995 final demands for these sectors.

REMI estimates of employment in the government and farm sectors indicated stable employment over the period of interest, therefore we assumed no appreciable change in final demand for these sectors and used IMPLAN base year values over the forecast period.

Step 4. Construct IMPLAN model for the region—A three-state region, 48-sector IMPLAN model was constructed following the steps described in the IMPLAN User's Guide (USDA Forest Service 1983). Since IMPLAN Version 2.0 was still in the development stage at the time of this study, it was necessary to correct for errors in reported trade patterns for certain sectors (approximately 10 percent of the sectors required adjustment). These errors were detected using supplemental REMI data. After adjustments, the IMPLAN and 1982 REMI state estimates of total final demands differed by less than 1 percent.

Step 5. Apply estimated final demand growth trends to IMPLAN base year final demands to derive sales, personal income, and employment estimates—The estimated growth in final demands from 1982 to 1985 and 1995 was used with the IMPLAN model to arrive at 1985 and 1995 regional projections of forest products industry economic activity. Sales growth rates and comparisons with regional manufacturing and total economy performance were then calculated.

Wood Energy

Estimates of regional economic impacts from wood energy are based on a 1985 study done for the Council of Great Lakes' Biomass Energy Program (Employment Research Associates 1985a and b). To summarize, the report found that customers turn to wood because it is a cost minimizing substitute for conventional fuels. The pulp and paper and the wood products industries are the major industrial users. For these industries, wood energy not only reduces their energy costs, but also reduces their waste disposal costs and avoids environmental degradation from other disposal methods. These industries are able to produce useful energy from wood wastes, and at the same time comply with Federal and State regulations which discourage open burning and landfilling of wastes.

The Great Lakes Biomass Energy Program study further found that wood energy use responds strongly to any changes in the cost of energy to end users. They note that it does not necessarily follow that lower crude oil prices will lead to lower costs for consumers. In fact, despite lower prices for crude oil, end-use prices have continued to edge up over the last few years and are forecast to increase moderately through the 1985-1995 period. Most private and government energy forecasters believe that these increases will occur even with stable oil and natural gas prices. The report concluded that wood will continue to be a cost minimizing choice for a significant number of residential, industrial, commercial, and public sector consumers. The news to consumers, however, is not all good—the rate of conversion to wood energy will accelerate if fossil fuels become more expensive, resulting in even higher energy costs for the end-user.

Using IMPLAN Version 1.1, the Biomass Energy Program study generated three wood energy economic impact scenarios in 1985 and 1995 for a seven-state Great Lakes region. Use of wood for fuel greatly increased during the 1970's, spurred on by dramatic increases in conventional fuel prices. Growth rates diminished in the mid-1980's as fossil fuel prices stabilized and, in some cases, declined. In light of fossil fuel price decreases and some reported energy system conversions back from wood to conventional fuels since the original Biomass Energy Program estimates were compiled, we used final demand estimates for Michigan, Minnesota, and Wisconsin associated with the report's low to moderate wood energy use estimates. These final demand estimates were used with IMPLAN Version 2.0 multipliers from our 48-sector model.

Step 1. Determine area to be considered "wildland"—The objective of this portion of the analysis was to measure the economic impacts of outdoor recreation in the more heavily forested areas ("wildland") of the three Lake States. Although outdoor recreation spending by residents and nonresidents plays a vital economic role in large areas within each state, estimating economic impacts of outdoor recreation is difficult. The impacts of outdoor recreation activities have been measured in numerous ways for different purposes, but none matched the needs of this analysis.

We chose to estimate regional impacts from recreation only in counties that were 30 percent or more forested, based on recent USDA Forest Service inventory estimates (fig. 4). However, since much of the recreation data was reported by sub-state regions consisting of multiple counties, a few counties slightly more than 30 percent forested were excluded and a few counties slightly less than 30 percent forested were included.

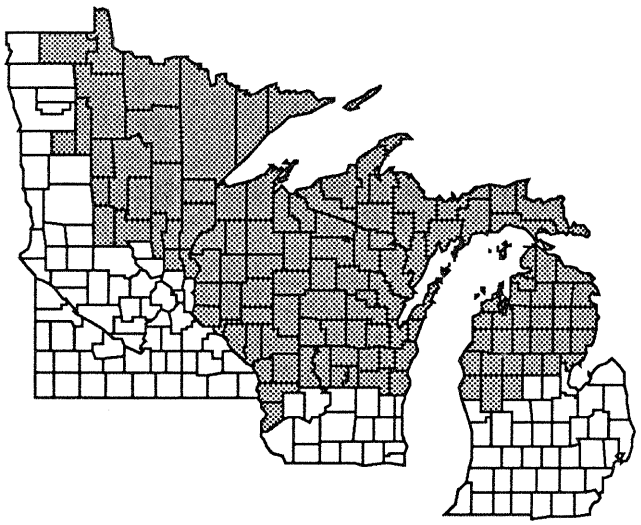

Figure 4.–*Outdoor recreation area included in this analysis.*

Step 2. Assemble information on both resident and nonresident recreation participation in the region's designated wildland—Outdoor recreation considered in this analysis includes:

bicycling	developed camping
primitive camping	hiking
backpacking	pleasure walking
horseback riding	swimming and sunbathing
boating	canoeing
fishing	hunting
downhill skiing	cross-country skiing
snowmobiling	sightseeing

This list includes several activities that are only nominally related to the region's forest resources, such as swimming, bicycling, and downhill skiing; however, this is in line with the focus of our study, which is to estimate total outdoor recreation economic impacts in the forested regions of the three states.

Sources of information on regional resident and nonresident recreation included the three states' SCORP's (State Comprehensive Outdoor Recreation Plans); the 1980 National Survey of Fishing, Hunting and Wildlife-Associated Recreation (USDI Fish and Wildlife Service 1982); and Travel and Tourism in Michigan: A Statistical Profile (Spotts 1986). These sources were used to construct a profile of regional recreation activity for 1985.

Due to the unreliability of existing recreation participation data, no effort was made to quantify 1995 recreation spending impacts. The 1985 base year data have many gaps and may not be dependable. Also, after substantial growth in the 1960's and 1970's, participation in many forms of outdoor recreation flattened out or were at depressed levels in the early to mid-1980's. It appears a number of markets are saturated; however, new markets should not be ruled out.

Step 3. Develop expenditure profiles for recreation participation—At the time of this study, no complete, consistent, and reliable outdoor recreation data base existed that could be used in an economic impact analysis of a sub-state region of a multi-state area (such as the more heavily forested areas of our three-state region). The lack of standardization in data reflects different objectives under which the data is gathered to measure tourism, state park attendance, or the multiple demands on lakes or streams.

Units of measurement may be simple head counts, number of trips, "occasions," recreational visitor and activity days, and hours spent in the activity. Studies also include and exclude different types of recreationists, again, depending on study objectives.

There are many other recreation analysis pitfalls. The sheer diversity of activities and recreationists makes impact estimation difficult. Double-counting is a risk when using multiple sources of data as in this study. Fishermen camp and campers fish; separating out what multiple data sources have included may be impossible. Typical spending categories mentioned in studies frequently do not fit the SIC codes used in impact analysis. Spending will also differ depending on the recreationist's origin and destination, lodging, activities engaged in, and the recreation season.

Analysis of the literature led us to the conclusion that detailed recreation expenditure data from Minnesota were most appropriate for purposes of this study. These data included estimates of both resident and nonresident average expenditures in 1984 dollars per recreation activity occasion (Kelly and Becker 1985). In addition, we obtained from the Minnesota Department of Natural Resources (1986) survey-based estimates of total Minnesota resident and nonresident outdoor recreation spending by IMPLAN sectors for 1985-1986.

Table 2 indicates how a recreationist's average dollar is spent among sectors included in the 48-sector regional IMPLAN model, based on the detailed surveys of recreation expenditures in Minnesota's forested areas. Because the distribution among sectors follows input-output conventions it differs from many recreation spending profiles. Retail and wholesale sector estimates reflect the shares of purchases in other sectors which are attributable to these services. For example, input-output tables do not have retail gasoline sectors. Every dollar for gasoline has to be apportioned to labor, profits, taxes, petroleum production, transportation services, and other sectors, including a portion to retail services. The same is true of spending for apparel, lodging, food, and restaurants. There will be some retail trade component, or "margin" as it is referred to, in virtually any type of recreation spending. Recreation spending profiles often do not separate out such charges from the primary good, *e.g.* food, hotels. This recreation spending profile is also different from others because it is an average of many types of lodging expenses, recreation activities, seasons, lengths of stay, modes of transportation, and other variables.

Step 4. Combine expenditure profiles with participation rates for use with multipliers derived from the 48-sector, regional IMPLAN model—The average Minnesota spending estimates, deflated to 1982 values, were combined with regional resident and nonresident participation rates for Michigan and Wisconsin to arrive at resident and nonresident outdoor recreation spending in Michigan and Wisconsin. This spending was combined with the Minnesota patterns of spending by sector to derive total regional recreation spending. Finally, the spending by sector was multiplied by the corresponding sectoral IMPLAN Type III multipliers to derive estimates of recreation impacts. The results, therefore, indicate how participation in outdoor recreation activities within the forested regions of the three states impacts the entire three-state region, assuming the spending distribution pattern of Minnesota's recreationists. The estimates represent the impact of recreation expenditures at or near the recreation site. As with most recreation studies, we did not include major equipment purchases (*i.e.*, boats, campers, etc.). Large recreational equipment items may be used both within and outside of the forested study area, and, in some cases, for nonrecreational purposes. Including major recreational equipment expenditures could double the impact estimates; however there is little equipment use data available to justify allocating a particular percentage of such expenditures to the study region.

RESULTS

Forest Products Industry

1982 Base Year Estimates

IMPLAN 1982 estimates of sales, employment and personal income by forest products sector are shown in table 3. Total forest products industry sales, employment, and personal income for the region account for between 7 and 9 percent of the total for all manufacturing industries. However, the forest products industry share of total economic activity is significantly higher for many heavily forested substate areas. In total, the forest product sectors in Michigan, Minnesota, and Wisconsin had combined sales of more than $15 billion and were responsible for more than 150,000 jobs in 1982. Personal

income directly associated with this employment amounted to $3.5 billion. The largest share of this economic activity was in the pulp and paper sector (SIC 26), which accounted for the majority of total forest product sales, employment, and personal income in 1982.[5]

1985 and 1995 Sales Growth Projections

The sales and sales growth rates reported in table 4 in real terms (1982 dollars) are the result of both final demand growth estimates and the IMPLAN model's input-output relationships. The projected growth in sales implies that significant economic opportunities exist in the forest product industries. The forest product industries in the three states are estimated to grow faster than the overall economy between 1985 and 1995. During this period, the average annual sales growth rate of the forest product sectors is projected to be 2.83 percent in comparison to the overall regional economy growth rate of 2.35 percent. Evidence from CBP employment data for 1982 through 1985 and the available information on forest product industry investment plans for the near future suggest these growth rates are reasonable and not overstated.

Sales growth rates for all lumber and wood products industries (SIC 24) and paper and allied products industries (SIC 26) are projected to be quite similar for the 1985 to 1995 period. The two wood furniture (SIC 25) sectors are estimated to have an even higher combined annual growth rate of almost 4 percent in this period.

It is instructive to note the estimated growth for several other specific sectors. Logging camps and contractors is the sector that should best reflect trends in forest harvests. Timber supply problems could materialize if this sector's estimated 4.75 percent output growth rate for 1982 to 1985 is maintained. However, the 1985 to 1995 estimated sales growth rate of 2.74 percent for logging camps and contractors is below currently estimated timber growth rates in the three states. This implies that the region's forest resources could potentially sustain forest product sales significantly above the levels shown in table 4, even without changes in forest management.

The paper mills sector is the largest forest-related industry in the three-state region in terms of sales, employment, and income. It is estimated to have an annual sales growth rate of 3.27 percent during 1985 to 1995 period, almost a full percentage point above the annual growth rate of 2.35 percent for the region's overall economy. The projected 1995 sales for all pulp and paper industries (SIC 26), in excess of $15 billion, are slightly greater than all 1982 forest product sales combined.

The lumber and wood products sector (SIC 24) estimated to have the lowest annual growth between 1985 and 1995 is an aggregation of hardwood and softwood veneer and plywood as well as structural members. This sector's low growth is anticipated because other new products, such as waferboard and oriented strand board, have significantly penetrated the traditional veneer and plywood markets. The particleboard sector, including waferboard and oriented strand board, stands out within the sector for its spectacular growth — an annual sales growth rate of 8.19 percent between 1985 and 1995. However, this growth starts from a relatively small 1982 sales base of $84 million.

1985 and 1995 Employment and Personal Income Projections

Table 5 shows the employment and personal income that would be associated with the levels of sales presented in table 4. The two columns of coefficients indicate the IMPLAN 1982 ratios of jobs and employment compensation to sales. For example, the coefficients of 7.6747 and 0.1980 indicate there are approximately 767 jobs and $19.8 million in wages and salaries for every $100 million in output by logging camps and contractors.

Variations among these sector coefficients reflect several factors including relative labor-intensity and wage levels, the mix of technologies and plant sizes, employee skill levels, and the sector's labor market. Larger coefficients do not necessarily indicate that

[5] *Surveys of forest product firms in the Lake States indicate that secondary sources of employment data significantly underestimate the number of jobs in the region's forest industries. This has been found to be particularly true with primary forest industries in both Michigan and Wisconsin. Unfortunately, we cannot correct for this problem in this analysis without additional survey data. Based on the Michigan survey (James et al. 1982), the total forest products industry employment estimates adopted from IMPLAN may be as much as 15 to 25 percent below actual employment levels.*

the industrial sector is more attractive, but they do indicate that there are more jobs or income associated with its sales. Greater mechanization and employment of the most advanced technologies may well make an industry more economically sound, but could be expected to reduce these labor-related coefficients.

Although lumber and wood products industries had half the number of employees pulp and paper industries had in 1982, by 1985 it is estimated to have closer to 60 percent of the number of pulp and paper employees. Although the particleboard sector will experience phenomenal growth in employment and personal income, it will still account for less than 2 percent of the 1995 employment and personal income of all the forest product sectors in the region.

Indirect and Induced Effects

Other indicators of the economic importance of forest-related industries are the indirect and induced sales, employment, and personal income associated with meeting demands for forest products. Tables 6, 7, and 8 present economic impact components and multipliers derived from the USDA Forest Service's IMPLAN model for the region's forest products sectors. The estimates apply only to the region considered in this analysis.

The impact categories (defined in the Methods section, above) and their sum ("Total") appear for employment and personal income in tables 7 and 8, respectively. They indicate what sales, employment, and personal income changes occur per unit of change in a sector's final demands. The Type I and Type III multipliers are also presented. This delineation of impact estimates is in line with conventional reporting of economic impacts which often presents results both with and without the induced impact included. Appendix A presents a detailed illustration of how to interpret the impact estimates.

Total estimates of the impacts for 1985 and 1995 are presented in tables 9 through 11. These estimates were derived by multiplying the Type I and Type III multipliers in tables 6, 7, and 8 by the corresponding estimates of direct sales, employment, and personal income for 1985 and 1995 presented in tables 4 and 5.

Wood Energy

Reported expenditures for wood energy are lower than expenditures for the fossil fuels they replace. This is due largely to the unpaid time many residential users devote to collecting their own fuelwood and the moderate raw material prices they pay. In addition, much industrial wood energy consumption involves use of inexpensive wood wastes and byproducts for fuel. As a consequence, the costs of conventional fuels displaced by wood fuels are larger in terms of sales than the total spending (sales) associated with using wood for energy. The regional economic impact from wood energy is, therefore, negative if only direct and indirect sales impacts are considered (table 12). The loss to the region is estimated to be more than $200 million for both 1985 and 1995 by this measure.

However, because wood fuels tend to displace imported fossil fuels and more of the spending associated with wood energy remains within the region, the net regional economic impact is positive by other economic measures. Including the induced impact, total regional sales associated with wood energy are estimated to be over $74 million in 1985 and close to $105 million in 1995. Total regional employment associated with wood energy is projected to grow modestly, about 1 percent annually, from about 9,000 employees to more than 10,600 in 1995. Total personal income is projected to grow at a higher rate over this period, from just over $150 million to nearly $180 million.

These estimates include impacts from residential fossil fuel savings which are assumed to be spent in the typical pattern of personal consumption expenditures. Similar savings for commercial and industrial users exist, but are not incorporated because such savings are more difficult to trace and model. Thus, the estimates are conservative and may well understate the net economic benefits from fuelwood use in the Lake States region.

Outdoor Recreation

Recreation in the forested areas of the region was associated with $4.2 billion of direct, indirect, and induced regional sales in 1985 (table 13). This level of sales generated $1.1 billion in personal income,

based on a Type III personal income multiplier. Using a Type III multiplier, over 85,000 jobs appear to be associated with the forested area's 1985 outdoor recreation. Perhaps more significantly, between 25 and 35 percent of total recreation impacts are due to nonresidents (table 14), representing new dollars and economic activity for the region.

Much of the value associated with outdoor recreation is not priced by organized markets. Therefore, economic impacts reflect only a fraction of the value placed by society upon use of the forest resources for recreation.

Summary of Findings

The total economic contribution to the three-state region of the three alternative forest resource uses, as measured in sales, employment, and personal income are presented in table 15. The total impacts shown are based on IMPLAN's Type III multipliers which include an estimate of the induced effect. Both resident and nonresident recreation are included and 1995 recreation impacts are conservatively assumed to be equal to those in 1985. Both direct and total average annual wage or salary (personal income per job) associated with the three forest resource uses are also shown. In addition, the average annual rate of forest product sales, employment, and personal income growth is contrasted with all manufacturing in the region for the period 1985 to 1995.

LIMITATIONS OF METHODOLOGY

Any forecast is subject to error because of data deficiencies and unforeseen changes in technology, markets, or other factors. For example, recent energy price swings have dramatically altered wood energy forecasts and can be expected to play a role in outdoor recreation participation as well. Increasing nonwildland recreational opportunities can substitute for those on wildlands. Interest rates can greatly influence levels of economic activity in the construction industry and, in turn, demands for lumber and other wood materials. Governmental policies may also deviate from those assumed in forecasts and thus change the future course of economic activity. Given these variables and their uncertain future, this report's estimates must be considered tentative and used with caution. They reflect a synthesis of the most recent available data used by the region's state governments and the USDA Forest Service for public policy analysis and planning, but it should be noted that they apply only to the particular forest resource use definitions used in this report.

All forecasts rely to some extent on historical trends that may or may not be replicated in the future. The base year for this analysis is 1982 which was a recessionary year. Some of the estimated growth in the forest industries and the economy in general stems from recovery out of depressed economic conditions. This can be seen in table 4 by contrasting the annual growth rates between 1982 and 1985 with growth rates for 1985 to 1995. For most sectors, the 1982 to 1985 period has the higher annual growth. Additionally, although it is not indicated in the table, most sectors are assumed to experience greater growth between 1985 to 1990 than between 1990 and 1995.

DISCUSSION

This report described the growing economic importance of Upper Lake State forests. The forests are valuable assets in the region's economy even if we focus only on outputs priced by organized markets. Their significance is growing and has the potential to grow beyond current projected trends through more intensive management, better marketing arrangements, and promotion.

Estimating final demands is, perhaps, the most critical aspect of this analysis. In general, between 1985 and 1995, timber supply in the Upper Lake States will not be the critical factor determining growth in the forest products industries, demand for forest products will be. There are a few exceptions to this. The region is the center of a dynamic structural particleboard (waferboard and oriented strand board) industry. Competition for supplies of individual timber species, especially aspen, has become intense in certain localities within the region and could constrain forest industry growth in those areas. Timber supplies are generally adequate, however. Another example of the influence of the region's timber supplies is that, as harvests approach or reach allowable cut levels in the South and Northwest, more forest product firms may consider expansion in the Upper Lake States.

Timber product demand, both inside and outside the region, is the overriding growth determinant and will continue to be so. Advances in technology will lessen dependence on particular species and expand the economic timber supply. Michigan, Minnesota, and Wisconsin have benefited from this process. Hardwoods, which dominate the total regional forest

resource, are frequently used in processes that formerly used only softwoods. Expansion in substitution possibilities can be expected to continue, but greater utilization of the region's vast timber resources will not occur unless demands exist for the products manufactured from those resources.

It should be recognized that USDA Forest Service projections of timber growth quantify only physical supply, not economic supply. Economic supply will nearly always be less than physical supply because of constraints on availability relating to such factors as stumpage prices, physical accessibility, pressure from competing uses, government withdrawals of forest land, and diverse ownership goals. Economic supply of timber was not investigated in this study. Use of a demand-driven input-output model assumes that additional inputs of every type are available at constant relative prices. Expansion of industrial capacity must always be based on an investigation of economic supply of timber within economic distance of feasible locations for new facilities.

Can the region's forests maintain higher levels of both timber harvests and recreational use? This appears to be more an issue of perception rather than physical capacity. Creative planning and management will be needed to realize potential increases in both timber production and recreational use from the Upper Lake States forests without increasing conflicts between forest users. For example, Michigan's state forest system is managed on a key-value basis. The central idea is to separate three major classes of uses and users to the degree necessary to prevent serious and unnecessary conflicts. These classes are areas managed primarily for naturalistic values, areas managed primarily for developed recreation (including motorized forms), and areas managed primarily for intensive vegetation management (for wildlife habitat and timber growth and harvest). Designation of these classes involves specifying primary and secondary purposes of management for designated areas. Areas where no conflict is foreseen remain in a mixed-use zone. The effect of this system is to concentrate efforts on areas most productive for particular purposes, and consequently to require less area for given levels of each major forest output.

Based on USDA Forest Service data, it appears that the region as a whole has sufficient forest resources to meet forecasted demands for wood products, wood energy, and forest recreation. Relative to the available resources, there appears to be deficiencies in final demands (in real terms) for many forest products. Therefore, prospects for increased economic activity in the forest product sectors are largely dependent on increases in final demands. This finding suggests a need for more detailed economic impact analysis and marketing research that can lead to increased and more effective marketing efforts on the part of the forest products industry.

Data limitations and the transitional status of the USDA Forest Service's IMPLAN model prohibit making extensive public policy recommendations here. More emphasis needs to be placed on estimating final demands and marketing analysis. These analyses should be conducted with a clear recognition of the international interdependencies in the timber market and many other sectors of the regional economy. They require a high degree of cooperation from the private sector to produce meaningful results for both government and commercial interests. More detailed consideration of import/export relations could identify import substitution prospects through greater regional production of forest products. Other research needs include detailed examination of supply constraints, cost factors, and effects on employment from changes in forest industry productivity. Another issue that should be evaluated is the impact of government policy towards the forests in terms of subsequent distributional income, tax, and employment effects.

Although the Lake States forests account for modest amounts of economic activity in the region as a whole, they are significant components of the economic base of rural areas. In this age of extreme economic distress in rural areas, caused largely by a severe downturn in the region's agricultural and mining sectors, further development of the region's forests as economic assets on which to base increased economic activity can help alleviate economic distress. It is necessary, however, to diversify the regional economy in ways that will lead to growth. Sectors targeted for emphasis must be selected on the basis of their expected future performance and expected regional comparative advantage, and not simply on their past performance.

This study took advantage of a wide range of data and models to construct a picture of the economic contribution the Lake States forests make to the region. The study particularly relied upon DRI and REMI estimates for forest products, Employment Research Associates' wood energy analysis, and

Minnesota DNR outdoor recreation data. The analysis would have been severely constrained had these sources of information not been available. Efforts aimed at conducting similar analyses for state or substate regions may well suffer from an absence of secondary information sources; however, some data and models comparable to those used in this study are likely to be available from the USDA Forest Service, state-level Commerce or Natural Resource Departments, and universities. Chappelle *et al.* (1986) provides an example of a state-level forest products industry I/O analysis.

Based on the projections presented in this report, it appears that the region's forest product industries will expand at a rate approaching 3 percent annually between 1985 and 1995. This is above the forecasted performance of the overall economy of the Lake States. Wood furniture appears to have the best growth prospects among the major groupings of forest products at the SIC 2-digit level. Starting from a relatively small base, the structural particleboard sector (SIC 2492) is projected to continue its rapid growth through the 1985 to 1995 period with an average annual growth rate of more than 8 percent. Other sectors that were projected to grow by more than 3 percent included the aggregated hardwood dimension and flooring and special product sawmills sector, pulp and paper mills, and paper coating and glazing.

This study provides the basis for an important Lake States agenda for the future. In conducting the study, we noted many data deficiencies, particularly with respect to outdoor recreation. Higher quality, compatible and consistent data on recreation needs to be developed so that economic impacts relating to recreation can be evaluated on the same basis as are those for the forest products industry.

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APPENDIX A

Interpretation of Impact Estimates

The personal income impact estimates for the logging camps and contractors sector will be used to illustrate how to interpret economic impact estimates (tables 4 through 11). The personal income direct impact component for this sector is estimated to be 0.198, the indirect to be 0.109, and the induced to be 0.068 (table 8). This implies that for every dollar change in final demand for this sector, 19.8 cents goes directly to personal income. Additional personal income equal to 10.9 cents is generated by intermediate transactions required to meet the final demand, and 6.8 cents in personal income is generated through additional household (induced) spending. Thus, for every $1 million change in final demand for logging camps and contractors there would be $198,000 in direct personal income, $109,000 in indirect personal income, and $68,000 in induced personal income. The Type I multiplier is the sum of the direct and indirect impacts, divided by the direct impact. For the logging camps and contractors sector, the Type I personal income multiplier can be derived as follows:

$$0.198 + 0.109 = 0.307$$
$$0.307/0.198 = 1.552$$

The Type III multiplier is calculated similarly by adding the induced impact to the direct and indirect impacts, and then dividing by the direct impact. It would be derived for the logging camps and contractors sector (with rounding) as follows:

$$0.198 + 0.109 + 0.068 = 0.375$$
$$0.375/0.198 = 1.897$$

These multipliers are used with the direct impacts to estimate the "ripple effect" from initial changes in economic activity. For example, with a $1 million change in final demands for the logging camps and contractors sector, the Type I multiplier indicates there will be 1.897 x $198,000 = $307,296 in direct and indirect personal income generated, whereas the Type III multiplier indicates there will be 1.897 x $198,000 = $375,606 direct, indirect, and induced personal income generated.

The Type I and Type III multipliers are useful as measures of the additional activity which can be expected to occur throughout the economy from changes in a particular economic sector if additional inputs are available. Because they are ratios of total impacts to the direct impact, use of the Type I and III multipliers can be misleading if used by themselves. For example, sanitary paper products has the largest Type I and III personal income and employment multipliers (tables 7 and 8). This, however, is partly a result of the low direct impacts associated with this sector.

The size of impacts differs depending on the economic measure considered and whether the induced component of the impact is included. For example, particleboard has a higher than average Type I sales multiplier, 1.54, but its Type III sales multiplier, 1.79, is lower than average for lumber and wood products (SIC 24) (table 6). As another example, the particleboard total personal income and employment multipliers can be misleading if the sector's lower than average direct impacts are not considered (tables 7 and 8).

TABLE TITLES

Table 1.–Standard Industry Classification (SIC) codes, SIC forest industry sectors, and Lake States forest industry sectors used in this study

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Table 9.–Estimated sales multiplier effects from changes in final demand, by forest product sector, 1985 and 1995, Lake States

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Table 11.–Estimated employment impacts and multiplier effects from changes in final demand, by forest product sector, 1985 and 1995, Lake States

Table 12.–Wood energy sales, employment, and personal income impacts, 1985 and 1995, Lake States

Table 13.–Estimated direct and total sales, employment, and personal income impacts by sector for all (resident and nonresident) outdoor recreation in forested areas, 1985, Lake States

Table 14.–Estimated direct and total sales, employment, and personal income impacts by sector for nonresident outdoor recreation in forested areas, 1985, Lake States

Table 15.–Summary of direct and total forest-related impacts, including sales, personal income and employment; average annual wage or salary associated with forest resource uses; and contrast of rates of growth between forest product sectors and regional manufacturing, 1985 and 1995, Lake States

Table 1.—*Standard Industry Classification (SIC) codes, SIC forest industry sectors, and Lake States forest industry sectors used in this study*

SIC code	SIC forest industry sectors	Lake States forest industry sectors
2411	Logging camps & contractors	Logging camps & contractors
2421	Sawmills & planing mills	Sawmills & planing mills
2426	Hardwood dimension flooring	Dimension flooring & special product sawmills
2429	Special product sawmills[1]	
2431	Millwork	Millwork
2434	Wood kitchen cabinets	Wood & lumber products[1]
2441	Nailed & lock corner boxes	
2448	Wood pallets & skids	
2449	Wood containers[1]	
2491	Wood preserving	
2499	Wood products[1]	
2435	Hardwood veneer & plywood	Veneer, plywood, structural members
2436	Softwood veneer & plywood	
2439	Structural wood members	
2451	Mobile homes	Prefabricated buildings and mobile homes
2452	Prefabricated wood buildings	
2491	Particleboard	Particleboard
2511	Nonupholstered furniture	Household wood furniture
2512	Upholstered wood furniture	
2517	Wood TV, radio, phone...	Other wood furniture
2521	Wood office furniture	
2531	Public bldg. & related furniture	
2541	Wood partitions, shelving...	
2611	Pulpmills	Pulpmills
2621	Paper mills	Paper mills
2631	Paperboard mills	Paperboard mills
2641	Paper coating & glazing	Paper coating & glazing
2642	Envelopes	Miscellaneous converted pulp & paper products
2643	Bags	
2645	Die-cut paper, paperboard...	
2646	Pressed & molded pulp goods	
2648	Stationery, tablets, related...	
2649	Converted paper & paperboard[1]	
2661	Building paper	Building paper
2647	Sanitary paper products	Sanitary paper products
265	Paperboard containers & boxes	Paperboard containers & boxes

[1]Not elsewhere classified.

Table 2.—*Distribution of a recreational expenditure dollar among sectors for all recreationists and nonresident recreationists, Lake States, 1985-1986*

SIC code	Major outdoor recreation spending categories /sectors	Average spending all recreationists	Average spending, nonresident
20 & 21	Food & tobacco products	0.12	0.06
22 & 23	Textiles & apparel	.02	.03
29	Petroleum production	.12	.14
38 & 29	Misc. manufacturing	.03	.03
50 & 51	Wholesale trade	.06	.05
52 - 59	Retain trade	.13	.12
70	Hotels & lodging places	.21	.22
71 - 90	Misc. services	.04	.06
58	Restaurants & bars	.16	.16
79	Amusement & recreation services	.04	.05
	Other	.07	.08
	Total	1.00	1.00

Source: Derived from the Minnesota 1985-1986 DNR Outdoor Recreation and Expenditure Survey and the summer 1978 Motor Vehicle Visitor Survey (converted to 1982 values by sector-specific inflators from the USDA Forest Service IMPLAN Analysis Guide (1985).

Table 3.—*IMPLAN estimates of sales, employment, and personal income by forest product sector, Lake States, 1982*

Forest sector name	Sales	Employment	Personal income
	$million	*Thousand jobs*	*$million*
	Lumber & wood products—SIC 24		
Logging camps & contractors	411.0	3.2	81.4
Sawmills & planing mills	244.0	4.7	68.3
Hardwood dimension flooring, special product sawmills	65.0	1.9	22.2
Millwork	680.0	11.0	139.3
Wood & lumber products[1]	710.2	13.7	196.1
Veneer, plywood, structural members	226.9	3.7	55.9
Prefabricated buildings & mobile homes	287.2	4.1	59.1
Particleboard	84.0	0.8	16.2
SIC 24 total	2,708.3	43.1	638.5
	Wood furniture & fixtures—part SIC 25		
Household wood furniture	346.2	6.6	111.1
Other wood furniture	984.0	17.7	307.0
SIC 25 total	1,330.2	24.3	418.1
	Pulp & paper products—SIC 26		
Pulpmills	51.1	0.7	11.8
Paper mills	4,263.9	31.3	1,013.0
Paperboard mills	1,056.6	7.5	242.4
Paper coating & glazing	1,593.5	15.2	357.6
Miscellaneous converted pulp & paper products	876.2	10.8	217.2
Sanitary paper products	1,827.4	6.5	261.4
Paperboard containers & boxes	1,598.9	12.7	342.0
SIC 26 total	11,267.6	84.4	2,445.4
Total all forest product sectors	15,306.1	152.1	3,502.0
Percent of region's total manufacturing	8.0	9.1	7.7

[1] Not elsewhere classified

Table 4.—*Estimated forest product sales and growth in sales, Lake States, 1982, 1985, and 1995*

Forest product sector	Estimated sales 1985	Estimated sales 1995	Growth ratios 1982-1985	Growth ratios 1985-1995	Annual growth rate 1982-1985	Annual growth rate 1985-1995
	1982 $million				*Percent*	
Lumber & wood products—SIC 24						
Logging camps & contractors	472	619	1.15	1.31	4.75	2.74
Sawmills & planing mills	294	375	1.20	1.28	6.38	2.47
Dimension flooring & special product sawmills	75	106	1.16	1.41	4.95	3.49
Millwork	815	1,015	1.20	1.24	6.24	2.21
Wood & lumber products	899	1,131	1.27	1.26	8.16	2.33
Veneer, plywood, structural members	260	319	1.14	1.23	4.58	2.09
Prefabricated buildings & mobile homes	454	590	1.58	1.30	16.45	2.66
Particleboard	185	406	2.20	2.20	30.03	8.19
SIC 24 total[1]	3,454	4,561	1.28	1.32	8.44	2.82
Wood furniture & fixtures—SIC 25						
Household furniture	429	664	1.24	1.55	7.45	4.46
Other wood furniture	926	1,338	.94	1.44	-2.00	3.74
SIC 25 total[1]	1,355	2,002	1.02	1.48	.63	3.98
Pulp & paper products—SIC 26						
Pulpmills	52	72	1.02	1.37	.77	3.19
Paper mills	4,526	6,244	1.06	1.38	2.01	3.27
Paperboard mills	1,136	1,430	1.08	1.26	2.44	2.33
Paper coating & glazing	1,782	2,462	1.12	1.38	3.81	3.28
Miscellaneous converted pulp & paper products	933	1,211	1.06	1.30	2.12	2.64
Sanitary paper products	1,729	1,915	.95	1.11	-1.82	1.02
Paperboard containers & boxes	1,800	2,273	1.13	1.26	4.02	2.36
SIC 26 total[1]	11,958	15,607	1.06	1.31	2.01	2.70
Total all forest product sectors[1]	16,767	22,170	1.10	1.32	3.09	2.83
Region's total economy			1.15	1.27	4.77	2.35

[1]Total forest product sector and regional growth ratios and growth rates are sales weighted averages.

Table 5.—*Estimated forest product employment and personal income, 1985 and 1995, and IMPLAN employment and personal income coefficients, Lake States*

Forest industry sector	Employment 1985	Employment 1995	Personal income 1985	Personal income 1995	Employment coefficient	Personal income coefficient
	Number of jobs		*1982 $million*		*Number of jobs per $million in sales*	*Personal income per $1 in sales*
Lumber & wood products—SIC 24						
Logging camps & contractors	3,625	4,749	94	123	7.6747	0.1980
Sawmills & planing mills	5,621	7,174	82	105	19.1331	.2798
Dimension flooring & special product sawmills	2,140	3,016	26	36	28.476	.3420
Millwork	13,171	16,396	167	208	16.151	.2049
Wood & lumber products[1]	17,335	21,817	248	312	19.294	.2762
Veneer, plywood, structural members	4,208	5,173	64	79	16.2146	.2465
Prefabricated buildings & mobile homes	6,504	8,459	93	121	14.3404	.2058
Particleboard	1,719	3,779	36	78	9.3046	.1933
SIC 24 total	54,323	70,563	810	1,062		
Wood furniture & fixtures—part SIC 25						
Household wood furniture	8,134	12,584	138	213	18.9419	.3209
Other wood furniture	16,673	24,079	289	417	18.0009	.3120
SIC 25 total	24,807	36,663	427	630		
Pulp & paper products—SIC 26						
Pulpmills	726	993	12	17	13.8807	.2307
Paper mills	33,247	45,870	1,075	1,484	7.3464	.2376
Paperboard mills	8,117	10,222	261	328	7.1463	.2294
Paper coating & glazing	16,985	23,451	400	552	9.5255	.2244
Miscellaneous converted pulp & paper products	11,500	14,930	231	300	12.3254	.2478
Sanitary paper products	6,192	6,855	247	274	3.5805	.143
Paperboard containers & boxes	14,295	18,056	385	486	7.9428	.2139
SIC 26 total	91,062	120,377	2,611	3,441		
Total all forest product sectors	170,192	227,603	3,848	5,133		

[1] Not elsewhere classified.

Table 6.—*IMPLAN Type I and Type III sales multipliers by forest product sector, Lake States*

Forest industry sector	Multipliers	
	Type I	Type III
Lumber & wood products—SIC 24		
Logging camps & contractors	1.571	1.808
Sawmills & planing mills	1.476	1.877
Dimension flooring & special product sawmills	1.375	1.935
Millwork	1.466	1.851
Wood & lumber products[1]	1.463	1.888
Veneer, plywood, structural members	1.470	1.838
Prefabricated buildings & mobile homes	1.508	1.871
Particleboard	1.541	1.793
SIC 24 weighted average	1.485	1.859
Wood furniture & fixtures—part SIC 25		
Household wood furniture	1.386	1.801
Other wood furniture	1.443	1.855
SIC 25 weighted average	1.428	1.841
Pulp & paper products—SIC 26		
Pulpmills	1.439	1.753
Paper mills	1.391	1.588
Paperboard mills	1.455	1.657
Paper coating & glazing	1.461	1.703
Miscellaneous converted pulp & paper products	1.471	1.765
Sanitary paper products	1.495	1.650
Paperboard containers & boxes	1.465	1.678
SIC 26 weighted average	1.443	1.648
Total all forest product sectors weighted average	1.450	1.714

[1] Not elsewhere classified.

Table 7.—*IMPLAN employment impacts expressed in number of jobs per million dollars (1982) of sales and Type I and Type III employment multipliers by forest product sector, Lake States*

Forest industry sector	Type of impact				Type of multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II
	Number of jobs per $million sales					
	Lumber & wood products—SIC 24					
Logging camps & contractors	7.675	6.583	4.098	18.356	1.858	2.392
Sawmills & planing mills	19.133	4.927	6.915	30.975	1.258	1.619
Dimension flooring & special product sawmills	28.476	5.156	9.666	43.297	1.181	1.521
Millwork	16.151	6.973	6.646	29.770	1.432	1.843
Wood & lumber products[1]	19.294	6.277	7.349	32.920	1.325	1.706
Veneer, plywood, structural members	16.215	5.866	6.346	28.427	1.362	1.753
Prefabricated buildings & mobile homes	14.340	7.487	6.273	28.101	1.522	1.960
Particleboard	9.305	5.821	4.347	19.472	1.626	2.093
SIC 24 weighted average	16.060	6.436	6.465	28.962	1.401	1.803
	Wood furniture & fixtures—part SIC 25					
Household wood furniture	18.942	5.988	7.165	32.095	1.316	1.694
Other wood furniture	18.001	6.758	7.116	31.874	1.375	1.771
SIC 25 weighted average	18.246	6.557	7.128	31.932	1.359	1.750
	Pulp & paper products—SIC 26					
Pulpmills	13.881	4.989	5.423	24.293	1.359	1.750
Paper mills	7.346	4.479	3.399	15.224	1.610	2.072
Paperboard mills	7.146	5.000	3.491	15.637	1.700	2.188
Paper coating & glazing	9.526	5.060	4.192	18.778	1.531	1.971
Miscellaneous converted pulp & paper products	12.325	5.298	5.065	22.688	1.430	1.841
Sanitary paper products	3.581	5.732	2.676	11.989	2.601	3.348
Paperboard containers & boxes	7.943	4.873	3.683	16.499	1.614	2.077
SIC 26 weighted average	7.307	4.974	3.530	15.810	1.681	2.164
Total all forest product sectors weighted average	10.384	5.461	4.554	20.399	1.526	1.965

[1] Not elsewhere classified.

Table 8.—*IMPLAN personal income impacts expressed in amount of personal income per dollar (1982) of sales and Type I and Type III personal income multipliers by forest product sector, Lake States*

Forest industry sector	Type of impact				Type of multiplier	
	Direct	Indirect	Induced	Total	Type I	Type III
	Personal income per $1 sales					
Lumber & wood products—SIC 24						
Logging camps & contractors	0.198	.109	.068	.376	1.552	1.897
Sawmills & planing mills	.280	.104	.115	.499	1.372	1.784
Dimension flooring & special product sawmills	.342	.102	.161	.605	1.297	1.768
Millwork	.205	.140	.111	.456	1.685	2.226
Wood & lumber products[1]	.276	.126	.122	.524	1.455	1.898
Veneer, plywood, structural members	.247	.119	.106	.471	1.483	1.912
Prefabricated buildings & mobile homes	.206	.152	.105	.462	1.738	2.246
Particleboard	.193	.133	.072	.399	1.687	2.062
SIC 24 weighted average	.236	.127	.108	.472	1.539	1.995
Wood furniture & fixtures—part SIC 25						
Household wood furniture	.321	.117	.119	.558	1.366	1.738
Other wood furniture	.312	.136	.119	.567	1.437	1.817
SIC 25 weighted average	.314	.131	.119	.564	1.418	1.796
Pulp & paper products—SIC 26						
Pulpmills	.231	.111	.090	.433	1.483	1.875
Paper mills	.238	.102	.057	.396	1.429	1.667
Paperboard mills	.229	.113	.058	.400	1.491	1.745
Paper coating & glazing	.224	.122	.070	.416	1.542	1.854
Miscellaneous converted pulp & paper products	.248	.127	.084	.459	1.511	1.852
Sanitary paper products	.143	.139	.045	.326	1.969	2.281
Paperboard containers & boxes	.214	.121	.061	.397	1.567	1.854
SIC 26 weighted average	.213	.118	.059	.389	1.553	1.829
Total all forest product sectors weighted average	.229	.121	.076	.426	1.530	1.861

[1] Not elsewhere classified.

Table 9.—*Estimated sales multiplier effects from changes in final demand, by forest product sector, 1985 and 1995, Lake States*

(In 1982 $million)

Forest industry sector	1985 multipliers		1995 multipliers	
	Type I	Type III	Type I	Type III
Lumber & wood products—SIC 24				
Logging camps & contractors	741	853	972	1,119
Sawmills & planing mills	434	552	554	704
Dimension flooring & special product sawmills	103	145	146	205
Millwork	1,195	1,509	1,488	1,879
Wood & lumber products[1]	1,315	1,698	1,654	2,136
Veneer, plywood, structural members	382	478	469	586
Prefabricated buildings & mobile homes	685	850	890	1,104
Particleboard	285	332	626	728
SIC 24 total	5,140	6,417	6,799	8,461
Wood furniture & fixtures—part SIC 25				
Household wood furniture	595	773	920	1,196
Other wood furniture	1,336	1,718	1,931	2,483
SIC 25 total	1,931	2,491	2,851	3,679
Pulp & paper products—SIC 26				
Pulpmills	75	91	104	126
Paper mills	6,296	7,187	8,686	9,915
Paperboard mills	1,653	1,882	2,080	2,370
Paper coating & glazing	2,603	3,035	3,596	4,194
Miscellaneous converted pulp & paper products	1,373	1,647	1,782	2,137
Sanitary paper products	2,585	2,854	2,863	3,161
Paperboard containers & boxes	2,636	3,020	3,329	3,814
SIC 26 total	17,221	19,716	22,440	25,717
Total all forest product sectors	24,292	28,624	32,090	37,857

[1] Not elsewhere classified.

Table 10.—*Estimated personal income impacts and multiplier effects from changes in final demand, by forest product sector, 1985 and 1995, Lake States*

Forest industry sector	Type of impact				Type of multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II
	1982 $million					
1985						
	Lumber & wood products—SIC 24					
Logging camps & contractors	94	52	32	177	145	177
Sawmills & planing mills	82	31	34	147	113	147
Dimension flooring & special product sawmills	26	8	12	45	33	45
Millwork	167	114	90	372	281	372
Wood & lumber products[1]	248	113	110	471	361	471
Veneer, plywood, structural members	64	31	27	123	95	123
Prefabricated buildings & mobile homes	93	69	47	210	162	210
Particleboard	36	25	13	74	60	74
SIC 24 total	810	443	365	1,619	1,250	1,619
	Wood furniture & fixtures—part SIC 25					
Household wood furniture	138	50	51	239	188	239
Other wood furniture	289	126	110	525	415	525
SIC 25 total	427	176	161	764	603	764
	Pulp & paper products—SIC 26					
Pulpmills	12	6	5	22	18	22
Paper mills	1,075	461	256	1,792	1,536	1,792
Paperboard mills	261	128	66	455	389	455
Paper coating & glazing	400	217	124	741	617	741
Miscellaneous converted pulp & paper products	231	118	79	428	349	428
Sanitary paper products	247	240	77	564	487	564
Paperboard containers & boxes	385	218	110	714	603	714
SIC 26 total	2,611	1,388	717	4,716	3,999	4,716
Total all forest product sectors	3,848	2,007	1,243	7,099	5,852	7,099

(Table 10 continued on next page)

(Table 10 continued)

Forest industry sector	Type of impact				Type of multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II
	1982 $million					
1995						
	Lumber & wood products—SIC 24					
Logging camps & contractors	123	68	42	232	190	232
Sawmills & planing mills	105	39	43	187	144	187
Dimension flooring & special product sawmills	36	11	17	64	47	64
Millwork	208	143	112	463	350	463
Wood & lumber products[1]	312	142	138	593	454	593
Veneer, plywood, structural members	79	38	34	150	117	150
Prefabricated buildings & mobile homes	121	90	62	273	211	273
Particleboard	78	54	29	162	132	162
SIC 24 total	1,062	585	477	2,124	1,645	2,124
	Wood furniture & fixtures—part SIC 25					
Household wood furniture	213	78	79	370	291	370
Other wood furniture	417	182	159	758	600	758
SIC 25 total	630	260	238	1,128	891	1,128
	Pulp & paper products—SIC 26					
Pulpmills	17	8	7	31	25	31
Paper mills	1,484	636	353	2,473	2,119	2,473
Paperboard mills	328	161	83	572	489	572
Paper coating & glazing	552	300	172	1,024	852	1,024
Miscellaneous converted pulp & paper products	300	153	102	556	454	556
Sanitary paper products	274	265	85	625	539	625
Paperboard containers & boxes	486	276	139	901	762	901
SIC 26 total	3,441	1,799	941	6,182	5,240	6,182
Total all forest product sectors	5,133	2,644	1,656	9,434	7,776	9,434

[1] Not elsewhere classified.

Table 11.—*Estimated employment impacts and multiplier effects from changes in final demand, by forest product sector, 1985 and 1995, Lake States*

Forest industry sector	Type of impact				Type of multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II
	Number of jobs					
1985						
	Lumber & wood products—SIC 24					
Logging camps & contractors	3,625	3,107	1,934	8,666	6,732	8,666
Sawmills & planing mills	5,621	1,449	2,033	9,103	7,070	9,103
Dimension flooring & special product sawmills	2,140	387	725	3,252	2,527	3,252
Millwork	13,171	5,683	5,416	24,270	18,854	24,270
Wood & lumber products[1]	17,335	5,643	6,607	29,585	22,978	29,585
Veneer, plywood, structural members	4,208	1,525	1,650	7,383	5,733	7,383
Prefabricated buildings & mobile homes	6,504	3,399	2,848	12,751	9,903	12,751
Particleboard	1,719	1,077	804	3,600	2,796	3,600
SIC 24 total	54,323	22,270	22,017	98,610	76,593	98,610
	Wood furniture & fixtures—part SIC 25					
Household wood furniture	8,134	2,569	3,074	13,777	10,703	13,777
Other wood furniture	16,673	6,258	6,589	29,520	22,931	29,520
SIC 25 total	24,807	8,827	9,663	43,297	33,634	43,297
	Pulp & paper products—SIC 26					
Pulpmills	726	259	282	1,267	985	1,267
Paper mills	33,247	20,271	15,382	68,899	53,518	68,899
Paperboard mills	8,117	5,680	3,966	17,763	13,797	17,763
Paper coating & glazing	16,985	9,017	7,470	33,472	26,002	33,472
Miscellaneous converted pulp & paper products	11,500	4,943	4,726	21,168	16,443	21,168
Sanitary paper products	6,192	9,911	4,627	20,730	16,103	20,730
Paperboard containers & boxes	14,295	8,771	6,630	29,696	23,066	29,696
SIC 26 total	91,062	58,852	43,083	192,995	149,914	192,995
Total for all forest product sectors	170,192	89,949	74,763	334,902	260,141	334,902

(Table 11 continued on next page)

(Table 11 continued)

Forest industry sector	Type of impact				Type of multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II
	Number of jobs					
1995						
	Lumber & wood products—SIC 24					
Logging camps & contractors	4,749	4,075	2,536	11,362	8,826	11,362
Sawmills & planing mills	7,174	1,848	2,593	11,616	9,023	11,616
Dimension flooring & special product sawmills	3,016	546	1,025	4,589	3,565	4,589
Millwork	16,396	7,078	6,745	30,216	23,471	30,216
Wood & lumber products[1]	21,817	7,099	8,312	37,232	28,921	37,232
Veneer, plywood, structural members	5,173	1,871	2,024	9,068	7,044	9,068
Prefabricated buildings & mobile homes	8,459	4,417	3,701	16,579	12,878	16,579
Particleboard	3,779	2,363	1,765	7,906	6,141	7,906
SIC 24 total	70,563	29,297	28,701	128,568	99,869	128,568
	Wood furniture & fixtures—part SIC 25					
Household wood furniture	12,584	3,976	4,757	21,311	16,553	21,311
Other wood furniture	21,079	9,042	9,521	42,648	33,127	42,648
SIC 25 total	33,633	13,018	14,278	63,959	49,680	63,959
	Pulp & paper products—SIC 26					
Pulpmills	993	359	390	1,749	1,359	1,749
Paper mills	45,870	27,965	21,220	95,056	73,836	95,056
Paperboard mills	10,222	7,150	4,992	22,361	17,369	22,361
Paper coating & glazing	23,451	12,458	10,320	46,230	35,910	46,230
Miscellaneous converted pulp & paper products	14,930	6,416	6,134	27,475	21,342	27,475
Sanitary paper products	6,855	10,977	5,125	22,959	17,834	22,959
Paperboard containers & boxes	18,056	11,076	8,372	37,502	29,130	37,502
SIC 26 total	120,377	76,401	56,553	253,332	196,780	253,332
Total for all forest product sectors	227,603	118,716	99,532	445,859	346,329	445,859

[1] Not elsewhere classified.

Table 12.—*Wood energy sales, employment, and personal income impacts, 1985 and 1995, Lake States*

Impacts	1985	1995
Sales ('82 $million)		
Direct & indirect	-207.12	-216.75
Direct, indirect & induced	74.44	104.70
Employment (jobs)		
Direct	6,069	7,041
Indirect	981	1,193
Induced	2,046	2,389
Total	9,097	10,623
Personal income ('82 $million)		
Direct	104.67	123.16
Indirect	12.82	16.08
Induced	34.32	40.08
Total	151.81	179.32

Table 13.—*Estimated direct and total sales, employment, and personal income impacts by sector for all (resident and nonresident) outdoor recreation in forested areas, 1985, Lake States*

Industry sector	Sales		Employment		Personal income	
	Direct	Total[1]	Direct	Total	Direct	Total
	1982 $ million		*Jobs*		*1982 $ million*	
Food & tobacco products	256,798	519,142	1,311	4,099	30,353	80,215
Textiles & apparel	50,591	77,612	727	1,156	14,995	22,881
Petroleum production	322,995	485,365	381	2,186	15,407	56,469
Misc. manufacturing	60,624	100,812	978	1,617	20,436	32,328
Wholesale trade	125,090	204,072	2,198	3,572	51,537	75,126
Retail trade	275,369	530,719	10,663	14,920	127,992	201,830
Hotels & lodging	441,738	984,325	17,677	26,330	127,353	282,775
Misc. services	85,329	154,061	2,069	3,217	35,812	56,093
Restaurants & bars	326,848	735,049	11,035	16,721	94,753	195,978
Amusement & recreational services	85,958	192,476	3,712	5,566	28,959	59,847
Other	144,942	260,896	3,624	5,798	43,483	79,718
Total	2,176,282	4,244,529	54,375	85,182	591,080	1,143,260

[1] Multiplier impacts based on Type III multiplier.

Table 14.—*Estimated direct and total sales, employment, and personal income impacts by sector for nonresident outdoor recreation in forested areas, 1985, Lake States*[1]

Industry sector	Output		Employment		Personal income	
	Direct	Total	Direct	Total	Direct	Total
	1982 $million		*Jobs*		*1982 $million*	
Food & tobacco products	35,667	72,104	182	569	4,216	11,141
Textiles & apparel	21,648	33,210	311	495	6,416	9,791
Petroleum production	102,423	153,912	121	693	4,886	17,907
Misc. manufacturing	17,554	29,191	283	468	5,918	9,361
Wholesale trade	33,372	54,442	586	953	13,749	20,042
Retail trade	77,474	149,316	3,000	4,198	36,010	56,784
Hotels & lodging	131,407	292,814	5,258	7,832	37,885	84,119
Misc. services	39,842	71,936	966	1,502	16,722	26,191
Restaurants & bars	97,596	219,483	3,295	4,993	28,293	58,518
Amusement & recreation services	29,120	65,206	1,258	1,886	9,811	20,275
Other	47,390	85,302	1,185	1,896	14,217	26,065
Total	633,494	1,226,916	16,445	25,485	178,122	340,194

[1]Multiplier impacts based on Type III multiplier.

Table 15.—*Summary of direct and total forest-related impacts, including sales, personal income and employment; average annual wage or salary associated with forest resource uses; and constrast of rates of growth between forest product sectors and regional manufacturing, 1985 and 1995, Lake States*

Summary sector	Output		Employment		Personal income		Average annual wage or salary[1]	
	Direct	Total	Direct	Total	Direct	Total	Direct	Total
	1982 $million		*1,000 jobs*		*1982 $million*		*1982 $thousand*	
1985								
Forest products industry	16,767	28,624	170.2	334.9	3,848	7,099	22.6	21.2
Wood energy	-207	74	6.1	9.1	105	152	17.2	16.7
Outdoor recreation	2,176	4,245	54.4	85.2	591	1,143	10.9	13.4
Total	18,740	32,943	230.7	429.2	4,544	8,394	19.7	19.6
1995								
Forest products industry	22,170	37,857	227.6	445.9	5,133	9,434	22.6	21.2
Wood energy	-217	105	7.0	10.6	123	179	17.6	16.9
Outdoor recreation	2,176	4,245	54.4	85.2	591	1,143	10.9	13.4
Total	24,129	42,207	289.0	541.7	5,847	10,756	20.1	19.9
Percent rate of growth 1985-1995								
Forest products sector average annual rate of growth	2.56	2.51	2.28	2.35	2.55	2.51		
Manufacturing rate of growth	2.27	2.29	2.61	2.50	2.48	2.43		

[1]Calculated by dividing personal income by employment, where employment includes full and part-time jobs. The relatively low outdoor recreation average yearly wage reflects outdoor recreation affecting sectors which have both more part-time jobs and lower employee compensation. The 1995 average yearly wages are virtually the same as 1985 because the same IMPLAN base year (1982) relationships were used to construct the estimates.

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Pedersen, Larry; Chappelle, Daniel E.; Lothner, David C. 1989. **The economic impacts of Lake States forestry: an input-output study**. Gen. Tech. Rep. NC-136. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 32 p.

The report describes 1985 and 1995 levels of forest-related economic activity in the three-state area of Michigan, Minnesota, and Wisconsin, and their impacts on other economic sectors based on a regional input-output model.

KEY WORDS: Project forest-based economic activity, economic impacts of outdoor recreation, economic impacts of wood energy.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.

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