

Forest Industry as a Force in Economic Development: Options for Minnesota's Future

Miscellaneous Publication 33
Agricultural Experiment Station
University of Minnesota—1985



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The University of Minnesota Agricultural Experiment Station and the College of Forestry paid for the production of this publication. It is intended for use by a wide range of persons and organizations interested in the use of forests for purposes of economic development. Initial distribution was made by the College of Forestry. Until the original printing is exhausted, copies are available from the College of Forestry, 110 Green Hall, 1530 North Cleveland Avenue, University of Minnesota, St. Paul, Minnesota 55108, USA.

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**Forest Industry
as a Force
in Economic
Development:
Options for
Minnesota's
Future**

**Proceedings of the
Governor's Conference on Forestry
December 1984
St. Paul, Minnesota**

**Edited by Paul V. Ellefson,
Bernard J. Lewis,
and Richard A. Skok**

**Paul V. Ellefson is professor, forest economics and policy,
and Bernard J. Lewis is a research fellow, Department of
Forest Resources, College of Forestry. Richard A. Skok is
dean of the College of Forestry.**

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Conference Highlights

Forestry is the third largest economic sector in Minnesota, generating over \$2 billion in sales and employing over 120,000 persons.

Minnesota's forests occupy 16.7 million acres of land, 13.7 million acres of which is classified as commercial timberland. Ownership of the latter is unique among the nation's states, namely, 36 percent state and county, 41 percent non-industrial private, 17 percent federal, and 6 percent industrial.

Minnesota is currently utilizing its "second" forest, the "first" having been used for economic development in the late 1800s and early 1900s. The state has an opportunity to develop an even more productive "third" forest.

Minnesota's forestry sector has seen a number of very positive actions during the past 10 years, including intensified timber management on county, state, federal, and industrial forest land; large-scale investments in wood processing facilities; and adoption of major forest policies addressing planning, financing, and research programs.

Numerous resource, economic, and political changes will have a major influence on the future direction of the state's forestry sector, including an emerging Lake States regional perspective, signals for expanding the export of forest products to foreign markets, an ever-maturing structure of forest stands, a perception of forests as strategic resources to be used for industrial development, an awareness of the need for long-term sustained financial support for forestry programs, a recognition of commitment to lifelong professional education, a recognition of resource information as critical to informed management, and a growing awareness that science and technology are the foundations of success in achieving economic development goals.

Minnesota's forestry sector must continue to strengthen linkages with other units within the sector, with other sectors within the state and nation, and, indeed, with other parts of the world. A strong and understanding partnership between public and private forestry interests is critical to forest sector development in the years ahead.

Many of Minnesota's forested areas are located in the state's most economically depressed areas; thus, forest industry is often in a special position to assist such areas. The economic woes facing these areas, however, are often so large that development of forest industry will be only a partial solution.

Conditions that can facilitate economic development within the state's forestry sector include a positive and receptive interest in the industry and its activities, a spirit of cooperation by pollution control administrators, an efficient and timely review process for large-scale investments, an understanding of and a willingness to facilitate modern timber management practices (especially pesticide use), and equitable tax

policies which encourage industrial development while providing for fair contributions to the operation of government.

Public industrial development programs are many and their use in the state's forestry sector should be encouraged. Important programs include the Iron Range Resource and Rehabilitation Board's loan participation and industrial revenue bond programs and the Minnesota Department of Energy and Economic Development's loan, employment and training, and tax incentive programs.

Products that might be involved in further development of the industrial forestry sector include secondary processing of dimension blanks from hardwood, speciality products such as wood boxes and turnings, finished products such as furniture, structural "I" beams from secondary products, treated waferboards from hardwood chips, and forest biomass as an energy source.

Secondary wood-product manufacturing industries and forest product machinery and equipment manufacturers are important elements of the state's wood-based sector and should be encouraged.

High quality labor is critical to a progressive wood-based industry; such should be facilitated by cooperative union-management programs and sincere bargaining efforts on the part of management and labor.

Advances in product technology (e.g., composite products) and process innovation are probably more critical to forest sector economic development than timber resource availability. As such they should be given special emphasis in forest sector development programs.

Investments in forestry research fuel increased productivity in the forestry sector. Research opportunities are especially lucrative in the areas of reconstituted wood, wood chemistry, biodecomposition of wood, integration of commodity and non-commodity outputs from land management, and development of timber-related products capable of generating economic activity.

Information required for forest industry expansion should be readily available, especially information concerning timber inventories, transportation, energy and fuel, workforce, and market conditions.

High quality, timely information about the state's timber supply is critical to industrial development interests; usefulness of forest survey information can be improved by reducing time between measurement cycles, focusing on the county as a reporting unit, encouraging consistency among surveys, incorporating current utilization standards, providing direct access to survey information, developing survey user guides, developing procedures for updating timber supply information, and

incorporating means of identifying forest ecosystem impacts that result from changes in technology (e.g., acid rain).

Forest survey information primarily reflects the physical supply and condition of timber resources. Efforts should be made to more adequately present information on the economic supply of timber and the availability of recreation and wildlife resources.

Information management systems enable forestry professionals to gain access to a wide range of statistical data about forests and related resources. Their development should be encouraged.

Timber is the principal raw material of wood-based industries. Timber management policies therefore should be directed to long-term stability of the commercial timberland base, to increasing the productivity of existing commercial timberlands, to development of long-range forest plans for public forests, to increasing the availability of timely information about long-term timber supplies, to increasing road access to commercial timberlands, and to implementation of equitable tax policies.

County-administered forestry programs are of growing importance to economic development of the forestry sector. As such, they should be well-planned to meet long-term state and local development goals, be committed to high levels of timber production as soon as possible, be committed to the production of a favorable balance of hardwood and softwood timber, be encouraged to focus on development of markets for unutilized tree species, be subject to efficient investment in modern timber management practices, be involved in an expanded role of

encouraging industrial development, be directed to development and implementation of wise land exchange programs, and be organized administratively so as to reflect a commitment to long-term forest management.

State-administered forestry programs can play a major role in the development of the state-owned forest resources. They should involve strategies to address the uneven distribution of aspen age classes; link forestry program objectives to economic development and energy goals; invite cooperation and coordination of forestry and related programs at local, state, regional, and national levels; look to opportunities for achieving economic development via exports to foreign nations; and facilitate the development of consistent and responsive public policies that encourage enterprises to develop Minnesota's forestry sector.

Nonindustrial private forests are major suppliers of timber. Unified and coordinated programs should encourage their active participation in timber management by providing appropriate incentives and technical assistance to interested landowners with long-term planning horizons and productive forest land.

Multiple-use management of national forests includes forest sector economic development. This will involve little or no conversion of hardwood to conifer timber; reduction in the cost of offering timber for sale; coordination of land management decisions with adjacent county, state, and private landowners; and accelerated focus on the provision of more timely information about the forest resource.

Conference Objectives and Minnesota Forestry Background

Richard A. Skok, Dean, College of Forestry, University of Minnesota

Welcome to the Minnesota Governor's Conference on Forestry. As stated on your program, the title of the conference is *Forest Industry as a Force in Economic Development: Options for Minnesota's Future*. This is most befitting, given the positive role that forests can play in the state's economic development.

Minnesota's forestry community has seen major changes in the type and intensity of forestry programs implemented over the last five to six years. Public and private agencies have seen fit to respond to new state and federal laws, to intensify the level of management applied to forests throughout the state, to expand the capacity of the wood-based industry, and to encourage more sophisticated forest resource planning. New statewide programs implemented by public and private organizations have had a significant impact on the ability of Minnesota's forests to contribute to the economic and social well-being of state residents. Opportunity now exists to assess past accomplishments and to define and focus directions for the future.

This conference complements a similar one held in December 1980. The latter was organized as a means of informing the state's forestry community about, and securing reactions to, policy options suggested in *Minnesota's Timber Resources: Options for Development*—a study sponsored by the Legislative Commission on Minnesota Resources. This conference has been designed to focus on new public and private initiatives in the forestry sector; the nature of economic, social, political, and resource conditions which are likely to shape public and private forestry programs in the years ahead; and the major policy and program directions needed to further enhance contributions made by Minnesota's public and private forests.

The conference has as a special focus the use of forests for timber and closely related purposes. There are, however, other forest values that must be kept in mind: recreational values, wildlife values, forest amenities. Urban forests, too, have taken on new meaning to state residents over the past decade, as has concern for wise soil and water conservation measures. These uses of the forest must not be forgotten as we deliberate means of enhancing forestry's contribution to economic development.

An understanding of certain key characteristics is important to evaluation of forestry sector progress and assessment of future options. First, forest ownership patterns in Minnesota are quite different from those in most other states. Of the 13.6 million acres of forest within the state's boundaries, 36 percent

are under state and county management. Consequently, the state has an opportunity to exert substantial control over its forestry destiny. Other important categories of commercial timberland ownership within the state are nonindustrial private landowners (41 percent), federal landowners (17 percent), and industrial forestry landowners (6 percent).

Second, the state's forestry sector is currently utilizing the "second" forest, the "first" forest having been used in the late 1800s and early 1900s for developing the central portion of the nation. At that time the forest was not treated with a long-term interest in timber production; rather, it was viewed as land to be transferred from forest to agriculture. In utilizing the state's resulting "second" forest, we have an opportunity to develop a "third" forest that can achieve much greater productivity for future use.

Third, the state's commercial timberland has declined over the last three decades. A continuation of this trend could have serious implications for long-term stability and growth of the forestry sector. Supply of the sector's raw material—timber—rests on the presumption of a stable forest land base that is subject to continuing investments by both public and private sectors. Long-term perspectives on forest land use and forest investments are essential for the sustained high timber outputs required by industry. Because forestry often competes with other land uses (e.g., agriculture), short-term demand for such uses can overshadow the long-term outlook required for timber production.

Fourth, Minnesota's forestry sector cannot operate in isolation, as events of the past decade have illustrated. It is increasingly important for the sector to develop and strengthen linkages within itself, to other sectors within the state and nation, and, indeed, to other parts of the world. Such linkages should be fostered in an economic, social, and political context as well as in the biological and physical sciences where these can be brought to bear on forests and their management. The state's forestry community is diverse; opportunity to be at odds over proposed solutions to problems has occurred and will continue to occur. However, the development over the past six to eight years of strong interactions among major participants in the state's forestry sector has proven the wisdom of working together toward goals of common interest—goals that further the ability of forests to contribute to economic development and Minnesota's overall betterment.

The opportunity to participate in the Governor's Conference on Forestry is a special pleasure for me. The large number

of attendees demonstrates that forestry remains an important interest to a wide range of persons throughout the state. The willingness of Governor Perpich to lend the prestige of the governor's office to the conference is especially rewarding; it is a clear indication of the state's interest in forestry activities

undertaken by public and private organizations within this state. Also to be commended are the speakers for today's conference and their willingness to take the time to explore a wide range of topics important to deliberations over future directions for the state's forestry sector.

Minnesota Forestry: A Decade of Positive Change

Gerald L. Willet, Chairman, Senate Finance Committee, Minnesota State Legislature

The past decade has fostered a number of very positive steps toward change in Minnesota's forest industry, in timberland preservation, and in the management of forests within the state. Before discussing these accomplishments in detail, let me highlight some significant events that have occurred in the forestry area over the past 8 to 10 years. Consider:

- state and county timber management intensification following enactment of the Boundary Waters Canoe area Act of 1972;
- large-scale impact of the Legislative Commission on Minnesota Resources (LCMR) and the Banzhaf timber development study;
- highly significant Minnesota Forest Management Act of 1982;
- large-scale capital investments in timber management and in wood-processing facilities within the state.

My remarks will focus on these accomplishments. In addition, I will offer some general comments on the larger role our state's forests can play in enhancing the well-being of Minnesota's citizens and their overall high quality of life.

BWCA Timber Management Programs

Passage of the Boundary Waters Canoe Area (BWCA) Act of 1972 led to a number of improvements in county, state, and federal management of timber resources. According to the fourth "Annual Accomplishment Report," issued by the Minnesota Department of Natural Resources (DNR) for fiscal year 1984 (October 30, 1984), BWCA timber intensification "program accomplishments have generally continued to meet work plan goals," with few exceptions.

- State forest development is actually *exceeding* goals:
 - improved timber sale layout, design, and supervision led to 6,300 acres of improved regeneration.
 - timber stand improvement occurred on 8,024 acres, including 4,674 acres of thinnings and other commercial timber cuttings.

- Some 2.3 miles of state forest road were constructed, adding to the 377 miles already completed. This is 151 percent above the planned target for the first five years of the program.
- A planned state-county forest inventory is under way and there is cause for optimism that the targeted completion date (June 30, 1985) will be met, even though the forest lands being surveyed are quite scattered.
- A pilot unit plan for the Moose Lake Area was made available to the public in November 1984.
- County reforestation has exceeded goals for the fourth straight year.
- Management aid to nonindustrial private owners exceeded targets by 33 percent, and marketing and management assistance to landowners continued to advance. Unfortunately, private land reforestation fell 17 percent below targets and timber stand improvement activity fell to 55 percent of planned levels. These areas suffer from reductions in federal cost-share programs for private landowners and from continued poor markets for plantation pulpwood.

Overall, most elements of the BWCA intensification and closely related programs are on or ahead of schedule. The BWCA forestry intensification program is accomplishing its goals of intensified softwood management and hardwood utilization on state, county, and private forest lands. I would agree with the 1984 DNR report which forecasts achievement of all the program's goals by 1990. It has been one of the most cooperative and successful forestry programs in the history of our state.

LCMR/BANZHAF TIMBER DEVELOPMENT REPORT

As early as 1974, the LCMR began studies to identify and seek solutions to forest management problems. After a series of hearings which revealed a need for a major study of the state's timber resources, the LCMR in 1977 commissioned the

George Banzhaf Company to identify and evaluate policy and program options for development of the state's forestry sector. The company presented a report entitled *Minnesota's Timber Resources: Prospects for Development* (1980). The report helped the commission define major issues and presented policy and program options which were important to the development of the Minnesota Forest Management Act of 1982.

The Banzhaf report continues to serve as a standard for fostering the state's future timber development. The LCMR uses the report to carry out its charge "to provide the Legislature with the background necessary to evaluate programs proposed to preserve, develop, and maintain the natural resources of this state." It is via the LCMR that the legislature provides direction to state forest policy. Over the past decade, the commission has carried out its legislative oversight function by monitoring and advising the Legislature on the need for forestry program funding; I trust it will continue to do so in the future.

MINNESOTA FOREST MANAGEMENT ACT OF 1982

Investment and production in the timber resource system are guided not only by economic signals but also by the state's political system. Public land management agencies, conservationists, forest industries, the LCMR, landowner groups, and others all provide input to legislative committees as to future directions for timberland management in Minnesota. A major outgrowth of this process was the Minnesota Forest Management Act of 1982—the culmination of eight years of effort by a wide variety of individuals and organizations. Among the act's many provisions are:

- *Forest Management Fund.* Approximately \$2.75 million was earmarked for the current biennium; the act has been and will continue to be very specific about how it is to be spent.
 - Reforestation.* The act requires reforestation of harvested areas in the year they were harvested. Money from the fund will be used for such purposes. An effort will also be made to replant a backlog of thousands of harvested but nonreforested acres from previous years.
 - Forest Roads.* The act authorizes money from the fund to be used to extend and upgrade the road system in state forests. Estimates indicate it will take \$5 million per year over the next five years to complete this vital work. Such roads are critical to the harvest of mature but currently isolated timber stands.
 - Fire Protection.* The act authorizes money from the fund to be used to train and equip local volunteer firefighters. Experience indicates that one of the best ways to combat the threat of wildfire in the forest is to cooperate with local fire companies. With money from the fund, such companies will receive stepped-up training and technical assistance.
- *Self-Sufficient Nursery Operations.* Under the act, state owned and operated nurseries are to become self-sufficient by implementing seedling charges sufficient to cover the cost of seedling production.
- *Forest Planning.* The act requires preparation and periodic updating of a comprehensive state forest plan that

presents a supply-and-demand assessment of forest resources (updated every 10 years) and a program (updated every 4 years). The plan must be consistent with the act's new forest management policy of multiple use and sustained yield. The current comprehensive plan is the state's first attempt to impose a unified and coherent philosophy of resource management on Minnesota's forests. It is becoming a practical and guiding philosophy for the management of state forest land. "Consistency" is the key word. In the past, there was variation from region to region and district to district in land management and conservation procedures.

A number of people worked extremely hard to ensure the act's passage; many of you are now implementing it in the field. My hope is that the act has given you the necessary tools and guidance to do the kind of job we all desire in protecting and preserving our forest resources.

CAPITAL INVESTMENT IN TIMBER AND TIMBER PROCESSING

Capital investment in management and growth of timber and in wood-processing facilities has been substantial over the past few years. Consider highlights of some of these investments.

Timber Management

The DNR Division of Forestry is well into a major program of intensified forest management. The management team approach of the division is working well to coordinate inputs of silviculture, soils, harvesting, and insect and disease control. Marketing specialists are being used to ensure a cost-effective and successful program that can meet the demands of the timber industry and other users of the state's timber resource. The division has in place an orderly plan to maintain state-owned forest lands with appropriate forest cover and stocking levels necessary to multiple-use and sustained-yield principles. Included are the following:

- *Regeneration.* The division has implemented a number of actions designed to ensure quality regeneration. Examples are:
 - contracting planting projects to organized hand-planting crews rather than hiring labor by the hour.
 - improving handling and storage techniques for planting stock.
 - improving planting success via planting quality checks.
 - increasing production by lengthening the planting season.
- *Tree Improvement.* The division has implemented actions designed to improve seedling quality and tree growth. Examples are:
 - improving seed cone collection procedures, including identification of seed sources.
 - improving seed and seedling purchase practices.
 - improving tracking and development of seed orchards.

Management activities such as the above should lead to more cost-effective investments in the timber capital necessary to meet industrial raw material needs in the years to come.

Wood-Processing Facilities

A number of factors have led to a pressing need to increase the number and capacity of wood processing facilities operated by forest industry. Among such factors are a need for jobs in northeastern Minnesota to counteract mining layoffs; a need to develop the forest industry as a long-term, stable source of economic activity; and a need to parallel increased interest and funding which is now occurring in the tourism sector.

The LCMR 1978 preliminary study of prospects for developing Minnesota's timber resources identified a number of conditions which have implications for expanding industrial wood-processing capacity in the state, including:

- increasing volumes but decreasing quality of growing stock;
- discrepancies between consumer demand for forest products and the large volumes of timber in the forest;
- underutilization and uneven exploitation of timber resources;
- high mortality rates in existing timber stands;
- considerable pressure for nontimber uses of forests.

More recently (April 1984), the Northeast Minnesota Task Force, through the University of Minnesota Agricultural Extension Service, highlighted some obvious examples of opportunities for industrial expansion in the forests of northern Minnesota. The study concluded that "there is a realistic possibility for expanding the forest products industry in northeast Minnesota. This conclusion is based on the annual surplus growth in commercial forests of the region, a potential for much higher growth rates, and the possibility of producing more secondary products locally than is now the case. Much of the technological development needed for this kind of expansion to occur is complete and a number of steps can be taken in the short run to move toward this goal."

It is important to keep optimistic projections such as these in perspective when considering economic impacts. For example:

- The state's timber industry is the third largest manufacturing industry in the state.
- The total sales value of forest products, including secondary manufacturing, approaches \$2 billion (1980), with the pulp and paper industries making the major contribution.

- In 1980 more than 52,000 people were employed by the Minnesota forest products industry. For each job created in the forest industry, an additional 2.3 jobs are supported in related trade and service industries.
- Considering both direct and indirect employment, over 119,000 Minnesotans depended on the state's forest products industry for employment in the 1980s.

The Northeast Minnesota Task Force report goes on to list some of the more important "opportunities for further development of the northeastern Minnesota forest products industry," including:

- secondary processing of dimension blanks from unused hardwood;
- specialty products such as novelties, wood boxes, and turnings;
- high-valued finished products such as furniture;
- structural "I" beams made from secondary products;
- treated waferboards made from hardwood chips;
- wood used for fuel, especially substituting for expensive petrochemicals and as a cheaper fuel for producing residential and industrial electricity.

All in all, there are myriad uses for wood to which state wood-processing and timber industries can look as means of expanding markets and encouraging employment.

CONCLUDING REMARKS

In summary, Minnesota's timber processing, growing, distribution, and marketing systems play an important role in the state and can play an even greater role in enhancing the economic well-being of its citizens, not only in northern Minnesota but—through the economic multiplier effect—throughout the state. With your assistance and support at the legislative level, we can work together to foster development of the state's forest resource and boost the forest products industry in order to continue improving our overall quality of life.

Thank you for inviting me to the conference. I look forward to the remarks of other speakers and your reactions to them. Both will be taken back to the Capitol as we discuss forestry in future legislative sessions.

Minnesota's Industrial Forestry Sector: Program Directions for the Future

The Honorable Rudy Perpich, Governor, State of Minnesota

I want to thank all of you for taking time today to exchange ideas about one of Minnesota's most important industries. The number one goal of my administration has been, and continues to be, job creation. And we have viewed expansion of our forest industry as an important way to meet this goal. I have considered this industry so important that I have personally contacted chief executive officers of almost every major wood products company in the world, from those here in our state to those in New Zealand, halfway around the world.

Forestry is, of course, already our third largest industry in Minnesota. It also is an industry with strong growth potential. I want to talk today about the action we are taking to see that this potential is realized.

First, I would like to briefly cover how far Minnesota has come in the past two years, the challenges that lie ahead, and our proposals for meeting these challenges. We have experienced a dramatic turnaround in Minnesota from two years ago, when one business columnist predicted the state would be bankrupt. Two years ago we had unemployment of more than 10 percent, we had severe budget cuts, we had lost our credit rating, and another budget deficit was on the horizon. Today, 180,000 more Minnesotans are working. Month after month we have set all-time employment records for the state of Minnesota. Instead of a deficit, we have a \$375 million reserve fund as a cushion for those economic downturns that plagued us in the past. As of January 1985, our need for short-term borrowing will have been eliminated. Today, instead of budget cuts, we are talking tax cuts.

We have to look at tax reform seriously for a number of reasons. One of the key reasons is that Minnesota must become more competitive with other states. Our ability to compete with other states now is hindered by some factors beyond our control: climate, location, reserves of oil, gas, and coal. California, Texas, and Florida have the edge on us in these areas, and that is why one-third of the growth in this country is occurring in these states.

Economic prosperity in all states is threatened by a federal deficit, which Congress and the president are not moving quickly to address. Minnesota cannot resolve the problem of the deficit, we cannot change our location, our climate, or our lack of conventional fuels, but we can maximize the resources we do have, such as wood products. And we can minimize our weaknesses. To become more competitive we must have tax reform. Tax reform must mean a reduction in personal income taxes. We are not proposing a cut of a half billion dollars. Tax

reform must mean simplification. By this we mean a one-sheet tax form, printed on one side. Tax reform also must mean greater accountability, so that the public clearly understands that property taxes are local taxes, not state taxes.

Becoming more competitive also means having the fiscal stability that only an adequate state reserve fund can insure. We want Minnesota businesses to be able to plan far into the future. Both businesses and individuals should have a fair idea of what their tax burden will be in the years ahead. An adequate reserve fund should prevent the unexpected tax increases Minnesotans have experienced in the recent past. Our priorities for the coming session therefore must be tax reform and fiscal stability.

We also are looking at assistance targeted for certain promising industries. Forestry is one of these promising industries. We have many reasons to be optimistic about our wood products.

First, our resources are abundant, and should remain so for the next few decades. The Department of Natural Resources has greatly expanded its reforestation program over the past years. This spring 16,000 acres will be planted, which compares with less than 4,000 acres annually in the mid-1970s. (We are looking at tax policies that would encourage private landowners to follow suit and maintain their forests.)

Another reason for optimism is that our timber resources produce—in addition to other products—a very high quality paper which is in demand worldwide. In talking to our Minnesota pulp and paper companies I have learned that they are planning a \$1 billion expansion in the next few years.

Our logging force is in place, and those workers are part of the best force in the nation.

We also are optimistic because we have proven that we can compete against any state in putting together financial incentives for industry expansion:

- We have encouraged the development of Louisiana-Pacific in Two Harbors.
- We are close to announcing agreements in Hibbing on a Canadian sawmill and specialty poplar products plant that would use aspen resources.
- We are confident that we can put a package together to attract a fiberboard plant to Hibbing.

We have had good success in attracting the interest of potential foreign investors, particularly Scandinavian and Canadian companies. Because 35 percent of our people are of

Scandinavian descent, Nordic businesses feel very at home here:

- Sigdal will begin test-marketing cabinets. If successful, it may locate a plant near Duluth.
- A casket-making firm is considering building a plant.

These would be good investments for Minnesota because they involve specialty product manufacturing, which results in many jobs without heavy timber consumption. These manufacturing operations furthermore would give us the mix we need in the forest industries for proper utilization of the various woods we have, some of which have not been in great demand. They also present us with an opportunity to exchange technology to make our light woods more marketable.

The state also is working to increase consumption of wood residue, which has greatly increased in importance over the past decade. During the past two legislative sessions, loan funds have been provided to school districts and local units of government to encourage them to convert to energy systems using indigenous fuels like wood residue and peat. Fiber-fuel burning systems have been installed or are planned for 100 public buildings. In addition, we know of about 90 Minnesota businesses now burning fiber fuels. These conversions not only expand the market for our wood residues, but also help us achieve our goal of becoming more energy independent, reducing the more than \$7 billion we now spend on energy.

While we plug away at developing new markets for our raw wood, we also are looking at some concerns of this industry. The 1984 Legislature's interest in further developing this industry was evident in the \$700,000 appropriation for expansion of Green Hall at the University. We are confident that the research done there will greatly help us to expand our markets.

We also are looking at keeping better track of our wood resources. We have had tremendous growth—about three-quarters of a billion dollars in development in forest industries over the past 10 years. And, as I said, about another \$1 billion is planned in the years to come. This growth spurt demands that we speed up our state forest inventory so that we have a better picture of our timber resources into the future. More up-to-date information also will help us in our efforts to attract new investment. We will seriously be considering the additional expenditure necessary to accelerate the inventory process.

With the awareness that transportation expenses are an increasing portion of operating costs in our timber-related industries, we also are taking a close look at the adequacy of our roads and highways. We recognize the need for better access to timber supplies, so we are considering a proposal to upgrade our forest road system. It also may be necessary to change the load limits on certain highway routes.

I think it is clear that, on many fronts, Minnesota is making a commitment to the forest industry, because we know that our overall economic well-being depends on it. In the past two years, we have asked people in every segment of the Minnesota economy to pull together with us to make Minnesota the state that works. We have formed strong partnerships with the high-tech industry, agribusiness, the tourism industry, and this industry. As we continue to work to develop new markets for our products, we will rely on this continuing cooperation.

Our forest industry has great potential to make use of an abundant, inexpensive resource, to attract new investment to Minnesota, and most importantly—to put our people to work.

Again, thank you for your interest and participation.

Wood-Based Industrial Expansion: Necessary Business Conditions

Harold F. Zigmund, Chairman, Minnesota Governor's Commission on Wood Products, and Former President (retired), Blandin Paper Company

I have been asked to speak on the subject of the current economic conditions in northeastern Minnesota and the business climate needed to encourage expansion of the wood products industry in the state in order to make the wood products industry a greater contributor to Minnesota's economy.

ECONOMY OF NORTHEASTERN MINNESOTA

Northeastern Minnesota is where most of the state's forests are located, where most forest industry expansion would prob-

ably occur, and where new employment opportunities are desperately needed. Most Minnesotans know that the economy of the Iron Range in the Northeast is not as prosperous as that of the Twin Cities—or even as prosperous as some of the state's economically hurting farming areas. In my opinion, northeastern Minnesota is now, and has been since 1981, in a very deep depression. Last spring and summer the region showed some signs of recovery—only to lose ground again this fall. To say that the region is just “in a recession,” or even worse, to say

that it "lags the rest of the state in economic recovery," grossly misrepresents the facts.

Why do I characterize northeastern Minnesota as being in a depression? What else can you call it when the area's largest source of employment is practically shutdown? Operating at full capacity, Minnesota's eight taconite plants have employed as many as 14,440 people. As of today, December 17, there are fewer than 2,000 hourly paid taconite workers. Only two of the Range's eight plants are in production—and neither is operating even close to capacity. The remaining six will be down until at least spring 1985, while some will not be operating for many months to come. Managers of these plants will not even hazard a guess as to when such plants will be started again, or how many employees will be recalled when they do start. At a recent Chicago meeting at which the management of Minnesota's eight taconite plants was present, the question was asked: "When will you be starting up again?" The answer of those responding directly was, "We don't know, we honestly don't know, we can't predict it." And those who did not respond directly nodded their heads in agreement. Now, according to my arithmetic, the unemployment rate among these eight plants is 85 percent. If that does not qualify as a depression, we surely are having problems with definition.

Unemployment rates have been over 50 percent in some Range cities. Mountain Iron is a case in point. When U.S. Steel shut down MINTAC a few years ago, unemployment in that city was in the neighborhood of 70 percent. Countywide in the Northeast, unemployment is also very high. Lake County has unemployment levels of over 40 percent when Reserve Mining Co. is shut down. Compare such unemployment rates with those occurring in the Twin Cities (4.4 percent) or Sioux Falls, South Dakota (3.7 percent). Compounding the region's troubles due to iron ore layoffs is the recent announcement that a major forest industry plant will shut down permanently, leaving 650 persons unemployed. You must agree that northeastern Minnesota is in deep economic trouble. Need for an economic force such as might be brought about by a major expansion in the forest industry is obviously very great in the area.

Northeastern Minnesota's economic problems are not new. The area has been declining economically since the mid-1970s. The current depression in the steel industry is only accelerating the decline. From 1976 to 1982, the number of jobs in the region declined by 8.2 percent, while state employment increased 13 percent. In 1976 government jobs in the region provided 19 percent of the nonfarm income, while in 1982, they provided 22 percent of the region's nonfarm income. In contrast, statewide income from government jobs declined from 17 percent to 15 percent over the same period.

The population in northeastern Minnesota is also changing—it's getting older and older. Because opportunities for employment are so scarce, many young people are leaving the region in search of jobs. Transfer payments from Social Security, pensions, and related funds increased from 28 percent to 39 percent between 1976 and 1982. Such payments, in total, are 25 percent higher in the region than in the rest of the state. If you add federal job income and transfer payment income, the remaining proportion—39 percent—is income from the region's private sector. On the other hand, private sector income for the entire state is in the neighborhood of 53 to 54 percent of total state income. The gap is 14 to 15 percent and it is probably widening.

Many people are of the opinion that the forest industry can be expanded to provide employment for those losing jobs in the taconite industry. Realistically, expansion in the state's forest industry will result in only a moderate replacement of those jobs. In normal times, the mining industry probably employed more than twice as many people as the forest industry. This does not mean, of course, that forest industry does not have a role in easing the economic plight of the region. It simply means that we must be realistic in our expectations.

POSITIVE AND RECEPTIVE INTEREST IN INDUSTRY

Probably the condition that plays the most important role in fostering industrial development is for a company to feel welcome in the state and, particularly, in the community in which it operates. Ironically, iron mining companies, which have been operating in the state for over 100 years, are not genuinely welcome in Minnesota. With the large-scale investments in plants that such companies have already made within the state and the number of jobs they can provide, it would seem reasonable to me for the state to look very kindly on their problems. I well know that there are historical reasons for some of these attitudes, but I would think that it is time to let bygones be bygones and to get on with the task of making the most important industry in northeastern Minnesota competitive with the rest of the world.

In addition to the mining industry, wood products companies, if they are of any size, are not always made to feel very welcome within the state. People welcome insurance companies and computer companies on "high-tech row," but do not always welcome big wood-using companies to their communities. They object to logging the forests, with its attendant mess. The public does not seem to know, or tends to forget, that scientifically conducted logging, rather than destroying forests, is an ideal way of regenerating them; and that the industry and the state are doing a very good job of reforestation. People do not always appreciate the fact that wood harvesting and processing is in the best interest of the state's economy, and when properly done, is in the best interest of the forest itself. A positive, welcoming attitude in the state and local communities toward new and existing wood-processing industries would be an important and constructive step in improving the economy of Minnesota.

POLLUTION

The public's lack of knowledge in focusing its concerns on air and water quality and solid waste disposal can have a substantial negative impact on economic development within the wood processing industry. Unfortunately, the public is not generally aware that wood-using plants can be, and are, operated to meet all state and federal standards and, except in rare cases, will continue to meet them. (In this regard, I might add, it is easier for new plants to meet the very high Minnesota pollution control standards, since they can utilize the latest pollution control technology when they are first built.)

The state's Pollution Control Agency (PCA) may be one of the best places to begin efforts to improve Minnesota's business climate. My own personal experience with this agency when I was with Blandin was good. In 1976 the Blandin Paper Company received a compliment from the PCA director. We

were congratulated as the first company to come to the PCA ahead of time to describe our expansion plans and to inquire what we would have to do in order to comply with their regulations.

It has occurred to me since that the director of the agency might go to a company that announces an expansion or plans to locate in the state and say: "Congratulations, I am glad to have you in Minnesota. I am the director of the PCA and I want to put my staff at your disposal to make sure you understand what the regulations are and to offer assistance in helping you meet the regulations. Please call on me if you have problems." I believe such an approach would enhance, rather than jeopardize, the PCA's role in enforcing control regulations. It might then be perceived as encouraging economic growth, rather than as setting up roadblocks at every turn to prevent growth. A warm welcome to new and expanding industries, and a positive assumption by administrators of pollution control laws that the regulations can and will be met, would be very helpful in encouraging industrial development in Minnesota.

STREAMLINE APPROVAL PROCESSES

Industrial expansion or relocation requires a certain amount of time devoted to securing the necessary government permits. In my opinion, the delay between the time an industry has the urge to do something and the time it has government permits in hand to begin the project is unduly lengthy. We might learn from Wisconsin. There, a paper mill decided to expand and went to the appropriate environmental regulation agency with detailed plans. The agency informed the company of the standards and told it that if it met the standards, construction could begin. Forewarned that when construction was complete they must meet the standard, the company built the facility, met the standards, and was happy.

The procedure is not as smooth in Minnesota. When this same company investigated the possibility of expanding in Minnesota, knowledgeable people who had dealt with the PCA in the past said, "It'll take you a year, plus or minus three months, to get necessary permits." The question then came up: "Can't we proceed with our project if we promise to meet your standards? If we don't, that's our problem, and if we do, will you assure us that we will be issued permits?" The answer was "no." This is not the best way to really get something going in Minnesota. In my view, it would be very worthwhile to look at ways of streamlining the approval process so that a company wishing to move forward on industrial development in Minnesota could do so with assurances that if standards will be met, permits will be issued.

PESTICIDE AND HERBICIDE USE

Intensive management of forests frequently requires the use of some tools that the public does not approve of. Notable in this respect is the use of pesticides and herbicides. The usual condition surrounding their use is that standards guiding pesticide and herbicide use in agriculture—or in our own backyards—are not the same standards that apply to the use of such chemicals in the forest.

The Canadian Pulp and Paper Association recently pleaded for greater understanding of pesticide use in forested areas. Pointed out were the facts that (1) in Canada, only two percent of the nation's usable land area (excluding the arctic and simi-

lar nonproductive areas) is in city and urban uses, yet such areas receive 13 percent of the pesticides used nationwide; (2) fifteen percent of Canada is in farms, which use 85 percent of the pesticides used annually; and (3) the remaining portion of Canada is in forests (83 percent), which receive a mere two percent of the pesticides consumed nationally. Such percentages are probably similar in the United States.

Given such facts, it is difficult to understand why the public perceives use of herbicides and pesticides in a forested setting as such a serious problem, especially when the wood products industry is often the major source of their livelihood. Ironically, people accept pesticide use on farms and in their own backyards, yet fail to accept it for intensified forest management. Since the use of pesticides plays an important role in sustaining long-term investments in timber growth, there is great necessity to enlighten the public on the use of pesticides in the forest industry.

TAXATION

A healthy business climate is often predicated on sound local, state, and federal tax policy. The Governor's Commission on Wood Products made recommendations on forest taxation to the Latimer Tax Commission. In the Wood Product Commission's judgment, implementation of these recommendations would have a positive impact on Minnesota's wood industry.

The first recommendation was to adopt an incentive for reforestation similar to that used at the federal level. The incentive is a tax write-off over seven years and a ten percent investment tax credit. The Minnesota Department of Revenue calculated that such provisions would reduce state tax revenue by approximately \$400,000.

The second major tax recommendation involved changes in tree-growth property tax provisions which would reduce state tax revenues by about \$650,000. From my perspective, such revenue losses would be far outweighed by the benefits.

A state capital gains tax treatment for timber growth on corporate lands was the commission's third major recommendation. Such a provision would make the state consistent with federal law in this respect. Revenue reductions to the state as a result of capital gains treatment of timber income were about \$4.8 million—a significant figure that surprises me. If enacted, corporations would be treated as they now are on federal income taxation and would be treated similarly to companies operating in other states. Minnesota is one of the few states that does not treat income from timber as a capital gain for corporate tax purposes. Recognized is that President Reagan is proposing elimination of capital gain treatment of income from timber. In my judgment, such elimination would be a serious mistake, and should not influence our actions on the matter in Minnesota.

In summary, Minnesota's forest industry has much to offer the state in terms of economic development. Whether it is able to do so depends on the extent to which industry's plans to expand or to locate in the state are welcomed. This implies favorable conditions concerning pollution control regulations, ability to use modern tools of forest management (e.g., herbicides and pesticides), efficient and less time-consuming state review of large-scale investment projects, and tax policies that encourage industrial investment.

Forest industry investments are a major cost. For example, a waferboard plant costs between \$30 million and \$60 million, while papermills can involve expenditures between \$250 million and \$325 million. Since the latter often employ 200 or more persons, excluding people such as loggers, investments are over \$1 million per job. If the forest industry is to make

such investments, it must find a business climate that sends the industry a positive and welcoming signal to its proposed actions. Only then will the residents of the state be in a position to reap the benefits of the expanded employment and income the industry is capable of providing.

Industrial Development Incentives: Public Programs

Dently Haugesag, Development Officer, Minnesota Department of Energy and Economic Development

Few industries are in a better position to benefit from a variety of local, regional, state, and federal economic incentives than the wood products industry. In both primary and secondary manufacturing, companies can take advantage of programs that are practically tailor-made for them.

Primary processors for forest products can benefit because the forested areas in which they are likely to locate stand in the most economically distressed parts of the state, and many programs are targeted at those distressed areas. It may be only coincidence that unemployment and forests occupy much the same turf in Minnesota, but the alert entrepreneur in forest products can turn that coincidence to a considerable advantage and ease the plight of Minnesota workers at the same time.

IRON RANGE RESOURCES AND REHABILITATION BOARD

Besides this geographical congruence of forests and programs, there is a financial congruence as well. Primary processing tends to be capital intensive. Fortunately, there is an agency, The Iron Range Resources and Rehabilitation Board (IRRRB), whose territory of operations coincides with most of the forested northeastern Arrowhead region of Minnesota, and whose pockets are deep enough to finance many primary-sized operations. Moreover, it has designated wood products as a category of manufacturing to receive special encouragement.

A farsighted Minnesota legislature back in the 1940s recognized the need to diversify the Iron Range economy. It established a fund made up of revenues from a special tax on taconite production. The IRRRB administers this fund to promote the growth of new and existing businesses through two approaches.

Loan Participation with Banks

The IRRRB can participate in loans with banks for up to

50% of the total project cost to be financed. The IRRRB's portion of the loan carries 8% interest, the bank's portion is based on the usual market and credit factors, and the final rate to the borrower is the blended rate of the two institutions. The proceeds can be used for:

- Land and building acquisition;
- Land improvements;
- New building construction;
- Building renovation;
- Purchase of machinery and equipment;
- Working capital (but not a revolving line of credit);
- Purchase of inventory;
- Limited refinancing, when it creates expansion, new jobs, or an improved collateral position for IRRRB;
- Reasonable accounting, legal, architectural, engineering, and appraisal fees.

By buying participation rather than simply using its money to buy down interest rates on bank loans, IRRRB earns interest which can be used to finance further projects.

Industrial Revenue Bonds

The IRRRB can issue industrial revenue bonds, much as a municipality does, to finance capital costs up to a total of \$10 million per project.

IRRRB has taken an active role in promoting wood industry development on the Iron Range. A report it commissioned from Rural Ventures recommended the establishment of a Wood Industrial Park in Hibbing to bring together primary and secondary manufacturers in a synergistic setting. Hibbing already has invested significant funds to prepare the infrastructure of the project, and IRRRB is working out financing for the first factory to open there.

Even though IRRRB may be uniquely equipped to finance primary processing, its interest is not confined to that. Job creation is its highest social priority, and secondary manufacturing tends to create more jobs than primary.

MINNESOTA DEPARTMENT OF ENERGY AND ECONOMIC DEVELOPMENT

When we turn to financial programs offered by the Minnesota Department of Energy and Economic Development, we find programs that probably have more relevance to smaller, secondary types of manufacturing than they do to large-scale primary types. Whereas IRRRB cites utilization of indigenous natural resources as a criterion, these other programs are overwhelmingly concerned with job creation. The ratio of jobs created to capital investment is important and this favors smaller, labor-intensive operations over automated continuous process manufacturing. The programs mostly have lower limits than IRRRB and are more likely to be used to supplement other kinds of financing than as basic source of capital. The programs fall into three categories: loans, job and training subsidies, and tax incentives.

Loan Programs

The list of loan programs begins with Minnesota Small Business Development Loans. These loans offer fixed interest rates below the rate paid by the federal government on its loans, terms up to 20 years, and amounts between \$250,000 and \$1 million.

The SBA 503 Loan Program is administered through Opportunities Minnesota Inc. (OMNI), a private corporation certified by the U.S. Small Business Administration as a Section 503 development company. The program provides subordinated mortgage financing to manufacturing companies up to 40% of fixed assets with a maximum loan of \$500,000. A local lending institution provides 50% and the borrower the remaining 10% of the project cost. Interest is three-quarters of a percentage point over U.S. Treasury bonds of similar maturity. Small businesses with net worth up to \$6 million can apply.

The Minnesota Fund provides direct loans at fixed rates on fixed assets to small businesses expanding or locating in Minnesota. The loan cannot exceed \$250,000 or 20 percent of the total project cost. Terms run 15 years for land and buildings, 7 years for machinery.

The Minnesota Economic Recovery Fund established by the Minnesota State Legislature in 1984 makes grants to cities for loans to businesses to create new jobs or retain existing ones, to leverage new private investment, and to enhance local tax bases through economic expansion. The loans can be used for building construction or renovation, equipment, or working capital. Rates and terms are negotiable between the city and the borrower. To qualify, the project must meet one of three federal objectives:

- to benefit low- and moderate-income people (creating jobs will suffice);
- to eliminate slums and blight;
- to eliminate threats to public health or safety.

And it must meet two of three state objectives:

- to create or retain private sector jobs, with one job secured for each \$20,000 or less of state funds;

- to leverage private investment on a dollar-for-dollar basis;
- to increase the local tax base.

Two loan programs promoting alternative energy are applicable to most wood processing operations which use or sell residues as fuel. The Energy Development Loan Fund finances up to 90% of the costs of purchasing, installing, rehabilitating, or constructing projects to use alternative energy sources in the course of doing business, or to manufacture alternative or renewable energy products. Another program, the Energy Loan Insurance Fund, insures up to 90% of the principal for loans made by private lenders for cost-effective energy projects.

Industrial Development Bonds are tax-exempt instruments that allow the borrower to finance new buildings, land, certain items of machinery, and virtually all loan closing costs at below-market interest rates because interest paid to lenders is exempt from federal income tax and, in certain cases, from state income tax as well.

Minnesota ranks fourth in the nation in the annual total of tax-exempt financing sold for Industrial Revenue Bond projects. Application is made through the local unit of government.

Employment and Training Programs

Employment and training programs subsidize the start-up costs of a new business or business expansion by contributing pay to workers during their training period. This is an especially effective tool for attracting secondary manufacturing to Minnesota because we do not have a large labor pool trained in furniture manufacturing.

The largest of these programs is the Minnesota Emergency Employment Development Act (MEED), enacted in 1983. Its purpose is to place unemployed Minnesotans in public- and private-sector jobs. The employee must be:

- a Minnesota resident for at least thirty days;
- unemployed;
- ineligible for unemployment compensation or workers' compensation;
- available for full-time employment.

For each eligible employee hired under this program, the state will subsidize up to \$4.00 per hour in direct pay and \$1.00 in fringe benefits for 26 weeks up to a total of \$4,160. In return, the employer must agree to continue employment for 12 months after the subsidy ends. The company itself interviews and selects the employees.

The Minnesota Job Skills Partnership grants up to \$200,000 to businesses that are having trouble finding workers with necessary skills in current operations or in anticipated expansions. To qualify, employers must match the contribution in cash, equipment, or faculty. The employers design the training program in cooperation with a recognized educational organization. Employers are not required to make commitments to hire the trainees before their training begins.

The Federal Job Training Partnership Act of 1982 authorized programs to help economically disadvantaged and unemployed people train for jobs and find work. Administration of the fund, which currently totals \$35 million in Minnesota, is assigned to the governor with assistance from the state job training office. The state is divided into Service/Delivery

Areas in which local elected officials appoint a Private Industry Council of business and community representatives who develop training plans for the area. Training services include classroom and on-the-job training, vocational counseling, and job placement. Employers may receive reimbursements for on-the-job training and customized training services to meet the needs of the particular business or industry.

The Emergency Veteran Job Training Program supports on-the-job training for Korean and Vietnam war veterans. The program can reimburse an employer for 50 percent of wages paid during a training period up to a total of \$10,000 per employee.

Tax Incentive Programs

Partly a job training program and partly a tax incentive, the federal Jobs Tax Credit gives private sector employers a tax credit of 50% of the first \$6,000 wages—\$3,000 maximum—for each person hired. The second year the credit drops to 25% of the first \$6,000, or a maximum of \$1,500. Actual dollar savings depend on the company's tax bracket. There is no limit on the number of employees a company may hire.

A similar job creation tax credit, along with many other tax incentives, makes up the Minnesota Enterprise Zone Program. Under this program, communities which meet certain criteria for economic distress or which lie on the state border can apply for designation as an Enterprise Zone by the commissioner of Energy and Economic Development.

There are at this writing 16 designated zones qualifying for state tax reductions under the Enterprise Zone Program, which include:

- general sales tax exemption for capital equipment and construction materials;
- an income tax credit up to \$3,000 per employee per year for new jobs;
- an income tax credit for a percentage of the cost of debt financing to construct new or expanded facilities;
- a state-paid property tax credit for a portion of the property taxes paid by the owner of a new or expanded facility.

Most Iron Range cities have qualified under the Enterprise Zone Program.

SUMMARY

The eyes glaze at this litany of alphabet-soup programs. But the point is that there is a lot of financial help available to the wood products entrepreneur through IRRRB and the Department of Energy and Economic Development. And it does not end with these two agencies. Regional and municipal development agencies and public utilities like Minnesota Power and Light have their own business development programs. There are venture capitalists and small business investment corporations and banks and thrifts.

With all these resources, it is probably safe to say that if a wood products venture should be financed, it probably will be. Whether the money comes from a public agency, a private investor, or a bank, the company will have to have some kind of a track record, good management, a reasonable business plan, and some prospects for profitable operation.

It may be more difficult to attract investment to a basic industry like wood processing than to glamorous high-tech industries like information systems or medical technology. The best approach probably would be to appeal to companies already in the wood business or a related field. Many large lumber companies that have been stung by the deflation of commodity lumber and plywood prices are looking for investments in more specialized, value-added areas of manufacturing. The entrepreneur who does his homework and knows the public programs may be able to interest the big boys in a joint venture to produce high-tech wood products in Minnesota.

If today our humble aspen in the form of oriented strand board is killing West Coast plywood mills, who can say whether Minnesota composite lumber products might not do the same to dimension lumber in the future? The wood industry will become more technology-intensive in years to come. In Minnesota, we have the timber resources—and the financial resources—to make the most of changes yet to come.

Forestry Labor: Commitments for Encouraging Development

Roy A. Ockert, Coordinator, Department of Research, Education and Collective Bargaining, International Woodworkers of America

HIGH-TECH REVOLUTION

During the past hundred years, there have been three technological revolutions in this country. The first, in agriculture, began in about the mid-1880s. Another, in industry, began around 1900. Now we are in the midst of a third, the high-tech revolution.

The agricultural revolution created a great deal of unemployment, shifting farmers to cities. A tremendous amount of suffering occurred, but people were eventually absorbed by newly developed markets. The various revolutions had great differences in reaching various parts of the world. Some segments of the world participated only partly, others not at all. High tech, however, is a different matter. If applied universally, it could reduce the work force necessary to produce required levels of goods and services to less than half of current levels, and, in time, to nine percent of the existing work force. Some people wonder who will be the consumers given this sort of eventuality.

When we talk of high tech, we speak, at least in some quarters, in terms of hard productivity and soft productivity. Hard productivity results from high technology and from massive capital expenditures. It has great implications. It is tremendously costly. It is very fragile in the sense that engineering theories do not always work out in practice. It often takes much longer to remove bugs from production processes and achieve production levels than originally planned. Hard productivity also carries with it a tendency for wages to be very low. On upturns, income generally expands faster than consumption.

Particularly in the last 30 years there have been changes in industrial structure, such as the development of multi-nationals and conglomerates, which have enhanced the ability of corporations to dominate markets. This tends to expand the revenue potentially available for investment in high-tech facilities. Cash flows (net profits plus corporate welfare subsidies) have become available faster than consumption income, resulting in declining markets, reduced production, reduced employment, and growing stagnation—and we have had a good deal of these in the last ten years or so. Improvements of a year or so ago in the economy came about not as a result of greater tax incentives or tax loopholes for corporations, but because oil prices and interest rates declined enough to foster consumption and enhance markets.

Taxation of high-income corporations and individuals is necessary to achieve income redistribution. From our perspective, high taxes also reduce waste of investment funds on unnecessary advertising, on extremely expensive takeover battles that produce nothing and sell no goods, and on financial maneuvers, including anti-union campaigns.

Soft productivity is the increase in output per unit of input that results from stronger morale due to enlightened management practices, worker participation in decisions about work and work places, and incentives arising from sharing the rewards and benefits of productivity improvements. A number of studies indicate that Japan's success, for example, is based on a combination of hard and soft productivity.

COOPERATIVE UNION-MANAGEMENT PROGRAMS

The government has been emphasizing and advocating cooperative programs. It calls them *labor-management* programs. We call them cooperative *union-management* programs because we believe that without some sort of an independent organization of workers, there really cannot be cooperation. As a member of one of the government's committees for the Pacific Northwest which deals with and advocates such programs, I think they have tremendous potential. They are soft-productivity type programs which must be negotiated so that both sides know their rights and responsibilities. They must be part of the negotiating—the collective bargaining process—so that there will be recourse if either side fails to carry out the agreement. There must be joint implementation, development, and administration of a cooperative union-management program. We must require management practices consistent with industrial democracy, a development which has changed the old "master-servant" views and concepts of a century ago or less to a different sort of attitude and working arrangement between workers and management—a development, in large part, because of unions and changes in laws.

If we are really interested in entering an era of union-management cooperative programs, we have a long way to go. The programs must provide for bargaining unit participation and decisionmaking, yet preserve necessary management prerogatives. Workers and unions do not wish to take over a plant; they do not wish to become management. They do, however, feel a need for management to begin looking at and developing

the tremendous resource of knowledge and information that is represented by workers in all plants.

When talking about cooperative programs, some union members say, "Well, we don't want to be involved in decisionmaking in the plant." But when asked about what the company is doing wrong in the plant, they go on and on. No one knows a job better than the person performing that job. This is a resource that ought to be tapped.

A cooperative union-management program must provide for shared rewards and shared productivity gains. If there is no gain, there is no sharing—so there really is no risk to management. Yet it is interesting how reluctant management is to share potential rewards in so many cases.

The International Woodworkers of America (IWA) has adopted a resolution which calls for negotiation, where feasible and where it makes sense, of cooperative union-management programs. It has negotiated a number of such cooperative agreements, mainly in the Pacific Northwest in the logging industry. It has such agreements with Crown Zellbach, Weyerhaeuser, and ITT Rayonier. Most IWA loggers are now on some type of cooperative union-management agreement. These agreements work well for all concerned. They cut costs and make the operation more competitive for the company and a much better place to work.

Other unions have become involved in this type of program. The United Paperworkers International Union, for example, is involved in quality of work-life programs. Not all unions, however, are interested in them. Some reject such programs, questioning whether cooperative plans are really possible without laws requiring them and standards to guide them.

SINCERE BARGAINING

When we look at bargaining relationships, we can see some basic types that have evolved or are evolving. There have been situations of all-out war, where union and workers are on one side and the company is on the other, both engaging in constant hostility, having a difficult time arriving at an agreement, or possibly not arriving at an agreement. My experience leads me to believe that in the long run, the company is much less likely than the people to survive such conditions.

The second type of bargaining relationship is that of an armed truce, where an agreement exists but the parties are always maneuvering to get ahead of each other. Hostility exists to the extent that the agreement is carried out to the letter of the law, but not to its spirit.

Most labor relations in the United States are working harmonies, where agreements have been negotiated and are being effectively carried out. We have in our files thousands of agreements with employers, ranging from the largest companies in the industry to very small companies. Most of these

agreements are carried out harmoniously. They have been arrived at without strikes; they do not make the news headlines. They are worked out with representation by two sides and are negotiated in a way which is workable for both parties.

The fourth bargaining relationship that has been developing is that of cooperation. It seems that this is often very difficult for both unions and companies to accept. In one case of negotiations in which I was involved, the company insisted that the word "cooperation" be removed from the agreement. Both unions and companies have been suspicious of cooperation; both calling it co-opting. It takes courage for both to go beyond such suspicion. Articles and statements about a union-free environment have not helped.

Certainly there is more opportunity for educating the public about unions. The Canadian government has recognized the importance of such education programs; it provides several million dollars each year for public education about unions by unions so that problems can be dealt with from the standpoint of knowledge and experience rather than from positions of ignorance or misinformation.

Employers should remember that no employee owes one whit more to the employer than the employer owes to the employee—no more loyalty, no more dedication, no more effort, no more concern. The IWA and other unions, including the Paperworkers Union, are offering to sit down with management as equals to try and solve mutual problems, to try and reindustrialize America, to try to draw up new procedures for dealing with labor and management problems. Too often, management has arrogantly refused to discuss the proposals. In one very recent case in Minnesota, the IWA offered cooperation. We drew up a proposal, but were told that the company was not interested and would not discuss it. The week before last we were told that one of the two plants involved was being closed permanently with the loss of about 500 jobs and several million dollars to the community—but huge tax savings to the company. There were several unions involved in the case; they had unanimously agreed to present a proposal and negotiate it. We believe management and the unions could have saved the community's economy, if the company had been willing to negotiate a cooperative union-management program. One of the appalling lessons to me has been how insensitive management can be about dealing with these types of problems. It seems to me that very often management will do right only if a tightly enforced law compels it to do so.

In conclusion, we, the International Woodworkers of America, are willing to commit ourselves to work as equal partners with management to make working conditions more favorable to employees and to help companies become more competitive in the marketplace. Such cooperation is a must if a state or nation's aspirations for economic development are to be realized.

Industrial Expansion: Information Required

Ralph G. Peineke, Vice President, Timberland Resources, Boise Cascade Corporation

Information required by a forest products company in order to make a decision regarding industrial development in a particular geographic area must be readily available in proper form and sufficient quality. From the perspective of Boise Cascade, five basic types of information are of utmost importance: fiber, freight, fuel, funds, and labor. Additionally, we are interested in information about a state's general environmental, regulatory, and legislative climates, and about market conditions that would affect the manufacture and sale of products. Before a decision is made about expansion, relevant information in all these categories is gathered. Then questions are asked: "With these given factors in a state, can we be competitive?" "Can we achieve a fair and acceptable return on our shareholders' investment?"

WOOD FIBER INFORMATION

Information regarding a state's timber supply base is especially important to expansion decisions. If a new geographic area is being considered, we need to know the resource base—especially up-to-date information on the timber inventory a facility might draw from in the area. This includes information on:

- *Historical Growth and Drain Ratios.* Such information is generally available from U.S. Forest Service forest survey units within a state. It must be current and available by major species groups.
- *Future Growth and Drain Projections.* Such information is based on inventory data, and should reflect present and anticipated silvicultural practices and installed manufacturing capacity.
- *Stumpage Price Trends.* Historical as well as anticipated trends in stumpage prices are required. From such information, future fiber costs can be estimated.
- *Timberland Ownership.* Information on timberland and ownership and the forest management practices of owners is especially valuable. Important ownership categories are federal government, state government, county government, industry, and private nonindustrial owners.
- *Self-Sufficiency Level.* The self-sufficiency level—if any—deemed necessary to justify a major investment in a manufacturing facility must be determined. If timberlands are required to achieve a predetermined degree of self-sufficiency, are they available for purchase or lease? What are the self-sufficiency factors for competing plants in the area?

In addition to information about available timber supply, costs, and self-sufficiency levels, consideration must also be given to the feasibility of acquiring or expanding a mill site that logically fits the timber draw area, and at the same time satisfies numerous other logistical requirements.

Finally, information about how a state views its timber supply is required. Are the existing forest management practices reasonable to protect the environment, yet not overly restrictive to business? What role do "preservationists" play in molding public opinion about forest resources management? Will the timber resource be available under a multiple use/sustained yield concept or will it be "set aside" for single use, i.e., wilderness?

TRANSPORTATION INFORMATION

Transportation information also is important to a forest products company considering expansion possibilities. How will the company transport raw material to the mill and end products to consumers? Ideally, a company is looking for a state that possesses a transportation infrastructure with responsive service (either by rail or truck), competitive prices, and proximity or good access to customers.

Information about trucking regulations is sought from intrastate transportation agencies. Does the state have reasonable axle loads? Are over-the-road taxes reasonable? We prefer that more than one railroad company serve a proposed facility—"captive shipper" situations are not desirable. Details regarding possibilities of maximizing trucking capabilities are required. After a product is delivered to a market, can a needed raw material be hauled back to the plant? All of these transportation considerations translate into dollars. And when the company is cost efficient in terms of transportation, it is more competitive in the marketplace.

ENERGY AND FUEL INFORMATION

Manufacturing processes in wood-based industries are generally very energy intensive. Therefore we must have very good information about available fuel and purchased energy supplies specifically:

- source and long-term supply of fuel for local utilities;
- current and future fuel costs;
- overall efficiency of local utilities (to predict future energy rates);
- opportunity for cogeneration.

In addition to the above, information regarding state regulations governing energy development is sought. Such informa-

tion sheds light on whether a state is progressive in terms of energy development, a condition which can possibly influence a company's future expansion plans.

TAX CLIMATE AND FUNDING

Also important to location decisions is information on state-related taxes and financial incentives to industry. For example, what is the state's posture regarding industrial revenue bonds to finance construction of a wood processing plant? Are bonding procedures widely used to encourage industrial expansion? If so, what information is available on such procedures? Available bonding is a good indication that the state's general attitude toward business is favorable. As a gauge of an area's economic health, a company may also look at per capita income growth and average wage and income levels.

Any wood-based company considering expansion to a new area will be interested in a state's tax structure. Taxes are the funds a company pays out for state services and for the privilege of doing business in a state. Tax information such as the following would be sought:

- Is the corporate tax rate generally fair or does it penalize business?
- What is the local property tax rate?
- Are there economic incentives built into tax credits, or tax incentives for new companies?
- How and at what rate is timberland taxed by state government (i.e., standing or severed)?

And finally, information is required about a state's personal income tax rate. Such information provides a measure of how well a company will be able to attract and keep key management personnel.

WORK FORCE INFORMATION

Information about the men and women who will staff new operations in a state is especially important to a company's decision to locate. State departments of labor or employment and the federal Bureau of Labor Statistics can usually provide statistics about average age, literacy level, wage structure, and regional work force distribution. In addition to detailed statistics, we would desire information about the state's history of commerce. In industrialized states, for example, potential employees are generally better skilled for manufacturing operations that might be found in a forest products facility. States that are primarily agrarian may not have a pool of such employees.

Information regarding employee law is also of concern to a company contemplating expansion. What statutes govern how a business can manage its employees? For example, the following questions would be asked:

- What are the statutes regarding workers' compensation?

Are they fair, but not crippling to the employer? Do they provide appropriate incentives to return to work?

- Is the state's unemployment insurance punitive to business?
- What state laws might affect the natural give and take between employer and employee and might stand in the way of or enhance the way business competes in the marketplace?
- How is the labor force within the state organized? Does it have a history of strikes and labor unrest?
- How does the state generally view medical coverage of employees? Does it have a record of cost-efficient medical practices and health care cost-containment efforts?

Companies will also be concerned about continuing education opportunities for their employees. A state should have vocational and higher education systems that can provide training and continuing education to both white- and blue-collar workers.

In addition to information in the five areas described above, a company would also want information about the state's environmental regulatory climate. We would want to know if state laws governing air and water pollution and solid waste disposal are equitable and consistently enforced. Also of concern would be whether a state's environmental regulations meet or exceed federal requirements. If they exceed them, does it add exorbitant costs that make it difficult for a company to compete with companies in states with less stringent laws? Answers to these types of questions would be sought from a state's department of environmental quality or pollution control agency, or from the U.S. Environmental Protection Agency.

There is one final area that the business must consider before deciding to expand the market conditions affecting the manufacture and sale of company products. Even though a business has thoroughly researched its needs for fiber, freight, fuel, funds, and labor and has a good handle on environmental controls as they may affect production costs, the final decision to expand cannot be made until market conditions are considered. Many questions must be answered: Who are the company's major competitors in the area? Where are the primary markets for the products? Are they too far away from the location being considered? Does the location allow for export?

Obviously the information required by a forest products company wishing to pursue industrial development in a particular area is manifold. All facts are important in order to insure that the business will be competitive. It is my hope that the comments presented here provide some insight into the type of information wood-based companies must consider in their quest to locate in areas where they can contribute to local economies, yet remain competitive in the marketplace and loyal to their stockholders.

New Forest Products and Markets: Forces Defining the Future

John G. Haygreen, Professor, Department of Forest Products, University of Minnesota

In the past decade, the wood-based industry has moved as rapidly as any U.S. manufacturing industry in adopting new technologies (feedback control systems, microprocessors, electric transducers of many types, computer-based manufacturing control and monitoring systems). Those who have visited St. Regis's new mill in Sartell, Minnesota, or the new mills of Potlatch in Bemidji and Cook, and Blandin's plants in Grand Rapids, recognize that the smokestack image of the industry is no longer appropriate. Further, the forest products industry has attained a level of energy self-sufficiency, about 70 percent, which far surpasses that of any other U.S. manufacturing industry. It has also been a leader in adopting Japanese management techniques.

A common element of Minnesota's forest products future is that most products will result from new technology; further, the new technology will be more important to the performance and success of the product than the raw material from which it is produced. The chief executive officer of International Paper recently stated to a meeting of the American Institute of Chemical Engineers that "There are two principal routes to success in the manufacturing industries. We must find ways to become low-cost producers or carve out specialized markets which offer attractive profit margins. Taking the first route, becoming a low-cost producer of commodities, requires dedication to process improvement and innovation in fields that have been well-plowed. The other route, developing high-margin specialties, requires a management commitment and a corporate culture that supports innovation. *Advanced technology is the key to both routes.*"

We will discuss four areas related to the importance of new technology in developing Minnesota's forest products industry. First, we will review some of the new technologies being developed. Second, we will look at forest biomass as a source of energy. Third, we will look at manufacturers of machinery, equipment, and supplies for the forest products industry as an important element of Minnesota's economic future—an element that can be expected to grow in world, not just regional, markets. And fourth, areas where secondary manufacturing may have opportunities for regional markets (e.g., furniture, building components, consumer wood products) will be highlighted.

NEW TECHNOLOGICAL DEVELOPMENTS

Minnesota has a record of creating new forest industries from technological development. The fiberboard industry was

born here many years ago, and high-speed technologies for coating paper perfected in Minnesota are now used worldwide. Minnesota has been a leader in innovation in the manufacture of both wet- and dry-process hardboard; one of the first successful chipper-canter sawmills producing lumber from hardwoods is in northern Minnesota. We have manufacturers of wood machining, surfacing, sanding, and pallet assembly machinery that are leaders in the world.

The most exciting recent forest industry development in the state has been the establishment of the composite structural panel industry (waferboard and oriented strand board or OSB). Blandin's plant was the first in the United States to produce a composite structural panel product from wood wafers, an alternative to softwood plywood. These 5 structural panel plants were among the first of the 30 some such plants in the United States; Minnesota is now the leader in structural composite panel production. In November 1984 a structural composite product symposium held in Minneapolis attracted 250 industry representatives and technical specialists from nine countries. One reason for holding the international meeting in Minnesota was because of the dominance of our industry in this field and because of the research being conducted at nearby public institutions, principally the University of Minnesota and the U.S. Forest Products Laboratory in Madison, Wisconsin.

Thus, the forest products industry in Minnesota has depended heavily upon new technologies and process innovation rather than being mainly a producer of commodity products with contemporary technology like forest products industries in many other states. The future of Minnesota's forest industry will lie mainly with the second path to success quoted earlier, i.e., finding specialized products and market sectors and developing the products and the markets through innovation.

At today's conference there will probably be frequent mention of the adequacy of our timber resource and its potential importance to the economy of the state. Although this is true, a more important factor will be the progressive attitude of the industry, both present and future, toward innovation and new technology. Many states have an adequate resource conveniently located near major markets. In addition to that, we have a tradition of being the leaders in innovation and in developing the human talents which are in reality the most critical element in new development.

Another factor favoring the Minnesota forest industry's competitive position relative to other states is that the manufac-

ture of most products no longer need be tied closely to the type of timber available. Not many years ago construction lumber was produced from the less than 10 primary softwood species, plywood from a handful of West Coast species and southern pine, hardwood lumber and millwork from only large sawbolts, and high strength paper only from softwoods. We are now at a point when it is technically possible to make a product suitable for almost any wood-use markets from almost any type of timber resource. In the future we will not be constrained by the nature of our resource—the species and size of logs—and wood quality as defined in the past will not be the major determinant of our development. There are many forest industry opportunities for Minnesota; those that successfully emerge will do so through initiative and innovation encouraged by both private and public sectors.

What are some products and markets which are likely to develop in the next decade or two? Consider first the building materials field. We already recognize the importance of OSB and waferboard to Minnesota. But these are only the first of a new family of composite wood materials produced by bonding wafers, strands, and flakes together with durable synthetic or naturally derived adhesives—one of the most promising areas for growth. These panel products are the equivalent of plywood but have a great advantage in that they can be modified or engineered to possess specific properties for specific markets. Modification of present technology to allow access to markets for truck flooring, siding, concrete forms, structural “I” beams and other exterior products is well under way. These developments will allow our present industry to expand product lines into special markets and allow greater use of secondary hardwood species, i.e., hardwoods other than aspen.

We have several advantages over other states in further expansion of the composite structural panel industry. We have the ideal resource for the product, aspen. Although the supply of aspen is tightening we have other low density woods—balsam poplar, balsam fir, pines, and paper birch—which are well-suited for composite products. We also have the advantage of being leaders in structural panel production and technology with established marketing strategies.

How about plywood production in Minnesota? We have never been a producer of plywood because our timber did not produce peeler blocks of adequate size and quality. But the timber requirements for plywood production are dramatically changing. A process called the centerless lathe is now being developed, which will take 4- to 8-inch logs and peel them to a 2-inch core at a rate of one log every five seconds. The yield from this process is reported to be high—about the same as for an efficient waferboard or OSB process. It thus seems possible that plywood production could be a reality in Minnesota in the next decade. Such a product would probably not compete directly in the commodity marketplace with waferboard and OSB but would look for high-margin specialty markets as siding, marine panels, signboard, and car lining.

The production of structural panels, waferboard, OSB, and specialty plywood in the state could provide value-added output several times that of our four present plants. This value-added output could be doubled or tripled if there were firms to convert this material into building components and other secondary manufactured products. Manufacture of such products as structural “I” beams, floor and wall components, and prefabricated commercial buildings would be a logical first step.

Secondary manufacture of this type has the advantage of being four to six times as labor intensive as production of the basic commodity product. In looking further into the future, Minnesota has the material and human resources needed to become the first producer in the United States of a wood-composite manufactured house, i.e., a home using no lumber but with structural elements produced entirely from engineered wood elements manufactured of wafers, strands, and flakes.

Another new building materials technology with promise for the state in 5 to 15 years is the production of composite structural lumber from veneer strips, fingerlings, and wood strands. Softwood logs of sawtimber quality are periodically in short supply throughout the United States and the world. Because of this, a Canadian firm has for several years been working on development of an alternative for softwood lumber produced by pressing and curing long narrow strands of wood into rectangular blanks. This product has been tested extensively and is nearing commercialization. The firm has spent \$25 million to date on the research effort. Although this research will result in a proprietary process, public and other corporate research labs are finding alternative technical approaches to composite lumber production. The softwoods and low-density hardwoods in this state are well suited to manufacture of this exciting new product.

FOREST BIOMASS AS ENERGY

Let's turn from these new technological developments to use of our forest biomass for energy. Concern is sometimes expressed that using timber for energy will compete with production of paper, fiber products, and composite building materials. But we have a wealth of small, dense, low-grade hardwoods and logging residues which are probably best suited for generating energy. Today, of course, Minnesota is a significant producer of wood energy. We lead the United States in production of densified wood fuel, pellets, and briquettes. A Minnesota-born organization, the Fiber Fuels Institute, is recognized throughout the country for its effort to develop standards and specifications. Presently the use of biomass fuels in state industries and institutions is saving about \$50 million in money not exported for fossil fuels.

In the short run the major process for converting wood to energy will continue to be combustion. In the next decade, however, we should see wide acceptance of low-Btu gasification processes for industrial applications. Down the road, by 2000, technologies may be commercialized for production of pipeline-grade methane through anaerobic digestion. Our good old species, aspen, appears to be one of the best woody feedstocks for this process.

The form of wood for these energy processes, whether combustion, gasification, or biochemical, will be *prepared* fuels either in densified or chip form. The market for densified fuels will remain with smaller users, where convenience is important, while larger industrial users will rely on the less costly wood-chip fuels. I am convinced we will see great growth in this latter area, depending principally on the rate of increase in the cost of liquid fossil fuels. If this growth does occur, an infrastructure will develop for harvesting, processing, and distributing wood-chip fuels.

Fuel chip processing will involve more than just transport of chips from the forest to the boiler. It may also include size

classification and product separation, compression drying to a uniform moisture, thermal drying to a low moisture content (particularly for gasification), baling, and storage. In some cases wood-fuel processing will be developed by existing forest industry. In other cases firms will be established to exploit and develop this market as independent entrepreneurs.

Regardless of the form it takes, it seems very probable that energy will become an increasingly important product from the forests of Minnesota.

MACHINERY AND EQUIPMENT MANUFACTURE

We have another forest products-related industry in the state which is important but often not recognized: Firms that produce machinery, capital equipment, combustion systems, and technology for the wood-using industry. This machinery is marketed throughout the United States and increasingly worldwide. When we discuss the future of forest industries we should certainly not forget these firms and others like them which may be established. Statistics on the economic contribution of these machinery firms to the state are not readily available, but it is significant. Some of them produce equipment exclusively for the wood-using industries; others are more diversified. In total they employ hundreds of people, probably over a thousand. In addition, we have manufacturers of supplies such as adhesives, finishes, and abrasives. A characteristic of these firms is that they are strong in technology, use of microprocessors, and computer controls, and appear to be among the national or international leaders in their fields. Thus we will see many of these firms expanding their markets and developing new product lines.

One such firm, in Fridley, Minnesota, produces automated pallet manufacturing equipment. Theirs is the leading pallet processing system in North America; in fact, 45% of all ma-

chine-made pallets are made on their machines. The firm has just entered a venture with an Italian manufacturer and is now marketing its Minnesota product in Europe. This is just one example of Minnesota capital equipment firms who will be developing new business for the state in the future.

SECONDARY WOOD PRODUCT MANUFACTURE

There are many wood products yet to be discovered which could be developed to satisfy specific market niches. New technologies developed by USDA Forest Service research in cooperation with several universities, including Minnesota, make it possible to produce high-quality solid wood products from a timber resource that in the past would have been called low quality. The upgraded solid wood components produced by these technologies are ideal raw materials for a wide variety of furniture, millwork, and casegoods lines. Development of these possibilities will require an entrepreneurial approach backed by a realistic research and development program and adequate venture capital. This area of specialty products is one of the most promising for significant development in northern Minnesota.

In conclusion, time does not permit mentioning all the new products and markets which are possibilities for Minnesota in the next decade. New products will undoubtedly arise that are not now conceived. They will probably, however, fall into one of the four categories delineated here. Which of these products will emerge as realities for the state is subject for much speculation. However, a significant investment in research and development in both private and public sectors will be an important factor in determining when they arrive and when they will ultimately make significant contributions to Minnesota's economy.

Timber Supply Information: Meeting Industrial Needs

Robert N. Stone, Project Leader, National Timber and Wood Products Requirements and Utilization Unit, Forest Products Laboratory, USDA Forest Service

Statistics gathered during the 1962 and 1977 forest surveys reveal substantial change in Minnesota's forests; the overall changes in volume and area are huge if viewed in percentage terms. Hidden within these overall trends are some equally interesting but complex and dynamic changes that are specific to an expanding forest composed of dozens of forest species. The

data reflect, for example, waves of tree age classes and volumes that are shifting the basic character of the timber resource. Between the two forest surveys, timber inventories increased from 7 to 10 cords per acre, a change which has clear implications for the cost of harvesting wood. Such changes are occurring in Minnesota and across the Lake States.

Periodic inventories of forest resources can be used to characterize forest resources and to gain insights about economic supplies of wood which might be useful to firms contemplating expansion within a state.

Forest survey has had several names; it currently is known as the Forest Inventory and Analysis. Forest survey is not the sole product of the USDA Forest Service. In Minnesota, for example, surveys frequently have been carried out as partnership ventures involving the USDA Forest Service, state and county governments, and, in some cases, wood processing companies. Four complete inventories have been made in Minnesota since 1936. The trends revealed there show that forest land has gone down while timber inventories are going up. Such trends have a number of important implications.

Forest survey was authorized by the McSweeney-McNary Act of 1928; its mission was broadened considerably by the Forest and Rangeland Renewable Resources Planning Act of 1974 and the National Forest Management Act of 1976. Today's forest survey is charged with providing forest statistics to be used in multi-resource management activities. Seven research teams located at USDA Forest Service regional forest experiment stations carry out forest surveys. The survey unit at the Forest Service's Forest Products Laboratory is responsible for evaluating timber use by estimating wood consumption for the nation and deriving timber requirements (supplies) needed to meet expected consumption levels.

Forest survey basically provides information on the size of a particular forest attribute. It presents information about forest area, timber volume, tree growth, and timber removal. Ironically, it reflects conditions as they existed in the past, while we are most interested in answers to questions about tomorrow. Trend analysis of forest survey statistics provide the basis for estimates of the current timber situation or *physical supply*. However, firms would like to know what wood will cost during the life of their capital investment—the *economic supply* of timber over the life of a proposed mill. Such information does not come from forest survey data.

Another feature of forest survey information worth noting is the process by which it is aggregated and updated. Timber use and supply estimates used to compare forest conditions in different states come from national compilations. The updating process produces quirks in the data. First, there is no national forest survey; rather, state-by-state surveys must be aggregated or averaged to produce national information. As is widely known, averages must be interpreted with caution. Second, data from state surveys—carried out at different times—must be “updated” to a common time period. For example, “An Analysis of the Timber Situation in the United States” presents estimates for 1977. Most such estimates are derived by updating information which was gathered much before 1977. The process of updating often involves the use of sophisticated growth simulators which can deal with totals, but not with internal components such as forest ownership, site index, and tree class. This implies limitations to the use of forest survey data. Generally, however, one does not have to worry a great deal over this problem beyond acknowledging its existence.

The means by which forest survey is carried out and the type of information gathered and presented by survey processes have been subject to considerable review over the years. As a means of providing insight into directions forest survey might follow in the years ahead, we can look at recommenda-

tions made by state foresters who met in November 1983 to assess how well forest surveys were serving clients around the country and to suggest ways to improve the usefulness of forest survey information.

REDUCE MEASUREMENT CYCLE

The average number of years between surveys in Minnesota is 13 (surveys were made in 1936, 1953, 1962, and 1977). State foresters recommend that the inventory measurement cycle be reduced from the current 10-year national average to 5 years. If this were done, forest statistics would be more current and of greater value to firms assessing the timber base required to support proposed facilities.

COUNTY INFORMATION

Forest survey data may or may not be presented on a county basis. The state foresters recommended that the county be a reporting unit for resource data and that survey research units recompile data on a county basis. Such compilations should make it easier to put together “wood procurement” zones. However, the statistical reliability of the information may be questionable for counties with small forest acreages and small timber volumes.

CONSISTENCY BETWEEN SURVEYS

Consistency in the type of information and the manner in which it is gathered is important to users as well as preparers of survey data. The state foresters recommended increasing consistency from one survey to the next. Although a laudable goal, it does pose problems. Use of old product definitions may result in poor or missed estimates of potential wood uses in new products. For example, product or resource definitions followed in early surveys would not provide estimates of firewood use or biomass volume in Minnesota. Consistency may not provide answers to new questions, while judiciously changing definitions may allow for answering new resource questions as they begin to surface.

UTILIZATION STANDARDS

Utilization of forest biomass can change considerably over time; what was waste at one time may now be a valuable product. The state foresters recommended that survey information reflect current and expected utilization standards and the resources available for producing the products implied by such standards. If we plan on utilizing the entire tree—stumps, branches, and all—then definitions, volume tables, and estimating techniques will have to be changed. This would, however, cause difficulties if consistency is applied too rigorously.

DIRECT INFORMATION ACCESS

Modern computers and data processing equipment provide enormous opportunity to evaluate forest survey information in light of resource questions raised by individual managers. The state foresters recommended that users of forest survey information have direct computer access to forest inventory data.

FOREST SURVEY USER GUIDE

Forest surveys result in an enormous variety of information—information many are not aware of. The state foresters

recommended the preparation of a user catalog which would present in a very readable fashion the types of information available from the forest survey.

UPDATING PROCEDURES

Current forest survey information is of special importance to firms interested in locating new facilities in forested areas. The state foresters recommended developing better methods for updating inventories (i.e., better modeling). Most updating procedures used today cannot deal effectively with questions about current resource conditions. The procedures that are used are quite simple—grow the forest forward and then make guesses about harvest rates. Updated volume estimates are basically accounting answers to inventory changes on the old land base. This poses problems if land use or the definition of forest land changes. For example, commercial forest land is partially defined by site quality; if techniques for measuring the site improve the forest area may change.

FOREST ECOSYSTEM CHANGE

Forest ecosystems change over time and resources interact to produce multiple outputs with different values. The state foresters recommended that better models for predicting ecosystem change and resource interactions be developed and used. Although the issue is an important one, the approach that might be used to do so is not entirely clear.

The topics and recommendations mentioned above basically add up to a request for more data of better quality presented in a more timely fashion. The extent to which these recommendations are implemented will influence the direction that forest survey will assume in the years ahead.

Discussion of forest survey data and the techniques used to obtain and present such data invariably focuses on quantifiable, physical characteristics of the forest. In my judgment, we have ample information in this area—at least at the state level, we know quite well how much timber we have, where it is, and how fast it is growing. We could spend twice as much money and probably improve the data no more than 8 to 10 percent. There are, however, many more fundamental questions about the *economic* availability of the timber resource. For example, if there exists a given amount and quality of timber, how much is really available at what price and when? Such issues deserve additional attention.

There is a tendency to equate forest survey data—which reflect physical availability—with economic supply. This is erroneous. Economic supply is highly variable, depending on the region, state, county, or individual tract in which timber is found. There is no single estimate of the economic supply of timber. In fact, there are many, many economic supply schedules, each unique to the forest landowner in question.

Progress has been made, however, in defining economic timber supplies. There are computer programs for estimating wood supply at various costs in a given procurement zone. Unfortunately, if everyone used such estimates their value would be very limited. We live in a competitive world where amount of wood that can be purchased is a factor of inventory and timber demand.

There also exists TAMM (Timber Analysis and Marketing Model), which has been reasonably successful in defining economic timber supplies—at least at the national level for softwoods. TAMM was used to develop forecasts of timber consumption as presented in “An Analysis of the Timber Situation in the United States.” Here, supply and demand estimates are dampened by price. Consequently we remove ourselves from discussion of physical timber shortages; price will do the allocating. TAMM calculates price changes necessary to bring additional timber to the market. One can work backwards from there to determine the additional investments required to maintain price at acceptable levels. TAMM currently is being applied to the softwood timber resource; a hardwood version is now being prepared.

Traditionally, statistical designs for estimating physical supply (forest survey) have been good; statistical reliability can be determined quite well. The same cannot be said for estimates of timber demand. It becomes nearly impossible to determine the reliability of demand estimates. Without question, it is time to develop new approaches to this dilemma.

In conclusion, there are many, many opportunities to improve the timber information base that is currently available to forest managers. Even though existing information will answer nearly all of today’s practical questions concerning the physical supply of wood fiber in the forest, there are problems with forest survey information, especially estimating changes in land use, updating information from one survey to the next, defining changes in wood use given rapid changes in technology, and defining the impact of unforeseen changes in environmental conditions such as acid rain.

We are rapidly entering an era where computer repackaging of all types of forestry information will be quick, cheap, and very accurate. If industry is contemplating investment of \$250 million or more in a new facility and is undecided about a location, the magnitude of the investment would certainly seem to warrant a number of intensive surveys to make sure that existing forest survey data accurately portray resource conditions in the proposed area. Capital investments in processing facilities are large and must be incurred over many years. Information investments by comparison may be small relative to their ability to guide managers away from risky or poor decisions. Information from forest survey, complemented by privately gathered site-specific information, can do much toward insuring wise industrial development decisions which will be in the public’s best interest.

Information Management: Forestry Opportunities

Alan Robinette, Director, Planning Information Center, Minnesota State Planning Agency

The effectiveness and efficiency of information management have increased greatly in the past five to seven years. Such advances are of substantial value to the development of policies and programs important to both public and private sectors—land forestry is most certainly no exception. The extent to which information management has become important to professional managers can be illustrated by the frequency with which we use computers and the magnitude of data that we expect our computers to manage and analyze. Nearly everyone has ready access to computer terminal or microcomputer. We truly are in a sophisticated age with regard to information management.

One application of information is in strategic planning, in which decisionmakers chart broad future directions for resource management. In the forestry sector, the management of information for planning and decisionmaking about economic development can be especially important. This can be illustrated by reviewing the hierarchy of planning information starting from a global perspective and working toward detailed computer mapping—if you please, looking first at the forest and then at individual trees.

First, I recently saw a satellite image of the northern hemisphere that shows differences in vegetation between April and August 1983. It clearly demonstrates the broad coverage which remote sensing devices are capable of handling.

At the next level of consideration, we see that forests cover an estimated 28 percent of the world's land area (Table 1); about two-thirds is hardwood and one-third softwood. Approximately 60 percent of the world's forested area is available for wood production. Most productive forest lands are located in the Soviet Union and in the Western Hemisphere; over half the world's growing stock is in Latin America and the Soviet Union. However, North America, Europe, and the Soviet Union account for 75 percent of the worldwide production of industrial roundwood.

The next logical question might be, "How do Minnesota forests compare with those in other states?" Data from the USDA Forest Service illustrate state differences in growing stock (Figure 1). Minnesota has about 710 billion cubic feet of growing stock, approximately 1.6 percent of the nation's total. In terms of growing stock removal, Minnesota contributes 1.2 percent, or 175 million cubic feet, to the national total. Forest production nationally is heavily concentrated in the Far West and Southeast.

Focusing more narrowly, forest planners may wish to compare Minnesota with other states in the Lake States region. In terms of commercial forest land and timber growth, we are not

regional leaders. For pulpwood production, however, a somewhat different pattern emerges, although there is strong concentration of pulpwood production in northern Wisconsin and Michigan's Upper Peninsula (Figure 2).

Minnesota's forestry sector is a significant component of the state's economy (Figure 3). Contributing nearly \$2 billion annually, the sector compares very favorably with agriculture and mining. The bulk of this contribution comes from the manufacture of pulpwood. Fuelwood is increasing in importance. As planners project timber growth and demand into the future, they must consider changes in technology and markets in order to prepare accurate pictures of future supply and demand. Forecasts of future conditions are illustrated in Figure 4.

Forestry information is also available for planning which forested areas of the state should be managed more intensively. Such information usually involves resource inventories (especially forest survey information) available for different geographic scopes, including the state as a whole. For example, we have analyzed land use information for one watershed in nine categories, including agriculture, forest, wetlands, water, and urban development. In addition, the forested area is subdivided into six species groups based on 1977 Phase I Forest Inventory information. Other data studied might include soils, transportation networks, and public lands.

Public lands also can be the focus of resource information (Figure 5). About 25 percent of the state is owned and managed by public agencies, with approximately 5.5 million acres controlled by the Minnesota Department of Natural Resources (DNR). The DNR has a computerized inventory for each parcel of land it manages which provides information for preparing broader pictures of public land ownership in Minnesota.

The Planning Information Center can provide regional soil inventory information for assessing regional forest and agricul-

Table 1. World forest resources.

| Area | Percentage of forest land | Percentage of growing stock | Percentage of industrial roundwood production |
|---------------|---------------------------|-----------------------------|---|
| North America | 17.9 | 16.6 | 32.6 |
| Latin America | 15.3 | 34.4 | 5.8 |
| Europe | 5.5 | 3.7 | 20.2 |
| Africa | 12.9 | 9.8 | 3.7 |
| Asia | 14.5 | 11.4 | 12.9 |
| Japan | 1.0 | 0.5 | 2.3 |
| USSR | 30.7 | 22.2 | 20.4 |
| Pacific area | 2.1 | 1.4 | 2.0 |

Source: United Nations, FAO.

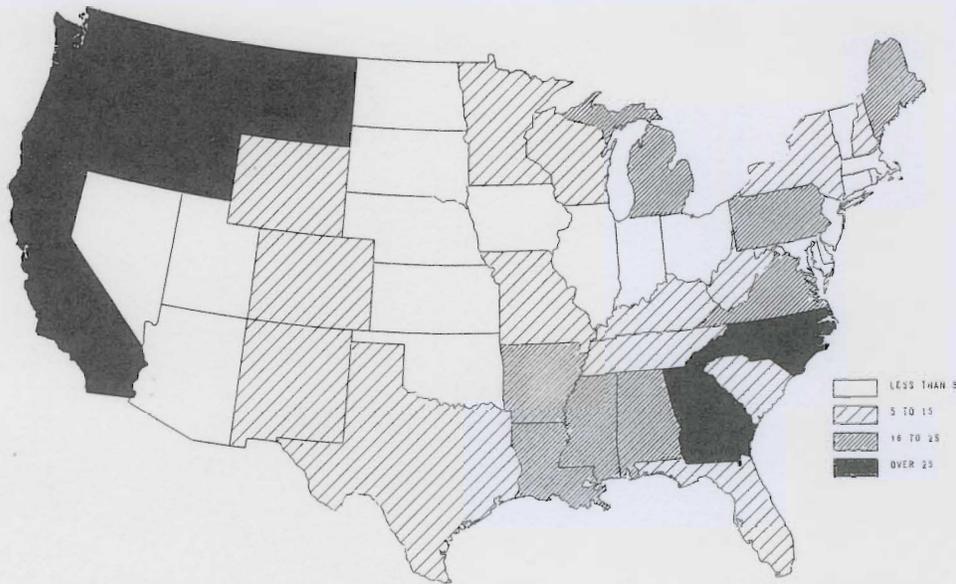


Figure 1. Forest growing stock volume, billions of cubic feet, 1977. (Source: U.S. Forest Service. Map provided by Planning Information Center, Minnesota State Planning Agency.)

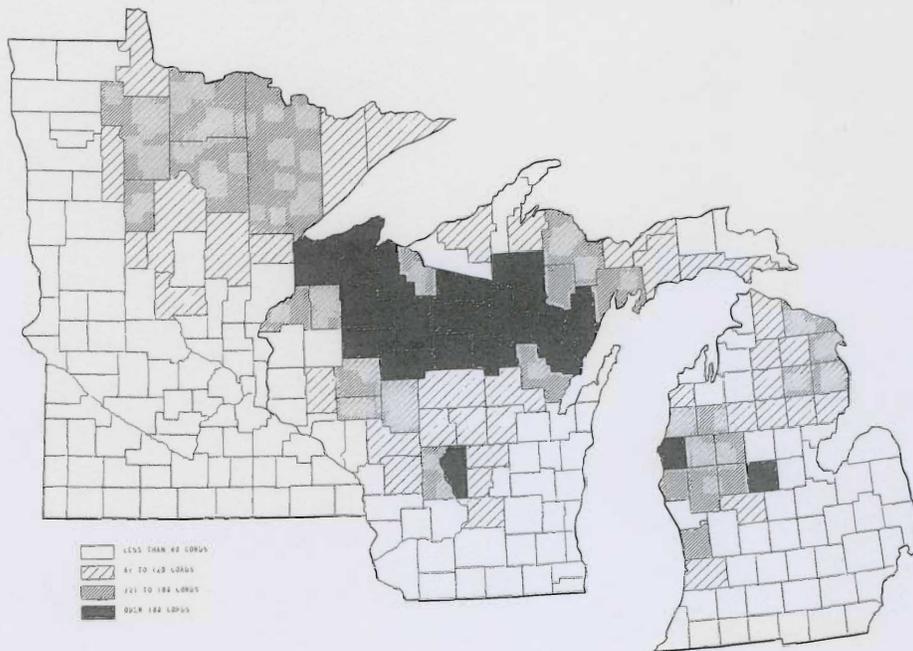


Figure 2. Cords cut per thousand acres of stocked commercial forest land, 1981. (Source: U.S. Forest Service. Map provided by Planning Information Center, Minnesota State Planning Agency.)

tural productivity and soil erodibility. The center also has topographic information from U.S. Geological Survey maps which enables managers to evaluate slope and runoff characteristics. Complementing such information is the DNR's inventory of small watersheds, which describes 5,700 watersheds as small as 10 square miles each. The stream network has been delineated from 7.5 minute quad maps.

In total, information of this sort represents a very complete regional natural resources inventory—an information base that is potentially very useful to planners and managers.

Minnesota has a positive history of developing statewide resource inventories. Legislative and executive leadership,

combined with financial support (especially from the Legislative Commission on Minnesota Resources) has placed Minnesota in a unique position in the field of natural resource information and its management. As resource professionals, we should appreciate this position and should take advantage of it at every opportunity. This includes making sure that available information reaches decisionmakers at all levels, including strategic planning, tactical planning, and operational levels.

LAND SUITABILITY PROGRAM

The DNR's Land Suitability Program is an excellent exam-

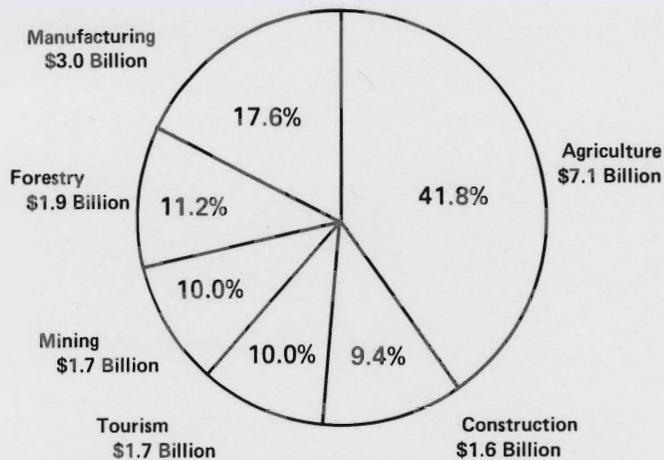
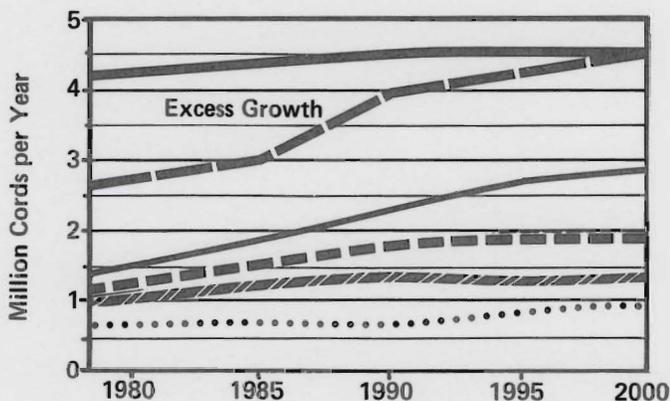


Figure 3. Contributions to Minnesota's economy. (Source: Minnesota Horizons, 1983.)



LEGEND

- Annual Growth
- Total Demand
- Wafer Board
- Pulpwood Exports
- Fuelwood
- Sawtimber

Figure 4. Projected timber growth and demand. Annual growth was based on industry standards for net growth. (Source: Minnesota Department of Natural Resources, Division of Forestry.)

ple of how regional forest and related inventory information can be applied. The program assesses state-owned land for its highest and best use as part of a land classification and land exchange effort. The program uses statewide forest inventory information, such as forest cover, which is built into a forest suitability model. A section is the basic unit of information; this unit contains a considerable amount of detailed information, including timber stand information (e.g., species, acreage, and site index) from the Phase II Inventory.

The land suitability model through which such information is passed considers four factors: site productivity, which reflects physical conditions that indicate ability to grow timber; accessibility to mills and other processing sites; density of state land, a measure of the degree to which state lands are consolidated for intensive management; and accessibility to roads re-

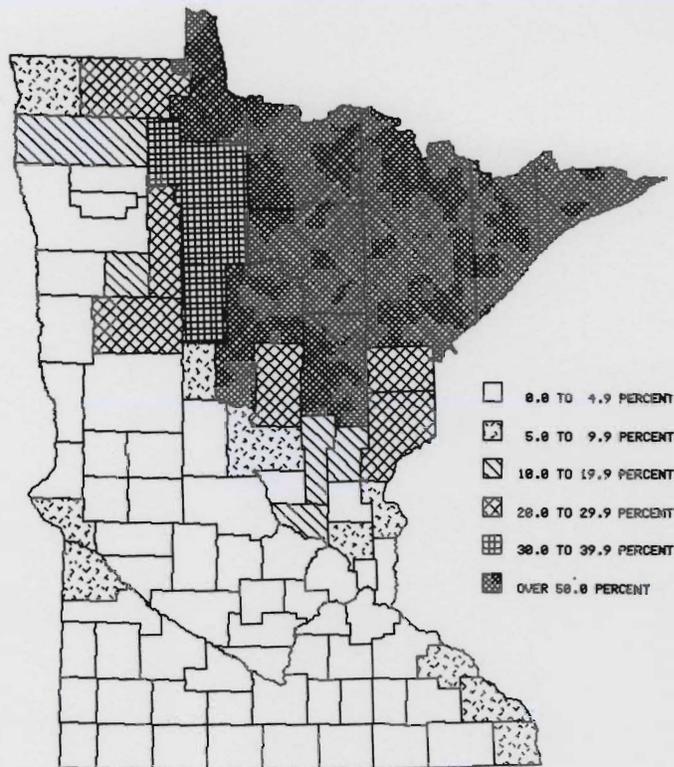


Figure 5. Total public land as a percentage of county land area, 1983.

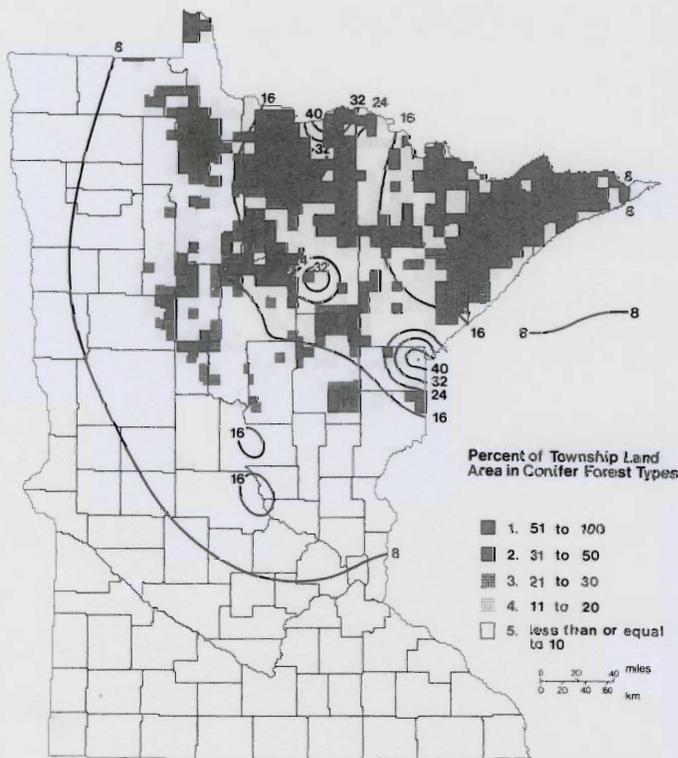


Figure 6. Conifer primary processor accessibility. Values plotted are percentages of maximum primary processor accessibility. (Source: 1978 Primary Processor Information, Minnesota Department of Natural Resources; Forest Cover Information, 1967-77, U.S. Forest Service.)

quired for harvesting and transportation. Mill accessibility to conifers or aspen-birch, for example, is shown in Figure 6; the shaded areas represent the density of the conifer forest within each township. The result is a display of various concentrations of conifer timber stands and a particular mill's accessibility to them.

Decisions regarding consolidation of land ownership can be guided by maps depicting ownership patterns. Such maps exist for state-owned land as well as for county-administered land and federal land. When such information is combined with other factors operating in the suitability model, a map illustrating suitability for intensive forest management results.

The model's weighting of the four information factors leads to some interesting results. Land in Koochiching County, though not very productive, rates high for retention and intensified forest management because of its proximity to mills and the high density of state/county ownership. In contrast, there may be highly productive land elsewhere in Minnesota that is quite inaccessible and, therefore, rates very low in suitability for intensive forest management.

FOREST PEST APPLICATIONS

Regional forest inventory information can be used not only for assessing timber productivity of forests but also for guiding

forest protection activities. For example, the Planning Information Center assessed the susceptibility of spruce and fir to sawfly infestations for the University of Minnesota's Department of Entomology with special focus on the Chippewa National Forest in Itasca County. A three-dimensional representation was used to illustrate topography, political boundaries, water systems, and forest type, and, ultimately, areas most susceptible to the insect pest.

OPERATIONAL INFORMATION

A number of systems are being used to present management information at a site-scale level. For example, a Potlatch forest in the western United States has been computerized to illustrate the type of information that can be presented; the system provides information about drainage networks, ownership patterns, highways, and fire lookout stations.

Using Phase II Inventory data, Itasca County can now prepare detailed maps showing a variety of information important to forest management activities, including stand boundaries and forest roads. In the past, such information was prepared by hand; it is now part of an automated system. A similar system being used in New Brunswick describes stand types, development stage, crown closures, and stand indicators. Stands are not only delineated, but also described in great detail; the re-

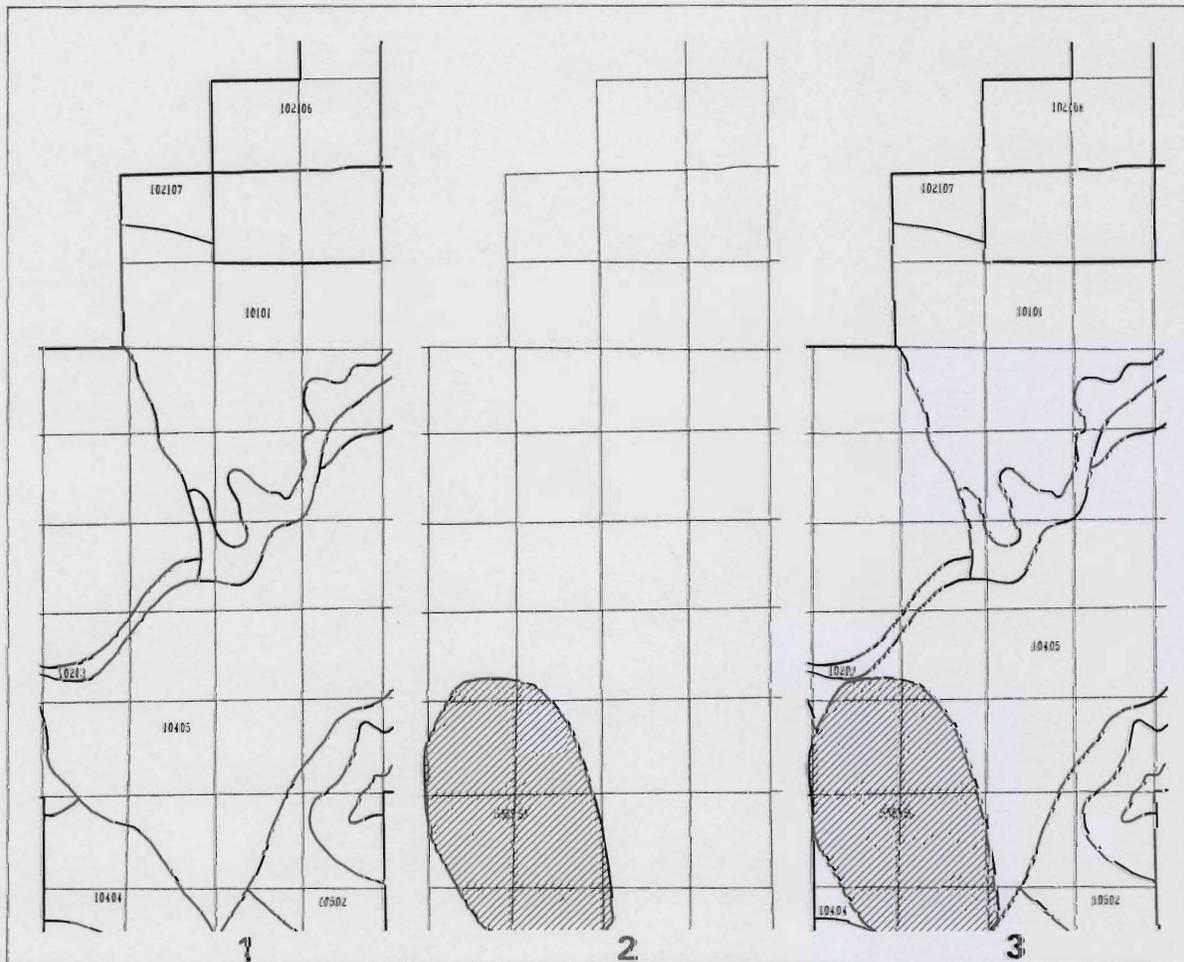


Figure 7. This series of three maps shows the update process. Map 1 shows the stand boundaries. Map 2 shows the areas of forest harvest. Map 3 shows the revised stand boundaries.

sulting information is readily available to resource managers. The Arizona Department of Fish and Game has accomplished similar results for the state's forestry activities.

As illustrated in Figure 7, it is possible to update forest inventory information with today's information management systems. The initial update process is labor intensive but offers very great potential for future analysis. It is also possible to incorporate nonforest information into site-scale forest inventory information. For example, flood-prone areas from a topography map define the limit of lowland forest, based on soil and topographic conditions.

Obviously, forest inventory information is a valuable resource in itself; if is even more valuable for making analyses. For example, basic forest stand data for a large area would take a considerable amount of time to prepare by hand and interpret. Computer systems, however, could readily quantify the forest land within 300 feet of roads and so provide data for setting limits for roadside harvesting. In Maine, a computer helps identify appropriate equipment for timber harvesting according to cover type, soil condition, and a stand's proximity to roads. In yet another application, stand vulnerability to spruce bud-

worm infestation is being evaluated based on various forest inventory data.

Information activities can also be used to plan harvests (Figure 8). Based on information about stand age, density, and type, appropriate cutting schedules can be delineated and clearly presented.

Mapping systems also have been applied to engineering problems. In Maine, for example, a forest road inventory provided detailed information about paving, bridge capacities, weight limits, and culvert locations. Information of this nature truly reflects site-specific conditions.

In conclusion, these examples clearly demonstrate the advanced state of today's information management systems and the various planning levels at which they can be applied. Such systems have much to offer decisionmakers selecting broad strategic directions for statewide forest resource management; likewise, they can be of substantial value to managers dealing with forestry operations at site-specific levels. Professional managers of forest resources should most certainly avail themselves of the opportunities such systems offer.



Figure 8. Chipman scheduled harvest sequence. The harvest schedule depicted in this map sustains the maximum annual spruce-fir harvest (72,500 cubic meters/year) for this 80,000-hectare forest. The sustainable harvest was determined using the forest development survey, wood supply simulations, and an "oldest first" harvest rule. The geographic information system, together with a stand growth model, was used to sort stands by decreasing volume loss, assign them a harvest period, and graphically display the resulting harvest progression that sustains the maximum harvest. (Source: Natural Resources, New Brunswick.)

Forestry Research: Investments in Information

Robert E. Buckman, Deputy Chief, Research, USDA Forest Service

Forestry research is an instrument of change. The economist Schumpeter—an Austrian Minister of Finance who later joined the Harvard University faculty—suggested years ago that the enormous growth experienced by the United States and the world was fueled in large part by technological change. Studies over the years have continued to support the notion that new technologies have been a major inducement to economic activity and enhanced productivity.

PRODUCTIVITY AND TECHNOLOGICAL PROGRESS

The productivity story in the nation's agricultural sector is well-known. In the 1920's, farms were marching up the slopes of the Appalachians; agriculture was being practiced on land that had heretofore not been used for such purposes. Then in the late 1920s came hybrid corn, heralding a series of other technological changes in agriculture. We no longer farm the foothills of the Appalachians; in fact, we are no longer farming portions of the Piedmont. A great deal of the credit for positive change in the agricultural sector can be directly attributed to science. Hybrid corn is but one example; today a single milk cow will produce as much milk as an entire herd did in the 1920s. We can provide one pound of weight gain in poultry, catfish, and rainbow trout for two pounds of animal feed. All of this has permitted us to more than double food production on a significantly smaller agricultural land base than existed in the 1920s.

The role of science and technology in forestry is not nearly as well understood. There have, however, been some significant success stories. The premier story of forest conservation is probably the resurgence of forest resources in the South. In the 1920s, the South was worn-out cotton fields, broomsedge, and abandoned pastures. In 1939, the region supported fewer than 20 pulp and paper mills. Today—a little more than 40 years later—it supports 160 pulp and paper mills, most of which have been modernized and expanded several times over. Forestry has become a leading generator of income in most southern states.

There are other forestry success stories in which science and education have played a role. What is happening here in the Lake States is surely an example. Land that many years ago was occupied by sharp-tailed grouse and prairie vegetation now contains aspen and hardwood stands of 20 to 30 cords per acre. Protection, education, and the application of scientific forestry permitted expanded timber production on these lands. One only wished that nature had endowed the Lake States with an environment that favored conifers more than hardwoods,

since it is the conifers that brought the great forest industries to the South and have maintained the industry in the West.

Many other forestry success stories flowing from application of new technologies can be added to the list. But let me now turn to how the public and private sectors are organized to conduct forestry research.

RESEARCH ORGANIZATIONS

Forestry research in the United States is carried out by many diverse organizations. For example, 61 forestry schools receive research funding under the McIntire-Stennis Act of 1962. Funding under the act is approximately \$30 million for 1985, but the states and other contributors bring expenditures to about \$80 million. The USDA Forest Service research budget is of a similar size if we subtract forest survey and similar information gathering activities. Combined, the Forest Service and the university forestry schools operate on a research budget of approximately \$160 million annually. If other public funding is included (e.g., research by state agencies and non-forestry schools at universities), the publicly supported forestry research budget is about \$200 million per year. Private forestry research investments bring the nationwide total to roughly \$400 million annually.

Pulp and paper activities receive far-and-away the largest proportion of the forestry research budget, i.e., approaching 0.5 percent of finished product value. Solid wood products, in contrast, are far behind; research dollars total less than 0.2 percent of the value of such products. Such low investments may be one of the reasons why the solid wood products industry is viewed as a low-tech industry in this high-tech era.

Forest land management research (e.g., silviculture, nursery activities, protection) is largely funded by the public sector. Less than \$15 million to \$20 million of private sector monies are invested in such land management research annually.

RESEARCH INFORMATION NETWORKS

The products of forestry research are many and varied. How do people tap the information that results from research? In the public sector there are some informal but effective mechanisms. The Forest Service and the university forestry schools, for example, share information and collaborate on research activities; in general, the two groups know remarkably well what each is doing. I wish others involved in forestry research, and user groups as well, were as knowledgeable.

Collaboration is probably more sophisticated for utilization research than for forest land management research. Twice a

year, for example, researchers and research users meet at the Forest Service's Forest Products Laboratory in Madison, Wisconsin. The fall meeting tends to involve publicly supported research persons and activities. The spring meeting focuses on the private sector and includes the American Paper Institute, the Technical Association of the Pulp and Paper Industry, the Committee on Research Evaluation of the National Forest Products Association, and the wood preservation industry. These meetings have been conducted for many years and provide an excellent coordinating mechanism.

Communication and collaboration among land management research organizations is not nearly as efficient. There are some obvious reasons for this. Land management research tends to be more site-specific, more geographically oriented, and much more diffuse. Nevertheless, some steps have been taken to secure better interactions among land management researchers and their constituencies. Recently, for example, industry and state foresters met to review possible future directions for forest survey activities. They provided advice on how the Forest Service could acquire information about forest resources more expeditiously and frequently.

Although we have some reasonably effective ways to communicate research findings to users, it is still an activity that requires constant nurturing by both scientists and users. We must also keep in mind that these interactions provide valuable feedback to scientists about research direction.

RETURN ON RESEARCH INVESTMENTS

The effectiveness of investments in research should concern forestry professionals in all fields. For example, recent studies have calculated the costs of all research and education required to achieve technologies such as press-dried paper, structural flakeboard, and truss-framed housing. The benefit-cost ratio was 18 percent—remarkably high in my judgment. Similarly, a recently completed study of the importance of containerized seedling technology in the South reported a benefit/cost ratio of nearly 100 percent. Similar studies are now under way to evaluate returns from research on forest fertilization in the Pacific Northwest and research focused on the southern pine industry.

To what extent can scientific and technical information substitute for other factors limiting timber production? Consider this example: Max Petersen, chief of the USDA Forest Service, and several of his staff met two or three years ago with Scott Wallinger, vice president for woodland operations of the West Virginia Pulp and Paper Company (WESTVACO). The company was contemplating an expansion that would increase its wood requirements by 10 percent but wished to be self-sufficient in the additional volume required. Two alternatives were proposed: purchase an additional 60,000 acres of forest land, or intensify management on existing lands to meet the additional fiber requirements. WESTVACO chose the latter—to make existing lands grow timber 10 percent faster. To do so they invested in research activities, including constructing a research laboratory at Summerville, South Carolina, and hiring 15 to 20 bright researchers—essentially substituting science and technology for the purchase of additional forest land. Ironically, many of us are curious about specific forestry technologies, yet fail to see science and technology as a policy alternative in its own right, as WESTVACO did.

RESEARCH AND FUTURE CHANGE

The results of research are obviously a driving force leading to change. Remember, however, that there are areas where new technologies are approaching maturity. The technology of reconstituted wood (e.g., oriented strand board, structural flakeboard, comply) appears sufficiently developed that future research in the area should probably be undertaken by the wood-based industry itself, while the public sector moves on to researching new technologies.

There are a number of completely new technologies that will greatly affect economic development in Minnesota and the rest of the country. For example, we are now reconstituting wood at the fiber level as well as the flake and strand level. Forming wood pulp under higher pressures and temperatures gives us paperboard characteristics we have not seen before in the press-drying concept. A derivative of the press-drying process is forming high yield pulps into three dimensional structural material (what the Forest Service's Forest Products Laboratory calls spaceboard). The day is coming when we will be able to form wood pulp into products such as doors, wall sections, and other structural materials. Perhaps there will be a whole new way of packaging using molded wood pulp as the raw material.

New technologies developed in other industries (e.g., textiles) will also provide opportunities for wood products. For example, sulfur dioxide and formaldehyde react with paper surfaces to give greater strength and higher resistance to moisture. My understanding is that a Minnesota firm is already experimenting with this process as a wood surface treatment. Research at the fiber level, in my estimation, is one of the technologies that has future implications for economic development in Minnesota.

Another of the future technologies involves the biodecomposition of wood into other useful products. A major announcement within the past year has been the identification of mechanisms by which lignin is decomposed by fungi and their associated enzymes. This may lead into new fields of biotechnology and chemistry. It is my hope that the next time an energy crisis occurs we will have a better foundation in chemistry, including biochemistry, than we did during the most recent major energy crisis, so that wood and biomass can better substitute for fossil fuels.

NONCOMMODITY VALUES AND TIMBER-RELATED PRODUCTS

There are many problems in forestry that are in need of new technologies. One involves land management. A major difficulty encountered by public land management agencies in the United States is evaluating the integration of commodity products with noncommodity values (e.g., recreation, water, wildlife). Publicly supported research should focus more heavily on such problems since commodity development will flounder unless better ways are found to accommodate the noncommodity aspects of public land management. An experimental development project in Itasca County called CHAMPS is working toward this end by integrating wildlife and timber values into forest management.

Another area deserving of research in Minnesota and having economic development payoffs deals with timber-related crops or activities that complement timber production. Paddy

culture of rice and culture of shiitake mushrooms are two examples; are there other products that deserve consideration?

In conclusion, science as a source of information is an important element in any state's or nation's economic development. In many respects, it is a precursor for economic

development. As such, the forestry community should be well-informed of events in the world of research and resulting new technologies. Surely they will have a major impact on the ability of forests to play an even more significant role in economic and social development in Minnesota.

Timber as a Critical Industrial Resource: Business Expectations

Thomas J. Smrekar, Vice President, Minnesota Wood Products Division, Potlatch Corporation

The opportunity to offer a business perspective on timber as a critical industrial resource is indeed a pleasure. Such is especially so when the forum is a conference that underscores the importance Governor Perpich and the state Legislature place on forestry and forest industry in Minnesota. This welcome emphasis has resulted in a number of very positive initiatives in recent years, including the Timber Development Study conducted by the Legislative Commission on Minnesota Resources (LCMR), the enactment of the Minnesota Forest Management Act of 1982, and the steady and vital flow of reforestation and forest management monies appropriated by the state. For these initiatives, we are thankful.

In many ways forest industry is much like any other industry. We spend our fair share of time on things familiar to all business people: attracting and keeping good workers, building and supplying markets for our products, keeping up with—and, if possible, staying ahead of—changes in technology. And we have even been known to share our views about Minnesota's tax structure. But forest industry is unique in one respect: it depends upon the forest for its principal raw material. For us, timber is not a critical resource, it is *the* critical resource. Without a steady supply of the proper species of timber, we are literally out of business. And without informed estimates of future timber supplies, we cannot make sound business decisions about maintaining, to say nothing of expanding, the industry.

ESSENTIAL ELEMENTS FOR INVESTMENT

Before looking to the future, we should review information gathered during the 1977 statewide forest inventory. That inventory, among other things, identified a large commercial surplus of aspen, a little under 1 million cords a year. A number of companies took advantage of the surplus, including:

- Blandin Wood Products: expanded waferboard mill in Grand Rapids;

- Northwood Panelboard Company: constructed waferboard plant near Bemidji;
- Potlatch: expanded Cloquet pulp mill and constructed two new oriented strand board mills, in Bemidji and Cook;
- St. Regis: expanded Sartell paper mill;
- Louisiana-Pacific: building a waferboard plant in Two Harbors.

For obvious reasons, I was not privy to the discussions that led to expansion decisions by other companies, but I can tell you the essential elements that led Potlatch to make additional investments in Minnesota. First, the demand for our product was projected to grow. For oriented strand board, we looked at the growing regionalization of the market for solid wood products in general and plywood substitutes in particular, and the growth projections for panels in our primary market area. And this looked promising. Second, Potlatch had in hand the technology to manufacture oriented strand board. We had been experimenting with oriented panels for about 15 years at the company's Idaho facility; we were confident that the company could bring such panels successfully to market. And third, the raw material required to manufacture these products existed, as was identified in the 1977 Minnesota forest inventory.

Each of these factors had to be positive before the investment decision was made. But without the knowledge of fiber availability—both now and, with reasonable assurance, well into the future—we can tell you flatly that Potlatch would not have made additional investments in Minnesota. It's as simple as that.

CRITICAL NATURE OF WOOD SUPPLY

Forest industry owns only about 7 percent of the commercial timberland in Minnesota. Obviously, the industry relies heavily on federal, state, county, and nonindustrial private

woodland owners to meet its needs. We can probably all agree that this situation is not likely to change in the near future. Given the essential nature of wood fiber to forest industry and given that Minnesota forest industry must rely on other timberland owners to grow and supply most of the needed fiber, what are the primary timber-related expectations of the industry in Minnesota?

Essentially, industry expectations fall into two areas. First is long-term timber supply: the industry needs both a stable commercial timberland base and proper management for sustained yield on all ownerships to have some assurance of long-term fiber supply. Second is the economic availability of the wood. Can industry get the wood from forest to mill at a competitive price? This involves the cost of growing the wood, timber sale design, and access to the wood.

We should look at long-term supply more carefully. To the forest products industry, land erosion or the shrinking of the commercial forest land base when land is withdrawn for exclusive nontimber purposes is an ongoing concern. The familiar history of land withdrawals in the 1960s and 1970s need not be rehashed; however, it must be underscored that each time a piece of forest land is removed from the commercial category—for whatever purpose—it is one less piece of land that is available for growing trees for industry. The Banzhaf Company Timber Development Study conducted for the LCMR projects even further erosion of the timberland base through the end of the century. While most companies understand the desires of those who propose land uses that preclude timber harvesting, we firmly believe that the Legislature needs to address long-term policy options aimed at stabilizing the commercial forest base. It is encouraging that the Joint Select Legislative Committee on Forestry has signaled an interest addressing this problem in 1985-86.

The other part of the timber supply equation is the productivity of existing commercial forest land. And here, in recent years, the record has improved considerably. State, federal, and county forest managers are making better use of the dollars made available by Congress, the Legislature, and county boards to reforest unstocked or poorly stocked lands. The Legislature still has opportunities to continue the recent momentum on state lands and, likewise, the counties have plenty of opportunities to intensify their management. The biggest challenge, of course, will be to find and allocate the necessary tax dollars.

There have also been some very healthy cooperative efforts between state and county land managers in recent years. Intensification of forest management on county lands has great potential. Perhaps the most innovative and visible initiative has been the St. Louis County Land Investment Program, which promises to show some very positive results. This program may well serve as a model for intensified efforts should other northern counties pursue similar cooperative ventures.

We have also seen progress in long-range planning for the management of both state and federal forest land. The federal draft plans for the Chippewa and Superior National Forests are just now being presented to the public for review and comment; it will be some time before the timber impacts and timber implications of those proposed plans are fully known. From our perspective, the jury is still out. On the state scene, a comprehensive forest plan has been completed by the Minnesota Department of Natural Resources (DNR), although it will

need periodic updating to remain fully relevant. And state forests are now undergoing individual scrutiny in unit management plans. Those will be important documents in charting a course for each of our 55 state forests.

FOREST INVENTORY

Forest planning efforts that help clear some of the fog surrounding future timber availability are excellent, but there continues to be a pressing need for a new generation Phase I Inventory.

Previously mentioned were several mills that had been constructed since the Phase I inventory of 1977. Obviously, these mills have taken a considerable bite out of the aspen surplus identified in 1977. While we do not have precise figures, we would estimate that roughly two-thirds of that surplus is now being utilized. We at Potlatch are uneasy about the aspen supply 15 to 20 years down the road when current old-growth aspen has either been harvested or is no longer merchantable, and the newer stands are not yet ready for harvest. We are not predicting that we will face an aspen shortage at the turn of the century, but, based on the figures we have, it is a real possibility.

Further, there is the problem of getting to the surplus aspen. Basically, we are harvesting the easy-to-reach aspen now, but some of the identified surplus, because it is too difficult to reach or too far from a mill, may never be harvested. What is needed is an up-to-date Phase I forest inventory that will tell us not only how much wood is out there but will also shed more light on the physical accessibility of the wood and thus give further direction to the planning and development of our forest road system in northern Minnesota.

To be usable for industrial purposes, a Phase I inventory should be completed every ten years, updated at five years, and contain better information on accessibility of species. The governor and the Legislature should give serious consideration to appropriating the monies for such an inventory in 1985, with completion targeted for 1987.

ENCOURAGING TIMBER PRODUCTION

On the economic side of wood fiber supply, several opportunities exist for encouraging timber production, keeping timber costs competitive, and gaining better access to timber supplies. Timber sale policy is one good, available tool for promoting efficient timber harvesting and ensuring proper forest management. And paying special attention to species mix and the size of timber sales will improve the effectiveness of harvesting and forest management activities. The 1982 Timber Sale Law Amendments—from the perspective of size—need to be more fully implemented in the immediate future.

The DNR and the forest industry have jointly made recommendations to deal with the problem of unmerchantable tree species. Such recommendations should be tested as soon as possible; however, we should also continue to search for additional solutions to the difficult task of balancing good silviculture with the economic realities of a dynamic—but sometimes stubborn—marketplace.

TAX POLICIES

As a businessman, it is impossible to resist the opportunity to mention tax-related matters—two in particular. Private non-

industrial forest land makes up roughly one-third of all of Minnesota's commercial forest land. It offers tremendous potential for timber production, if only the owners felt a strong incentive to grow timber. Too often the thought of economic gain many years down the road is not sufficient incentive to convince private landowners of the value of growing timber. Through tax incentives such as those recommended by the recent Legislative Task Force on Forest Land Taxation, these landowners could and should be encouraged to think of trees as a valuable crop. And private timber growers, be they individual or corporate citizens, would be much more likely to think in terms of timber production if the rapid escalation of timberland taxes—particularly the "tree growth" tax—were curbed through recommended modifications.

FOREST ROADS

Previously mentioned was the importance to the industry of access to timber. And in large part that means roads. As timber harvests have increased over the past four years, we have had to expand into previously inaccessible areas. This trend will continue as the demand for fiber grows. The construction and maintenance of roads to reach this timber is an ongoing need which cannot be ignored. This may mean exploring additional funding mechanisms, particularly at the state level, such as bonding or general fund appropriations. The 1985 Legislature must not ignore this need.

FOREST INVESTMENTS RESULT IN POSITIVE RETURNS

Some may think that forest industry sounds like the character in the country song, standing with "a handful of gimme and a mouthful of much obliged." But from the standpoint of public funds and public efforts, whether they be federal, state, or county, the dollars and hours spent on commercial forests in Minnesota are not costs to the taxpayers, they are investments. Certainly, we in industry gain from these investments. There

can be no argument about that. But the people of Minnesota also gain, in dollars, in jobs and products, and in better stewardship of a renewable resource.

Most of you are probably familiar with the calculations that show a dollar invested in reforestation today returns well over a dollar when the timber is harvested 40 or 50 years down the road. That is one way to look at it. Another is to look at forest investments in Minnesota as an investment in future jobs and products. Currently, almost 50,000 men and women derive their livelihood—directly or indirectly—from the state's forest products industry. To retain existing jobs and capture additional jobs in the future, we must make sure the forest is as productive as possible.

Perhaps one of the most important investments is in stewardship of the land. Whether we are working to properly manage public lands or caring for private forest land, it is our duty to make the wisest and best possible use of the resources on that land. We have almost limitless opportunities to improve the productivity of our forest resource. But to do so, we must curb the erosion of the commercial forest, invest in reforestation on public and private lands, provide tax incentives to private owners to grow more trees, and make certain that timber is accessible. And, if we expect the forest industry to make educated, good decisions about maintaining or expanding operations in Minnesota, there must exist accurate, up-to-date inventories of forest species and their accessibility. The Phase I Inventory must be kept current.

We will need, more than ever, a strong and understanding partnership between the public and private sectors in the years ahead. This governor's conference is a positive reflection of that partnership and a milestone along the route toward better stewardship of the forest and a healthy, growing forest products industry in Minnesota. Again, I would like to extend the thanks of Minnesota's forest industry to Governor Perpich, members of the Legislature, and those in the public agencies who have done so much to improve forest management in Minnesota.

County-Administered Forestry Programs: Timberland Strategies

John L. Vogel, Land Commissioner, St. Louis County, Minnesota

HISTORICAL-LEGISLATIVE PERSPECTIVE

Minnesota's county governments have historically played a significant role in the ownership and management of land. To-

day approximately three million acres of land are administered by counties—most of which is located in the north-central and northeastern portions of the state. The role of county land in economic development has largely been positive. However,

before judgments can be made about the future role of these lands, it is important to understand their history.

Most land administered by county governments originated from tax delinquencies. This is not a new problem to northern Minnesota; it was of concern to the first session of the Minnesota Legislature in 1858. Over the years, there have been numerous attempts to deal with delinquent lands; most such attempts have failed. Over the years, many parcels of tax-delinquent land were returned to private ownership and, very often, again reverted to delinquent status.

In 1935, the Minnesota Legislature authorized counties to give good title to purchasers of tax-delinquent land. This was accomplished by having the state take title to tax-forfeited lands and holding such titles in a trust. The value and the benefits of the lands remained with counties and their taxing districts. Since then, the Legislature has wisely provided a collection of statutes which allows counties to retain and manage lands while designing programs to meet their individual needs in a variety of settings.

During the 1950s, 1960s, and early 1970s, many counties were poorly equipped to manage land; fortunately, they received considerable assistance from the Iron Range Resources and Rehabilitation Commission. That task has since passed on to the Minnesota Department of Natural Resources (DNR), which now conducts a county assistance program.

More recently a very important change occurred in tax-forfeited land policy. As a part of the Minnesota Forest Management Act of 1982, statute language (Chapter 282) which had previously encouraged counties to divest themselves of tax-forfeited land was revised to direct counties to retain tax-forfeited lands for intensive management. At about the same time, the Legislature authorized in-lieu payments to counties. These monies are allocated by formula to various taxing districts, and a portion (37.5 cents an acre) is dedicated specifically to the management of county tax-forfeited lands. In-lieu payment funds combined with Boundary Waters Canoe Area (BWCA) timber management intensification monies have provided counties with the resources necessary to bring management up to speed.

An important consequence of new laws focused on counties has been improved and expanded staffing. In the 1950s and 1960s, counties had to sell tax-forfeited land to pay operating expenses. Today's counties are availing themselves of better technology as a result of improved staffing and better funding. We see an emergence of new and better programs at the county level—planning, for example. Recently three counties undertook or completed new planning efforts to bring management goals and objectives into finer focus.

CURRENT COUNTY PROGRAMS

A key factor in renewed emphasis on county forestry is recognition of its high potential. Land commissioners often become disenchanted when persons expect county land management to be the same as it was ten years ago. We ask you to take a careful look at how it exists today. As stated earlier, county-administered lands were once considered a millstone around a county's neck. More recently, however, they clearly are being recognized for the role they play in forestry and economic development in northern Minnesota. The 2.3 million acres of county-administered commercial forest land is approximately 17 percent of the state's commercial forest land. These lands

are a significant part of the overall commercial forest land base, and must be managed accordingly. Approximately 1,727,000 acres of county-administered commercial forest land is in hardwoods. Of this, slightly over one million acres is aspen. Much of the balance—about 26 percent or 614,000 acres—is softwoods, but of course the percentages vary from county to county. Based on Phase I Inventory, county-administered lands are approximately 14 percent higher in productivity than all other comparable state lands. This would suggest that if investments are made in county lands, a good or better-than-average return can be expected.

Several counties have recently developed comprehensive management plans and others are updating old plans. Some counties have also completed a new classification designed to identify lands for retention and further investment. A number of counties have begun, or are planning to take on, new initiatives, including substantial investment in their lands. St. Louis County, for example, recently dedicated two new memorial forests and has better than two-thirds of its 900,000 acres permanently dedicated to forest production. The remainder was excluded from such designation primarily to insure that it was available for exchange with other agencies.

STRATEGIES FOR THE FUTURE

Individual counties differ in how they approach the future. If we consider the variety of forest types and capabilities and the demands made upon them—for example, from Crow Wing County in central Minnesota to Lake County in the Northeast—this flexibility becomes an asset in helping to insure present and future supplies of forest outputs. What follows is a collective view of county strategies as seen by the Minnesota Association of County Land Commissioners.

First, counties are placing particular emphasis on quality timber production and are dedicating commercial forest lands to that end. While county lands are also managed for other amenities, the primary emphasis is on timber production.

Second, counties are committed to achieving high production as quickly as possible. We believe this is essential to capture the high level of productivity described earlier. Nearly 45% of the nearly 2.4 million acres of county commercial forest land is aspen, a relatively short-rotation species. Counties, like most other forest land management agencies in Minnesota, have a forest age class imbalance problem. They too are a party to the wall of wood (a temporary surplus of certain older age classes) now moving through the forest. With the potential to manage aspen on high site-index lands, we have an opportunity to improve the age class distribution with a short-rotation species. This strategy may also provide an opportunity to expand allowable cuts by capturing the improved growth and yield potential.

Third, there has been a continuous decline in softwood timber acreage in Minnesota. One of the collective county objectives is to work toward restoring, where silviculturally appropriate and economically practical, a more favorable balance of hardwoods and softwoods.

Fourth, where possible, counties wish to assist in the development of markets for underutilized species, markets that will facilitate early improvement in age class distribution and improve site utilization.

Fifth, Minnesota counties encourage and support the development of technologies that will increase production and re-

duce costs. Counties intend to take a new posture on program funding, not relying entirely on "enterprise accounting" as in the past. We are looking for additional funding sources which will enable counties to continue old and establish new programs. For example, counties intend to improve the careful use of pesticides and to participate in genetic tree improvement projects.

Sixth, counties will continue to expand their role in encouraging industrial expansion and development. We can do this by communicating our dedication and commitment to production of available long-term timber supplies. We can use some of the flexibility that is inherent to county management to make more immediate responses to forestry problems. We are also working closely with regional businesses and political communities. Counties are very close to the grass roots, a situation which allows us to work very effectively with our many constituencies.

Seventh, nearly all counties have a desire to get on with a carefully developed land exchange program. Perhaps now we can do it and again improve our efficiencies.

Eighth, through the Minnesota Association of County Land Commissioners, there is a strong signal that counties will con-

tinue to improve their programs. The association is committed to better coordination with other agencies, including the DNR, the University of Minnesota, and the USDA Forest Service. Along those same lines, we are seeing an increased commitment to forestry programs by elected county officials. Several county commissioners or county elected officials are here today; that probably would not have happened ten or fifteen years ago. County boards are displaying real commitment to county programs, including new support and new funding.

Ninth, we see the counties looking at taking on entirely new initiatives. For example, the Minnesota Association of County Land Commissioners is preparing a new funding proposal for presentation to the Legislature's Joint Select Committee on Forestry, a proposal which will work toward programs to intensify management in northern Minnesota counties.

In conclusion, the initiatives just mentioned should send a strong signal to the people of this state and to developers and investors that Minnesota's counties are serious about long-term commitments to forestry. We are interested in economic development within the forestry sector and are taking actions to encourage it.

State Forestry Programs: Timberland Strategies

Raymond B. Hitchcock, Director, Division of Forestry, Minnesota Department of Natural Resources

Forestry in Minnesota has been extremely exciting in recent years. In my judgment, we as a community are involved in a wide range of unique forestry programs that most assuredly have been conducive to the state's interest in economic development. Important to creating this very positive forestry climate has been leadership exercised by the state's two most recent governors and the very positive actions of the state Legislature, especially on matters of forest policy and program funding. As a forestry community we can be proud of forestry accomplishments within the state during the past decade.

DIVISION MANDATES AND RESPONSIBILITIES

The Division of Forestry's basic mission concerning state forest lands is to protect and manage natural resources for a combination of uses that best meets the needs and desires of Minnesota's citizens. These responsibilities are carried out via four program areas: forest protection, forest resource assessment, forest resource planning, and forest resource management.

Two major policy directives, delineated in the Minnesota Forest Management Act of 1982, drive these program activi-

ties. First, there is a set of legislated forest policies. In the past such policies were scattered through state law and state regulations—or not addressed at all. Now there exist clear policy statements on topics such as multiple-use, sustained-yield management; reforestation; and forest roads. Second, forest planning is clearly recognized by law as an important function of state government. A statewide forest plan (including program and assessment documents) has been prepared and opportunities for keeping it current have been made. In addition, we are in the process of preparing, with interdisciplinary teams, unit forest resource plans.

ASPEN AS A STRATEGIC RESOURCE

Aspen is an extremely important industrial raw material in Minnesota. Statewide, aspen harvest has increased from 1.2 million cords in 1982 to 1.6 million cords in 1983 and 1.7 million cords estimated in 1984. Approximately one-fifth of this comes from state lands—a volume commensurate with state ownership of aspen (847,000 acres). Current market demand for aspen trails state industrial capacity to produce waferboard products. We are looking to expanded pulp and paper manu-

facturing as a consumer of currently unused aspen. In our judgment, there is sufficient aspen to support additional pulping capacity, especially for the high-quality papers typically produced in Minnesota.

Approximately 847,000 acres of aspen forest type exist on state lands, with an unusually large volume of aspen timber in the 40- to 70-year-old age class. This imbalance is a significant problem; very few acres of aspen are in the 10- to 30-year-old age class. The annual allowable aspen cut on state lands is 24,000 acres; we are currently harvesting 60 percent of these acres, but more than 60 percent of the volume (339,000 acres have more than 17 cords per acre, 92,000 acres have 10 to 16 cords per acre, and 23,000 acres have 0 to 9 cords per acre). By current standards, 25 percent of the aspen volume is unmerchantable, i.e., less than 16 cords per acre, inaccessible, outside mill operating range, or economically unavailable. Even with increases in annual aspen harvest from 1982 to 1984, state lands still have a sizable aspen surplus. This is probably also the case for other land ownership categories within the state. It is recognized, however, that markets for timber are not uniform throughout the state. Especially limited activity is currently occurring in the Warroad area and in Becker and Pine counties.

A challenge to state management of forests is to attain a more even distribution of aspen age classes—and ultimately a more even flow of aspen timber supply. Given current harvesting and utilization standards, the imbalanced age distribution will eventually cause timber supply problems and may well pose difficulties for wildlife habitat management.

How can we achieve a more balanced distribution of age classes? One obvious step is carefully planning timber harvests. The Phase II Inventory has been of special help in this respect. A second approach will be to recycle over-aged, low-quality, low-volume aspen stands by shearing or other site preparation methods. This would involve the 25 percent of the aspen resource which is unmerchantable—a relatively small proportion of the total resource. Another possible approach is the sale of merchantable material via salvage sale operations. Perhaps the material could be sold to site preparation contractors for a very modest fee.

Obviously, these and other efforts to secure a more even distribution of aspen age classes are not unique to state lands. The imbalance in age classes is a collective problem in Minnesota. It will require the collective action of various landowners if the problem is to be successfully addressed.

IMPERATIVES FOR FUTURE FOREST POLICIES

With increasing demands for fewer and fewer state funds, state agencies are operating in a political environment quite different from that of a few years ago. Forestry programs and policies will be developed and evaluated within a broader framework of potential impacts on energy, inflation, employment, economic development, and the environment. Judgments about proposed forestry programs and their funding will be made in light of broader state, regional, and national goals. Not many years ago, forestry agencies were narrowly concerned about their own programs and activities as though

operating in isolation from other government mandates. We must now broaden our horizons and work together to accommodate such larger interests. For example, the Private Woodland Owners Coordinating Committee in Minnesota has facilitated public and private sector cooperation so as to secure an effective mix of services to nonindustrial private forest owners. Statewide, the framework for such coordination is the Minnesota Forest Resources Plan. At the regional level, the framework is groups like the Lake States Forestry Coordinating Committee, which attempts to define common regional interests of concern to public agencies and forest industry. And finally, the national framework for coordination comprises laws such as the Resources Planning Act, the Resources Conservation Act, and the Renewable Resources Extension Act.

Broader sets of goals for judging forest policies and forestry programs must be of growing concern to the state's forestry community. We must recognize that a new and different kind of effort will be needed if forestry is to be effective in such an arena. Most certainly it will require more cooperation among the forestry sector's many participants.

Minnesota's forest resources will assume an increased role in state economic development strategies. Forests, for example, are being looked to as major factors in our drive toward energy independence. Similarly, we are beginning to realize the potential of forest products in export markets. Nationally, the agricultural sector exports one-third of its production; only one-fifth of the nation's forest products are now being exported. The potential is there. We need to fully recognize the value of forests for achieving statewide economic development and, as appropriate, encourage the development of marketing strategies in concert with forest industry and economic development agencies to secure such development. In doing so, however, we must carefully consider the social and environmental effects of forest development. Such cannot be overlooked or support for economic development and the use of forests as an economic base will surely erode.

In conclusion, decisions regarding economic development of the forestry sector are complex. Here we have discussed but one very small aspect of a single forest species, aspen. Decisions concerning economic development in a broader context will only be as good as the information available to guide them. Access to accurate and current data about forest resources is essential. In addition, industrial development implies a need for consistent and responsive public policies. Industry must have a clear signal as to how public policies will affect its operations and influence the management of public forest lands from which flow the bulk of its raw material. In my judgment, industry has been given rather good readings of intent by the Minnesota Legislature and the state's executive offices. We are committed to further development of the state's forestry sector, ever mindful of employment, income, and economic stability goals. Obviously, such will be accomplished in a fashion consistent with legislative and executive mandates.

Nonindustrial Private Forest Landowners: Timber Supply Role

Robert W. Slocum, Jr., Manager, Private Woodlands Programs, National Forest Products Association

CURRENT CONDITIONS

In Minnesota, nonindustrial private forests (NIPF) make up 41 percent of the state's commercial timberland base and provide 53 percent of the state's total timber harvest. In contrast, over 53 percent of state commercial timberland is publicly owned but supplies only 38 percent of total harvest. And forest industry owns only 5.5 percent of such land, yet provides 9 percent of statewide harvest—a sum about equal to that supplied by county administered forests. Obviously NIPF lands are a major source of wood fiber in the state. The question is: will these lands be able to continue this significant timber supply role? To answer this we might start by looking at current forest management on these lands.

The 1979 Minnesota Forest Productivity Study reported that only one out of every four harvested acres in the state received any type of treatment for regeneration, including preparation for natural regeneration. In 1983, the USDA Forest Service Planting Report showed that of the 40,000 acres planted or seeded in the state, only about 4,600 acres (11 percent) were on NIPF lands. Timber stand improvement work was carried out on an additional 2,000 acres of NIPF lands. If the one in four harvest/regeneration treatment ratio is correct, approximately 160,000 acres of timberland are harvested per year in Minnesota. Of this, about 85,000 acres would be on NIPF lands. If such numbers are reasonably accurate, about 1 acre out of every 20 harvested on NIPF lands receives any type of regeneration management.

Another indication of current management level is the number of landowners receiving management assistance from a forester. In 1983, the Department of Natural Resources (DNR) reported that 6,000 landowners owning approximately 75,000 acres of forest land received some type of management assistance. If we include assistance provided by industry and consultants, these figures (especially the acreage) would increase, but probably not dramatically. With over 100,000 NIPF landowners holding some 5.5 million acres of timberland, it is safe to say that a fairly small percentage of Minnesota's NIPF land is receiving any more than custodial management.

FUTURE CONDITIONS

But perhaps the level of management on Minnesota's NIPF is not a problem. Maybe the state's need for wood can be met simply by maintaining current management levels. At current

supply and demand levels, this may in fact be true. But is today also the future? Probably not. Consider the following assumptions:

- Demand for wood and wood products will increase both domestically and internationally. There seems to be general agreement on this although the level of increase is debatable.
- The commercial forest land base will continue to decrease. Again, there is agreement on the concept but questions on the rate. This decrease will probably cross all ownership lines.
- Harvests on the national forests will probably not increase significantly because of heavy pressure for alternative land uses (e.g., wilderness, parks, and wildlife) and because budget deficits will probably limit annual harvest, which is tied to federal appropriations.
- State and county forest lands may well face similar limitations to a lesser degree. Public ownership essentially means public planning and management. And since few people see timber supply as a problem, they will likely push for other uses.
- Industry ownership of forest land will, if anything, decrease. The productivity of these lands is already high. Therefore, only marginal increases in productivity or harvest levels can be expected from such lands. The cost for the industry of acquiring and holding land is almost prohibitive. Even land already owned may be sold. That which is kept will be managed intensively, which is generally the case now.

If these assumptions are correct, any major increase in wood demand in the state will have to be satisfied from NIPF lands. And even here, a declining land base will mandate higher productivity on the remaining acres.

Another consideration which cannot be excluded is that of the public. There are two very important principles which must be considered and incorporated into any long-term forest development effort:

- Forestry and the forest industry exist because the public allows it and deems them to be in the public interest.
- The public is increasingly distrustful of decisionmaking by technical experts. The trend is for technical decisions to move out of the hands of experts and into the political arena.

If our logic is on track, it is apparent that the status quo may not meet Minnesota's future timber requirements.

CURRENT AND FUTURE PROGRAMS

By looking only at the surface of Minnesota's timber supply conditions, it would be easy to be reactionary and decide that current programs are ineffective and new ones are needed—or even worse, that massive public regulation of forestry is required. While both are options, it is doubtful that current programs are ineffective; certainly regulation is not the answer. So, what is the answer? What will it take to significantly improve the productivity of Minnesota's NIPF land? In my judgment the answer lies in the development of a *unified, coordinated* program that provides appropriate incentives, communication, and technical assistance to targeted nonindustrial private landowners.

Incentives

Forestry is a long-term investment, and landowners must be able to expect a reasonable return on that investment in order to be motivated to maintain it. Such motivation can come from market or nonmarket incentives. Market incentives are essentially a function of supply and demand, and thus very cyclical and also very short-term. Because of forestry's long-term nature, market incentives alone will probably not suffice.

The establishment of nonmarket incentives for forestry is, for the most part, a function of government. These are usually either tax incentives or cost-share incentives. Of the two, tax incentives are in my judgment by far the most important. The federal government currently provides tax incentives for forestry by allowing timber income to be treated as a capital gain, and by allowing an investment tax credit and rapid amortization of reforestation expenses. While both of these are very important, state governments need to recognize the special needs of forestry, particularly in the area of annual land taxes. Most forest landowners have a low threshold of pain on taxes, and will be reluctant to undertake long-term investments in a tax climate that does not recognize the economics of such investments.

Communication/Public Relations

Communication and public relations are critical to program development and climate building. Incentives and programs to promote forestry mean little if no one knows about them. If the public does not see forest lands as necessary or beneficial, there will be nothing to promote. In my judgment, the greatest barrier to improved forest management by private landowners is limited information and education. Many people do not know that a forest can be or needs to be managed. Overcoming this barrier alone could have dramatic effects.

On the public relations front, we must recognize that environmental protection is no longer limited to a handful of social critics and environmental activists, but is a continuing concern of the public as a whole. Any forest policy that runs counter to this sentiment risks becoming a problem and reducing the latitude given to forestry by the public. This means that we must convince the public that forestry is consistent with environmental protection.

Technical Assistance

Getting a professional forester in contact with a landowner is where you capitalize on your incentive and communication programs. This is the pay-off—the point where the landowner decides whether or not to do something.

There are two points I wish to make about technical assistance. First, it must be at a level equal to incentives and communication programs. To stimulate the interest of landowners without adequate follow-up is a sure way to jeopardize the entire effort. Second, the quality of the technical assistance must be high. Too often we (public agencies and industry) put the least experienced foresters in the most critical position—in contact with landowners. The foresters not only must be technically competent, but must possess good “people skills” and be good salespersons.

From my perspective, these three program elements—incentives, communication, and technical assistance—represent the “power triangle” for private forestry and the key for achieving future wood supply goals. But to work, the three sides of the triangle must be equal in strength *and* directed toward meeting identified goals. As mentioned earlier, current programs are not necessarily ineffective. In many cases, however, they lack focus and coordination. Too often the sides of the power triangle are not connected at all and operate independently. The result is that often none is as successful as it could be.

If insuring a long-term wood supply from NIPF lands is important, we need to define how much wood is required and what levels of management it will take to get it. Some solid goals must be set in order to focus programs. For example, nationwide 86 percent of the commercial NIPF land over 50 acres is owned by about 15 percent of the landowners. This means that the bulk of economic opportunities for improving timber productivity is concentrated in the hands of a fairly small number of landowners. This suggests an excellent focus for our power triangle.

CONCLUSION

How far Minnesota goes in achieving development of its industrial forestry sector will depend in large measure on how committed it is to insuring a future wood supply from NIPF lands. To do so will take action, leadership, and commitment from the state forestry leaders. Improvements in forestry will not just happen—someone must make them happen.

In 1985 the forest industry, the National Forest Products Association, and the Minnesota Forestry Association will initiate a cooperatively funded private woodlands program. The program's primary objective is to obtain measurable increases in forestry investments on NIPF lands. It will be targeted at a four-county area; if results warrant, it will be expanded in future years. This is a major step in making something happen.

Minnesota will continue as an important tree-growing state because you have the necessary land, know-how, and environment. How far you go beyond these natural advantages will depend on whether the forestry community in the state can pull together toward common goals.

National Forest Programs: Timberland Strategies

James E. Brewer, Supervisor, Chippewa National Forest, USDA Forest Service

A first reaction to the conference's agenda was concern over the apparent premise that development and growth are always socially desirable. Is bigger always better? What does industrial development do for a community, region, or state? Are the effects of growth on jobs, tax base, and economic activity always blessings? How does economic growth impact schools, highway traffic, air quality, noise and water pollution? In the northland, will growth lead to more people wanting to use a limited land base and consequently to "no trespassing" signs, higher land prices, and "shotgun only" deer hunting? Is it a moral imperative that wood should not "go to waste?" In our unrelenting quest for something better, do we distinguish between material standard of living and quality of life? Although convinced that we have not fully considered these questions, we will assume in what follows that economic development and industrial growth are what is desired.

National forest managers must consider national and regional interests as well as state and local interests in their land management decisions. The Conservation Foundation's Report of the Lake States Forest Policy Workshop states: "Citizens of Michigan, Minnesota and Wisconsin have an extraordinary opportunity to determine the future they want for their region's abundant forest resources. Within the three states, a growing recognition exists that there is strength in regional action—that by working together they might accomplish more than if they pursue individual objectives without coordination with their neighbors . . . The second growth hardwood forests of Michigan, Minnesota and Wisconsin are a vastly under-utilized resource in a region suffering extraordinary economic hardships."

Without going into detail about the economics, geography, biology, and politics involved, most of us can probably accept these three states as a logical, natural, appropriate region for coordinated forest-based economic activity. We need also to be aware that Canada has a surplus of wood, and is very competitive in our markets.

Much of the "forested" land (land occupied by trees and other woody plants) in northern Minnesota is also "timber" land (land from which we can get usable, economically producible wood). It is hard to think of timberland apart from the other forest land with which it is associated, and it is hard to think about the economic potential of wood without thinking about the economic potential of the hunting, skiing, snowmobiling, hiking, foraging, and other recreation that occurs on those woodlands.

The simple reality of the timberland situation on the national forests in northern Minnesota is that they are producing

more wood than is being harvested and are capable of producing a long-term sustained yield well in excess of the current demand. We estimate the national forest sustained yield capacity at about two or three times current demand. (This prediction may be lowered as we become able to quantify effects of acid precipitation on forest growth.)

The exception to this surplus situation is in aspen. A shortage of aspen seems likely in two to five decades unless we use trees with a greater percentage of defect than is now acceptable, shift to more use of dense hardwoods, or the fair share demands on national forests are not as predicted. At that time we expect that recently established stands will be too young to harvest, and that today's unharvested, overmature stands will become very rotten or will have evolved into dense hardwoods.

In addition to wood, Minnesota national forests, with their unique geology, vegetation, and soils, offer a highly variable visual variety. They provide a very attractive setting in which to re-create one's psyche and re-establish one's bonds with Mother Earth.

With but few exceptions, the national forests in Minnesota's north country are easily capable of supplying substantially more of both wood and recreational uses than are now being demanded of them. We accept the RARE II exercise as having definitely settled the question, "how much wilderness should the national forests in Minnesota provide?" at least for the 10 to 15 years in our current planning cycle. Thus we can confidently say that the recreation, water, wildlife, wilderness, and wood outputs expected from them can be produced in an integrated, balanced, and harmonious fashion without further significant conflict.

We are not anticipating a substantial increase in demand for either the timber or the recreation use of the national forests. We have only to look around us to come to this conclusion. We are an urban nation—even most foresters now live in the city. We have almost achieved zero population growth in the United States. One or two children and one or two parents now constitutes the typical family. These small urban families tend to use small, multifamily housing units which use much less wood, so we are building fewer large single-family houses. Electronic "everything," despite some current gargantuan piles of printouts, will probably limit the growth of demand for paper products.

With little or no population growth, increased demands for forest land recreation must come from shifts from other forms of recreation or from an increase in leisure time. In my judgment, the north country's tourism industry can attract a significant amount of this shifting recreation if it packages

experiences to appeal to urban people, who are increasingly spending less on things (such as boats, RV's, and recreation gear) and more on experiences. These are people living on the fast track. Their time is scarcer than their dollars, and they want to limit the amount of *time* they spend preparing for their recreation experiences. They would rather pay to have it done for them. These folks will rent a sailboat in the Florida Keys on a bare-boat (no crew) basis, but they want it fully provisioned. These are people responsive to the "ski through" program of several north shore resorts, where they can spend a few days skiing from resort to resort without having to pack heavy gear. When the tourism industry learns how to package outdoor recreation experiences for such consumers, we can expect a considerable increase in that business in northern Minnesota. Farmers and foreign residents are other potential consumers of expanded outdoor recreation opportunities.

The conference's program promises something about "timberland strategies." These strategies can, in part, be deduced from the philosophy and policies of the current administration. Assistant Secretary of Agriculture John Crowell has said that the Reagan administration's philosophy is "that a healthy economy is critical to a healthy and perpetually productive environment." This underlies efforts to tame rampant and negative economic forces through: 1) monetary restraint; 2) controlled federal spending; 3) changed tax policy to encourage savings, investment, and capital formation; and 4) regulatory reform.

Current policy for the national forest is to increase revenue, reduce operating costs, and achieve market and nonmarket values while reasonably protecting the environment in a cost-effective way. How we propose to carry out this policy of economic efficiency on the Chippewa and Superior National Forests is spelled out in the proposed forest plans for operating national forests in the foreseeable future.

Economic analysis has played a major role in our planning and, as a consequence, we propose on both national forests that little or no additional conversion of timber type from hardwood to conifer be done. It simply costs too much to make the conversions, and there do not seem to be significant nonmarket reasons for altering the present vegetative composition. On the contrary, given the current economics of plantation management, it is possible that some sites in the Superior National Forest may be converted from conifer to hardwood. On the Chippewa National Forest we propose converting a few dense hardwood stands to aspen, balsam fir, and jack pine.

The Superior proposes to meet total timber demands for the next fifty years. On the other hand, the Chippewa proposes to meet total timber demands for the next ten years, but will fall short in succeeding decades. This is in part due to the aspen age-class imbalance on the Forest, but also a result of current economics. Simply put, returns on aspen and short-rotation conifers do not cover our investment costs to get the wood out. Volumes offered for sale in the future will depend on our ability to reduce our unit costs to a point where the public receives at least one dollar in benefits for every dollar spent. If strong markets generate higher stumpage prices, the time when benefits meet or exceed costs may occur sooner.

Other significant proposed changes from our current *modus operandi* on the Superior National Forest include:

- a reduction in the number of developed campsites;

- emphasis on creating more moose habitat in the eastern portion of the forest;
- a proposal to study the Vermilion River for possible wild or scenic designation.

For the Chippewa National Forest we propose:

- to close to public vehicular use about two-thirds of newly constructed local roads after initial timber harvest;
- to begin a long-term, gradual phaseout of private recreation residences on public lands, through denial of permits to reconstruct, as existing buildings succumb to the shifting geology and nutrient-cycling processes of Mother Nature;
- to initiate a "semi-primitive, motorized" use area in part of the forest, where improvements will be minimal, but where the primary users will be on three-wheelers, snowmobiles, four-wheel drives, and other motorized recreational vehicles;
- to earmark the Trout Lake area for semi-primitive, non-motorized use. It would eventually be managed like the nearby Suomi Hills for cross-country skiing, hiking, hunting, observing wildlife, and using light watercraft.

It has long been the policy of the Forest Service to be as responsive as possible to policies and objectives of the state of Minnesota. As Minnesota pursues the forest-based development that we have been talking about today, the national forests will (to the extent that it is biologically and economically possible) attempt to provide a dependable wood supply and abundant, high-quality outdoor recreation opportunities. Recent criticism of "below cost" timber sales notwithstanding, we will continue to use timber sales not only to produce wood but also to achieve multiple-use forest management; for example, to improve wildlife habitat and aesthetics, and as a means of developing the kind of road system that is the key to effective forest management. We will continue to coordinate our land management decisions with adjacent state, county, and private land managers. We will continue to provide forest survey and other information upon which the wood-using and recreation industries can plan their strategies and investments. (One of our strategies is to accelerate the survey cycle in the near future so that this important information will be more timely.)

What are the potential opportunities for these industries? A little over a decade ago, red pine was the species to grow. It seemed as though industry just could not get enough long-fiber conifer wood. Some aspen was being marketed, mostly in bolts. Very little of any other species was being harvested. Now, the demand and supply for upland conifer appear to be in approximate balance. Aspen may be in short supply for a while. The remaining opportunities for wood use appear to be with dense hardwoods and swamp conifers, of which there are fairly significant volumes and for which there is limited competition and markets.

We are much closer to markets for finished products than many wood-producing areas of the country. This should make shipping products cheaper. We have substantial potential for the use of wood for fuel since we have no gas, oil, or coal in Minnesota, but we do have a large amount of wood biomass for which there is no current demand. We have embraced the

new flakeboard technology enthusiastically and are receptive to other new ideas.

We are reasonably close to substantial urban populations. Northern Minnesota's dry, cool climate and unique lake country ought to attract city folks who want to get back to the earth for a little while. We offer them a distinctive "north country" not found elsewhere in the United States, a land of forests and lakes where the potential for public use and access is relatively abundant.

To the extent that the wood-using industry can economically bring additional new technologies such as System 6 (which makes economically useful lumber out of small pieces) to bear on the utilization of currently underutilized timber species; and to the extent that the tourism industry can package unique outdoor recreation experience for the urban, foreign, or farm-based recreationist, we will experience a demand for the goods and services that can be produced on the national forests. As managers of these forests, we will do our best to satisfy our fair share of that demand in the most economical and environmentally responsible way we can.

Should we apologize for not confining remarks to the wood-using industry? We think not. Many in this audience knew all along that we in the Forest Service have been preaching and practicing multiple use for so long that we could not live with ourselves if we did. It was reassuring to find Minnesota State Forester Ray Hitchcock's statement: "The state foresters from Michigan and Wisconsin have been working with me to integrate our planning efforts, especially in the areas of resource assessment and development of the forest based recreation and resource using industries. We share a common desire to provide for the noncommodity benefits of our forest as well."

It was also reassuring to find a recent article in *Forbes*, December 3, 1984, about growth in south Florida and how development there depends upon water from Lake Okeechobee and

the Everglades. One might expect that the conflict between the need for water for the people who will buy and live in the developments and the need for water to maintain the Everglades ecosystem would lead to all-out war between environmentalists and developers. Instead it has started them working together. To quote from *Forbes*, "...the developers are learning that they make more money by spreading out the condos, the state is learning that preserving the swamp promotes long-term growth more than selling off the acres, and the dairymen have learned that keeping the manure out of Lake Okeechobee saves the lake, not only for the alligators but for themselves."

In Minnesota, we have our share of controversies between environmentalists and industry and between rural people and urban people, but there is hope. Industry can harvest and process wood in a way that is environmentally responsible. Timber sales can improve wildlife habitat, aesthetics, and recreational access to the forest. The sanity of the urban dweller often depends upon recreation that comes from a change from an artificial to a natural environment. Rural and small town people have abundant additional employment opportunities in both the wood-using and recreation industries. The goods and the services thus produced should move dollars from areas of dense population and high incomes to the "low-rent" North Country. With a little extra planning effort, it is possible to attain a higher standard of living and a higher quality of life simultaneously. It is possible for people with different interests to work together for their mutual benefit. Our national forest plans, despite their complexity (due to law and regulation), can serve as a way of communicating with each other about the strategies appropriate to these priceless national treasures, these Minnesota national forests. And while at this conference we concentrate our thoughts and energies on the "Minnesota Miracle," let's keep in mind the rest of our Great Lakes Region, Wisconsin and Michigan, and heed the advice to "think globally—act locally."

Minnesota Forestry: Opportunities for the Future

Paul V. Ellefson, Professor, Department of Forest Resources, University of Minnesota

Minnesota is fortunate—in many respects it is in an enviable position from a national perspective. Why? Because it has forests of substantial magnitude—forests which provide the raw material for manufacturing products demanded by state, national, and in some cases international markets. The existence of forests implies an economic base from which flows jobs, income, and a sense of economic stability. Many states would find such wealth especially desirable, with their nar-

rowly focused own economies subject to damaging abuses as shown by the most recent economic downturn. Our wood-based sector is among the leaders in the state's economy, standing tall with agriculture, tourism, and minerals. It is a most significant contributor to the quality of life experienced by Minnesotans and visitors alike.

Forested vegetation covers nearly 17 million acres (one-third) of the state's 50 million acres of land. Fourteen million

acres of forest are classified as commercial timberland. From a national perspective we are the sixteenth most forested state. Of every 10 acres covered with trees, roughly 4 are occupied by aspen, 3 by hardwoods, and 2 by spruce-fir; the remainder is in pine or unforested. Obviously, different regions of the state have different mixtures of forest—such is a condition in a state that can brag of forest diversity.

Our commercial forest land is divided nearly equally between private (47 percent) and public (53 percent) landowners. The proportion of forest land controlled by state and county governments is unusually large, accounting for 35 percent of all forest land so owned nationwide. In state-owned land alone we rank third in the nation, behind only Michigan and Pennsylvania; countywise we lead all states with 34 percent of the nation's county administered forest land. Our privately owned forest land totals 6.4 million acres—only 14 percent of which is industrially owned. Clearly, the state's wood-based industry depends on the actions of other landowners for its raw material.

Most private forest land, commonly referred to as nonindustrial private forests, is controlled by a heterogeneous lot of owners. Such owners account for 38 percent of commercial timberland within the state and more often than not have holdings of less than 50 acres. They have a variety of forestry objectives, not always of a timber nature. And their numbers can be large. Minnesota is thought to have 120,000 of the 7.8 million which exist nationwide. Indeed, they are a challenge to the management skills of the forestry professional.

Forested land area has declined within the state. This can be good or bad depending on successes in intensifying management on remaining forest land. Between 1962 and 1977, commercial forest land found its way into cropland, pasture, marsh, urban, and productive reserved (nontimber uses). In total, 1.7 million acres were so converted; 700,000 acres of this was given national park or wilderness status. All forest ownership categories except forest industry have experienced losses of a timberland base; nonindustrial private forests experienced the greatest erosion over the past 30 years, 915,000 acres. Conversions of approximately 780,000 acres of commercial timberland to nonforest uses through 1990 are predicted. Most will go to urban and agricultural uses.

Forest land and the trees which occupy it are physical features of the landscape, having no value in and of themselves. They take on meaning when used to enhance the economic and social well-being of people. This they do by producing recreation, water, timber, wildlife, and pleasing landscapes. More specifically, they are the foundation on which rests the state's third largest manufacturing industry—the wood-based industry. In 1982, total sales by the industry's primary and secondary segments approached \$2.5 billion. Over 45,000 people were directly involved in product manufacturing—more than half in the Twin Cities metropolitan area. If persons employed in related trade and service industries are included, employment attributable to the industry probably exceeds 100,000. Based on late 1970s information, Minnesota's wood-based industry accounts for 13.5 percent of statewide manufacturing employment, 15 percent of personal income generated by such industries, 9 percent of gross sales, and 12.3 percent of the value added by manufacturing within the state.

In sum, the woodbased industry is certainly an important cog in the state's economy—and not one which is prone to in-

action. During the past five years, the industry has made capital expenditures in excess of \$700 million, directly creating over 1,000 new jobs in northeastern Minnesota—the most economically distressed area in the state.

Programmatic advances in the state's forestry sector have been substantial over the past six to eight years. With significant leadership from the Legislative Commission on Minnesota Resources and a sense of vision established by state political leaders and professional resource managers, Minnesota has established and implemented programs that place it in the honored position of being looked to for leadership in state and county forestry and in forestry research and education. In a relatively short period of time, Minnesota has:

- reforested over 80,000 acres and applied timber stand improvement practices to over 31,000 acres of forest land, using both federal (BWCA) and state monies;
- constructed 40 miles of forest roads, applied intensive maintenance to 3,000 miles of such roads, and built 10 new bridges;
- prepared a premier statewide forest plan and begun developing a series of unit forest plans;
- established in law some of the most comprehensive forestry programs in the nation, notably a statewide forest planning system, a forest management fund, a continuing education plan, and basic policy guidance for state forestry research and extension;
- recognized stable ownership of forest land by county governments as in the public's best interest;
- established a cooperative tree improvement program with a coordinator to implement it;
- seen capital investments in wood processing facilities which could exceed \$1 billion in a 10-year period;
- carried out major activities concerning forest information systems, fire management analyses, private forest management assistance, and accelerated forest inventories.

The breadth and scope of advancement are in many respects remarkable given the relatively short time over which they have been accomplished. Resource managers and political leaders would be hard pressed to identify a state that can boast similar accomplishments. Especially rewarding to the state will be the processes and procedures which have been set in place. Funding and leadership per se may change with the times, but institutionalized processes will remain to enhance the stability of the forestry sector in the years ahead.

The forestry community of Minnesota must not, however, rest on its laurels. If the potential of the state's forests is to be fully realized, we must look ahead with a sense of vision. The direction in which we steer the vessel is largely a political decision. What could be of value in determining such direction is an assessment of the major structural conditions that might be imposed on Minnesota by its own forestry and political climate as well as national events. From my perspective, the direction that such forces will move us is uncertain—answers are not always clear. But what might be some major challenges to forestry over the next 5 to 10 years? A short summary is in order.

EMERGING LAKE STATES REGIONAL PERSPECTIVES

Minnesota's forests and the economics which thrive on them are part of the broader system of forests and forest economies of the Lake States Region, composed of Minnesota, Michigan, and Wisconsin. In total the region claims one in ten acres of the nation's commercial timberland. The three states have much in common from a forestry perspective, including marketing advantages in terms of raw material supplies being close to major population centers; similar tree species and natural ecosystems; a relatively high percentage of public (especially state and county) forest land over which public control can be directly exercised; and a healthy interest in using forests for economic development.

During the past three to five years, the forestry community within the region (especially state governments) has been operating under strong bipartisan support for forestry programs—optimism over forestry and forest development has been high. There has emerged a growing interest in cooperative efforts focused on common regional interests. For example, wood products from the South are identified with the region rather than with states per se. Such a regional image could be used in the Lake States to secure significant portions of emerging domestic and foreign markets for wood. Obvious too may be opportunities to directly address problems that impede the flow of forest products between states (e.g., transportation regulations, building codes). Regional consortiums may also enable the forestry community to act as a more formidable political force when dealing with competing regions and the federal government.

In sum, the objectives of cooperating regionally have yet to fully materialize; what their nature will be remains to be seen. It should, however, be recognized that a Lake States regional forest perspective is emerging with some important implications for Minnesota's forestry sector. It is a factor deserving attention and, as appropriate, action.

SIGNALS FOR EXPANDING FOREST PRODUCTS EXPORTS

The United States is a major exporter of forest products—\$3.7 billion in 1980. The South has taken on an especially aggressive role in export markets. To date, Minnesota has played a minor role; in the late 1970s, shipment of lumber, paper, and board products from the state to international markets represented approximately 9 percent of the value of all forest products shipped by Minnesota firms, and 8 percent (2,200 persons) of our wood-based employment was oriented toward export markets.

There are signs, however, that such a role could increase. Because of increasing worldwide demand for wood products, international markets are expected to grow. U.S. forest products exports to Europe, which stood at \$700 million in 1981, are forecast to rise to \$1.6 billion by 1990 with panel products leading the way. To meet such markets, nationwide interest in the export of wood products (raw material and finished) has become exceptionally keen in recent years.

For example, in the past two to three years the Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture has augmented its forest products exporting activities to encourage market access, provide market information, and en-

courage market development. Wood-product interests are now tied to some 709 FAS posts located around the world—in some cases forest product representatives per se have been assigned to such offices.

Further augmenting the national push to expand export activities is the establishment of an industry-wide program called Foreign Market Development. Through the National Forest Products Association, 15 industrial associations representing thousands of companies are involved with federal international agencies in the development of wood product markets. They mean business—world trade business, that is.

And legislatively, companies have been given a major new incentive to become involved in exports by the Export Trading Company Act of 1982. This act enables competing companies to form export trading companies which may aggressively pursue previously prohibited trading activities (third country roles, bartering), secure very favorable tax advantages for export activities, be virtually free from federal antitrust laws, and seek out banking partners which can provide financial support at very favorable rates. The new law is in its infancy—surely it will be used extensively by companies with an interest in worldwide markets.

Thus, nationally a number of public and private export programs are surfacing. Much of this interest is obviously designed to diversify markets and thus buffer dismal domestic market experience such as occurred over the past five years. Where does Minnesota fit in? We're not sure. With a sense of vision by the state's government and industry there is no doubt that our role in exporting forest products could be enhanced. We may never be in the wood export league of our West Coast neighbors, yet the export climate that is now developing nationally surely has more in store for us than now exists.

AGING STRUCTURE OF FOREST STANDS

Although Minnesota's forests are diverse in terms of species, growing conditions, and use, they are all undergoing a common and major structural change: they are getting older. This shift is much the same as that occurring in the U.S. human population. Older age classes account for ever-increasing volumes of timber—what some have labeled a "wall of wood" moving through the forest system. Despite an 11 percent decline in commercial timberland area, growing stock volumes have increased 21 percent and sawtimber volumes 65 percent statewide since 1962. Most of the growing stock volume increase is on trees 7 to 12 inches in diameter—a fact which signals a forest landscape dominated by trees approaching "old age."

Consider the aspen forest type, for example. The age class distribution for this type is a bell-shaped curve. Nearly one-quarter of aspen acres throughout the state are occupied by 40- to 50-year-old trees, while nearly 60 percent is occupied by 30- to 60-year-old stands—mature by aspen standards. The evidence for maturing stands is even more apparent for paper birch. Although reasons for this distribution are many, the most influential factors are related to fire and logging activities of many years ago. We are not alone in this respect; forests in Michigan and Wisconsin are undergoing the same changes.

What does all this mean? One obvious consequence is that we will be blessed with a substantial volume of timber—particularly aspen—for a number of years. Combined with appropri-

ate utilization technology, our industrial development strategies can flourish under such conditions. But beyond that, what is implied of a mature forest? Will it require greater investment in protection activities against fire, insects, and diseases? Will the younger forest to follow mandate development of different products capable of using the substantially different forest and raw materials? Will wildlife habitats and recreation conditions change for better or worse? Will the natural death of mature forests result in forest sites reverting to species of lesser value for timber, recreation, and wildlife? And will the cost of wood fiber rise because fiber volumes per acre go down?

A list of speculative questions such as this can go on at great length. As we look to establish the state's third forest, we face a need to address in a strategic sense the development of a better distribution of age classes on commercial timberland within the state. This may well be beyond the capabilities of a single generation. The least we can do, however, is to recognize the situation and attempt to formulate industrial and related strategies accordingly and, when possible, carry out cultural treatments that will temper the "wave of wood" flowing through the forest.

FORESTS AS STRATEGIC RESOURCES FOR DEVELOPMENT

Forests represent vast storehouses of raw materials. They generate the raw fiber viewed by forest industry in much the same way that iron ore is seen by the steel industry or fields of grain by the food processing industry. There is a growing interest nationally in a more focused view of forests and timber as strategic resources through which industrial development and diversification can be achieved. Implied therein is a cohesive program which brings together various sectors of a state's forestry community with a common focus on industrial development based on forest resources.

Some states have formulated target industry programs which bring together skills and information amassed in state research units, universities, businesses, and government agencies to secure development of the wood-based industrial sector. Programmatically, efforts focus on attracting new industry, developing national and international markets for products of a state's forests, targeting assistance to existing businesses so as to insure long-term viability, and encouraging support for new products and new product research. Michigan has gone so far as to propose a "strategic fund" from which capital could be supplied to new enterprises unable to secure financing from conventional sources, and has targeted "forest development zones" within the state—zones within which exists the mix of ingredients necessary for new industry or expansion of existing industries (e.g., labor, raw material, water). States which are aggressively pursuing such actions will influence Minnesota; they are deserving of attention.

LONG-TERM SUSTAINED FINANCIAL SUPPORT

By their very nature, timber management programs imply long-term investments. They equally imply sustained levels of funding free of dramatic shifts in emphasis. Only then can the raw material supplies flowing from them be predicted with reasonable accuracy, and the risk of uncertain raw material supplies be kept at acceptable levels.

Public—notably state and county—forestry agencies in Minnesota are well on their way toward development of intensified timber management programs. On the national horizon are rising circumstances which will undoubtedly affect the financial health of these programs. For example, there are major adjustments occurring in federal assistance to state forest programs (e.g., fire, private cost share, planning). Federal cooperative funds to states are being reduced. Admittedly such funds are less than 7 percent of current Department of Natural Resources (DNR) Division of Forestry budgets and are likely to drop to 2 percent by 1988-89. They are, however, hard money which must be sought elsewhere if programs are not to be jeopardized.

A related funding concern is the BWCA Intensification Program, which has been a major catalyst for renewed interest in state and county forestry programs. With authorization for funding through the program due to expire in 1990, a sizable reservoir of financial support will be removed.

In some respects, the Forest Management Fund authorized by the 1982 Minnesota Forest Management Act will shore up the deficit. But is that all we wish to do? Or are we willing to make up the difference with state financial commitments and continue the growth of total financial investments in forestry which has occurred over the past five to six years? Obviously the latter implies commitments by the state—commitments that must be judged in light of other demands made on state tax revenues.

LIFELONG PROFESSIONAL EDUCATION

Natural resource professionals are the implementers of policies and programs developed by legislative and administrative systems. As in any profession, they must maintain a high level of professional skills if programs to which they are assigned are to be administered efficiently and the program wishes of political leaders are to be carried out effectively. Forestry professionals at national and state levels are demanding access to well-organized and current continuing education programs—the technologies they use are changing too rapidly to be satisfied with current understanding. Nationally, the Society of American Foresters has recognized the opportunity and has set in motion a forestry certification program for post-collegiate education. The USDA Forest Service and certain states have long had keen concern for keeping their professionals attuned to current knowledge. In California, continuing education evidence is required for license renewal of professional foresters. Our own DNR Division of Forestry provides continuing education programs for its professionals. And the importance of the problem was formally recognized by the Minnesota Forest Management Act of 1982, which called for a recommended program, including an ongoing means of identifying training needs and the mechanisms by which they will be addressed.

There remains a concern, however, that we have yet to really face up to the issue. The time may be ripe for some aggressive action. A comprehensive program needs to be developed, leadership authority needs to be designated, and funding must be forthcoming. We have grand designs and high expectations for the forestry sector within this state. National and state indications are, however, that hand in hand with such designs must go a knowledgeable forestry professional—one who is attuned to the skills and technologies of the day.

RESOURCE ASSESSMENT/INFORMATION MANAGEMENT

Information is a vital ingredient for effective decisionmaking. As we expect more from our forests and the professionals managing them, a better understanding of the forest and its response to management activities becomes increasingly critical. We have begun to view information as a capital resource to be invested in. With the advent of computerized information systems at the lowest level of management, there is an enormous surge in demand for broad information about forests. Heightened management intensity is creating a nearly insatiable demand for information: more timely and intense inventories, better estimates of the physical response of forests to management, and a clearer statistical picture of the demands which will be made on forests in the years ahead. We would be hard pressed to deny that such information is needed; the question is always, "How much?"—for which answers are at times elusive.

Tied to the demand for more planning and management information is the arduous task of managing the information gathered and integrating information systems within and between agencies. In Minnesota alone there are more than 45 division-level organizations (agencies) in the business of gathering data important to forest administrators, planners, and managers. As the volume of information grows and demand for its use increases, the integration of information systems becomes more critical. One step in the right direction—although itself a major consumer of information—is forest planning. If wisely carried out, it can focus information-gathering on critical needs and move emphasis away from "it's nice to know" information. Information and its management are products of complex programs being applied to equally complex biological forestry systems. They most certainly are of growing importance and should be recognized as such.

SCIENCE AND TECHNOLOGY

Public and private forestry programs rest on a foundation of science and technology. Without investment in such endeavors the progress realized by the forestry community during the last four decades would be dubious at best. In our own state, the results of research conducted by public and private organizations throughout the nation include new products such as waferboard, the application of technologies such as remote sensing and satellite imagery, moves toward high-speed information management techniques, and the application of computer technologies. What lurks on the horizon is subject to speculation—robotics, biotechnology, genetic engineering.

Opportunities for research to help forests more fully contribute to social and economic well-being include:

- development and application of advanced silvicultural techniques (e.g., seed production, stand establishment) to improve timber yields;
- genetic improvements to provide trees with greater yields and resistance to diseases and insects, and biotechnology procedures to circumvent the long regeneration cycle of trees;
- development of processing techniques which lead to new wood products, many of which may use abundant hardwood species and so extend scarce softwood species volume;
- reduction of timber losses resulting from destructive agents such as fire, insects, and disease (volumes lost from such agents are larger than volumes harvested).

Suffice it to say that opportunities for directing research activities abound. To carry out such work requires sustained high level investments commensurate with the economic gains to be realized. This implies research funding focused on specific problem areas as well as continued support for buildings, equipment, and numerous indirect costs. Not to invest in the latter jeopardizes the foundation on which many "special project" research activities are carried out. Research, then, is a key ingredient to any forestry program. It should be supported in a fashion consistent with our vision of where forestry is going in the years ahead.

These are but a few of the many conditions which will influence the direction of the state's forestry sector in the years ahead. Obviously many more could be brought forth for attention. The forestry sector of the state is on the move—no question about it. In large measure the advances of the past few years must be credited to the vision and leadership of persons in the state's forestry community, especially recent governors and legislative leaders. If there are essential ingredients to be identified with Minnesota's forestry future, they are leadership and the financial commitment which goes with it; such must be sustained in support of forestry initiatives begun so well. There most certainly are untested policies and programs which, if implemented, may pay off handsomely to the state and its economic structure. Minnesota and the region of which it is a part are being looked to once again as major suppliers of forest products for markets across the nation—in some respects we are in keen competition with other regional sources of wood products, especially the South. Now is not the time to be "resting on our oars." Let's continue to make Minnesota forestry the hallmark of the nation and thereby serve the residents of the state in a most respectable fashion.

Minnesota's Forest-Based Sector: Review of Structure and Economic Activity

Bernard J. Lewis, Research Fellow, Department of Forest Resources, University of Minnesota

Minnesota's abundant forest resources are an important part of its economic fabric and quality of life. They are the source of raw materials used in the manufacture of wood products for local, regional, national, and international markets. The state's forests also provide wildlife, scenic amenities, and recreational opportunities valued so highly by its citizens.

A key to sustaining the economic and social value of the state's forests lies in the viability of its timber-based economy. Minnesota's forest industry forms the economic base through which timber is converted into wood products, the sale of which provides employment and economic security for many Minnesotans.

In 1980, Minnesota's timber resources were the focus of statewide attention with the release of a study funded by the Legislative Commission on Minnesota Resources. Among the many options for the future described in that report, the stability and growth of the state's wood-based industry was of major importance.

Since that time many of those options have been pursued through both public and private initiatives. But it would have been difficult for anyone in the fall of 1980 to predict the course that economic events would take during the following four years. Since that time Minnesota's economy has ridden the shifting tides of a national recession and recovery. The sensitivity of the state's natural resource-based industries to national and world markets made Minnesota susceptible to the economic downturn of 1981 and 1982. However, as in the case of past recessions, the state's rate of growth during the recovery has outpaced that of the nation as a whole.

Minnesota's wood-based industry has always been an important part of the state economy. As the state adapts to changing economic times, the industry will be an active participant in fostering sustained economic growth. Meeting this challenge requires continually reassessing the role of forest industry in state economic development as well as public and private efforts which might make that role even stronger. This is the underlying theme of this conference.

This paper presents a brief overview of forest industry and its role in the state economy, and of the other participants—both public and private—in the state's forestry sector. Included are brief descriptions of the forest-based sector in the Minnesota economy; the nature, ownership, and supply of the state's timber resource; Minnesota's wood-based industry—its composition, markets for stumpage and wood products, and regional and national economic linkages; the public forestry sector in Minnesota; the state's nonindustrial private forest

landowners; and forestry research and education in Minnesota.

FOREST INDUSTRY AND MINNESOTA'S ECONOMY

The Minnesota economy may be described in a number of ways, all of which attempt to distinguish among different kinds of economic activity important to the state. Each activity or economic sector is composed of individuals and firms interacting to produce particular kinds of goods and services desired by consumers. Figures 1 and 2 depict Minnesota's economic structure in terms of ten major industry "clusters," groups of closely related industries or activities which depend upon one another for sales and purchase or information, or which perform a similar function in the economy (1).

Minnesota's economy derives strength from the diversity of its natural-resource-based manufacturing, service, and supporting industries. The state's forest-related industries make up one of the ten major industry clusters. Within this cluster are included the state's logging community; primary processors, which produce lumber, paper, board, and other products; and secondary processors, which utilize primary inputs to produce wood-based products such as wood furniture and fixtures.

In 1982, Minnesota's forest-based sector accounted for 3.6% of a gross state output of \$81 billion; this amounted to \$2.4 billion of products of local and out-of-state markets. As the state's third largest manufacturing industry, the sector generated almost 9% of gross sales and 12% of value added¹ by manufacturing in the state.

The forest-based sector also produced 7.1% of Minnesota's \$12 billion net exports in 1982 (Figure 2). Dollars generated from the sale of exports represent income flowing into the state, as opposed to the redistribution that occurs when products are manufactured and sold within the state. Income derived from exports, therefore, provides the basis for economic growth and development. It is notable that the forest-based sector's share of exports is approximately twice as large as its share of gross output. This underscores the sector's importance as a basic or exporting industry within the Minnesota economy. Minnesota's forest-related industries—along with

¹This is the value that is "added" to raw material that is "worked on" (and already possesses its own value as a raw product) in the production process. Major components of value added include direct and indirect taxes (value to the government), depreciation allowances, employment compensation, and retained earnings (values to labor and capital).

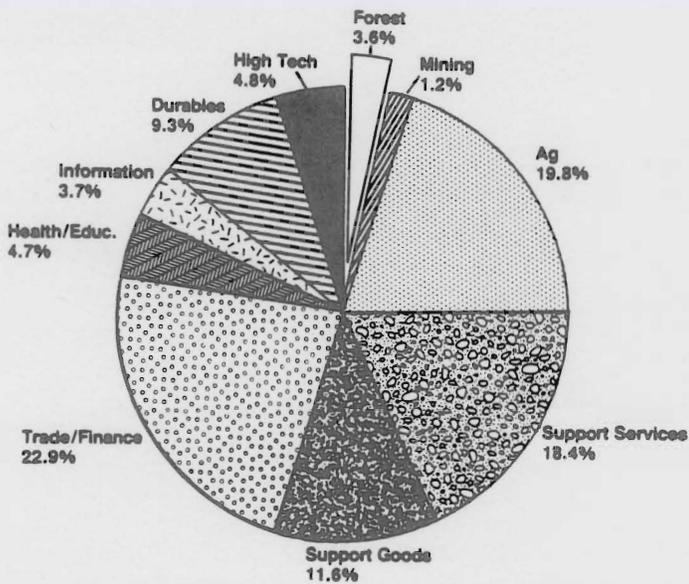


Figure 1. Distribution of Minnesota gross output. (Source: Dougherty, Dawkins, Strand, and Yost, Inc., July 1983.)

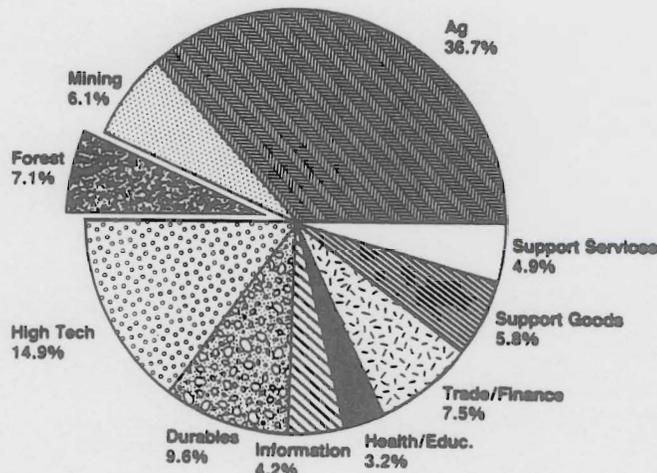


Figure 2. Distribution of Minnesota exports to U.S. and world markets. (Source: Dougherty, Dawkins, Strand, and Yost, Inc., July 1983.)

its agribusiness, mining, and high technology manufacturing industry clusters—form the core of the state's economic base of exporting industries.

Minnesota's forest-based sector employed more than 45,000 full- and part-time workers in 1982, approximately 2.7% of total employment within the state (2). Personal income (from all sources) of these workers amounted to more than \$1.2 billion in 1981. It is also estimated that each job in the forest-based sector supports two to three jobs in the state's services and trade sectors (3). In short, Minnesota's forest-related industries are an important part of the state economy, providing products and employment that enhance the quality of life within the state.

FOREST RESOURCES CHARACTERISTICS

Minnesota's forests, in addition to contributing to recreation, tourism, and other activities, provide the raw material on which the state's wood-based industry depends. In 1977, forests covered some 16.7 million acres in Minnesota, approximately one-third of the state's total land area. Almost two-fifths of Minnesota's total forest land base is owned by private individuals or firms; the remaining three-fifths is under public jurisdiction (Table 1).

About 82% of this forest land base—some 13.7 million acres—is classified as commercial forest land, capable of producing wood suitable for industrial consumption and not withdrawn for other uses. For these lands, public and private ownership percentages narrow to 54% and 46%, respectively (Figure 3; Table 2). Four-fifths of the state's commercial forest lands are located in 17 counties in north-central and northeastern Minnesota. Of the state's remaining noncommercial forests (18% of total), two-thirds are not suited to timber production, while the rest are withdrawn by statute or administrative regulation for wilderness, parks, wildlife refuges, and so on.

Aspen and other hardwood forest types predominate throughout Minnesota; together these species account for over 70% of the state's commercial forest area (Figure 4; Table 3). Spruce-fir is the dominant softwood type, while pines make up about 6% of the total commercial forest area.

The state's wood-based industry owns only a small percentage of Minnesota's commercial forest lands, and therefore depends heavily upon stumpage obtained from other private and public sources. Nonindustrial private landowners—including farmers and other individuals and corporations—control almost two-fifths of all commercial forests in the state. Although by far the largest ownership class, these owners have diverse motivations and objectives for the use of their lands. The production of timber may or may not rank as an important ownership goal.

Table 1. Area of forest land by ownership class and land class, Minnesota, 1977.

| Ownership class | Total forest | Noncommercial | | |
|------------------------------|-----------------|-----------------|----------------|---------------------|
| | | Commercial | Unproductive | Productive-reserved |
| ----- thousand acres ----- | | | | |
| National Forest | 2,599.4 | 1,715.1 | 125.6 | 758.7 |
| Other federal | 875.0 | 621.2 | 127.1 | 126.7 |
| State, county, and municipal | 6,552.4 | 4,992.1 | 1,278.7 | 281.6 |
| Forest industry | 807.2 | 772.0 | 35.2 | — |
| Farmer | 3,614.8 | 3,403.7 | 211.1 | — |
| Miscellaneous private | 2,260.4 | 2,191.0 | 57.8 | 11.6 |
| Total | 16,709.2 | 13,695.1 | 1,835.5 | 1,178.6 |

Source: Jakes, 1980 (12).

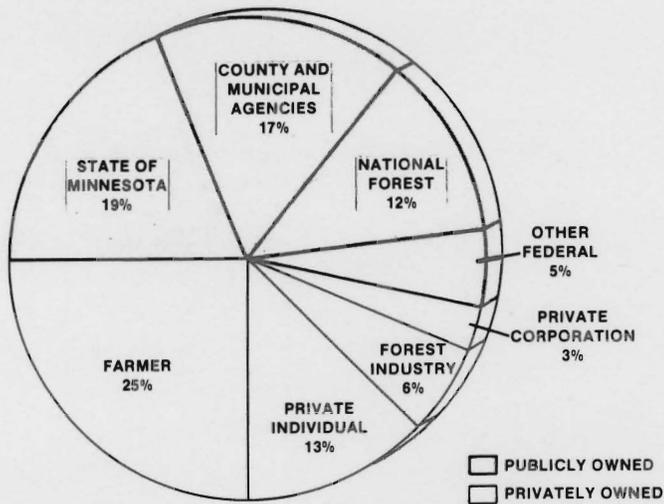
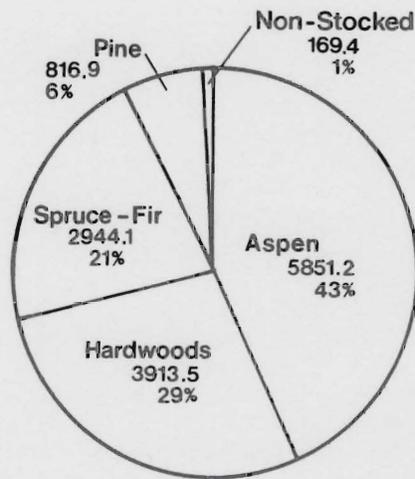


Figure 3. Distribution of commercial forest land by ownership class, Minnesota, 1977. [Source: Jakes, 1980 (12).]



- Aspen**
 - Aspen
 - Balsam Poplar
- Hardwoods**
 - Oak
 - Elm/Ash
 - N. Hdwds.
 - Birch

- Spruce - Fir**
 - Balsam Fir
 - White Spruce
 - Black Spruce
 - Cedar
 - Tamarack
- Pine**
 - Jack Pine
 - Red Pine
 - White Pine

Figure 4. Commercial forest land in Minnesota by forest type, thousands of acres and percentage of total. [Source: Minnesota Forest Resources Plan, 1983 (4).]

Table 2. Area of commercial forest land in Minnesota by ownership category, 1977.

| Ownership category | Acreage | Percent |
|----------------------|------------|---------|
| National Forest | 1,715,100 | 12.5 |
| Other federal | 621,300 | 4.5 |
| State | 2,650,500 | 19.4 |
| County and municipal | 2,341,600 | 17.1 |
| Forest industry | 772,000 | 5.6 |
| Other private | 5,594,600 | 40.9 |
| All ownerships | 13,695,100 | 100.0 |

Source: Jakes, 1980 (12).

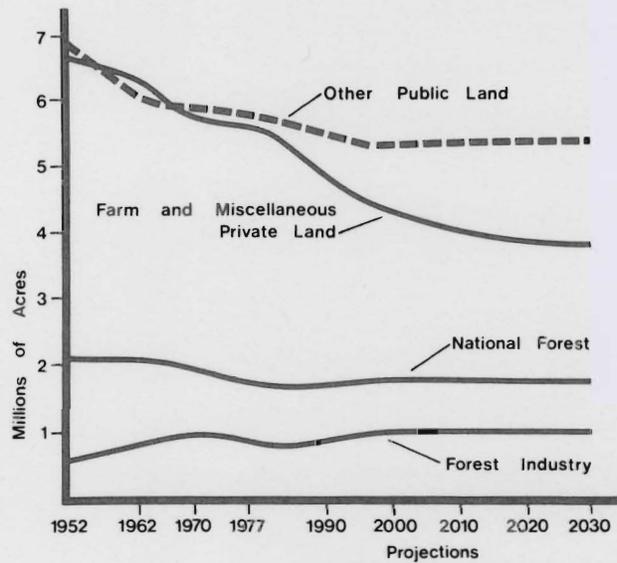


Figure 5. Area of commercial forest land by ownership category, 1952, 1962, 1970, 1977, and projections to 2030. [Source: Minnesota Forest Resources Plan, 1983 (4).]

State and county governments administer almost two-fifths of the state's commercial forests, while two national forests administered by the USDA Forest Service comprise the bulk of Minnesota's federal commercial forest lands. Indian lands managed by the U.S. Department of the Interior Bureau of Indian Affairs (BIA) account for most of the other federally administered commercial forests in the state.

Minnesota's commercial forest base has declined by 11% since 1952, while total forest land in the state has decreased by 9% (Figure 5). Forest industry has been the only ownership class to increase its landholdings during this period, with net holdings rising almost 8%. Nonindustrial private lands have accounted for the bulk of the overall decline in the land base, as parcels are disposed of by landowners and then converted to nonforest uses. While public and industrial holdings are expected to remain relatively stable in the future, the decline in nonindustrial private lands is expected to continue at a decreasing rate before leveling off well into the next century (4).

The supply of timber for Minnesota's forest industry, which arises from the commercial forest base depicted in Figure 3, has both biological and economic dimensions. The former includes such factors as the amount and volume of timber available, the distribution of species, the age of stands, and rates of growth and mortality within the commercial forest base. Economic aspects of timber supply include accessibility, stumpage prices, transportation costs, the nature and location of markets, and the degree to which wood products may substitute for others not currently derived from wood and vice versa. All of these considerations affect the kinds of stumpage that will be required by the state's forest industry and its availability for use in the production process.

In 1977, commercial forest lands in Minnesota contained a growing stock of 11.5 billion cubic feet or almost 145 million cords of timber (Figure 6; Table 4). This represented a 21% increase in growing stock volume from 1962. Almost half of the state's commercial forests, some seven million acres, is of pole timber size (from 5 to 9 inches in diameter at breast height), and four-fifths of the total commercial volume is in trees 12

Table 3. Area of commercial forest land in Minnesota by timber type, 1977.

| Timber type | Acreage (thousands) | Timber type | Acreage (thousands) |
|--------------------------|--------------------------|--------------------------|---------------------|
| Upland softwoods | | Upland hardwoods | |
| Jack pine | 504.4 | Aspen | 5,302.3 |
| Red pine | 246.9 | White birch | 997.6 |
| White pine | 65.6 | Balsam poplar | 548.9 |
| Balsam | 850.1 | Oak | 893.9 |
| White spruce | 79.2 | Maple-basswood | 1,283.9 |
| Lowland softwoods | | Lowland hardwoods | |
| Black spruce | 1,041.8 | Elm-ash | 738.1 |
| Cedar | 498.6 | | |
| Tamarack | 465.4 | | |
| Total softwoods | 3,761.0 | Total hardwoods | 9,764.7 |
| | Nonstocked forest | | 169.4 |
| | Total—all types | | 13,695.1 |

Source: Jakes, 1980 (12).

inches or less in diameter. This contributes to a significant imbalance in the age distribution of Minnesota's forests, as exemplified by an aspen resource with substantial volumes of timber in mature and over-mature age classes (Figure 7).

In 1976, Minnesota's commercial forests were growing at a net annual rate of approximately 3% of total inventory, about 6.1 million cords per year. This is down from the 1962 rate of about 4%; however, declining growth rates are to be expected in a state such as Minnesota where inventory volumes are expanding rapidly (5). The net growth rate also reflects the loss of 1.2% of total inventory per year to mortality, caused principally by disease, insects, and weather.

From 1962 to 1976, removals (the harvested portion of the biological timber supply) increased by one-third; all of this increase is attributable to removals of hardwood species (primarily aspen), reflecting an obvious trend toward increased hardwood utilization in Minnesota (Table 5). In 1976, timber removals amounted to approximately one-half of net annual

growth. This suggests that current growth rates could sustain substantial increases in removals (5).

In the context of its distribution by age and size class and its rate of net growth, it is of interest to speculate how Minnesota's commercial forests will hold up in the future. This will also depend, of course, upon anticipated future harvests from these lands. In 1981, projections of inventory, growth, and removals through the year 2007 were constructed for Minne-

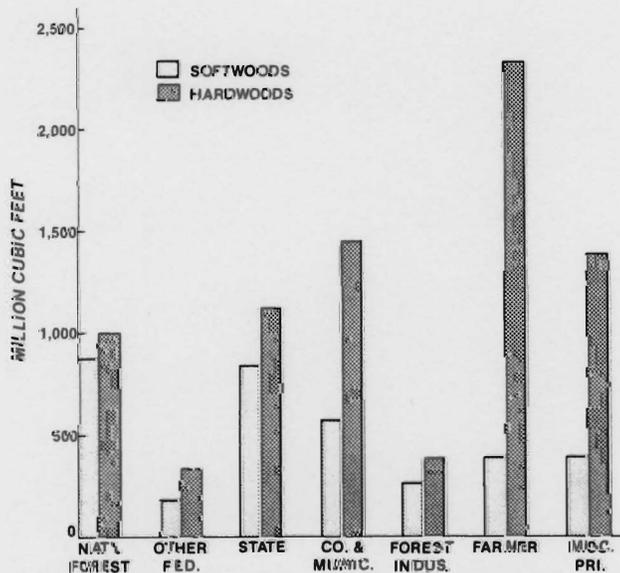


Figure 6. Net volume of growing stock on commercial forest land by wood type, Minnesota, 1977. [Source: Spencer, 1982 (5).]

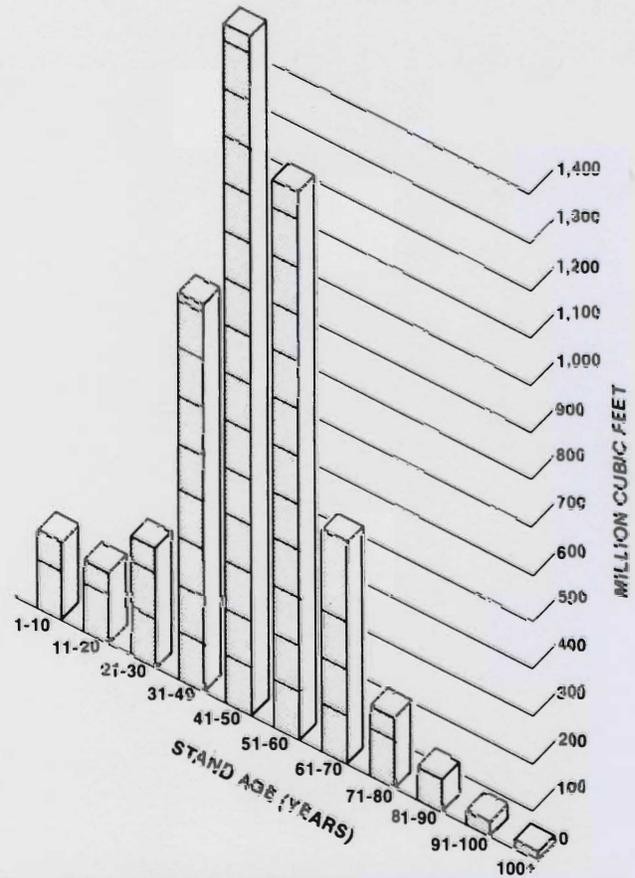


Figure 7. Net volume of growing stock in aspen forest type on commercial forest land by stand-age class, Minnesota, 1977. [Source: Spencer, 1982 (5).]

Table 4. Net volume of growing stock on commercial forest land by ownership class, Minnesota, 1977.

| Ownership class | All species | Softwoods | Hardwoods |
|---|--------------------------------|-----------|-----------|
| | ----- million cubic feet ----- | | |
| National Forest Bureau of Land Management | 1,871.1 | 871.1 | 1,000.0 |
| Indian | 37.4 | 22.8 | 14.6 |
| Miscellaneous federal | 374.6 | 136.6 | 238.0 |
| State | 96.6 | 20.2 | 76.4 |
| County and municipal | 1,942.1 | 818.2 | 1,123.9 |
| Forest industry | 2,012.3 | 566.7 | 1,445.6 |
| Farmer | 636.0 | 265.0 | 371.0 |
| Miscellaneous private | 2,706.2 | 383.6 | 2,322.6 |
| | 1,777.7 | 392.8 | 1,384.9 |
| Total | 11,454.0 | 3,477.0 | 7,977.0 |

Table 5. Timber removals from growing stock, Minnesota, 1962 and 1976.

| Species | Timber removals from growing stock | |
|-------------|------------------------------------|-------|
| | 1962 | 1976 |
| | - million cubic feet - | |
| Softwoods | 68.9 | 68.8 |
| Hardwoods | 77.0 | 124.8 |
| All species | 145.9 | 193.6 |

Source: Spencer (1982) (5).

sota's commercial forests using two different scenarios for timber removals (5). The first assumed a continuation of recent harvesting levels, while the second assumed a higher rate of removal (Figure 8).

Under current removal rates, annual net growth is projected to peak in about 1987 and then begin to decline. Inventory is projected to increase and then gradually level off as removals approach annual growth near 2007. Under a higher rate of timber harvesting, removals are projected to surpass annual growth in about 2000, and continue upward as annual growth declines further. The increase in inventory is projected to drop off more rapidly than for current removal rates and begin to decline when growth and removals intersect.

Characteristics of the biological supply of timber from Minnesota's commercial forest lands can be summarized as follows:

- More than four-fifths of the state's total forest area is both suitable and available for timber production.
- Ownership of the state's timber supply is balanced between the private and public sectors.
- Nonindustrial private forest landowners constitute by far the largest single ownership class.
- Hardwood species, notably aspen, predominate throughout the state.
- Minnesota's commercial forests show a significant imbalance in age-class distribution; much of the state's current timber supply is in mature and over-mature age classes.
- The state's commercial forests are growing at a net annual rate of 3%; substantial increases in removals could likely be sustained in the immediate future.

- Annual removals are projected to surpass annual growth within the next 40 years; when this occurs will depend on both the rate of removals and anticipated further declines in the commercial forest land base.

As noted above, the supply of timber for Minnesota's forest industry depends not only upon the nature and condition of the physical resource, but also upon the demand for wood-based products within Minnesota and other parts of the country. This suggests that a closer look at the structure of the wood-based industry in Minnesota and at current and potential markets for wood products is in order.

MINNESOTA'S WOOD-BASED INDUSTRY

In considering the current and potential contribution of forest industry to economic development within the state, it is helpful to identify the major components of sustained economic growth. Figure 9 presents a broad overview of important participants and activities within the state's wood-based economy, from the harvesting of timber to its conversion to various kinds of wood products and their ultimate purchase by consumers.

Markets exist whenever buyers and sellers interact for the purpose of exchanging goods and services. Prices generally signal the perceived value of whatever is being exchanged. The process of converting a tree to a board, a cabinet, or a piece of paper involves interactions within two kinds of markets composed of distinguishable buyers and sellers. At the broadest level, one might envision a market for stumpage provided by commercial forest landowners, and separate markets for the variety of final products produced by wood-processing industries. In effect, these markets provide the key to describing how Minnesota's wood-based industry organizes itself in the conduct of economic activity.

Stumpage is produced in various forms from lands held by private and public owners. It may be exported, processed further by industrial firms within the state, or go directly to final consumers. The processing of wood may occur in one or more stages. *Primary manufacturing* includes all activities involved in the processing of logs, bolts, chips, and other wood raw material into a variety of first-level products including lumber, veneer, plywood, paper, and panel boards (6). Some of these products may be sold as final products within the state, some may be exported, and others may serve as inputs to firms for additional processing. *Secondary manufacturing* includes all activities involved in the remanufacture of primary wood products into a variety of finished goods (6). Like primary products, final products may be exported or sold to consumers within the state; depending on the product, they may be imported as well.

Thus, the nature and amount of stumpage required by Minnesota's forest industry depends ultimately on the demand by consumers for wood-based products. In economic jargon, stumpage is said to have a *derived demand* in the sense that it is derived "through" the demand for finished wood-based products, both processed and nonprocessed.

In addition to the production of stumpage and wood products, other important kinds of economic activity occur as well. Timber harvesting and primary and secondary processing provide employment and income to many Minnesotans. Also, at various stages within this overall process wood products are

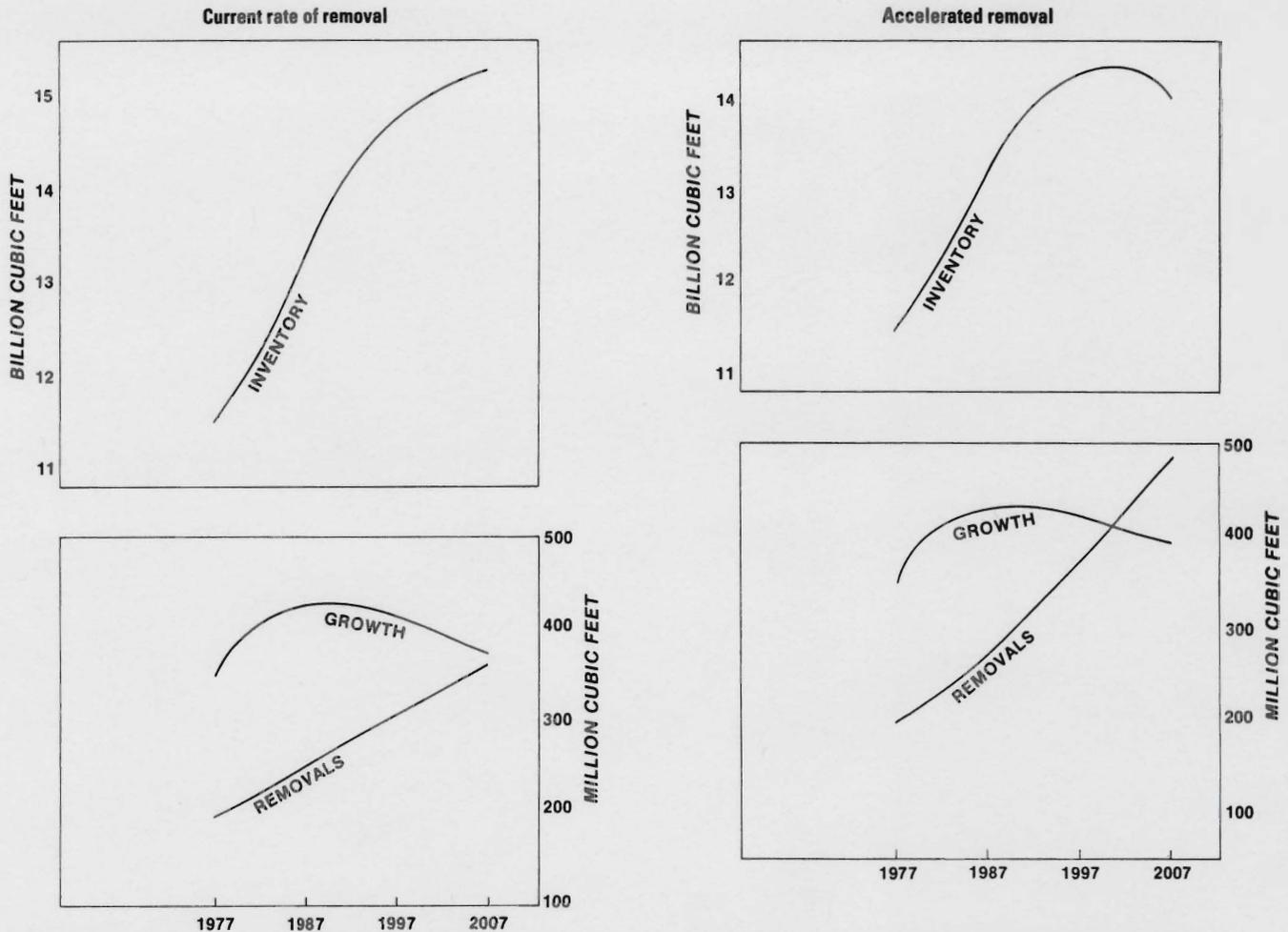


Figure 8. Removals, net growth, and inventory of growing stock in Minnesota, 1977, and removal projections for 1977-2007. [Source: Spencer, 1982 (5).]

exported to out-of-state markets or imported for use within the state. As noted earlier, having greater exports than imports (i.e., net exports) is critical to sustained economic growth.

This suggests that within this broad framework there are several key indicators of the economic vitality of Minnesota's wood-based industry. These include:

- the kinds of products produced, and the types of firms which produce them;
- the amount and value of products produced, including stumpage, primary products, and finished goods;
- the jobs arising from each type of activity in the wood-based industry as a measure of its contribution to the well-being of Minnesota citizens;
- the level of investment undertaken by Minnesota forest industry as an indicator of prospects for economic growth;
- the level of trade for Minnesota's wood-based products, including the kinds and amounts of products that make up the state's wood-based imports and exports.

While it is not possible to examine these measures in great detail in this paper, each will be considered briefly.

Accurately gauging these key economic indicators requires a clear picture of the kinds of products that result from each

stage of the production process. Figure 10 expands on the previous diagram to include not only processors and other economic agents, but also the products derived at each stage of economic activity within Minnesota's wood-based sector.

Stumpage provided by timberland owners may be differentiated according to whether it is processed or sold directly to consumers as a final product. Almost two-thirds of the 4.1 million cords of wood harvested from Minnesota's commercial forests in 1983 underwent some type of additional processing on the way to becoming a final product. Processed wood may be categorized as either pulpwood or sawlogs and veneer logs. Pulpwood accounted for 46% of the total state harvest in 1983, while logs and nonprocessed wood accounted for 18% and 36%, respectively (7).

Much of the pulpwood that is not exported is converted to wood pulp in the manufacture of paper and board. In 1982, Minnesota mills produced 856,000 tons of paper, an increase of 6% and 14% from production in 1977 and 1974, respectively (8). Primary paper and board products may be sold directly to consumers, but many are converted into a wide variety of allied paper products prior to final consumption. Pulp and paper mills also utilize pulpwood in the form of wood chips for the manufacture of flakeboard (waferboard and cri-

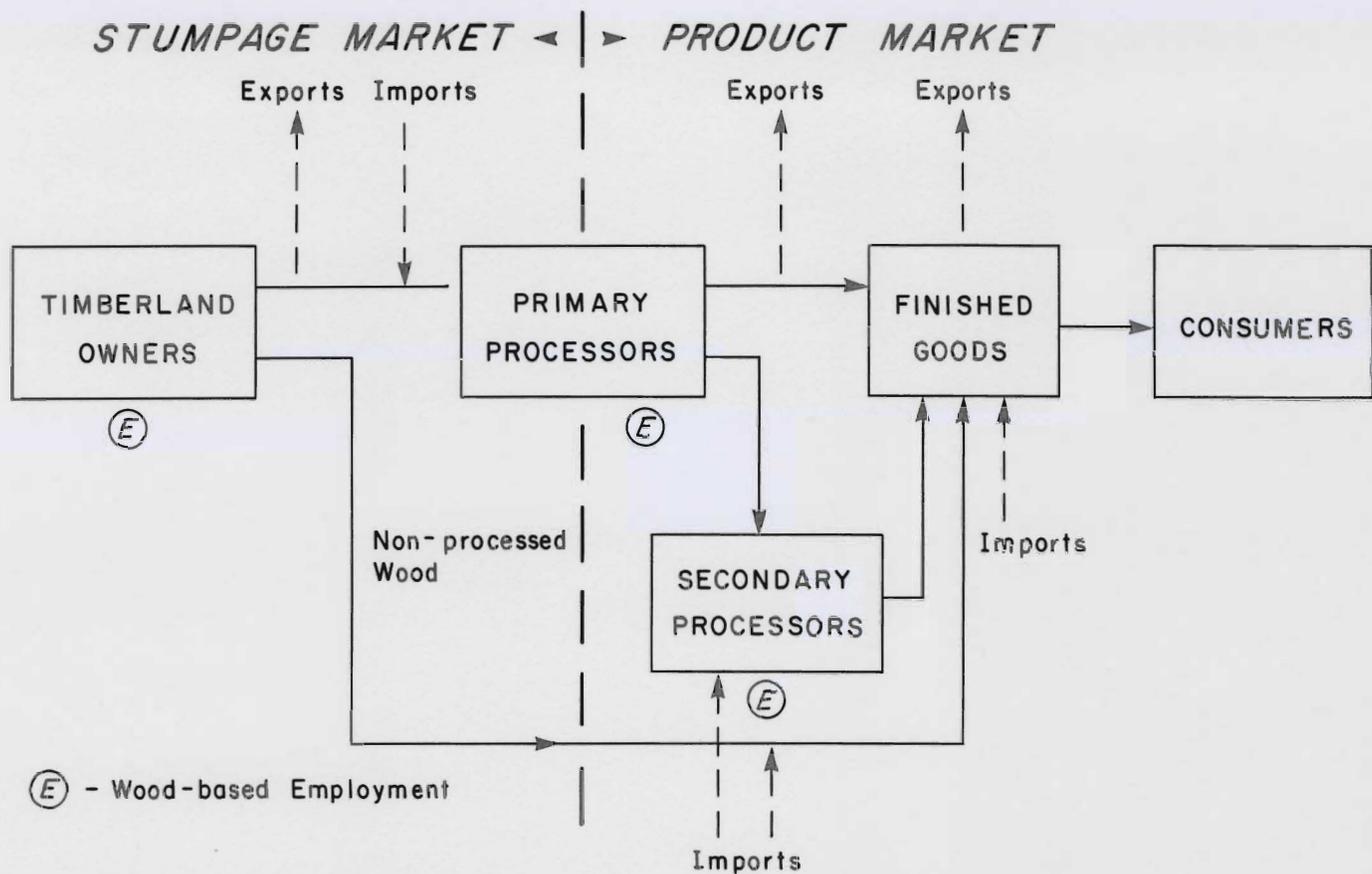


Figure 9. Economic activity within Minnesota's wood-based industry.

ented strand board), which is primarily a substitute for plywood and thus is sold in that product market.

Sawlogs and veneer logs, which constitute the second major category of processed wood, are utilized by sawmills in the production of lumber and plywood-veneer. These primary products then serve as raw materials for the production of pallets and containers, and as inputs to the construction industry. Construction, treated here as a final product, is actually a major economic activity that accounts for 77% of the state's industry cluster of support goods (Figure 1). Thus much of the demand for lumber is from construction, which in turn ultimately depends on the demand for housing and related structures. Lumber and plywood-veneer are also inputs to firms that produce furniture and fixtures, and to other secondary processors not depicted in Figure 10.

Nonprocessed wood consists primarily of posts, poles, piling, and fuelwood, all of which are utilized directly by consumers as final products. Among these, fuelwood is by far the largest category, accounting for 1.4 million cords or more than one-third of all wood harvested in the state in 1983. It is estimated, however, that only about 20% to 30% of total fuelwood removals may be from commercial growing stock; the rest consists of dead and downed materials and logging residues (15, 18).

The economic importance of mill by-products has greatly increased during the past decade. These may serve as inputs to pulp and paper manufacture or as an energy source for industrial and residential use. Almost \$16 million worth of wood residues were generated from Minnesota mills in 1983 (7).

This broad picture of economic activity within Minnesota's wood-based industry provides the framework for examining the important economic indicators noted above. Figure 11 breaks out the previous description of stumpage produced in Minnesota into a slightly more refined picture of stumpage products. Processed wood other than pulpwood is further differentiated into that used in the production of railroad ties (a sawmill product) and a variety of specially processed wood such as shaving bolts and wood used in the manufacture of cooperage, dowels, charcoal, and other primary products not shown in Figure 10.

A look at recent trends in stumpage production within the state (Table 6) reveals that pulpwood harvest increased by more than 43% between 1980 and 1983. Much of this reflects the construction of several new flakeboard plants in Minnesota during that period, helping to offset the dampening effect of

Table 6. Minnesota wood harvest by stumpage category, 1980-83.

| Category | 1983 | 1982 | 1981 | 1980 |
|-------------------------|------------------------------|-------|-------|-------|
| | -----thousands of cords----- | | | |
| Pulpwood | 1,910 | 1,484 | 1,371 | 1,333 |
| Lumber logs and bolts | 622 | 516 | 651 | 671 |
| Specialty wood products | 105 | 100 | 102 | 96 |
| Railroad ties | 34 | 25 | 20 | 21 |
| Posts, poles, piling | 43 | 46 | 45 | 37 |
| Fuelwood | 1,445 | 1,520 | 1,410 | 1,360 |
| Total | 4,161 | 3,691 | 3,598 | 3,519 |

Source: Minnesota Forest Industries, Inc., 1984 (7).

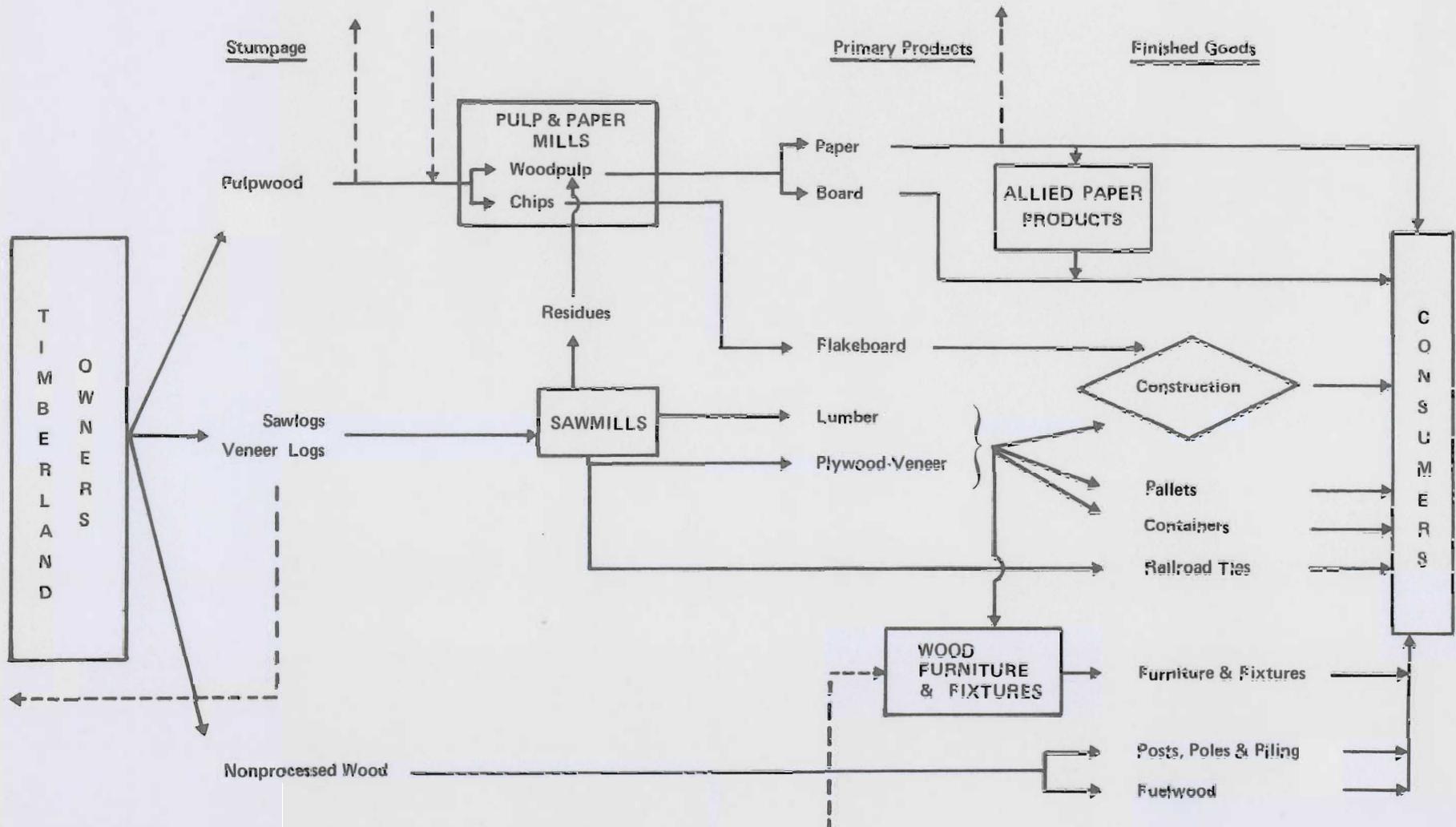


Figure 18. Product flows in Minnesota's wood-based industry. [Constructed from Gray, 1984 (8)]

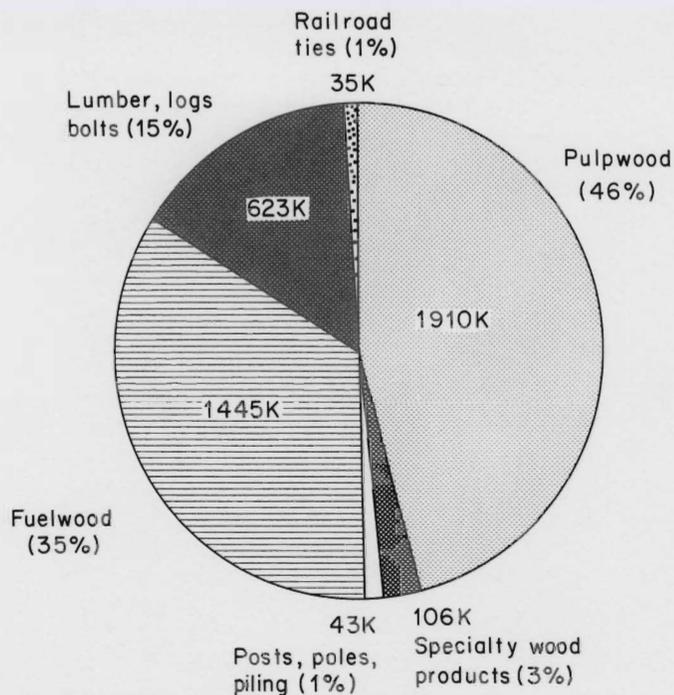


Figure 11. Distribution of Minnesota harvest by stumpage product category, thousands of cords, 1983. (Source: Minnesota Forest Industries, Inc., 1983.)

the 1981-82 recession. Production of sawlogs and other processed wood utilized in construction was severely curtailed by the recession, but rebounded rapidly in 1983 with the release of pent-up demand for construction. The recession's effect upon fuelwood consumption in 1982 was also quite noticeable. Overall, the surge in pulpwood production resulted in an 18% increase from 1980 levels in total wood harvested in Minnesota.

In 1983, the harvesting of stumpage in Minnesota employed 4300 full- and part-time loggers, about 9% of total employment within the state's wood-based industry (7). This represents the best available estimate in light of the difficulty of identifying part-time workers and of including all independent loggers, who make up most of the state's logging community. Although actual working hours are somewhat difficult to calculate due to part-time work, logging employment increased by almost 14% between 1980 and 1983 (Table 7). Most loggers deliver stumpage to mills without extensive pre-arrangements. Those with more mechanized equipment may enter into short-term supply contracts involving the delivery of specified volumes and species over a three- to six-month period (9). Wood processing firms themselves have few if any full-time logging employees.

Table 7. Employment in Minnesota's wood-based industry, 1980-83.

| Category | 1983 | 1982 | 1981 | 1980 |
|---------------------------|--------|--------|--------|--------|
| Logging (full, part time) | 4,300 | 4,000 | 3,700 | 3,700 |
| Pulp, paper, board plants | 6,200 | 6,000 | 6,100 | 6,900 |
| Sawmills, etc. | 9,600 | 9,000 | 12,100 | 11,240 |
| Furniture and fixtures* | 2,600 | 2,500 | N/A | N/A |
| Allied paper products | 26,200 | 25,300 | 25,100 | 26,700 |
| Total | 48,900 | 46,800 | 50,700 | 52,290 |

*Adjusted for nonwood labor component.

Source: Minnesota Forest Industries, Inc., 1984 (7).

The value of products generated at each stage of the process of converting wood into finished goods is an important indicator of the economic vitality of the wood-based industry. Table 8 depicts the value of primary and nonprocessed wood products produced in 1983, along with the best available estimate of the combined value of all secondary wood products. The value of all products arising from the industry in that year exceeded \$2.8 billion, with primary and nonprocessed wood accounting for about 38% of this amount.

Almost 49,000 people were employed in generating this economic contribution to the state (Figure 12), taking home wages in excess of \$1.17 billion (2, 7). Hidden within this figure is the enormous importance of the timber economy to northern regions of the state. In Koochiching County, for example, almost two-thirds of total employment depends directly or indirectly upon the wood-based industry (16).

Pulp and paper are the dominant products of primary wood manufacturing in Minnesota. Pulpwood-using firms account for more than 90% of the value of primary production in the form of paper, hardboard, and flakeboard. Much of the state's paper production is in high quality grades.

Ten firms, most of which are headquartered in other parts of the country, control all of pulp, paper, and board operations in Minnesota. They are divided as follows (10):

| Number of plants | Products (→ reflects integrated operation) |
|------------------|--|
| 5 | Pulp → Paper |
| 3 | Pulp → Hardboard |
| 1 | Pulp → Roofing |
| 1 | Pulp → Insulation |
| 1 | Paper |
| 2 | Waferboard |
| 2 | Oriented strand board } Flakeboard |
| 1 | Repulping (recycled paper) → Boxboard |

Five of the state's paper mills integrate pulp and paper operations. Five other pulp mills integrate pulping with the production of hardboard, roofing, or insulation. Since 1980, Minnesota has witnessed the arrival of three new flakeboard

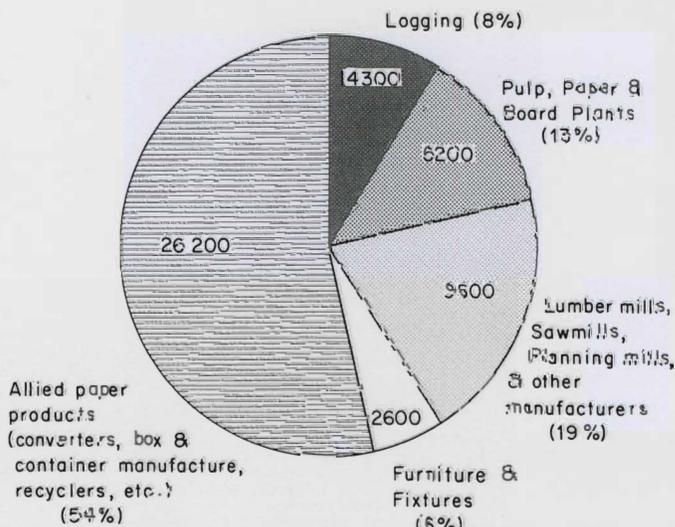


Figure 12. Employment in Minnesota's wood-based industry, 1983. (Source: Minnesota Forest Industries, Inc., 1983.)

Table 8. Value of forest products manufactured in Minnesota, 1983.

| Products | Value | Percentage of value | | |
|-----------------------------------|-------------|----------------------|--|-------|
| | | All primary products | All products excluding secondary manufacturing | Total |
| ----- thousands of dollars ----- | | | | |
| Pulp and paper board* | \$ 699,629 | 71.2 | 65.2 | 24.5 |
| Lumber logs and bolts | 199,313 | 20.3 | 18.6 | 6.7 |
| Specialty wood products | 54,679 | 5.6 | 5.1 | 1.9 |
| Railroad ties | 25,448 | 2.6 | 2.4 | 0.9 |
| | 2,928 | 0.3 | 0.3 | 0.1 |
| Primary products | \$ 982,037 | 100.0 | 91.6 | 34.4 |
| Posts, poles, piling | \$ 5,111 | | 0.5 | 0.2 |
| Fuelwood | 59,606 | | 5.5 | 2.1 |
| Christmas trees | 10,125 | | 0.9 | 0.4 |
| By-products, mill residue | 15,812 | | 1.5 | 0.6 |
| Primary and nonprocessed products | \$1,072,691 | | 100.0 | 37.6 |
| Secondary manufacturing | \$1,780,755 | | | 62.4 |
| Total | \$2,853,446 | | | 100.0 |

*Waferboard, oriented strand board, hardboard, hardboard siding.

Constructed from: Minnesota Forest Industries, Inc., 1984 (7).

plants and significant expansion in another. A fifth is currently under construction. The emergence of the state's flakeboard industry has been an important factor in the sharp increase in pulpwood harvested in Minnesota since 1980.

Capital investments in Minnesota's wood-based industry have occurred primarily within its pulp and paper sector. Although dampened sharply in the wake of the recession, firms invested more than \$600 million in plant modernization and new plant construction between 1980 and 1983 (Table 9). Current construction and other modernization efforts should boost this figure in 1984.

In 1983 there were approximately 110 firms in the state producing converted paper products such as envelopes, bags, boxes, and containers (2). These secondary processors provided more than half of all wood-based jobs within the state (Figure 12) and accounted for 48% of the value of wood-based secondary manufacturing in Minnesota (7).

In contrast to the relatively few large plants producing primary pulp and paper products, Minnesota's lumber and wood products sector is composed of numerous small firms, many of which operate only seasonally. Approximately 750 primary processors, mostly sawmills, are located throughout the state (10). Of these, about 10% account for more than four-fifths of all lumber produced in Minnesota (11). Only a few small veneer mills are found within the state.

Although the value of lumber produced in the state is dwarfed by that of paper and board products, almost one in every five workers in Minnesota's wood-based industry is employed in sawmills or other primary wood-processing firms (Figure 12). This is also the one sector within the industry in which employment during the last decade has increased faster than the national industry average (17).

Lumber and other primary wood products serve as inputs to the construction sector and to a wide variety of firms engaged

in secondary manufacturing, the largest of which are those that make wood furniture and fixtures. This segment of the industry provided approximately 2600 jobs for Minnesotans in 1983, slightly more than 5% of employment within the state's wood-based industry. A large number of other secondary processors produce inputs for construction such as millwork, trusses, and prefabricated building components. Other firms produce signs, display parts, wooden novelties, and so on. All told, about 300 to 400 firms are engaged in secondary wood manufacturing in the state (14). The estimated value of secondary lumber and wood products processing in Minnesota during 1983 exceeds \$800 million (7). However, this value also includes the use of imported wood in secondary manufacturing, which in the case of certain products may be substantial.

Nonprocessed wood, which accounted for more than one-third of removals from Minnesota commercial forests in 1983, is used primarily for fuelwood within the state. The total value of wood residues (including mill by-products) utilized in Minnesota exceeded \$75 million (Table 8). Residue utilization for wood energy has increased greatly in economic significance during the last decade, and its full potential has yet to be real-

Table 9. Capital and maintenance investment in Minnesota's pulp and paper industry, 1977-83.

| Date | Plant expansion and modernization | Upkeep |
|------|-----------------------------------|--------------|
| 1977 | \$ 27,124,591 | \$14,763,341 |
| 1978 | 65,285,002 | 17,337,533 |
| 1979 | 86,973,839 | 20,920,549 |
| 1980 | 143,904,369 | 22,366,287 |
| 1981 | 300,072,332 | 29,338,237 |
| 1982 | 127,383,460 | 45,172,364 |
| 1983 | 50,713,734 | 38,281,888 |

Source: Minnesota Forest Industries, Inc., 1984 (7).

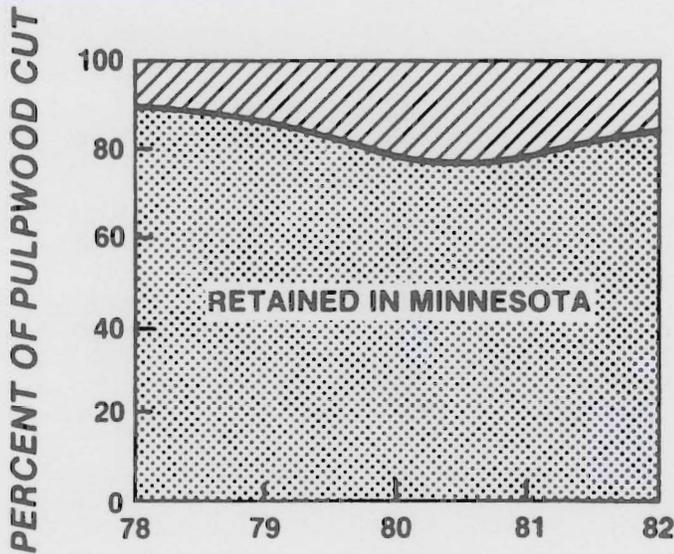


Figure 13. Percentages of Minnesota pulpwood retained in and shipped out of the state, 1978-82. [Source: Blyth, 1984 (21).]

ized. Conservative estimates indicate that there will be more than two million cord equivalents of residue available per year from Minnesota forests between 1980 and 2000 (18, 19). Over half will be unutilized given current circumstances. This suggests that the use of wood residues for energy production could contribute significantly to the state economy.

FOREST INDUSTRY AND TRADE

In addition to the amount and value of products produced by Minnesota's forest industry and the employment derived by citizens within the state, another important economic activity reflected in Figure 10 is trade. Exports and imports play varying roles in the flow of wood through Minnesota's timber economy and, as noted earlier, maintaining a satisfactory level of net exports is an important ingredient in economic growth. This suggests that a brief look at levels of trade within the state's stumpage and wood-based product markets would be worthwhile.

Minnesota's exports are significant for pulpwood, primary paper and board products, and some allied paper products. Some wood furniture and much of the state's limited production of veneer logs are also exported. The state's pulp and paper firms import some pulpwood and wood pulp, and lumber imports to secondary wood processors are also significant.

Trade within the state's pulpwood stumpage market is depicted in Figure 13 and Table 10. From 1977 to 1981, Minnesota's pulpwood exports grew to about 20% of total production, then gradually declined to near 10% in 1983. Value of pulpwood exports in that year exceeded \$8.5 million (7). Increased capacity brought about by the state's new and expanded board plants accounts for this overall pattern. Increases in wood processed within the state may enable the industry to increase exports of primary paper and board products, thus strengthening its role as a basic industry within Minnesota. Between 1977 and 1982, imports of pulpwood to state mills declined to a small fraction of total production.

Both in 1975 and 1980, Minnesota exported about 2% of its sawlog production to other states, primarily Wisconsin and

Table 10. Minnesota pulpwood trade, 1977-83.

| Date | Pulpwood produced | Exports | Imports | Mill receipts | Net exports |
|---|-------------------|---------|---------|---------------|-------------|
| ----- thousands of standard cords ----- | | | | | |
| 1983* | 1,910 | 190 | NA | NA | NA |
| 1982 | 1,484 | 220 | 34 | 1,298 | 186 |
| 1981 | 1,371 | 252 | 46 | 1,164 | 206 |
| 1980 | 1,333 | 290 | 53 | 1,097 | 237 |
| 1979 | 1,458 | 232 | 69 | 1,295 | 163 |
| 1978 | 1,338 | 183 | 63 | 1,218 | 120 |
| 1977 | 1,333 | 184 | 60 | 1,209 | 123 |

*Minnesota Forest Industries, Inc. (1984).

Source: Gray (1984) (8), except where noted.

Iowa (8, 15). In 1975 only about 12% of the veneer logs produced in Minnesota were processed within the state; more than two-thirds of these logs, produced primarily in southeastern counties, were exported to Wisconsin. Since veneer is a high value-added product, this situation leads to the loss of potential gains from instate processing.

Minnesota's primary paper and board products represent key elements in the identity of Minnesota's wood-based sector as a basic industry. Almost 70% of the state's primary wood-based products, largely paper and board, are exported (Figure 14), and the state's new flakeboard plants were built in large part with an eye on supplying Midwestern markets. In contrast, only 9% of the state's lumber and wood products are exported, with secondary manufacturing accounting for most of this (20).

In general, imports make up a rather small part of products consumed by the state's wood-based industry. However, pulp mills do import about 16% of the wood pulp they process (9) and imports do play a significant role for some firms involved in secondary wood products manufacturing. Although difficult to pinpoint exactly, a number of Minnesota firms import a substantial amount of lumber for making millwork, windows, and other products. Minnesota sawmills may not be able to meet the species requirements or product specifications for the manufacture of these products. Capital investment in improving the state's sawmill operations is basically a small business venture and differs greatly from large-scale plant modernization projects in the pulp and paper sector.

In reviewing this brief sketch of Minnesota's wood-based industry and the timber resource on which it depends, the following picture emerges:

- The pulp and paper sector forms the core of primary wood-based manufacturing in the state, accounting for

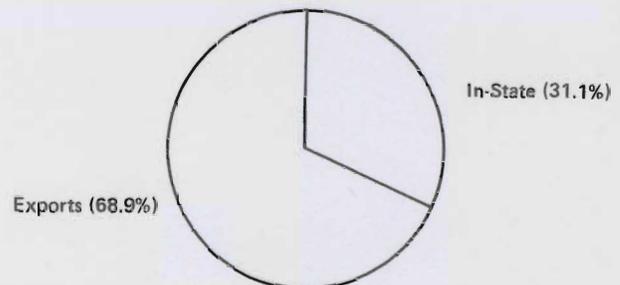


Figure 14. Minnesota primary forest products destinations, 1982. [Source: Minnesota Department of Natural Resources, Division of Forestry, 1984 (3).]

more than nine-tenths of the value of all primary production.

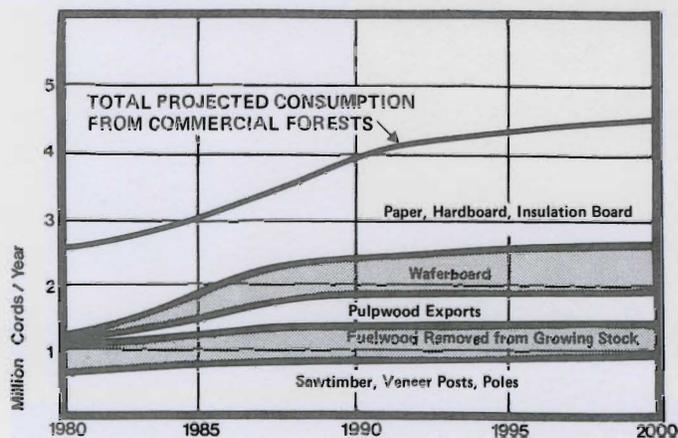
- Almost half of the wood harvested from Minnesota forests goes to pulp and paper and board production.
- Substantial capital investments in flakeboard production have occurred in recent years, enhancing prospects for better utilization of the state's plentiful pulpwood resource.
- In contrast to the concentrated pulp and paper sector, Minnesota's lumber and wood products industry consists of many small firms serving instate markets.
- The lumber and wood products sector provides one-fifth of all employment in the state's wood-based industry.
- Most harvesting is carried out by independent loggers, for whom employment opportunities may continue to improve with more intensive use of the state's timber resources.
- More than half of total employment within Minnesota's wood-based sector is in allied paper products manufacturing.
- Secondary manufacturing more than doubles the value of Minnesota's primary wood-based products.
- Seven-tenths of the state's primary paper and board products are exported, bringing dollars into the state that enhance prospects for economic development.
- Pulpwood exports are significant, but have declined in recent years as mill capacity within the state has expanded.
- Lumber imports account for a significant amount of wood utilized by some secondary wood products manufacturers in Minnesota.

REGIONAL AND NATIONAL ECONOMIC LINKAGES

Thus far this perspective of forest industry in Minnesota has focused on important indicators of economic activity, such as the output and value of products, the firms that produce them, employment, and trade. All of these facets of the industry, however, depend upon consumers and what they are willing to purchase. If primary products or finished goods are cheaper elsewhere, consumers are likely to take their business there, even if this means buying goods produced outside of the state.

This suggests that economic conditions not only within Minnesota but also in the rest of the nation and world have an important influence on the vitality of the state's wood-based industry. Minnesota firms must continually balance the prices at which they can profitably sell their products with those of producers elsewhere. The state's economic base can be strengthened by increasing net exports only when all relevant patterns of regional and national economic activity in the wood-based industry are taken into account.

A 1980 study funded by the Legislative Commission on Minnesota Resources (9) included a forecast of future demand for wood-based products in national and world markets, with implications for Minnesota's forest industry. World economic growth, though slowing a bit from earlier decades, was still expected to result in high demand on the world's forest resources, particularly within industrialized nations. In the United States, the demand for softwood lumber, hardboard, and particleboard was expected to increase at varying rates,



Note: Projected product volumes are depicted by the area between upper and lower lines. Total demand is the sum of each product volume (area).

- 1) Sawtimber, Veneer, Posts & Poles - Also includes lath, shavings, dowels, domestic and export veneer and lumber logs. Projected industrial growth at 2%/yr.
- 2) Fuelwood - Amount removed from growing stock on commercial forest land only. Growing stock is defined as all live trees of commercial species except rough and rotten trees. Includes 100,000 cords planned for a one source industrial energy use beginning in about 1990.
- 3) Pulpwood Export - Roundwood, other than veneer or lumber logs, exported to Wisconsin and Canada.
- 4) Waferboard - Projected at 85% of announced and projected mill capacity.
- 5) Paper, Hardboard, Insulation Board - Projected at 85% of announced and projected mill capacity.

Figure 15. Projections of consumption for wood resources from commercial forest land in Minnesota, 1980-2000. [Source: Minnesota Department of Natural Resources, Division of Forestry, 1991 (11).]

with that for hardwood lumber lagging behind. A significant increase in flakeboard production also was anticipated. Paper and paperboard production were forecast to grow more slowly than the U.S. economy, with the notable exception of paper utilized in printing and publishing, one of the fastest growing sectors in the U.S. economy.

In interpreting these national demand trends for Minnesota's wood-based industry, it was found that while paper production in the United States would likely expand only slowly, the demand for many of the kinds of paper Minnesota mills are producing will increase significantly. Printing and publishing continues to be a high growth area within the Minnesota economy and across the nation, and the state's currently underutilized timber resource contains more than enough wood fiber to sustain this trend for some time. In addition, the stellar performance of flakeboard as a substitute for plywood in the construction industry, coupled with recent significant expansion of plant capacity within the state, places Minnesota in an enviable position within this newly developing market.

What all of this means with respect to the state's timber resource is reflected in Figure 15. Based on estimates by industry representatives within the state, total industrial roundwood harvests (excluding fuelwood) are expected to increase by almost 50% by the year 2000. Pulpwood accounts for the vast majority of this increase, while sawlogs and other processed wood will likely exhibit only marginal gains.

The anticipated doubling of waferboard production will undoubtedly be influenced by the industry's ability to capture a significant portion of out-of-state markets, particularly in the Midwest. The Great Lakes Region must be identified as a viable source of wood products for national needs, just as the South is viewed as a major actor in national markets. Forest industry in Minnesota must develop a strong regional image to effectively market its wood products.

Table 11. Production of 3/8-inch structural panel in the Lake States, 1980-1983.

| Year | Michigan | Minnesota | Wisconsin | Total |
|------|-------------------------------|-----------|-----------|-------|
| | -----million square feet----- | | | |
| 1983 | (2) 185 | (4) 670 | (1) 151 | 1,006 |
| 1982 | (2) 21 | (3) 328 | (1) 99 | 448 |
| 1981 | (1) 19 | (3) 148 | (1) 111 | 278 |
| 1980 | (1) 20 | (1) 65 | (1) 70 | 155 |

Estimates are from Economics Report E37, American Plywood Association.

() indicates the number of plants

By definition, structural panel includes softwood plywood, waferboard, oriented strand board, and composite plywood.

Source: Gray, 1985 (8).

For the past several years Wisconsin has far surpassed Minnesota as the leading paper producer in the nation. Sawlog and veneer log production in Michigan and Wisconsin also exceed that in Minnesota by a wide margin. In the emerging structural panel market, however, Minnesota is at the forefront of both regional and national markets (Table 11). The ability of the Lake States region to merge its regional forestry strengths into an integrated national image will likely be a major key to its access to emerging domestic and foreign markets for wood.

International markets may also enhance the contribution of Minnesota forest industry to state economic development. This past summer a shiplod of logs left the Duluth harbor for Egypt's fledgling match and splint industry. These were the first logs ever to move out of the harbor, and plans for further experimental shipments are in the works. Nationally, a number of public and private export programs are being aggressively pursued (13). Fostering international markets requires the combined skills of the state's timber suppliers, its wood-based industry, and government organizations. As the demand for wood both in developing nations and the industrialized countries of Europe continues to grow, finding and developing a suitable niche in international trade is a challenge well worth pursuing.

THE PUBLIC FORESTRY SECTOR

The public forestry sector is an important participant in Minnesota's wood-based economy. As managers of more than half of the state's commercial forest lands, public agencies furnish much of the wood utilized by forest industry within the state. They also provide a wide variety of services to Minnesota citizens who value their forest lands for timber production, recreation, solitude, and as a reservoir for many kinds of wildlife.

The title to two-thirds of Minnesota's public commercial forests rests with the state; the remaining third is held by the federal government (Figure 3, Table 2). Almost half of these state-owned lands are administered by county governments. In this sense there are three distinct "publics" with whom federal, state, and county forestry agencies are concerned.

Most of the state's federal commercial forests are administered by the USDA Forest Service as part of its national forest system. Two national forests, the Chippewa and Superior, are located in Minnesota. Indian lands, held in trust by the federal government for Minnesota tribes and managed by the BIA, account for the rest of the state's federal commercial forests. These agencies report directly to the U.S. Congress for appropriations and management direction.

The Division of Forestry within Minnesota's Department of Natural Resources (DNR) administers 2.7 million acres of state-owned commercial forest land. Funding for the division is provided on a biennial basis by the Minnesota Legislature. The state's remaining commercial forests, some 2.3 million acres, are administered by land departments within county governments. These agencies report to a county board of commissioners, which performs both legislative and executive functions within each county. All of the major forested counties in the state now have land departments.

Despite the differences in legislative direction, levels of funding, and number of personnel, Minnesota's public forestry agencies share many objectives. Figure 16 presents a broad overview of the activities of these organizations. It outlines a

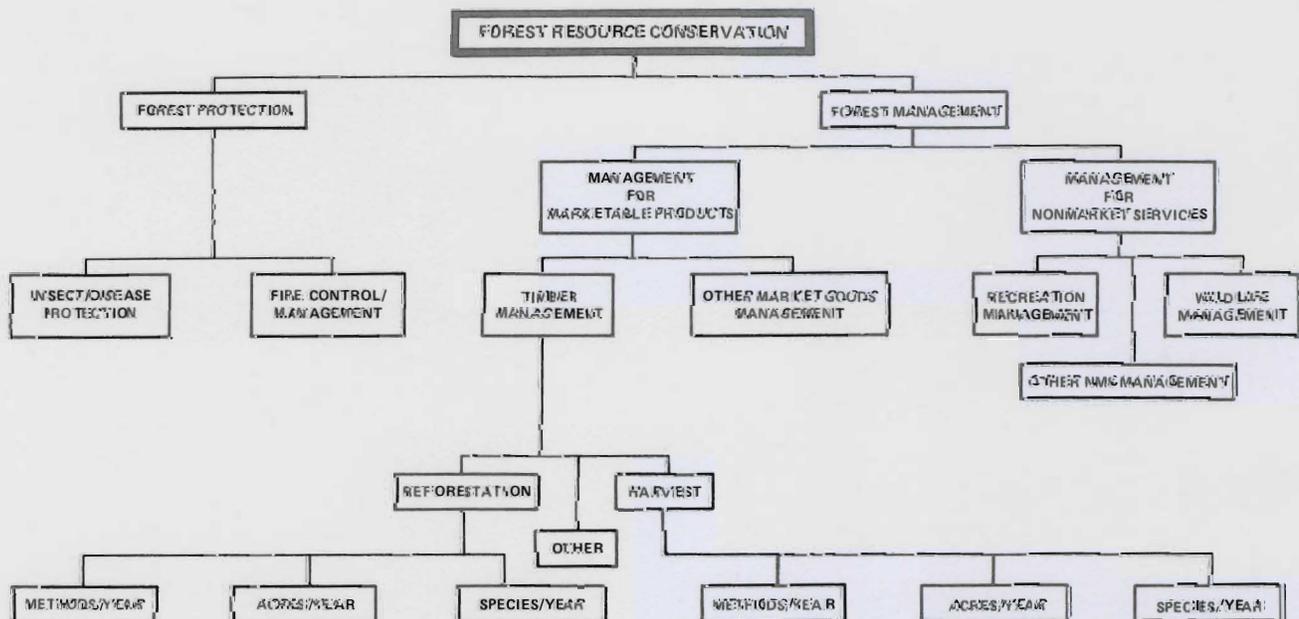


Figure 16. Goal structure of the public forestry agency. (Source: Lewis, 1984 (23).)

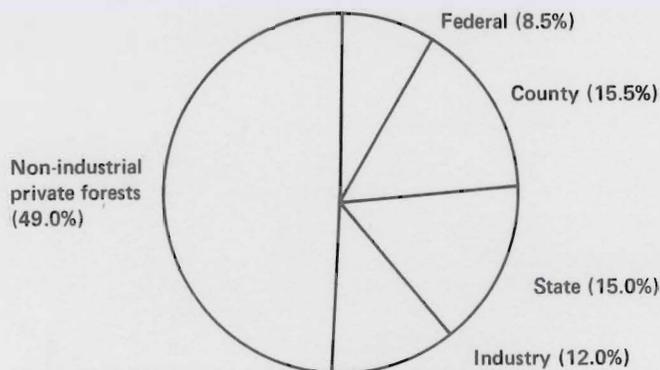


Figure 17. Minnesota timber harvest by ownership class, 1983. [Source: Minnesota Department of Natural Resources (18).]

process through which their broad legislative mandate for forest resource conservation is expressed in concrete goods and services for Minnesota citizens.

Forest protection involves insuring that the state's public and private forests are shielded from fire, insects, and disease. Forest management entails the development and execution of programs to provide both goods, to which a market value can be attached, and services, for which markets are not efficient mechanisms for exchange.

Many of the activities of Minnesota's public forestry agencies are of vital importance to the state's forest industry. In 1983, the public sector provided 39% of the industrial roundwood harvested in the state (Figure 17). One way to gauge these contributions is through a brief look at programs of these organizations and their potential benefits to the forest industry and state economic development.

The DNR Division of Forestry is responsible for managing 4.6 million acres of state-owned lands, two-thirds of which are commercial forests. The agency's St. Paul staff coordinates a field organization which divides the state into five regions, each of which is composed of two levels of smaller administrative units.

The division's activities are organized into 19 kinds of programs:

Forest Protection

- Fire Management
- Forest Pest Management

Resource Status

- Forest Resource Inventory
- Forest Soils
- Nursery and Tree Improvement
- Land Administration

Planning and Information

- Forest Resources Planning
- Forest Management Information Systems
- Economics and Statistics

Timber Resource Development

- Timber Management
- State Forest Roads

Nonmarket Resource Services

- Forest Recreation Management
- Fish and Wildlife Management

Forestry Services

- County Assistance Program
- Private Forest Management

- Utilization and Marketing
- Urban Forestry
- State Government Interaction
- Environmental Review
- Maintenance and Administration

A number of these management responsibilities directly affect the availability of wood to the state's forest industry. Others indirectly contribute to stumpage supply through their impacts on timber management conducted by other ownership classes. The division's accomplishments within this management framework developed in the 1980s are noteworthy.

State-owned forest lands provided about 400,000 cords of wood for industrial consumption in 1983. Along with this wood has come intensified timber management on state lands. With the aid of federal and state funds the division reforested more than 15,000 acres in 1983. Release treatments have benefited some 20,000 acres within the last five years (24). In 1982, the division completed a comprehensive inventory of forest roads on state-owned lands which included a prioritized list of projects for each region. Improved access to these lands will greatly aid in meeting the increased wood requirements of the state's forest industry.

Another important industrial concern pertains to the actual status of the timber resource. Since 1977 the division has been conducting an intensified inventory of all state- and county-owned forest lands in Minnesota; field work is almost completed, and all information will be fully computerized by the end of 1985. The agency has addressed other resource-related concerns by adding several new positions in forest soils, and its nursery operations are expected to become self-supporting in 1985.

The division also has made major investments in fire analysis activities in fulfilling its responsibility for providing wild-fire protection to public and private lands in forested areas of the state. It also maintains a cooperative funding arrangement with the USDA Forest Service to attain annual targets in survey, evaluation, prevention, and control of forest pests.

In addition to its wildlife and recreation management programs, conducted cooperatively with other DNR divisions, the Division of Forestry provides a number of services to Minnesota forest industry, county forestry agencies, and private forest owners. The agency's Utilization and Marketing Program is a major source of economic information on the status of the wood-based industry in Minnesota. The program identifies primary and secondary processing firms and provides them with technical assistance in such areas as sawmill operations, residue use as a source of energy, lumber grading, and marketing techniques. It is estimated that the agency's marketing efforts generate more than \$1 million in additional trade annually for the state's forest industry (4).

The division also aids county forestry agencies through its County Assistance Program (CAP). Nine foresters, funded jointly by the state and counties, are presently staffed within county land departments. In conjunction with the current inventory program on county lands, CAP has provided a major boost to county forest management in Minnesota. The division also assists nonindustrial private forest landowners within the state as an aid to improved management on those lands.

In carrying out this wide variety of activities, the Division of Forestry has made major strides in organizing the information necessary to achieve its objectives and describe its actions

to the public. Since 1980, substantial investments in automated information processing have benefited both central and field staff. The agency is currently developing a management information system; inventory, fire management, nursery accounting, and timber sales components have already been completed.

One of the most important of the division's numerous accomplishments within the last four years occurred in 1983 with the release of the Minnesota Forest Resources Plan. This represented the initial output of a permanent planning process established by law in 1982 that involves establishing a planning framework, identifying issues, assessing resources, and developing and implementing goals and programs. The plan is now being extended to field operations through a series of unit plans, the first of which was completed this year. Perhaps the most valuable contribution of this planning effort has been to provide a clearer picture of how the agency is managing the state's forests. The plan reflects a sound investment by the Legislature and citizens of Minnesota, one which promises to increase in value in the years to come.

Minnesota has more acres of county-administered commercial forest land than any state in the nation. Four-fifths of all county forest lands, some 2.3 million acres, are of commercial value. Almost all of this acreage was acquired from private individuals who forfeited land when they were unable to pay property taxes. County land departments administer these lands at the discretion of local governments headed by a county board of commissioners. Land departments represent county boards in all transactions related to the status and use of public lands within their jurisdiction, including land sales, leases, easements, and so on.

A major theme in considering the contribution of Minnesota counties to the state's forest economy is diversity. Counties vary significantly in size and distribution of forest resources. St. Louis County administers almost 960,000 acres of tax-forfeited lands, while many smaller counties manage only a fraction of that amount. Counties are diverse geographically; some have extensive acreages that regenerate naturally to aspen, while others find regeneration to be a difficult management problem. County board members differ in backgrounds and interests, reflecting the regional perspective of areas in which they have spent most of their lives. And finally, funding for county forestry programs comes from a variety of sources, increasing the uncertainty about agency budgets. In short, there is no such thing as a "typical" Minnesota county or county forestry agency.

All of these considerations translate into a forest management picture for counties that differs vastly from that for larger state and federal agencies. County agencies more than others could most aptly be described as a few professionals managing a lot of land. Staff sizes within county land departments range from 35 to 3. Given these circumstances, management has focused on timber programs that generate much-needed revenues of benefit to citizens within these less-populated regions of the state.

In 1983, Minnesota counties produced 400,000 cords of industrial wood, almost 15 percent of the state's total industrial harvest. Information from the late 1970s indicates that county timber sales account for nearly half of the total land-based revenue for county governments (26). Moreover, three-fifths of county forests are on sites capable of producing more than 50

cubic feet of wood per acre per year—the highest percentage of any ownership class in the state (26).

County forestry agencies approach their management responsibilities in a pragmatic way given the funding arrangements within which they operate. Many have developed land management plans which, while lacking the sophistication of those of the larger agencies, describe briefly and clearly the nature of the forest resource, the agency's objectives in terms of the goods and services it hopes to provide, and the ways in which it intends to do so.

County timber management programs focus on the key areas of reforestation, road development, and harvesting. Utilizing both county and state/federal funds, most land departments establish basic annual targets in the above areas. For timber this involves estimating the number of sales the agency can administer and the demand for the timber it can provide. In nine counties, CAP foresters funded jointly with the Division of Forestry contribute greatly to this process.

Most county agencies attempt to integrate wildlife and recreation management into their programs with the assistance of the DNR Division of Wildlife and the U.S. Forest Service. The Division of Forestry has provided direct assistance in the preparation of a land management plan for two counties in the state, with a third nearing completion.

County forest management in Minnesota has produced tangible results for the state's timber economy. With the aid of federal funds, county reforestation programs have increased by 30 percent within the last five years; currently counties are planting almost five million trees per year (27). Some of the larger land departments are also enhancing their management capabilities through the purchase of automated information processing equipment. Within the last three years the total number of staff positions within county land departments has increased from 60 to more than 100 (27). As county management programs become even more crystalized, rural parts of Minnesota will have an increasingly sound forest resource to complement the quality of life to which they are accustomed.

Minnesota's federal forests make up about one-fifth of the state's total forest land base. About two-thirds of these lands, some 1.7 million acres, are of commercial value. The USDA Forest Service manages most of the state's federal lands as part of a larger network of national forests throughout the country.

The Superior National Forest in northeast Minnesota administers 2.1 million acres of land, a third of which is congressionally withdrawn from commercial use and forms the Boundary Waters Canoe Area. The state's other national forest, the Chippewa, covers some 660,000 acres in north-central Minnesota.

The Forest Service is organized to respond to national objectives defined in the Renewable Resource Planning Act (RPA) of 1974. National goals for forest outputs of timber, minerals, recreation, wildlife, range, water, and wilderness are allocated to nine regions throughout the country, where they are further disaggregated in the form of specific output targets to individual national forests.

As part of a national land management agency, Minnesota national forests must respond to directives established on the basis of many events which occur beyond the boundaries of the state. National directives may provide opportunities and constraints different from those of state and local government. Nevertheless, the state's national forests are still a component of Minnesota's wood-based economy.

The Forest Service is structured along functional lines. Each national forest in Minnesota is subdivided into five to seven administrative districts which report to a forest supervisor. Staff positions generally parallel the targeted outputs noted above.

About 9 percent of the state's timber harvest in 1983 came from national forest lands. As part of a nationwide agency objective of enhancing its land management capabilities, the production of timber and other outputs from Minnesota's national forests has benefited in recent years from a large national investment in automated information systems. Although this transition has at times been difficult, the Forest Service has now computerized many of its inventory, timber sales, planning, accounting, and budgeting functions. Though in themselves not the answer to effective forest management, these systems do provide valuable tools with which to construct cost-effective programs in timber management and other areas.

In considering the contribution of Minnesota's national forests to economic development within the state, it is notable that in 1984 both forests in the state had arrived at the culmination of one of the most intensive planning processes in the nation's history of public land management. The recent release of the proposed Forest Land and Resource Management plans for the Superior and Chippewa national forests reflects an attempt by the Forest Service to provide both forest industry and the general public with a detailed picture of the organization's approach to public land management.

The Superior plan includes a proposed five-year timber sale program along with descriptions of 15 management areas within the forest with scheduled management practices, standards, and guidelines. Economic criteria used to calculate potential output levels reflect an attempt by the agency to be explicit about the costs of doing business in public forest management. Trade-off analyses have attempted to compare increases in one output with losses in another.

The Superior plan also reflects efforts by the agency to address the future supply of timber for Minnesota forest industry while fulfilling its national mandate. The Forest Service expects to be able to accommodate the demand for softwood in the future, but voiced concern over the imbalance in age structure of Minnesota's aspen resource (Figure 7). It indicated that it is able to change the composition of its timber resource to provide more aspen and still produce substantially larger volumes of timber on a sustained basis if necessary (28).

The release of land management plans by Minnesota's national forests is more of a beginning than an end to the planning process. Numerous problems remain, particularly with respect to identifying values for nonmarket services for use in quantitative modeling. Nonetheless, the plans do provide all participants within Minnesota's forestry community with a concrete picture of how the National Forests interpret their management situation, with an opportunity to provide input to that process if they so desire.

Nonindustrial Private Forest Landowners

Nonindustrial private landowners are the silent majority within Minnesota's forestry community. As of 1977 they owned almost 6 million acres or 35 percent of all forest land in the state, more than nine-tenths of which were of commercial value (12). In contrast to public and industry-owned lands,

most nonindustrial private lands are scattered across the state's rural agricultural areas and southeastern Minnesota.

Latest estimates place the number of private owners in Minnesota at about 130,000 (29). About three-fifths, accounting for 15 percent of total nonindustrial ownership, own tracts of 30 acres or less. While only one-fifth of nonindustrial owners have tracts exceeding 100 acres, these individuals own almost 45 percent of all nonindustrial private lands in the state (29).

Almost half of the wood harvested for industrial use in Minnesota during 1983 came from nonindustrial private lands (18). An obviously critical element within the state's timber economy, these owners have increased their contribution to the state's total harvest within the past few years.

Individuals have diverse reasons for owning forest lands. Some believe strongly in the value of growing, harvesting, and regenerating trees much as one would an agricultural crop. Others, such as full-time farmers, may maintain small woodlots as a reserved source of income. Many landowners close to urban areas value their forests for amenities and as a haven from the hectic urban environment. Understanding motivations for owning forest lands is one important way for both forest industry and public agencies to identify and assist those private owners to whom timber management is an attractive option.

As noted earlier, one of the functions of the Division of Forestry is to provide technical advice and assistance to nonindustrial private landowners. In conjunction with the USDA Forest Service, it is presently devoting 45 person-years of technical forestry assistance annually to Minnesota landowners. This includes the preparation of management plans and advice of timber sales and marketing, reforestation, wildlife and recreation management, and pest control. Almost 7000 landowners are assisted annually, almost twice the level in 1977 (25). The Forest Service's role in this important process is performed by its branch for State and Private Forestry (S&PF). This unit coordinates federal cost-sharing to Minnesota private landowners for activities such as reforestation and timber stand improvement.

Overall, although much has been achieved in assisting landowners improve management of their lands, much work remains to be done. The Division of Forestry estimates that combined state and federal efforts are still only able to reach about 15 percent of landowners who would likely accept assistance in managing their forests (25). A better understanding of this important segment of Minnesota's forestry community benefits both landowners themselves and the state's forestry economy as a whole.

Research and Education

Research and education form the backbone of the Minnesota industrial and public forestry sectors. Research provides resource management and production information to forestry professionals and other Minnesotans interested in the state's forest lands. Education is a rewarding experience for many who have decided upon forestry as a career, as well as for those who have participated in Minnesota's forestry community for a number of years.

The primary institution for forestry research and education in the state is the University of Minnesota's College of Forestry. The recently established Natural Resources Research Institute will also be an important participant in state forestry

research efforts in years to come. The North Central Forest Experiment Station of the USDA Forest Service complements the College of Forestry with a wide range of research activities.

The College of Forestry conducts basic and applied research and educational programs in forest resources, forest products, and fisheries and wildlife management. It is the principal unit of forest scientists in Minnesota with a specific commitment to state forestry problems. The college conducts its research activities under the auspices of the Minnesota Agricultural Experiment Station.

Currently over 60 college faculty are conducting some 90 original projects through grants and experiment station funding. Those of particular interest to Minnesota forest industry include work on forest harvesting systems, industrial structure and regional timber processing, timber demand and supply in the Lake States, technology transfer, and chemical solvent extraction systems. Other projects focus on biological aspects of timber resource management, including work on mycorrhizal inoculation of tree species, tree stand dynamics, and site productivity in southern Minnesota. A host of additional research efforts in areas such as water quality modeling, state forest practice laws, and wildlife population systems are also under way.

The College of Forestry has been involved in forestry education since 1906, and has been accredited by the Society of American Foresters since such a process began in 1935. Current undergraduate and graduate student enrollments total 400 and 120, respectively. The college also manages a 3700-acre forestry research and education center at Cloquet, Minnesota, and its Remote Sensing Laboratory, associated with the Institute of Agriculture, is among the most respected in the nation.

According to the 1983-84 Gourman Report (30), which is a service providing for the maintenance of higher educational standards, the College of Forestry ranked third among 51 institutions granting undergraduate degrees in forestry. In the same report, its graduate program was ranked second among 28 leading institutions, and its Department of Fish and Wildlife scored fifth among 88 institutions evaluated.

The forestry component of the Minnesota Agricultural Extension Service includes nine specialists staffed in the College of Forestry. Forestry, forest products, and wildlife extension specialists disseminate information and sponsor workshops and conferences frequently throughout the year. Within the last four years, forestry extension has emphasized continuing education of foresters, management of nonindustrial private forest lands, wood energy, marketing, and small wood products firms.

Among these areas, particular emphasis has focused upon providing increased assistance to private forest landowners. Programs include an annual woodland owners conference, a highly successful forestry correspondence course, technical workshops and seminars for landowners at various locations around the state, and programs for Christmas tree and maple syrup producers.

The North Central Forest Experiment Station of the USDA Forest Service is one of a network of eight research stations nationwide. It is charged with conducting forestry research for seven states in the Upper Midwest, including Minnesota. The station focuses on timber management, forest products and engineering, fire management, forest insects and disease, eco-

nomics research, and wildlife and recreation management. Eight of its research work units are located in Minnesota.

Since completing Minnesota's fourth statewide forest inventory in 1977, the station's forest inventory work unit has produced a variety of summaries depicting the status of the state's forests in terms of acreages by ownership, condition classes, volumes, and numerous other descriptive categories. Annual reports of the state's wood production by various product categories also provide both Minnesota forest industry and public agencies with a valuable picture of many aspects of economic activity within the state's wood-based sector.

The station's regional economics unit has been tracking stumpage prices for Minnesota wood for the past twenty years, and conducts other research related to harvest scheduling, red pine management, and wood residue utilization. The forest ecosystems unit has conducted extensive analyses of tree growth models suitable for use in the Lake States. The Forest Service's STEMS and TWIGS models were developed and tested using a database with over 4,000 plots and 80,000 trees.

Activities within the station's other work units include substantial research on intensively cultured plantations for biomass and energy production; Lake States tree genetics; hardwood processing systems; water quality management in Northern forests; and ecology and culture of aspen, birch, and conifers (31).

Many other research efforts not included here also contribute to the emerging information base for Minnesota forestry. They arise from both the natural and social sciences, mirroring the changes which forestry in the state has experienced within the last two decades. Education and training will continue to play a major role in how well Minnesota forestry adapts to new challenges and opportunities in the coming years.

LOOKING AHEAD

This brief picture of Minnesota forestry and its wood-based economy has been far from exhaustive. Many others—including public agencies, industry and landowner associations, and consultant organizations—contribute to the state's forestry sector. A major impetus in recent years has arisen through the efforts of the Minnesota Legislature, which with the passage of the Minnesota Forest Management Act of 1982, set in motion many of the activities described in this paper.

In summary, several implications for Minnesota's forest industry and the forestry sector seem to emerge from the preceding pages. The industry's potential for increasing its contribution to Minnesota economic development depends on:

- an active search for enhanced economic linkages both within and outside Minnesota;
- steps to organize the vast amount of information available in some way relevant to the task at hand;
- cooperation by all participants within the state's forestry community.

These three themes have been the focal points of the Governor's Conference on Minnesota Forestry Industry, and they will continue to embody new challenges and opportunities for all Minnesotans as a century of progress fades into history and a new one emerges.

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