

CHAPTER VI

The Forest Resource Base

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Summary

The U.S. forest resource is quite adequate to meet expected domestic demand for wood products. U.S. forests also could supply expanded international wood markets or unexpected increases in domestic demand if existing technologies for growing, harvesting, and processing wood are widely applied. If demand increases without corresponding adoption of such technologies, however, land resource constraints could arise. These potential constraints include the declining size of the forestland base, private nonindustrial forest ownership patterns, and other uses for forestland that may conflict with industrial wood production.

The U.S. forestland base is declining in size and further reduction is anticipated in the next 50 years, but how much it will decline is uncertain. The Forest Service estimates that 27 million acres of commercial forestland were lost between 1962 and 1977. This drop from 509 million acres to 482 million acres represents a 5-percent reduction over the period. A primary reason for the decline was the conversion of private forestland to agriculture and development. Also, some commercial acreage on Federal land was reclassified as wilderness and is no longer available for timber production. The decline was visible in all regions, but was largest in the south, which lost 12 million acres. By 2030, the Forest Service projects that commercial forests will decline further to 446 million acres, chiefly because the conversion of private nonindustrial land to other uses may continue.

The exact magnitude of the national trend towards a decline in commercial forestland is not certain, because up-to-date field surveys were not available in most States when the Forest Service acreage estimate was made in 1977. While individual State forest surveys are highly reliable, they are only conducted every 12 years on the average. As a result, when the

1977 estimate was compiled, forest surveys in 22 States predated 1970. The Forest Service adjusted some of these surveys, but not on the basis of field data; other pre-1970 surveys were used without adjustment. Consequently, the 1977 composite figure may not fully reflect the diversion of forestland to agriculture and urban uses that took place during the 1970's and may not reflect some shifts back to forestland. Some post-1977 State surveys published by the Forest Service show far higher rates of decline in commercial forestland acreage than listed in 1977, while others show moderate increases.

Divergent estimates of non-Federal forestland by the Forest Service and the Soil Conservation Service (SCS) need to be clarified or resolved if Congress is to receive consistent information in congressionally mandated assessments of land resources. The Forest Service and SCS, both Department of Agriculture (USDA) agencies, collect data on forestland, but SCS efforts are limited to non-Federal lands and do not differentiate between commercial and noncommercial forests. For 1977, the SCS survey showed 74 million acres less non-Federal forestland than the Forest Service estimate and a more rapid rate of decline. The Forest Service figure was reported to Congress in the 1980 assessment required by the Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974, while an assessment for the parallel Soil and Water Resources Conservation Act (RCA) of 1978 used the SCS figure.

Much of the discrepancy arises from different classifications of forest-range ecosystems that are not of importance to industrial timber supplies. The remainder of the discrepancy is due in part to different procedures, methodologies, and judgments about classification of currently forested land that is in or near built-up areas. In addition, all of the SCS data was collected in the 1975-77 period and may

reflect some land use changes not captured by the Forest Service estimates.

The Forest Service and SCS currently are in the process of developing a common non-Federal acreage figure for use in future assessments of renewable resources. Preliminary activities include identifying areas of disagreement between the two agencies on a State-by-State basis. As this report went to press, the agencies' were still developing revised acreage estimates at the national level.

The net effect of an acreage overcount, if it exists, is uncertain. On the one hand, an overcount of forest area could cause an upward bias in estimates of current and projected growing stock volumes. On the other hand, Forest Service estimates about growth rates and management intensity are conservative and consequently may bias the estimates downward (see ch. IV for a discussion of projection methods).

More up-to-date information about forestland acreage and ownership is needed in Forest Service data used for the periodic assessment and program required by RPA. The long interval between State surveys is a major cause of uncertainty about national forestland data. The interval is probably too long to meet the periodic reporting requirements of RPA, and it may explain some of the discrepancy between Forest Service land data and that of the SCS. Recent cooperative initiatives by the Forest Service, other Federal agencies, and State agencies, such as "midcourse" survey updates in key timber-producing States, may help to improve the timeliness of information. More detailed data about forest land ownership, especially in the southern United States, could also improve the information available to decisionmakers.

Rapidly increasing residential use of wood for fuel is a major new influence on the U.S. wood situation, but it is so recent that its precise effects are hard to determine. Home fuelwood use may have both positive and negative ramifications for forest resource management. For example, fuelwood harvesting could complement timber management by removing

"weed" trees. If poorly done, however, fuelwood harvesting could conflict with timber management by removing trees that are more valuable for industrial uses. If wood demand continues to grow and prices rise significantly, competition in the roundwood market could intensify between industry and homeowners.

The magnitude of these effects is difficult to analyze. Recent Forest Service and Department of Energy estimates of residential fuelwood use for 1981 are seven to eight times greater than those the Forest Service issued for 1976. Preliminary Forest Service figures indicate that about 27 percent of the residential fuelwood cut by landowners comes from trees that potentially contain sawlogs and pulpwood. It is not known what proportion of purchased fuelwood comes from industrial growing stock.

Predictive capabilities about tradeoffs between timber production, environmental values, and other forest uses need to be improved. Timber production both affects and is affected by rising demand for many other economic, social, and environmental uses and values that forestland provides. Both public and private forests are critically important for recreation, wildlife habitat, watershed management, soil conservation, environmental quality, landscape esthetics, and other purposes. While timber production often is compatible with all of these purposes, and while land management strategies can be designed to achieve multiresource objectives, tradeoffs among resource values are inevitable.

Water pollution and soil erosion can result when timber management and harvesting are conducted without adequate attention to proper safeguards. Increased levels of timber harvesting also could intensify conflicts with other land uses such as agriculture, recreation, wilderness, and wildlife.

The diversity of conditions on U.S. forests complicates the analysis of such effects beyond specific sites, but the capacity to trace and predict multiresource interactions at the State or regional level is improving as more information becomes available. Current efforts by the Forest Service and others to develop

models of these interactions could improve understanding of resource tradeoffs involved in increasing timber production on both public and private lands.

Forest industry lands have high potential for increasing national timber supplies. The recent trend on industry lands has been away from “extensive” rudimentary forest practices and toward more intensive management, which probably will bring higher productivity in the future. Despite this trend, however, some industry forests are not managed intensively.

The forest industry is in a favorable position to increase yields on its lands for several reasons. First, industry lands on the average are naturally more productive than land in other ownerships, and tracts are large and tend to be located close to mills. Second, the large forest products firms, which own most of the industry land, ordinarily have access to capital for major management investments. Third, timber production is the primary ownership objective of these firms. Although the size of the industrial land base is no longer increasing at the rate it once did, intensive timber management could enlarge the forest industry’s contribution to U.S. timber supplies significantly.

There is an opportunity for nonwood-based corporations to play a more important role in private forestland timber production. Several financial firms recently have offered investment opportunities in private nonindustrial forestland. The impact of such investments on forest management and ownership is still unknown, but significant capital may become available for intensive timber management if these investment programs continue to grow.

In addition, USDA landownership data suggests that nonwood-based corporations have major forestland holdings. These properties may enjoy some of the same advantages as forest industry lands in terms of their potential for increased production. More information about nonwood-based corporate holdings would be desirable to assess their possible contribution to U.S. wood supplies.

Private nonindustrial forest (PNIF) lands contribute nearly half of the industrial wood used in the United States, and their increased contribution can be expected as new local markets develop. Opportunities for more intensive timber management on PNIF lands exist but are complicated in some cases by ownership patterns and financial considerations.

The forest products industry obtains 47 percent of its roundwood from PNIF lands, which account for 58 percent of the U.S. commercial forestland base. In the South, about 60 percent of the region’s wood comes from PNIF lands.

Net annual growth on PNIF lands has been increasing more rapidly than on other ownerships, and this growth rate could double PNIF output by 2030 if current trends continue. On the whole, therefore, PNIF lands can be expected to enlarge their contribution to domestic timber supplies without substantial increases in timber management activities. Far higher supply levels could be achieved through intensive management, but there are impediments to making such investments.

Lack of certainty about future markets, particularly in the North where hardwoods predominate, may discourage small landowners from investing in timber management activities that may not provide returns for decades. Also, many PNIF owners are unwilling to assume risks such as fire, weather damage, insects, disease or other catastrophes when safer, shorter term nontimber investments are available.

Changes in land use and ownership also may affect long-term management investments on PNIF lands. The total acreage of these lands is declining, especially in the South, due to competition from other uses, and further decline is expected in the future. Since PNIF lands change hands rapidly, only a small proportion is likely to be under single ownership for the length of time needed to grow a tree crop. Some PNIF lands are in parcels too small for economical management. Parcellation may be increasing in some locales, but regional and national data is fragmentary and inconclusive,

Nonfarmers have replaced farmers as the dominant owners of private nonindustrial forests. These new owners have less predictable ownership objectives, but in some cases they may have investment capital available for timber management.

Impediments to PNIF management may not be as great as many observers traditionally have believed. In general, higher timber output can be expected even if management levels remain the same. Still, some PNIF holdings offer appreciable opportunities for more intensive management. The cost effectiveness of limited public funds available for PNIF management incentives could be improved if directed towards those lands with the highest management potential. The forest products industry, through landowner assistance programs and long-term leasing agreements, may be even more important than government in putting management capital into PNIF lands.

While existing law provides some flexibility for temporary increases in timber harvest on Federal lands, statutory changes could be required if more acreage is to be allocated to

timber production. Over the long run, however, more intensive timber management of lands already open to timber production could increase national wood supplies significantly. Harvest levels on national forests are set by a "nondeclining even flow" policy intended to ensure sustained yields in perpetuity, although temporary departures from this policy are legal under certain circumstances. For instance, a 1979 Presidential directive called for accelerated updating of land management plans for some national forests to increase the harvest of mature timber. Because of the simultaneous nontimber uses mandated by Federal law, however, major statutory changes could be required to open more Federal forestland to timber production than is currently allowed. Some Federal forestland, such as tracts being studied for possible wilderness designation, is in an indeterminate status regarding its potential availability for timber production. Nevertheless, more intensive management on lands now allocated to timber harvest could increase production, provided political and budgetary constraints are eased,

Characteristics and Productivity of U.S. Forests

The United States ranks third among the nations of the world in exploitable forest-acreage and growing stock (table 22). * U.S. forests are highly productive, providing more industrial wood than any other country, including the Soviet Union, which has 3½ times more growing stock than the United States.

The suitability of U.S. forestland for timber is enhanced by favorable climatic conditions, especially in the Southern States, which result in greater annual growth and faster timber regeneration than in Canada or the U.S.S.R. Mature timber can be grown in 30 to 40 years in the South, for instance, while production of

similar tree crops in parts of Canada or the U.S.S.R. may take two to three times longer.

There are well-developed transportation and manufacturing systems in the most heavily forested regions of the United States. In contrast, countries like Brazil and the U.S.S.R. Would require significant investments in transportation before exploitation of remote interior forests even could begin. The majority of American processing facilities are located in the two most important timber areas—the Pacific Northwest and the South—which are accessible to the major markets of Japan and Western Europe. The United States also has a large number of different forest ecosystems that provide a wide variety of commercially important softwood and hardwood species (fig. 21).

*No standardized international definitions are used by countries to identify exploitable forest areas. Some countries use more conservative criteria than others. Canada recently reduced its estimate of its exploitable forestland area significantly.

Table 22.—Countries With Largest Forested Areas

	Exploitable forest area (million ha) ^{ab}	Growing stock (million meters ³ over bark) ^c		Industrial harvest (billion ft ³) 1977	
		Total	Coniferous		Broadleaved
U.S.S.R.	389	74,710	62,000	12,710	10.0
Brazil	305	47,088	98	46,990	1.5
United States	195	20,132	12,906	7,226	11.5
Canada	191	19,645	15,571	4,074	5.1

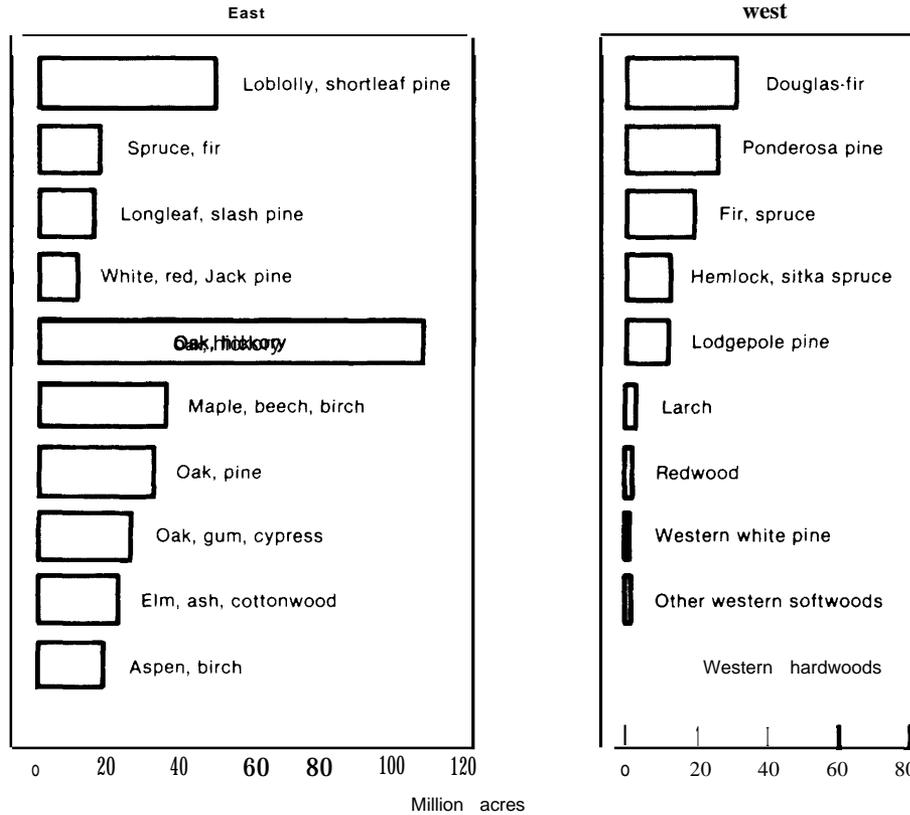
^aExploitable forest definitions differ by country. Some countries such as Canada have restrictive definitions that result in conservative estimates of exploitable forestland. Volume estimates for the U.S.S.R. include growing stock on some 110 million acres considered to be unproductive forestland.

^b0 convert hectares to acres, multiply by 2.471.

^c0 convert cubic meters to cubic feet, multiply by 35.31.

SOURCES: United Nations Food and Agricultural Organization, *Yearbook of Forest Products, 1979* (Rome, 1981), G. M. Bonner, Canada's *Forest Inventory 1981* (Environment Canada, 1982), United Nations Environment Program/Food and Agricultural Organization, *Los Recursos Forestales de la American Tropical* (Rome, 1981), United Nations Economic Commission for Europe, *European Timber Trends and Prospects, 1950 to 2030* (Geneva, 1976), U.S. Department of Agriculture Forest Service, *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D.C. 1982).

Figure 21.—Commercial Timberland Area by Type, 1977



SOURCE: U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D.C. U.S. Government Printing Office, 1982), p. 122.

Reversing a historical trend toward apparent depletion, U.S. timber inventories have been increasing since at least 1952. Growth patterns are uneven, however, with irregular patterns in land clearing, tree planting, and harvesting causing waves or bulges in the distribution of tree sizes and species. Most increases in timber inventories have been in hardwood species, but most increases in timber demand in the past 20 years have been for softwoods. Although preferred species generally are in shorter supply than less valuable trees, and regional trends differ, higher levels of timber harvesting are biologically sustainable on U.S. forestlands.

Trees that are already growing will be the predominant source of industrial wood for the next 30 to 50 years. This is because of the long length of time required for tree crops to mature. However, if intensive timber management systems (applications of planned treatments to forestland aimed at increased production of industrial roundwood) are widely adopted, more timber could be available for harvest in the long term. In theory, "economic opportunities" for management intensification are promising. In particular, studies by the Forest Service and the Forest Industries Council have identified substantial opportunities for management investment in 25 States.¹ These investments would be expensive to make (\$10 billion to \$15 billion over 30 to 50 years, the course of a single rotation) but would boost growth tremendously.

Extent of Domestic Forests

Before the colonization of America, forests covered about half of the 2.3 billion acres that span the United States. Until 1800, removals of the original forest cover were relatively minor, but the westward expansion of the 19th century brought the clearing of nearly 300 million acres for farming, settlements, and other uses.² Timber generally was considered a nuisance

and cleared land was often worth more than land supporting large timber stands. Regional cycles or waves in the amount of forest acreage have been significant; in some areas, in the past 200 years, forestlands more than once have been cut, used for agriculture, and again allowed to revert to woods.

The rate of decline of U.S. forestland leveled off around 1920, although slight declines continued through 1940. From 1940 to the early 1960's, acreage then increased slightly, because of farm abandonment and reversions of fields to forests in the Southeast, Northeast, and the upper Great Lakes States. During the late 1950's and early 1960's, the Federal soil bank program (now suspended) stimulated forestland expansion by encouraging farmers to plant trees on cropland. Since 1962, forestland area again has declined somewhat—chiefly because of expanded agricultural and developmental uses.

Today, only about one-third of the United States is forested (fig. 22), with the acreage divided about equally between the East and the West. This area—736 million acres in 1977—includes some land that is sparsely stocked with trees or otherwise unsuited for industrial timber production.

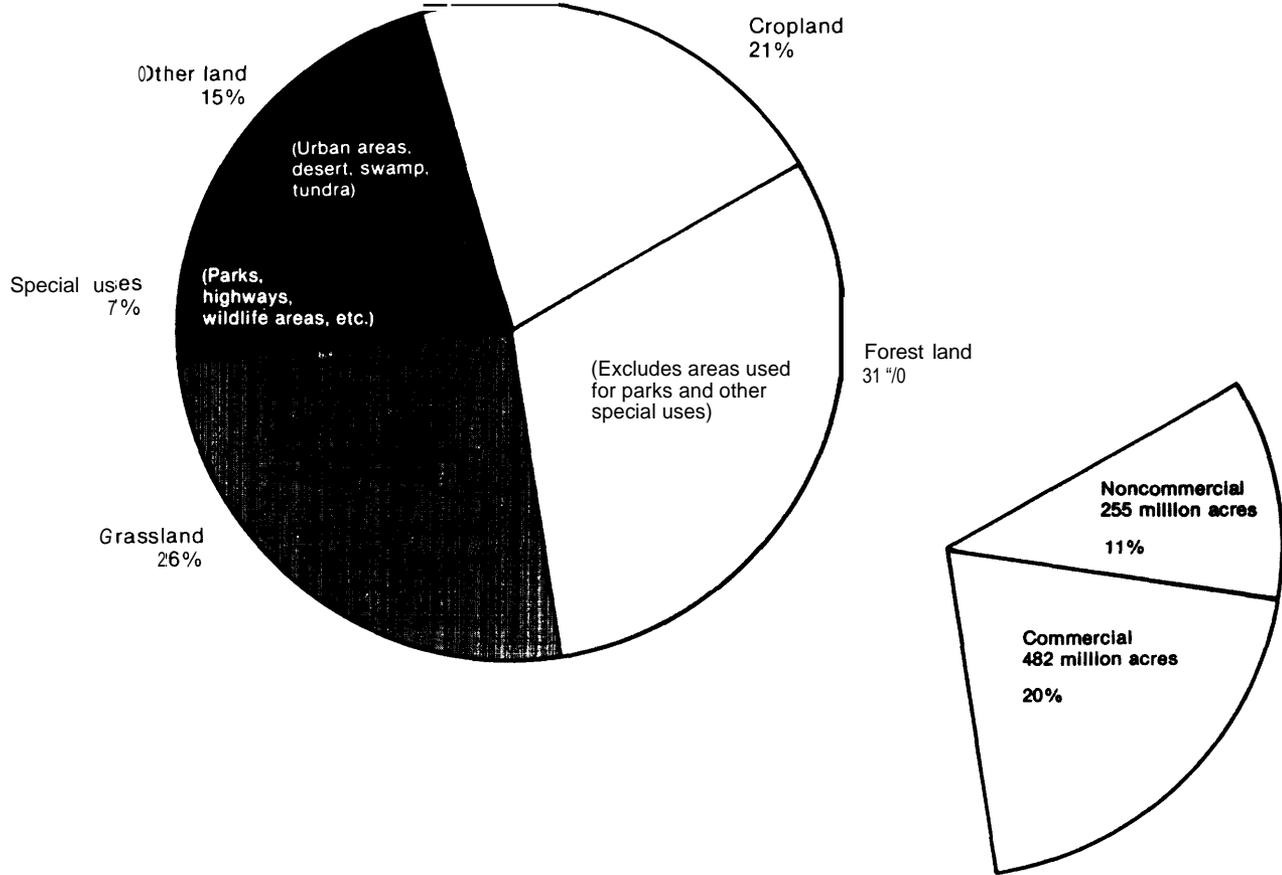
About two-thirds or 482 million acres of the total forestland area is classified by the Forest Service as "commercial." The commercial classification includes all forestland that is capable of growing 20 cubic feet (ft³) of industrial wood per acre annually in natural stands and which has not been withdrawn from timber harvesting by statute or administrative action. Non-commercial forestland may produce fuelwood and some timber, but is generally not important for industrial forestry.

The commercial forest designation does not imply that all or even most of this land currently is used to supply timber markets. Only about 14 percent of the commercial base is owned by the forest products industry, the single group for which timber production is unequivocally the primary ownership objective (table 23). Twenty-eight percent is publicly owned and generally is managed for multiple uses including recreation, wildlife habitat enhance-

¹ Forest Industries Council, *Forest Productivity Report* (Washington, D. C.: National Forest Products Association, 1980); and U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States, 1952-2030* (Washington, D. C.: U.S. Government Printing Office, 1982), pp. 246-255.

² Marion Clawson, "Forests in the Long Sweep of American History," *Science*, June 15, 1979, pp. 1168-1174.

Figure 22.—Major Uses of Land in the United States, 1978^a



^aThe estimates shown in this figure were derived by using several data sources, and may differ in some instances from other published data.
 SOURCE U S Department of Agriculture, *Major Uses of Land in the United States, 1978* (Washington, D C U S Government Printing Office, 1982)

Table 23.—Area of Commercial Timberland in the United States, by Owner Class and Region, 1977

Owner class and region	Million acres ^a of total	Percent of total
National Forest	86.7	18.4
Other public	47.0	9.7
Forest industry	68.7	14.3
Farm and miscellaneous private	278.0	57.6
Total	482.4	100
North	166.1	34.4
South	188.0	39.0
Rocky Mountains	57.8	12.0
Pacific coast ^b	70.5	14.6
Total	482.4	100

^aTo convert acres to hectares, multiply by 0.4047

^bIncludes Alaska

SOURCE Adapted from Brian R. Wall, *Trends in Commercial Timberland Area in the United States by State and Ownership, 1952-1977, With Projections to 2030* (Washington, D C U S Government Printing Office, 1981), p 10

ment, and watershed protection in addition to timber production. Fifty-eight percent of the commercial base is PNIF held by over 7 million owners with diverse objectives and management capabilities. Although most PNIF land is not owned primarily for timber production, nearly half of the industry's wood supplies come from this acreage.

Regionally, the South has the most commercial forestland and makes the greatest contribution to nationwide timber supplies (table 23). The Pacific coast supplies the most softwood. Although the North has about one-third of the commercial acreage, the forest products industry is less developed there than in the South or on the Pacific coast.

Variation in Productivity of Forestland

Nearly all forestland in the Eastern United States (93 percent) meets the commercial standard for productivity. In other words, it is capable of producing the Forest Service's designated minimum of 20 ft³/acre/year in natural stands. In the Rocky Mountain and Pacific coast regions respectively, only 42 and 33 percent of the forestland area is considered commercial. The lower proportion of Western commercial acreage arises mostly from the pervasiveness of low productivity forests, such as pinyon-juniper in the Southwest and mixed conifers in interior Alaska. Administrative restrictions on timber management on Federal land also play a role.

Natural productivity also varies greatly within the commercial timberland classification (fig. 23). About 28 percent of the commercial forestland is capable of growing 20 to 50 ft³/

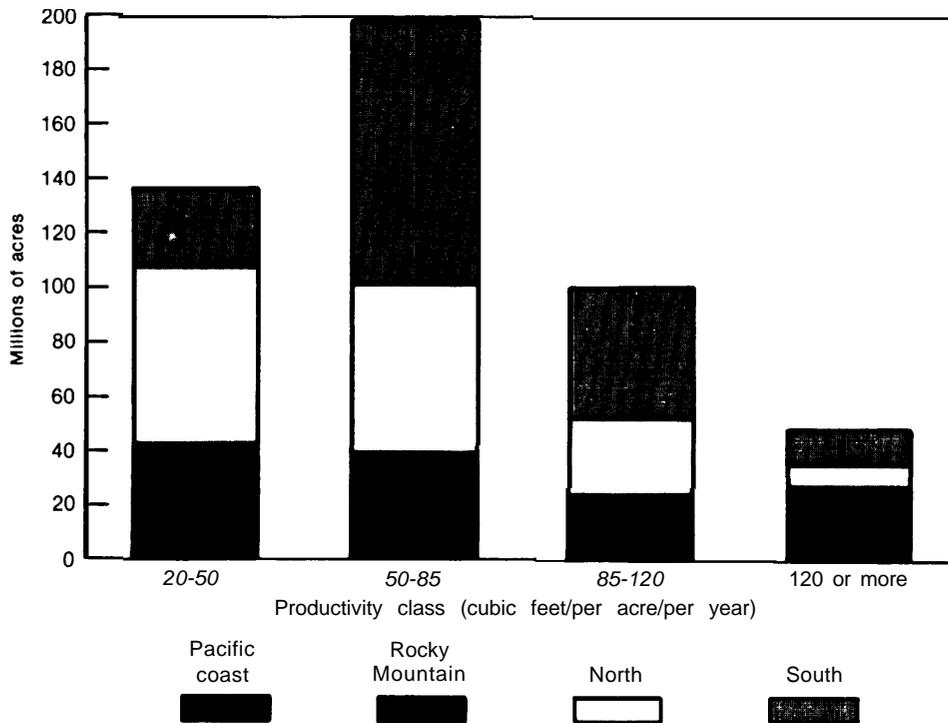
acre annually. This low-quality acreage may provide timber and fuelwood, but ordinarily it is not well suited for intensive timber production. Another 40 percent is in an intermediate range of productivity at 50 to 85 ft³/acre/year.

The remaining 30 percent of commercial forest is "prime timberland" capable of producing 85 ft³ or more of industrial wood per acre per year in natural stands. All else being equal, management investments on such lands will be more cost effective than investments on less productive lands. In 1970, nearly 48 percent of the productive capacity of all commercial forests was on the 34 percent of the commercial forest base that was considered prime timberlands

Even within the prime category, there is a wide range in productivity. Some forestland in

³U.S. Department of Agriculture, Forest Service, *USDA Prime Forestlands Program*, Mimeograph, May 23, 1977, p. 3.

Figure 23.—Commercial Timberland Area by Productivity Class and Region, 1977



SOURCE: U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States, 1952-2030* (Washington, D.C.: U.S. Government Printing Office, 1982), pp. 350, 355.

the Pacific Northwest is naturally capable of producing 225 ft³ of wood per acre per year. Thus, the productive capacity of such lands without intensive management is 10 times greater than the productivity of marginal commercial forestland, and nearly three times greater than land on the threshold of qualification as "prime timberland."

The distribution of prime forestland also varies among ownership classes (table 24). As a general rule, forest industry lands include proportionately more land in the better site classes than public or private nonindustrial forestland. This is especially true in the West, where two-thirds of the forest industry's holdings are prime lands and nearly half of them are capable of producing over 120 ft³/acre/year.

Table 24.—Area of Commercial Forestland in Site Classes Capable of Producing 85 Cubic Feet of Wood per Acre or More, by Ownership, in 1977

	Million acres ^a	As a proportion of acres in ownership category (percent)
National Forests	27.0	30.4
Other public	11.5	24.5
Forest industry	30.3	44.0
Farm, miscellaneous	77.4	27.8
All ownerships	146.2	30.3

^aTo convert acres to hectares, multiply by 0.4047

SOURCE Adapted from U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States, 1952-2030* (Washington, D.C. 1982), pp. 350-359

Decline in Commercial Acreage

The Forest Service estimates that commercial forestland declined by about 5 percent between 1962 and 1977—from 509 million acres to 482 million acres. Most of this decline resulted from diversion to other uses, such as agriculture, urbanization, and wilderness; some is attributed to reclassification of land. The decline in acreage represents a reversal of an earlier trend toward a slight increase in forestland that occurred between 1920 and 1952. Although pressures on forests are expected to continue, less rapid declines in forest acreage for the coming decades are projected by the Forest Service and other resource analysts (table 25).⁴

Most of the 1962-77 nationwide decline was in private forests owned by farmers or other nonindustrial parties. Some of this private land was purchased by the forest products industry, whose holdings increased by about 7 million acres during the period, making the net decline in private holdings about 19 million acres. Na-

⁴Brian R. Wall, *Trends in Commercial Timberland Areas in the United States by State and Ownership, 1952-1977, With Projections to 2030*, General Technical Report WO-31 (Washington, D.C.: U.S. Government Printing Office, April 1981), p. 7. For discussion of agricultural competition for forestland, see Thomas N. Schenartz, "Dynamics of Agricultural Land Use Change," *Agricultural Land Availability: Papers on the Supply and Demand for Agricultural Land in the United States* [Washington, D.C.: U.S. Government Printing Office, July 1981], pp. 187-216.

Table 25.—Area of Commercial Timberland in the United States, by Owner Class and Section, 1952, 1962, 1970, 1977, and Projections to 2030^a (million acres)

Owner class and section of United States	1952	1962	1970	1977	Projections				
					1990	2000	2010	2020	2030
National Forest	94.7	96.9	94.7	88.7	81.3	80.4	79.8	79.2	78.8
Other public	49.0	46.8	46.9	47.0	46.6	46.5	46.4	46.4	46.4
Forest industry	59.5	61.6	67.0	68.7	70.9	72.2	72.7	73.0	73.1
Farm and miscellaneous private	296.1	304.1	287.8	278.0	268.8	261.8	256.1	251.5	247.9
Total	499.3	509.4	496.4	482.4	467.6	460.9	455.0	450.1	446.2
North	168.8	170.9	168.6	166.1	164.2	162.5	160.9	159.1	158.5
South	192.1	199.9	192.5	188.0	182.5	179.7	177.2	175.2	172.9
Rocky Mountains	63.9	64.4	62.1	57.8	56.2	55.2	54.1	53.6	53.0
Pacific coast ^b	74.5	74.2	73.2	70.5	64.7	63.5	62.8	62.2	61.8
Total	499.3	509.4	496.4	482.4	467.6	460.9	455.0	450.1	446.2

^aData for 1952 and 1982 as of Dec 31, other years as of Jan 1

^bIncludes Alaska

SOURCE U.S. Department of Agriculture, Forest Service, *Trends in Commercial Timberland Area in the United States 1952-77, With Projections to 2030* (Washington, D.C. 1981), p. 10

tional forest acreage also declined by 8.2 million acres as a consequence of wilderness designations and other administrative actions that preclude timber harvesting. Most of the Forest Service land that shifted to noncommercial purposes was in the low productivity range (between 20 and 50 ft³/acre) and was thus of marginal value for timber production.

The greatest regional decline in commercial forestland was in the South, the Nation's fastest growing region between 1970 and 1980.⁵ Here, about 12 million acres were diverted to other uses between 1962 and 1977 according to the Forest Service. In particular, the South's "prime timberland" declined very rapidly—a matter of special concern because of the region's importance to national timber supplies. Between 1970 and 1977, the decline was about 6 million acres—a 10-percent reduction in the region's prime acreage in 7 years. Loss of prime timberland apparently exceeded the region's total timberland loss for the period, which was 4.7 million acres, because some poorer quality land reverted to forest during the same timeframe.

Shifts between agriculture and forestry probably will continue to be the major factor influencing forestland acreage, although the extent is unclear. Rapid changes in agricultural land requirements have made it extraordinarily difficult to project long-term interactions between forestland and cropland. Projections made in the 1960's and early 1970's, when grain surpluses were common, assumed that cropland needs would decline due to improved yields per acre. During the 1970's, however, expanded world demand for U.S. food, together with the lifting of farmland set-aside programs by the Federal Government, led to a very rapid expansion of cropland. Projections by the U.S. National Agricultural Land Study (NALS) made in 1979-80 assumed that cropland requirements would expand rapidly and would accelerate conversion of forestland to agricul-

tural use. Specifically, NALS concluded that most of the 31 million acres of forestland that have a high or medium potential for crop production could be cleared and converted to crop use by 2000. Most of this converted land presumably would be commercial forestland, and two-thirds of it would be located in the South. Some agricultural land reverts to forest each year, but generally is not stocked with commercially important species.

Since the NALS study was published in early 1981, the agricultural situation has again changed dramatically. In the 1980-82 period, enormous grain supplies similar to those of the 1960's developed once more, and the Reagan administration instituted a payment-in-kind (PIK) cropland set-aside program for eligible farmers. In 1983, under the PIK program, agriculture activities on 82 million acres of cropland will be restricted to eligible conservation uses during the growing season.

Urban and other developmental uses such as water reservoirs also will affect the forestland base. For the first time in memory, populations in rural areas grew at a faster rate than in metropolitan areas between 1970 and 1980, chiefly as a result of in-migration of people to non-metropolitan counties. This shift occurred in all regions of the country, including high wood production areas.

Out-of-Date Forest Surveys

Forest Service acreage estimates are based on periodic State forest surveys, which, at the time they are taken, are the most reliable and consistent sources of information available. However, because they are conducted in individual States only on an average of every 12 years, many surveys are out-of-date by the time they are used to assess nationwide trends; this was the case in 1952, 1962, 1970, and 1977.

The 1977 national estimate of commercial forestland, used for the 1980 assessment required under RPA and for subsequent analyses

⁵For discussion of southern land use conflicts and their relationship to the forest products industry, see Robert G. Healy, "Land in the South: Is There Enough to Satisfy Demands," *Conservation Foundation Letter*, September 1982; and Schenartz, "Dynamics of Land Use Change," *op. cit.*

⁶U.S. National Agricultural Lands Study, *Final Report (Washington, D.C.: U.S. Government Printing Office, 1981)*, pp. 8-10, p. 13.

of timber supply and demand trends, exemplified this timing problem. In 1977, the most recent forest survey had been conducted prior to 1970 in 22 States. The Forest Service reported some of these estimates without change in compiling its 1977 data; in other instances, revisions were made, but these were riot based on field data and consequently carry a higher likelihood of error. Forest surveys completed after 1977 show important differences with the acreage figures issued in 1977.

Budgetary and political constraints underlie the Forest Service's difficulty in increasing the frequency of forest surveys. Congress, through the Forest and Rangeland Renewable Resources Research Act of 1978 (Public Law 95-307), recognized that adequate information was a key component of RPA planning. While Congress initially provided expanded funding for surveys, current budget cuts may slow the survey schedule again. To overcome some of the scheduling problems, in some States, the Forest Service and State agencies have cooperated in producing "midcycle updates." Another option would be to give greater survey priority to the most important timber producing States and to those where rapid changes in inventories and acreage are expected.

Soil Conservation Service Estimates of Non-Federal Forestland

In addition to the Forest Service, SCS also compiles data on non-Federal forest area. SCS does not distinguish between commercial and noncommercial forestland, in contrast to the Forest Service. SCS's estimate of non-Federal forest area in 1977 was 74 million acres less than the Forest Service's estimate for the same year. Both figures were reported to Congress by USDA in 1980. The higher Forest Service estimate was part of the 1980 assessment required by RPA, while the lower SCS figure was reported in the 1980 assessment for the parallel Soil and Water Conservation Act.

The two USDA agencies are working to resolve this discrepancy and have agreed to use common forestland acreage figures in future assessments. Nevertheless, the situation

demonstrates some of the difficulties in providing decisionmakers with accurate national level data on natural resources,

According to the Forest Service, non-Federal forestland amounted to 451 million acres, including noncommercial forestland, in 1977. According to SCS, which does not distinguish between commercial and noncommercial forestland, only 377 million acres were non-Federal forestland in 1977.⁷

Nearly half the difference is attributable to the fact that SCS classifies some transitional forest-range ecosystems as rangeland, while the same land is called forest by the Forest Service. As much as 35 million acres of transitional land may be involved, according to a report prepared for the U.S. National Agricultural Lands Study in 1980.⁸ Most of this land would not be considered commercial forestland by the Forest Service's definition.

Additional differences are attributable to the fact that SCS includes more forestland in its "urban or built up" classification than does the Forest Service, and some land may be classified as native pasture by SCS but forestland by the Forest Service. The timing problems associated with uniform reporting of Forest Service data at a given date may partially explain some of the difference. The 1967-77 period witnessed major land use changes in agriculture and development that could be expected to affect forestland, and Forest Service estimates may not fully reflect these. The 1977 SCS inventory data, on the other hand, was compiled in a 2-year period and estimates were based solely on field data. Several technical difficulties have been identified with the SCS field data, how-

7. U.S. Department of Agriculture, Forest Service, 411 *Assessment of the Forest and Range Land Situation in the United States* (Washington, D. C.: U.S. Government Printing Office, January 1980), table 2.3, p. 35; U.S. Department of Agriculture, *Soil and Water Resources Conservation Act of 1980 Appraisal Part I* (Washington, D. C.: U.S. Government Printing Office, 1981), p. 49.

⁸Ernest McGill, Allen Hidlebaugh, and Joseph Yovino, "Federal Data on Agricultural Land Use," *Agricultural Land Availability: Papers in the Supply and Demand for Agricultural Lands in the United States*, prepared for the U. S. National Agricultural Lands Study and printed for use of [J. S. Senate Committee on Agriculture, Nutrition, and Forestry, [Washington, D. C.: U.S. Government Printing Office, July 1981), table 1, p. 246.

ever, which may have resulted in overstatement of the magnitude of shifts in land use during the 1970's.

As this report was going to press, the two agencies appeared close to reconciling key differences associated with their 1977 estimates. *

Anticipated Further Declines in Forest Acreage

To estimate long-term timber supplies, assumptions must be made about the amount of forestland that will be available in the future. Predicting future land use trends is still little more than guesswork. The magnitude of recent trends affecting forestland, such as increased diversion of forestland to agriculture and developmental uses, was not anticipated by analysts in the 1960's. Current analysis is equally subject to uncertainty.

There is little surety that the dramatic land use changes that occurred in the 1970's will be repeated. The 1981-82 recession, which brought slumps in housing demand and slackened growth in world markets for U.S. food, presumably has reduced conversion pressures on forestland. If agricultural surpluses keep mounting, forestland acreage could begin to increase as agricultural land is retired from production. Such land, if allowed to naturally revert to forest, probably would be poorly stocked with commercial tree species. However, if government programs such as the soil bank of the late 1950's and early 1960's were reinstated, planting of commercial species on land that is now cropped could result.

Based on trends through 1977, it is reasonable to assume that forestland will continue to be diverted to other uses. The Forest Service projections used in modeling long-term timber supplies show commercial forestland declining at a net average rate of about 700,000 acres annually over the next 50 years. This projected 36 million acre net decline would reduce the

commercial forestland base by about 7.5 percent from what it was estimated to be in 1977.⁹

The Forest Service anticipates that most of the decline would result from conversion of private nonindustrial lands to other uses. Commercial land on national forests would decline slightly due to wilderness designations, while commercial industry lands would increase somewhat. All regions of the country would experience a decline in commercial forest, but the most significant decline would be in the South (table 25).

The projected decline is less than half the rate of decline measured by the Forest Service in the 1962-77 period, but it is consistent with the longer term trend seen in Forest Service statistics between 1952 and 1977. There are some technical difficulties with this projection due to the out-of-date information used in the 1977 baseline data. Recently completed State surveys in Arkansas and Michigan, for example, show that 1977 RPA forestland acreage projections in those States were overstated. The 1978 survey in Arkansas showed that commercial forest acreage in the State had already declined to the level that had been projected for 2010.¹⁰ Arkansas' 1977 projection was based on the State's 1969 survey, but Arkansas forestland was greatly affected by expanded soybean production in the mid-1970's, a change apparently not incorporated into 1977 projections. The preliminary 1980 Michigan forest survey data shows present commercial acreage to be about what was projected for the period from 2010 to 2020.¹¹

Close monitoring of forestland acreage is needed in the coming years. A revived economy coupled with potential renewed growth in agricultural exports could produce a more rapid decline in commercial forest acreage

⁹Wall, *Trends in Commercial Timberland Areas in the United States*, op. cit., p. 9.

¹⁰The projected level of decline, based on 1969 data, is in *Ibid*, p. 17. The new survey is in William W.S. Van Hees, *Arkansas Forests: Trends and Prospects*, Forest Service Resource Bulletin SO-77 (Washington, D. C.: Government Printing Office, 1980). Arkansas forests declined 9 percent between 1969 and 1978.

¹¹Cited in W. Brad Smith, "Michigan Forest Inventory Fieldwork Completed," *Northern Logger and Timber Processor*, April 1982, pp. 20-22.

*Shortly after OTA released a review draft of this assessment, the Forest Service and the Soil Conservation Service moved rapidly to resolve their differences. Agreed upon statistics for State by State and national non-Federal forestland acreage were expected to be released shortly as the report went to press.

than has been projected. If the 1962-77 trend extended through the year 2000, commercial acreage would decline by 41.4 million acres rather than by the projected 21.5 million acres.

Availability of Commercial Forestland for Intensive Management

Merchantable trees eventually may be harvested from most commercial forestland. As a practical matter, however, only part of the forestland base is worth special management treatment. Since some lands are better suited for such investment than others, the issue has arisen on how to direct limited public incentives and private investment capital to acreage offering the most cost-effective intensive management opportunities.

Factors affecting a tract's suitability for intensive management include:

- management profitability;
- parcel or stand size;
- market proximity;
- landownership objectives;
- accessibility; and
- site specific variables such as natural productivity and slope.

To demonstrate the information systems needed to portray the interaction among these factors, OTA asked the Forest Service's South-

east Forest and Range Experiment Station to screen its data on private nonindustrial commercial forestland. The Southeastern Station operates the Forest Information Retrieval System (FIR)—a sophisticated system that is able to cross-reference inventory data for the five Southeastern States on local, county, State, and regional levels without double-counting acreage. Low productivity, lack of accessibility, and other factors were assumed to limit the feasibility of tree planting and silvicultural activities. Although these factors are likely to impede intensive management activities, the specific criteria chosen (such as exclusion of tracts of 10 acres or less) are somewhat arbitrary and may not necessarily preclude economical management in all circumstances.

Of the 64 million acres of private nonindustrial lands in the region, only 34 million acres were not affected by the selected management-constraining factors. The 30 million acres of affected lands currently contain 40 percent of the region's PNIF softwood growing stock and 50 percent of the hardwood growing stock. This land can be expected to provide timber, but silvicultural activities on the affected lands would presumably be less cost effective than investments on nonaffected lands (table 26). The FIR analysis does not include ownership objectives or financial limitations on management and therefore is not a complete picture

Table 26.—Screening of Land-Related Management Constraints on Private Nonindustrial Forestland in the Southeast

Step	Description	Maximum PNIF discount			Residual		
		Commercial forest (acres)	Growing-stock volume (thousand cubic feet)		Commercial forest (acres)	Growing-stock volume (thousand cubic feet)	
			Softwood	Hardwood		Softwood	Hardwood
1	Total area and volume	—	—	—	87,999,537	49,040,888	53,279,042
2	Minus public and forest industry holdings	—	—	—	64,089,209	34,670,624	40,649,933
3	Minus remaining stands on poor sites (site 5)	10,523,496	3,289,981	3,666,237	53,565,713	31,380,643	36,983,696
4	Minus remaining stands 10 acres or less	14,673,950	8,557,411	7,429,750	40,936,396	23,516,864	30,072,922
5	Minus remaining stands that are inaccessible	668,975	298,788	804,547	40,512,090	23,330,665	29,384,892
6	Minus remaining stands with difficult operability	6,857,375	2,383,606	7,663,517	36,434,599	22,036,160	23,959,028
7	Minus remaining stands in strips, stringers, and strands	4,017,883	1,582,757	5,259,451	33,787,967	21,099,625	20,184,492
8	Minus remaining stands that are poorly stocked	12,696,671	1,998,743	3,142,848	28,890,905	20,188,588	18,826,225

SOURCE Data and table provided by the U S Department of Agriculture, Forest Service, Southeastern Forest Experiment Station

of the factors needed for a comprehensive assessment.

The screening described illustrates the capabilities of advanced information systems to provide refined data about forestland management opportunities. Broader application of such systems could provide decisionmakers with a more realistic picture of feasible goals both regionally and nationally.

A better national assessment of the management potential of U.S. forestland ultimately may require a modified conceptual framework as well as additional data. One possibility, proposed by resource economist Marion Clawson, would be to incorporate economic and environmental considerations into site class designations.¹² Three classes of commercial forestland could be established:

1. Class A—lands capable of producing at least 85 ft³/acre per year in natural stands, able to yield a 10-percent return on management investments in real terms, and posing no serious environmental problems;
2. Class B—50 to 85 ft³/acre/year, less than 10-percent return on investment, and no serious environmental problems; and
3. Class C—less than 50 ft³/acre/year, and/or serious environmental or other constraints that would preclude commercial operations. Other analysts have proposed similar classification systems, although the specifics differ.

The growing importance of fuelwood also points to a need to redefine commercial forestland. In some areas, rising fuelwood use has increased demand for wood growing on lands that are marginal for producing industrial roundwood. In the Southwest, for example, large areas of pinyon-juniper classified as non-commercial are being utilized for energy production.¹³ Hence, it may be necessary in the

¹²Marion Clawson, "An Economic Classification of U.S. 'Commercial' Forests" *Journal of Forestry*, November 1981, pp. 727-730.

¹³See Michael L. Samuels and Julio L. Betancourt, "Modeling Long-Term Effects of Fuelwood Harvests in Pinyon-Juniper Woodlands," *Environmental Management*, vol. 6, pp. 505-575, for discussion.

future to take into account both industrial and nonindustrial commercial uses for wood when assessing commercial forestland.

Growing Stock Volumes

The Forest Service estimated that commercial growing stock* in 1976 amounted to over 710 billion ft³.¹⁴ Softwood species, currently preferred for most high-volume wood uses, comprise about two-thirds of the stock; hardwoods comprise one-third.

About half the softwood volume is in the Pacific coast region; the South and the Rocky Mountain areas each have about one-fifth of the softwood growing stock, while the North has about 10 percent (fig. 24). Over 90 percent of the hardwood stock is in the Eastern United States—half in the North, 40 percent in the South. The South, therefore, has a high proportion of both hardwood and softwood volumes. Even though only one-fifth of the Nation's standing softwood volume is in the South, the region accounts for more than half the annual growth of softwoods.

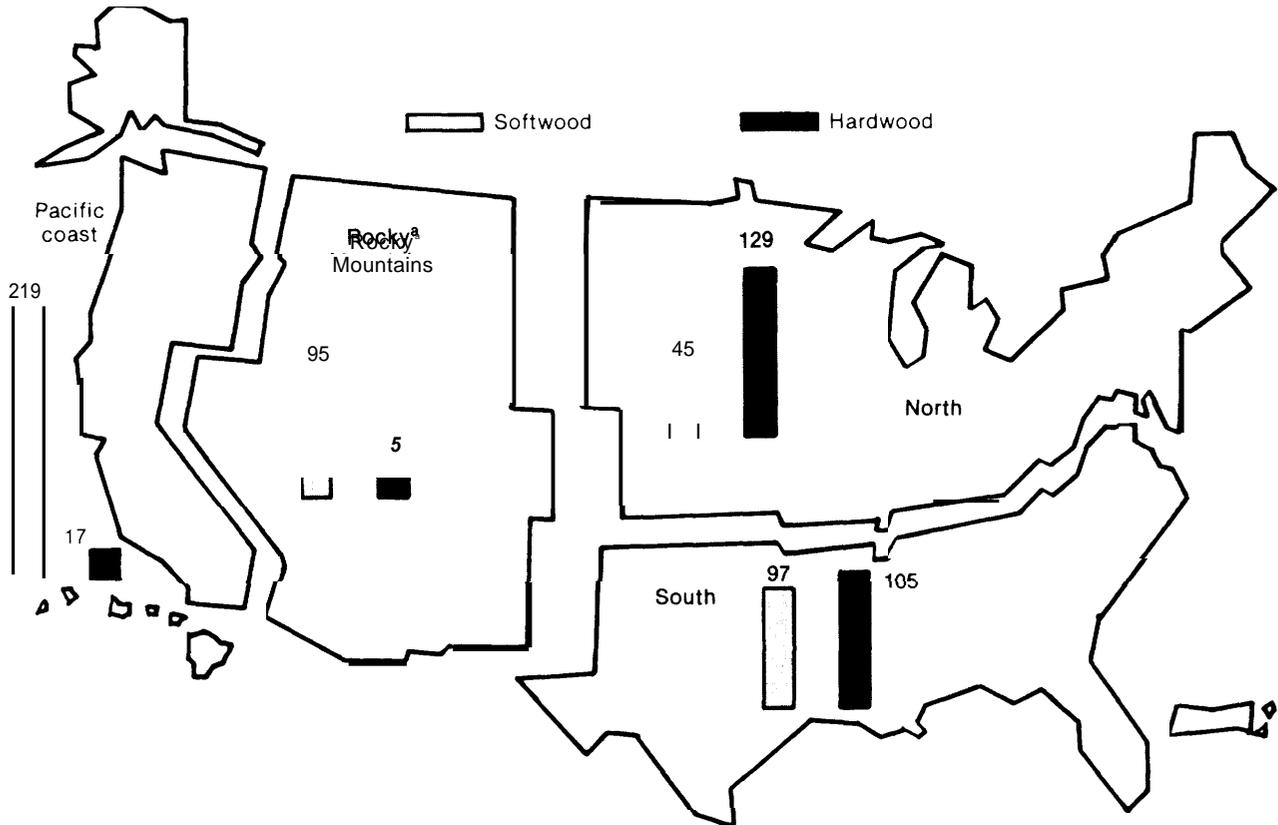
Ownership of inventories varies significantly by region. About 56 percent of the softwood inventory is in public ownership, primarily in the old-growth stands of the western national forests. The forest products industry currently owns relatively small volumes of sawtimber in the Pacific Northwest, because most old-growth has been cut; many of these harvested areas now support rapidly growing second-growth stands. Most growing stock in the South is located on private nonindustrial lands and a lesser amount on forest industry lands.

Current efforts to manage forestland are aimed primarily at increasing the area in softwood species or in reducing the hardwoods among existing softwood stands. Emphasis on softwood management is largely a function of the higher demand for softwood timber, the resulting higher value of such wood and projections of its increasing economic scarcity.

* Net volume of live sawtimber and pole timber trees from the stump to a minimum 4 inch top of the central stem or to the first limbs.

¹⁴*Analysis of the Timber Situation*, op. cit., p. 182.

Figure 24.—Timber Inventories by Region, 1976 (billion cubic feet)



^aData for Kansas, Nebraska, North Dakota, and eastern South Dakota included in the North

SOURCE U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D.C.: U.S. Government Printing Office, 1982), p. 158

Much less attention has been given to hardwood management because hardwood growth in general greatly exceeds removals. Desirable and undesirable hardwood species may be intermixed in a stand, thus complicating harvesting and processing. In many hardwood forests, "high grading"—removal of high-value trees—has left mature stands of hardwood species that are currently undesirable from an industrial perspective.

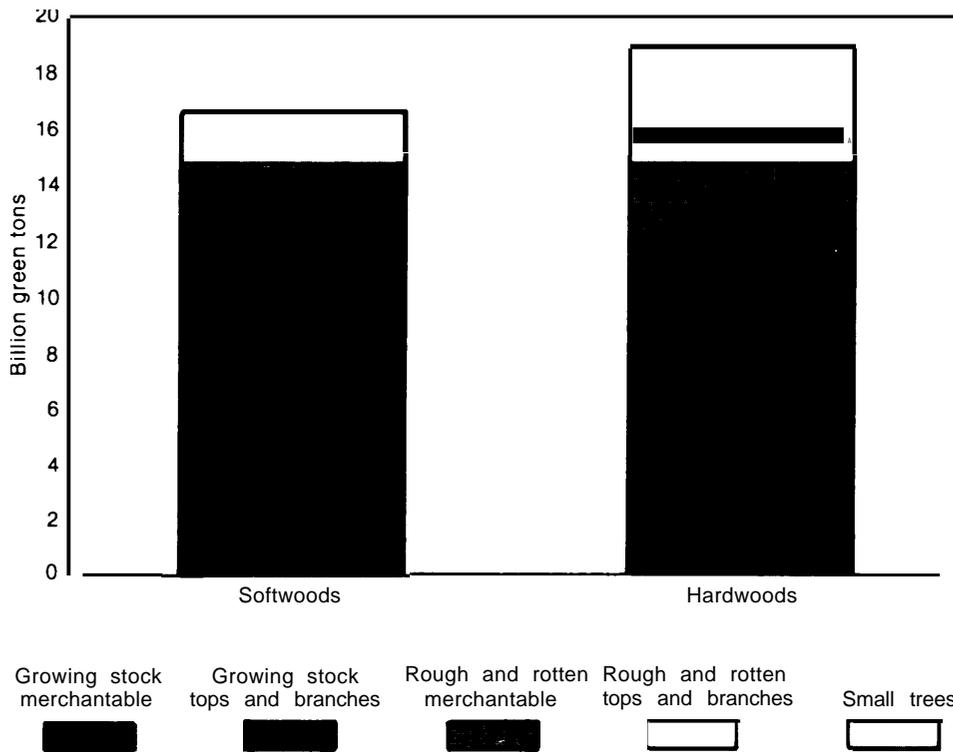
Growing stock volumes comprise only part of the potentially usable woody biomass in forests. Nongrowing stock sources—limbs, tops, and rotten and small trees—currently account for 7 percent of softwood and 14 percent of hardwood industrial wood supplies and also are important for fuelwood. Technological ad-

vances in harvesting such as whole tree chippers that convert the entire above-ground portion of trees into chips, may expand the importance of nongrowing stock sources of wood, as may fuelwood demands and manufacturing processes able to use wood chips,

In 1980, the Forest Service established a National Tree Biomass Compilation Committee to gather more precise information about potentially usable above-ground woody biomass [growing stock plus nongrowing stock wood). Preliminary national estimates of tree biomass were issued in late 1981¹⁵ (fig. 25).

¹⁵U.S. Department of Agriculture, Forest Service, *Tree Biomass—A State of the Art Compilation*. General Technical Report WO-33 (Washington, D.C.: U.S. Government Printing Office, November 1981).

Figure 25.— Biomass on Commercial Forestland



SOURCE Derived from U.S. Department of Agriculture, Forest Service, *Tree Biomass—A State of the Art Compilation* (Washington, D. C. U. S. Government Printing Office, 1981), p. 5

Because of economic constraints, as well as possible harm to soil, wildlife, and future tree growth, however, only a portion of the non-growing stock biomass actually could be utilized.

Resource Implications of Increased Wood Fuel Demand

The effects of the recent growth in demand for wood fuel (discussed in detail in ch. IV) on the Nation's forest resources are difficult to predict. Continued growth in wood fuel consumption presents both opportunities and problems for timber management.

It is clear that supplies of woody biomass in domestic forests could sustain higher levels of fuelwood use than at present without affecting industrial wood supplies. The Office of Technology Assessment's 1980 report, *Energy From Biological Processes*, concludes that the biolog-

ical capacity exists to produce between 4 and 10 quadrillion Btu (Quads) of energy per year—two to four times current levels—mostly through utilization of wood wastes, logging residues, dead wood, management thinning, etc.¹⁶ The Forest Service's 1981 biomass inventory also showed large quantities of potentially available biomass that could be utilized without affecting merchantable portions of trees.

Fuelwood for residential use already has re-emerged as an important timber crop in some areas. A sustained market for residential fuelwood could have positive effects on industrial wood supplies if properly managed. It could stimulate timber stand improvement activities on private nonindustrial forests, for example, because trees of little current commercial value are often suited for fuelwood. This

¹⁶*Energy From Biological Processes* (Washington, D. C.: U.S. Congress, Office of Technology Assessment, OTA-E-124, 1979), p. 24.

could enhance growth of the remaining trees by reducing crowding, an important problem on some forestland. Harvesting residues, which are normally left behind in the forest where they can increase the cost of regeneration as well as create fire hazards, are now sometimes removed for fuel.

However, there are no guarantees that fuelwood harvesters will confine their removals to trees that are of little value to the forest products industry. In some areas, markets for fuelwood already are stronger than for industrial roundwood. Many fuelwood harvesters may be unconcerned about restricting removals to nonindustrial timber and may harvest trees that are more valuable as nonfuelwood. This is less likely to be a problem with high-value mature trees than for young trees that could provide high-value forest products if left to mature.

In addition, a large number of inexperienced fuelwood harvesters could exacerbate environmental damage to forestlands. Improper harvesting can result in increased water pollution, soil erosion, and damage to fish and wildlife habitat. Only about 12 percent of homeowners who cut fuelwood from their own land in 1981 consulted a professional forester, according to the Forest Service.¹⁷

Clearly there is a need for more information about fuelwood use and its ramifications for forest management. Current levels of residential fuelwood use (40 million to 43 million cords annually) are several times higher than estimated by the Forest Service for 1976 (6 million cords per year) and greatly surpass levels initially projected for 2030 (26 million cords). Although a Forest Service Forest Products Laboratory study, to be published soon, has improved the understanding of key aspects of residential fuelwood harvesting (see box F), it is not yet clear what proportion of residential fuelwood is coming from commercially important forestland or what kinds of trees (industrial

quality, nongrowing stock, or rough and rotten trees) predominate in fuelwood harvests.

Nontimber Values of Forestland

Domestic forestland serves a wide variety of uses in addition to timber production (table 27). These uses include watershed and soil protection, fish and wildlife habitat, grazing, landscape esthetics, and recreation. Also, significant energy and mineral resources are found on domestic forestland, both public and private.

Conflicts between timber production and other land uses, such as wilderness preservation, are unavoidable to some extent. Commercial timber management and harvest necessarily disturb natural forest ecosystems, although the degree of disturbance varies greatly depending on the practice used, site conditions, and the care that is taken to minimize harm. For example, silvicultural application of herbicides, pesticides, and fertilizers, if not properly done, can adversely affect water quality, fish, and wildlife. Timber harvest and associated logging roads and skidding activities disturb the soil and often lead to increased soil loss and sedimentation of streams, at least temporarily. Erosion problems may continue if stand regeneration is not accomplished promptly. Stand conversion to different species also radically alters the previous natural ecosystem.

Interactions among the various objectives of forest management are often complex. Some land uses such as grazing can interfere with timber growth if improperly handled, but are compatible with timber production if precautions are taken. Timber production can improve some kinds of wildlife habitat by producing increased forage after harvest, but other kinds of wildlife, such as those that are dependent on mature forests for habitat, may be adversely affected. In general, however, forestlands can be managed to produce a mixture of economic and noneconomic values important to society even though some tradeoffs cannot be avoided.

Multiple use management has long been a key tenet of national forest policy and also is

¹⁷U.S. Department of Agriculture, Forest Service, "Residential Fuelwood Use in the United States: 1980-81," draft research paper, Forest Products Laboratory, March 1983.

Box F.—Wood Fiber for Fuel

Fuelwood (or firewood), once the primary source of heat for American homes and businesses, was relegated to footnote status in most government energy reports prior to the 1973 oil embargo. The post-embargo rise in fuelwood use was so rapid that adequate estimates of residential fuelwood consumption were not available until surveys were conducted in 1980-81 by the Forest Service and the Department of Energy. The unexpectedly high levels of fuelwood use in the last few years raise significant forest management issues and are intensifying competition between homeowners and the forest products industry in some areas.

The following are among recent findings related to wood fuel:

- According to preliminary statistics prepared by the Forest Service Forest Products Laboratory, residential fuelwood usage during the 1980-81 heating season amounted to 42.1 million cords. By contrast, the total forest products industry harvest of pulpwood in 1979 amounted to 86 million cords.
- Thirty million cords of the residential fuelwood was self-cut by the user; the rest was obtained from mill residues or purchased. About 27 percent of the self-cut wood came from industrially merchantable trees. It is not known what proportion of the mill residues or purchased cordwood came from industrially merchantable trees.
- Millions of Americans are now harvesting wood for residential fuel. Some 3.9 million households cut fuelwood from their own land. In addition, 3.4 million other households cut fuelwood from private land they do not own.
- An estimated 12 percent of those who cut from their own land stated that they cut their wood based on the advice of a professional forester.
- About 11 million cords of residential fuelwood were acquired, averaging 1.5 cords per purchase, at \$85 per cord. Variations in both volume and price paid were great, with those buying larger quantities paying less per cord, and those buying smaller quantities (less than a third of a cord), reportedly paying typically more than twice the average—\$193 per cord.
- Fuelwood permits for national forests have increased tenfold in the last 10 years, and legal removals have increased from 400,000 to 4 million cords. National forest administrators are trying to manage fuelwood harvests, but there are severe problems with fuelwood thefts. The number of reported thefts increased over sixfold between 1971 and 1980, and these thefts are considered one of the top three law enforcement problems in the National Forest System.
- Wood fuels are beginning to be utilized by commercial and industrial establishments that are not part of the forest products industry. A recent nationwide study which compared wood-fired systems to energy production based on other fuels has found that wood energy systems are in many cases economically attractive. Wood fuels are particularly competitive in the South, the Northeast, and the North Central region, especially for residential and small industrial applications.
- A recently released American Paper Institute study concluded that the burning of waste paper in municipal powerplants will present major competition for recyclable fiber (now accounting for 25 percent of the fiber requirements of the paper industry) in coming decades. Waste paper exports, which constitute a major share of U.S. wood fiber exports, also maybe affected if municipal burning accelerates.
- International trade in wood fuels, long thought impractical, is now being contemplated seriously in some areas. Shell International reportedly expects trade in densified wood fuels to develop in the Far East. And Minnesota and the Seaway Port Authority of Duluth are examining the prospects for exporting wood fuels from that State.

Table 27.—Classification of Renewable and Nonrenewable Resources

Resource	Kind of management required	Time required to replenish consumptive use
Herbage (livestock)	Intensity of grazing must be balanced with annual growth	One year
Fish and wildlife	Varies with species that are desired. Habitat must be protected, created, or enhanced for the species desired	Generally less than 10 years
Endangered species (alive)	Critical habitat must be protected, enhanced, or created	Preservation of habitat requires no time, creation of habitat may take a few years to hundreds of years
Water	Control sources of pollution, some modification of quantity possible by manipulating vegetative cover	Generally less than 10 years unless the hydrologic balance has been drastically disturbed
Timber	Replanting unforested areas, silvicultural practices to increase growth rates	Thirty to over a hundred years
Landscape esthetics	Varies with values and objectives, in relation to timber harvest generally involves restriction of harvest in areas of high recreation use, reduction in size of clear cuts	Tens to hundreds of years (higher end to establish wildernesslike esthetics)
Wilderness	Withdrawal from other consumptive uses, restriction of use intensity to preserve wilderness condition	Usually hundreds of years to reestablish once wilderness environment has been disturbed
Soils and watersheds	Protection and preservation	Thousands to tens of thousands of years to reestablish equilibrium after drastic disturbance
Minerals	Control rate and efficiency of use	Millions to hundreds of millions of years
Endangered species (extinct)	Generally none, unless possible to reestablish species through genetic breeding	New species may evolve to replace niche left by extinct species, but the loss of the gene pool is usually irreversible

SOURCE Off Ice of Technology Assessment



Photo credit: U.S. Forest Service

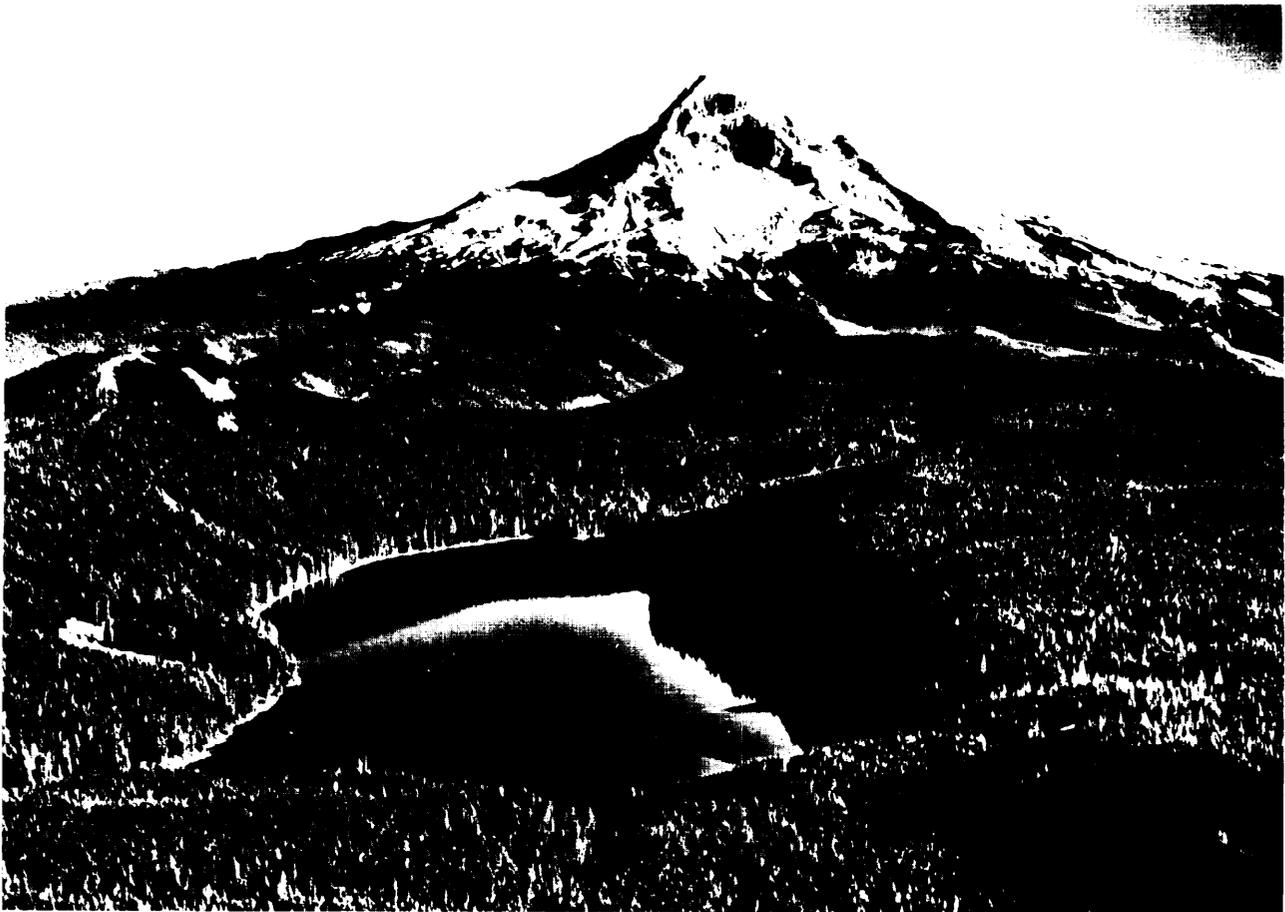
Tree plantation can help prevent erosion while also providing landowners with income. This farm was badly gullied by erosion before loblolly pine plantings were begun in the mid-1940's on the hill sides. By the early 1960's, the owners were able to harvest some of the pine for pulpwood.

applied in some other Federal, State, and local forest systems. The Forest Service's RPA assessments call for increased production of both timber and nontimber resources from national forest lands.

Lands owned by the forest products industry and by some States are managed primarily to produce timber, but other objectives such as wildlife and recreation also may be included. Multiple use resource management is less often a goal of private nonindustrial landowners, but they too have numerous opportunities for it. For example, less than 15 percent of eastern forestland with grazing potential is now being grazed, according to the SCS. The recreational potential of private acreage also is far greater

than is currently realized. In a limited number of cases, forests can serve pollution control objectives, such as in the application of treated sewage sludge to forestland. When properly conducted, sludge applications enhance growth by providing important plant nutrients without appreciable environmental damage or health hazards.

Some forestland functions are difficult to quantify in economic terms. The importance of the forest in hydrologic regimes and in minimizing soil erosion has been understood for over a century. Many of America's most scenic areas are forested. Designated wilderness areas, most of which are on Federal lands, are critical for recreation and scientific



M N m O

research and increasingly are being recognized both as a national and global heritage of immeasurable long-term value.

Because of wide variation in site conditions, it is hard to generalize about the nationwide or regionwide effects that increased timber production would have on other forestland values. In the 1980 RPA assessment, the Forest Service introduced a model to show some of these interactions (table 28). An important

characteristic of the model is that it permits different assumptions to be used about resource management while quantifying potential effects on other resources. A more refined model is expected to be used in the 1985 assessment. Such efforts, by developing realistic portrayals of future effects on domestic forests of increased timber production, can help decision-makers understand resource tradeoffs.

Table 28.—Multiresource Interactions in the Southeast Resulting From Meeting Projected Timber and Range Grazing Demands

Item	Units	1977	1985	1995
Projected demands:^a				
Softwood timber	Billion cubic feet	—	2.42	3.06
Hardwood timber	Billion cubic feet	—	1.01	1.35
Range grazing	Million animal unit months	—	18.10	21.50
Resource use and environmental effects:				
Dispersed recreation use	Percent change from 1977	—	10.1	-4.0
Herbage and browse	Percent change from 1977	—	6.0	16.0
Wild ruminant grazing	Percent change from 1977	—	-0.3	2.0
Water yield	Percent change from 1977	—	0.4	1.0
Sediment	Percent change from 1977	—	89.0	116.0
Storm runoff	Percent change from 1977	—	0.3	0.1
Intensity of land resource used:				
National Forest lands:^b				
Extensive use ^c	Percent of area	89	77	72
Intensive use ^c	Percent of area	11	23	28
Other Federal lands:				
Extensive use ^c	Percent of area	98	91	89
Intensive use ^c	Percent of area	2	9	11
State and private lands:				
Extensive use ^c	Percent of area	78	70	65
Intensive use ^c	Percent of area	22	30	35

^aProjected demands as shown in the review draft of the 1980 RPA assessment
^bIn this multiresource interaction analysis the areas recommended for wilderness or further planning by the RARE II process were considered wilderness
^cThe land resource use is said to be intensive if one or more of the timber, range, or wildlife activities of the resource management options are intensive. Timber activities are defined as intensive if intermediate treatments between regeneration and harvesting are conducted. Range activities are defined as intensive if practices, mainly species conversion, are made to maximize livestock forage production. Wildlife activities are defined as intensive if vegetative manipulation practices are undertaken to improve wildlife habitat. If none of the three activities are intensive, the use is considered extensive.

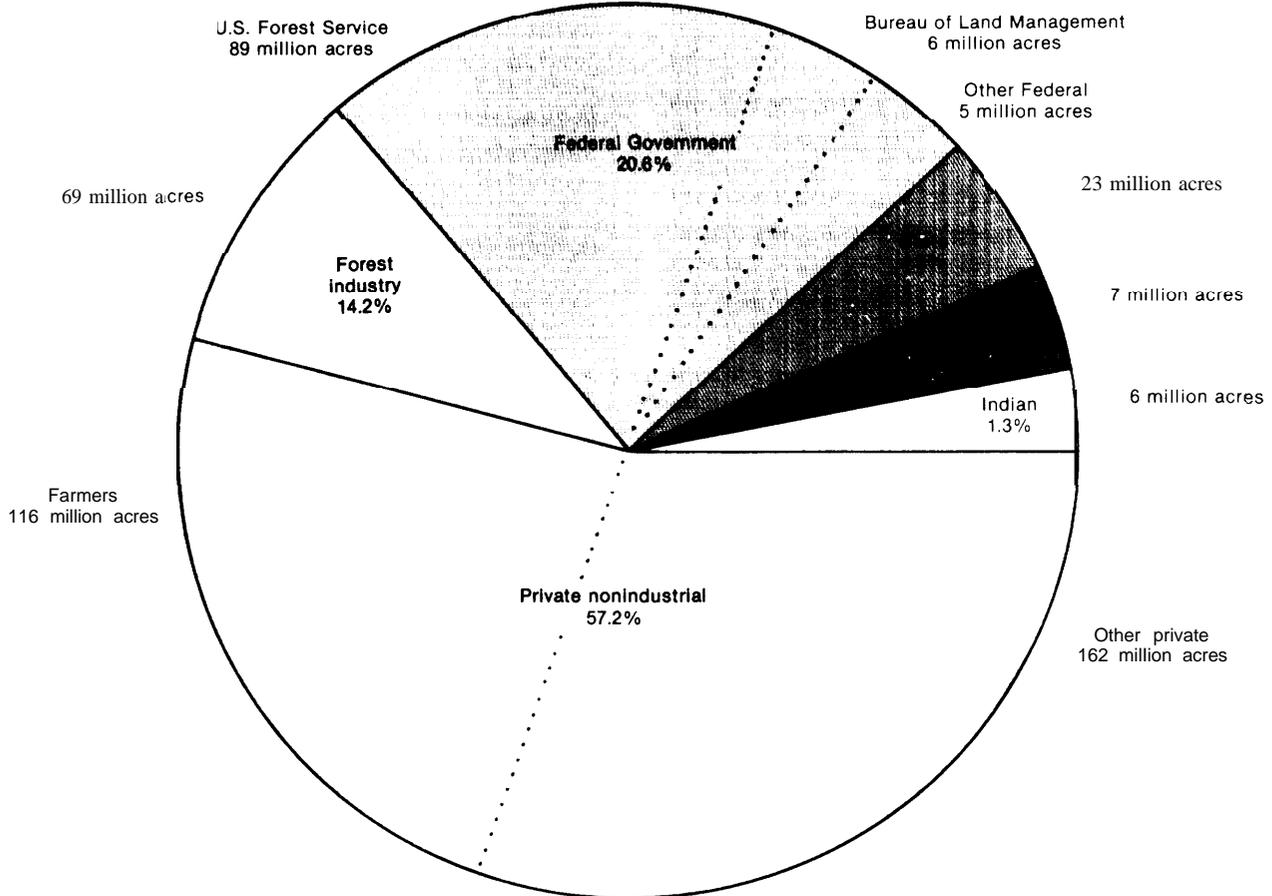
SOURCE: Adapted from *An Assessment of the Forest and Rangeland Situation in the United States* (Washington, D. C. U. S. Department of Agriculture, Forest Service, 1980) p. 513

Ownership and Management of Forestland

Trends in ownership have an important bearing on current and prospective uses of forestland. The Forest Service separates forest landowners into three basic categories: public (Federal, State, local, and Indian), forest industry (corporations or individuals who own or operate a wood-processing facility), and

private nonindustrial forest owners (farmers, “miscellaneous” individuals, and corporations that are not part of the forest industry). PNIF land comprises 58 percent of all commercial forests; industry lands 14 percent; and public lands the remaining 28 percent (fig. 26).

Figure 26.—Ownership of U.S. Commercial Forestland, 1977



SOURCE U S Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D C U S Government Printing Office, 1982), p. 121

Ownership composition varies significantly by region. In the Western United States, Federal and State Governments and the forest industry, which collectively own over 75 percent of the region’s forests, dominate. In the Eastern United States, private nonindustrial owners hold most of the forestland, although forest industry holdings are large in Maine and in the South. Federal holdings in the East may be locally important, but constitute only 5 percent of forested areas.

Timber harvest levels among ownership classes are not a function of acres held (table 29). Forest industry lands—14 percent of commercial forests—accounted for an estimated 31 percent of timber harvested in 1976, while other ownerships provided less timber per acre.

Nearly half (47 percent) of all U.S. timber supplies in 1976 came from private nonindustrial lands. In the East, however, PNIFs’ contributions to regional timber supplies are far higher. Forest Service projections suggest that the forest products industry will rely increasingly upon these PNIF lands for wood. By 2000, according to the Forest Service, 54 percent of the harvest will come from private nonindustrial sources (fig. 27). This represents more than a 50-percent increase in roundwood supplied from PNIF lands in 24 years.

Publicly Owned Forestland

About 28 percent of commercial forestland is owned or held by Federal, State, or local governments or kept in trust for Indian tribes.

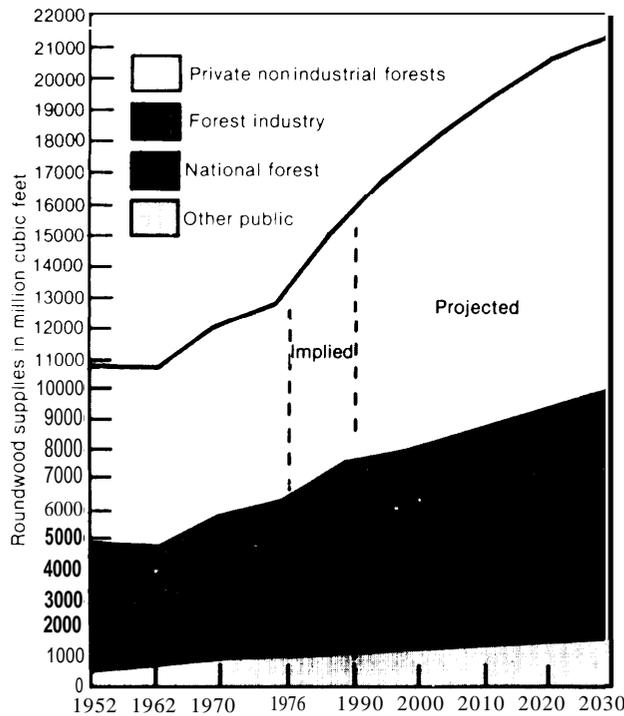
Table 29.—Roundwood Supplies and Acreage by Ownership Class

	Million acres ^a		Percent of commercial forest		Volume harvested (million ft ³)		Proportion of harvest	
	1976	2000	1976	2000	1976	2000	1976	2000
Forest Service	88.7	80.4	18	17	1,987	2,555	14.9	14.9
Other public	47.0	46.5	10	10	982	1,219	7.7	7.1
Forest industry	68.8	72.2	14	16	3,890	4,141	30.7	24.3
Private nonindustrial forests	278.0	261.9	58	57	5,946	9,169	46.7	53.7
U.S. totals	482.5	461.0	100	100	12,805	17,084	100.0	100.0

NOTE Survey data in 1981 shows fuelwood consumption to be several times higher than estimated for 1976, but it is not known what proportion of the fuelwood consumed comes from commercial growing stock. Harvest levels cited above for 1976 and projections for 2000, may underestimate historical and projected fuelwood removals.
^aTo convert acres to hectares, multiply by 0.4047.

SOURCES Adapted from *An Analysis of the Timber Situation in the United States, 1952-2030* (Washington, D C U S Department of Agriculture, Forest Service, 1982), p 158

Figure 27.—Roundwood Supplies by Ownership Class; With Base Level Projections to 2030^a



^aSupply data for 1952, 1962, 1970 and 1976 are estimates of trend levels of harvests and differ somewhat from Forest Service estimates or actual consumption. Projection year supply data shows volume that would be harvested given the assumptions made by the Forest Service.

SOURCE Derived from the U S Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States, 1952-2030* (Washington, D C U S Government Printing Office, 1982), p 160

State and local governments hold about 30 million acres forestland nationwide. In the Great Lakes States, State and county forests are especially prominent, comprising one-fourth of the region's timberlands. Pennsylvania, Alaska,

and Washington also own sizable forests. Elsewhere, State and county holdings may be important locally, but comprise a minor fraction of regional timber acreage. Indian lands, about 6 million acres in total, are concentrated in Oregon, Washington, and Arizona.

The Federal Government is by far the most important public owner of forestland. It manages more commercial forestland than any other single entity. Its holdings—nearly 100 million acres in 1977—amount to about one-fifth of the commercial acreage in the country. Ninety-five percent of the Federal holdings are administered by the Forest Service, which manages the National Forest System, and by the Department of the interior's Bureau of Land Management. Other Federal agencies, such as the Department of Defense, also have commercial forest holdings, mostly located in the East and generally small. In the Western United States, where three-fourths of the Federal commercial timberland is located, Federal holdings comprise 57 percent of the region's commercial acreage.

National Forests

Most of the National Forest System, administered by the Forest Service, is composed of lands reserved by Congress from the original public domain. Other portions, primarily in the East, were acquired by purchase, exchange or donation. Only about half of the land in national forests is commercial forestland. The rest is rangeland, grassland, nonproductive forests, and lands closed to timber production. Some

national forest land has been closed to timber production by Congress through wilderness designation, and other land has been deferred pending such designation. Some land **also** is administratively closed for endangered species habitat or recreation or because it is deemed “unsuitable” (see box G).

In March 1983, the Reagan administration stated that about 6 million acres of national forest land were being considered for possible sale as part of its asset management program.¹⁸ Further study of these parcels was announced; actual sale may require congressional approval.

¹⁸“6 Million Acres of U.S. Forest Eyed for Sale,” *Washington Post*, Mar. 16, 1983, p.A8.

Most of the tracts were in isolated ownerships, checkerboard patterns, special use permits, and community expansion lands.

In 1977, the National Forest System contained about 89 million acres of commercial forestland or 18 percent of total U.S. commercial timberland. Most of the commercial timberland in national forests is located in the West—41 percent in the Rocky Mountain region and 36 percent in the Pacific coast region. The 23 percent in the East is divided about equally between the North and South.

Several different laws govern Forest Service administration of commercial timberland on national forests. The Multiple Use and Sus-

Box G.—Basic Forest Service Management Principles

Multiple Use—The Multiple Use and Sustained Yield Act of 1960 directs that all resource values be weighed and tradeoffs made in making management decisions. It requires that economic factors be considered but not necessarily control management decisions. Also, management objectives must preserve land productivity. The multiple use concept has proven difficult to implement because Congress did not provide criteria for deciding between conflicting land uses. Lands that are managed primarily for recreation, wilderness, wildlife habitat, or watershed may receive little or no timber management treatment.

Sustained Yield—The principle of sustained yield is closely linked to the principle of multiple use. The Multiple Use and Sustained Yield Act defines it as “the achievement and maintenance in perpetuity of a high-level annual or regular periodic output. . . .” This relatively straightforward concept is complicated in practice, because many different levels of sustained yield can be defined for a given tract of land, depending on management intensity and the interval chosen for “periodic output.” NFMA reaffirmed the concept of sustained yield (nondeclining even flow) but also authorized the Forest Service to depart from even flow in order to meet “overall multiple use objectives.” The act failed, however, to provide clear guidance as to what specific situations justify such departures. Under a 1979 Presidential directive, departures are being assessed on some national forests through acceleration of planning.

Harvesting at the High Point of Forest Growth—NFMA affirmed the Forest Service’s existing policy of setting timber rotation age at the point of maximum biological growth of a forest stand (called “culmination of mean annual increment”). Such a policy maximizes the volume of timber that is harvested, but financial maturity (the age at which economic efficiency would dictate harvest) generally comes well before biological maturity. This policy has been criticized by economists and the forest industry as being economically inefficient, but by law it remains a strong influence on the formation of national forest management objectives.

Exclusion of “Unsuitable” Land From Timber Production—NFMA restricts timber harvest on lands that have been identified as unsuitable for timber production based on physical, economic, and “other pertinent factors.” It also directs that cutover lands be restocked within 5 years after harvest and sets specific criteria for the choice of cutting method. NFMA further requires that the reforestation backlog—which as of October 1, 1982, had been reduced from 6.1 million acres in 1975 to 413,000 acres—be treated by 1985.

tained Yield Act of 1960 (Public Law 86-517) articulated a congressional policy that national forests should be managed for “outdoor recreation, range, timber, watershed, and wildlife and fish purposes, ”

The setting of land management objectives for national forests is controlled by RPA and its amendment, the National Forest Management Act (NFMA) of 1976 (Public Law 94-585), under the overall framework of multiple use and sustained yield principles set forth in the 1960 act, RPA requires the assessment of all forest and rangeland renewable resources in the United States on a continuing basis and the preparation of a 50-year renewable resources program. These mandates were intended to help Congress set a forest resource budget.

NFMA requires the preparation of management plans under regulations consistent with congressional guidelines, a lengthy and complicated process. At the regional level, forest plans are developed to establish general management objectives, standards, and guidelines. At the local level, forestland and resource management plans are drawn up for each national forest, using the regional standards and guidelines to develop specific objectives and prescriptions for planning units within the forest. The first round of this new planning process is still underway. As of March 1983, individual plans for 18 out of 121 national forests had been released in draft form; the remainder are scheduled for completion in 1983-84.¹⁰

Basic management principles set by Congress provide a framework for planning and managing the use of timber and nontimber national forest resources (see box G). Their implementation limits timber management and harvest levels in the interests of meeting other resource management objectives. Harvests on individual national forests generally cannot exceed a level which could be removed “annually in perpetuity on a sustained yield basis. ” However, temporary exceptions to this policy

through “planned departures” are authorized in some cases to achieve sustained yield objectives. In 1979, the Carter administration called for accelerated updating of plans on some national forests to increase sales of mature timber. This process continues today.

The potential for producing more wood per acre of allocated timber production land under Federal laws is substantial. An important limitation to more intensive management, however, is budgetary constraints.

Bureau of Land Management Land

The Bureau of Land Management (BLM) was created in 1946 to administer Federal Government properties that were never disposed into private ownerships or set aside for special uses. Nearly all of these are in the West,

BLM manages 5.8 million acres of commercial timberland. About half of this is original public domain lands. The other half is the so-called “O&C” lands, located in western Oregon. This acreage is the remains of a land grant that was reverted by Congress in 1866 when a railroad failed to comply with the terms of its grant. The O&C lands are BLM’s most productive and are among the most productive forestlands in the country.

Permanent objectives for BLM-administered lands were not clarified until enactment of the Federal Land Policy and Management Act (FLPMA) of 1976 (public Law 94-579). FLPMA directs that public lands, only 1 percent of which are forested, be managed on a multiple use, sustained yield basis, but the act does not provide specific objectives for timber resources. O&C lands are administered under FLPMA and the O&C Act of 1937 (50 Stat. 875), which name timber production as the major ownership objective. In the event of conflicting purposes, the O&C Act prevails.

In response to FLPMA’s mandate, BLM is preparing Resource Management Plans for each of its management units. These documents will combine in one environmental impact statement, as required by the National Environmental Policy Act of 1969 (public Law 91-190), both land use allocations and specific

¹⁰U.S. Department of Agriculture, Forest Service Land Management Planning Staff, personal communication, Washington, D. C., Oct. 14 1982.

guidelines on how lands will be managed. Six factors must be considered in reaching decisions:

1. legislative and Department of the Interior goals,
2. resource demand forecasts,
3. estimated sustained levels of the multiple uses that may be obtained under existing biological and physical conditions and differing management practices,
4. degrees of management intensity which are economically viable,
5. opportunities to resolve public issues, and
6. degree of local dependence on public land resources.

Thus, planning objectives for BLM-administered forestlands, like those for the National Forests, balance many different legislative mandates.

Other Legislative Mandates for Federal Lands

Many other statutes related to environmental protection and the management and use of public lands affect Federal forest management. The National Environmental Policy Act (NEPA), for example, requires preparation of environmental impact statements for Federal actions that may significantly affect the environment, including some forest management activities on Federal lands.

Another example is the Endangered Species Act of 1973 (Public Law 93-205). The act protects endangered species on Federal lands by prohibiting activities that damage their habitats, and some view it as a potential major conflict with timber production on Federal forests. Although about 200 threatened and endangered species are listed by the Federal Government, most have specialized habitats that cover relatively small areas. Only a few species appear to have potential for serious conflict with timber production. The grizzly bear and gray wolf are two of them. The national forests are considered to be of major significance in the recovery of these species, because large portions of their habitat—82 percent or 4,432,920 acres of the gray wolf's, for instance—are on national forest lands. In the Pacific Northwest,

efforts to protect the spotted owl may conflict with timber production because this species requires old-growth conifer stands for habitat. In other national forest regions, there may be cases where endangered species protection reduces Federal lands available for timber production, but these areas are likely to be small in relation to total national forest acreage available for harvest.²⁰

Another law, the Wilderness Act of 1964 (Public Law 88-577), also has been perceived by timber interests as a threat to future wood supplies. Although the act clearly has resulted in substantial acreage being removed from production, wilderness lands are generally below average in productive potential. There are presently 25.1 million acres in the National Wilderness Preservation System, but only 40 percent of this land (10.2 million acres) is "productive reserved land"—i.e., land that would be called commercial forestland if it had not been withdrawn from timber production. Table 30 shows the average productive potential by Forest Service region of "productive reserved land" included in existing wilderness areas. Only Alaska and the Pacific Southwest have wilderness with high productive potential, and the acreages are relatively small. In four regions, the average productive potential of wilderness areas is less than 50 ft³/acre/year, which often is considered the minimally acceptable cutoff point for economical timber management.

In recent years, Congress has prohibited the sale of Federal timber to companies who intend to export it prior to processing. It also has prohibited the sale of timber to purchasers who use Federal timber to substitute for exported unprocessed logs from private lands. The rationale for this restriction has been jobs. Congress intended to encourage domestic processing of the raw material to provide employment for U.S. workers, implying that this benefit is yet another objective of Federal forest management.

²⁰As discussed in J. Russell Boulding, *Federal Forests: An Assessment of Their Management, Use, Potential Productivity, and Economic Significance*, OTA contract report, June 1982, p. 5-9.

Table 30.—Regional Distribution of Productive Reserved National Forest Lands in Wilderness and Their Average Productive Potential, 1981

Forest Service region	Productive reserved forest in wilderness (millions of acres) ^a	Average potential production (ft ³ /ac/yr) ^b	Regional productive potential average (ft ³ /ac/yr) ^b
Northern	2.2	56	—
Rocky Mountain	1.5	43	63.7
Southwestern	0.8	41	—
Intermountain	1.8	40	—
Pacific Southwest	0.4	78	90.8
Pacific Northwest	1.2	42	—
Southern	0.1	59	71.1
Eastern	0.8	56	62.3
Alaska	1.4	109	—
Total	10.2		

^aTo convert acres to hectares, multiply by 0.4047.
^bTo convert ft³/ac to cum/hectares, multiply by 0.07

SOURCE: Compiled by the Wilderness Society, Washington, D C , from 1981 Forest Service Data

Forest Industry Lands

The forest industry owns land primarily to produce commercial timber. About 69 million acres were owned by the forest industry in 1977. These lands on the average are naturally more productive than lands in other ownerships, they generally are in larger tracts, and they often are located near mills.

Forest industry landownership is highly concentrated. In 1978, the 90 largest firms owned 62 million acres of forestland—91 percent of all industry-held acres.²¹ Nearly half (48 percent) of the total was owned by just 17 companies, with the half-dozen largest firms each having holdings the size of Connecticut. Most of the remaining 30,000-plus companies in the lumber or pulp and paper sector either have minor landholdings or none.

In addition to land they actually own, forest products firms lease a substantial amount of private property. Management activities on leased land vary from minimal maintenance to intensive timber management practices. Short-term leases generally involve timber harvesting but not management. Long-term leases, which often do involve management, are an impor-

tant trend in the South, where nearly 6.7 million acres are leased for 25 years or more.²² Leasing activities by the forest industry may increase in the future, especially in those areas where large mills require large timbersheds for supplies.

The South contains more than half of the industry's holdings. All but one of the southern States have at least 1 million acres, and in each of six of these States, the industry owns more than 3 million acres.

In the West, where Federal forestlands dominate, the major forest industry holdings are in Oregon, Washington, and California, with much smaller (1 million acres) but still significant holdings in Idaho and Montana. In the North, Maine alone contains nearly half of the region's industrial forestland. Most of the remaining northern industrial holdings are in the Great Lakes States and in Pennsylvania and New York.

The era of large-scale assembly of new forest industry lands may be over. There are many reasons for this, but possibly the most important is the tremendous increase in land prices in the 25 years following World War II. Although price increases have moderated or

²¹Jay O'Laughlin and Paul V. Ellefson, *New Diversified Entrants Among U.S. Wood Based Companies: A Study of Economic Structure and Corporate Strategy*, Bulletin 541-1982 (St. Paul, Minn.: University of Minnesota Agriculture Experiment Station, 1982), p.18.

²²U.S. Department of Agriculture, *The Federal Role in the Conservation and Management of Private Non-industrial Forestlands*, Interagency Committee Report (Washington, D. C. U.S. Department of Agriculture, 1978), p. 41.

declined just recently (1980-82), it still seems unlikely that the forest industry as a whole will embark on major new land acquisition programs in the coming years. In fact, during the 1980-82 recession, forest industry firms have tried to sell several million acres of commercial timberland; this may have been a short-term response to acute cash flow problems brought on by high interest rates and by the economically depressed state of the industry. The Forest Service projects that only about 4.4 million acres of additional industry holdings will be purchased in the next 50 years (table 31). About three-fourths of this increase is projected for the South, much of the remainder is in the North, and a modest increase is expected to occur in the West. The Forest Service projects that most of these purchases will take place before 2000; thereafter, forest industry holdings will begin to decline—chiefly as a result of the disposal of some industry lands in the Pacific Northwest.

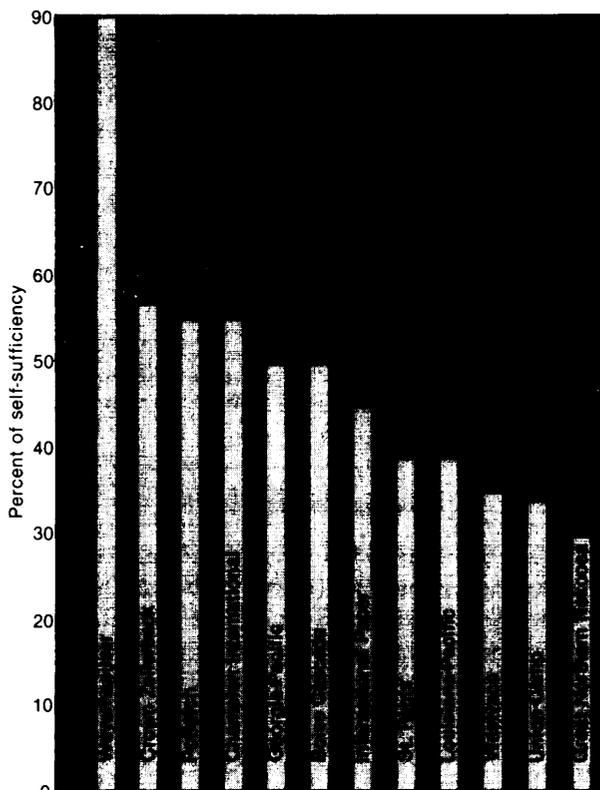
Ownership Objectives

The forest industry’s major landowning objective is the production of timber for its mills.²³ For strategic corporate reasons, partial self-sufficiency in timber supply is considered important to those forest products companies that own land. Relatively few firms, however, can rely on their own lands for more than a portion of their timber needs (fig. 28). Most firms are highly dependent on PNIF or public lands to provide much of their wood.

In the past, when old-growth timber was abundant and land prices low, companies ac-

²³O’Laughlin and Ellefson, *New Diversified Entrants*, table 5, p. 16.

Figure 28.—Timber Self-Sufficiency of Major Timber Processing Firms



SOURCE: *Forbes*, Dec. 24, 1979, as reproduced in U.S. General Accounting Office, *New Means of Analysis is Required for Policy Decisions Affecting Private Forestry Sector* (Washington, D. C.: U.S. General Accounting Office, 1961), p. 18.

quired land with the simple objective of cutting the trees. Today, however, old-growth supplies have dwindled and land prices have risen sharply, so objectives now center on managing existing holdings for improved production. Potential acquisitions are evaluated for their productive capacity as well as for their existing timber stand.

Table 31.—Forest Industry Holdings, 1952-77 (million acres)^a

	1952	1962	1970	1977	Projected 2030
North	14	13.9	17.4	17.9	18.7
South	32	33.4	35.0	36.2	39.7
West	13.5	14.1	14.5	14.6	14.7
Total United States	59.5	61.5	67.0	68.8	73.1

^aTo convert acres to hectares, multiply by 0.4047.

SOURCE: Brian R. Wall, *Trends in Commercial Timberland Area in the United States by State and Ownership, 1952-1977, With Projections to 2030* (Washington, D. C.: U.S. Government Printing Office, 1981) pp. 15, 18, and 21.

Rapid population growth and increased demand for outdoor recreation have made some industry land more valuable for uses other than timber production. Firms with large holdings usually have realty divisions or subsidiaries, Forest industry real estate activities were highly publicized in the early 1970's when several firms began to promote recreational home sales and development on their lands. Since the 1974-75 recession, however, the industry's real estate ventures have been relatively conservative. Rural population growth also is increasing the potential for conflict between industry and residential goals. A case study in one Texas county found that local timber companies opened their lands to the public for hunting, in part because of a good neighbor policy but also because of threatened arson or vandalism.²⁴

Management of Industrial Lands

Since timber production is the major objective of the forest industry, the prospects for higher output in response to increased demand look very good. Response would be limited, of course, by how profitable it would be to invest in more intensive management. The productive capacity of most industry lands is high, however, and they are generally well-located near processing facilities and contain large tracts capable of capturing "economies of scale" in management.

Management intensity on industrial forestlands apparently is increasing, although significant differences exist among firms and data is limited. According to a review by Jay O'Laughlin and Paul V. Ellefson, those few studies that have been conducted suggest a mixture of management intensity among different industrial size classes. One study of 20 major firms, which together owned almost 40 million acres of timberland in 1969, found that 16 of the firms practiced varying degrees of management. All of them had planting programs, 11 used timber stand improvement, and 13 practiced site preparation. Four of the com-

panies apparently did not practice management even though they each owned more than 1 million acres. Another study of 166 firms in the mid-1970's found that those with holdings of 250,000 acres or more used certain management practices (precommercial and commercial thinning, timber stand improvement, fertilization, site preparation, and genetic improvement) to a greater extent than did firms with smaller holdings, but it found no significant differences between other forest management techniques. This study also found that industrial lands were managed most intensively in the South and Pacific Northwest, and that large tracts were more intensively managed than small ones.²⁵ Industry planting and direct seeding of harvested land have increased from an average annual rate of about 150,000 acres in 1950 to over 1 million acres per year in the mid- to late-1970's,

Since 1949, about 19 of the 90 largest forest industry firms have merged or been acquired by conglomerates. These 19 companies presently own about 14 percent of the total forest industry land base and account for about 8 percent of wood-based sales in the United States.²⁶ It has been speculated that these conglomerates may be less inclined toward long-term forest management than traditional forest industry firms, but a recent University of Minnesota report found little ground for such speculation. Based on questionnaires and interviews with several diversified and traditional forest product firms, the study concluded that, ". . . the large diversified firm with a wood-based subsidiary manages its lands no differently than does the traditional wood-based company."²⁷ In fact, the study found that the diversified firms that were surveyed invested slightly more in forest management on a per-acre basis than did traditional companies. It should be noted, however, that the study was based only on a partial response by firms and that some traditional forest products companies may have been more reluctant to reveal information

²⁴Robert C. Healy and James L. Short, *The Market for Rural Land: Trends, Issues and Policies* (Washington, D. C.: Conservation Foundation, 1981), pp. 51-58.

²⁵This discussion of industrial forestland management is drawn extensively from *New Diversified Entrants*, pp. 33-35.

²⁶*Ibid.*, p. 20.

²⁷*Ibid.*, p. 43.

about management than the new diversified firms.

Private Nonindustrial Forest Lands

Private nonindustrial forestland, sometimes termed underproductive, actually makes a major contribution to U.S. wood supplies. About half (46 percent) of all roundwood and 38 percent of sawtimber were harvested from these lands in 1976. While their contribution to national wood production is proportionately smaller compared to the total acres their owners hold—about 58 percent of the commercial forestland or about 278 million acres—this difference is less pronounced when regional markets are considered.

About nine-tenths of PNIF lands are in the East (table 32), where they account for over two-thirds of regional timber supplies. PNIF lands are especially important in the South, which contains more than half of all private nonindustrial land. Because the forest products industry is concentrated more heavily in the South than in the North,²⁸ the southern PNIF

²⁸ *AN Analysis of the Timber Situation*, op.c it., p. 1 09.

Table 32.—Area of U. S. Commercial Timberland in Private Nonindustrial Forest (PNIF) Ownership by Region (thousands of acres)^a

	Commercial timberland in PNIF ownership
North	117,715
South	134,070
Rocky Mountains	12,502
Pacific coast	13,695
Total United States	277,982

^aTo convert acres to hectares, multiply by 0.4047.

SOURCE: *An Analysis of the Timber Situation in the United States 1952-2030*, (Washington, D.C U.S. Department of Agriculture, Forest Service, 1982), pp.344-349

is viewed as a critical part of the national timber supply.

In the Pacific coast region, PNIF owners account for less than 20 percent of commercial forestland. The proportion of large timber on these lands is small relative to other ownerships since the old-growth has been cut and most stands are still immature; thus PNIF lands in this region are relatively insignificant in terms of near-term timber resources. About one-fourth of the Rocky Mountain commercial forestland base is in the private nonindustrial category.

Changing Ownership Composition

Information about PNIF owners comes from three major sources—State forest surveys, a nationwide rural landownership survey conducted in 1978 by USDA, and statewide surveys conducted in 11 Northern States by the Forest Service. The Forest Service traditionally divides PNIF landowners into two categories—farmers and “miscellaneous other” (or all those who are not farmers). “Miscellaneous other” represents a cross-section of society, including professionals, retired people, blue collar workers, and nonwood-based corporations.

State forest surveys over the last three decades have shown a very rapid transfer of land from farm to miscellaneous ownership. In 1952, about 58 percent of all PNIF acreage was in farm ownership and 42 percent was in miscellaneous other (table 33). In 1977, the situation was exactly the reverse—42 percent was in farm ownership and 58 percent were in miscellaneous other. More than 60 percent of the decline in farm forestland occurred in the South and most of the rest occurred in the North.

Table 33.—Change in Farm and “Miscellaneous Other” Ownership: 1952-77 (millions of acres)^a

	1952		1962		1970		1977	
	Number of acres	Percent total						
Farm	172	58	145	48	125	44	116	42
Miscellaneous other	124	42	159	52	163	56	162	58
Total	296	100	304	100	287	100	288	100

^aTo convert acres to hectares, multiply by 0.4047

SOURCE Derived from *An Analysis of the Timber Situation in the United States 1952-2030* (Washington D C U S Department of Agriculture, Forest Service, 1982), p 349

The implications of this transfer in ownership for timber harvesting and management are unclear. Nonfarm owners sometimes are considered to be less interested in harvesting timber than are farmers and more interested in amenity values. Many of the new owners, how-

ever, may be investors able to provide capital for timber management if it is profitable. Some of the PNIF land is owned by nonwood-based corporations, which also may be in favorable positions to undertake management activities (see box H).

Box H.—Forestland Holdings of Nonwood-Based Corporations

Nonwood-based corporations own substantial forest acreage but do not operate wood processing facilities.

Forest Service landownership surveys in 11 Northeastern and Middle Atlantic States provide the best data about these corporate holdings. In the surveyed States, about 6.7 million acres are owned by nonwood-based companies—nearly twice as much land as is owned by the forest industry. (This excludes the major forest industry holdings of Maine, where a survey is not yet complete.) In other surveys, five Southeastern States show a total of 7.4 million acres owned by such firms—about half as much as forest industry holdings in those States.²⁹ In California, just nine nonwood-based corporations are said to hold 30 percent of all PNIF land.³⁰ In western Oregon, about 15 percent of the PNIF lands are owned by such firms, and roughly half of this land is in parcels of 5,000 acres or more, according to a recent Forest Service study.³¹

National information on nonwood-based corporate holdings is imprecise. The Forest Service study, *The Private Forest Land Owners of the United States*, identified 89.5 million acres of forestland as being in all categories of corporate ownership—21.8 million acres above estimated forest industry holdings for 1977. This figure is an inexact estimate of nonwood-based corporate holdings, because the landownership survey and forest industry data were derived from different data series and some of the forest industry data is out-of-date.

National information about the kinds of companies involved also is imprecise. Mining and energy corporations may own large quantities of forestland, but information is fragmentary. While it is known, for example, that 21 such firms own at least 3 million acres of land and lease far more private land,³² the proportion of these holdings that is forested is unknown.

The extent of forestland owned by real estate firms is not available nationwide, but it maybe substantial, judging from the Northeast and Middle Atlantic landownership surveys.³³ In Maryland, realty firms held 32 percent of all corporate forestland—more than forest industry holdings in that State. In Pennsylvania, 13 percent of all corporate forestland is owned by real estate firms. Sports and recreation clubs, churches, and other nonprofit organizations hold a significant amount of private forests. About 5 percent of Pennsylvania's private forestland, for example, is owned by hunting and fishing clubs.

Recently banks, investment firms, and other financial institutions have become involved in private forestland management, with some firms offering limited partnerships in these ventures. The trend is too recent to appraise fully, but it is potentially important as a means for channeling capital into PNIF management.

²⁹Information provided by the USDA Forest Service Southeastern Forest Experiment Station.

³⁰Cited in Marion Clawson, *The Economics of U. S. Non-Industrial Private Forests*, Research Paper R-14 (Washington, D. C.: Resources for the Future 1979), p. 24.

³¹Donald R. Godney, *Characteristics of Private Timberland Ownership in Western Oregon*, draft manuscript (Portland, Oreg.: Pacific Northwest Forest and Rangeland Experiment Station), p. 32.

³²Douglas G. Lewis, *Corporate Landholdings: An Inquiry Into a Data Source* (Springfield, Va.: National Technical Information Service, 1976).

³³Data on real estate firm holdings are taken from USDA Forest Service surveys of landownership in the Northeastern and Middle Atlantic States conducted during the last decade by the Northeastern Forest Rangeland Experiment Station, Broomall, Pa. Separate reports are available for each of the surveyed States.

More detailed national and regional information about private forest owners is available through a U.S. rural landownership survey that USDA conducted in 1978. Although the survey did not specifically ask questions about forestland, Forest Service analysts were able to construct from the survey data the first nationwide statistical profile of private forest owners in 25 years. The profile is entitled *The Private Forest Landowners of the United States*.³⁴ In addition, Forest Service analysts have conducted in-depth forest land ownership surveys in the Northeastern and Middle Atlantic States.

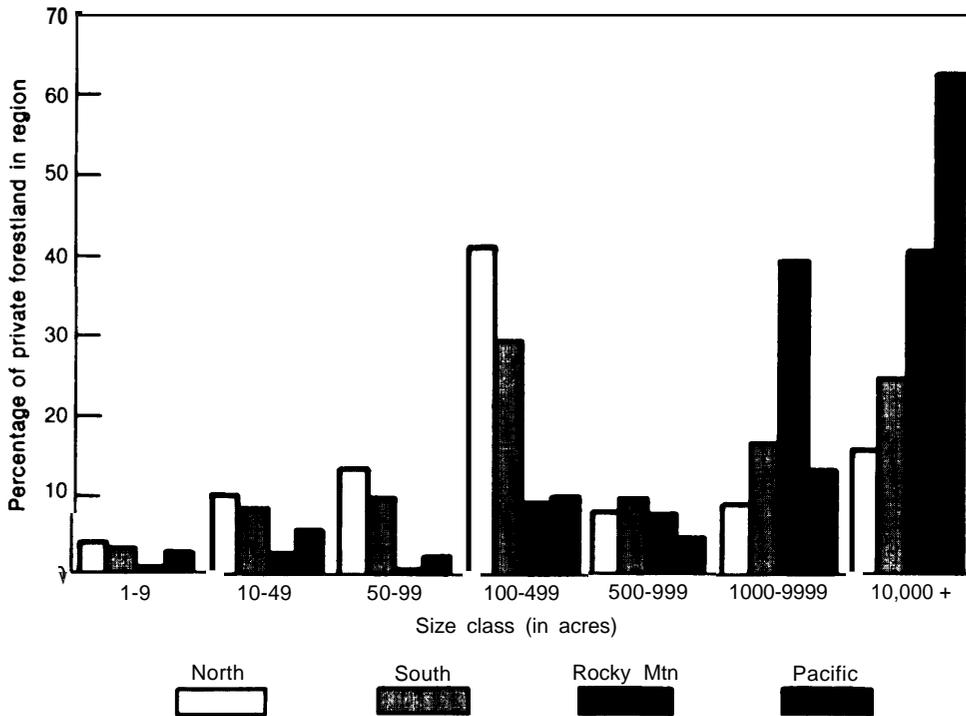
The national survey provides data about owners, including their numbers, acres held,

occupation, educational level, and other factors relevant to assessment of timber management. It was based on 11,000 respondents. The survey does not distinguish between forest industry owners and PNIF owners—an important qualification, since forest industry holdings account for 69 million acres of forestland,

The national survey provides general information about the size of individual holdings. The overwhelming majority of the 7 million owners of private forestland held less than 10 acres apiece, but these holdings collectively comprised only a small proportion of the land base (fig. 29). Four-fifths of the private forestland is held by people or corporations who own 100 acres or more. Although some individuals own enormous tracts of forestland, most of it that is in the 10,000-acre-plus category shown in figure 29 presumably belongs to the forest products industry or other large corporations.

³⁴Thomas W. Birch, Douglas G. Lewis, and Fred H. Kaiser, *The Private Forestland Owners of the United States*, Forest Service Resource Bulletin WO-1 (Washington, D. C.: U.S. Government Printing Office, 1982).

Figure 29.—Acres of Private Forest Land Ownership Units by Size Class and Region, 1978



SOURCE: Thomas W. Birch, D.C. Lewis, and H. F. Kaiser, *The Private Forestland Owners of the United States*, USDA Forest Service Technical Bulletin (Washington, D. C.: U.S. Government Printing Office, 1982), p. 36.

It is clear from the national data that most U.S. forestland is in large enough holdings for efficient commercial harvesting and management. However, some observers are concerned that parcellation (division of land without development) may be effectively reducing the acreage available for timber production. Adequate historical data is not available to determine whether the proportion of forestland in small tracts has increased nationwide. Most case studies in specific rural areas suggest that parcellation has been most intense on tracts that were small to begin with.³⁵ Hence, forestland in holdings of 100 acres or less (about 20 percent of the private acreage according to the 1978 survey) are probably most likely to be subject to parcellation. Still, in some areas, consolidation of land into larger parcels may have occurred. Closer monitoring of parcellation will be needed to identify national trends clearly.

Ownership Objectives

Many local surveys have been conducted which reveal landowner objectives, but the results of such surveys cannot be combined or compared with statistical accuracy because of different methodologies. Nevertheless, some generalizations can be made about their findings:

- PNIF ownership objectives vary widely both within and among regions. Owners in the Southeast appear to be more interested in timber production than those in the North, who are more interested in recreational and other nontimber uses. Lack of markets in the North may explain part of this difference.
- PNIF owners who harvest timber tend to have larger parcels of forestland than those who do not; hence, the proportion of land held by owners with timber production objectives tends to be high relative to their numbers, and the proportion with recrea-

tional objectives tends to be low relative to their numbers. se

Limited regional data on ownership objectives is available for both the Northeast and Southeast. In a survey of PNIF owners in the Southeast, 62 percent reported that timber management is very important on the land they own, but fewer owners (54 percent) actually named timber growing as an important ownership objective. Much of the land was not specifically acquired for timber management, however, and is held for reasons in addition to timber production. For example, over half of the owners indicated that they had inherited their land and that a highly important reason for owning it was to pass it on to their heirs.³⁷

In the Northeast, nearly half of the owners have forestland simply because it is part of their farm or residence or because they derive esthetic enjoyment from it. These owners, however, hold only about one-third of the region's PNIF acreage. About 10 percent of the PNIF lands in the Northeast are held for recreational purposes and 14.5 percent for investment reasons. Less than 2 percent of the owners report that they hold land for timber production, but they own approximately 15 percent of the acreage.³⁸

Forest Service landownership surveys in the Northeastern and Middle Atlantic States found that less than 1 percent of the harvests on PNIF lands were conducted for timber stand im-

³⁵Healy and Short, *Market for Rural Land*, Op. cit., p.22.

³⁶Jack P. Royer, *A Report to the Forest Productivity Committee of the Forest Industries Council Highlighting the Findings of a Review of Non-Industrial Private Forest Owner Surveys, and Assessing the Usefulness of Data from Past Surveys in Evaluating Alternative Proposals for Improving Forest Productivity*, unpublished manuscript, Center for Resource and Environmental Policy Research (Durham, N. C.: Duke University, School of Forestry and Environmental Studies, 1979), p. 16.

³⁷Unpublished results of the 1981 Reforestation Survey conducted by U.S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board.

³⁸Neal P. Kingsley, "The Northeastern Forest Landownership Study," in Jack P. Royer and Frank J. Convery, eds., *Non-Industrial Private Forests: Data and Information Needs Conference Proceedings* (Durham, N. C.: Duke University School of Forestry and Environmental Studies, April 1981), p. 90.

provement purposes. Only 9 percent of the owners have ever received any kind of forestry assistance,³⁹

Similar but more explicit findings come from the Southeast. For instance, on lands from which pine has been cut, the most common harvest method was partial cutting, a practice resulting in site conditions that are suboptimal for pine regeneration. On 80 percent of the harvested lands, no site preparation practices (readying the land for reforestation) were carried out, and 65 percent of the lands were not planted or seeded with pine but left to reforest

themselves naturally. As a result, these lands probably will be restocked eventually with hardwood or mixed pine/hardwood stands of relatively low timber value. Eighty percent of the lands in the sample were not covered by forest management plans.⁴⁰

These statistics would be more illustrative if they could be compared with similar data for other ownerships, but such information is not available. They do suggest, however, that PNIF owners as a whole in the Southeast are not taking active steps to perpetuate their supplies of pine.

³⁹Kingsley, "Northeastern Forest Landownership Study," op. cit., pp. 91-92.

⁴⁰U N published results of the 1981 Reforestation Survey.

Factors Affecting Implementation of Intensive Timber Management

Timber growth trends, while favorable, could be increased dramatically through intensified management. Net annual growth on all commercial forestland in the United States in 1976 was about 60 percent of the estimated productive potential if all forests were in well-stocked natural stands. Among regions, the Pacific

coast has the highest productive potential (97 ft³/year), although actual growth in 1976 reached only about half that, The South has the next highest potential (77.3 ft³/year), with actual growth the highest for any region (74 percent of potential) (table 34 and fig. 30).

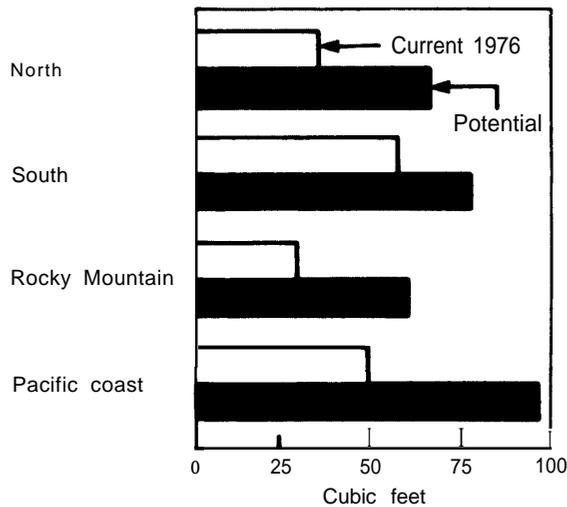
Table 34.-Average Net Annual and Potential^aGrowth per Acre in the United States, by Ownership and Section, 1976 (cubic feet)

Item	All ownerships	National Forest	Other public	Forest industry	Farmer and other private
North					
Current	35	43	36	44	33
Potential.	66	63	59	74	66
South					
Current	57	57	54	60	56
Potential.	77	71	71	83	77
Rocky Mountain					
Current	29	30	25	50	25
Potential.	60	64	55	74	51
Pacific coast					
Current	49	30	53	80	62
Potential.	97	91	88	119	99
United States					
Current	45	35	42	59	45
Potential.	74	74	68	87	72

^aPotential growth is defined as the average net growth attainable in fully stocked natural stands. Much higher growth can be attained in intensively managed stands.

SOURCE: *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D.C.: U.S. Department of Agriculture, Forest Service, 1952), p. 137.

Figure 30.— Current and Potential Net Annual Growth per Acre by Section*



*Potential growth is defined as the average net growth attainable in fully stocked natural stands. Much higher growth can be attained in intensively managed stands.

SOURCE: U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States, 1952-2030* (Washington, D.C.: U.S. Government Printing Office, 1982), p. 137.

Historical evidence suggests that dramatic gains in productivity could be made with modest improvements in the intensity of timber management practices.⁴¹ The rate of improvement would depend on two factors—the time required for wood output to be increased as a result of management investments and the rate at which landowners are willing and economically able to intensify forest management. Because of the lag time between management investments and resulting yields, the full impact of intensification measures begun immediately would not be attained nationwide until after 2000 and probably would not peak until after 2030.

Through cooperative Federal, State, and private programs, most U.S. forestland is now managed extensively to control wildfire and limit damage from insects and disease. About 1.4 billion acres of forest, rangeland, and other rural land are now under organized fire protection. The total area of commercial forestland

burned by wildfire has decreased significantly since the early 1950's, in part because more land is now protected. Successful control and suppression of wildfire almost certainly has contributed much to improved growth trends on private nonindustrial lands.

Intensive timber management is applied currently on only a small portion of U.S. forestland, but apparently its use is spreading. Most of the practices now applied involve planting trees or seeding harvested areas with commercially desirable species, primarily softwoods, and intermediate stand treatments, primarily precommercial thinnings and release/weeding (see ch. V for a discussion of management practices).

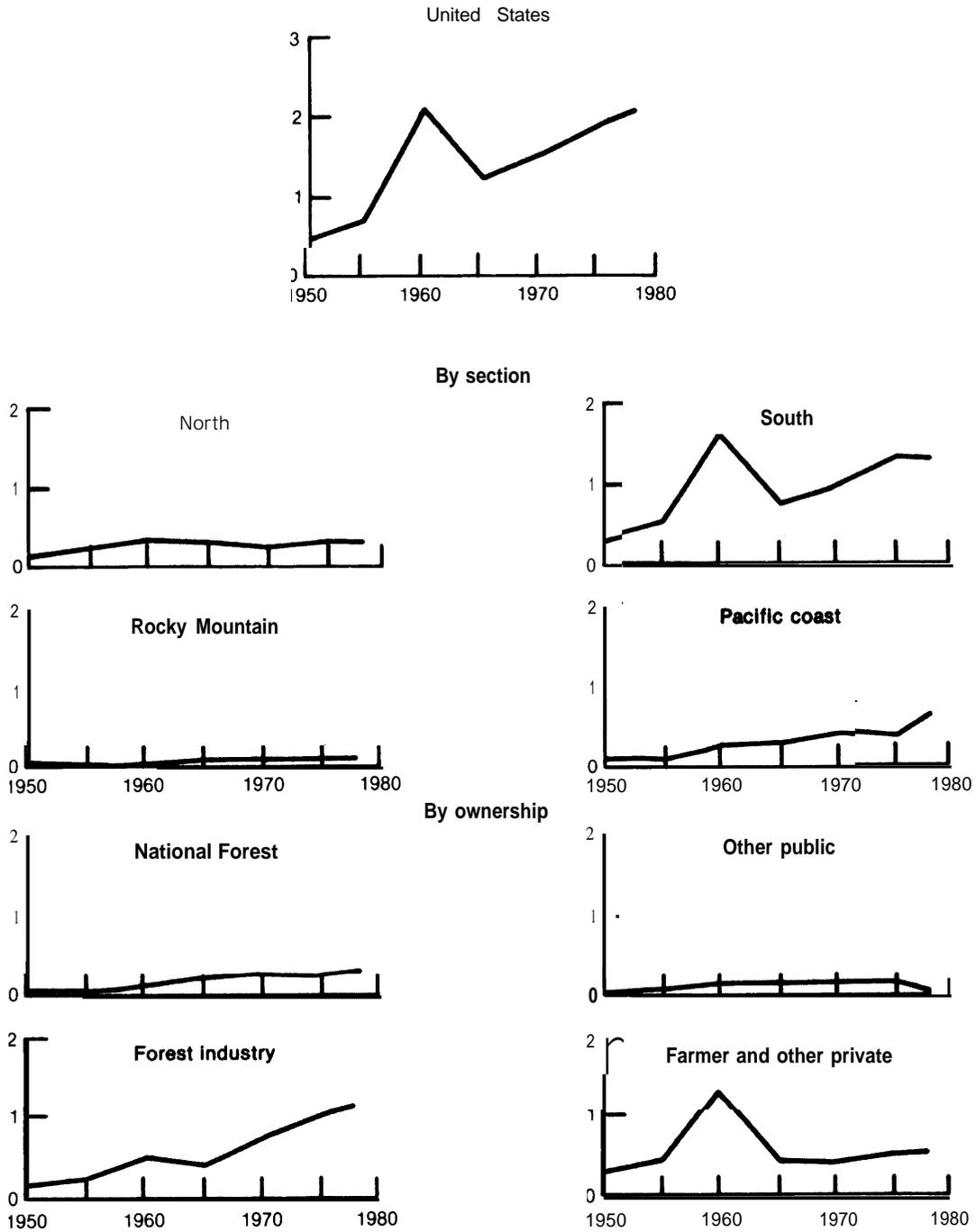
Artificial regeneration of stands has increased steadily on forest industry lands since the early 1950's as well as on public lands, although to a lesser extent. Planting of PNIF lands reached an all time high in the late 1950's and the 1960's as a direct result of the Federal soil bank program, now defunct, which paid farmers to plant trees on cropland to conserve soil and reduce grain surpluses. Intermediate stand treatments on all ownerships reached a high point in 1968, having fallen off subsequently. Figure 31 and table 35 show estimated annual acreage treated by ownership and region. Current levels of tree planting and seeding on all PNIF lands are less than half the levels of the soil bank era.

The first systematic evaluation of the possible effects of cost-effective management was completed in 1980 by the Forest Productivity Project of the Forest Industries Council. This project developed detailed estimates of the economic potential for increasing timber growth, by ownership, in 25 States that contain about 80 percent of the commercial forests in the United States,

The Forest Industries Council study estimated that profitable management opportunities could be undertaken on 139 million acres of commercial forestland in these 25 States if the minimum rate of return was 10 percent. The Forest Service, using a 4 percent return-on-investment criteria, estimated that 168

⁴¹R. Fisher, "Productivity in Florida's Third Forest," *Journal of Forestry*, vol. 79, 1981, pp. 613-615.

Figure 31.—Area Planted and Direct-Seeded, 1950-78 (million acres)



SOURCE: U.S. Department of Agriculture, Forest Service, *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D.C.: U.S. Government Printing Office, 1982), p. 229.

Table 35.—Area Planted and Direct-Seeded in the United States, by Section and Ownership, 1950-78 (thousand acres)

Year	Section					ownership			Farmer and other private
	United States	North	South	Rocky Mountain	Pacific coast	National Forest	Other public	Forest industry	
1950	488	137	285	15	52	45	54	153	237
1951	453	164	245	15	29	46	49	106	253
1952	520	191	250	15	63	50	67	143	260
1953	710	212	420	17	60	53	89	217	352
1954	808	236	506	17	49	54	70	265	419
1955	779	242	482	5	51	56	72	239	413
1956	886	235	574	7	70	61	84	257	484
1957	1,138	258	782	7	91	85	86	311	657
1958	1,533	285	1,080	7	161	89	119	370	955
1959	2,117	283	1,642	13	179	112	123	417	1,465
1960	2,100	308	1,567	14	212	134	130	521	1,315
1961	1,761	302	1,205	18	235	163	140	588	870
1962	1,366	270	816	27	253	198	151	443	573
1963	1,325	270	798	37	221	221	151	467	486
1964	1,313	269	756	42	246	208	161	485	460
1965	1,285	268	708	64	245	233	136	455	461
1966	1,281	265	696	69	251	237	144	475	425
1967	1,373	245	769	65	294	257	132	527	457
1968	1,439	281	795	69	294	269	128	604	437
1969	1,431	250	808	73	300	257	127	681	367
1970	1,577	225	925	70	357	261	131	763	422
1971	1,667	271	1,002	84	310	267	124	895	381
1972	1,647	211	1,014	68	354	268	114	828	436
1973	1,721	195	1,051	81	394	299	123	879	420
1974	1,576	168	1,037	65	306	272	116	836	352
1975	1,900	249	1,269	73	309	293	138	1,059	410
1976	1,858	184	1,172	76	426	292	135	1,040	391
1977	1,942	160	1,301	57	424	257	120	1,138	427
1978	2,072	233	1,245	74	520	296	124	1,145	507

SOURCE *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, DC: US Department of Agriculture Forest Service 1982) p. 231

million acres in the same 25 States presented “economic opportunities” for management (national forest land was excluded). Capital requirements for taking advantage of all of the management opportunities identified in the two studies would be high, both in aggregate (\$10 billion to \$15 billion nationwide) and on a per-acre basis.⁴²

Most of the opportunities identified involved establishing and maintaining softwood species in the East, primarily on private nonindustrial forestlands and often at a cost of more than \$100 per acre (table 36). Less costly management opportunities (such as management of existing hardwood stands to optimize growth)

⁴² *Analysis of the Timber Situation*, op. cit., p. 248; and Forestries Industry Council, *Forest Productivity* Report, p. 46.

received less attention. Planting softwoods on idle fields also is less expensive than stand regeneration on harvested sites, but this too was not emphasized in the two studies, which were conducted prior to 1983 cropland set-asides.

Many factors are believed to influence private landowners’ management decisions, and the most important ones seem to be closely related to potential return on the management dollar.⁴³ Other factors such as tract size and ownership tenure also are believed to be influential, especially on PNIF ownerships. In addition, there is evidence that timber manage-

⁴³ U.S. Department of Agriculture, Forest Service, *Economic Opportunities to Increase Softwood Production on Forest Lands*, vol. 11 (Investments) (Washington, D.C.: USDA Forest Service, 1981).

Table 36.—Costs per Acre of Achieving Management Opportunities Identified by the Forest Service and the Forest Industry Council

	Acres (million)	Total cost (million dollars)	Per acre (cost)
Forest Service:			
Reforestation/stand conversion	121.5	\$13,525	\$111.30
Stocking control	46.7	1,569	33.60
Forest Industry Council:			
Harvest and regeneration	48.2	4,072	84.50
Stand regeneration	16.4	1,872	114.15
Intermediate stand treatment	38.3	756	19.74
Stand conversion	33.3	3,353	100.69
Plant idle cropland	2.6	81	31.15

SOURCES Forest Industries Council, *Forest Productivity Report* (Washington, D.C.: National Forest Products Association, 1980); *An Analysis of the Timber Situation in the United States 1952-2030* (Washington, D.C.: U.S. Department of Agriculture, Forest Service, 1982)

ment costs have been rising faster than inflation since the late 1960's.⁴⁴

Markets

Uncertainty about future timber markets is perhaps the single greatest deterrent to intensified timber management, since investments need to be made decades in advance of harvest. Limited markets are an especially important constraint on private nonindustrial forests of the North, where the majority of stands support low-grade hardwood stands that historically have been in low demand. New manufacturing processes (such as waferboard plants) have improved markets for such materials in some areas. Expanded hardwood markets, particularly opportunities to sell lower grade, small-size hardwood timber, could stimulate investment in the conversion of less profitable hardwood stands to more valuable softwoods or could lead to improved hardwood management. Increased fuelwood consumption also could encourage such stand improvements if properly undertaken. Since only a small percentage of fuelwood harvesters seek professional advice, fuelwood removals probably are not improving existing stands appreciably.

Stumpage Prices and Market Structure

PNIF owners respond to increases in stumpage prices by making more of their timber

⁴⁴J. Moak, W. Watson, and P. Van Deusen, "Costs and Cost Trends for Forestry Practices in the South," *Forest Farmer Manual*, 1981, pp. 58-63.

available for harvest.⁴⁵⁻⁴⁶⁻⁴⁷ Seventy-three percent of PNIF owners surveyed in the Southeast said that they harvested their timber because they were offered a good price, while the second most important reason was that the timber had reached maturity.⁴⁸

Stumpage prices also influence the propensity of landowners to **manage** their timber, although the effect is less clear. Among PNIF owners in general, a poor market usually is not considered a serious land management problem.⁴⁹ However, landowners who see timber production as an important priority respond differently. For example, nonindustrial members of the American Tree Farm System (an industry-sponsored program providing recognition and information to landowners) said low stumpage prices more often than any other variable discouraged them from managing their tree farms more intensively.⁵⁰⁻⁵¹

⁴⁵Clark S. Binkley, *Timber Supply From Private Non-Industrial Forests, A Macroeconomic Analysis of Landowner Behavior*, Bulletin No. 92 (New Haven, Conn.: Yale University, 1981), p. 78.

⁴⁶Roger A. Sedjo and David M. Ostermeier, *Policy Alternatives for Non-Industrial Private Forests*, report of the Workshop on Policy Alternatives for Non-Industrial Private Forests [Washington, D. C.: Society of American Foresters and Resources for the Future, 1978], p. 22.

⁴⁷Clawson, *The Economics of U.S. Nonindustrial private Forests*, op. cit., p. 187.

⁴⁸Unpublished results of the 1981 Reforestation Survey.

⁴⁹Stoneland Research, "A Study of Private Woodland Ownership in the U.S.," report prepared for American Forest Institute, Washington, D. C., September 1974, p. 11.

⁵⁰American Forest Institute, "Profile of a Tree Farmer," *Tree Farm News*, February 1973, p. 4.

⁵¹American Forest Institute, "Tree Farm Survey Yields Interesting Data," *Tree Farm News*, summer 1979, p. 3.

PNIF owners in many areas are at a disadvantage in the marketplace because there are relatively few timber buyers. Because of the high ratio of transportation cost to wood value, markets for many tree species and grades of logs are highly localized and may be monopolistic in some respects, often with only one or two purchasers.

Information

PNIF owners often know little about current wood prices, volume estimation techniques, and other aspects of stumpage sales. Thus, many owners have little chance or ability to influence the price they receive for their wood other than electing not to sell. PNIF owners in some areas are seeking more professional assistance and getting better prices as a result,⁵² but they are exceptions to the rule.

In addition, owners also may not know enough about potential yields, market characteristics, and timber prices to make good decisions about investing in intensive forest management. Computerized information programs may be an important solution to this problem. The Tennessee Valley Authority (TVA), for example, has developed a software program usable in personal computers that can facilitate timber management decisions (see box I), TVA also is training consulting foresters as part of an outreach effort to expand the use of this tool. Plans by USDA to place computers in county extension offices could broaden the use of such systems.

Length of Ownership

The private nonindustrial forest owner typically owns a parcel of land for a relatively short time. According to the Forest Service report, *The Private Forest Land Owners of the United States*, more than one-fifth of all private forests were acquired by the present owner between 1970 and 1978, while another 20 percent were acquired between 1960 and 1969. In contrast, only 27 percent of the commercial forest

area was owned by the present owner for at least 30 years.⁵³ These estimates include forest industry land, which tends to be held for long periods of time. Transfer of ownership on PNIF lands, therefore, may be more rapid.

Tenure may be slightly longer for lands whose owners name timber production as a major objective, but the difference does not appear to be significant. PNIF owners as a whole acquired their land somewhat more recently than did members of the American Tree Farm System, according to one survey, but 24 percent of American tree farmers still have owned their property less than 10 years.⁵⁴

Short tenures may have a beneficial effect on timber harvest, since owners who are reluctant to harvest soon may be replaced by new owners with new objectives. However, the rapid transfer of forest real estate from one owner to another may complicate efforts to increase the intensity of PNIF management. Most private forestland is held in a single ownership for less than 30 years—the minimum amount of time required even in the South for a stand to reach maturity. It is uncertain whether new owners in general continue management efforts begun by the prior owner.

Tract Size

various studies show that owner inclination to harvest timber correlates with parcel size. The larger the holding, the more likely it is that the owner will harvest timber from it. According to one researcher, "A shift in the distribution of parcel size to small holdings will, all else equal, lead to less timber supplied."⁵⁵ Even when owners of small parcels want to harvest, small-scale logging may be unattractive to large buyers because of the high cost of moving equipment from one logging site to the next. Cooperative management approaches and small-scale machinery can alleviate this problem.

⁵³Birch, Lewis, and Kaiser, *The Private Forest Land Owners of the United States*, op. cit., p. 38.

⁵⁴American Forest Institute, "Profile of a Tree Farmer," op. cit.

⁵⁵Binkley *Timber Supply From Private Non-Industrial Forests*, op. cit., p. 79.

⁵²Personal communication with J. E. Carothers, Louisiana Tech University, Aug. 2, 1982.

Box I.—Information Technology and Forest Management

Computer technology can assist forest managers in several ways through easy storage and rapid retrieval of data, development of management strategies for forestland at various geographic scales, and education and training for foresters, landowners, and decisionmakers.

Computerized information systems have been used by the Forest Service in developing individual forest plans (FORPLAN) as well as in modeling long-range forest needs. The Forest Information Retrieval System (FIR) administered by the Southeastern Forest Experiment Station has for many years provided landowners, industry, and government with easily retrieved, low-cost data at the local, State, and regional levels. The system is commercial and users pay for information retrieved.

With the advent of the microcomputer, personal computers, and associated software programs, computers may now facilitate PNIF management operations. Several forest management software programs now are commercially available. One of the leaders in the development and application of computer technology to forest management is TVA, a public corporation established by the Federal Government in 1936. TVA has developed a software program (WOODPLAN) that combines forest management and business administration that can be used in personal computers.

WOODPLAN programs now available permit users to process timber inventory data into standard stock tables, to forecast yields according to alternative management strategies, and to predict potential lumber yields and corresponding value based on current prices. Financial analysis programs, as well as a "caretaker program" which will store, retrieve, and process information for clients of consulting foresters, facilitate management decisions.

The WOODPLAN program plays an important role in an innovative cooperative effort by TVA, the Forest Service, and the Association of Consulting Foresters to establish self-employed consulting foresters in the region. About 10 consulting foresters have been setup in business since the program was established. TVA presently guarantees work to these foresters during their first 3 years of business to help them get started.

Distribution of the WOODPLAN program has been facilitated through the establishment of Forest Service and State forestry agency computer terminals in central locations in several States. TVA intends to charge for the program in time. The program is offered by at least one commercial firm.

National and regional data comparing management intensities by tract size is not available. However, a similar relationship probably exists. Owners of smaller tracts probably are less likely to manage their land than owners of larger tracts, although there is no data to support this hypothesis. Management of small tracts often is relatively more expensive than large tracts, because it lacks economies of scale. The Forest Service estimates that the per-acre cost of site preparation and planting, pre-commercial thinning, and removal of trees can

be two to five times higher on a 10-acre parcel than on a 160-acre parcel.⁵⁶

Financial Considerations

The peculiar economics of PNIF management often have been singled out as a major roadblock to improved productivity. Specifically, investment requirements or costs of man-

⁵⁶U. S. Department of Agriculture, *The Federal Role in the Conservation and Management of Private Nonindustrial Forestlands*, op. cit., p. 20.

agement often are high—as much as \$100 to \$200 per acre for stand establishment—and cash returns cannot be expected for at least 15 years. This lack of immediate or regular income may discourage PNIF owners, especially those who may not be able to realize a return within their lifetimes. In addition, investments in timber management are illiquid and risky due to potential damage from fire, insects, and disease.

Also, capital sometimes has not been readily available for PNIF management, but this dearth may be improving as forestland becomes more valuable. Although data on forestland prices is fragmentary, anecdotal evidence suggests that in many areas forest prices increased even more rapidly than farm prices, which rose 900 percent between 1950 and 1977 before tapering off recently.⁵⁷

Increased land values, coupled with financial incentives (such as low-rate long-term loans with no payback penalty offered to PNIF landowners by Federal Land Banks) permit landowners to use their timberlands for collateral. Federal, and in many cases State, tax codes also give preferential treatment to timber acreage. In addition, limited assistance has been offered to PNIF owners through Federal programs such as the Agricultural Conservation Program and the Forestry Incentives Program, although funding for these programs currently is uncertain.

Insurance companies, banks, and other commercial investors are showing interest in owning and managing PNIF lands, especially in the South.⁵⁸ The E. F. Hutton Group, which has acquired, managed, and sold timber in the Southeast since 1979, bought 40,000 acres of southern forestland for commercial management in 1981. The First National Bank of Atlanta's "Collective Timberland Fund" is an intermediary for pension funds and for other investors in managed commercial forestlands. Since

these companies do not operate mills, they are not classified as part of the forest products industry.

Federal and State Programs for Private Forestland Management

Federal and State tax policies offer preferential treatment to timberland owners. Federal tax incentives that make timber management more attractive to private investors include the capital gains treatment of timber income, the deductibility of some reforestation costs, the preferential valuation of forestland for estate tax purposes, and the deductibility of timber losses (see box J). Many State governments also provide preferential estate tax treatment and have established preferential assessment of forestland for property tax purposes.

The Federal provision allowing capital gains treatment of timber income entails a greater subsidy to timberland owners than all other Federal programs combined, but does not require that tax savings be used for management activities. Although the favorable tax treatment of timber income probably has encouraged management intensification, its direct effect on investments is difficult to establish, due to their long-term nature and many other factors. Another Federal tax provision, adopted in 1980, allows a deduction for reforestation expenses, up to a maximum of \$10,000 annually under certain circumstances.

Several Federal programs to provide information, technical help, and direct cost-sharing assistance to private landowners have been established over the last 50 years. These programs are administered by several USDA agencies besides the Forest Service, including the Soil Conservation Service, the Agricultural Stabilization and Conservation Service, and the Cooperative Extension Service. Most funds go through the Forest Service to State forestry agencies for subsequent dispersal, although some USDA agencies administer forestland assistance through general agriculture programs.

The most important cost-sharing program is the Forestry Incentives Program (FIP), which

⁵⁷Healy and Short, *Market for Rural Land*, *op. cit.*, p. 9.

⁵⁸See, for example, E. F. Hutton & Co., Inc. *Hutton Southern Timber Partner I: Prospectus*, Oct. 30, 1981; and The First National Bank of Atlanta, *Timberland, A Growing Investment From the Ground Up*, May 1, 1981.

Box J.-Federal Tax Incentives to Timberland Owners

Capital Gains Treatment of Timber Income—Under the current IRS Code, gains on the sale of timber may be treated as capital gains rather than as ordinary income—a provision favored by the forest products industry and timberland owners since capital gains are taxed at a lower rate than ordinary income. Capital gains treatment makes timber growing more lucrative, although there is no requirement that owners spend tax savings on management investments. By one estimate, funds available to one subsector of the forest products industry for investment in timberlands and plants and equipment would have been 5 to 7 percent less between 1971 and 1978 if the capital gains provision did not exist.⁵⁹ If timber-growing alone were the sole purpose of the capital gains provision, however, other tax options (such as investment tax credits) would be a more direct route to assure that Federal tax expenditures were contributing to management. Current Federal revenues foregone because of the provision are about \$500 million per year, two-thirds of which goes to corporations, one-third to individuals.

Deductibility of Reforestation Costs—In 1980, Congress amended the IRS Code to permit “above the line” deductibility of certain reforestation expenses—up to a maximum of \$10,000 annually under certain circumstances—with associated limited income tax credits. Under the amortization schedule established by the 1980 law, a landowner needs to incur reforestation expenses of \$10,000 per year for 7 years before the maximum deduction can be taken. Although directly linked to reforestation expenditures, this tax provision is not likely to affect significant acreage since it currently covers reforestation costs of about 100 acres per landowner (assuming \$100 per acre in costs). Current Federal tax expenditures accruing from the program are \$20 million to \$30 million per year—about 200,000 to 300,000 acres, assuming \$100 per acre reforestation costs. Most of these benefits now go to corporations, but the individual share is expected to increase in the next 2 or 3 years as noncorporate owners become more aware of the program.

Federal Estate Taxes—Several provisions in Federal estate tax law benefit people who inherit forestland. Heirs are exempt from Federal estate taxes on gains in property values realized prior to forestland inheritance. The provision eases tax burdens on those who harvest inherited timber, and in theory it makes more money available to landowners for post-harvest management. Estate tax payments may be spread over a 10-year period if forest property comprises 35 percent of the estate’s value and therefore may discourage premature cutting of timber stands to pay taxes. Forestland may be assessed for estate tax purposes according to its current use rather than for its market value—a provision which also theoretically removes incentives to prematurely cut timber. The requirements for use of this benefit are strict, however, and are thought by some to preclude its widespread use.

Casualties, Thefts, and Condemnations—Deductions are permissible for timber losses due to fire, storm or other casualty, theft or condemnation by a public agency if the timber is not salvageable and not covered by insurance. Although not a tax provision, the Federal Crop Insurance Act of 1980 (Public Law 98-365) authorized a pilot program related to insurance against risks and losses associated with forest industry needs (including appreciation). The initial pilot program is not expected to begin until late 1983.

⁵⁹Joseph E. Carrier, et al., *Economic Considerations Relating to Capital Gains Taxation of Timber Income*, report prepared for Forest Industries Committee on Timber Valuation and Taxation, Stanford Research Institute, September 1981, p. 58.

is jointly administered by the Forest Service and the Agricultural Stabilization and Conservation Service. Between its 1973 inception and 1981, some \$88.8 million in FIP cost-sharing

assistance was delivered for timber stand improvement and reforestation on about 2.2 million acres of private forestland. FIP assistance is restricted to owners of between 10 and 1,000

acres (5,000 acres under certain circumstances) and to sites capable of producing 50 ft³/acre annually in natural stands.

A recent evaluation of the FIP program by the Forest Service and the University of Minnesota concluded that the program has gained in efficiency over time.⁶⁰ The average size of tracts has increased and 70 percent of the treated acres in 1979 were on timberlands capable of producing 85 ft³/acre/year in natural stands. Nonetheless, most of the treated sites in 1979 were small (41 acres for reforestation and 31 acres for timber stand improvement), and about 6 percent of the acres treated in 1974 had not been retained by the owner through 1981. Several States have established their own forestry incentives programs since FIP was enacted. The Reagan administration, in its fiscal year 1984 budget proposal, has requested that Congress consolidate FIP with the Agricultural Conservation Program and has sought no funds for FIP.

Three 1978 enactments—the Cooperative Forestry Assistance Act (Public Law 95-313), the Renewable Resources Extension Act (Public Law 95-306), and the Forest and Rangeland Renewable Resources Research Act—placed additional emphasis on technical assistance, research, education, and information programs for private forestry. These programs have the potential to reach more landowners than direct cost sharing, but funding has been limited, especially for education and information. In addition, several Federal environmental laws have direct and indirect effects on timber management on private lands (see box K).

For many years, State governments have provided forestry-related technical and information services to forest land owners, as well as fire suppression and other extensive management assistance. Currently, these programs are supported by the Forest Service's Rural Forestry Assistance Program.

Recently, State legislatures have expanded forestry-related activities. A 1981 survey by the National Conference of State Legislatures found significant modifications in State programs during the 1970's⁶¹ (table 37). State programs at the end of 1981 included:

- preferential forestland tax treatment in at least 22 States;
- six cost-sharing programs, either independent of or supplemental to the Federal Forestry Incentives Program;
- 15 State forest practices acts that regulate harvesting activities, environmental practices or reforestation;
- other initiatives designed to retain forestland in productive use; and
- forestland retention Provisions of various kinds.

Most of the State programs are intended to encourage timber production and management. Some State forest practices acts, however, have more complex objectives, including environmental protection which in some instances may have negative effects on intensified forest management. California's law (California Public Resources Code Division 4, ch. 8), which is the most stringent, is believed by some to actually discourage timber management, even though one of its goals is to improve it, because of high compliance costs. One analyst makes informal estimates of \$10 to \$40 per thousand board-feet for additional costs resulting from implementation of practices required by law and concludes, ". . . it seems quite unlikely that the costs associated with rule requirements are likely to have much effect on the magnitude of operations, except in a limited number of marginal cases. Quite clearly, however, the net returns from timber harvesting to some stumpage owners have been significantly reduced."⁶²

⁶⁰Christopher D. Risbrudt and Paul V. Ellefson, *An Economic Evaluation of the 1979 Forestry Incentive Program* (St. Paul, Minn: University of Minnesota, Agricultural Experiment Station 550, 1983).

⁶¹Cited in Gordon Meeks, Jr., "State Incentives for Non-Industrial Forests," *Journal of Forestry*, January 1982, pp. 18-22.

⁶²Henry J. Vaux, "State Interventions on Private Forests in California," paper presented at the National Conference on Coping with Pressures on U.S. Forestlands, sponsored by Resources for the Future, Mar. 30-31, 1981, Washington, D.C., p. 36.

Box K.—Environmental Regulations and Timber Management

Environmental damage is to some extent unavoidable in timber harvesting and management activities, but many of these impacts can be ameliorated through environmentally sound management. Environmental protection is a key management objective of congressional policy articulated for Federal lands. Several recent Federal and State laws related to water quality, air pollution control, and chemical use affect forest management activities on private lands, although often less directly. These laws have been cited as potential barriers to more intensive timber management, but empirical evidence that this is the case is limited to relatively few instances.

Clean Water—Certain provisions of the Federal Clean Water Act (33 U.S.C. 1251 et seq.) affect forestry activities, but to date implementation of these provisions has not substantially impeded silvicultural activities. The act's section 208-aimed at reducing nonpoint pollution (including that which results from timber harvesting and other silvicultural practices)—has been implemented primarily through State level educational efforts and voluntary compliance with forest practice guidelines. It is not known whether these voluntary guidelines have been widely adopted by PNIF owners or how widely the guidelines diverge from common practices, but it appears unlikely that timber production would be significantly affected by compliance. Some foresters feared that section 404 of the act would restrict some practices for crossing streams and forest drainage areas, especially in the South where wetlands abound. To date, however, forest managers apparently have been successful in qualifying for exemption from 404 provisions or in obtaining the necessary permits to conduct forestry operations. The extent to which 404 restrictions may diminish forest productivity or discourage landowners from intensifying management is speculative but appears to be minimal.

Clean Air—Prescribed burning of forestlands is regulated under particulate emission provisions of the Clean Air Act (42 U.S.C. 7401 et seq.), and forest management interests have feared that these restrictions may impair managers' ability to effectively use fire as a silvicultural tool. However, OTA found no evidence that burning activity has been significantly constrained. Permit and notification requirements do not appear to be burdensome, and smoke management regulations seem to restrict scheduled burning activity only rarely.

Chemical Use—Regulation of chemical uses under the Federal Insecticide, Fungicide, and Rodenticide Act (92 Stat. 819-838) is restricting timber management activities in some regions. The most important restriction is a ban on forestry uses of 2,4,5-T, but the effect of the ban on forest productivity is uncertain. Some States' legal requirements for applicator licensing and water monitoring, coupled with rising insurance Premiums, may result in higher Costs of chemical application

Table 37.—Selected State Activities Related to Private Forest Management, 1981

State	Cost sharing	Tax provisions	Forest practice acts	Retention of forestland
Alabama ^a	Considered but not adopted	Fixed assessment rate on land Timber exempted from ad valorem Severance on timber	Voluntary with recommended guidelines for nonpollut source pollution ^b	—
Alaska ^a	Authorization exists but no appropriation to date	No special tax treatment	Requires reforestation of all public and private harvested lands; regulates harvesting practices	Authorization exists for retention of forestland in State ownership for multiple use, but no lands designated
Arizona	—	Ad valorem with market-value assessment on forestland and timber on more than 40 acres	—	—
Arkansas ^a	—	Use value assessment on productivity of forest land. Severance tax on timber products. Five cents per acre fire protection tax	—	—
California ^a	80- to 90-percent cost-sharing for reforestation, Timber stand improvement and land conservation-1 978	Use valuation on zoned land; yield tax on severed timbers	Comprehensive regulations to maintain timberland productivity water quality, and other values	Favorable tax treatment is conditioned on timberland preserve zoning, permit is required to convert
Colorado	—	Ad valorem tax on land; conditional exemption of increased value as result of planting	—	Educational program to promote multiuse
Connecticut ^a	—	Use valuation on land; yield tax on land and timber	—	Open-space law provides favorable tax treatment for classified timberland
Delaware	—	30-year exemption for established commercial plantation of 5 acres or more	—	—
Florida	Considered but not adapted ^c	Forestland valuation based on potential yield according to site index as an annual ad valorem tax on capitalization of net income expected from yield	—	—
Georgia	—	No special treatment for forest lands	—	—
Hawaii	—	Use valuation on land; yield on severed timber. Private lands under public management are exempted	—	Statewide zoning by land-use commission provides some protection
Idaho	—	Yield tax on severed timber 61 per acre assessment on land	Requires reforestation and regulates harvesting practices ^b	—
Illinois	Considered and defeated in legislature 1979 and 1980	No special treatment for forestlands	—	—
Indiana	—	Lands classified as forest are eligible for \$1 per acre assessment	Classified forestlands must meet minimum management standards	Tax provision of the Forest Classification Act encourages retention
Kansas	—	Use valuation is authorized but not implemented	—	—
Kentucky ^a	—	Use valuation on land; standing timber is included in land valuation	—	—
Louisiana	Considered but not adopted	Use valuation on land; severance tax on timber	—	—
Maine	—	Tree Growth Law provides productivity valuation; standing timber included with land	Land Use Regulation Law regulates harvesting in shore lands and hazard areas	—
Maryland	—	Assessment limits on classified lands; income tax credit being considered	Forest Conservancy Law and Pine Reforestation Law	Forest Conservancy Law and its tax provisions are intended to encourage retention

Table 37.—Selected State Activities Related to Private Forest Management, 1981 (continued)

State	Cost-sharing	Tax provisions	Forest practice acts	Retention of forestland
Massachusetts.	.	Land is taxed at fixed rate; yield tax on severed timber	Slash reduction, wetlands protection, and harvesting plans are required	Forest Tax Law is intended as Incentive for retention
Michigan	—	Classified forestland is taxed at a fixed rate; yield tax on timber	—	—
Minnesota.	50-percent cost-share for 7-county area administered by Soil and Water Conservation District, 1979	Productivity valuation on land plus yield tax at fixed rate on land. Valuation on timber is at fixed rate and according to management agreement	—	—
Mississippi	75-percent cost-sharing Program funded by severance tax with \$37 per acre limit, 1974	Ordinary Property tax on land; severance tax on timber	Mississippi forest harvesting law	—
Missouri ^a	—	Fixed assessment on classified land (voluntary tax law); yield tax on timber harvested from classified land only	—	—
Montana	—	Land is assessed by productivity and accessibility for ad valorem taxes	—	—
Nebraska.	—	Related to grassland value	By executive order, owners must have State approval for tree cutting	—
Nevada	—	Use value assessment on classified land; yield tax on severed timber	Very extensive seed-tree requirements and strict harvesting standards	—
New Hampshire	—	Use valuation on land if certified as tree farm; yield tax on severed timber ^d	Several laws regulate timber harvesting techniques	—
New Jersey ^a	—	Use value assessment base on productivity	Voluntary with recommended guidelines for nonpoint pollution	Pineland Protection Act limits development and encourages forestry or agricultural use on 1.1 million acres
New Mexico ^a	—	Productivity valuation on land; severance and excise tax on timber	Forest Conservation Act requires reforestation, seed tree, harvesting standards, and fire prevention	—
New York ^a	—	Forestland is assessed at a reduced rate; yield tax	Extensive technical assistance including management planning and timber marking	Tax treatment is intended to encourage retention and management of forestland
North Carolina ^a	60-percent cost-sharing on a maximum 100 acres per year funded by primary products assessment and State appropriations, 1978	Use valuation on land; exemption for standing timber. Amortization of timber receipts	—	—
North Dakota	—	Differential valuation in lieu of ad valorem taxes on land and timber	—	—
Ohio.	—	Forestland is taxed at 50 percent of normal rates, use valuation is optional	—	—
Oklahoma	—	Market valuation on land; ad valorem on timber	Voluntary guidelines developed by forestry committees	—
Oregon ^a	Considered but not adopted ^d	Use valuation on land; income tax credit for reforestation capitalization of income over rotation; yield tax on timber	Practice Act provides for reforestation, reading, harvesting, chemicals, and slash burning	State land-use law requires local use plans to conform with State goals and guidelines

Table 37.— Selected State Activities Related to Private Forest Management, 1981 (continued)

State	Cost-sharing	Tax provisions	Forest practice acts	Retention of forestland
Pennsylvania	—	Use or productivity valuation on forest reserves	—	Assessment Act of 1974 intended to stimulate retention
Rhode Island	—	15-year exemption, or use valuation on land	—	1980 revisions allow present value assessment on lands with management plan
South Carolina	75-percent cost-sharing for reforestation, 1981	Fixed assessment based on value and productivity of land	Voluntary guidelines by forestry association ^b	—
South Dakota	—	Ad valorem at market rates on land and timber	—	—
Tennessee	—	Current-use valuation on land and timber on classified forestlands	—	1976 current use tax law is intended to preserve forest, agricultural, and open-space land
Texas	Texas Reforestation Foundation funded by industry for 65-percent cost-sharing. Initiated 1981—no legislative action	Assessment on land based on capitalized value of average net income over preceding 5 years	—	—
Utah	—	Timberland is assessed as grazing land	—	—
Vermont	—	Use valuation on managed forestland	—	Use value appraisal law is intended to encourage forest and agricultural land conservation
Virginia	75-percent cost-sharing for reforestation of pine up to \$90 per acre, 1970	Use valuation on classified land; severance tax on timber reforestation on nonindustrial public forests is funded by industry tax	Seed trees must be left after harvesting, or some other plan made for ensuring regeneration	Land-use tax of 1971 is intended to preserve agricultural forest, and open-space lands; Agricultural and Forest Districts Act authorizes zoning
Washington	—	Fixed tax on land plus yield tax on land and timber, or optional use valuation; severance tax on timber	Minimum reforestation standards and harvesting guidelines	Conservation of forestland is intended by tax incentives
West Virginia	—	Severance tax on timber	Voluntary by State Forest Practice Standards Committee ^b	—
Wisconsin ^a	—	10-year fixed rate assessment per acre on land plus 10-percent yield tax on stumpage value	—	Tax structure intended to prevent forests from destruction
Wyoming	—	Ad valorem	—	Mineland Reclamation Act includes restocking of mined forestlands

^aResponded to request for review with corrections and comments

^bSources: Elertson and Cabbage (1980) and Klein (1980)

^cSource: N. Williams. "A Study of State Cost Sharing Programs for Reforestation and Timber Stand Improvement on Nonindustrial Private Forests." unpublished report, U.S. Forest Service, Washington, D.C., 1978

^dSource: Forest Industries Committee on Timber Valuation and Taxation (1979)

SOURCE: Gordon Meeks, Jr., "State Incentives for Non-Industrial Private Forestry," *Journal of Forestry*, January 1982.