Hardwood timber supplies in the United States

William A. Bechtold and Raymond M. Sheffield

Hardwood inventories are at their highest levels in more than 50 years, and demand for hardwood products is expected to increase as softwood supplies decline.

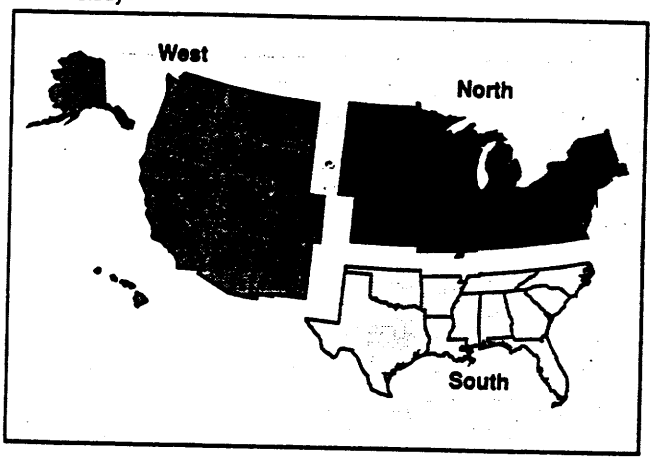
Long recognized for their wildlife, watershed, and aesthetic value, hardwoods are becoming increasingly important from the standpoint of timber production. The abundance of hardwood inventory volume, technological advances allowing greater substitution into softwood markets, and relatively low stumpage prices have generated a growing interest in increased utilization of the hardwood resource. The objective of this paper is to provide a broad overview of present and expected future hardwood timber supplies in the United States.

In order to monitor the nation's forest resources and develop policies for their management, Congress has directed the Secretary of Agriculture through the Renewable Resources Planning Act of 1974 (RPA) to assess periodically the current and anticipated forest resources in the United States. Most of the information in this paper is derived from the timber statistics reported in conjunction with the latest of these national evaluations—the 1989 RPA Assessment (*1–3*). Documents describing the outlook for nontimber forest resources are also available.

Timber data presented in the 1989 Assessment were gathered from two main sources: the National Forest System and the regional Forest Inventory and Analysis (FIA) Work Units of the USDA Forest Service. Statistics for western national forests were provided by the National Forest System. Resource statistics for the Eastern United States, as well as data for non-national forest lands in the West, were supplied by the FIA network. Authorized by the Forest and Rangeland Resources Research Act of 1978, there are seven FIA units responsible for monitoring forest resources on public and private lands in various subregions of the country. To simplify our discussion of the hardwood resource, all of the detailed subregional data available in the RPA documents have been collapsed into three major regions—West, North, and South, as defined in **Fig. 1**.

The first half of this paper is devoted primarily to the current hardwood resource as it exists today. Since there are timing differences among the various surveys feeding into the RPA assessment, all current resource data were adjusted to common years: 1987 for area and inventory volume statistics and 1986 for growth, removals, and mortality. The second half of the paper describes past trends and future projections. The RPA analysis provides a variety of future simulations extending to the year 2040. These alternate futures are based on various assumptions concerning demand, supply, prices, and harvest. The simulations presented here are the base projections, intended to gauge the future direction of the resource under the present and most likely course of action.

1. Three major geographic regions of the United States as defined in this study

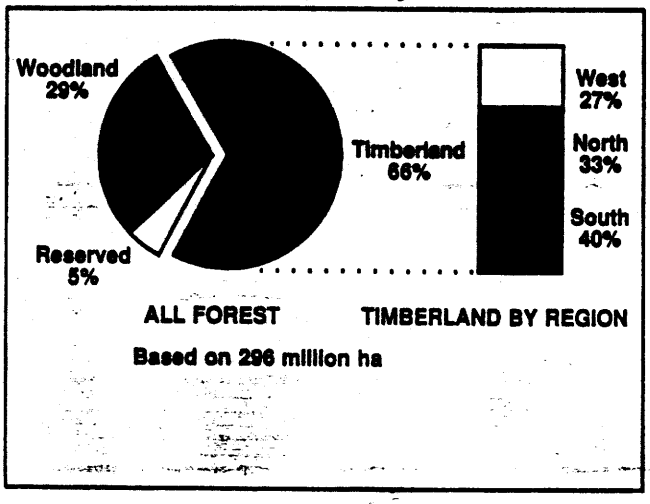


Forest area

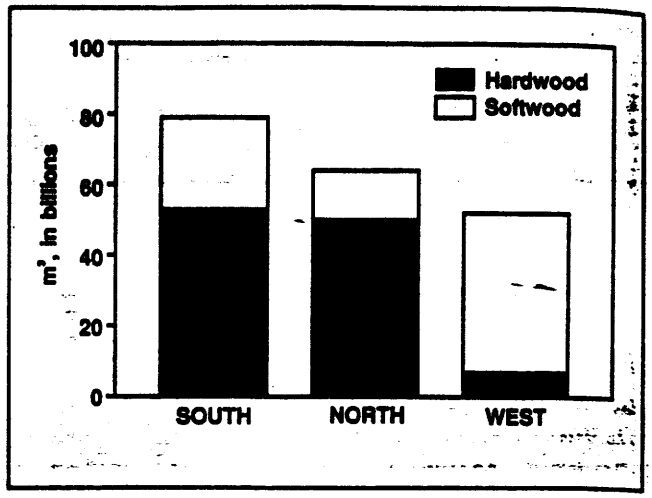
One-third of the total land area in the United States is occupied by forest. The productivity and composition of this resource varies tremendously, ranging from slash pine plantations on 12-year rotations in Florida to 4000-year-old bristlecone pines at timberline in California. Of the total forest area, 66%, or 196 million hectares (ha), qualifies as timberland, as illustrated in **Fig. 2**. This timberland is capable of producing at least 1.4 m^3 per ha of wood annually. Another 5% exceeds the minimum productivity standard but is set aside for such nontimber uses as parks and wilderness areas. The remaining 29% is classified as woodland, which is not capable of producing 1.4 m^3 per

Bechtold and Sheffield are resource analysts with the USDA Forest Service, Southeastern Forest Experiment Station, P.O. Box 2680, Asheville, N.C. 28802.

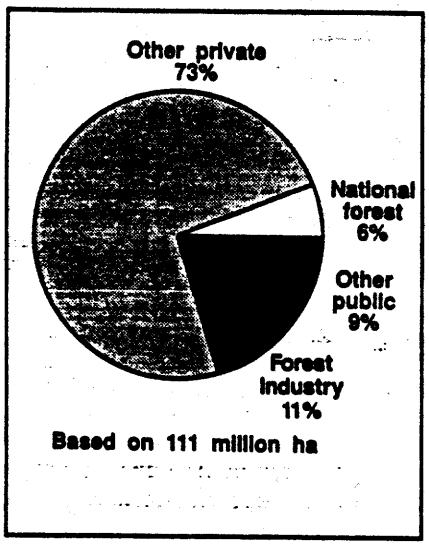
2. Timberland, reserved forest, and woodland in the United States, and timberland acreage by geographic region, 1987



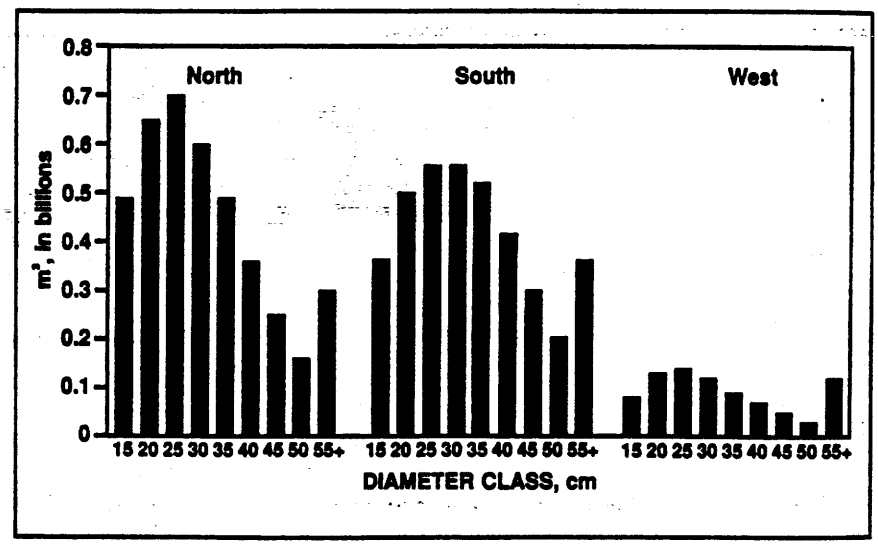
3. Timberland acreage in the United States by geographic region and forest type, 1987



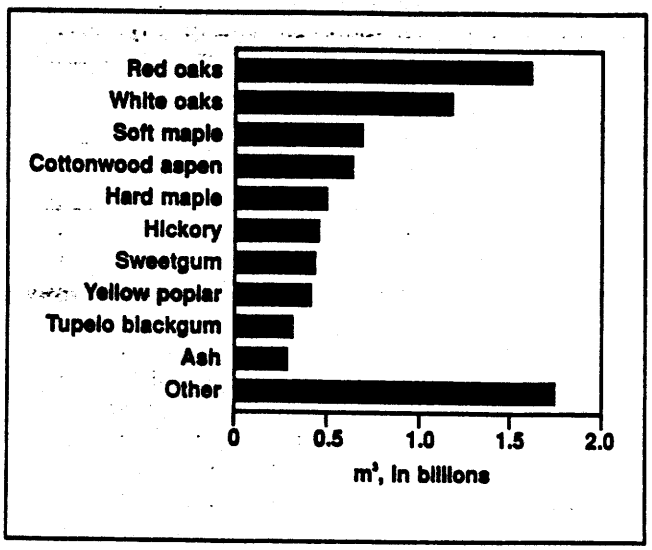
4. Hardwood acreage in the United States by ownership class, 1987



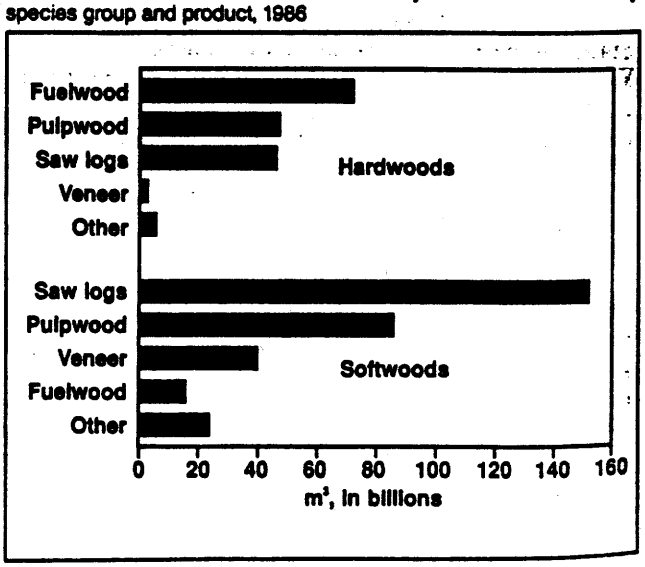
5. Hardwood volume in the United States by geographic region and diameter class, 1987



6. Hardwood volume in the United States by species, 1987



7. Volume of roundwood harvested annually in the United States by species group and product, 1986



ha but is vitally important for domestic range, watershed protection, and wildlife habitat. Nearly all the woodland is located in the West; over half is in Alaska.

This analysis focuses on that portion of the forest resource classified as timberland. By region, 27% of the timberland in the United States is located in the West, 33% in the North, and 40% in the South. The western share may seem low, especially since the total land area of that region is equal to the combined area of the northern and southern regions, but keep in mind that a high proportion of western woodland falls below the minimum production standard necessary to qualify as timberland.

Some 57% of all timberland (111 million ha) is currently dominated by hardwood. The vast majority of the hardwood resource is located in the two eastern regions, where 94% of the nation's hardwood cover types are concentrated. Hardwood forests dominate the landscape in the East, exceeding the area in softwoods by about 4:1 in the North and 2:1 in the South, as shown in **Fig. 3**. Hardwood stands form only a minor component of western forests, where they make up just 13% of the timberland area.

Since the bulk of the hardwood resource is centered in the East, the hardwood ownership pattern is governed by eastern forest ownership patterns. Nearly three-fourths of all hardwood stands are owned by private individuals and corporations other than forest industry, as illustrated in **Fig. 4**. National forests and other public agencies manage another 15%; forest industry owns the remaining 11%.

The hardwood ownership breakdown contrasts sharply with the breakdown for softwoods, which is more reflective of western ownership patterns. Only about a third of the softwood area falls into the nonindustrial private category, while nearly half is in the public domain.

Inventory volume

The volume of solid wood in all live hardwoods 13 cm in diameter at breast height (DBH) and larger now totals 10 billion m^3. Of the total, 13% is considered cull because of nonmerchantable species, poor form, or rot. The remaining 8.6 billion m^3 qualify as growing stock. Volume of hardwood growing stock is split evenly between poletimber and sawtimber. Sawtimber is defined as the volume to a 23-cm top in trees greater than 28 cm DBH. Trees between 13 cm DBH and 28 cm DBH, as well as the tops of sawtimber trees, are classified as poletimber. Proportions of hardwood cull in each of the three individual regions are all close to the national average of 13%. About 90% of all hardwood growing-stock volume is concentrated in the East, almost equally distributed between North and South. Most of the remainder is on the Pacific coast.

By 5-cm diameter class, the distribution of hardwood growing stock peaks at 25 cm DBH—indicating that a considerable number of hardwoods are harvested when they reach 30–35 cm. Although hardwood volume peaks at the same diameter class in all three sections of the country, there are some differences among regions, as shown in **Fig. 5**. In the North, the arrangement of hardwoods by size is skewed toward the smaller diameter classes and rapidly tails off above 25 cm DBH.

Hardwoods in the South and West are more evenly distributed across the range of diameters, with some buildup evident in the larger classes. The presence of more large trees in the South is related to unfavorable market conditions for hardwoods through the middle part of the century, as well as to accessibility problems. A sizable portion of the southern hardwood resource occurs on steep slopes in the Appalachian Mountains and deep swamps in the Coastal Plain and Mississippi River basin. In the West, a similar representation of trees in the larger size classes is mostly caused by limited demand.

As a group, oaks are more common than any other hardwood species, as shown in **Fig. 6**. They comprise nearly one-third of the hardwood growing-stock inventory. About 45% of the oak volume is in select species preferred by the hardwood flooring and furniture industries. Although there is an apparent abundance of premium species, much of this volume is in small trees, which limits its utility for products where quality is essential. In addition to oaks, other species found in abundance include maples, aspen, hickory, sweetgum, yellow poplar, blackgum, and ash. Overall, the hardwood resource is about evenly divided between soft- and hard-textured species.

Oaks account for the largest share of growing-stock volume in both the North and the South, but the mix of oak species differs considerably between these two regions. At 58%, the North has a higher proportion of oak volume in select species than the South, where the comparable figure is 35%. Besides the oaks, other prevalent species in the North include maple and aspen. In contrast, southern hardwood forests contain substantial volumes of gum and poplar. The hardwood resource in the West is comprised mainly of aspen, alder, and oak.

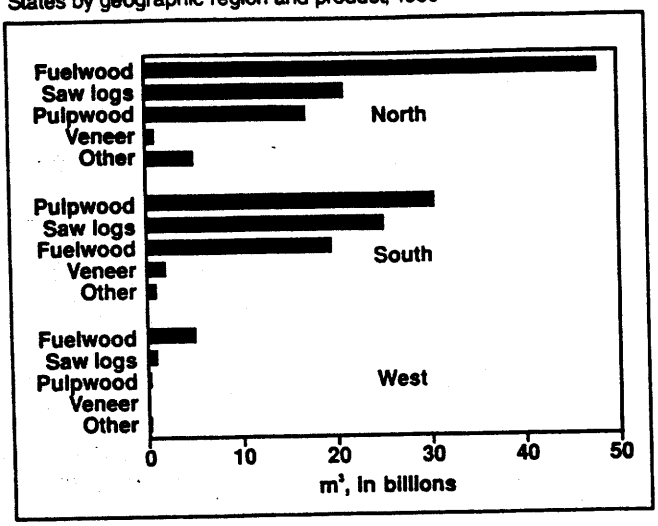
Timber products output

Counting all timber products made from both growing stock and nongrowing stock roundwood, fuelwood is the chief hardwood product in the United States, as indicated in **Fig. 7**. More than 41% of the annual hardwood harvest is burned for fuel. The bulk of this harvest is consumed for residential use, as industrial boilers utilize mill waste and bark. Other major uses of hardwoods include pulpwood and saw logs, each accounting for 27% of the annual harvest. Although fuelwood is the main product produced from hardwoods, much of the hardwood volume harvested for fuel originates from cull trees, stumps, tops, limbs, or trees growing in a nonforest setting.

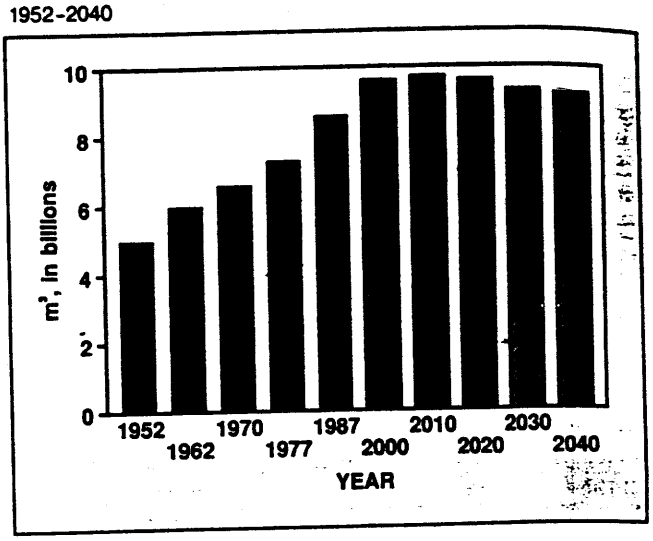
In contrast, fuelwood accounts for only a minor share of the softwood product output. Saw logs are the primary softwood timber product, responsible for half the output from softwood roundwood. Pulpwood is the second most important softwood product as well as the second leading product when all species are combined. Although softwoods are the primary source of raw material for pulp, hardwoods are becoming increasingly important. Hardwood species now account for 29% of the total consumption of roundwood by the pulp industry, up from 11% in 1952.

There are some notable regional differences in hardwood product output from roundwood, as shown in **Fig. 8**. Northern forests provide 52% of the hardwood harvest in the United States, while the South is the source for 44%. Fuelwood is far and away the leading hardwood product

8. Volume of hardwood roundwood harvested annually in the United States by geographic region and product, 1986



9. Hardwood inventory trends and projections in the United States, 1952-2040



in the North, followed distantly by saw logs and then pulpwood.

The order of hardwood product importance is the same in the West, only on a smaller scale. However, the order is completely reversed in the South, where there is considerably more industrial demand for hardwoods. Pulpwood is the leading timber product from southern hardwoods, followed by saw logs and then fuelwood. The high demand for domestic fuelwood in the North is the result of higher-than-average fossil fuel prices in that region, as well as proximity to large population centers.

Inventory trends, projections, and availability

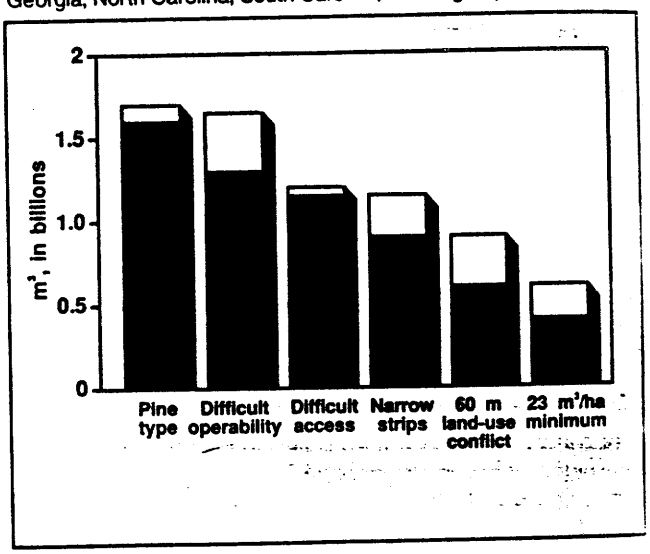
Between 1952 and 1987, the inventory of hardwood growing stock has expanded steadily, increasing by 69% from 5.1 billion m³ to 8.6 billion m³. **Figure 9** shows this expansion, as well as projected trends for the next century.

The latest RPA base projections indicate this buildup in hardwood inventory is expected to continue for the next two decades, when it will culminate at 9.6 billion m³. Thereafter, the projections show a period of relative stability, with the inventory declining slightly, finishing out the projection period at 9.1 billion m³, or 6% above the current level.

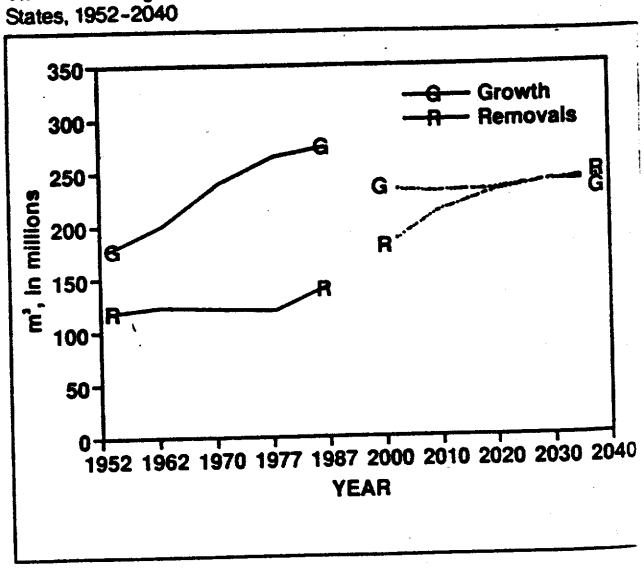
Since 1952, hardwood timber volume has increased steadily in all ownership categories in all sections of the country. Despite this buildup of inventory, many hardwood procurement agents perceive a declining resource and sometimes encounter difficulty obtaining the volume required to meet production schedules. The perception of a shrinking resource is largely due to hardwood markets that have, at least until recently, been highly specialized. Many hardwood producers are able to use only a limited range of species and tree sizes, which makes it difficult to locate stands with sufficient quantities of trees that are economically harvestable. In addition to spot shortages in specialized markets, physical constraints related to adverse sites also limit the availability of hardwood stands for either harvest or management.

As an illustration of the problem, a series of hypothetical screening criteria were imposed on the current hardwood

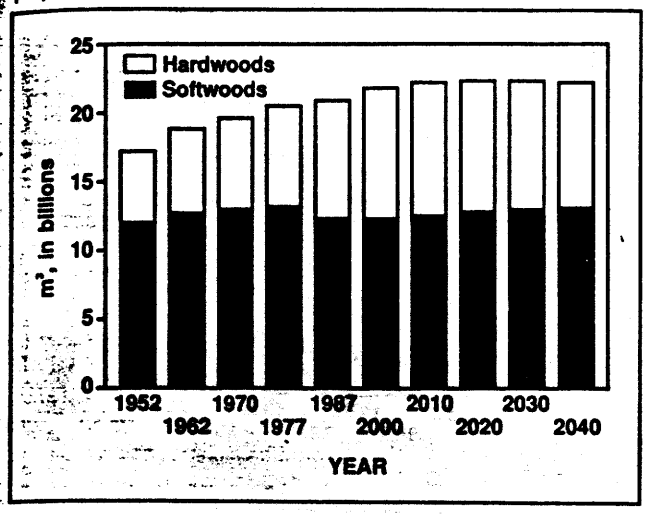
10. Hardwood inventory volume discount in the Southeast (Florida, Georgia, North Carolina, South Carolina, and Virginia), 1987



11. Hardwood growth and removal trends and projections in the United States, 1952-2040



12. Combined hardwood and softwood inventory trends and projections in the United States, 1952-2040



inventory from the five southeastern states to estimate the proportion of hardwood inventory that might be readily available for harvest. The breakdown is illustrated in Fig. 10.

Although this particular example applies to the Southeast, similar situations are applicable to other parts of the country. Starting with 1.8 billion m³ of hardwood growing stock, the inventory was progressively discounted for:

1. Volume of hardwoods in pine stands
2. Stands with difficult operating conditions (slope greater than 40% or year-round water problems)
3. Stands to which access roads would be difficult to build
4. Narrow bands of forest in strips or stringers typical of stream margins
5. Stands within 60 m of a nonforest land use, such as water or urban development
6. Stands with less than 23 m³/ha of sawtimber volume.

Only 0.5 billion m³ of inventory survived the screening process, indicating that less than one-third of the hardwood inventory is readily accessible. Added limitations, such as owner attitude and species preferences, restrict hardwood availability even further. One developing trend sure to have an impact on hardwood availability in the years to come is the transfer of timberland from farmers to other individuals within the private nonindustrial owner category. Young professionals and retirees who purchase timberland for second residences and recreational purposes are much less likely to manage the land for timber production than farmers.

Growth and removal trends and projections

A wide gap between growth and removals is the primary reason for the inventory expansion observed since 1952, illustrated in Fig. 11. Due to the rebounding of old-growth stands harvested during the early part of the century, hardwood growth accelerated steadily in all regions of the country between 1952 and 1977.

During this same period, hardwood removals stayed flat, resulting in the present buildup of hardwood inventory. The relatively soft demand for hardwood has also allowed the resource to age, causing higher mortality and slower growth rates. This maturing of the resource has caused hardwood growth to slow down and level off during the years since 1977.

Although hardwood demand remained stationary between 1952 and 1977, there were some notable changes in hardwood product output. Throughout the period, production of hardwood lumber, flooring, railroad ties, cooperage, and fuelwood all trended downward. These losses were offset by gains in hardwood pulp and pallet production. There were also some regional differences. Declining rates of hardwood removals in the South were countered by increased harvesting in the North. Since 1977, we've experienced a substantial upturn in hardwood removals, especially in the South, where increased industrial utilization of hardwoods for fuelwood, pulpwood, and composition-board products has contributed to a nationwide increase of 21% during the past decade.

The recent surge in demand for hardwoods is expected to continue, as hardwood removals are projected to escalate by 70% by 2040. Increased consumption of hardwood roundwood for pulpwood and fuelwood in both the North and South are the primary reasons for the expected gain, with steeper increases likely in the South. Nationwide, the mix of hardwoods consumed by the woodpulp industry is projected to increase from about 29% at present to 39% in 2040, reflecting a gradual shift toward greater usage of high-yield mechanical pulps that require more hardwoods.

While hardwood removals are now on the upswing, hardwood growth has reached a plateau and is soon expected to turn downward. A maturing hardwood resource, projected losses of timberland area, and a high proportion of poorly managed stands all point to a short-term reduction in hardwood growth over the next one or two decades, followed by an extended period of relative stability. Some time near the year 2020, hardwood removals are projected to reach equilibrium with growth, resulting in the culmination of hardwood inventory.

Hardwoods vs. softwoods

Since mid-century, the hardwood component of the U.S. timber resource has been gaining in importance. Hardwoods presently constitute about 40% of the nation's growing-stock volume—up from 29% in 1952—and the percentage of total inventory volume in hardwoods is expected to increase even more in the near future due to a slight dip in the softwood inventory, as shown in Fig. 12. Viewed as temporary, the current drop in softwood inventory is the result of increasing removals and loss of timberland area. Gains in growth brought about by better management techniques, a higher proportion of planted stands, and a restructuring of the resource toward younger ages are expected to reverse the softwood situation by the end of the century. Anticipated changes in the softwood and hardwood inventories tend to counterbalance each other, and the combined inventory of both groups is projected to increase steadily by about 4% between now and 2040.

Factors behind the trends

Due to the rebounding of old growth stands harvested during the early part of the century, and to depressed markets for hardwoods until the mid-1970s, hardwood inventories have been building for several decades. Many of these maturing stands are on adverse sites with accessibility problems. The more accessible stands have been periodically highgraded over the years to satisfy specialized markets for high-quality trees. Hardwood fiber in small diameter and poor quality trees was simply not valuable enough to pay its way out of the woods. As a result, a high percentage of hardwood stands now suffer from past mismanagement. As many as half the hardwood stands are in poor condition in some regions (4). The aging of the resource, along with past mismanagement, has brought a halt to the long upward trend in hardwood growth rates, even though the inventory continues to build.

All the latest signals indicate we are now witnessing a reversal of the unfavorable economic conditions that have influenced hardwoods in the past. Since the mid-'70s, we've experienced a significant upturn in removals of hardwoods for fuel, fiber, and chip products. Data from the latest surveys of timber resources in both northern and southern states confirm that this trend is accelerating. Tightening softwood supplies will continue to encourage substitution of hardwoods in markets previously dominated by softwoods.

In our view, the recent expansion of hardwood markets for small-diameter and poor-quality trees provides a welcome opportunity to improve the resource. Accelerated removals of low-quality hardwoods can work to balance the hardwood age distribution, stimulate growth, increase diversity, and discourage highgrading. However, it is crucial that we actively exploit any and all management opportunities resulting from increased marketability. Mere custodial management will rapidly deplete the inventory and further alienate a public already calling for restrictive regulation of management activities. Programs and research designed to improve hardwood management should be aimed primarily at private nonindustrial landowners. They control three-fourths of the hardwood resource and are expected to retain this high proportion in the years ahead.

The RPA projections are intended not to predict the future but to expose what seem to be developing trends. What actually happens could be much better or much worse than the scenario depicted here. The actual outcome is still largely dependent on actions yet to be taken.□

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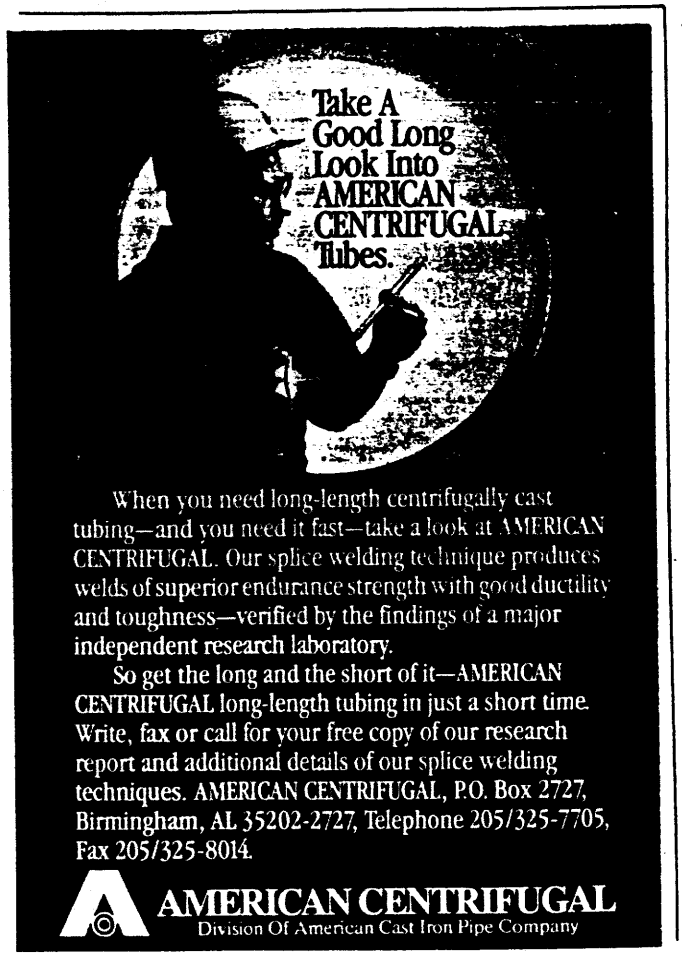

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