to statistically define the North American track loading spectra. Also, more laboratory fatigue testing is required to develop relative service lives of various track structure systems.

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Timber Availability for Crossties

IRENE A. WATTERSON

ABSTRACT

The consumption of wood products in the United States has increased during the past 20 years and is expected to increase further during the next 5 decades. At the same time, the area of commercial timberland has slowly decreased and is expected to decrease even further. In spite of these general trends, available timber resources will meet requirements for current and increased levels of crosstie production in the near future because crosstie production is a relatively small portion of total timber products production. Crossties can be made from lower-quality and smaller-diameter hardwood trees that are not used in the production of other major wood products, and the supply of hardwood timber is increasing and will continue to increase. Following the year 2000, however, hardwood timber inventories are expected to decline and, at the same time, the demand for hardwood timber is expected to increase sharply, which will tend to increase timber prices.

The consumption of wood products in the United States has increased during the past 20 years and is expected to increase further during the next 5 decades. At the same time, the area of commercial timberland has slowly decreased and is expected to decrease even further. With increasing numbers of railroad crossties being installed, the availability of timber for crossties is a concern to the transportation industry. The purpose of this paper is to assess that availability.

GENERAL TRENDS AND PROJECTIONS

In 1980 the total volume of all wood products consumed in the United States was 15.6 billion cubic feet, a 37 percent increase over the 1960 consumption level (1). Between 1950 and 1972 growth in timber product use occurred mainly in softwood species such as pines, firs, and spruces, whereas the use of products made from hardwood species such as oaks, elms, and ashes declined. Since 1972, however, use of hardwoods increased dramatically, mainly as a result of increased demand for hardwood pulpwood and fuelwood. Hardwood products account for 30 percent of the total timber product consumption (1). Crossties are generally made from hardwoods.

The Forest Service, U.S. Department of Agriculture, projects an increase (2) in consumption of timber products during the next 5 decades, reaching a total volume of 25.8 billion cubic feet by the year 2030 (see Figure 1). The demand for hardwood products is expected to double (2), eventually accounting for 40 percent of total consumption.

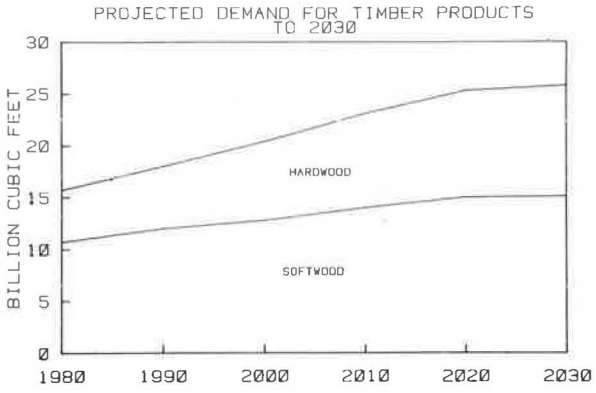

FIGURE 1 Projected demand for timber products to the year 2030.

Part of that increase will be in crossties. Annual crosstie installations by Class I railroads, though currently fewer today than in the 1940s and early 1950s, have also been increasing during the past 2 decades, despite reductions in track mileage (3,4). The number of ties installed annually increased 50 percent between 1960 and 1980. A small portion (3 to 5 percent) of these crossties are recycled ties and concrete ties. Most, however, are new wooden ties, which add to the continuing and increasing demand placed on forest resources.

However, the area of commercial timberland is decreasing. Since the early 1960s extensive forest land areas have been cleared for highways, cities, water reservoirs, and farmland. Between 1962 and 1977 the commercial timberland area decreased by 5 percent (5), although the volume of domestic consumption of timber products increased by 25 percent (1).

Assuming a continuation of the economic forces of the past 15 years, the Forest Service projects a further decline in commercial timberland during the next 50 years--from about 483 million acres in 1977 to 446 million acres in the year 2030, an 8 percent decrease (5). At the same time, domestic consumption of timber products is expected to increase 78 percent (2).

With such projected increases in the demand for wood products and such decreases in commercial timberland area, can the domestic timber supply meet the demands for wood products in general, and crossties in particular, in the decades ahead?

To answer this question, a comparison must be made of the relative amount and type of timber needed for crosstie production with that needed for the production of other wood products, including products for export. Such a comparison will give an indication of the potential sources of competition for the timber needed for crossties. Then the timber resource must be examined to see how much timber will be available.

PRODUCTION AND TIMBER REQUIREMENTS

Crosstie production is a small part of total timber production. In 1980 crossties accounted for about 1 percent of total production (6) compared, for instance, with lumber for pallets, which accounted for 6 percent of total production (7), and pulpwood, which accounted for 30 percent of total production (1).

Whereas the amount of timber needed for crossties is relatively small, the availability of timber for crossties will depend, in part, on the demand for those major products that use the type and quality of timber needed for crosstie production.

Most crossties are made from hardwood species, whereas most major timber products are made from softwood species. In 1980, 88 percent of treated crossties (6) were produced from hardwoods (Figure 2). In contrast, 76 percent of the lumber produced in 1980 was from softwoods, as was 83 percent of export products, 93 percent of plywood and veneer, 69 percent of pulp products, and 58 percent of other industrial products (1). Thus crosstie production does not compete directly with these products for the hardwood timber supply.

Products that use large amounts of hardwood material include fuelwood, premium wood products (such as furniture, paneling, and cabinetry), pallets, hardwood pulpwood (which accounts for the majority of hardwood exports), and some industrial products.

About four-fifths of residential fuelwood used in the United States is hardwood, but most residential fuelwood comes from timber sources not used for crosstie production. Nationwide, only 28 percent comes from live trees on forest land, and some of this consists of branches and other unmerchantable timber (8).

Products such as furniture, paneling, and cabinetry require large-diameter, high-quality logs from select species of oaks, hard maple, birch, walnut, ash, and cherry. Such premium hardwood timber is not needed for crosstie production because crossties can be made from smaller-diameter, lower-quality logs of a wider range of species.

The remaining wood products that could compete directly with crossties for hardwood timber supplies are hardwood pulpwood, pallets, and other industrial products such as poles, posts, and mine timbers. Hardwood pulpwood, which can use trees of nearly any size and quality, makes up almost 27 percent of the total hardwood products industry and about 31 percent of total pulpwood production (1). Pallets consist mostly of hardwood lumber and make up about 17 percent of the hardwood industry (7). Other industrial wood products make up, collectively, 3 percent of the hardwood industry (1). Crossties make up only 1.6 percent of the total hardwood industry (1,6).

Thus hardwood pulpwood and pallets are the major competitors with crossties for hardwood timber. Hardwood pulpwood production has almost tripled since 1960 and is expected to triple in the next 5 decades (1,5). Pallet production has tripled since 1960 and is expected to more than double again by the year 2030 (5).

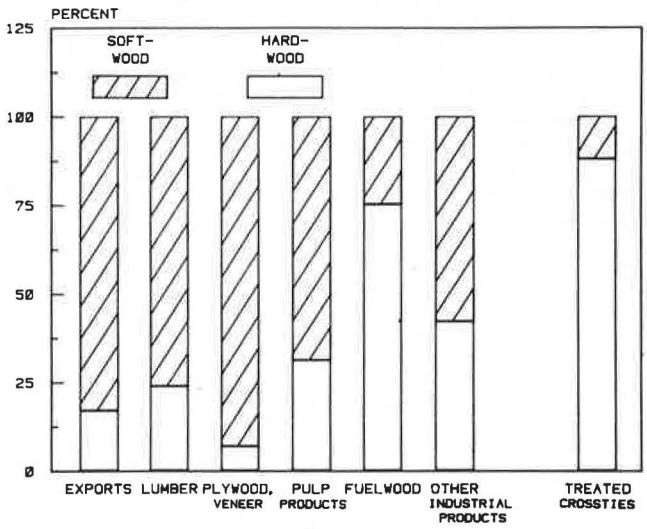

FIGURE 2 Production of timber products by softwoods and hardwoods, 1980.

With such expected increases in the use of hardwood timber suitable for crossties, the final question becomes: Is the current and projected supply of hardwood timber adequate to meet demand?

SUPPLY OF HARDWOOD TIMBER

In 1977, the year of the latest Forest Service inventory, commercial timberlands in the United States contained 792 billion cubic feet of wood in trees at least 5 in. in diameter. Although softwoods predominate, hardwoods make up about 39 percent of all standing timber, about 307.7 billion cubic feet (5).

About 45 percent of the hardwood inventory (137 billion cubic feet) is sawtimber, which consists of large, sound trees with commercially useful logs at least 11 in. in diameter (5). Most commercial wood products, including crossties, require sawtimber.

Another 38 percent of the hardwood inventory (118.2 billion cubic feet) is poletimber, which consists of trees with smaller-diameter logs down to 5 in. (5). Poletimber can be used for pulpwood and some miscellaneous wood products. If left growing, poletimber can eventually become sawtimber. Sawtimber and poletimber are collectively defined as growing stock. The volume of growing stock on commercial timberland is a measure of the commercial timber supply.

More than 80 percent of the hardwood inventory is growing stock. About half of this growing stock is in the North, another 42 percent is in the South, and the remaining 8 percent is in the West (5). The remaining portion of the hardwood inventory is composed of dead, rough, and rotten trees (5) that can be used for fuelwood; a relatively small amount of

sawlogs are included in this portion.

A large portion of the hardwood inventory is composed of trees potentially suitable for crosstie production. About 60 percent of the hardwood sawtimber is composed of species with limited potential for products such as high-quality furniture and veneer, which use premium wood, but suitable for ties, pallets, and pulpwood. Also, 42 percent of the hardwood growing stock is of a size between 12 and 19 in. in diameter, which is also undesirable for furniture and veneer, but is suitable for ties, pallets, and pulpwood. Trees 5 to 11 in. in diameter can increase future sawtimber supplies or can be used for hardwood pulpwood (5).

Even though the area of commercial timberland has been decreasing during the past 20 years, the volume of hardwood growing stock has been increasing (Figure 3). Hardwood inventory increased 43 percent between 1952 and 1977. This is in sharp contrast to the softwood inventory, which increased only 7 percent during the same period. Inventory increases have been concentrated on young trees in the North and South (5).

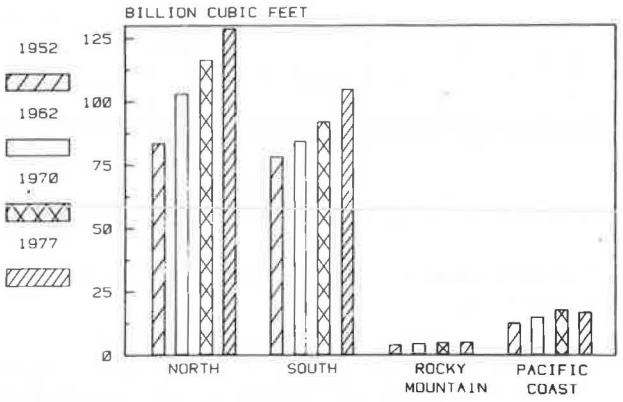

FIGURE 3 Hardwood growing stock volume by region, 1952-1977.

Timber inventories rise when net annual growth (total growth less mortality) is greater than timber removals (the volumes of timber removed by harvesting, clearing, or changing land use). Since 1952 the net annual growth of the hardwood inventory has been increasing and has exceeded removals by an increasing margin (Figure 4). In 1976 net annual growth was more than twice the volume of removals (5).

Hardwood sawtimber removals have been concentrated on large-diameter trees of preferred species. This has tended to reduce the growing stock of timber for products such as furniture and veneer. On the other hand, it generated a large buildup of smaller-diameter trees and nonpreferred species that are suitable for crosstie production (5).

Thus the supply of timber for crossties and other hardwood products such as pulpwood and pallets has increased substantially. Current growth-removal levels indicate that hardwood forests can support additional timber harvests, especially for nonpremium wood (2). Timber availability for crossties is adequate for the immediate future.

The outlook for the decades ahead, up to the year 2000, is for increasing volumes of hardwood growing stock at current management levels. The inventory of hardwood growing stock is expected to increase 29 percent by 2000 (Figure 5).

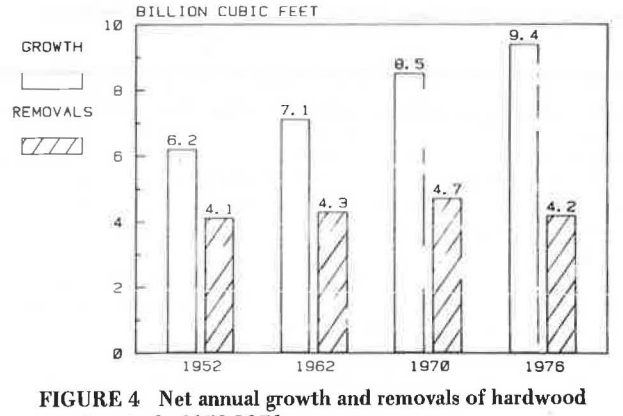

FIGURE 4 Net annual growth and removals of hardwood growing stock, 1952-1976.

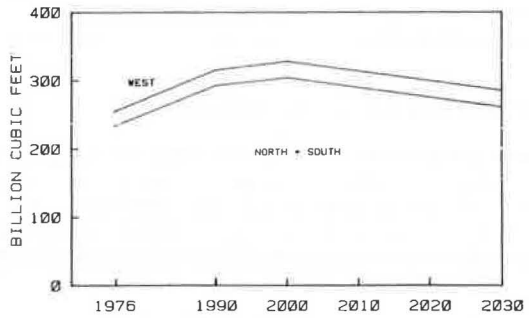

FIGURE 5 Projected hardwood growing stock inventory to the year 2030.

After 2000, however, hardwood inventories are expected to decline. Net annual growth is expected to decrease steadily after 1990 if increased cutting does not reduce overcrowding (Figure 6). By the year 2030 annual growth is projected to decrease 19 percent (5). At the same time, annual demand for domestic hardwood timber is projected to increase sharply. By 2030 the level of demand is expected to be almost double the level in 1980 (2).

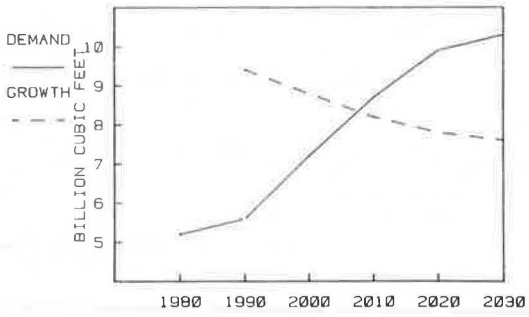

FIGURE 6 Projected demand and net annual growth of hardwood timber, 1980-2030.

With increasing demand for hardwood products and decreasing net growth in timber after 1990, the volume of hardwood growing stock removed annually will exceed the volume added by growth. As a result, the hardwood inventory is expected to decrease 13 percent (2,5) between the years 2000 and 2030 (Figure 5).

The projected trend in the hardwood inventory is reflected in the expected price index for hardwood stumpage (2). As the hardwood inventory increases

to the year 2000, the price index is expected to remain stable and favorable relative to 1967 prices. But with a decreasing inventory and increasing demand for timber after the year 2000, the price index is expected to rise (2).

CONCLUSIONS

In the near future and up to the year 2000, the outlook for timber availability for crossties is favorable. After 2000, increased demand for hardwood pulpwood, pallets, and miscellaneous hardwood products may affect timber availability for crossties, especially in regions where these products compete most for hardwood timber.

The opportunity exists for greater increases in growing stock inventories. This opportunity lies in more intensive, improved forest management. However, such a management level would require larger investments in timber stand improvement, reforestation, and research (9).

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Steel Ties: A Viable Alternative

ANGELO M. D'ATTOMA

ABSTRACT

Steel crossties are a viable, cost-effective alternative to wood and concrete, but they are not new to the railway industry. Steel ties have been used in Europe since the early 1800s. A recent report indicated that the life of steel ties is much greater than wood ties in the same track under identical conditions. Although the traffic density, matrix, and other conditions in Europe do not apply to the United States, there is no reason that the modern steel crosstie design would not apply in the United States. In addition, an extensive research program was recently conducted to develop and test a range of steel ties, which covered the spectrum of operating requirements from iron ore operations to secondary lines. The analyses included ballast depth and tie spacing requirements. All track system components were tested, including insulating pads and fasteners. Finally, Omark Industries developed a computer program to compare costs of different types of ties, including wood, concrete, and steel.

A recent study published by the University of Lausanne on the life of steel ties in the Swiss Railway (68 percent steel and 22 percent wood) stated the following conclusions [note that these data are from a collection of research reports on steel sleepers by l'Ecole Polytechnique de l'Universite de Lausanne, Lausanne, Switzerland (Number 1, undated)].

> The investigation carried out has shown that the steel sleeper has very considerable advantages over the other