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Study of West Virginia wood industry roundwood consumption in 1999

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Roundwood Consumption in 1999

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ABSTRACT

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Use of wood composite products has increased over the last decade in the market for construction material. Softwood species and soft hardwood species are the preferred forest resources for manufacturing these products. Reduction in available softwood forest resources from the Western states has forced a shift to use of more soft hardwood species in the Northeast. What impact this shift may have on the forest resources in the Northeast is not known.

The objective of this study was to canvass primary wood manufacturers in and around the forest of West Virginia and determine how roundwood consumption has changed since the shift occurred. Survey data is used to analyze the effect of new wood composite mills in West Virginia. Survey results show that sawlog products (61 million cubic feet) and wood composite products (43 million cubic feet) were the two leading products consuming roundwood in 1999.

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Chapter One - INTRODUCTION

The forest resource in the United States has experienced numerous seasons of intense harvesting to meet demand for wood products over the last four hundred years. Before the first European settlements in the 1600's, the forest covered about half of the land area in the United States, approximately one billion acres of land (MacCleery 1993). Currently the forest covers one-third of the land area in the United States, which is about 70 percent of the land area covered in 1600. The demand for forest resources and the necessity of available land area for pasture and cropland were the compelling factors in the decline of forested land area in the earlier stages of the United States.

1.1 STATEMENT OF PROBLEM

The problem addressed by this study is whether the state of West Virginia and the other states in Central Appalachia have the available hardwood sawtimber to supply the demand of the lumber, engineered wood products, and paper industry, given the changes in resource availability in the country. The amount of timber resources required to meet demand today will far exceed what was needed in earlier years. However, the methods, technology, and efficiency of the industry today will reduce the waste of timber resources and the volume of roundwood consumed to manufacture products. This study will highlight the efficiency of the wood industry, specifically in West Virginia, today and how the industry has made the necessary changes to accommodate changes in the national and international demand.

Knowing the amount of timber being harvested, the amount of timber available to be harvested, and the growing stock volume of timber are essential in effectively

managing the forest resources for next 30 to 40 years. To accomplish the objective of this study we will gather data from primary producing mills in and around the state of West Virginia that will be receiving roundwood or timber from the forest of West Virginia in the year 1999. The data will be obtained by surveying the primary wood manufacturers and will be used to determine an estimate of the wood consumed in 1999, species composition, and an estimated production volume.

1.2 SURVEY METHODS

The objective was to survey all the mills within the state and all the mills two counties into the neighboring states of Virginia, Pennsylvania, Maryland, Ohio, and Kentucky. The first survey was mailed in June of 1999 and one month later a postcard was sent to the non-respondents. Two weeks after the postcard was mailed a second survey was mailed to the remaining non-respondents and two weeks were allowed before another postcard was mailed to the non-respondents of the second mailing. After the second postcard, phone calls were made to the remaining non-respondents to obtain data from them.

Initial telephone follow-up attempts to mills that received fewer than three million board feet of roundwood from the forest of West Virginia were not very successful. According to the survey conducted by the Division of Forestry, the smaller mills (receiving fewer than 3 million board feet of roundwood) received only 73.8 million board feet (10%) of the total volume of roundwood harvested from West Virginia in 1999. So, the lack of cooperation from the smaller mills would not have a very strong effect on the accuracy of the estimated volume of timber harvested. Mills receiving 3

million board feet and up made up the remaining 90% (estimated 669.8 million board feet) of the harvested volume. So, we chose to contact larger mills and gain the information needed to determine the volume of roundwood consumed from West Virginia. Any company that had more than one mill consuming roundwood from West Virginia was contacted at the corporate headquarters for the volume of data for each mill, in and around the state of West Virginia. A copy of the survey is included in Appendix C.

1.2.1 Touring the industry

To better understand the wood industry in West Virginia, the wood composite mills, a pulpwood mill, several sawmills (variety of sizes), fencing mill, a pallet mill, and the mill producing plywood core stock were toured. These visitations were conducted after the first mailing, which allowed hand delivery of surveys to the non-respondents visited and in the vicinity of the mills toured.

Visiting the different types of mills allowed me to see the efficiency of the industry that the information of the mail survey did not provide. For example, Truss Joist MacMillan was shipping the cores from the peeler logs to West Virginia Split Rail Fencing for rails and posts. The cores were used to supplement the roundwood intake of West Virginia Split Rail. The supplementation of cores in West Virginia Split Rail allowed the cores not to be used for fuel or wasted. The cores were chipped for pulpwood if they were not used for manufacturing rails and posts.

Truss Joist MacMillan shipped approximately nine thousand tons of cores for fencing material and would sell to chip mills if the fencing mills did not want to utilize the cores. Also, sawmills are selling logging and milling residue to oriented strand board

mills to be more efficient with the resources in their possession and any peeler logs are being resold to peeled veneer mills in the southern and northern portion of the state by sawmills.

1.2.2 Out of state mills

The number of mills that participated in the study from the surrounding states was not enough to determine a good estimate of roundwood consumed by mills in the surrounding states from West Virginia. The collective volume of roundwood consumed reported by all five states was approximately 84.2 million board feet. Only three mills reported from Virginia (about 5.3 million board feet) and Maryland (21.1), four from Pennsylvania (12.4 million), six in Ohio (45.1 million board feet), and one mill from Kentucky reported 300 thousand board feet board roundwood consumption. The majority of the wood producers from Virginia were fuelwood producers and pallets. The one mill from Kentucky was a fencing mill. The corresponding West Virginia geographical units were the Northwestern unit (50.4 million board feet) and Northeastern Unit (33.8 million board feet).

The amount of roundwood consumed by the surrounding states in 1994 was assumed to be the same for 1999. The volume of roundwood exported to surrounding states constituted 14% (115.1 million board feet) of the consumption volume in 1994 (Widmann, 1998). The state of West Virginia imported 29.2 million board feet of roundwood in 1994 (Widmann, 1998). The only state that will have a significant increase in importing roundwood from West Virginia is Ohio.

The state of Ohio imported 62.5 million board feet from West Virginia and exported 165 thousand board feet of roundwood (Widmann, 1998). Ohio made up 63% of volume of roundwood exported out of West Virginia (Widmann, 1998). Pennsylvania imported 15.8 million board feet from West Virginia and exported 3.2 million board feet to West Virginia in 1994; Maryland reported receiving 1 million board feet and exported 6.7 million board feet to West Virginia in 1994 (Widmann 1998). Virginia was second in receiving roundwood from West Virginia in 1994 with 25.3 million board feet and exporting only 8.5 into West Virginia (Widmann 1998). Northern red oak was the dominant species for exports and imports in 1994 (Widmann 1998).

1.2.3 Fencing mills

The information from the fencing mills was reported by pieces, with only five fencing mills from West Virginia and one mill from Kentucky responding to the survey. The mills did not give the average diameter and length of log-piece so the data was not included in the analysis. Anecdotal information from a large sawmill corporation in and around the West Virginia gave an estimated 60 to 70 million board feet of roundwood being used by the fencing industry in West Virginia every year.

1.2.4 Concentration yards

Four concentration yards completed the survey but did not give the destination of the roundwood or the vendors that purchased roundwood from their log yards within the state. The volume of roundwood received by the concentration yards was 34 million board feet of timber. The survey was not filled out by all respondents. In spite of this,

the information was still used to determine the estimated volume of roundwood consumed for sawlog products.

1.2.5 Unit measurements

The log scale measurement reported by all the sawmills and veneer mills was the Doyle log scale and for pulpwood and oriented strand board was green tons (converted to cords). The different types of unit measurements and the can be found on the sample survey in Appendix C and the calculation conversions can found in Appendix B.

1.3 SURVEY OF STATE DIVISION OF FORESTRY

The state Division of Forestry conducted a survey in 1999-2000 to determine the number of mills in operation and the volume of roundwood required for the mill to operate in 1999. According to the Division of Forestry survey, there were 181 sawmills operating in West Virginia in 1999. We used the number of mills reported to be operating in 1999 from the survey of the State Division of Forestry to estimate the volume of roundwood consumed.

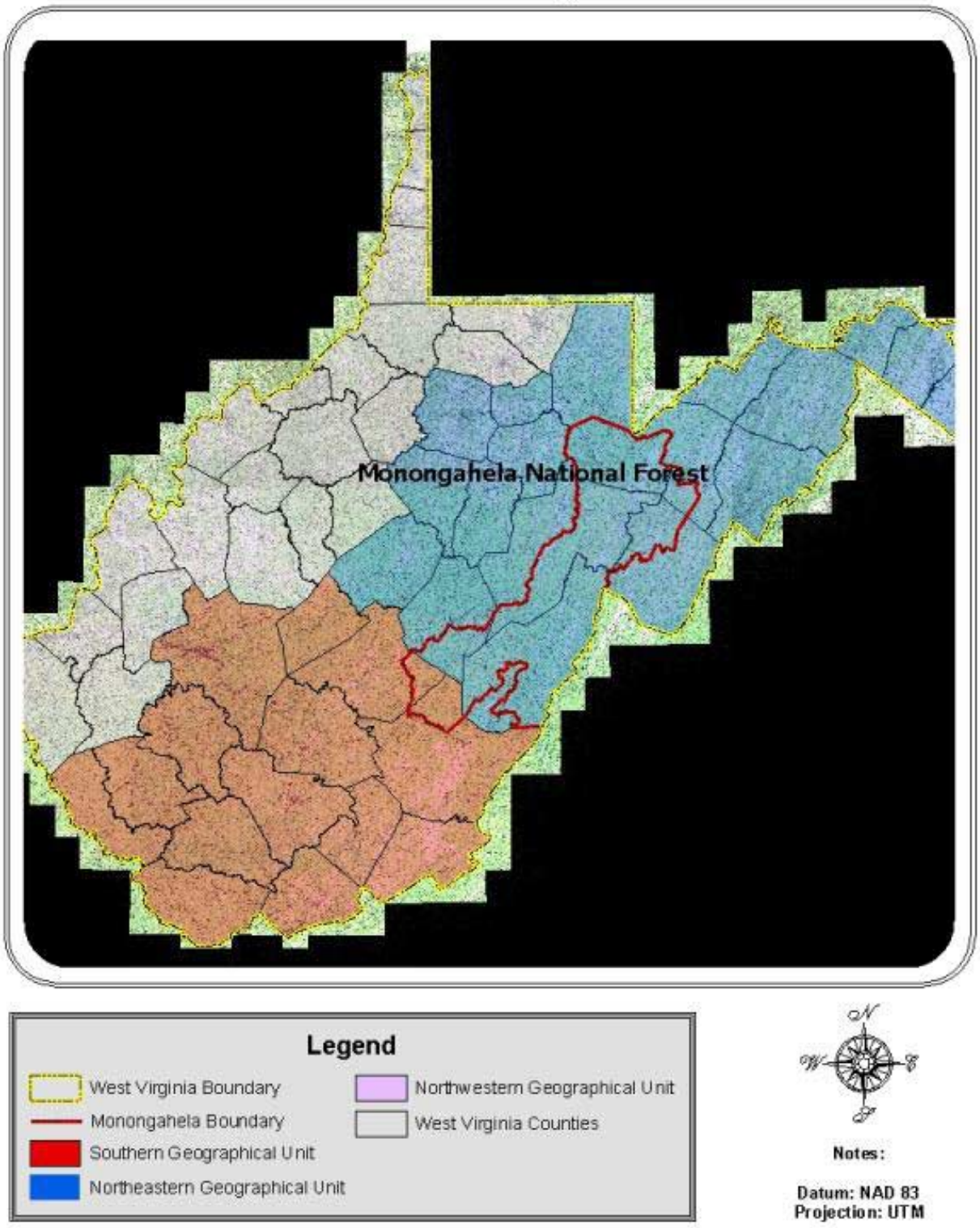
1.3.1 Sawmills of the 1999 Roundwood Survey

The mill data from our survey was broken down into the three geographical units: Northeastern unit, Northwestern unit, and Southern unit (Figure 1). The Southern counties supported 4.9 million acres of forested land area in 1961 and this increased to 5 million acres in 1975. The Northeast unit supported 5.1 million acres of land area in 1961, which increased to approximately 5.9 acres in 1975. The Northwestern land area

held to about 4.5 million acres for all the surveys. Both of the Southern and Northeastern units stayed about the same in land area for the period between 1975 and 1989**.**

Within each region, the mills using fewer than 3 million board feet of roundwood were separated from the mills using 3 million board feet and more of roundwood. The difference in the value and type of species used by the two types of mills is the reason for the separation. The smaller mills utilized low-grade mixed hardwood species, while the larger mills consumed the high-grade oaks, yellow-poplar, black cherry, and soft-hard maples. The differences between the two mill types can be seen also in the distribution of the roundwood volume for the different final products.

Figure 1 Geographical Units and National Forest of West Virginia



The population of sawmills in the state was 181 mills in West Virginia in 1999. There were 65 mills that received fewer than 3 million board feet in the Northeast, the Northwestern unit reported 33 small mills, and the South only had 16 mills receiving fewer than 3 million board feet of roundwood in 1999. The Southern unit had 25 mills that received 3 million board feet or more, the Northeast followed with 31 mills, and the Northwestern unit only had 11 mills that used 3 million board feet or more. The number mills that responded to the 1999 roundwood survey from the Northeastern unit was 16 mills using under 3 million board feet and 24 mills that received 3 million board feet or more. The Southern unit had 14 mills respond that received 3 million board feet or more and only 4 smaller mills. From the Northwestern unit, 5 large mills responded to the survey and 6 small mills.

1.4 STATISTICS OF SURVEY DATA

The statistical data for the survey information determines whether the sample successfully represents the entire population. The population of sawmills in the state was described in the previous section. The statistical data shows that the roundwood survey sample nearly included the entire population.

The margin of sampling error ($\pm$ ME) gives the plus or minus range for each estimated volume for the species and product from the survey data. The largest $\pm$ME was 322,000 board feet (South) for the big mills and 310,000 board feet (Northeast) for the small mills. The big mills will use 322,000 board feet of roundwood in less than one week of operation, so the margin of sampling error was less than one week in variation for the big mills. The margin of sampling error for the small mills was rather large in

Northeast due to a small response to the survey. However, the ±ME for the small mills in the Northwestern (95,000 board feet) and Southern (48,000 board feet) units had a variation of approximately one week of mill operation (Table 1)[a].

The standard error of a mean (SE) gives the variation of the species and product data of the survey for the small and big mills within each geographical unit. So, the Northwestern unit had a variation 12,000 board feet, the Northeastern unit was 5,000 board feet, and 6,000 board feet in the Southern unit, for the data gathered from the big mills by the roundwood survey. The SE of species and product data for the Northwestern and Southern units were 1,000 board feet and 2,000 board feet for the Northeastern unit.

Table 1. Statistics of roundwood survey data in 1999

	Geographical units		
	Northeast	Northwest	South
Small mills		(In Thousand units)	
SE	2	1	1
±ME	310	95	48
Big mills			
SE	5	12	6
±ME	297	269	322

a / The formulas for standard error of a mean (SE) and the margin of sampling error (±ME) are in Appendix B.

Chapter Two - LITERATURE REVIEW

This chapter will summarize the following: the timber harvesting before and after West Virginia officially became a state on June 20, 1863[1]; a summary of the geographical shift of timber harvesting in the United States from the Northeast, to the Southern region, and then to the Western region in the 1869-1946-period; and finally, a description of the growth and removal of the growing stock and sawtimber volumes in West Virginia after the heavy cutting between 1870 and 1920. The description of the growth and removal of the growing stock and sawtimber volumes in West Virginia will be achieved by summarizing the forest statistics reports for West Virginia in 1961[2], 1975, and 1989. Also, the conversion of the commercial forest land over the 1949 to 1989 period and the distribution of the commercial forest land within the geographical units and the transition of the species composition over the 1949-1989 period.

The forest resources and land area measurements in 1961, 1975, and 1989 will enable the reader to better understand the summary of the Timber Products Output[3] surveys. The Timber Products Output (TPO) for the years 1949, 1961, 1965, 1974, 1979[4], 1987, and 1994 in West Virginia will be used to give a summary of the harvesting trend of the forest resources timber-products-utilization volume for the last fifty years of surveys. The summary is composed of the sawlog, pulpwood, veneer, and miscellaneous production volumes. Only the sawlog production volumes are summarized for the geographical units for the last fifty years. Also, the brief history of the wood composite industry is included in this chapter.

1/ During the Civil War, the western portion of Virginia became the state of West Virginia on June 20, 1863.
2/ The 1961 publication combined the measurement of forest resources and land area together with the information from the timber products output survey.
3/ The 1994 survey described the Timber Products Output as, "studies that assess the quantities and species of wood being harvested for industrial use in West Virginia" (Widmann 1998).
4/ The 1979 TPO was not published by the US Forest service.

2.1 HISTORY OF WOOD INDUSTRY IN WESTERN VIRGINIA

During the period between the Revolutionary War and Civil War, the Appalachian settlements claimed timberland around the rivers and the less mountainous topography to build farms and communities. The land in these areas contained limestone rich soils needed to grow crops and vegetation for pasturing cattle. This fertile soil also had the best stands of timber in the Appalachian Mountains. Due to the inability to transport the large timber, the first settlers in West Virginia were not able to harvest much of the virgin timber in the higher elevations of western Virginia. There was some harvesting and selling of the timber resources before the Civil War but the majority of the timber on the land was cleared and the land used for farming purposes. The early mountaineers viewed the trees as a nuisance and desired to remove quantities of walnut, black cherry, yellow poplar and other species that are currently very valuable.

It was reported that settlers and farmers in western Virginia cleared timberland before the Civil War by "hacking" or girdling trees to provide natural growth of blue grass and bracken fern for the cattle (Clarkson 1964). The Report of the West Virginia Conservation Commission of 1908 gave some approximate figures to show the amount of timber in West Virginia of the year 1908 and what happened to the balance of the resources over the last 120 years (Brooks 1908). According to the West Virginia Conservation Commission report, 150 billion board feet existed in western Virginia around the 1790's. During the 120 years between 1790 and 1908 the volume doubled to 300 billion board feet (Brooks 1908).

The report showed approximate board foot volumes of: 4.3 billion in fence rails, 1 billion for farm timber, 1/2 billion for building houses in towns before 1880, 10 billion

for fuel, 238.8 billion wasted, 30 billion still in the forest, and a recorded amount of 15.4 billion cut since 1879 (Brooks 1908). The timber was cut with an attitude that the forest resources were inexhaustible.

2.1.1 Era after the Civil War

After the Civil War, emigrants from Ireland, Italy, and other European and Asian countries moved to the United States for the opportunity to escape political oppression, famines, and find better employment opportunities. Of course, this migration to the United States would cause the population to grow rapidly. The growing population would demand more of the young Nation's forest resources and land area than the earlier years of settlement. The people needed land area to farm and the timber to build homes for their families, for fuel, and to manufacture paper. The timber resources in the New England[1] and Middle Atlantic[2] States were exhausted and the timberland had been converted to farmland. The states of the Central Appalachian[3] and the Great Lakes[4] region still had the available forest resources and land area to support the demand of the growing population.

*The sub-regions in the report have been modified from the original report written by Henry B. Steer.
[1] The New England states are Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont (Steer, 1948).
[2] The Middle Atlantic states are Delaware, New Jersey, and New York (Steer, 1948).
[3] The Central Appalachian states are Maryland, Pennsylvania, Ohio, West Virginia, and Kentucky (Steer, 1948).
[4] The Great Lake states are Michigan, Minnesota, and Wisconsin (Steer, 1948).

So, the states within the Great Lakes and Central Appalachia were the primary source of timber production (Figure 2.1). Notice how the trends for the Great Lakes and Central Appalachian states are very close in timber and both dominate the Middle Atlantic and New England states that were previously harvested and converted to farmland.

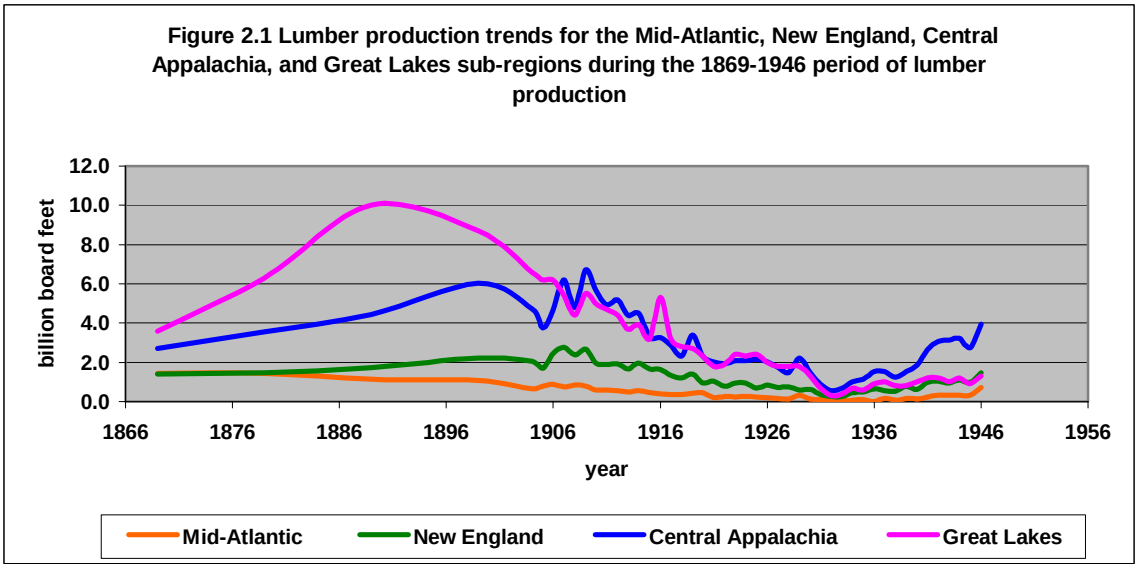


Figure 2.1 Lumber production trends for the Mid-Atlantic, New England, Central Appalachia, and Great Lakes sub-regions during the 1869-1946 period of lumber production

*The data is reported for every ten years from 1869-1899 and begin to be reported annually from 1904-1946.
**Steer, Henry B. Lumber Production in the United States, 1799-1946. Misc. Publ. 669. Washington, DC: U.S. Department of Agriculture, Forest Service, Division of Forest Economics., 1948.

2.1.2 Timber boom in West Virginia between 1870-1920

West Virginia became a state in June of 1863 to avoid separating from the Union during the Civil War. The state of West Virginia was one of the states in central Appalachia to be intensively harvested after the Civil War, from around the late 1870's to the late 1920's, for the forest resources and to be domesticated by building railroads into the heart of the state. Due to the settlers desire to dwell closer to river bottoms and absence of the transportation to haul the timber, the forest of West Virginia still had a large volume of resources and covered a large land area. J. H. Diss Debar stated around 1870, "At least 10,000,000 acres [in West Virginia] are still in the vigor and freshness of

original growth" (Clarkson 1964). Also, Maury & Fontaine reported, "Between 9,000,000 and 10,000,000 acres [in West Virginia] are in the original forest" (Clarkson 1964).

In the late 19th century, West Virginia was teeming with the original growth of enormous spruce, sycamore, tulip-trees, firs, oaks, white pine, scrub pine, yellow pine, maples, large cherry, walnut, and other trees native to Central Appalachia. The trees in the forest could easily exceed heights of 70 to 80 feet before the first branch, and were 7 to 11 feet in diameter. Even the branches were reported to be approximately 3 to 4 feet in diameter. The forest was overflowing with virgin timber of this caliber: a single yellow-poplar tree producing up to 12,916 board feet; and another occasion, a large poplar tree produced 17,500 board feet.

The railroad system opened the timberland of West Virginia to the forest industry. The plans to build railroads into the large reserve of timber resources, which commenced on November 2, 1881 and ended November 1, 1884, were the beginning of the expedition into the Appalachian Mountains of West Virginia to harvest the steep mountainous ranges (Clarkson 1990). The amount of timber sawn for lumber in the state of West Virginia, during the 1870-1920 era, was approximately 30.4 billion board feet (Clarkson 1964).

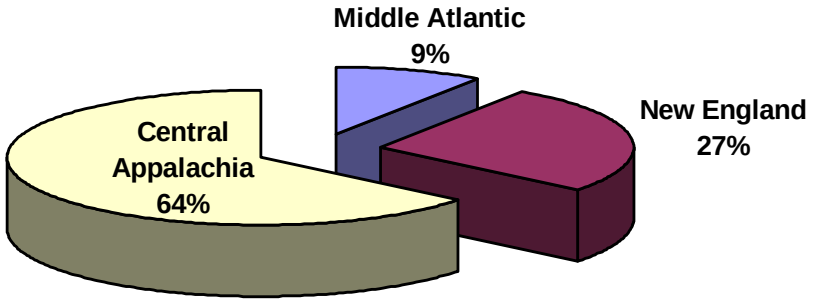
The peak year for lumber production was in 1909, where the state had 1524 sawmills that produced 1.5 billion board feet and ranking thirteenth in the Nation for producing lumber. In 1910, the area of virgin forest in the state was reduced to approximately 1.5 million acres from the 10 million acres around 1870 (Clarkson 1964). The volume of timber harvested for pulpwood was hard to track due to the nature of the

market in the late 1800's and early 1900's. The majority of raw material used to produce pulp was the wood residue and scraps from the sawmills.

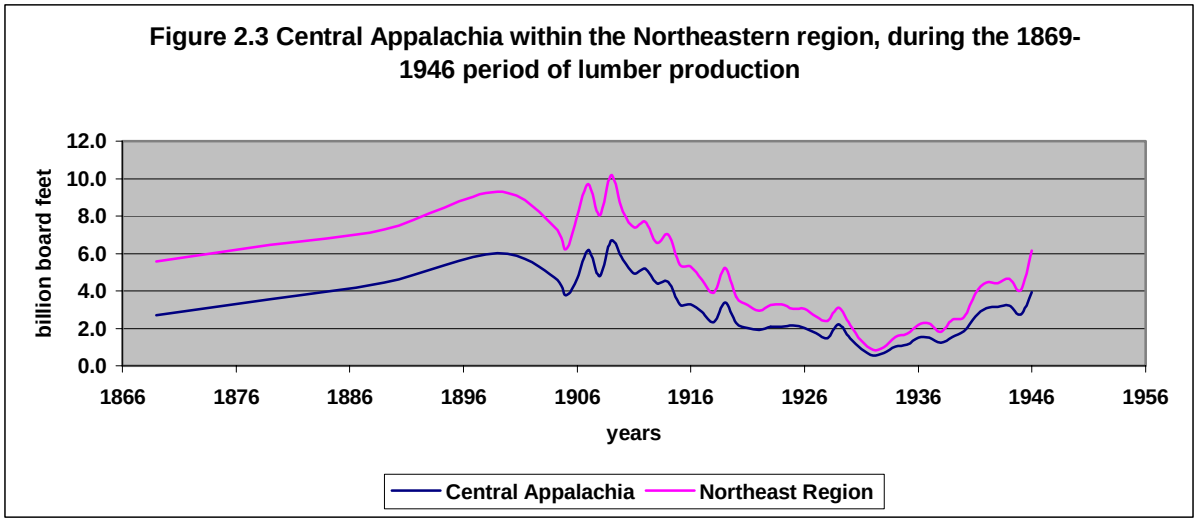
2.2 SHIFTING OF THE FOREST INDUSTRY TO THE WESTERN FORESTS

The timbering in the late 1920's to the early 1930's exhausted the timber resources in West Virginia and other the Central Appalachian states. The timber industry was shifting to the western portion of the United States to supply the resources for the demand of the Nation's population. The intense timber harvesting in the Central Appalachia region during the 1870 to 1920 era amassed a reported 139.5 billion board feet of harvested timber. The Central Appalachian region provided 64% of the overall volume of timber harvested in the Northeast region during the 1869-1946 era and 63% for the 1869-1921 period (Steer 1948). The New England States of the Northeast provided consistently 27% for the 1869-1921 period and the 1869-1946 period (Steer 1948). The Middle Atlantic States provided 10% of the timber production for the 1869-1921 period and 9% for the 1869-1946 period (Steer 1948). See figures 2.2 and 2.3.

Figure 2.2 The participation of the sub-regions within the Northeast during the 1869-1946 period of lumber production



*Steer, Henry B. Lumber Production in the United States, 1799-1946. Misc. Publ. 669. Washington, DC: U.S. Department of Agriculture, Forest Service, Division of Forest Economics., 1948.

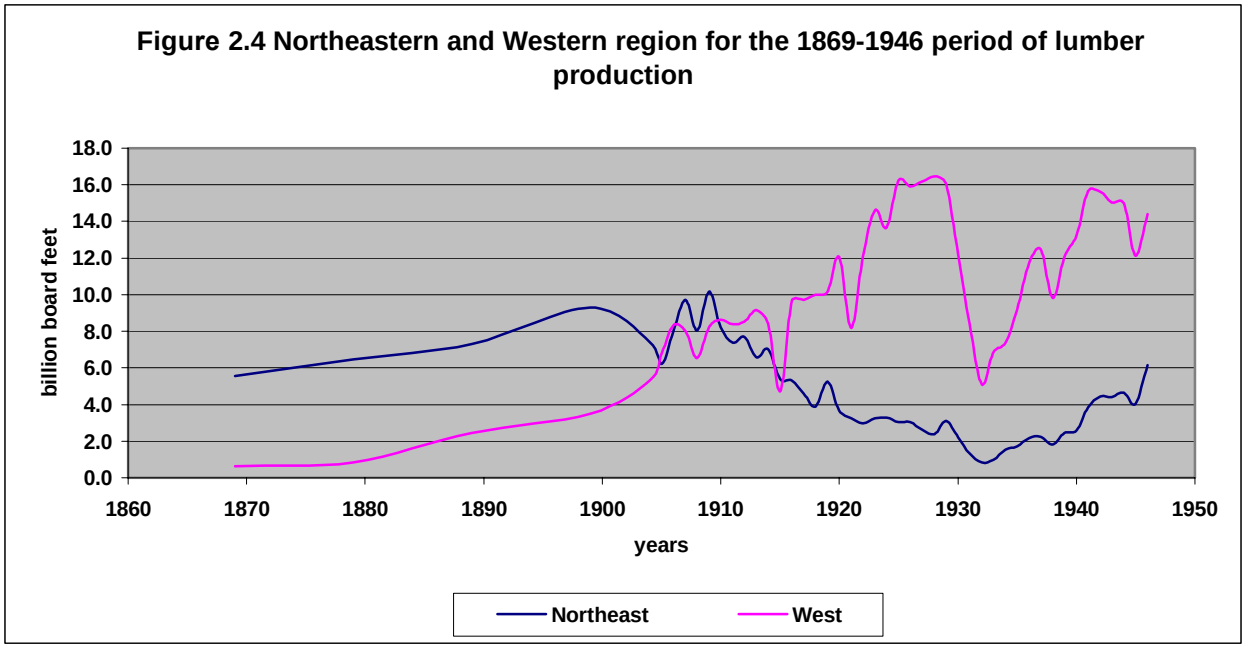


*Steer, Henry B. Lumber Production in the United States, 1799-1946. Misc. Publ. 669. Washington, DC: U.S. Department of Agriculture, Forest service, Division of Forestry Economics., 1948.
**The data is reported for every ten years from 1869-1899 and begin to be reported annually from 1904-1946.

2.2.1 Western dominance in lumber production

By mid to late 1920's, the Western region was reported to be cutting over 12 billion board feet of timber annually and steadily increasing, while the Northeast was cutting less than 3 billion board feet of timber per year and steadily decreasing (Steer 1948). The West was supplying over fifty percent of the harvested timber resources to the United States for domestic use and international exports by 1921, while the Northeast producing only eight to ten percent and steadily decreasing (Steer 1948). The Western[1] region was replacing the exhausted resources in the Northeast[2] (Figure 2.4 and 2.5).

1/ The Western region states are Oregon, Washington State, Idaho, Montana, Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming (Steer 1948).
2 / The Northeastern region are the Middle Atlantic, Central Appalachian, and New England states (Steer 1948).



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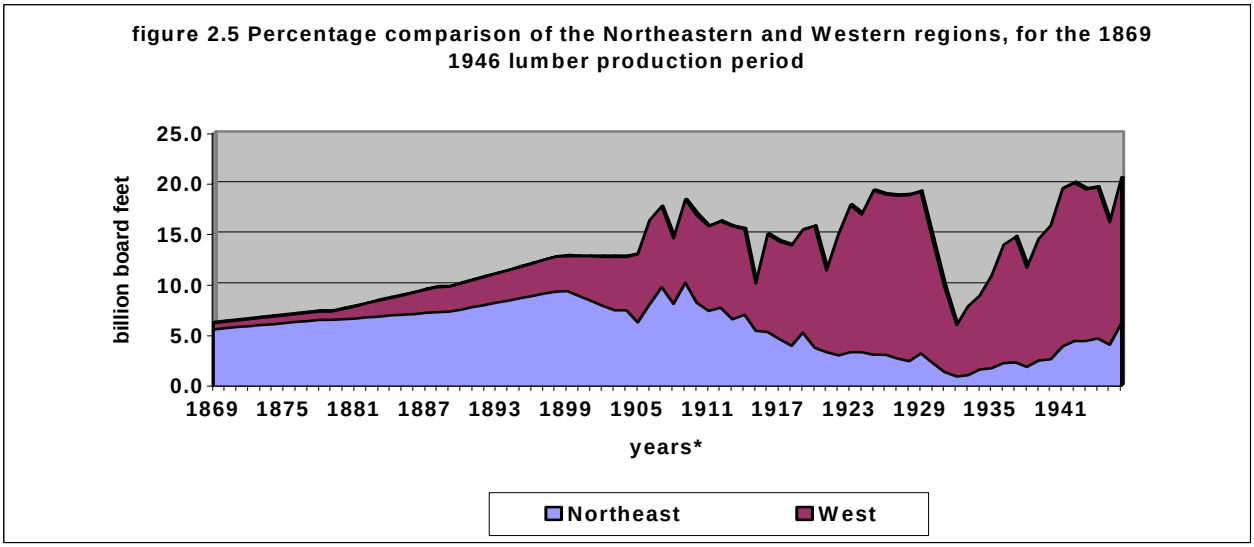
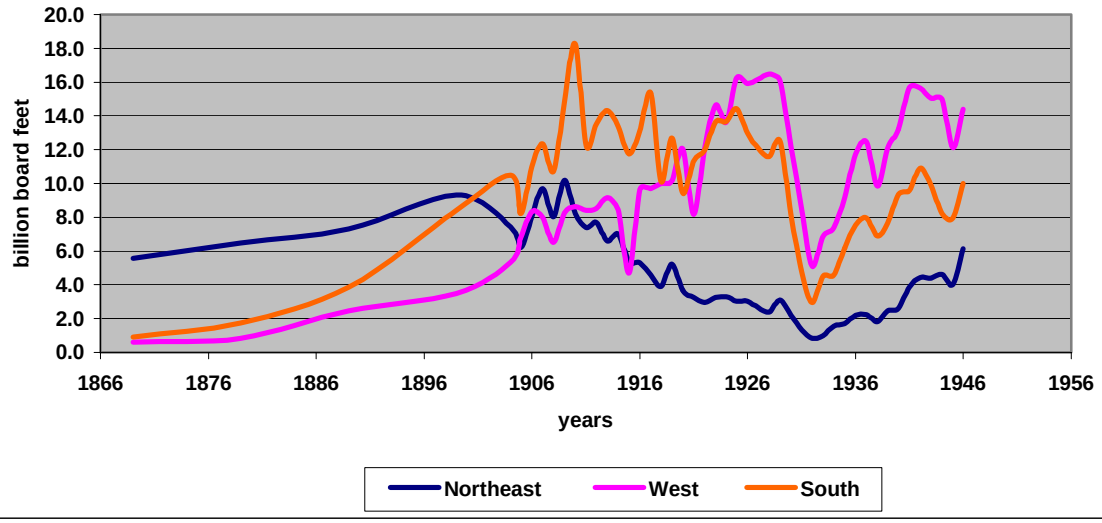


*The data for the years between 1869-1879, 1879-1889, 1889-1899, and 1899-1904 are increasing or decreasing averages of the years reported.
**Steer, Henry B. Lumber Production in the United States, 1799-1946. Misc. Publ. 669. Washington, DC: U.S. Department of Agriculture, Forest Service, Division of Forest Economics., 1948.

The West region was increasingly the main source for the Nation's timber resources while the South[1] and Northeast Region were steadily declining (Steer 1948). The South peaked in 1910, producing 18.2 billion board feet of timber, and by 1920 the South was producing only half of the volume of timber produced in the peak year (Steer 1948). The Northeast Region peak years were 1899 at 7.6 billion board feet and 7.4 billion board feet in 1907 (Steer 1948). The South had some years of low production but was consistent in producing annually 9 billion board feet of timber products (Steer 1948) (Figure 2.6 and 2.7).

Figure 2.6 Northeastern, Southern, and Western regions for the 1869-1946 period of lumber production



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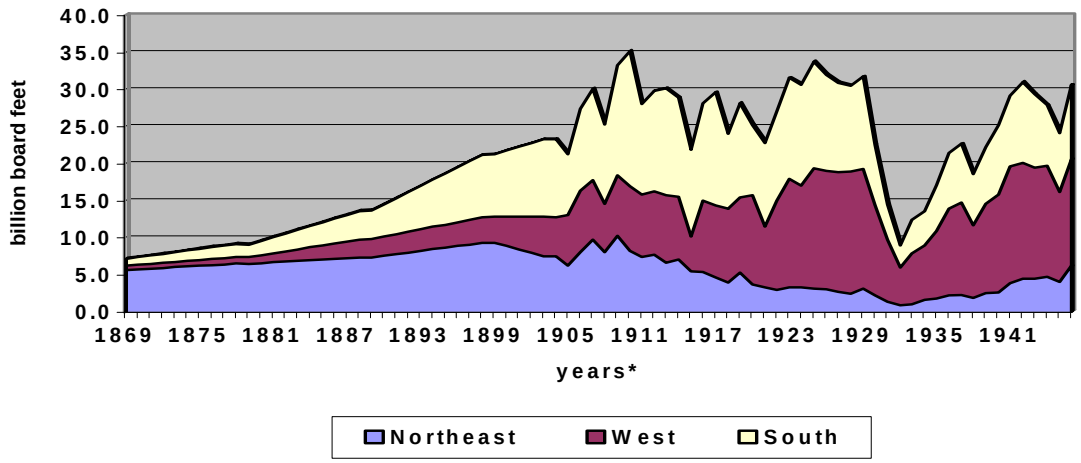
1/ The Southern region states are Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Texas, South Carolina, North Carolina, Tennessee, and Missouri (Steer 1948).

Figure 2.7 Percentage comparison of the Northeastern, Western, and Southern regions, for the 1869-1946 period



*The data for the years between 1869-1879, 1879-1889, 1889-1899, and 1899-1904 are increasing or decreasing averages of the years reported.
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2.2.2 Ownership of Western land or territory

The West Region had the available volume of softwood to supply the demands of the structural lumber industry and the paper manufacturing industry. Due to the government purchasing territory and obtaining land through treaties, the private and industrial timberland base was very small in the West in the 1920's as it is today. The small private and industrial owned timber base was not able to withstand a long period of timber harvesting. After World War II, the forest reserves in the West were the major suppliers of timber. The reserves had undergone some harvesting but not at the same level after World War II. The Nation was undergoing another boom in the population so the demands for structural timber to build homes were increasing.

The forest reserves in the West were set-aside during the heavy timbering in the central Appalachian and the Lake states to protect the woodlands of the Nation and insure a sustainable yield for future years. A concern for the natural resources in the United

States has been present before the Civil War but laws to reserve and manage the forest were not implemented until the 1890's. In 1891, the Forest Reservation Act was passed to give the President of the United States the ability or power to set apart of reserve lands covered with timber or undergrowth (Wellman 1987). The Forest Management Act of 1897 followed the Forest Reservation Act, which was passed to allow harvesting of the timber resources on the forest reserves. The federal government believed the forest resources would be better sustained by controlling the amount of timber being harvested on nationally owned land.

2.3 EFFECT OF LAND OWNERSHIP PATTERNS

The ownership of the timberland area in the United States is a significant factor in the increased demand for the hardwood roundwood in the Northeast Region of the United States. Due to reduced harvesting on public and federal owned timberland in the West, the hardwood timber resources of the eastern region are relatively important in meeting the demand for forest resources in the paper and structural component industry. The nationally owned timberland area in the Western Region held the majority of naturally regenerated softwood species in the sawtimber[1] and growing stock[2] volume. However, the eastern Region supplies the majority of hardwood species for the growing stock and sawtimber volume of the nation.

1/ The sawtimber includes commercial species trees with one 12' or 2 noncontiguous 8' bolts that is at least 11" diameter at breast height (dbh) for hardwoods and 9" dbh for softwoods.
2/ The growing stock include commercial species trees at least 5" dbh that will mature into sawtimber size and grade trees.

2.3.1 Eastern and Western ownership patterns

According to Luppold and Baumgrass (1999), the eastern national forest contributes only seven percent to the national timber supply. The larger timber base of non-industrial private forest and forest industry in the East Region will contribute a substantially larger amount of forest resources to the national timber industry. The non-industrial private forest (NIPF)[1] and forest industry timberland base in the United States is approximately 357.7 million acres, which is 71% of the overall timberland area in the nation (USDA Forest Service 1997 RPA Assessment). Only 14% (50.2 million acres) of the 357.7 million acres is found in the western regions of the United States, which are the Rocky Mountains and Pacific Coast states (USDA Forest Service 1997 RPA Assessment).

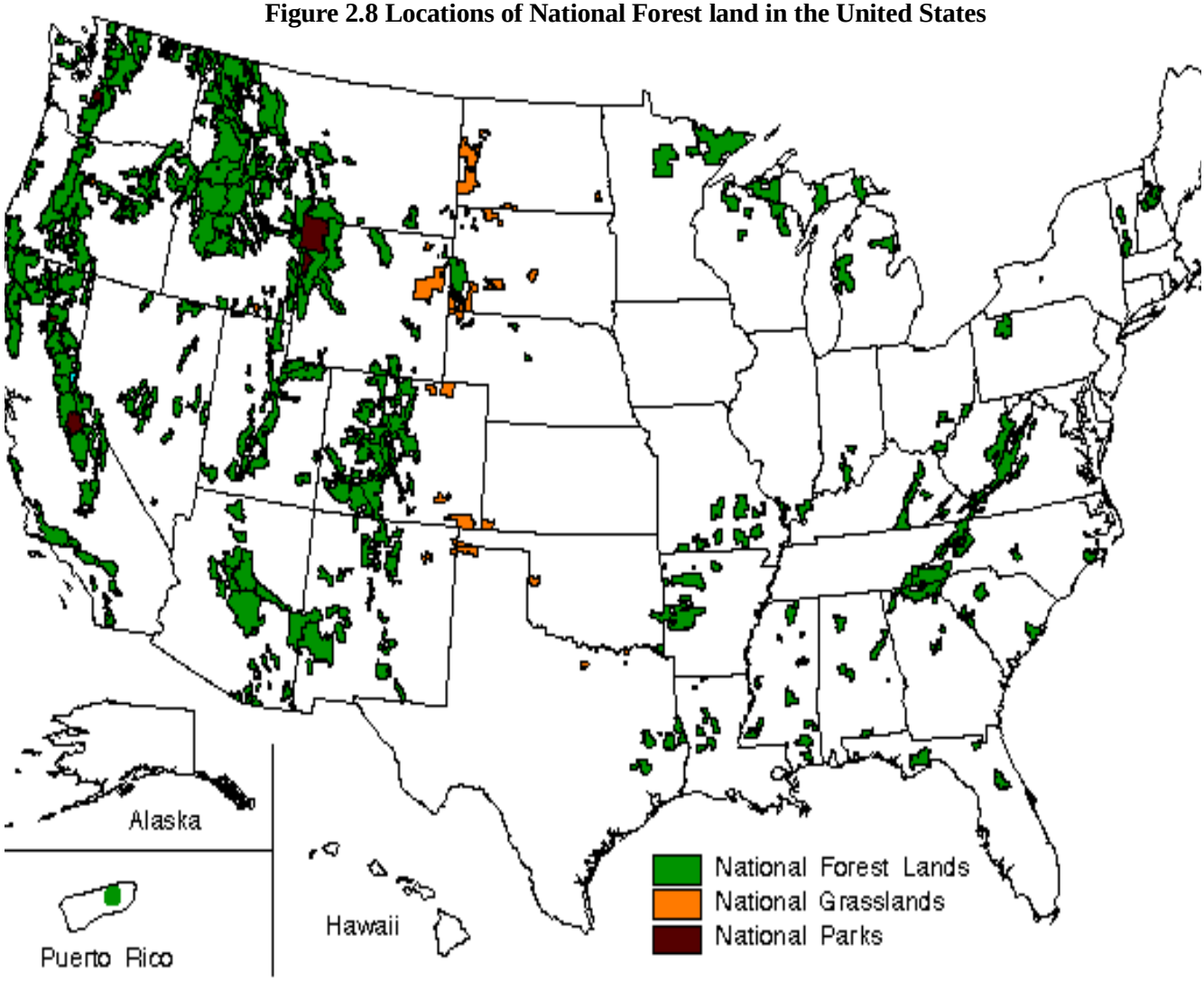
The remaining 307.5 million acres (86%) of the NIPF and forest Industry timberland area in the nation is in the East Region of the United States, which is distributed fairly even within the East (USDA Forest Service 1997 RPA Assessment). The North Central and South Central non-industrial private forest and forest industry timberland area includes 144.4 million acres, while the Northeast and Southeast non-industrial and forest industry timberland base contains the remaining163.1 million acres (USDA Forest Service 1997 RPA Assessment). The non-industrial private forest and forest industry timberland area in the Northeast and Southeast claims 89% of the land area in the East Coast subregions (USDA Forest Service 1997 RPA Assessment).

1/ The Forest Service in its forest inventory analyses and categorizes, privately –owned land as belonging to non-industrial private forests and forest industry land. This also includes land owned by mining companies, utilities, insurance companies, and other industrially owned land.

The Northeast NIPF and forest industry claimed approximately 76.3 million acres, which are about 47% of total acreage of timberland in the Northeast and Southeast (USDA Forest Service 1997 RPA Assessment).

The National Forest makes up 29%-146.7 million acres of the overall timberland area in the Nation. The Western region holds 85%-124.1 million acres of the National Forests 15%-22.7 million acres is in the Eastern region. The following map shows the low percentage of nationally or federally owned forestland in the Eastern region and high percentage in the Western region (Figure 2.8).

Figure 2.8 Locations of National Forest land in the United States



2.3.2 Land ownership patterns in West Virginia

The state of West Virginia has a publicly owned Federal and State timberland base of approximately 1.3 million acres (11%). The non-industrial private forests and forest industries timberlands consist of 10.6 million acres (89%) available for timber harvesting in the state of West Virginia. The focus of this paper is on the Northeast and Southeast subregions due to West Virginia's central geographical location within the Appalachian Region. The counties, geographical units, and Monongahela National Forest of West Virginia are delineated on a map in Chapter 1 of this report.

2.4 RECENT GEOGRAPHICAL SHIFT

The recent geographical shift of timber harvesting from the West back to the East is not due to an exhaustion of timber resources in the West. The recent shift of timber harvesting can be attributed to the growing harvesting restrictions on the National Forests, the regeneration of hardwood species in the Northeast, and the technology to utilize soft hardwood species in place of softwood species in the structural components and paper manufacturing industry.

The statistics do not depict an exhausted western forest but a healthy and vibrant forest until the government lets it burn down. According to the USDA Forest Service 1997 RPA Assessment of the Nation's Forests, the West has 1.8 trillion board feet or 56% of the 3.2 trillion board feet of available sawtimber volume in the United States. Correspondingly, the growing stock volume in the West constitutes 44% of the total growing stock volumes in the United States (USDA Forest Service 1997 RPA Assessment of the Nation's Forests). In 1996, the West only contributed 13% to the

harvested timber volume in the United States in comparison to contributing 32% to the Nation's production in 1986 (USDA Forest Service 1997 RPA Assessment of the Nation's Forests).

2.4.1 Anecdotal information

Through anecdotal information, a mill operator in West Virginia explained how during the 1920's mill owners in the Northeast were selling the sawmill equipment at scrap metal prices to acquire some capital gain during this era. The Western mill operators were buying the equipment to begin harvesting in their "neck of the woods". Recently, the situation turned so that the mill operators and owners in the Northeast are buying mill equipment from the Western mill operators for scrap metal prices of today. This information adds to assumption that the concentration of the National wood industry for roundwood consumption has returned to the eastern region, primarily the Northeast.

2.5 SPECIES COMPOSITION OF THE NATIOANL GROWING STOCK AND SAWTIMBER VOLUMES

Softwood species like Douglas-fir, ponderosa and Jeffrey pine, true firs, redwood, and other softwood species native to the Western region dominate the available sawtimber volume in the region of the United States. The USDA Forest Service 1997 RPA Assessment of the Nation's Forests reported the West region has a total of 1.8 trillion board feet of available sawtimber and 1.7 trillion board feet or 94% is in softwood species.

Like the West Region, the Northeast and the piedmont and coastal plains of the South was dominated by softwood species before the era of heavy timber harvesting and

European settlement. The dominant softwood species were the white pine, red spruce, yellow pine, and other species native to the regions. However, the species composition in the available sawtimber and growing stock volumes of the eastern regions is presently dominated by hardwood species. The Northeast available sawtimber volume is 74% hardwood species comprising 258.9 billion board feet of timber (USDA Forest Service 1997 RPA Assessment of the Nation's Forests). Three-quarters of the growing stock volume in the Northeast has regenerated into hardwood species (Luppold 1997).

2.5.1 Growing stock and sawtimber volumes

The southern region growing stock volume is approximately 151.5 billion cubic feet with 66% in hardwood regeneration (Luppold 1997). The South's available sawtimber volume is approximately 54% in hardwood species, or approximately 464.6 billion board feet (USDA Forest Service 1997 RPA Assessment of the Nation's Forests). The regeneration of mainly hardwood species in the growing stock and sawtimber volume in the East Region will allow the forest industry to place more confidence in the East. The confidence will be to relieve the demand on the softwood in the East for manufacture of paper and structural components. The reduced harvesting of the softwood on the publicly and nationally owned forests in the West has helped to increase the demand for softwood species in the southeast.

The overall sawtimber softwood and hardwood volume in the Nation's forest is 3.2 trillion board feet and the growing stock softwood and hardwood volume is 835.7 billion cubic feet. Approximately 76% of the national softwood sawtimber volume is located in the West Region, while the East Region possesses 90% of the hardwood

sawtimber volume in the nation. Furthermore, the Pacific Coast possesses 55% of the federally owned softwood sawtimber volume.

The growing stock volumes are distributed fairly even within the Nation's forest in reference to the softwood species but 90% of the hardwood growing stock volume in the Nation's Forests is in the East Region. The hardwood growing stock volume in the East Region is approximately 316.4 billion cubic feet of the 351.8 billion cubic in the Nation's forests. Of the four subregions in the East, the Northeast hardwood growing stock volume is the largest of the four. The hardwood growing stock volume in the Northeast is 100 billion cubic feet or 32% of the growing stock in the East.

2.6 WEST VIRGINIA COMMERCIAL FORESTLAND AREA[1]

Approximately three-fourths of the land area in the state of West Virginia was covered by forestland in 1961, which totaled approximately 11.4 million acres. The commercial forestland area had increased 1.5 million acres since 1946. An excerpt from the reports states, “The U.S. Census of Agriculture for 1959 showed that the number of farms in West Virginia decreased from 81,434 in 1950 to 44,011 in 1959”. This released approximately 1.4 million acres of land to regenerate seedlings and saplings.

1/ The report of “The Timber Resources of 1961” are the source for the information under the heading, unless noted otherwise within the paragraphs.

2.6.1 History of commercial forestland from 1950 to 1989[2]

In the third forest survey of 1975, the cropland (land used to grow crops) in West Virginia decreased by 1.1 million acres since 1950. Approximately 1 million acres of the 1.1 million acres were converted to highways, residential communities, and commercial developments. The remaining 100 thousand acres was converted to commercial forestland. Since the abandonment of farms and pastures, the commercial forestland area has increased to 11.5 million acres in 1975 and to 11.9 million acres in 1989 and held to the same acreage in 1994. The majority of the increase in commercial forestland was from 1949 to 1961. The years following did not have substantial increases in commercial forestland.

2.6.2 Growing stock and sawtimber area of the commercial forestland

The commercial forest lands were dominated by sawtimber stands in 1961, with about 5.6 million acres-49% of the commercial forest land although this decreased to 5.1 million acres-44% of the commercial forest land in 1975. The sawtimber acreage had a 14% increase between 1975 and 1989 to 63%-7.6 million acres of commercial forestland area. The land area for poletimber stands remained constant around 3.1 million acres and fluctuated between 26-31% of total land area during the period from 1961 to 1989. The seedling-and-sapling stands occupied 2.4 million acres in 1961 and increased seventeen percent in 1975 to 2.9 million acres but decreased to 1.2 million acres in 1989. The nonstocked (commercial forest land that is less than 10% stocked) portion of the growing stock on commercial forestlands occupied 234 thousand acres in 1961 but

2/The reports of "The Timber Resources of West Virginia of 1961" and "Forest Statistics for West Virginia--1975 and 1989" are the sources for the information under the heading, unless noted otherwise within the paragraphs.

dropped to 9,600 acres in 1975 and 2,600 acres in 1989. The reversion of pastureland and abandonment of family farms to timberland were the significant factors for the larger acreage of nonstocked area in 1961.

The state of West Virginia's growing stock hardwood volume was reported to be 20.3 billion cubic in the USDA Forest Service 1997 RPA Assessment of the Nation's Forests, while the sawtimber volume of hardwood was 54.5 billion board feet. The non-industrial private forests and forestry industry in West Virginia claimed 17.4 billion cubic feet (86%) of the growing stock, while the non-industrial private forests and forest industry claimed 49.3 billion board feet (86%) of the hardwood sawtimber volume in the state.

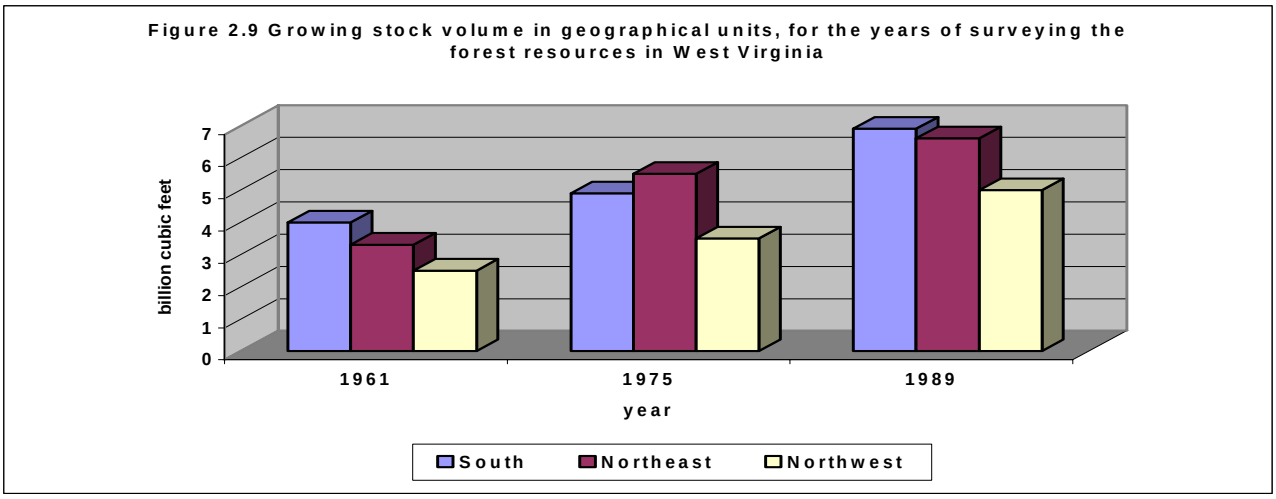
2.7 GEOGRAPHICAL UNITS AND NATIONAL FORESTS

The state of West Virginia is broken-down into the Northwest, Northeast, and the South geographical units. The Southern counties supported 4.9 million acres of forested land area in 1961 and this increased to 5 million acres in 1975. The Northeast unit supported 5.1 million acres of land area in 1961, which increased to approximately 5.9 acres in 1975. The Northwestern land area held to about 4.5 million acres for all the surveys. Both of the Southern and Northeastern units stayed about the same in land area for the period between 1975 and 1989.

2.7.1 History of growing stock and sawtimber volumes in geographical units

The Southern unit’s 4.1 million acres of commercial forestland had slightly over 10 billion board feet of sawtimber and 4 billion cubic feet in the growing stock in 1961.

The Northeast was second with about 8 billion board feet of sawtimber and 3.3 billion cubic feet of growing stock. The Northwest had almost 7 billion board feet of sawtimber and 2.5 billion cubic feet of growing stock in 1961 (Figures 2.9 and 2.10).



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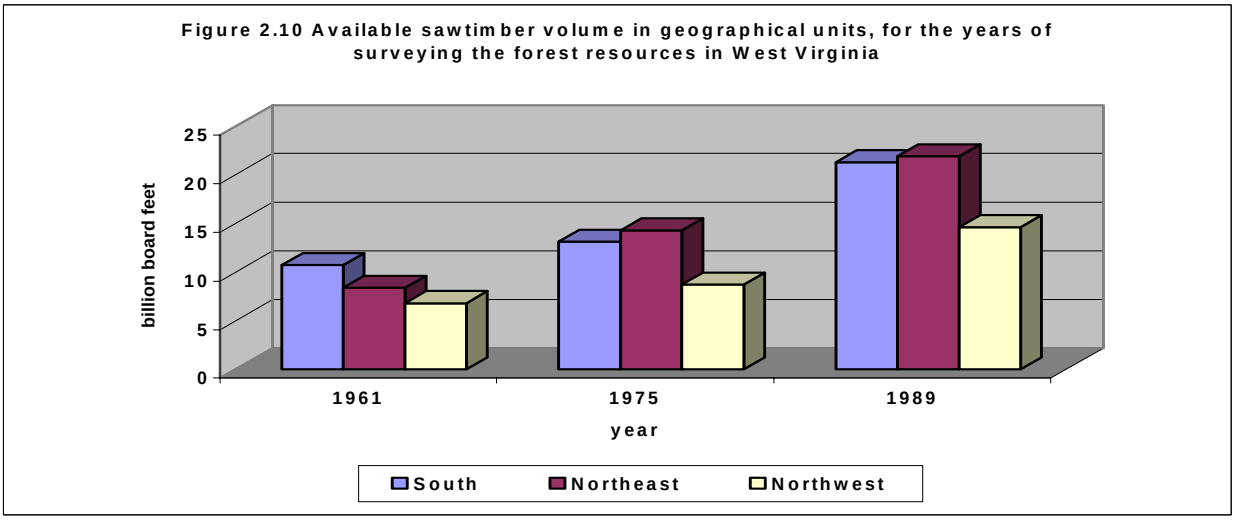

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The large increase of timberland area in the Northeast between 1961 and 1975 surveys resulted in a 41% increase in sawtimber volume from 8.4 billion board feet to 14.3 billion board feet, and reaching 21.9 billion in 1989. The volume of sawtimber in

the South and Northwest had 18% and 22% increases between 1961-75 and reaching 21.3 billion and 14.6 billion in 1989, respectively. The Southern unit was not as large as the Northeast in land area but was overall more productive both in growing stock and sawtimber volumes per acre (Figures 2.9 and 2.10).

2.7.2 Forestland area of the National Forests in West Virginia

The state contains the Monongahela and George Washington National Forests as separate forests within the Southern and Northeastern units. Two counties in the Southern unit and nine counties in the Northeastern unit support the National Forest's 904,000 acres. The National Forest remained constant with an approximate 0.9 million acres of forestland for the 1949, 1961, 1975, and 1989 survey of the forest resources. Ninety six percent of the National Forests' land area was productive forestland (869,000 acres), approximately 1,000 acres of productive-reserved land, and 34,000 acres of unproductive forestland. The Monongahela National Forest has 775, 000 acres while 94,000 acres are contained in the George Washington National Forest. Together, they constitute about 8% of the productive forestland acreage in the state.

2.8 SPECIES COMPOSITION

The hardwood species dominate the commercial forestland in all the geographical units with red oak, yellow-poplar, chestnut oak, and hickory regenerating an estimated 1/2 billion cubic feet each year during the 12 year span between the 1949 and 1961 surveys. The dominant softwood species were pitch pine, Virginia pine, and hemlock.

The other softwood species in the growing stock volume were shortleaf pine, white pine, and spruce.

2.8.1 Species composition of growing stock and sawtimber stands

The growing stock volume of commercial timber was 91% (10.5 million cubic feet) hardwood in 1961 and the hardwood percentage steadily increased to 93%-12.9 million cubic feet in 1975 and 94%-17.8 million cubic feet in 1989. The percentage of softwood in the growing stock decreased but the volume increased from 0.6 million cubic in 1961 to 1.2 million cubic in 1989. The sawtimber volume was 95% (27.2 million board feet) hardwood in 1961with a slight decrease to 93% in 1975 and 1989. The 27.2 million board feet of hardwood sawtimber in 1961 doubled to 57.8 million board feet in 1989 and the softwood volume had a similar growth from 1.6 million board feet to 3.8 million board feet between 1961 and 1989. Fifty-five percent (10.5 million cubic feet) of the growing stock volume in 1989 was in the sawlog portion of the sawtimber trees in the stand.

2.8.2 Softwood species

The dominant softwood species was hemlock that increased by 41% (592.4 million board feet to 1 million board feet) in volume between 1975 and 1989. Virginia pine was second, followed by white pine and finally red spruce. Softwood species have decreased as a percentage of overall sawtimber volume, however the volumes for individual species have increased. The climate, atmosphere, soils, and topography of West Virginia's forest better suits the regeneration of hardwood species.

2.8.3 Hardwood species

The dominant hardwood species of the sawtimber stands were red and white oak, yellow-poplar, hickory, red and sugar maple, beech, black cherry, and basswood. The white and red oaks dominated the hardwood volume of sawtimber since the abandonment of farms and pastureland in the 1950's. The sawtimber volume of timber showed a large increase in quantity between 1975 and 1989, especially in the oaks and yellow-poplar. The three forest statistic's reports showed the oaks making up over 40% of the sawtimber size trees between the 1960-89 survey years and yellow-poplar increasing to 18% of the sawtimber volume of trees for the period between 1975-89. The oaks and yellow-poplar species made up 63% of the total volume of sawtimber trees in the 1989 survey.

2.8.4 Future prediction of species composition in West Virginia

Trees that have reached the size required for commercial usage are included in the reported sawtimber volume. This influences the current species composition of commercially available trees. The species composition in the growing stock (poletimber size trees) influences the species composition of the forest in the future because the trees found in the growing stock are part of the ongoing forest regeneration. The leading species of the diameter sized classes of 5.0-6.9 dbh and 7.0-8.9 dbh in the growing stock volume was red maple with respective volumes of 196.8 and 254.3 million cubic feet in 1989. According to the 1989 survey of forest statistics, the maples may replace the oaks in the future species composition in the forest.

2.9 GROWTH AND REMOVAL[1]

The assessment of the timber resources of West Virginia in 1949 reported six billion cubic feet of trees poletimber size-5.0 inches and larger in diameter at breast height. The total growth in the growing stock was comprised of only 24% ingrowth (saplings growing into poletimber sized trees) in 1949. Between the 1949 and 1961 surveys, the volume jumped from 6 billion cubic feet to 11 billion cubic feet of trees poletimber size and larger. The net annual ingrowth constituting 48% of the total growth in the growing stock in 1961 depicted a healthier and younger forest than the forest in 1949. The application of fire suppression, technology to efficiently use the resources and cut less volume, forest management practices, and better equipment to harvest and remove the timber played a major part in having a healthy and young forest in West Virginia in this period (Figures 2.11-2.14).

2.9.1 Comparison between the growth and removal of the timber resources

The annual percentage of ingrowth dropped slightly to 43% during the period between 1960-74 and to 16% for the 1975-89 survey period. The ingrowth into the growing stock went from 200 million cubic feet in 1960 to only 83 million cubic feet in 1989 (58% decrease of ingrowth), which was showing an older and maturing forest.

1/ The removal volume measurements are not the same as the timber products output volumes. The timber products output volumes measure the amount of roundwood consumed by the primary wood manufactures. The removal volume is measured by tallying the volume of roundwood extracted since the previous forest resources measurement.

The decrease in saplings growing into poletimber size trees between 1960-89 can be attributed to the larger volume of sawtimber sized trees in the forest (Figures 2.11-2.14). The annual net growth of timber into the sawtimber stands was over a billion board feet for the periods between the 1949-60 and 1975-89, with 823 million board feet for the fourteen years between 1960-74 surveys. Also, the net annual removal of the sawtimber volume increased from 42% of the growth in the sawtimber volume between 1949-60 to 53% for the period between 1960-74 and dropped to only 22% between 1975-89. The percentage of timber removed in comparison to the growth of the timber fluctuated but the actual volume removed remained around 435 million board feet for the 40-year duration between 1949-89 (Figures 2.11-2.14).

In contrast, the growing stock volume average annual net removals fluctuated within the periods between the surveys. The fourteen-year period between 1960 and 1974 had an annual net removal of 166.1 million cubic feet in the growing stock volume, 119 million cubic feet for the period from 1949 to 1960, and 137.3 million cubic feet for the period from 1975 to 1989. But the percentage of timber removed in comparison to the growth was around 31% for the 40-year duration between 1949 and 1989 (Figures 2.11-2.14).

2.9.2 Removals by the timber industry

According to the three (1961, 1975, and 1989) measurements of the forest resources and land area, the Southern geographical unit was the most intense area of timber removal in West Virginia. The Southern unit's average net annual removals constituted half of the volume being cut in the state, with 212 million board feet between

1949 and 1960 and 219 million board feet between 1960 and 1974. The Southern unit dropped to 161 million board feet of sawtimber volume being removed annually between 1975 and 1989. The Northeast was removing only (178.5 million board feet) 10% more than the South between 1975-89. The Northwest remained in third place with an average net annual removal of 104.5 million board feet in 1975 and 1989 (Figures 2.11-2.14). The industry was cutting more timber than the growth, annually, in the South for the period between 1960-74. The removal rate exceeding the growth will be a significant factor in determining the reason for the tremendous decrease in the volume removed annually for the period following, between 1975-89. Even the growing stock removal rate was very close on the growth rate between 1960-74. The industry was removing almost 60% of the annual growth of the growing stock volume during the 1960-74 period in the South. The Northeast removal rate was consistently 33% of the annual growth being removed and the Northwest's annual removal about 22% of the annual growth over the forty-year duration between 1949 and 1989 surveys (Figures 2.11-2.14).

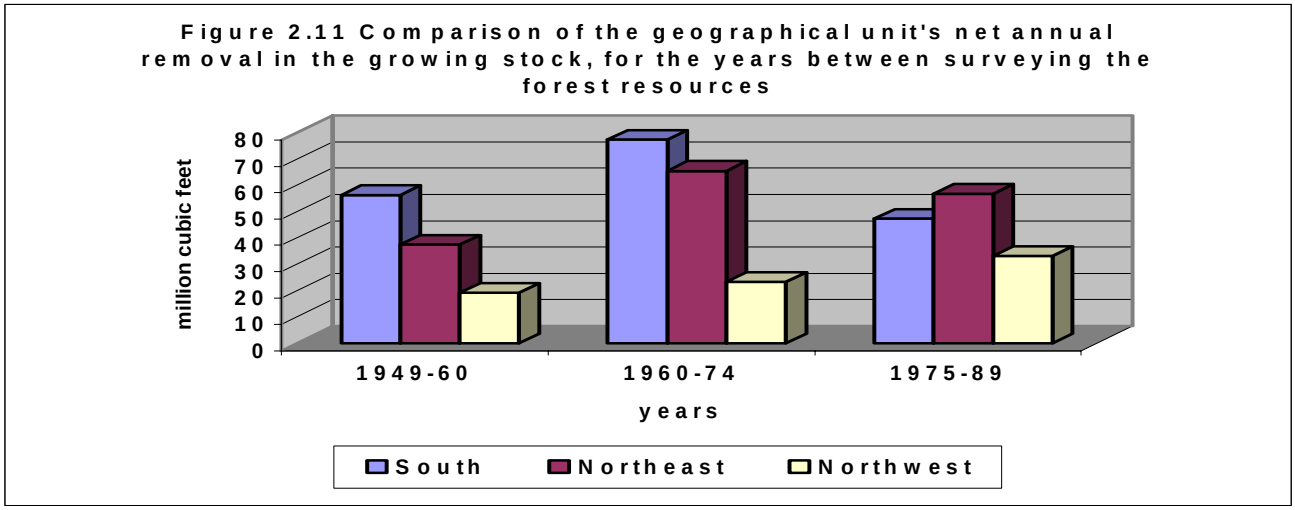

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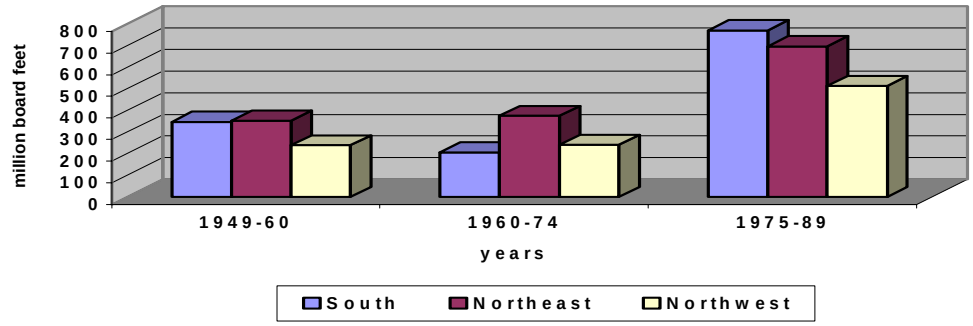
Figure 2.12 Comparison of the geographical unit's net annual growth in the saw-timber stands, for the years between surveying the forest resources



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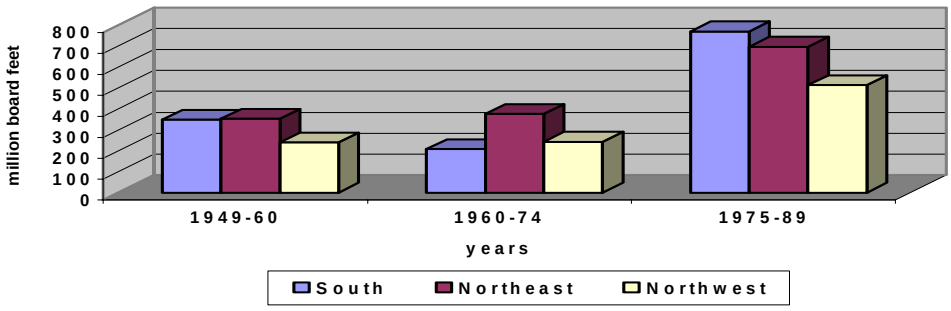

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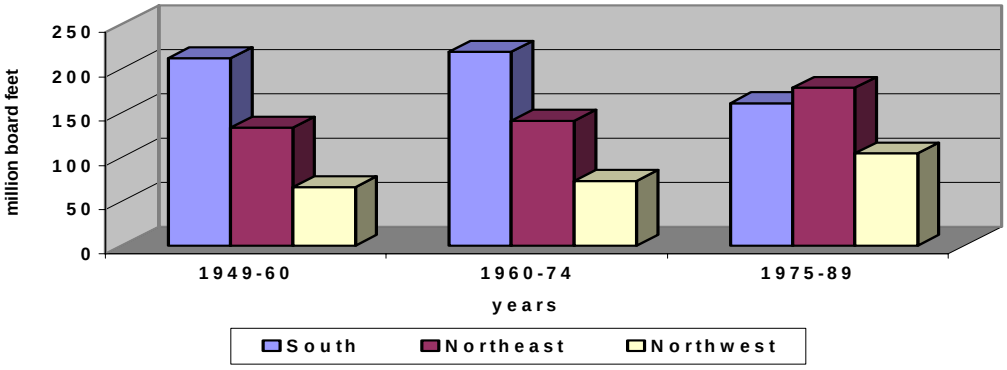

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2.10 TIMBER PRODUCTS OUTPUT VOLUMES[1]

The introduction gave a history of the amount of roundwood produced in the earlier years in the state of West Virginia. The 30 billion board feet of lumber produced between 1870-1920 does not reveal the timber products output volume for mine timbers, pulpwood, cooperage, miscellaneous industrial products, and fuelwood. So, the actual production volume between 1870-1920 exceeds 30 billion board feet of production. However, the timber products output (timber-products-utilization) survey conducted in 1960, 1965, 1974, 1979, 1987, and 1994 measured the output volume of mine timbers, pulpwood, and other roundwood products manufactured in West Virginia other than lumber. According to the survey, the state produced 108.3 million cubic feet of roundwood products in 1960 and jumped to 136.4 million cubic feet only five years later in 1965. The volume of roundwood products output dropped to 89.3 million cubic feet in 1979. By 1994, the state volume of roundwood products output had risen to 165.4 million cubic feet.

Lumber production remained the dominant roundwood product for each survey, increasing from 47% of the total volume in 1960 to 75% in 1994 of the total volume. Pulpwood constituted an average 18% of the total volume of timber products for the entire period of the surveys, which was second to lumber production. The veneer industry increased to 6.5 million cubic feet of roundwood products output in 1994 from an output of less than one half million cubic feet in 1960. The leading miscellaneous roundwood products were mine timbers, posts and poles, cooperage, and charcoal for the period between 1960 and 1989.

1/ The Timber Products Output surveys of 1949, 1961, 1965, 1974, 1979[1], 1987, and 1994 are the sources for the information under the heading, unless noted otherwise within the paragraphs.

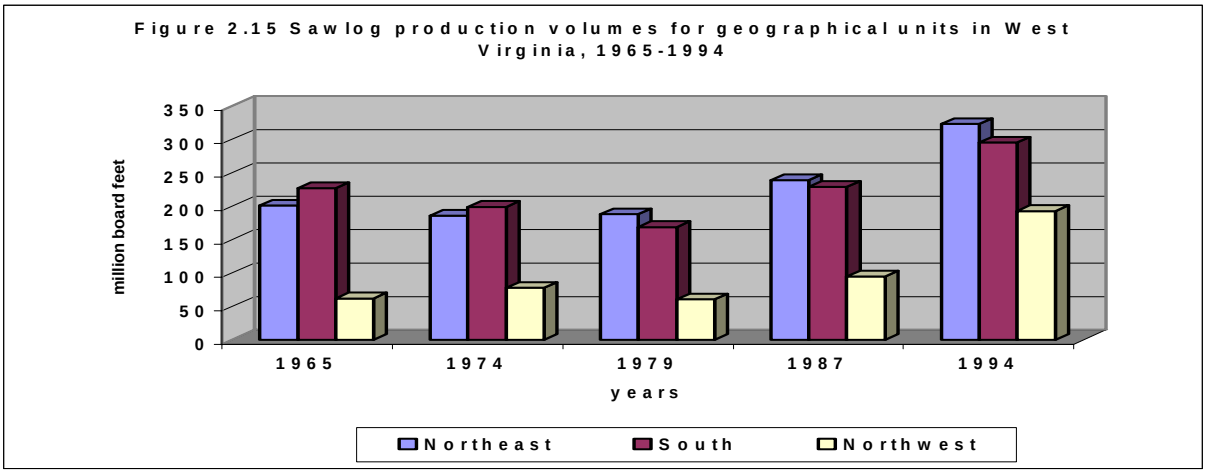
2.10.1 Sawlog production

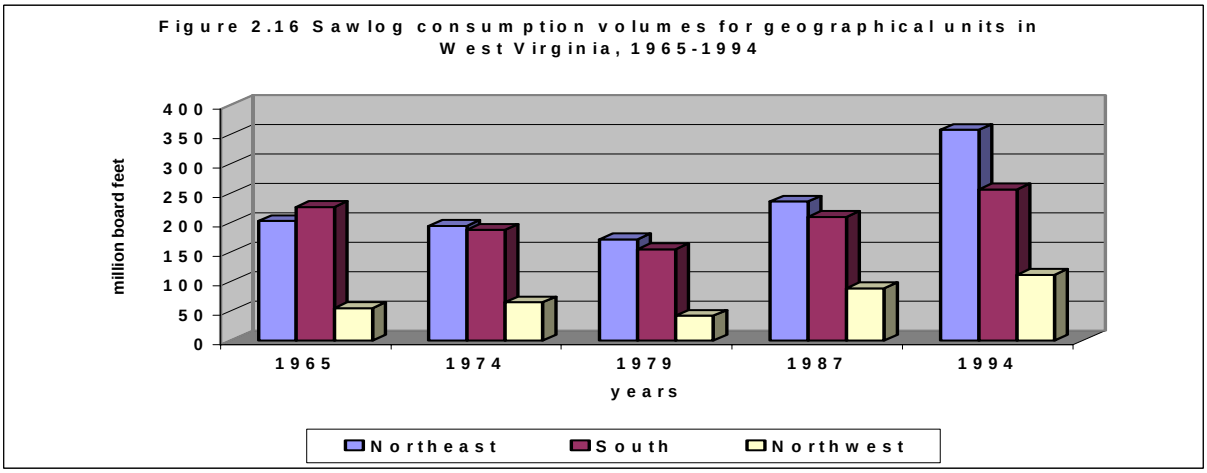
The production of lumber between 1880 and 1920 in West Virginia plummeted by 1933 to only 185 million board feet (28 million cubic feet) of lumber. Lumber production had a slight recovery after World War II but leveled off to an average 425 million board feet (65 million cubic feet) per year through 1979. Lumber production between World War II and 1979 peaked in 1965 when 84.5 million cubic feet of lumber (490.7 million board feet) was produced. This timber was cut from the growing-stock trees because the forest had not matured by 1965 but was young and vigorous according to the forest statistics survey of 1960. Ninety-nine percent of the volume (83.4 million cubic feet) of the sawlog volume was comprised of growing stock tree and the remaining volume was from cull trees and salvageable dead trees.

The geographical unit leading in sawlog production was Southern unit by producing 227.4 million board feet of sawlogs in 1965, although it dropped to second place behind the Northeastern unit for the next four survey periods. The Northeast and South units proved to be the leaders in sawlog production but the Northwest showed the most improvement between the 1979-87 survey years with a 55% increase in sawlog production and 112% increase in receipts. The Northwestern unit only produced 94.7 million board feet sawlogs and 88.7 million board feet in sawmill receipts during the period between 1979 and 1987.

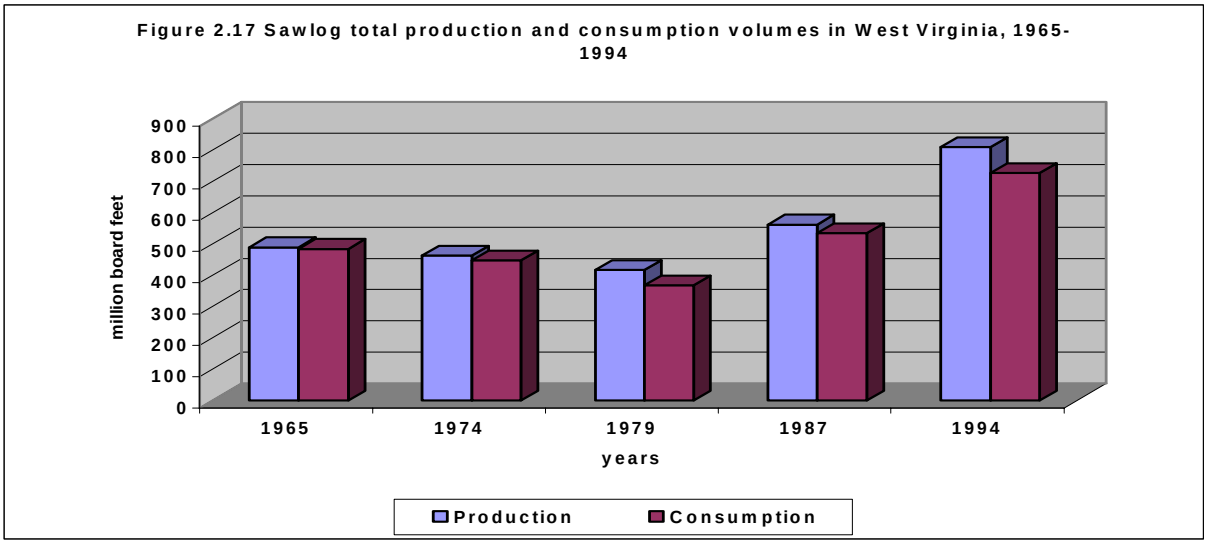
The TPO of 1994 reported an even stronger Northeastern region with 323.3 million board feet of production and 357.6 million board feet of consumption. The production volume increased by 26% since 1987 to 1994 and the consumption volume increased by 33%. The roundwood consumption volumes for the Southern (256.5 million

board feet-18% increase) and Northwestern (111.6 million board feet-20% increase) regions did not increase very much since the 1987 survey. The production volume doubled (51% increase) for the Northwestern unit by producing 193.4 million board feet and the Southern unit had a 22% increase to 294.9 million board feet (Figure 2.15-2.17).





*Kingsley, Neal P.; David R. Dickson. Timber Products Production in West Virginia 1965. U.S. Forest Service Resource Bulletin NE-10. Upper Darby, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1968.
**Bones, James T.; Ralph P. Glover, Jr. The Timber Industries of West Virginia. U.S. Forest Service Resource Bulletin NE-47. Upper Darby, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1977.
***Nevel, Robert L., Jr., Timber Industries of WV-1979. USDA Forest Service, Northeastern Forest Experiment Station, Internal Report.
****Widmann, Richard H.; Edward C. Murriner. West Virginia Timber Products Output-1987. U.S. Forest Service Resource Bulletin NE-115. Radnor, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1990.
*****Widmann, Richard H.; Eric Wharton and Edward C. Murriner. West Virginia Timber Products Output: 1994. U.S. Forest Service Resource Bulletin NE-143. Radnor, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1998.



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***Nevel, Robert L., Jr., Timber Industries of WV-1979. USDA Forest Service, Northeastern Forest Experiment Station, Internal Report.
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*****Widmann, Richard H.; Eric Wharton and Edward C. Murriner. West Virginia Timber Products Output: 1994. U.S. Forest Service Resource Bulletin NE-143. Radnor, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1998

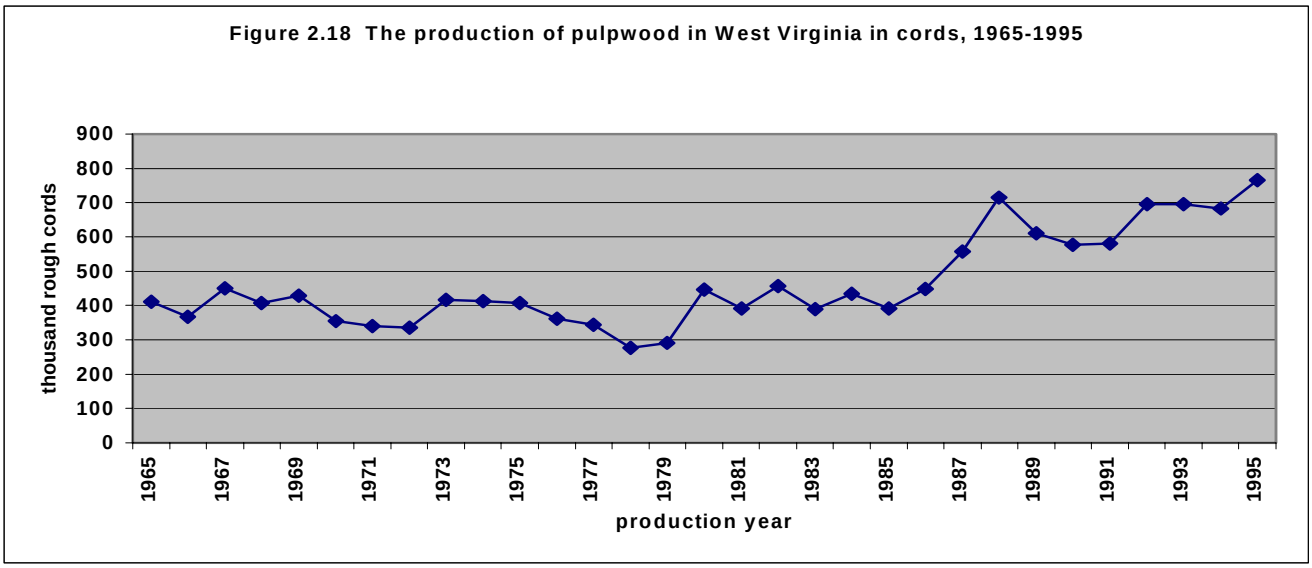
2.10.2 Pulpwood production

The production of pulpwood constituted about 18% of the total production timber products in West Virginia over the 1965-95 period. The state of West Virginia produced average 466,000 rough cords of pulpwood, annually, from 1965-95 with about 58% of the pulpwood coming from roundwood and the remaining 42 % from manufacturing residues. (The definition for rough cords is found in Appendix A.) The lower quality poletimber sized trees and the upper-portion of a sawtimber tree that does not meet the standards for a sawlog are used for pulpwood. The manufacturing residues include slabs, edgings, trimmings, and other solid wood material not used by the sawmills. These are chipped at the sawmill and marketed to the paper industry. The ratio of the pulpwood production coming from manufacturing residues has changed from 27% in the 60's to over 40% for the following years. The increasing use of manufacturing residues in the

production of pulpwood indicates efficiency in the wood industry of West Virginia (Figure 2.18).

Pulpwood production increased by 60% during the thirty-one years from 411,700 rough cords in 1965 to 765,300 rough cords in 1995. However, the increase in volume was very unstable between 1965 and 1995, by falling below 300,000 rough cords in 1978 and 1979. The volume of pulpwood produced for the years following 1979 fluctuated as well but did not fall below 300,000 rough cords. Pulpwood production exceeded 550,000 rough cords in 1987.

The pulpwood industry in West Virginia is very sensitive to the economic status of the mills in the neighboring state, due to the absence of pulp mills in the state. Because West Virginia is on the edge of the mill's procurement area, it typically is the first to receive cutbacks on procurement if the mills are undergoing economic strain (Widmann 1987). The reduction of the procurement area can have a significant effect on the pulpwood harvesters of West Virginia (Widmann 1987).



* Widmann, Richard H.; Eric Wharton and Edward C. Murriner. West Virginia Timber Products Output: 1994. U.S. Forest Service Resource Bulletin NE-143. Radnor, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1998.

2.10.3 Veneer log production

The veneer industry reported a large increase in production and receipts (the roundwood received by the mills-consumption) in 1994, producing 42.7 million board feet and marketing 44.7 million board feet. The increase in volume was due to the opening of a peeled veneer mill in the state that produced core material for plywood. The abundant yellow-poplar peeler logs (low quality veneer logs) was the primary species used in manufacturing the core material.

The volume of production and receipts was up and down between 1963-87 but never exceeding 10 million board feet in production, averaging six million board feet annually. The volumes for veneer receipts were about the same as production with the exception of 1979 and 1980 years reporting 23 and 23.4 million board feet in receipts. The veneer industry only produced four percent of the total production in 1994 and averaged about 1% of the total volume from 1960-87.

2.10.4 Miscellaneous products

The production of miscellaneous wood products (mine timbers, cooperage, poles and posts, charcoal, and fuelwood) has declined over the survey periods. The timber products surveys reported miscellaneous products constituting 27% of the total volume in 1960 and decreasing to only 3% of the volume in 1994. Fuelwood (industrial and domestic) and mine timbers were the leading products in this category. The dependency of fuelwood and mining timber products on other industries, particularly the mining industry, in and around the state dictated the production of the products. Substitution of

other natural resources for fuel and the decreased construction of underground mines in the state caused a reduction in the production of fuelwood and mining timbers.

2.11 THE TECHNOLOGY TO UTILIZE HARDWOOD SPECIES IN STRUCTURAL COMPONENTS

Engineered wood products are produced using a technology that allows the utilization of the available soft hardwood species. The engineered wood products industry manufactures oriented strand board and other panel board products to replace products like plywood. This helps alleviate the demand on the softwood volume on the private and forest industry owned softwood sawtimber. Due to the abundance and the physical constitution of softwood species, softwood has been the leading species to supply the demand for structural lumber. At present, the majority of the softwood species are growing on federally owned timberland, where the National forests hold 65% of the softwood species sawtimber volume in the Nation (USDA Forest Service 1997 RPA Assessment of the Nation's Forests). As noted earlier in the introduction, the National Forest is steadily decreasing the amount of timber harvested each year.

2.11.1 Wood composite products

The Engineered Materials Handbook defined composite materials in the American Society for Metals International of 1987 as "a combination of two or more materials (reinforcing elements, fillers, and composite matrix binder), differing in form or composition on a macroscale. The constituents retain their identities; that is, they do not dissolve or merge completely into one another although they act in concert. Normally, the components can be physically identified and exhibit an interface between one

another." Composite materials can be man-made or natural like wood. Wood is also considered a complex composite material in micro, macro and molecular levels (Lang 2000). The macro level includes the foundation of earlywood and latewood, the micro level includes middle lamella-primary layer-secondary layer, and the molecular level identifies a fiber-matrix relation (Lang 2000).

Wood is used to manufacture composite products by slicing, stranding, peeling, or chipping the wood into desired lengths and size and then recombining these with adhesives. Therefore, by grinding or chipping the wood and recombining with adhesives, the wood composite products can be used to manufacture structural components from less desirable and low-grade roundwood (with large amounts of the raw materials coming from tops of trees). The introduction of a wood composite mill in an area will be a benefit for forest management.

2.11.2 History on wood composite production

The production of wood composites has been around for many years in the eastern nations of the world. Composite wood products into the United States around the late 1800's and early 1900's. Hardwood plywood and veneer production was reported to be 23 million square feet in the year 1900 for manufacturing furniture and softwood plywood for construction material was being produced as early as 1910 but reported to be producing 77 million square feet in 1920 (Ince 2000). Although, the majority of the wood industry does not recognize plywood as a wood composite, the process and quality of wood is very close to some wood composite products. So, plywood will be considered

as a relative or pioneer for the wood composite industry in the United States in this report.

The production of hardboard surfaced in 1916 with production of about 5 million square feet and insulating board in 1925 with 88 million square feet (Ince 2000). In 1950, production of 21 million square feet of particle-board was reported. Fifteen years later, medium density fiberboard production was reported as 75 million square feet (Ince 2000). MacMillan Bloedel, Ltd. was in the process of pioneering parallel strand lumber in the 1960's but did not market the product (Ince 2000). Production did not occur until 1980 when 135 million square feet of OSB and 3 million cubic feet of laminated veneer lumber were reported (Ince 2000). Laminated veneer lumber was being produced in the 1970's but was not reported until 1980 (Ince 2000).

The majority of the wood composite materials have been developed over the past 40 years (Maloney 1996). The wood industry capitalized on the surplus wood residue and paper recycling around the 1950's (Ince 2000). The family of composite wood products is broken down into three parts: panel products, molded products, and lumber and timber products (Maloney 1996). The panel products are plywood (softwood and hardwood), blockboard, fiberboard, medium density fiberboard, particleboard, waferboard, oriented strandboard, and com-ply panels (Maloney 1996). The molded products are automobile panels and residential door skins, while the lumber and timber products are laminated veneer lumber, com-ply lumber, parallel strand lumber, oriented strand lumber, and railroad ties (Maloney 1996). Recently, some of these composite products were grouped together under a broader heading and identified as engineered

wood products including plywood, oriented strandboard, particleboard, medium density fiberboard, and glue laminated veneer and timber (Maloney 1996).

2.12 WOOD COMPOSITES IN WEST VIRGINIA

Three more engineered wood product mills was added to the wood industry in West Virginia over the past six years. The mills utilize the available soft hardwood timber in the forest of West Virginia and neighboring states' forests. The three-engineered wood products mills are Weyerhaeuser, Georgia Pacific, and Truss Joist Macmillan-A Weyerhaeuser Company, which manufacture oriented strand board, laminated veneer lumber, and parallel strand lumber. Weyerhaeuser and Truss Joist, two of the three mills recently moving into the state, are newcomers to West Virginia. The previous wood composite mill in the state is a veneer (lathe) mill in the southern portion of the state that manufactures core stock for plywood. This mill was added to the wood industry after the 1987 Timber Products Output survey was completed in West Virginia.

The first three wood-composite mills mentioned above (two oriented strand board mills and one lathe mill) were under construction in West Virginia while the 1994-timber products output survey was being prepared (Widmann 1998). Roundwood consumption in West Virginia was therefore expanded to include low-grade wood, underutilized species and logging residue (i.e., tree tops up to 4-inches in diameter). The mills compete with small scragg mills and out-of-state paper mills that use low-grade timber and undesirable species for pallets, pulpwood, and building material for local farmers and residents. The possibility of better management of the forest and reduced the waste of

resources while harvesting are advantages which result from wood composite mills using a substantial amount of underutilized species and low-grade wood (Widmann 1998).

One of the oriented strand board mills began operating in the southern portion of the state in 1995. The other oriented strand board mill and the lathe mill (producing parallel strand lumber and laminated veneer lumber) began operating in 1996. The three mills used approximately 31 million cubic feet of roundwood with the OSB mills using 80% of the volume-25 million cubic feet in low-grade trees up to a 4-inch top while the lathe mill used approximately 6 million cubic feet of low-quality veneer trees. In 1999, the mills consumed approximately 52 million cubic feet, with 87% of the volume coming from low quality roundwood. The lathe mill and a mill that produces cores stock for plywood depend on the availability of the yellow-poplar peeler logs in the state to produce peeled products.

2.13 ENGINEERED WOOD PRODUCTS MANUFACTURED IN WV

The products being manufactured in the mills are sheathing for walls, roofs, floors, columns, beams, headers, and posts. Although I-joists are not engineered in the state, laminated veneer lumber is used in the production of the flanges on the I-joist and oriented strand board is used in the production of the webbing. The laminated veneer lumber and parallel strand lumber manufacturers produce beams, columns, headers, posts and flanges for I-joist. The oriented strandboard manufacturers produce panel products used in the underlayment and subflooring, wall and roof sheathing, and siding.

2.13.1 Panel products

Waferboard and oriented strandboard is virtually the same product with slight differences in manufacturing the material. The waferboard is the predecessor to oriented strandboard. Waferboard was first produced in Dover, Idaho in 1955. Waferboard was produced from randomly-oriented square flakes of wood and was used for various sheathing applications that used low-density hardwoods, mostly aspen (Maloney 1996). In the 1970's, waferboard evolved into oriented strandboard by stranding the flakes to approximately three to six inches in length and arranging the layers more or less at a right angle to one another and using an adhesive to bond the layers together (Maloney 1996).

Oriented strandboard improved the strength of waferboard, which helped the producers better compete with plywood manufacturers. Over the past twenty years, oriented strandboard has taken over the sheathing market for waferboard and has surpassed plywood in the construction market. Oriented strandboard is less expensive to manufacture due to the better utilization of low-grade trees and undesirable species. Also, oriented strandboard has proven to be a better and stronger product than the plywood.

2.13.2 Lumber and timber products

Laminated veneer lumber commercial development was pioneered by The Truss Joist Corporation (Truss Joist MacMillan) in the 1960’s and developed by James D’aClark in the 1950’s (Maloney 1996). The purpose of the products was to create stronger structural lumber while efficiently utilizing the diminishing resources. The

composites use low-quality trees and undesirable species found in the forest, so fewer resources are wasted and utilized (Maloney 1996).

Laminated veneer lumber is a composite of thin sheets of veneer (1/8") that are vertically laminated together with an adhesive to manufacture headers and beams (Lang 2000). The width of the product is one and three-quarter inches and the thickness ranges from $5^1/_2$-inches to 18-inches (Truss Joist 2000). The composite product of parallel strand lumber is the bonding together of long and thin strands (8-inches or less) of wood to manufacture headers, beams, and columns (Truss Joist 2000). The structural veneer PSL has a $^1/_8$-inches in thickness and the width ranges from $^1/_2$-inches to 1-inches and 8-feet in length (Lang 2000). The strands of wood are highly oriented lengthwise within the cross-section of the wood (Lang 2000).

The species of yellow-poplar, southern yellow pine, hemlock, and fir are used to manufacture the parallel strand lumber and laminated veneer timber. Parallel strand lumber uses low-quality peeler logs while laminated veneer lumber uses the higher quality peeler logs. The species used to manufacture laminated veneer lumber in West Virginia is yellow-poplar, sugar maple, and a small volume of sycamore peeler logs. The logs are peeled on a wood lathe to obtain the sheets of veneer needed for producing the products. The resin used to bond the strands and timber together is phenol-formaldehyde. The laminated veneer lumber products can be frameworks for buildings and houses like "I-joist", webbing for the I-joist, and flanges for the I-joist. However, the products manufactured from the parallel strand lumber and laminated veneer lumber processes are beams, columns, and headers within the state of West Virginia. The oriented strand board is also used for sheathing walls, floors, and roofs.

Chapter Three - RESULTS AND DISCUSSION

The information in this chapter will consist of the estimated volumes for the consumption of sawlog products and veneer, peeled products, the species composition, and the estimated production volume for the sawlog products. The cordwood volume reported in 1999 in West Virginia is broken down into oriented strand board (OSB) and pulpwood. Also, the engineered wood products (wood composite) industry is analyzed within this chapter (Table 3.4).

3.1 ESTIMATED CONSUMPTION VOLUME

The estimated volume for the products from all mills was 884.8 million board feet and the total volume broken down by species was 866.8 million board feet. The survey asked for the breakdown of the volume of roundwood consumed by species and by products. However, some mills did not give the volume for certain species but did give the volume for sawmill products. This resulted in an 18 million board feet difference between the break down for estimated species and for products (Tables 3.1 and 3.3). The margin of sampling error ($\pm$ME) for the total estimated consumption was 1.3 million board feet for the species and products. The species low $\pm$ME was 865.5 million board feet and 868.1 million board feet for the high $\pm$ME of roundwood consumed in 1999 (Table 3.1). The products low $\pm$ME was 883.5 mmbf and 886.1 mmbf of roundwood consumed (Table 3.3). Due to a large population of small sawmills, the Northeastern geographical unit had the largest $\pm$ME of 607 mbf. The Southern ($\pm$ME of 370 mbf) and Northwestern ($\pm$ME of 364 mbf) units had smaller populations of big and small populations than the Northeastern unit

The estimation of the consumption volumes for the species and products are proportionally different by the regions. The Southern (36%) and Northeastern (35%) units constitute 71% of the total estimated volume for roundwood consumed by species and the Northwestern unit makes up the remaining 29% of the volume. The estimated volumes for the products are 45% in the South, 38% in the Northeast, and only 16% in the Northwest. The estimated species and product volumes for the Northwestern units are not very close (Table 3.1).

3.2 ESTIMATED SAWMILL CONSUMPTION OF ROUNDWOOD BY PRODUCTS

The volumes by species are broken-down into the three geographical units and softwood and hardwood volumes. The estimated volume for products is broken-down into the three units and three categories. The first category is the sawlog products, which are lumber, pallets[1], and dimension. The products manufactured in the sawmill are categorized as sawlog products that were processed through either a circle or band saw. The resale products are peeled products[2], sliced veneer, and pulpwood, oriented strand board, and fencing products. The resale[3] products are sold to other primary wood manufacturers that specialize in manufacturing veneer by either slicing or peeling the log, wood composite products, and fencing products (posts and rails). The resale volume shows the efficiency and cooperation of the wood industry. The mills understand the value of the roundwood and desire to see the entire tree used and none wasted or lose value. The final category is labeled "other" due to the variation of products.

1/ The pallet lumber is the portion of the Sawlog or whole sawlogs that will not be marketed as graded sawlogs. The lumber used to produce pallets is called "shook."
2/ Peeled products in West Virginia use the available resources of yellow-poplar to produce structural products (composite products).
3/ The resale volumes given for pulpwood, oriented strand board, and peeled products were reported in board foot volume, which is the incorrect unit measurement. The correct unit measurements for the products are rough cords, green tons, and cubic feet.

3.2.1 Sawlog products

The sawlog products constituted approximately 83% (732 million board feet) of the estimated total volume of roundwood consumed by the sawmills. Lumber made up 89%-652.8 million board feet of the sawlog volume, dimension and pallet industry contributed 79.2 million board feet-15% of the roundwood harvested in 1999.
The dimension products are handle stock, furniture blanks, and turning stock. The dimension products utilize a high quality roundwood that is cut to specific length for secondary manufacturers.

The larger mills utilized more roundwood for lumber and dimension than the smaller mills. However, the amount of roundwood used to manufacture lumber in the larger mills was 93% (601.3 million board feet) of the estimated sawlog volume for the larger mills. The manufacturing of pallets and dimension was only 6% (37.6 million board feet) and 1% (9.5 million board feet) of the estimated sawlog volume for the larger mills. The smaller mills utilized 51.5 million board feet of roundwood (61%) for lumber production, 14.7 million board feet (18%) for pallets, and 17.4 million board feet of roundwood (21%) into dimension products.

The mills in the Southern unit utilized an estimated volume of 315.2 million board feet of roundwood, 288.6 million board feet in the Northeastern unit, and 128.2 million board feet of roundwood in the Northwestern unit. The Southern unit used an estimated 297.2 million board feet of roundwood for lumber production, the Northeastern unit followed with an estimated 252.5 million board feet of roundwood, and finally the Northwestern unit with 103.1 million board feet of roundwood. The pallet industry was largest in the Northeast, consuming 23.5 million board feet; the Southern unit followed

with 17.9 million board feet, and the Northwestern unit with 10.9 million board feet. The dimension industry was largest in the Northwestern unit (14.1 million board feet), second was the Northeastern unit using 12.6 million board feet, and an estimated 126 thousand board feet in the Southern unit (Table 3.1).

3.2.2 Resale products

The resale volume is considered the volume for the roundwood sold to primary manufacturing mills that produce specific products like pulpwood, engineered wood products, fencing, and veneer. The estimated resale volume of roundwood was 117.9 million board feet of roundwood, which made up 13% of the total estimated volume for the sawmills. The pulpwood (46.2 million board feet) and oriented strand board (14.4 million board feet) industries used the low-grade trees up to a four-inch top. The peeled products industry used 33 million board feet of yellow-poplar peeler logs, which was used for plywood core stock, parallel strand lumber and laminated veneer lumber. The split rail fencing industry used an estimated 14 million board feet for posts and rails. The high quality roundwood (10.4 million board feet) was resold to the sliced veneer industries. There was only one sliced veneer mill in West Virginia while this survey was conducted, so approximately 90% of the veneer roundwood was manufactured outside of West Virginia.

The Southern geographical unit contributed 67%-79 million board feet to the estimated resale total, the Northeastern unit followed with an estimated resale volume of 25 million board feet, and the Northwestern unit with 14 million board feet of roundwood. The Southern unit was first in the resale volume for peeled products (17

million board feet), pulpwood (43 million board feet), and fencing (12.5 million board feet) volumes. The Northeastern unit was strongest in the resale volume of sliced veneer (4.9 million board feet) and oriented strand board (7.5 million board feet). The Northwestern unit was second in the resale volume of pulpwood (1.9 million board feet).

The estimated resale volume gives a numerical depiction of the efficiency of the wood industry in West Virginia. According to the analysis, the resale volume of the sawmills made up 12% of the total estimated volume for sawmills. The estimation from the survey shows the mill ship from the yard but does not take into account the roundwood that the sawmills resold directly from the logging site (Table 3.1).

3.2.3 Other products

The total estimated volume for this category is 34.9 million board feet of roundwood, which made up only 4% of the estimated volume of roundwood consumed by sawmills in 1999. The products that make up this category are exports (8.3 million board feet) and miscellaneous (26.6 million board feet).

The miscellaneous products are railroad ties, mine materials, pilings, poles, and other products that would use low grade and quality roundwood. The survey did not have an option for mine timber usage so the mills were not able to indicate the utilization of roundwood for mine timbers. However, while visiting the mills, a large portion of the smaller mills was manufacturing mine timbers. So, the mine timbers would be considered the dominant product manufactured as a miscellaneous product for the smaller mills (Table 3.1).

3.2.4 Sliced veneer[1]

The veneer industry is the smallest member of the wood industry in West Virginia but produces a substantial amount of revenue for the state's economy. In 1999, the sliced veneer industry consumed estimated 10.4 million board feet of timber but only 1 million board feet remained in the state, which produced approximately 1.3 million board feet of sliced veneer products. According to the study, the Northeastern unit supported 4.9 million board feet of the total estimated volume, Southern region followed with 3.7 mmbf , and the Northwestern unit was last with 2.1 mmbft of roundwood (Table 3.1).

Table 3.1 Estimated Consumption of Sawmill Roundwood by Product and Region, 1999
(Thousand board feet)

	Northeastern	Southern	Northwestern	Total
PRODUCTS	**unit**	**unit**	**unit**	**consumption**
Lumber	252,534	297,184	103,112	652,830
Pallets	23,463	17,939	10,940	52,342
Dimension	12,611	126	14,129	26,866
Sawlogs total	**288,608**	**315,249**	**128,181**	**732,038**
Peeled products	10,214	16,687	6,054	32,955
Sliced veneer	4,867	3,361	2,143	10,371
Pulpwood	1,421	42,911	1,906	46,238
Fencing	864	12,500	520	13,884
OSB	7,461	3,870	3,117	**14,448**
Resale total	**24,827**	**79,329**	**13,740**	**117,896**
Exports	4,171	2,543	1,626	8,340
Miscellaneous	22,485	4,074		26,559
Other Products Total	**26,656**	**6,617**	**1,626**	**34,899**
All products	**340,091**	**401,195**	**143,547**	**884,833**
+ME[2]	***607***	***370***	***364***	***1,341***

[a]**Doyle board feet**

1/ The highest quality of roundwood is sliced to produce sheets of veneer used for decoration.
2/ The margin of sampling errors for the small and big mills was combined from Table 1.

3.2.5 Sawmill production

The estimated production of sawlog products was determined by using a 1.25 adjustment factor. This factor takes into account the over estimation of small logs (diameter of 8-12-inches) and under estimation of large logs (diameter greater than 12-inches) when using the Doyle board feet measurement. The volumes for the resale and other products are not included in the calculation of sawmill production. The roundwood used to produce sawlogs was processed through either a circular or band saw for manufacturing.

The estimated production volume for lumber was 816 million board feet for 1999 in West Virginia, the production of pallets followed with 65.4 million board feet, and 33.6 million board feet for dimension products. We estimated that the Southern region produced 394 million board feet of lumber, the Northeastern region produced 360.1 million board feet, and 160.2 million board feet for the Northwestern region. The production of pallets was larger in the Northeastern region (29.3 million board feet), the Southern region followed (22.4 million board feet), and last was the Northwestern unit (13.7 million board feet). The production of dimension product was larger in the Northwestern and Northeastern units with estimated volumes of 17.7 and 15.8 million board feet. The Southern unit produced over 158 thousand board feet of dimension product (Table 3.2).

Table 3.2 Estimated Production of Sawmill Roundwood by Product and Region, 1999 (Thousand board feet)[a]

PRODUCTS	Northeastern Unit	Southern unit	Northwestern unit	Total Production
Lumber	315,668	371,480	128,889	816,037
Pallets	29,330	22,423	13,675	65,428
Dimension	15,764	158	17,661	33,583
Sawlog total	**360,761**	**394,061**	**160,225**	**915,047**

aDoyle board feet

3.3 ESTIMATED CONSUMPTION OF ROUNDWOOD BY SPECIES

The species with the largest reported sawlog volume was yellow-poplar (198.5 million board feet), followed by northern red oak (139 million board feet), other red oak species (97.2 million board feet), and white oak (75.5 mm board feet). The other significant species like the other white oaks (59.3 million board feet), the maples (86 million board feet), ash (39.5 million board feet), and black cherry (35.7 million board feet) made up a large percentage of the overall volume. The softwood species of white and red pine made up only 1% of the estimated board foot volume. Roundwood consumption reported by species mirrors the sawtimber volumes reported earlier.

Leading roundwood consumption in all three regions of the state were yellow-poplar, northern red oak, and white oak. The black cherry had the largest sawlog volume in the Northeast unit and the other red oaks in the Southern unit. The Northeast region supported 8.4 million board feet of white pine and the 355 thousand board feet of red pine (Table 3.3 and Figure 3.1).

3.3.1 Hardwoods

The hardwood species estimated volume of roundwood consumption was 857.8 million board feet or 99% of the overall volume of sawmill consumption. Yellow-poplar species had the largest consumption in all three units and northern red oak followed in second place. The other red oaks followed in third place for the Southern and Northwestern regions and black cherry was third in the Northeastern region. The consumption of white oak and other white oaks was quite low due to a lack of demand in

the wood industry. White oak is traditionally used for cooperage and railroad ties but the industries have definitely declined since the early 1900's (Table 3.3 and Figure 3.1).

3.3.2 Softwoods

The Northeastern unit reported the most softwood roundwood (8.8 mmbf) with the majority of this being white pine (7.9 mmbf) followed by red pine (200 mbf). While visiting mills in the state, a large number of the smaller mills were using softwood species to supply the demand of local consumers (Table 3.3 and Figure 3.1).

Figure 3.1 Species composition of roundwood consumed by sawmills in 1999, West Virginia

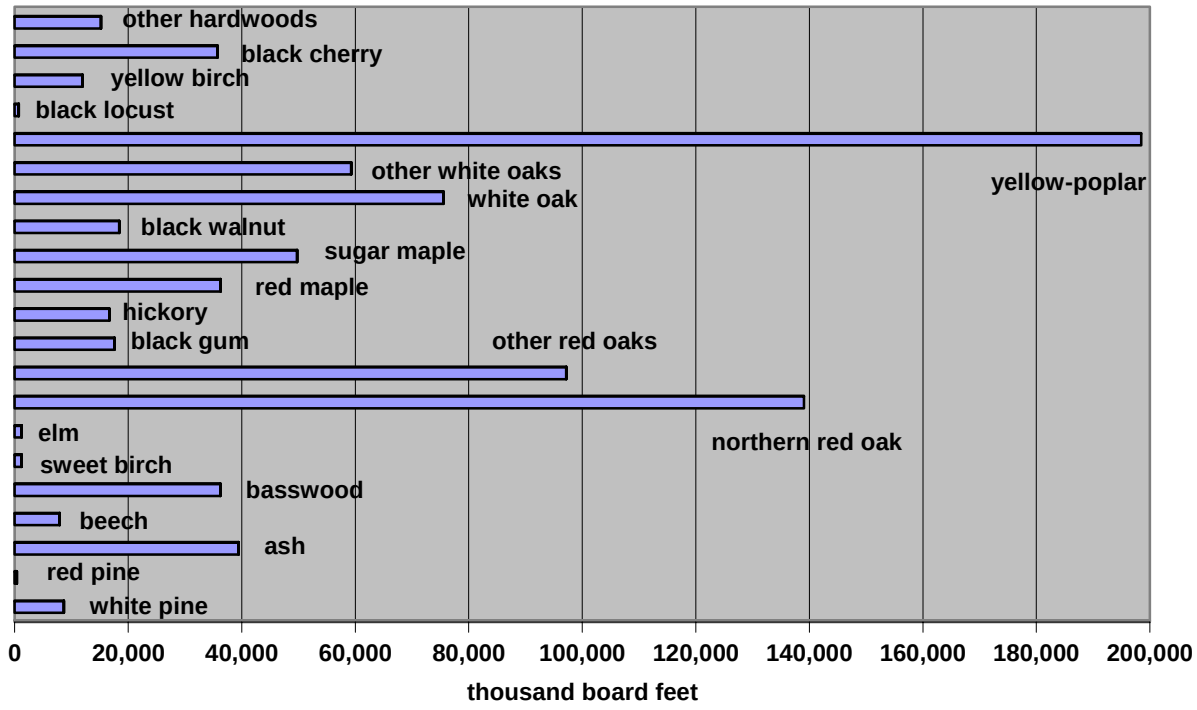


Table 3.3 Estimated Consumption of Sawmill Roundwood by Species and Region, 1999 (Thousand board feet)[a]

SPECIES	Northeastern unit	Southern Unit	Northwestern unit	Total consumption
White pine	8,434	62	171	8,667
Red pine	355			355
Total softwood	**8,789**	**62**	**171**	**9,022**
Ash	9,477	10,217	19,764	39,458
Beech	3,532	2,319	2,072	7,923
Basswood	8,997	16,170	11,055	36,222
Sweet birch	942	250		1,192
Elm	1,142		90	1,232
Northern red oak	57,764	43,894	37,377	139,035
Other red oaks	21,149	42,599	33,447	97,195
Black gum	396	10,155	7,036	17,587
Hickory	5,224	6,181	5,250	16,655
Red maple	20,312	9,677	6,270	36,259
Sugar maple	18,830	17,731	13,188	49,749
Black walnut	2,601	9,410	6,404	18,415
White oak	35,019	19,744	20,754	75,517
Other white oaks	13,526	26,171	19,599	59,296
Yellow poplar	70,395	71,034	57,065	198,494
Black locust	691			691
Yellow birch	965	6,826	4,115	11,906
Black cherry	25,467	5,406	4,865	35,738
Other hardwoods	294	8,855	6,046	15,195
Total hardwoods	**296,723**	**306,639**	**254,397**	**857,759**
All species	**305,512**	**306,701**	**254,568**	**866,781**
+ME	***607***	***370***	***364***	***1,341***

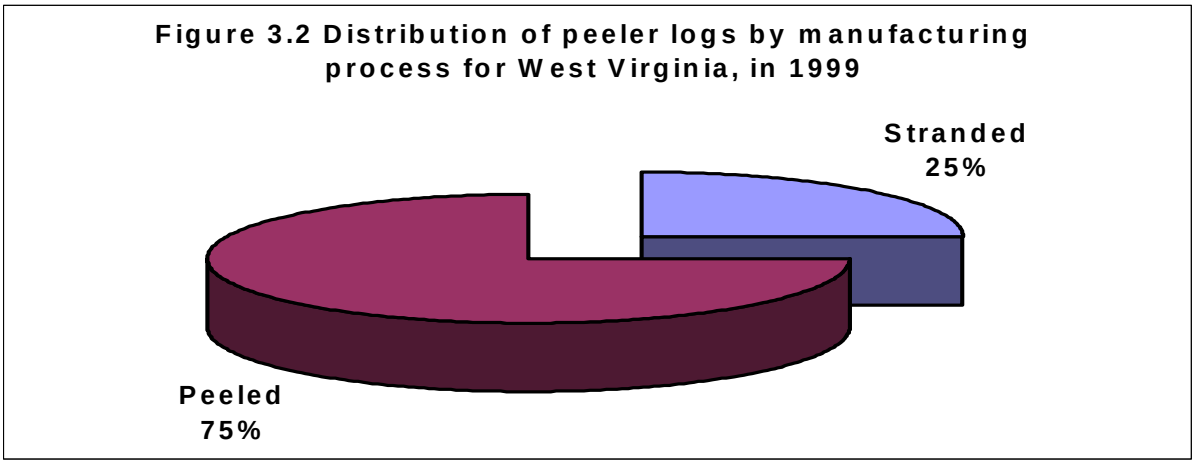
aDoyle board feet

3.4 PEELED PRODUCTS

The two peeler mills (the products manufactured are plywood cores stock, parallel strand lumber, and laminated veneer lumber) consumed a combined 12.1 million cubic feet of predominantly yellow-poplar (96%-10.9 million cubic feet) and a minimal amount

of sugar maple (3%-1.2 million cubic feet) peeler log quality. The estimated resale volume of roundwood used for peeled product constituted (13%-2.7 million cubic feet) of the total volume. The estimated board foot volume of roundwood used was 145.2 million board feet, which 32.4 million board feet were resale volume and 111.8 million board feet were non-resale volume.

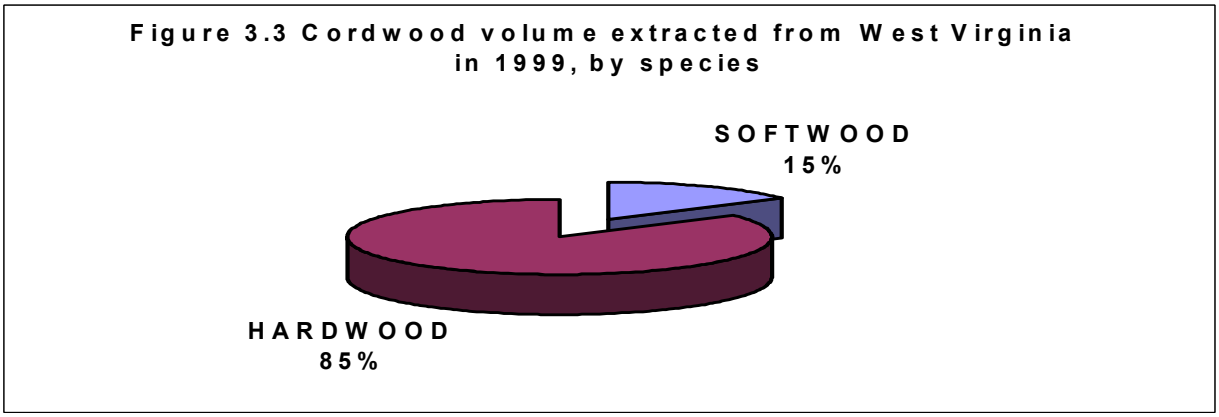
The roundwood material that was not suitable for laminated veneer lumber and plywood core stock was used for manufacturing parallel strand lumber-PSL. The parallel strand lumber consumed about 25% of the peeled veneer volume. The PSL product can use the lower grade or quality roundwood because the process to manufacture the product is stranding of the raw material and recombining the strands with adhesives (Figure 3.2).

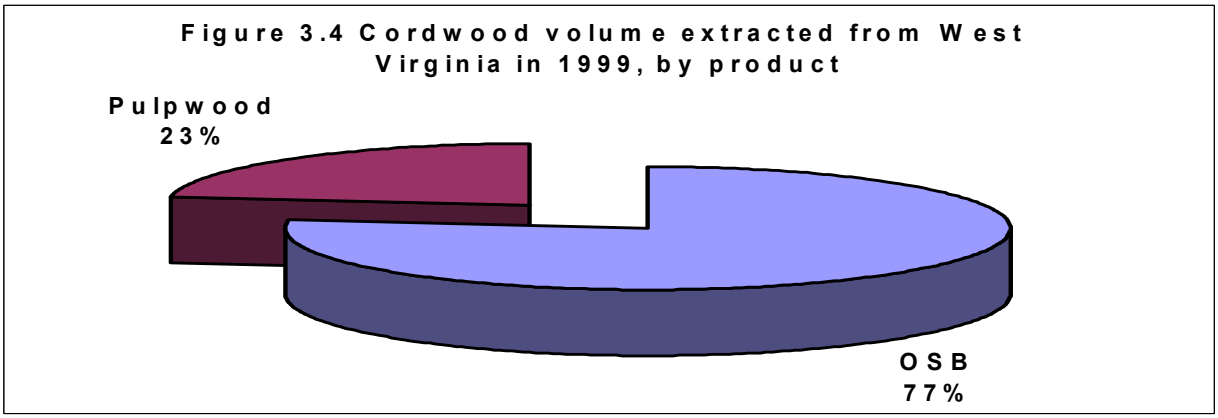


3.5 CORDWOOD VOLUME

Like oriented strand board mills, pulpwood mills use low-grade hardwood species (mixed hardwood tree tops and mill residue) to manufacture paper. Competition between the two was evident while analyzing the data. Overall, the mills consumed approximately 717,000 cords of mixed hardwood and white pine, red pine, and Virginia

pine softwood species. The cordwood volume of mixed hardwoods was 608,000 rough cords (85%) and the softwoods were 109,000 rough cords (15%) of the total volume. The softwood species of the cordwood volume was used entirely for pulpwood (Figures 3.3 and 3.4).





3.5.1 Oriented strand board (OSB)

Oriented strand board strand mills utilized approximately 67% (480 thousand rough cords) of the total cordwood volume and made up 77% of the mixed hardwood volume within the cordwood volume that was extracted from West Virginia in 1999. Primarily, the mills used the abundant supply of low-grade soft hardwood species. The mills can use tops of trees down to four inches in diameter and logging residue. The sawmills welcome the OSB mills into the state due to the lack of competition for raw

material. Through anecdotal information, a mill operator explained the value of the OSB mills to the wood industry of West Virginia. He described how the loggers are allowed to continue harvesting during slow seasons for the larger sawmills because the OSB mills will take what the larger mills do not utilize. This would allow the loggers to continue operating when the sawmills are not demanding large quantities of logs. Also, the sawmills can gain a financial profit by selling the lower quality roundwood cut from timber sales owned by the sawmills. The sawmills will lose money by sawing lower quality roundwood or waste it when left in the woods. The OSB mills allow markets for underutilized roundwood.

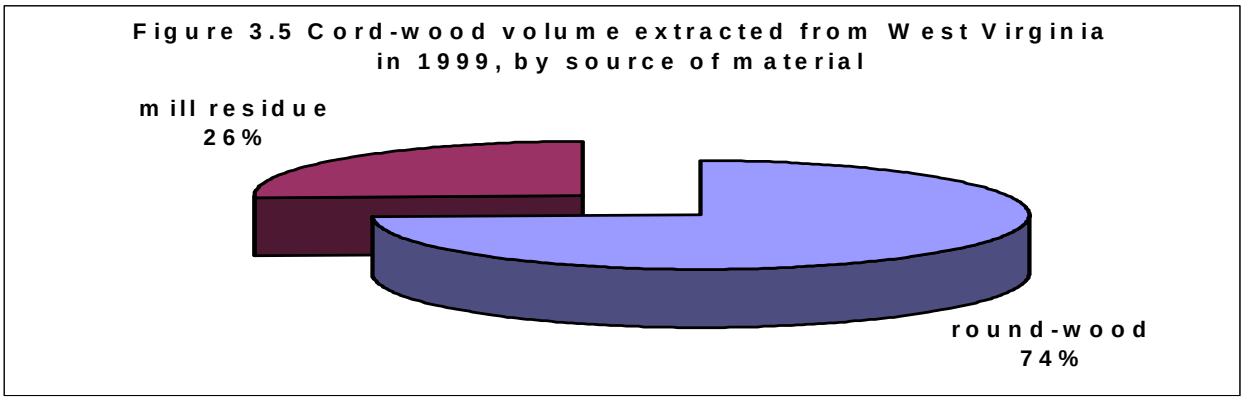
The survey reported approximately 1.2 million cubic feet of roundwood not of sawlog quality (13,003 rough cords) was resold for OSB material by the sawmills. This volume is compared to overall cordwood volume consumed by the mills. It does not include material taken directly from the logging sites and dead or cull trees harvested to better manage the forest.

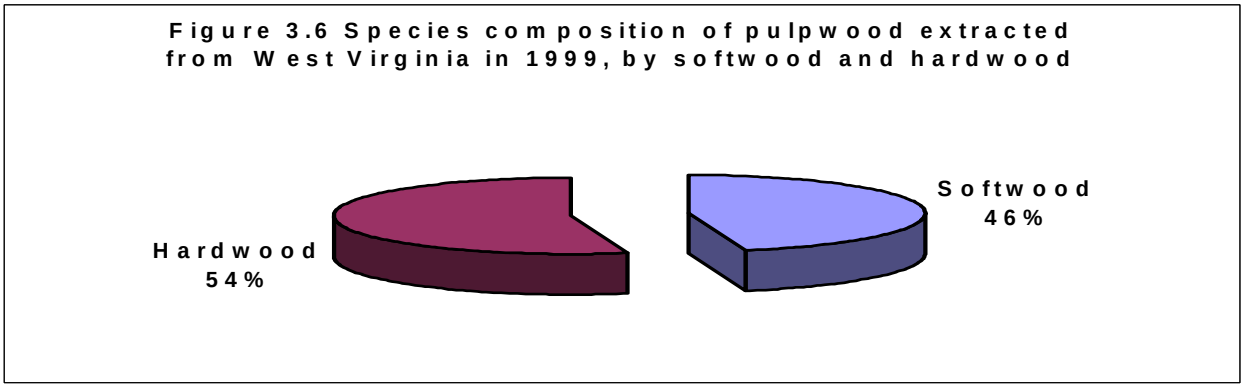
3.5.2 Pulpwood

The pulpwood mills used 23% (237 thousand rough cords) of the total cordwood volume extracted from West Virginia and 21% (128 thousand rough cords) of the mixed hardwood in the total cordwood volume (Figures 3.3 and 3.4). The softwood species constituted 46% (109 thousand rough cords) and the mixed hardwood species constituted 54% of the pulpwood cordwood volume extracted from West Virginia in 1999 (Figure 3.6). The sawmill residue constituted 26% (60 thousand rough cords) and roundwood

constituted 74% of the pulpwood roundwood volume extracted from West Virginia (Figure 3.5).

The increase in softwood composition of the pulpwood cordwood volume is a definite indication of competition between oriented strand board and pulpwood mills for mixed hardwoods. The oriented strand board mills placed a strong demand on the mixed hardwood volume, which caused the pulpwood mills to use more softwood species in the pulping process or looked to the neighboring states for the hardwood supply (Figures 3.5 and 3.6).

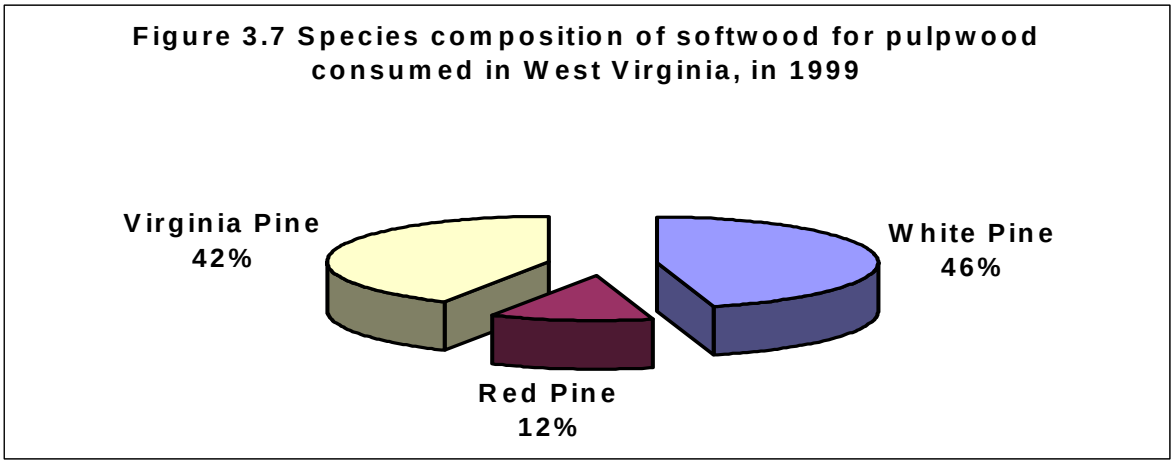




3.5.3 Species composition of pulpwood

The white pine constituted 46% of the softwood volume, Virginia pine was second with 42%, and finally red pine with 12% of the softwood volume in 1999. The

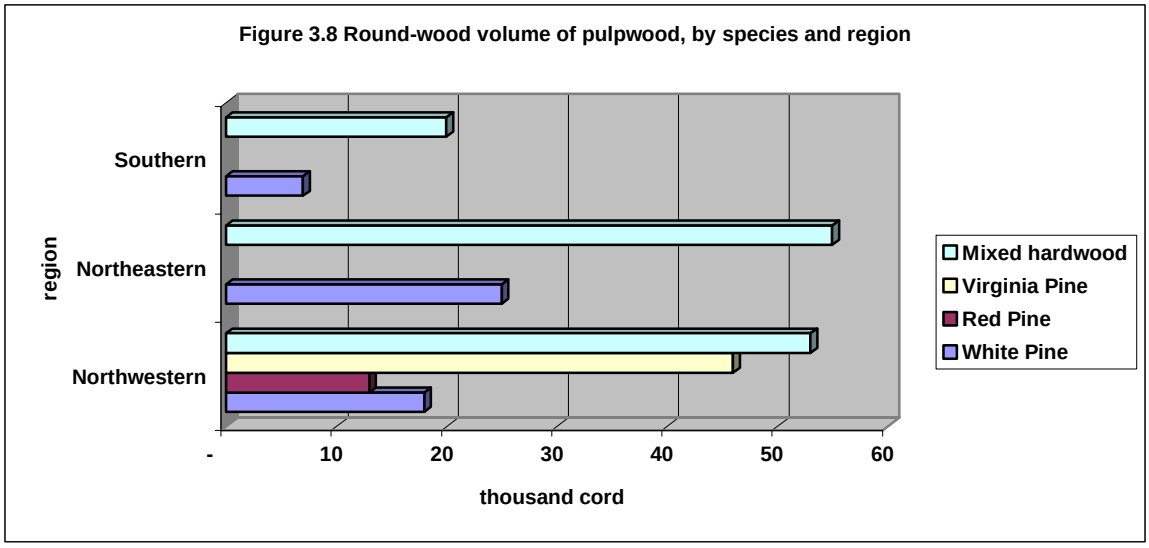
breakdown for mixed hardwoods was not obtained from the survey, however red and white oak, yellow-poplar, ash, and maple would be the more dominant of the mixed hardwood species being used by the pulpwood industry (Figure 3.7).



3.5.4 Pulpwood consumption within the geographical units

In 1999, the Northwestern unit supplied more roundwood to the pulpwood industry than the other geographical units (130 thousand cords of roundwood). The Northeastern unit supplied 80 thousand cords and the Southern unit supplied 27 thousand cords of roundwood. The Northwestern unit made up 71% (77 thousand cords) of the softwood volume, the Northeastern unit followed with 23% (25 thousand cords), and last was the Southern unit made up 6% (7 thousand cords) of the softwood volume.

The mixed hardwood volume was distributed fairly even between the Northeastern and Northwestern units, with the Northeast supplying 43% (55 thousand cords) and the Northwest supplying 41% (53 thousand cords) of the mixed hardwood volume. The Southern unit supplied only 16% (20 thousand cords) of the mixed hardwood volume (Figure 3.8).

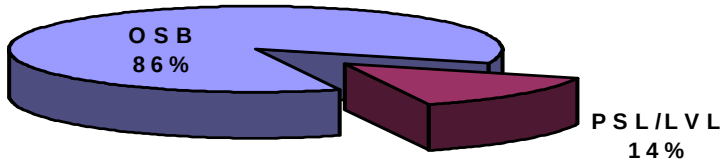


3.6 ENGINEERED WOOD PRODUCTS

Engineered wood products produced in West Virginia are oriented strand board, parallel strand lumber-PSL, and laminated veneer lumber-LVL. These products used 52 million cubic feet of roundwood to manufacture the products, which is 35% of the total estimated volume of roundwood consumed from West Virginia in 1999. The oriented strand board products used 45 million cubic feet (86%) and parallel strand lumber and laminated veneer lumber used 7 million cubic feet (14%) of roundwood from West Virginia in 1999 (Figure 3.9).

As stated earlier, the species type and quality of the roundwood used to manufacture the engineered wood products vary according to the product manufactured. Laminated veneer lumber uses yellow-poplar peeler logs and the parallel strand lumber uses the material not suitable for LVL. Parallel strand lumber can also use the low quality mixed hardwood roundwood that is used to manufacture oriented strand board due to the strand or grinding of the material in manufacturing the product.

Figure 3.9 Volume of roundwood used to manufacture engineered wood products in 1999 from West Virginia, by product



3.7 OVERALL ESTIMATED TIMBER PRODUCTS OUTPUT

The estimated volume of roundwood consumed from the forest of West Virginia in 1999 was 143.2 million cubic feet or approximately 1.7 billion board feet of roundwood. The sawmill industry utilized 61 million cubic feet, the oriented strand board industry utilized 44.5 million cubic feet, and the pulpwood industry used 21.9 million cubic feet. The peeled veneer industry utilized 12.1 million cubic feet, 2.9 million cubic feet was used for other wood products, and the sliced veneer industry used 864 thousand cubic feet. The estimated amount of softwood made up approximately 7% (10.7 million cubic feet) of the total volume and the hardwoods made up the remaining 93% (132.5 million cubic feet). The majority of the softwood volume was used for pulpwood, which was about 10.1 million cubic feet. The majority of the hardwood volume was used for sawlog products, oriented strand board, and veneer (Table 3.4).

The output from primary manufacturing residue or resale volume made up 7% (10.3 million cubic feet). The pulpwood had the larger volume with 5.6 million cubic feet of roundwood, peeled veneer followed with 2.7 million cubic feet, OSB was next with 1.2 million cubic feet, and finally sliced veneer with 781 thousand cubic feet. The pulpwood industry received 26% of the total output volume from primary manufacturing

resale or residue. The information on table 3.4 shows the OSB industry receiving on 1.2 million cubic feet of roundwood from resale volume, which is only 3% of the total output volume of OSB. This figure does not reveal the amount roundwood from a sawmill's timber sale that is transported directly from the forest to the OSB mills. The sawmills are able to maximize the value of timber sale by selling the low-quality roundwood to the OSB mills (Table 3.4).

Table 3.4 Distribution of estimated volumes of roundwood consumed by product, softwood and hardwood, and source of material, in West Virginia, 1999 (In standard units and thousands of cubic feet)

Product and, species	Output from roundwood: Board-foot output	Output from roundwood: Cordwood output	Output from roundwood: Output in common units	Output from primary manufacturing resale or residue	Total, timber products output
	Thousand board feet	Standard cords	Thousand cubic feet		
Sawlogs			**INDUSTRIAL PRODUCTS**		
Softwoods	7,320		610		610
Hardwoods	724,718		60,393		60,393
Total	**732,038**		**61,003**		**61,003**
Peeled Veneer					
Softwoods					
Hardwoods	111,800		9,317	2,746	12,063
Total	**111,800**		**9,317**	**2,746**	**12,063**
Sliced Veneer					
Softwoods				8	8
Hardwoods	1,000		83	773	856
Total	**1,000**		**83**	**781**	**864**
Softwoods					
Hardwoods		467,446	43,282	1,204	44,486
Total		**467,446**	**43,282**	**1,204**	**44,486**
Pulpwood					
Softwoods		80,968	7,497	2,572	10,069
Hardwoods		95,050	8,801	3,020	11,821
Total		**176,018**	**16,298**	**5,592**	**21,890**
Other products					
Softwoods	314		26		26
Hardwoods	34,585		2,882		2,882
Total	**34,899**		**2,908**		**2,908**
All products			**TOTAL, ALL PRODUCTS**		
Softwoods	7,634	80,968	8,133	2,580	10,713
Hardwoods	872,103	562,496	124,758	7,743	132,501
Total	**879,737**	**643,464**	**132,891**	**10,323**	**143,214**

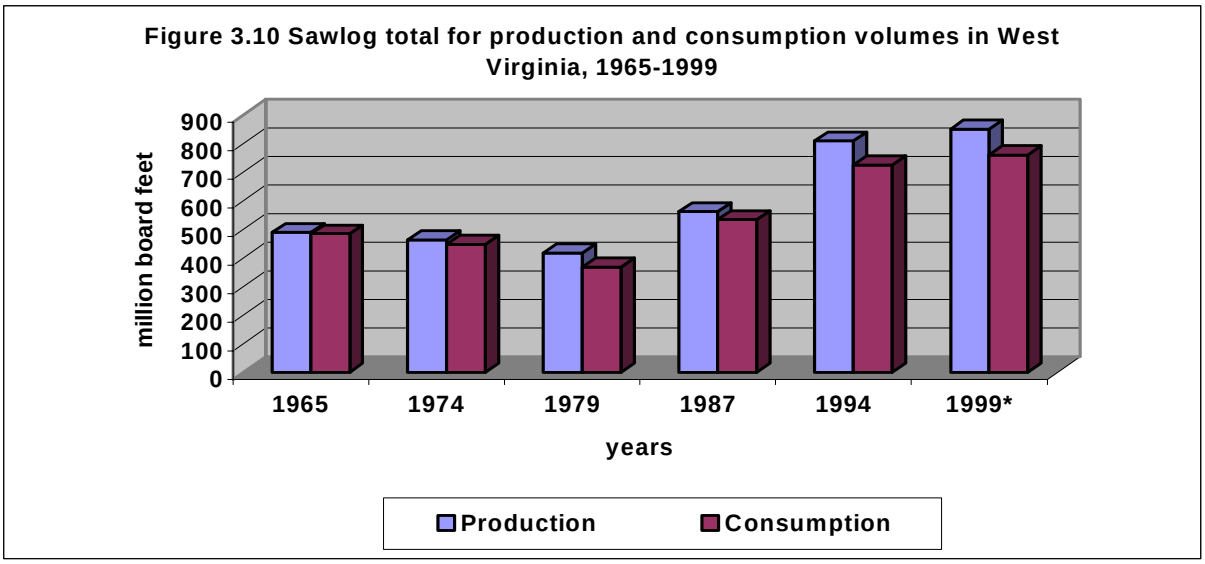
The cordwood volume (643 thousand cords) products like OSB and pulpwood made up 42%, and the board foot volume (879.7 mmbf) products made up 51% of the total estimated volume of timber products output in 1999 (Table 3.4). The Sawlog products like lumber, pallet, dimension, and other products like mine timbers made up the board foot volume. The veneer industry made up the remaining 7%, which is broken down into two segments due to the quality of roundwood used and processes used to manufacture the product. The quality of roundwood within the board foot volume section varies from veneer logs to logs that are marketed as grade sawlogs (Table 3.4).

3.8 SAWLOG PRODUCTION AND CONSUMPTION VOLUME IN WV, 1965-1999

The total estimated volume of sawlog production from the survey in 1999 (852 mmbf) was 41 million board feet more than the 1994 survey year (811 million board feet). The 852 million board feet volume was formulated from adding 120 million board feet to the estimated 732 million board feet volume from the survey data. Assuming a 120 million board feet export volume for 1999, which is an estimated 5 million board feet increase from 1994. The exported volume of roundwood is assumed to not significantly increase over a five-year period.

The total estimated volume of sawlog consumption from the survey in 1999 was 762 million board feet of roundwood, which only increased by 35 million board feet (from 727 million board feet) in 1994. The 1999 estimated consumption volume was formulated by adding 30 million board feet to the estimated volume of 732 million board feet of the roundwood survey in 1995. Also, the assumption was that the amount of roundwood imported from the surrounding states would not significantly increase within

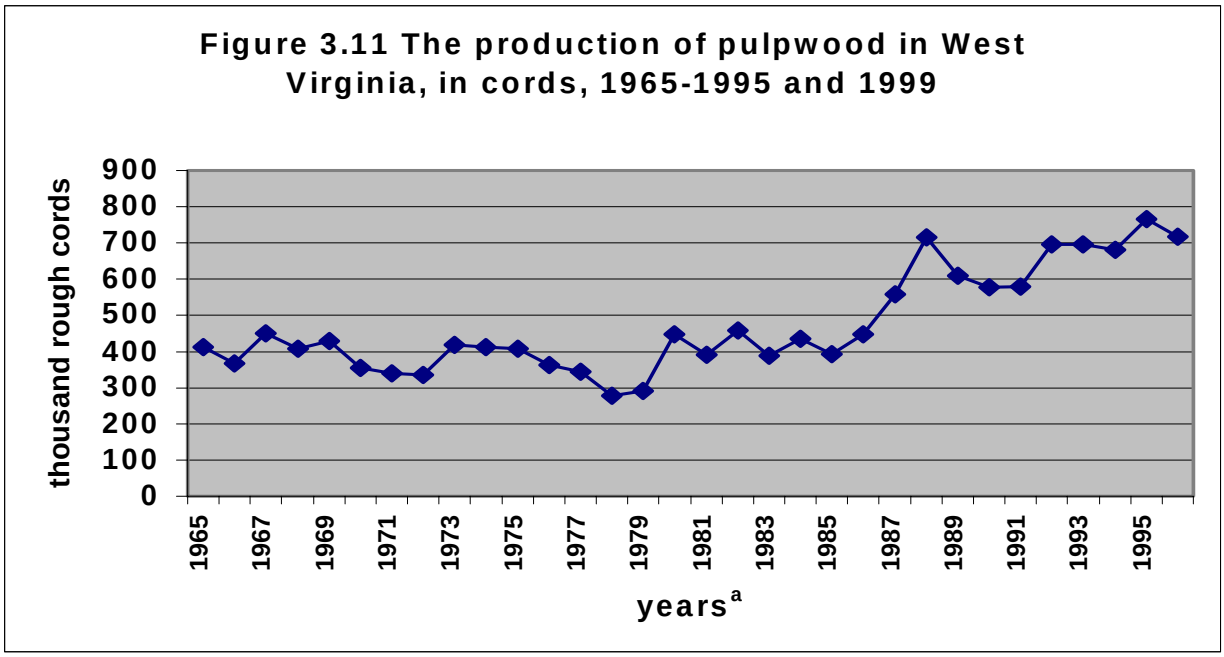
a five year period from 29.2 million board feet in 1994. So, the actual volume of roundwood harvested and used within West Virginia was 697 million board feet in 1994 and an estimated 732 million board feet in 1999 (Figure 3.10).



* The production and consumption volumes for 1999 are from the 1999 Survey of Roundwood consumption conducted for this study.
**Widmann, Richard H.; Eric Wharton and Edward C. Murriner. *West Virginia Timber Products Output: 1994*. U.S. Forest Service Resource Bulletin NE-143. Radnor, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1998.

3.9 CORDWOOD CONSUMPTION VOLUME FROM WV FOR THE 1965-1995 PERIOD AND THE 1999 SURVEY YEAR

The cordwood volume in West Virginia no longer is used solely by the pulpwood industry. The oriented strand board industry now extracts a substantial amount of cordwood quality roundwood from West Virginia. Since 1995 the cordwood volume has decreased slightly to 717,000 rough cords from 765,300 rough cords in 1994. The slight decrease in cordwood volume from 1995 to 1999 may be the result of the increased competition from the OSB industry for this portion of the resources (Figure 3.11).



a The data points from 1965-1995 are consecutive for each year and the last data point represents the year of 1999.

* Widmann, Richard H.; Eric Wharton and Edward C. Murriner. *West Virginia TimberProducts Output:1994.* U.S. Forest Service Resource Bulletin NE-143. Radnor, Pennsylvania: Northeastern Forest Experiment Station Forest Service, U.S. Department of Agriculture.,1998.

3.10 QUALITY OF ROUNDWOOD DETERMINED BY PRODUCT USAGE

The sawlog products like lumber and dimension, veneer products, and exported roundwood utilize higher quality roundwood that is marketed as grade sawlogs and veneer roundwood. The miscellaneous wood products like mine timbers and fencing materials, OSB, pallets, PSL, and pulpwood would use the roundwood that is not marketed as grade sawlogs. The largest in volume of the two groups is the low-quality roundwood by constituting 54%-76.7 million cubic feet of roundwood and the higher quality roundwood constitutes 46%-66.6 million cubic feet of roundwood. The wood composite products (OSB and PSL) that use low-quality roundwood will be in competition with the existing pallet, pulpwood, and miscellaneous products industry. The large sawmills produce grade lumber so the wood composite mills would not have a negative effect on them, as stated earlier in this chapter (Table 3.4).

Chapter Four - CONCLUSION

The objective of the study was to obtain the volume of roundwood extracted from the forest of West Virginia by the primary wood producing mills in and around the state of West Virginia for 1999. The information would be used to estimate the species composition and the utilization of the roundwood for West Virginia in 1999.

4.1 INTRODUCTION OF EWP INDUSTRY IN WEST VIRGINIA

The introduction of the engineered wood products (wood composite products) industry into the state of West Virginia in 1995 and 1996 was one of the reasons to conduct the study. Also, an assessment of the primary wood manufactures of West Virginia was not done since the introduction of the wood composite product mills. Due to the lack of a current wood industry survey, the impact on the sustainability of the forest resources and the consumption of species and quality of roundwood were unknown. After completing the survey and analyzing the data, the species composition and quality of roundwood was determined. The data show that the sustainability of forest resources in West Virginia should not be a problem in the future. In addition, the industry is more fully utilizing species and roundwood that were previously underutilized, which can promote better managed forests.

4.1.1 Species Composition and Quality of the roundwood utilized

Yellow-poplar, red and white oaks, and maples dominated the species composition of the harvest in 1999. The findings for the species composition of the

consumption of roundwood were in line with the sawlog composition discussed in the literature review section.

The survey helped to determine the quality of the roundwood consumed by assessing the products manufactured from the primary wood producers. The data gave a good depiction of how much low-quality and high-quality timber was being used by the industry in 1999 from West Virginia. The sawlogs (lumber, dimension, and pallets) and veneer products used higher quality roundwood, while the oriented strand board and pulpwood mills used the lower quality roundwood.

The cordwood volume (mill residue and mixed hardwoods) constituting 46% of the total volume of roundwood consumed is a positive result because it shows an increase in efficiency of the wood industry and less waste. The state of West Virginia produced 757.7 thousand rough cords (70.1 million cubic feet) of pulpwood in 1995, while the survey in 1999 reported 717 thousand rough cords (66.4 million cubic feet) of roundwood for pulpwood and wood composites.

4.2 CLOSING STATEMENT

The study itself proved to be quite productive in gathering the information from the primary wood manufactures. According to the survey and analysis, the wood industry of West Virginia in 1999 proved to be very healthy and efficient in regards to the introduction of the wood composite mills in 1995 and 1996. As predicted in the 1994 TPO, the wood composite industry used underutilized species and grades of roundwood in West Virginia. The use of roundwood of low-quality helps to decrease the low-quality

roundwood in the forest. The wood composite mills have proved to be a valuable asset to the wood industry in West Virginia.

Although, the wood industry in West Virginia did not cause a strain on the forest resources in 1999, the question remains whether or not the forest resources of West Virginia will be able to withstand the long-term existence of the wood composite mills.

Chapter Five - RECOMMENDATIONS

Further research to follow the 1999 Roundwood Survey should include creating a dynamic model of the consumption of roundwood in the state of West Virginia for the next 30 to 40 years. In regards to the dynamic model, the frequency of conducting a Timber Products Output canvass must be done on an annual basis for at least 10 to 15 years before an accurate view of the wood industry of West Virginia can be implemented in a dynamic model. The introduction of new industries, like the wood composite industry, will have a definite effect on the quantity and quality of roundwood consumed in the state. The frequent surveys will obtain a better picture of the wood industry, which will increase validity to a model of the consumption of the wood industry in West Virginia or any state. Correspondingly, natural disasters, like fire, drought, floods, or insect infestation, and recession of the economy can be factors unforeseen in the future that can frustrate the purpose of the dynamic model. However, the dynamic model of the wood industry in West Virginia or any state can be valuable to foresters managing the forest resources.

Another recommendation in further researching the subject would be to contrast minor industries within the entire wood industry of West Virginia. Survey different types of mills that use approximately the same quality of roundwood. Determine the losses and gains of each type of mill within the category of roundwood quality. For example, categorize the mills that use low quality roundwood and determine the most important of the group and why that type of mill is dominant. Is it able to process more roundwood and better market the manufactured product? By understanding the dominance of a certain industry within the category, other mills in competition for the resources will have

a better view of where to purchase roundwood and not be entangled in competing for the resources. Although mills will compete for resources, the knowledge acquired from the studies will hopefully decrease some competition. Some mills can even form alliances like the larger sawmills have formed with the OSB and pulpwood mills. Pulpwood mills use the same quality of roundwood as do the OSB mills. So, the competition for roundwood could compel pulpwood mills within the same procurement area to merge and not compete for resources, which will inhibit financial losses in the future. Also, the study will possibly be able to help smaller mills survive the introduction of larger scale mills into an area that use the same type of roundwood.

A final recommendation would be for further research on the amount of roundwood that is underutilized due to the introduction of the wood composite mills into West Virginia. This research would determine the efficiency of the mills for resource utilization as well as for the manufactured product. The study can illustrate the extent the industry maximizes the value of the roundwood consumed. The intent is to avoid conversion of high-quality logs into wood composite, which will make that material available to industries that require higher quality roundwood in the future.

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APPENDIX A – DEFINITIONS

Board foot. **–** A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent (DiGiovanni, 1990).

Coarse or mill residues. – Manufacturing residues suitable for chipping, such as slabs, edgings, and veneer cores (DiGiovanni, 1990).

Cropland. – Land that currently supports agricultural crops for animals and humans, bare farm fields resulting from cultivation or harvesting, and maintained orchards (DiGiovanni, 1990).

Cull tree. - A poor form tree or rotten tree

Forest land. – The minimum classification for forest land in 1 acre that is at least 10 percent stocked of any sized tree or the land previously had tree cover and is not currently developed for forest use (DiGiovanni, 1990).

Green ton. – A green weight measurement equivalent to 2,000 pounds or 907.1848 kilometers (DiGiovanni, 1990).

Hardwood. – Dicotyledonous trees, usually broad-leaved and deciduous (DiGiovanni, 1990).

Logging residue. – The unused portions of the trees harvested or killed in the process of logging (DiGiovanni, 1990).

Pasture land. – Land used for grazing livestock and not classified as cropland.

Poletimber size trees. – A tree smaller than a sawtimber tree for each species (hardwood-11 and softwood-9) and at least 5-inches d.b.h. (DiGiovanni, 1990).

Primary manufacturing plants or mills. – A plant or mill that produce woodpulp, veneer, lumber, cooperage, dimension products, and wood composite products from logs, bolts, or tree chips (DiGiovanni, 1990).

Rough cords. - Is measured as a standard cord, which is the "unit measure for stacked wood encompassing 128 cubic feet of wood, bark, and air space" (Ferguson, 1965). Also, the rough cord can derived from cubic by applying a factor of 80 cubic feet that represents 1 rough cord or standard cord (Ferguson, 1965). The factor of 85 cubic feet per rough or standard cord can be used for pulpwood due to the uniformity of pulpwood (DiGiovanni, 1990).

Round-wood products. – Logs, bolts, and total tree chips, or other round timber generated by harvesting trees for industrial and consumer uses (DiGiovanni, 1990).

APPENDIX A, continued

Salvable dead trees. – A tree recently died of at least 5.0 inches diameter at breast height with bark still intact (DiGiovanni, 1990).

Sawlogs. – A log that meet regional standards with a minimum length of 8-foot, a minimum diameter inside bark of 6-inches for softwoods and 8-inches for hardwoods (DiGiovanni, 1990).

Sawtimber trees. – Live commercial trees with at least 11.0 inch-d.b.h. for hardwoods and 9.0 inches-d.b.h for hardwoods, that contains at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs (DiGiovanni, 1990).

Softwood. – Coniferous tree, usually evergreen and having needles or scalelike leaves (DiGiovanni, 1990).

APPENDIX B – CALCULATION CONVERSIONS

Green tons to cords (rough or standard) = *tons/2.5*

Cords (rough or standard) to green tons = *cords*2.5*

Green tons to cubic feet = *(tons*2000)/54*

Cubic feet to green tons = *(cubic feet*54)/2000*

Cubic feet to board feet = *cubic feet*12*

Board feet to cubic feet = *board feet/12*

Sawlog consumption to products of sawlog production = *1.25[1]*sawlog consumption*

Estimation of sawlog consumption = *# of mills[2]*average volume for species or product*

Standard deviation = *square root of (N-n/N*n); N = # of mills and n = # of mills responded within N population.*

Standard error of a mean or estimate = *standard deviation/(square root of n)*

Margin of sampling error = *±2 * standard error of a mean*

1/ The 1.25 factor was derived from determining an average 25% over-run for the sawing of sawlog round-wood into sawlog products (lumber, pallets, and dimension) and veneer.
2/ According to the West Virginia State Division of Forestry, the number of mills will vary for the small and big mills in the geographical unit.

APPENDIX C:

WVU Division of Forestry: 1999 Survey of Roundwood Consumption

If your company processed roundwood (defined below) into wood products or received any roundwood in 1999 from West Virginia forests, please complete the 4 survey questions below and return the survey to WVU Division of Forestry in the self-addressed envelope provided. If you did not process or receive any roundwood in 1999, please circle the word **NONE** and return the questionnaire in the enclosed envelope.

Roundwood (roundwood logs) is defined as logs, bolts, or other round sections cut from trees for industrial or consumer use. The products of roundwood are any primary products such as lumber, poles, pilings, pulp, or fuelwood, which is produced from roundwood.

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1. What percentage of the roundwood, received by your firm, meets the following description(s)? Provide the percentages for the types of roundwood received from the forest of West Virginia in 1999. (The percentages should add up to 100%.)

Types or uses	%	Types or uses	%
Peeled veneer logs		Sawlogs used for lumber	
Sliced veneer logs		Sawlogs used for pallets	
Export logs		Cabin logs	
Fencing (posts and rails)		Pulpwood	
Oriented Strand Boards		Large posts (ex.:quadrails)	
Sawlogs used for bats and handle blanks		Sawlogs used for dimension	
Other:			

2. Please give the total volume of roundwood received by the mill in 1999 from West Virginia forests: _____*

   *Please check the unit of measure used to report the total volume.
   - ___ Thousand Board Feet (What log rule used?)
   - ___ Pieces
   - ___ Linear Feet
   - ___ Standard Cords (128-cubed feet/cord)
   - ___ Green Tons
   - ___ Dry Tons
   - ___ Non-standard cords (Specify size: _____)

3. Based on the total volume reported in Question 2, please indicate the percentage of total volume of roundwood the mill received in 1999 for each species shown below. (Note: The percentages should add up to 100%.)

Species	%	Species	%	Species	%
Ash		Black Gum		Yellow Poplar	
Beech		Hickory		Black Locust	
Basswood		Red Maple		Yellow Birch	
Sweet Birch		Sugar Maple		Black Cherry	
Elm		Black Walnut		White Pine	
N. Red Oak		White Oak		Red Pine	
Other RO:		Other WO:		Other species	

4 If the mill receives roundwood from a concentration yard, please record the volume of roundwood received from the yard. If possible, estimate the percentage of this roundwood that came from West Virginia forests.
Volume: _____; Percent: _____%

***Thank you for your help by completing this survey.

1024 Chamberlain Ave Phone 304-363-1549
Fairmont, WV 26554 E-mail tuck657@cs.com

O'Dell E. Tucker

Objective

To obtain a career in forest resources management or wood industries.

Education

1993 – 2001 West Virginia University **Morgantown, WV**

- M.S., Wood Industries - 2001
- B.S., Forest Resources Management - 1998

Professional experience

2001 WVU Division of Forestry **Morgantown, WV**

Research Technician

- Collecting water samples on watersheds

2000 – 2001 Eastgate Forest Resources Management **Fairmont, WV**

Consulting Forester Trainee

- Inventoried forest resources and stewardship planning

1999 – 2001 WVU Division of Forestry **Morgantown, WV**

Graduate Research Assistant

- Created and conducted a survey and analyzed data from the survey
- Researched the growth, removal, and timber products output trends of the Nation and West Virginia from the late 1800's to the present
- Completed the relevant courses and master's thesis for a M.S. degree in Forestry
- Thesis title: *Study of West Virginia wood industry roundwood consumption in 1999*
- Teacher's assistant for the WVU Wood Sciences Department

1997 – 1998 Westvaco Corporation **Summerville, SC**

Forest Technician

- Inventoried forest resources and collected soil samples
- Used GPS unit to install forest research plots and to measure stand acreage
- Assisted in conducting an annual natural resources camp
- Supervised contract work
- Summer employee in 1997 and permanent employee in 1998

Summer – 1994 U.S. Forest Service **Asheville, NC**

Field Technician

- Collected data on continuous forest inventory plots
- Used aerial photographs, topographic maps, and state maps to locate the plots

1983 – 1993 C. A. Tucker Farming and Firewood **McKenney, Va.**

Farmer

- Raised and harvested soybeans, wheat, corn, tobacco, and livestock
- Supervised hired manual labor for harvesting and cultivating crops

Related educational courses

land surveying, business and economics, computers sciences, forest resources management, foreign language, remote sensing, computer probability models, plant sciences, soil sciences, statistics, and wood and tree identification