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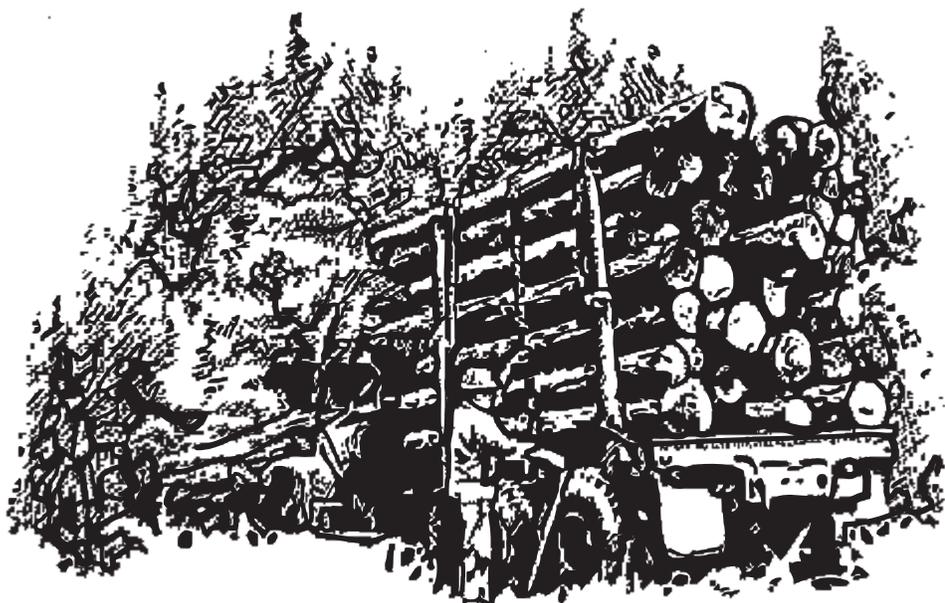
North Carolina Harvest and Utilization Study, 2007

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Foreword

This resource bulletin describes the principal findings of a harvest and utilization study conducted during the eighth inventory of North Carolina's forest resources. Survey crews sampled and measured trees harvested in a variety of logging operations, and analysts calculated wood volume and percent of wood utilization. Harvest volume data and factors for growing-stock and nongrowing-stock logging residue are described and interpreted.

Annual surveys of America's forest resources are mandated by the Agricultural Research, Extension, and Education Reform Act of 1998 (1998 Farm Bill). Surveys and utilization studies are part of a continuing, nationwide undertaking by regional experiment stations of the Forest Service, U.S. Department of Agriculture. Inventories and utilization studies of the 13 Southern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia) and the Commonwealth of Puerto Rico are conducted by the Southern Research Station, Forest Inventory and Analysis (FIA) Research Work Unit. Unit headquarters is in Knoxville, TN, and FIA has operational offices in Asheville, NC, and Starkville, MS. The primary objective of these appraisals is to develop and maintain resource information needed to formulate sound forest policies and programs. More information about Forest

Service resource inventories is available in "The Enhanced Forest Inventory and Analysis Program—National Sampling Design and Estimation Procedures" (Bechtold and Patterson 2005).

Tabular data included in FIA resource bulletins present a comprehensive array of forest resource statistics, but additional information is available to those who require more specific information. Access to data for the Southern States can be found at: <http://srsfia2.fs.fed.us/data/index.shtml>.

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^a All tables in this report are available in Microsoft® Excel workbook files. Upon request, these files will be supplied on compact disc. The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

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Introduction

Forest planners and managers have a continuing need for information about the timber resource, and the public is expressing increasing interest in the effects of logging. Therefore, up-to-date data on the Nation's forests—and how the forests are changing—are essential to well informed decisionmaking. Information about the condition of and changes in the timber resource of North Carolina comes from three primary sources: (1) inventory plots, which describe current conditions and quantify changes due to mortality, growth, removals, and land use; (2) mill surveys, which quantify timber volume harvested and delivered to primary wood products facilities, i.e., sawmills, pulpmills, veneer mills, composite panel mills, and pole mills; and (3) logging utilization studies, which characterize harvest operations and quantify the timber volume that is cut and utilized, and that portion that is left in the forest.

This bulletin presents the findings of a 2007 harvest and utilization study in North Carolina. The study's main goal was to provide an estimate of softwood and hardwood volume used, and of volume left in the woods as logging residue. Survey crews randomly selected and measured felled trees on 83 active harvest operations throughout North Carolina (fig. 1). This bulletin also provides some general characteristics of trees harvested for various

products, examples of which are average diameter at breast height (d.b.h.) by product, average bole length by product, average heights of residual stumps, and average diameter outside bark (d.o.b.) at the end of utilization.

Some standard Forest Inventory and Analysis (FIA) terms are used in this study. Two of particular importance for understanding and interpreting study results are growing stock and nongrowing stock. A growing-stock tree is a live tree of commercial species that either contains or is capable of producing at least one 12-foot or two 8-foot logs in the saw-log portion of the bole. A nongrowing-stock tree is one that does not meet the requirements of growing stock due to poor form or rot. For growing-stock trees, the growing-stock portion of a tree (5-inches d.b.h. or larger) includes the volume of sound wood between a 1-foot stump and a 4-inch top, d.o.b. Volume in the 1-foot stump, volume in the main stem from 4 inches to the growing top of the tree, and the volume of any limbs 4 inches or larger with at least one 5-foot section are considered nongrowing-stock volume by FIA standards. Rough or rotten trees were also sampled and make up another piece of nongrowing stock (cull) volume. Figure 2 illustrates a poletimber tree, a sawtimber tree, and the growing-stock section of each.

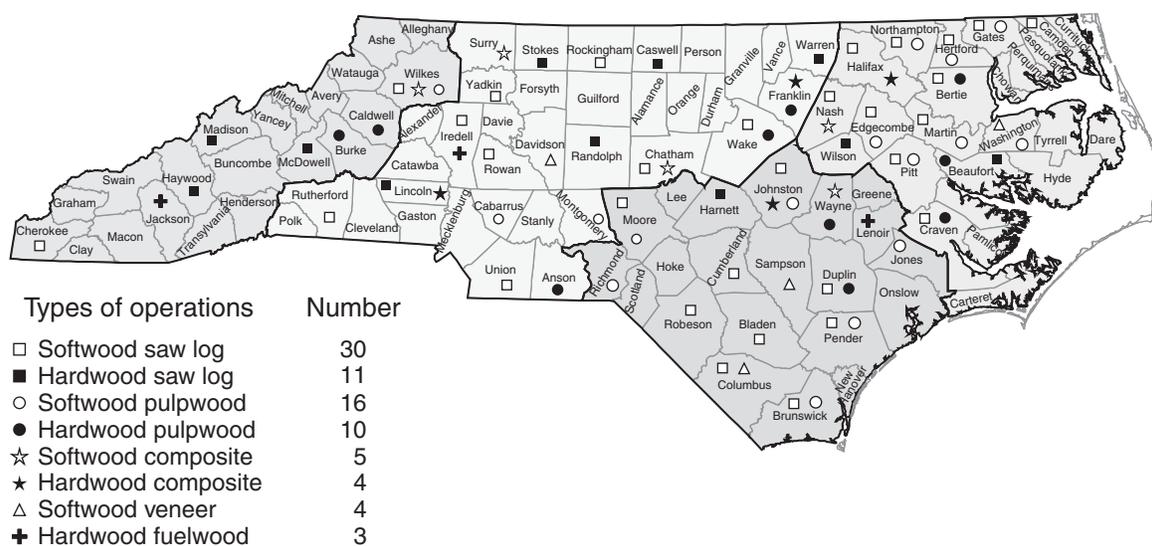


Figure 1—Harvest operations, North Carolina, 2007.

Sawtimber tree

Softwood = at least 9.0 inches d.b.h.

Hardwood = at least 11.0 inches d.b.h.

Poletimber tree

Softwood = 5.0–8.9 inches d.b.h.

Hardwood = 5.0–10.9 inches d.b.h.

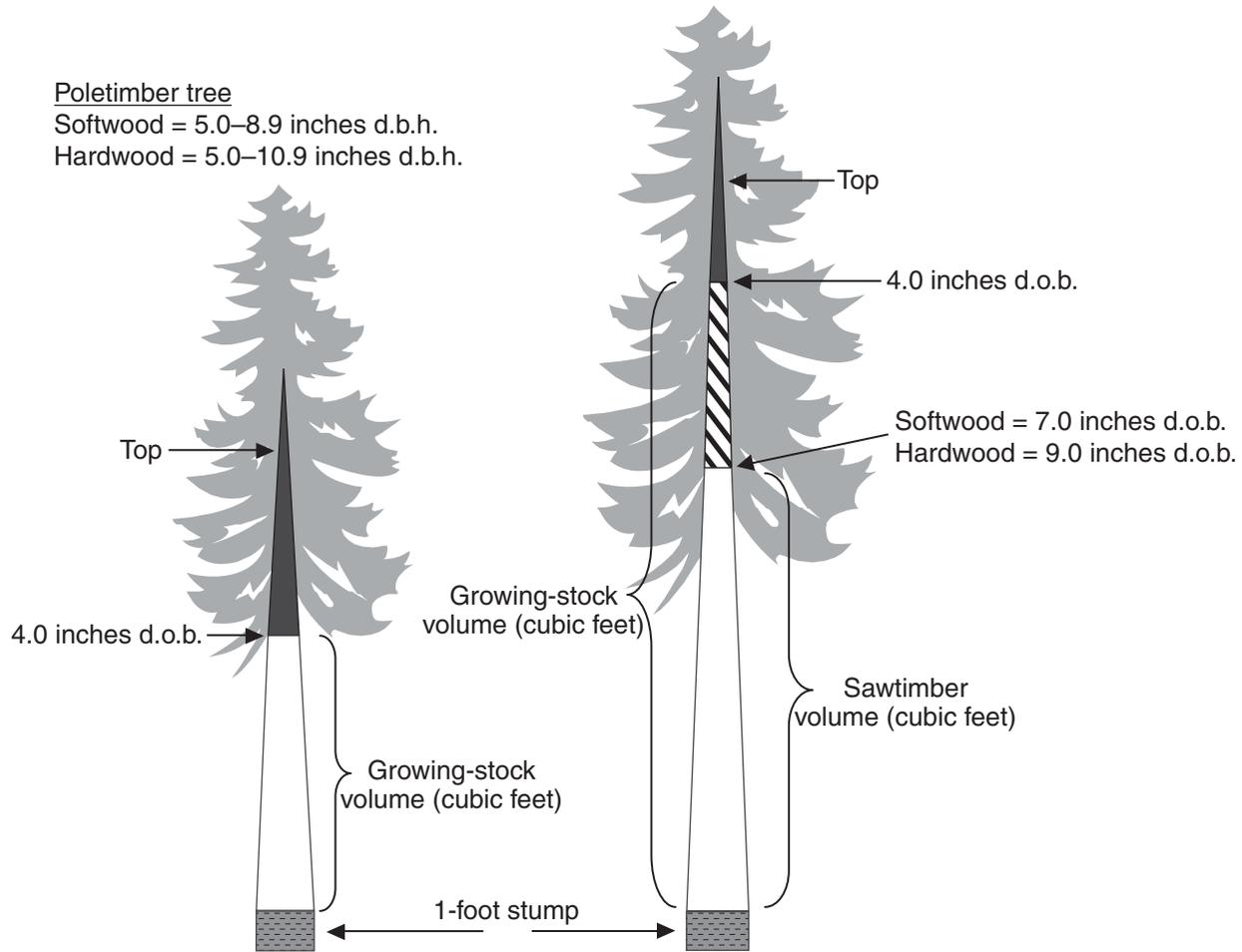


Figure 2—Stem sections of poletimber and sawtimber trees.

Methods

Site Stratification and Selection

Producing a complete list of timber-harvesting operations and ownerships in a State such as North Carolina is problematic. Because of the complexity of the timber industry, it is impossible to list the names and locations of all during the timeframe considered in this resource bulletin. Many uncontrollable factors affect how, when, and where harvesting operations take place, but the most common events that affect harvesting operations are weather and timber markets. A random sample provides a reasonably accurate estimate of utilization.

The sites selected for study were stratified by species group and product using the most recent data available for county-level output of timber products harvested in North Carolina by species group (Cooper and Mann 2009). Using those

proportions, 55 of the 83 selected sites were designated as softwood operations and the remaining 28 as hardwood operations. The same guidelines were used to designate harvest operations by product but allow for more flexibility because of the difficulty in locating harvesting operations for some products. Table 1 shows the final breakdown number of harvest operations, total trees, trees planted, and percentage of trees planted by product and species group.

After the harvest operations were stratified by major species group and product, the operations were placed in the appropriate region and county in the State. Using county-level product output data (Cooper and Mann 2009) and a map showing current mill locations, prospective utilization sites were selected based on a high probability of locating a harvesting operation for the particular product and species group assigned. Figure 1 shows where the final harvest operations considered in this bulletin were located.

Table 1—Number of operations, total trees, planted trees, and percent planted by product and species group, North Carolina, 2007

Product and species group	Operations	Trees		
		Total	Planted	
	----- number -----		percent	
Saw logs				
Softwood	30	672	265	39
Hardwood	11	256	4	2
Total	41	928	269	29
Veneer logs				
Softwood	4	84	29	35
Hardwood	0	4	0	—
Total	4	88	29	33
Composite panels				
Softwood	5	118	71	60
Hardwood	4	92	6	6
Total	9	210	77	37
Pulpwood				
Softwood	16	449	162	36
Hardwood	10	370	42	11
Total	26	819	204	25
Fuelwood				
Softwood	0	0	0	—
Hardwood	3	74	0	—
Total	3	74	0	—
All products				
Softwood	55	1,323	527	40
Hardwood	28	796	52	7
Total	83	2,119	579	27

— = no sample for the cell.

Data Collection

During the eighth survey, field crews were trained to collect data on felled trees at harvest locations. Using the list of operations and a map of sites, they began collecting data by county for the particular species group and designated product(s). Data collection was from September 2007 to November 2008 on active harvest operations. To locate active harvest sites, field crews visited local mills and consulted county personnel.

At each harvest operation site, field crews talked to the logger or person in charge of operations. These contacts provided vital information about product(s) utilized, specific diameters, and log lengths the receiving mill(s) would accept, along with minimum diameters at the cutoff points for specific products. Field crews also noted the type of logging equipment used. This information was used to determine the level of mechanization for each harvesting operation.

The goal of the field crew at each harvest operation site was to measure 25 to 30 trees for each product. This number ensured an adequate representation of overutilization and underutilization for a given type of harvest operation. Trees were randomly selected and had to be at least 5 inches d.b.h. and alive prior to harvest. Although often bucked, limbed, and topped, the main bole of each tree selected for measurement had to be intact to be measured for utilization. The State, unit, county, and location number were recorded for each site. Each tree was assigned a number and identified by species, d.b.h., tree class, product, bole length, and percentage of cull (if rot was detected). Each tree was measured from the top of the cut stump to the end of utilization. Measurements were made along the main stem in sections no longer than 16 feet until the end of utilization. The sawyer, according to particular specifications set by the receiving mill, usually determines the end of utilization. FIA merchantability standards for growing-stock volume are defined as the volume in the main stem of the tree from a 1-foot stump to a 4-inch top. However, most trees are not cut exactly at a 1-foot stump, nor are they cut off at exactly 4 inches. For example, trees cut off above a 1-foot stump and below 4 inches would be considered underutilized, and that volume not utilized would be considered growing-stock residue. On the other hand, by FIA standards, trees cut below a 1-foot stump and above a 4-inch top are considered 100 percent utilized, and those portions below and above are considered overutilization. A myriad of combinations actually occur on active harvest operations. The aggregated volume from measured trees has provided overutilization and underutilization factors that can be applied to statewide inventory results for an estimate of growing-stock and nongrowing-stock logging residues. Other required measurements, besides d.b.h. and end of utilization, are the top of the sawtimber portion (7.0 inches in softwoods and 9.0 inches in hardwoods). Those measurements allow calculation of the sawtimber and poletimber portion of the growing-stock section.

Highlights

Characteristics of Harvested Trees in North Carolina

Results of this study identify several key characteristics of trees harvested. Such findings cannot be obtained from a typical field inventory or a forest industry study that supplies product output data only. Characteristics such as average d.b.h. by product, average bole length by product, average residual stump height, and average d.o.b. at the end of utilization is vital information for a full understanding of the complex nature of removals. Averages discussed in this section are based on the measurement of 2,119 trees, of which 1,323 (62 percent) were softwood and 796 (38 percent) hardwood.

According to Cooper and Mann (2009), softwood and hardwood saw-log volume together accounted for 44 percent of the total product output for the State. The study classified 672 trees as having softwood saw logs averaging 12.3 inches d.b.h. Thirty-nine percent, or 265 trees, were classified as planted softwood saw logs averaging 11.7 inches d.b.h., nearly 1 inch smaller than natural softwood saw logs averaging 12.6 inches d.b.h. It classified 256 hardwood trees as having saw logs averaging 15.5 inches d.b.h. Veneer and plywood constitute another component of the product mix for North Carolina. Based on 84 trees measured for softwood veneer, the average d.b.h. was 16.4 inches. As expected, the d.b.h. of trees measured for pulpwood and composite panels was significantly smaller. Of the 449 softwood pulpwood trees measured, the average d.b.h. was

6.8 inches, while the 370 trees measured for hardwood pulpwood averaged 7.7 inches d.b.h. Thirty-six percent, or 162 trees, of the softwood pulpwood trees were planted, averaging 6.9 inches d.b.h., little difference in d.b.h. when compared to trees that come from natural stands. One hundred-eighteen trees were measured for softwood composite panels averaging 6.9 inches d.b.h. Table 2 shows the average d.b.h. for each product by species group.

Bole length is the distance between a 1-foot stump and a 4-inch top. As expected, trees harvested for solid wood products tended to have longer average bole lengths than trees harvested for pulpwood or composite panel products. The average bole length for softwood trees measured for saw logs was 59 feet, while trees measured for hardwood saw logs had an average bole length of 64 feet. In comparison, trees measured for pulpwood had average bole lengths of 30 feet for both softwoods and hardwoods. Softwood veneer trees had an average bole length of 74 feet. Planted sites constituted a subset of all trees measured. Trees measured in planted stands tended to have shorter bole lengths than those measured in the natural stands. Table 3 shows the average bole length by species group.

Residual stump height is a key component in determining utilization rates for harvested trees. By FIA standards, the stump is that portion of the tree measured at ground level from the uphill side of the tree to 1 foot up the bole. Loggers try to maximize volume harvested by cutting the tree as close to the ground as possible. Residual stump heights across the products ranged from 0.44 to 1.00 foot; however,

Table 2—Average diameter at breast height by species group, stand origin, and product, North Carolina, 2007

Species group and stand origin	Product				
	Saw logs	Veneer logs	Composite panels	Pulp- wood	Fuel- wood
	<i>inches</i>				
Softwood					
Natural	12.61	16.23	7.15	6.82	—
Planted	11.70	16.70	6.78	6.87	—
Total	12.25	16.39	6.93	6.84	—
Hardwood					
Natural	15.50	18.30	8.35	7.85	6.94
Planted	13.73	—	5.28	6.48	—
Total	15.47	18.30	8.18	7.67	6.94

— = no sample for the cell.

Table 3—Average bole length by species group, stand origin, and product, North Carolina, 2007

Species group and stand origin	Product				
	Saw logs	Veneer logs	Composite panels	Pulp- wood	Fuel- wood
	<i>feet</i>				
Softwood					
Natural	62.43	72.22	38.30	29.83	—
Planted	52.68	77.48	25.25	29.85	—
Total	58.59	74.04	30.45	29.84	—
Hardwood					
Natural	64.51	73.50	31.02	30.58	27.04
Planted	63.50	—	16.00	23.50	—
Total	64.49	73.50	30.20	29.65	27.04

— = no sample for the cell.

most softwood trees harvested had an average residual stump height of about a 0.60 foot, while harvested hardwood trees averaged slightly higher residual stumps. In softwoods and across all products, this accounted for about 28 percent of the stump volume being utilized. In hardwoods and across all products, about 18 percent of stump volume was used. Stump volume for both hardwood and softwood contributed to utilization of the nongrowing-stock portion of trees, i.e., overutilization. Residual stump heights for trees coming from natural stands appear slightly higher than residual stump heights in planted stands. Table 4 shows the average residual stump heights for each product by species group.

The final component we used to determine use rates was d.o.b. at the end of utilization. Tops and limbs constitute most of the nongrowing-stock volume; they accounted for 50 percent of the nongrowing-stock portion that was utilized. The average end of utilization for softwood saw logs was 4.5 inches, and for hardwood saw logs 6.3 inches. The average end of utilization for softwood and hardwood pulpwood was 3.3 and 3.9 inches, respectively. Trees coming from natural and planted stands showed almost no difference in the end of utilization. Table 5 shows the average end of utilization by the different products and species group.

Table 4—Average residual stump height by species group, stand origin, and product, North Carolina, 2007

Species group and stand origin	Product				
	Saw logs	Veneer logs	Composite panels	Pulp- wood	Fuel- wood
	<i>feet</i>				
Softwood					
Natural	0.66	0.68	0.66	0.62	—
Planted	0.55	1.00	0.44	0.59	—
Total	0.62	0.79	0.53	0.60	—
Hardwood					
Natural	0.76	0.95	0.61	0.71	0.79
Planted	0.65	—	0.66	0.62	—
Total	0.76	0.95	0.62	0.69	0.79

— = no sample for the cell.

Table 5—Average end of utilization by species group, stand origin, and product, North Carolina, 2007

Species group and stand origin	Product				
	Saw logs	Veneer logs	Composite panels	Pulpwood	Fuelwood
	<i>inches</i>				
Softwood					
Natural	4.74	5.73	3.63	3.40	—
Planted	4.04	8.57	2.91	3.06	—
Total	4.47	6.71	3.29	3.27	—
Hardwood					
Natural	6.31	4.95	4.67	3.94	3.98
Planted	5.95	—	3.32	3.22	—
Total	6.31	4.95	4.59	3.85	3.98

— = no sample for the cell.

Softwood Removals

Results from this study document 30,117 cubic feet of softwood volume, of which 25,694 cubic feet, or 85 percent, was used for product(s). Fifteen percent, or 4,423 cubic feet, was left onsite as logging residue (fig. 3). Thirty-one percent of the residue volume came from the growing-stock portion of the tree, while 69 percent came from the nongrowing-stock portion (stumps, tops, and limbs) (fig. 4) (table A.1).

The total softwood growing-stock volume measured was 26,396 cubic feet, of which 95 percent was utilized

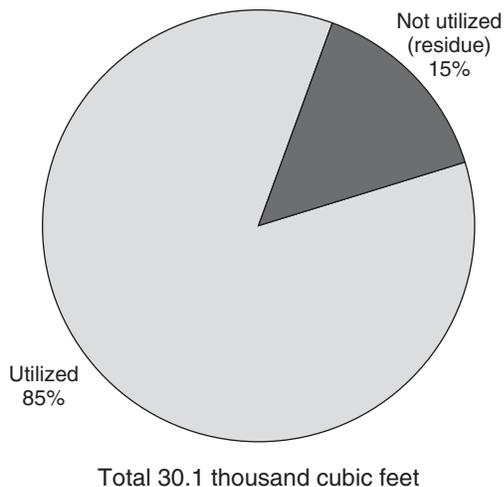


Figure 3—Disposition of total softwood harvest volume, North Carolina, 2007.

and 5 percent was logging residue (fig. 5). By FIA merchantability standards, the logging residue portion of growing-stock trees is underutilized volume. Of the total utilized volume, 663 cubic feet, or 2.6 percent, was from the nongrowing-stock portion of trees. By the same merchantability standards, that volume is considered overutilization (tables A.2 and A.3).

Softwood volumes and percentages are broken down further by poletimber and sawtimber, and by the various products measured (tables A.2 through A.9). By product, trees harvested for pulpwood and composite panels had average rates of utilization for the merchantable portion of the tree (89 percent) and the highest rates of overutilization (10.1 and 10.5 percent, respectively), meaning that more of the nongrowing-stock portion of the tree was used for product(s) and less was left as logging residue.

Softwood percentages and volumes presented in these tables represent only trees measured in this study of 55 active harvest operations. These percentages were used to refine the inventory estimate of softwood logging residues reported in the North Carolina's Forests State report.¹ The annual merchantable softwood removal from all-live trees was 607.7 million cubic feet (table 6). Softwood growing-stock

¹Brown, Mark J., North Carolina's Forests, 2007. Manuscript in preparation. Author can be reached at U.S. Department of Agriculture Forest Service, Southern Research Station, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919.

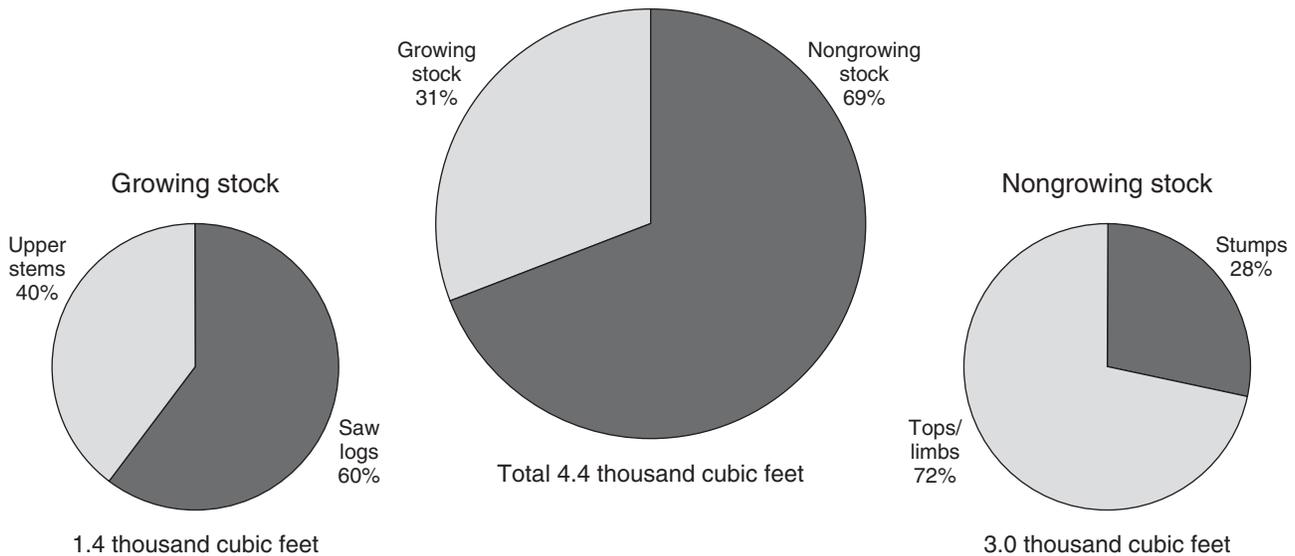


Figure 4—Softwood residue by volume type, North Carolina, 2007.

removals were 595.7 million cubic feet, or 98 percent of the total. Using the factors from this study to refine total softwood removals for all-live trees tallied in the State survey provides an estimate of 150.3 million cubic feet total annual softwood residue. Of the total residue for all-live trees, 41.6 million cubic feet, or 28 percent, was considered residue from the merchantable portion. The remaining 72 percent, or 108.7 million cubic feet, was residue from the nonmerchantable portion (stumps, tops, and limbs, and cull trees).

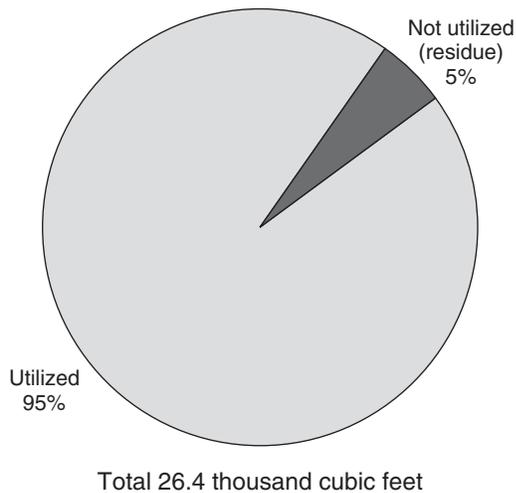


Figure 5—Disposition of softwood growing-stock volume, North Carolina, 2007.

Hardwood Removals

Results from this study document 17,564 cubic feet of hardwood volume, of which 13,444 cubic feet, or 77 percent, was utilized for product(s). Twenty-three percent, or 4,120 cubic feet, was left onsite as logging residue (fig. 6). Thirty-nine percent of residue volume came from the growing-stock portion of trees, and 61 percent came from the nongrowing-stock portion (stumps, tops, and limbs) (fig. 7) (table A.1).

The total hardwood growing-stock volume measured was 14,766 cubic feet, of which 89 percent was used and 11 percent was logging residue (fig. 8). By FIA merchantability standards, the logging residue portion is underutilized volume. Of the total utilized volume, 284 cubic feet, or 2.1 percent, was from the nongrowing-stock portion of trees. By the same merchantability standards, that volume is considered overutilization (tables A.10 and A.11).

Hardwood volumes and percentages also were measured for poletimber and sawtimber, and differentiated by the various products they provided (tables A.10 through A.17). At 94 percent, however, those trees measured for pulpwood were more fully utilized, and more of the nongrowing-stock portion was used for pulpwood. Trees measured for hardwood saw logs and veneer were the least utilized of all, although they have the most nongrowing-stock material.

Table 6—Volume of all-live timber removals by removals class, species group, and source, North Carolina, 2002–07

Removals class and species group	All sources	Source	
		Merchantable	Non-merchantable
<i>thousand cubic feet</i>			
Timber products			
Softwood	514,790	501,539	13,251
Hardwood	312,911	306,277	6,634
Total	827,701	807,816	19,885
Logging residues			
Softwood	150,284	41,554	108,730
Hardwood	151,938	66,752	85,186
Total	302,222	108,306	193,916
Land use removals			
Softwood	79,125	64,613	14,512
Hardwood	196,118	157,379	38,739
Total	275,243	221,992	53,251
Total removals			
Softwood	744,199	607,706	136,493
Hardwood	660,967	530,408	130,559
Total	1,405,166	1,138,114	267,052

Hardwood percentages and volumes presented in the tables represent only trees measured in this study of 28 active harvest operations. These percentages are used to refine the inventory estimate of hardwood logging residues reported in the North Carolina’s Forests State report (see footnote 1). The annual merchantable hardwood removals from all-live trees totaled 530.4 million cubic feet (table 6). Hardwood growing-stock removals totaled 472.9 million cubic feet, or 89 percent of that total. Using the factors from this study to refine total hardwood removals from all-live trees tallied in the State survey provided an estimate of 151.9 million cubic feet total annual hardwood residue. Of that total, 66.8 million cubic feet, or 44 percent, was considered residue from the merchantable portion. The remaining 56 percent, or 85.2 million cubic feet, was residue from the nonmerchantable portion (stumps, tops, and limbs, and cull trees).

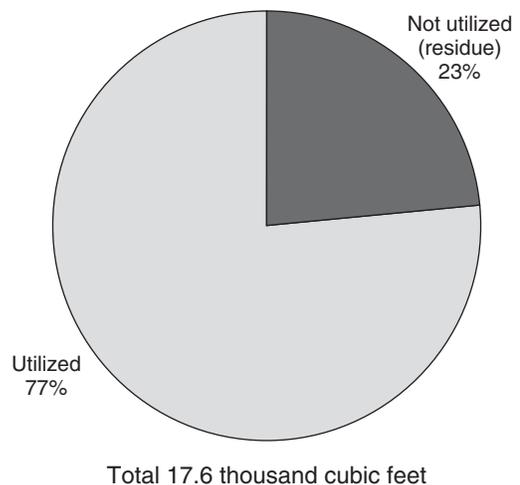


Figure 6—Disposition of total hardwood harvest volume, North Carolina, 2007.

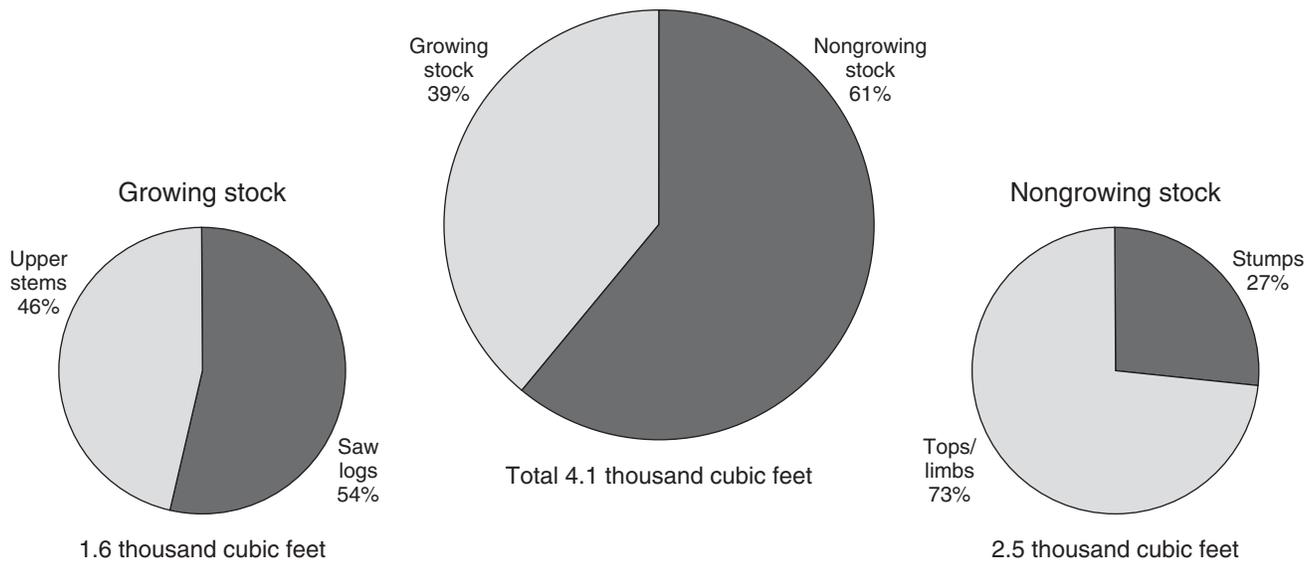


Figure 7—Hardwood residue by volume type, North Carolina, 2007.

North Carolina’s Potential Biomass Availability

Logging residue has long been viewed as a possible source for bioenergy and other timber products, although traditionally it has not had any merchantable value. Retrieval of logging residue is a matter of economics, based on markets and demand. If markets are available and a willingness to pay a reasonable price exists, then more total tree volume is utilized for products. With this in mind, logging residue volume in North Carolina for 2002–07, or the eighth survey, amounted to 302.2 million cubic feet, or 10.8 million green tons. Softwoods accounted for 50 percent, or 150.3 million cubic feet (5.2 million tons), of the logging residues, while 151.9 million cubic feet (5.7 million tons) came from hardwood species. Logging residue from the merchantable portion of all-live tree removals totaled 108.3 million cubic feet (3.9 million tons), or 36 percent of the total logging residue. Other sources accounted for 193.9 million cubic feet (6.9 million tons), or 64 percent of the total logging residue. Trees < 5 inches d.b.h. contributed another 2.4 million tons of possible logging residue. Tables 6 and 7 express the volume of timber removals by removals class, species group, and source in million cubic feet and green tons.

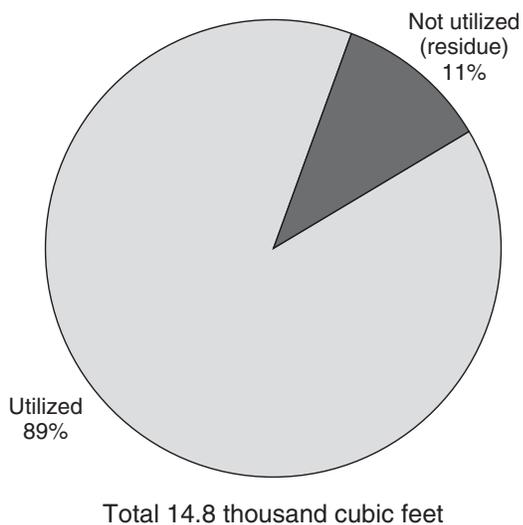


Figure 8—Disposition of hardwood growing-stock volume, North Carolina, 2007.

Table 7—Weight of all-live timber removals by removals class, species group, and source, North Carolina, 2002–07

Removals class and species group	All sources	Source	
		Merchantable	Non-merchantable
<i>green tons</i>			
Timber products			
Softwood	17,655,379	17,200,919	454,460
Hardwood	11,699,918	11,451,869	248,049
Total	29,355,297	28,652,788	702,509
Logging residues			
Softwood	5,154,182	1,425,147	3,729,035
Hardwood	5,681,053	2,495,895	3,185,158
Total	10,835,235	3,921,042	6,914,193
Land use removals			
Softwood	2,713,693	2,215,985	497,708
Hardwood	7,332,965	5,884,489	1,448,476
Total	10,046,658	8,100,474	1,946,184
Total removals			
Softwood	25,523,254	20,842,051	4,681,203
Hardwood	24,713,936	19,832,253	4,881,683
Total	50,237,190	40,674,304	9,562,886

Over the same period, the area of timber harvested annually in North Carolina amounted to 424,200 acres. The removals volume attributed to timber products and logging residues are directly related to these treated acres. Based on these estimates, we can say that 94.7 tons per acre in the merchantable and nonmerchantable portion of trees > 5 inches d.b.h. were removed annually from North Carolina’s timberland. Of the nearly 95 tons removed, 69.2 tons per acre were utilized for products, while 22.2 tons per acre were left as logging residue, excluding the residual stump. Assuming a 20-percent recovery rate for trees < 5 inches d.b.h., an additional 1.1 tons per acre was added, bringing the total logging residue to 23.3 tons per acre. This volume of logging residue is equivalent to about a tree-length trailer load of wood for every acre treated in North Carolina.

Most loggers are very well equipped to handle the main bole or merchantable portion of the tree and even long, straight sections of forks or major limbs. However, a more effective way to handle rough trees with crooked boles, tops, and limbs is to chip this material at the site and transport the material in chip vans. Whole trees and portions of trees chipped onsite have a very limited use for industrial timber products. About the only use for this material is as mulch or

boiler fuel. Bioenergy and mulch markets are available and are a particularly cost-efficient means of dealing with small trees < 5 inches d.b.h., as well as with rough and rotten trees and the nonmerchantable portions of growing-stock trees. Current literature suggests that, with conventional logging equipment, a 60-percent recovery rate is a realistic goal for possible extraction of formerly unutilized material (Perlack and others 2005). At this recovery rate, an additional 14.0 tons per acre of material once classified as logging residue could be added to the volume going for timber products.

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Glossary

Board foot. Unit of measure applied to roundwood. It relates to lumber that is 1-foot long, 1-foot wide, and 1-inch thick (or its equivalent).

Composite products. Roundwood products manufactured into chips, wafers, strands, flakes, shavings, or sawdust and then reconstituted into a variety of panel and engineered lumber products.

Drain. The volume of roundwood removed from any geographic area where timber is grown.

Growing-stock removals. The growing-stock volume removed from poletimber and sawtimber trees in the timberland inventory. (Note: Includes volume removed for roundwood products, logging residues, and other removals.)

Growing-stock trees. Living trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. Growing-stock trees must contain at least one 12-foot or two 8-foot logs in the saw-log portion, currently or potentially (if too small to qualify). The log(s) must meet dimension and merchantability standards and have, currently or potentially, one-third of the gross board-foot volume in sound wood.

Growing-stock volume. The cubic-foot volume of sound wood in growing-stock trees at least 5.0 inches d.b.h. from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem.

Hardwoods. Dicotyledonous trees, usually broadleaf and deciduous.

Soft hardwoods. Hardwood species with an average specific gravity of 0.50 or less, such as gums, yellow-poplar, cottonwoods, red maple, basswoods, and willows.

Hard hardwoods. Hardwood species with an average specific gravity > 0.50, such as oaks, hard maples, hickories, and beech.

Industrial roundwood products. Any primary use of the main stem of a tree, such as saw logs, pulpwood, and veneer logs, intended to be processed into primary wood products, such as lumber, wood pulp, and sheathing, at primary wood-using mills.

International 1/4-inch rule. A log rule or formula for estimating the board-foot volume of logs, allowing 1/2-inch of taper for each 4-foot length. The rule appears in a number

of forms that allow for kerf. In the form used by FIA, a 1/4-inch of kerf is assumed. This rule is used as the USDA Forest Service standard log rule in the Eastern United States.

Log. A primary forest product harvested in long, primarily 8-, 12-, and 16-foot lengths.

Logging residues. The unused portion of trees cut or destroyed during logging operations.

Merchantable portion. That portion of live trees 5.0 inches d.b.h. and larger between a 1-foot stump and a minimum 4.0-inch top d.o.b. on the central stem. That portion of primary forks from the point of occurrence to a minimum 4.0-inch top d.o.b. is included.

Merchantable volume. Solid-wood volume in the merchantable portion of live trees.

Noncommercial species. Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land. Land that has never supported forests and land formerly forested where timber production is precluded by development for other uses.

Nongrowing-stock sources. The net volume removed from the nongrowing-stock portions of poletimber and sawtimber trees (stumps, tops, limbs, cull sections of central stem) and from any portion of a rough, rotten, sapling, dead, or nonforest tree.

Other forest land. Forest land other than timberland and productive reserved forest land. It includes available and reserved forest land that is incapable of producing annually 20 cubic feet per acre of industrial wood under natural conditions because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness.

Other products. A miscellaneous category of roundwood products, e.g., cooperage, excelsior, shingles, and mill residue byproducts (charcoal, bedding, mulch, etc.).

Other removals. The growing-stock volume of trees removed from the inventory by cultural operations such as timber stand improvement, land clearing, and other changes in land use, resulting in the removal of the trees from timberland.

Other sources. (See: Nongrowing-stock sources.)

Poletimber-size trees. Softwoods 5.0 to 8.9 inches d.b.h. and hardwoods 5.0 to 10.9 inches d.b.h.

Posts, poles, and pilings. Roundwood products milled (cut or peeled) into standard sizes (lengths and circumferences) to be put in the ground to provide vertical and lateral support in buildings, foundations, utility lines, and fences. May also include nonindustrial (unmilled) products.

Primary wood-using plants. Industries that convert roundwood products (saw logs, veneer logs, pulpwood, etc.) into primary wood products, such as lumber, veneer or sheathing, and wood pulp.

Pulpwood. A roundwood product that will be reduced to individual wood fibers by chemical or mechanical means. The fibers are used to make a broad generic group of pulp products that includes paper products, as well as chipboard, fiberboard, insulating board, and paperboard.

Rotten trees. Live trees of commercial species not containing at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, primarily because of rot or missing sections, and with less than one-third of the gross board-foot tree volume in sound material.

Rough trees. Live trees of commercial species not containing at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, primarily because of roughness, poor form, splits, and cracks, and with less than one-third of the gross board-foot tree volume in sound material; and live trees of noncommercial species.

Roundwood (roundwood logs). Logs, bolts, or other round sections cut from trees for industrial manufacture or consumer uses.

Roundwood chipped. Any timber cut primarily for industrial manufacture, delivered to nonpulpmills, chipped, and then sold to pulpmills for use as fiber. Includes tops, jump sections, whole trees, and pulpwood sticks.

Roundwood product drain. That portion of total drain used for a product.

Roundwood products. Any primary product, such as lumber, poles, pilings, pulp, or fuelwood that is produced from roundwood.

Salvable dead trees. Standing or downed dead trees that were formerly growing stock and considered merchantable. Trees must be at least 5.0 inches d.b.h. to qualify.

Saplings. Live trees 1.0 to 5.0 inches d.b.h.

Saw log. A roundwood product, usually 8 feet in length or longer, processed into a variety of sawn products such as lumber, cants, pallets, railroad ties, and timbers.

Saw-log portion. The part of the bole of sawtimber trees between a 1-foot stump and the saw-log top.

Saw-log top. The point on the bole of sawtimber trees above which a conventional saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber-size trees. Softwoods 9.0 inches d.b.h. and larger and hardwoods 11.0 inches d.b.h. and larger.

Sawtimber volume. Growing-stock volume in the saw-log portion of sawtimber-sized trees in board feet (International ¼-inch rule).

Seedlings. Trees <1.0 inch d.b.h. and >1 foot tall for hardwoods, >6 inches tall for softwood, and >0.5 inch in diameter at ground level for longleaf pine.

Softwoods. Coniferous trees, usually evergreen, having leaves that are needles or scalelike.

Standard cord. A unit of measure applied to roundwood, usually bolts or split wood. It is a stack of wood 4 feet high, 4 feet wide, and 8 feet long encompassing 128 cubic feet of wood, bark, and air space. This usually translates to approximately 75.0 to 81.0 cubic feet of solid wood for pulpwood, because pulpwood is more uniform.

Standard unit. A unit measure applied to roundwood timber products. Board feet (International ¼-inch rule) is the standard unit used for saw logs and veneer; cords are used for pulpwood, composite panel, and fuelwood; hundred pieces for poles; thousand pieces for posts; and thousand cubic feet for all other miscellaneous forest products.

Timberland. Forest land capable of producing 20 cubic feet of industrial wood per acre per year and not withdrawn from timber utilization.

Timber product output. The total volume of roundwood products from all sources plus the volume of byproducts recovered from mill residues (equals roundwood product drain).

Timber products. Roundwood products and byproducts.

Timber removals. The total volume of trees removed from the timberland inventory by harvesting, cultural operations such as stand improvement, land clearing, or changes in land use. (Note: Includes roundwood products, logging residues, and other removals.)

Tree. Woody plant having one erect perennial stem or trunk at least 3 inches d.b.h., a more or less definitely formed crown of foliage, and a height of at least 13 feet (at maturity).

Upper-stem portion. The part of the main stem of sawtimber trees above the saw-log top and the minimum top diameter of 4.0 inches outside bark, or to the point where the main stem breaks into limbs.

Utilization studies. Studies conducted on active logging operations to develop factors for merchantable portions of trees left in the woods (logging residues), logging damage, and utilization of the unmerchantable portion of growing-stock trees and nongrowing-stock trees.

Veneer log. A roundwood product either rotary cut, sliced, stamped, or sawn into a variety of veneer products such as plywood, finished panels, veneer sheets, or sheathing.

Weight. A unit of measure for mill residues, expressed as oven-dry tons (2,000 oven-dry pounds).

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Table A.1—Harvest and utilization volume by species group, source, and volume type, North Carolina, 2007

Species group and source	Total tree volume	Growing stock					Nongrowing stock				
		Total	Saw log		Upper stem		Total	Stumps		Tops/limbs	
			Utilized	Not utilized	Utilized	Not utilized		Utilized	Not utilized	Utilized	Not utilized
<i>cubic feet</i>											
Softwood											
Sawtimber	26,661.76	23,577.89	21,037.32	823.32	1,204.67	512.58	3,083.87	261.71	740.44	95.06	1,986.66
Poletimber	3,455.48	2,818.28	—	—	2,789.30	28.98	637.20	68.08	123.16	238.14	207.82
Total	30,117.24	26,396.17	21,037.32	823.32	3,993.97	541.56	3,721.07	329.79	863.60	333.20	2,194.48
Hardwood											
Sawtimber	14,557.98	12,359.99	9,864.12	862.36	982.95	650.56	2,197.99	96.15	528.20	22.61	1,551.03
Poletimber	3,006.22	2,406.43	—	—	2,312.31	94.12	599.79	50.44	143.78	115.22	290.35
Total	17,564.20	14,766.42	9,864.12	862.36	3,295.26	744.68	2,797.78	146.59	671.98	137.83	1,841.38

— = no sample for the cell.

Table A.2—Volume of softwood growing stock by product and utilization for sawtimber and poletimber, North Carolina, 2007

Product	Total volume utilized	Growing stock			Nongrowing stock utilized	Saw-log portion			
		Total	Utilized	Not utilized		Total	Utilized	Cull utilized	Not utilized
<i>cubic feet</i>									
Saw logs	18,214.08	18,998.35	17,870.52	1,127.83	343.56	16,952.66	16,179.51	667.76	105.39
Veneer logs	4,740.13	4,884.18	4,706.63	177.55	33.50	4,680.58	4,655.03	18.41	7.14
Composite panels	613.98	568.96	551.97	16.99	62.01	77.19	69.81	7.37	—
Pulpwood	2,126.09	1,944.67	1,902.16	42.51	223.93	150.21	132.96	17.25	—
Fuelwood	—	—	—	—	—	—	—	—	—
Total	25,694.28	26,396.17	25,031.29	1,364.88	662.99	21,860.64	21,037.31	710.79	112.53

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.3—Percent of overutilization and underutilization for softwood growing stock by product for sawtimber and poletimber, North Carolina, 2007

Product	Overutilization		Underutilization		Saw-log portion		
	Growing stock utilized/ total volume utilized	Nongrowing stock utilized/ total volume utilized	Growing stock utilized/total growing-stock volume	Growing stock not utilized/ total growing-stock volume	Saw log utilized/ total saw-log volume	Cull utilized/ total saw-log volume	Saw log not utilized/ total saw-log volume
	<i>percent</i>						
Saw logs	98.11	1.89	94.06	5.94	95.44	3.94	0.62
Veneer logs	99.29	0.71	96.36	3.64	99.45	0.39	0.15
Composite panels	89.90	10.10	97.02	2.98	90.44	9.55	—
Pulpwood	89.47	10.53	97.81	2.19	88.52	11.48	—
Fuelwood	—	—	—	—	—	—	—
All products	97.42	2.58	94.83	5.17	96.23	3.25	0.51

— = no sample for the cell.

Table A.4—Volume of softwood growing stock by product and utilization for sawtimber, North Carolina, 2007

Product	Total volume utilized	Growing stock			Nongrowing stock utilized	Saw-log portion			
		Total	Utilized	Not utilized		Total	Utilized	Cull utilized	Not utilized
	<i>cubic feet</i>								
Saw logs	17,570.42	18,374.76	17,257.31	1,117.45	313.11	16,952.66	16,179.51	667.76	105.39
Veneer logs	4,740.13	4,884.18	4,706.63	177.55	33.50	4,680.58	4,655.03	18.41	7.14
Composite panels	98.65	108.78	94.56	14.22	4.09	77.19	69.81	7.37	—
Pulpwood	189.56	210.16	183.48	26.68	6.08	150.21	132.96	17.25	—
Fuelwood	—	—	—	—	—	—	—	—	—
Total	22,598.76	23,577.88	22,241.98	1,335.90	356.78	21,860.64	21,037.31	710.79	112.53

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.5—Percent of overutilization and underutilization for softwood growing stock by product for sawtimber, North Carolina, 2007

Product	Overutilization		Underutilization		Saw-log portion		
	Growing stock utilized/ total volume utilized	Nongrowing stock utilized/ total volume utilized	Growing stock utilized/total growing-stock volume	Growing stock not utilized/ total growing-stock volume	Saw log utilized/ total saw-log volume	Cull utilized/ total saw-log volume	Saw log not utilized/ total saw-log volume
	<i>percent</i>						
Saw logs	98.22	1.78	93.92	6.08	95.44	3.94	0.62
Veneer logs	99.29	0.71	96.36	3.64	99.45	0.39	0.15
Composite panels	95.85	4.15	86.93	13.07	90.44	9.55	—
Pulpwood	96.79	3.21	87.30	12.70	88.52	11.48	—
Fuelwood	—	—	—	—	—	—	—
All products	98.42	1.58	94.33	5.67	96.23	3.25	0.51

— = no sample for the cell.

Table A.6—Volume of softwood growing stock by product and utilization for poletimber, North Carolina, 2007

Product	Total volume utilized	Growing stock			Nongrowing stock utilized
		Total	Utilized	Not utilized	
	<i>cubic feet</i>				
Saw logs	643.66	623.59	613.21	10.38	30.45
Veneer logs	—	—	—	—	—
Composite panels	515.33	460.18	457.41	2.77	57.92
Pulpwood	1,936.53	1,734.51	1,718.68	15.83	217.85
Fuelwood	—	—	—	—	—
Total	3,095.52	2,818.28	2,789.30	28.98	306.22

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.7—Percent of overutilization and underutilization for softwood growing stock by product for poletimber, North Carolina, 2007

Product	Overutilization		Underutilization	
	Growing stock utilized/ total volume utilized	Nongrowing stock utilized/ total volume utilized	Growing stock utilized/ total growing-stock volume	Growing stock not utilized/ total growing-stock volume
	<i>percent</i>			
Saw logs	95.27	4.73	98.34	1.66
Veneer logs	—	—	—	—
Composite panels	88.76	11.24	99.40	0.60
Pulpwood	88.75	11.25	99.09	0.91
Fuelwood	—	—	—	—
All products	90.11	9.89	98.97	1.03

— = no sample for the cell.

Table A.8—Volume of softwood cull by product and utilization, North Carolina, 2007

Product	Total volume utilized	Nongrowing stock			
		Merchantable			Unmerchantable utilized
		Total	Utilized	Not utilized	
		<i>cubic feet</i>			
Saw logs	42.23	41.65	41.65	—	0.58
Veneer logs	—	—	—	—	—
Composite panels	74.43	71.06	70.75	0.31	3.68
Pulpwood	440.18	424.75	422.53	2.22	17.65
Fuelwood	—	—	—	—	—
Total	556.84	537.46	534.93	2.53	21.91

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.9—Percent of overutilization and underutilization for softwood cull by product, North Carolina, 2007

Product	Overutilization		Underutilization	
	Merchantable utilized/total volume utilized	Unmerchantable utilized/total volume utilized	Merchantable utilized/total merchantable volume	Merchantable not utilized/total merchantable volume
	<i>percent</i>			
Saw logs	98.63	1.37	100.00	—
Veneer logs	—	—	—	—
Composite panels	95.06	4.94	99.56	0.44
Pulpwood	95.99	4.01	99.48	0.52
Fuelwood	—	—	—	—
All products	96.07	3.93	99.53	0.47

— = no sample for the cell.

Table A.10—Volume of hardwood growing stock by product and utilization for sawtimber and poletimber, North Carolina, 2007

Product	Total volume utilized	Growing stock			Nongrowing stock utilized	Saw-log portion			
		Total	Utilized	Not utilized		Total	Utilized	Cull utilized	Not utilized
	<i>cubic feet</i>								
Saw logs	10,597.24	11,849.21	10,486.13	1,363.08	111.11	10,082.83	9,336.33	699.25	47.25
Veneer logs	219.18	280.42	217.60	62.82	1.58	255.04	203.39	51.65	—
Composite panels	528.83	565.52	505.35	60.17	23.48	168.47	143.83	24.65	—
Pulpwood	1,833.02	1,826.30	1,715.74	110.56	117.28	174.97	135.41	38.62	0.94
Fuelwood	265.55	244.97	234.56	10.41	30.99	45.17	45.17	—	—
Total	13,443.80	14,766.42	13,159.38	1,607.04	284.42	10,726.48	9,864.13	814.17	48.19

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.11—Percent of overutilization and underutilization for hardwood growing stock by product for sawtimber and poletimber, North Carolina, 2007

Product	Overutilization		Underutilization		Saw-log portion		
	Growing stock utilized/ total volume utilized	Nongrowing stock utilized/ total volume utilized	Growing stock utilized/total growing-stock volume	Growing stock not utilized/ total growing-stock volume	Saw log utilized/ total saw-log volume	Cull utilized/ total saw-log volume	Saw log not utilized/ total saw-log volume
	<i>percent</i>						
Saw logs	98.95	1.05	88.50	11.50	92.60	6.94	0.47
Veneer logs	99.28	0.72	77.60	22.40	79.75	20.25	—
Composite panels	95.56	4.44	89.36	10.64	85.37	14.63	—
Pulpwood	93.60	6.40	93.95	6.05	77.39	22.07	0.54
Fuelwood	88.33	11.67	95.75	4.25	100.00	—	—
All products	97.88	2.12	89.12	10.88	91.96	7.59	0.45

— = no sample for the cell.

Table A.12—Volume of hardwood growing stock by product and utilization for sawtimber, North Carolina, 2007

Product	Total volume utilized	Growing stock			Nongrowing stock utilized	Saw-log portion			
		Total	Utilized	Not utilized		Total	Utilized	Cull utilized	Not utilized
	<i>cubic feet</i>								
Saw logs	10,282.86	11,530.18	10,178.27	1,351.91	104.59	10,082.83	9,336.33	699.25	47.25
Veneer logs	219.18	280.42	217.60	62.82	1.58	255.04	203.39	51.65	—
Composite panels	184.20	227.01	182.71	44.30	1.49	168.47	143.83	24.65	—
Pulpwood	204.93	253.52	199.63	53.89	5.30	174.97	135.41	38.62	0.94
Fuelwood	74.66	68.86	68.86	—	5.80	45.17	45.17	—	—
Total	10,965.83	12,359.99	10,847.07	1,512.92	118.76	10,726.48	9,864.13	814.17	48.19

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.13—Percent of overutilization and underutilization for hardwood growing stock by product for sawtimber, North Carolina, 2007

Product	Overutilization		Underutilization		Saw-log portion		
	Growing stock utilized/ total volume utilized	Nongrowing stock utilized/ total volume utilized	Growing stock utilized/total growing-stock volume	Growing stock not utilized/ total growing-stock volume	Saw log utilized/ total saw-log volume	Cull utilized/ total saw-log volume	Saw log not utilized/ total saw-log volume
	<i>percent</i>						
Saw logs	98.98	1.02	88.28	11.72	92.60	6.94	0.47
Veneer logs	99.28	0.72	77.60	22.40	79.75	20.25	—
Composite panels	99.19	0.81	80.49	19.51	85.37	14.63	—
Pulpwood	97.41	2.59	78.74	21.26	77.39	22.07	0.54
Fuelwood	92.23	7.77	100.00	—	100.00	—	—
All products	98.92	1.08	87.76	12.24	91.96	7.59	0.45

— = no sample for the cell.

Table A.14—Volume of hardwood growing stock by product and utilization for poletimber, North Carolina, 2007

Product	Total volume utilized	Growing stock			Nongrowing stock utilized
		Total	Utilized	Not utilized	
	<i>cubic feet</i>				
Saw logs	314.38	319.03	307.86	11.17	6.52
Veneer logs	—	—	—	—	—
Composite panels	344.63	338.51	322.64	15.87	21.99
Pulpwood	1,628.09	1,572.78	1,516.11	56.67	111.98
Fuelwood	190.89	176.11	165.70	10.41	25.19
Total	2,477.99	2,406.43	2,312.31	94.12	165.68

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.15—Percent of overutilization and underutilization for hardwood growing stock by product for poletimber, North Carolina, 2007

Product	Overutilization		Underutilization	
	Growing stock utilized/ total volume utilized	Nongrowing stock utilized/ total volume utilized	Growing stock utilized/ total growing-stock volume	Growing stock not utilized/ total growing-stock volume
	<i>percent</i>			
Saw logs	97.93	2.07	96.50	3.50
Veneer logs	—	—	—	—
Composite panels	93.62	6.38	95.31	4.69
Pulpwood	93.12	6.88	96.40	3.60
Fuelwood	86.80	13.20	94.09	5.91
All products	93.31	6.69	96.09	3.91

— = no sample for the cell.

Table A.16—Volume of hardwood cull by product and utilization, North Carolina, 2007

Product	Total volume utilized	Nongrowing stock			
		Merchantable			Unmerchantable utilized
		Total	Utilized	Not utilized	
		<i>cubic feet</i>			
Saw logs	85.86	85.33	85.33	—	0.53
Veneer logs	—	—	—	—	—
Composite panels	217.31	212.66	209.36	3.30	7.95
Pulpwood	649.89	644.42	618.87	25.55	31.02
Fuelwood	229.54	200.87	200.87	—	28.67
Total	1,182.60	1,143.28	1,114.43	28.85	68.17

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Table A.17—Percent of overutilization and underutilization for hardwood cull by product, North Carolina, 2007

Product	Overutilization		Underutilization	
	Merchantable utilized/ total volume utilized	Unmerchantable utilized/ total volume utilized	Merchantable utilized/total merchantable volume	Merchantable not utilized/ total merchantable volume
	<i>percent</i>			
Saw logs	99.38	0.62	100.00	—
Veneer logs	—	—	—	—
Composite panels	96.34	3.66	98.45	1.55
Pulpwood	95.23	4.77	96.04	3.96
Fuelwood	87.51	12.49	100.00	—
All products	94.24	5.76	97.48	2.52

— = no sample for the cell.

Bentley, James W.; Johnson, Tony G. 2010. North Carolina harvest and utilization study, 2007. Resour. Bull. SRS-167. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 27 p.

In 2007, a harvest and utilization study was conducted on 83 operations throughout North Carolina. There were 2,119 total trees measured: 1,323 or 62 percent were softwood, while 796 or 38 percent were hardwood. Results from this study showed that 85 percent of the total softwood volume measured was utilized for a product, and 15 percent was left as logging residue. Seventy-seven percent of the total hardwood volume measured was utilized for a product, while 23 percent was left as logging residue.

Keywords: FIA, growing stock, logging residue, nongrowing stock, overutilization, product, removals, underutilization.



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