Forest Products Industries' Economic Contributions: West Virginia

June 2020

Prepared by

Public Sector Consultants
Lansing, Michigan
www.publicsectorconsultants.com

Prepared for

West Virginia Division of Forestry
Charleston, West Virginia
www.wvforestry.com

Michigan Department of Natural Resources
Forest Resources Division
Lansing, Michigan
www.michigan.gov/dnr

Foreword

Almost Heaven, Mountain State, Wild and Wonderful, West-By-God-Virginia—all names used to identify the second most forested state in the nation. Known worldwide for high-quality Appalachian hardwoods, West Virginia has become a major contributor to the world's supply of hardwood lumber and logs. Strategically positioned to both East Coast and Midwest markets with good access to transportation to West Coast and international markets, West Virginia has developed a forest products industry present in all of the state's 55 counties.

Current estimates put timber removals across the state at approximately 780 million board feet, with the potential to double this consumption, as growth estimates annually (net of mortality) are double (two to one) the current drain.

Like many other hardwood-producing states, the lack of production is creating an over-mature situation. 69 percent of West Virginia's timber stands are 61 years and older, with 32 percent 81 years and older, and only 11 percent growing stock.

West Virginia has 11.7 million acres of commercial timberland, of which is 87 percent privately owned, with only 10 percent federally owned, and 3 percent owned by the state. Only a small percentage of the state- and federal government-owned timber has harvesting restrictions. There are very attractive incentives for private timberland owners to keep their lands in timber production.

With all these positives, the future for the forest products industries in the West Virginia are bright.

Suggested citation: Public Sector Consultants, Barry Cook, Kathryn Gazal, Clinton Gabbert, Jeremy McGill, Steve Harouff, and Joseph F. McNeel. 2020. *Forest Products Industries' Economic Contributions: West Virginia*. Lansing: Public Sector Consultants.

Special Dedication

IN MEMORY OF

Barry L. Cook

May 10, 1949 — May 9, 2020

West Virginia State Forester/Director

May 1, 2017 —May 9, 2020

Barry L. Cook was a seasoned forester with more than 45 years of experience before being appointed by Governor Jim Justice to serve as West Virginia State Forester/Director in 2017. He was a native of southern West Virginia and a graduate of both West Virginia University and Duke University.

Barry started his forestry career as a logging superintendent for Weyerhaeuser Company in Plymouth, North Carolina. In 1975, he accepted a position with J. P. Hamer Company as a procurement forester, a position he held until 1978 when he became the procurement manager for Coastal Lumber Company. Director Cook spent the following 26 years advancing through the leadership ranks until he resigned in 2002 as Vice-President of Operations. He then became President of Forest Products Group, an arm of Kimball International. Barry and his wife Donna then purchased and successfully operated Indiana Hardwoods. In 2008, the Cook family relocated to Beckley, West Virginia, so that Barry could personally oversee the acquisition of Indiana Hardwoods by Cranberry Lumber Company.

As West Virginia State Forester/Director, Barry orchestrated numerous initiatives to promote and expand the forest-products industry. Specifically, Barry worked to attract students and increase

enrollment in forestry programs to ensure that West Virginia's forest-products industry enjoyed the benefits of a skilled workforce. He was also instrumental in securing a grant for WVU's Davis College to explore the possibility of certifying West Virginia's hardwoods as a cross-laminated timber suitable for building construction. Director Cook implemented a sound, silvicultural practice on state-owned forests to provide an environment ripe for forest growth—places that can be enjoyed for generations to come. He reorganized the West Virginia Division of Forestry to provide the most services with limited resources. One of Barry's favorite pastimes during his tenure was traveling the country attending national conferences to promote the benefits of West Virginia's vast array of forestlands to potential investors and manufacturers. Barry was a man who believed in his product and worked at selling it.

During his life Director Cook was many things. He was a veteran who loved his country. A native West Virginian who loved his state. A brother, husband and father who loved his family. A great leader who loved his employees. A forester who loved the land.

Barry's presence in West Virginia's forestry family is greatly missed, but to all who had the pleasure of knowing him, he will always be a pleasant memory. May he rest in peace.

Acknowledgements

This report was produced as part of a 20-state project supported by a U.S. Department of Agriculture Forest Service 2017 Landscape Scale Restoration Grant, administered by the Michigan Department of Natural Resources, Forest Resources Division on behalf of the Northeast-Midwest State Foresters Alliance (NMSFA) Forest Markets & Utilization Committee. Barry Cook, Kathryn Gazal, Clinton Gabbert, Jeremy McGill, Steve Harouff, and Joseph F. McNeel contributed extensively to the West Virginia report, and we thank them for their contributions.

Table of Contents

Executive Summary

This report assesses broad forest conditions and economic contributions of forest products industries in West Virginia. It is one of 20 coordinated and comparable state reports in the northeastern and midwestern United States that provides an improved assessment of forests and the economies they support. Forest data come from the U.S. Forest Service's Forest Inventory and Analysis website, and economic data come from the 2017 Impact Analysis for Planning (IMPLAN), a commercially available economic input-output (IO) model.

West Virginia boasts 12.1 million acres of forest land that cover 79 percent of its land base, with most of this forest land able to produce commercial timber. The majority, 87 percent, is privately owned, while state and local governments own about 3 percent and the federal government owns about 10 percent.

Economic Transitions

The forest products industry has seen significant change in the past decade. As shown below in Exhibit 1, the forest products sector in West Virginia slowly recovered from the great recession over a period of several years. Benchmark economic contributions in 2010 were 30 percent lower than those attained in 2015 and 2017. As a state, West Virginia has worked to position the forest products industry as a key driver for the West Virginia economy.

However, events in 2019 that have continued into 2020 have significantly affected the forest products industries. In particular, Chinese tariffs imposed on hardwood lumber and logs in 2019 slowed the export trade in these products, and the economic impact was exacerbated in 2020 by the large-scale economic shutdown in response to the COVID-19 pandemic. Moving into 2021, the state and key industrial players need to focus on restoring the forest products industry back to 2017 levels, which may take several years.

Exhibit 1. Total Contribution of the West Virginia Forest Products Industry

Economic Measure	2010	2015	2017
Total output (millions of dollars)	$2,644	$3,242	$3,229
Employment	16,608	19,029	17,171

Forest Industries

This report presents seven forest products industries, which are based on 32 economic sectors in IMPLAN, 25 of which are present in West Virginia:

- Forestry
- Logging

- Primary solid wood products
- Secondary solid wood products
- Wood furniture
- Pulp, paper, and paperboard mills
- Secondary paperboard and other paper products

In 2017, West Virginia's forest products industries provided direct employment to over 10,000 people, leading to $2.2 billion in output. That same year, labor income was $520.2 million and value-added was $747.0 million. In total contributions, these industries supported over 17,000 jobs, $853.1 million in labor income, $1.3 billion in value-added, and $3.2 billion in output.

Among the top sectors (excluding forest products sectors) impacted by forest products industries were wholesale trade, real estate, restaurants, trucking, and hospitals. This group of sectors reflects spending by forest products companies, their suppliers, and individuals.

Leading Forest Products Industry Groups

Among the seven industry groups, the leading industries' rank in terms of direct jobs, value-added, and direct output varied by chosen measure:

- Primary solid wood products had the highest number of direct jobs (2,836), labor income ($137.6 million), and output ($878.9 million) and the second-highest value-added ($171.3 million).
- Secondary solid wood products had the second highest number of direct jobs (2,613), the third highest value-added ($152.8 million), and the second highest direct output ($512.7 million).
- Logging products had the third highest employment (1,919), highest value-added ($312.2 million), and third highest output ($354.3 million).
- Secondary paperboard and other paper products had the sixth highest number of direct jobs (281), value-added ($20.5 million), and direct output ($109.3 million).

Leading Individual Forest Products Sectors

Among the 25 forest products sectors present in West Virginia, the top four, by measure in order from highest to fourth highest of direct contributions, were:

- Employment—Sawmills; commercial logging; other millwork, including flooring; and wood kitchen cabinet and countertop manufacturing were the top four sectors and had a combined total of over 6,588 direct jobs, or 65 percent of direct employment.
- Labor income—Commercial logging; sawmills; other millwork, including flooring; and wood kitchen cabinet and countertop manufacturing had the highest labor income, totaling $342.8 million, or 66 percent of direct labor income.

- Value-added—Commercial logging; sawmills; other millwork, including flooring; and wood kitchen cabinet and countertop manufacturing had the highest value-added, totaling $538.7 million, or 72 percent of direct value-added.
- Output—Sawmills; commercial logging; other millwork, including flooring; and wood kitchen cabinet and countertop manufacturing were the top four sectors in output, totaling $1.4 billion, or 61 percent of total direct output.

West Virginia's Forest Products Industries Compared to Other West Virginia Industries

The forest products industries provided the second highest direct labor income, value-added, and output when compared to mining and oil and gas production, and agricultural production industries (plant crop and animal). Overall, the forest products industries accounted for 16.8 percent of the nonfood manufacturing jobs in West Virginia. Agricultural production provided the most employment. Over 15 percent of West Virginia's 49,000 direct manufacturing jobs in 2017 were in the forest products industries, one out of every seven manufacturing jobs.

West Virginia's Forest Products Industries Compared to Those of Pennsylvania, Maryland, and Ohio

Forest products industries in West Virginia and the neighboring states of Pennsylvania, Maryland, and Ohio employed over 305,000 workers and accounted for over $70.0 billion in direct output. Pennsylvania's forest products economy was the largest in the region, followed by that of Ohio, Maryland, and West Virginia.

Glossary

The following technical terms are used throughout this report when discussing forestry and economic contributions.

Forestry Terms

Average annual harvest removals: The average annual merchantable volume of growing-stock trees that were live at the time of the previous inventory and were either cut and removed by direct human activity related to harvesting or died as a result of silvicultural or land-clearing activity by the time of the current inventory.

Average annual mortality: The average annual merchantable volume of growing-stock trees that were live at the time of the previous inventory and are dead in the current inventory.

Average annual net growth: The average annual change in merchantable volume of growing-stock trees, after deducting mortality volume, between inventories.

Forest land: Land that is at least 10 percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and non-forested lands that have at least 10 percent canopy cover with live tally trees, or recently had at least 10 percent canopy cover by live tally trees based on the presence of stumps, snags or other evidence, and forest areas adjacent to urban and built-up lands, including pinyon-juniper and chaparral areas in the western U.S. and afforested areas. The minimum area for classification of forest land is one acre and 120 feet wide measured stem-to-stem from the outermost edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest land if less than 120 feet wide.

Growing stock: Live trees of commercial species that meet minimum merchantability standards and only includes trees at least 5 inches in diameter at breast height. In general, these trees have at least one solid eight-foot section, are reasonably free of form defect on the merchantable bole, and at least 34 percent or more of the volume is merchantable. Excludes rough or rotten cull trees.

Timberland: A subset of forest land that produces or can produce crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland can produce at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Economic Contribution Terms

Direct effects/contributions: The economic activities (e.g., output, employment, labor income, and value-added) associated with an industry or sector in the study area. These can describe the current economic sectors or changes to those sectors.

Employment: The number of full- and part-time jobs associated with an industry.

Indirect effects/contributions: The impact of local industries purchasing goods and services from other industries, leading to others' outputs, employment, and labor income. This report uses "indirect effects" to refer to the combination of indirect and induced effects.

Induced effects/contributions: The impact of labor income (employee compensation and proprietor income) via goods and services purchased due to the direct and indirect spending by industries. For this report, induced effects are included with indirect effects and referred to as indirect effects.

Labor income: The dollar total of employee compensation and proprietor income; the latter is associated with self-employed individuals.

Output: The dollar measure of production within an area; it is also viewed as sales.

Social Accounting Matrix (SAM) multipliers: These multipliers are derived by dividing the sum of direct, indirect, and induced effects by the direct effects. The social accounts include payments made between households, households and government, and more. These are available for output, employment, labor income, and value-added and are used to assess effects of changes in industry activity (i.e., "ripple effects").

Total effects/contributions: The sum of direct, indirect, and induced effects.

Value-added (also known as gross state product, or GSP): The sum of labor income, other property income (e.g., rents and profits), and indirect business taxes (e.g., excise and sales taxes). It is the difference between an industry's total output and the cost of its intermediate inputs. The sum of value-added for all economic sectors within the region equals the total GSP.

Introduction

Forest products industries are an integral component of West Virginia's economy. They provide jobs, raw materials, and finished goods that generate additional economic activity throughout the state, region, and nation. This report compares the contributions of West Virginia's forest products industries with those of adjacent states. It is one of 20 reports in the Northeast and Midwestern area of the United States that broadly assesses forests and their economic contributions. The interactions of these 20 states are covered in a regional report. In total, these documents provide a consistent reporting format, compiled using identical methods, across the northeastern and midwestern United States. Previous state-level reports in this area were not comparable because they used different methods and data.

To help quantify these relationships and consistently document the industries' contributions, the Forest Markets & Utilization Committee of the Northeast—Midwest State Foresters Alliance (NMSFA) secured federal grant funds to conduct an analysis of 20 midwestern- and northeastern–area states as well as Nebraska. As part of this work, the same project team that completed the individual state reports—comprising members of the Michigan Department of Natural Resources, Public Sector Consultants, Michigan State University forestry economics professor emeritus Larry Leefers, and state forestry experts—published a 20-state report summarizing the economic contributions of forest products industries at a regional level. The U.S. Forest Service funded this work through a 2017 Landscape Scale Restoration grant.

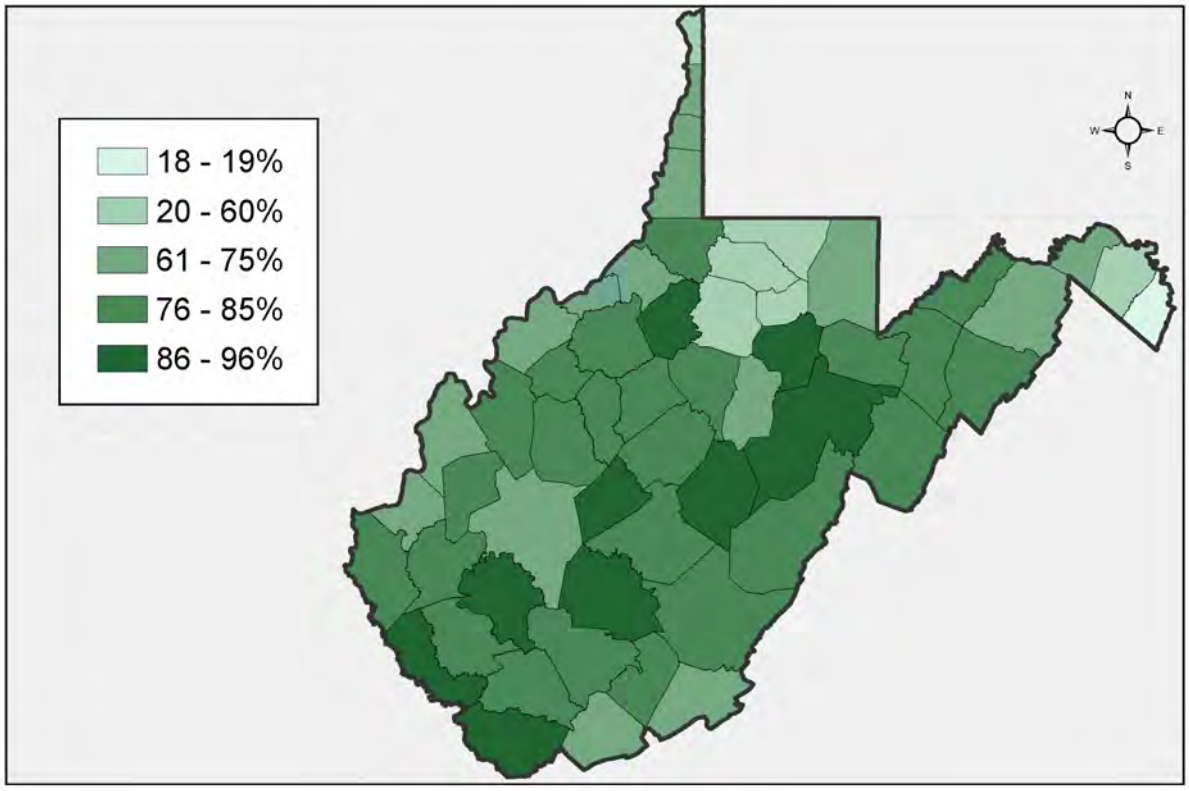
Much of the data used in this report were derived from the U.S. Forest Service Forest Inventory and Analysis database and from IMPLAN, a widely used economic modeling system. These data and related information are presented in four major sections: Forest Resources of West Virginia, Forest Products Industries, Economic Contributions of West Virginia's Forest Products Industries, and Summary. Due to rounding, some figures in the following tables may not sum to the exact total indicated. The appendices present the economic methods and detailed economic sector data used for this report.

Forest Resources of West Virginia

West Virginia is a state rich in forest resources, as shown in Exhibit 2, which illustrates the percent of forest land by county throughout the state. Over 78 percent, approximately 12.1 million acres, of the state is forested (Exhibit 3).

Privately owned timberland is the largest component of forest land, totaling 10.4 million acres, while national forests comprise an additional 1.1 million acres (9 percent) of the state's forest land. State forest land makes up only 373,319 acres. Non-forest land area accounts for 3.3 million acres.

Exhibit 2. Percent of Forest Land by County in West Virginia, 2017



Most land is privately owned, and the State of West Virginia and U.S. Forest Service are the major public owners (Exhibit 4). Landowners pursue diverse goals. Private landowners have wide latitude in how they treat their lands—some have a hands-off approach, while others pursue active management. There are several state and federal programs designed to encourage the active management of private forestlands. State forests are actively managed in many areas, while resource protection is emphasized in others. Active timber management provides the feedstock for West Virginia's forest products industries. It is estimated that there are 14 billion trees in West Virginia—1,400 trees for each person in the state.

Exhibit 3. West Virginia Land Area by Land Use Type, 2017 (U.S. Forest Service)

Land Use Type	Acres	Percentage
Forest land	12,072,879	78.5%
Non-forest land	3,297,480	21.5%
Total	**15,370,359**	**100.0%**

The majority of West Virginia's forest land is privately owned (86.5 percent). Over 10 percent is in federal ownership, while only 3 percent is owned by state and local governments.

Exhibit 4. Forest Land by Ownership Group in West Virginia (2017)

Ownership Group	Acres	Percentage
National forest and other federal	1,252,482	10.4%
State and local governments	373,319	3.1%
Private	10,447,077	86.5%
Total	**12,072,879**	**100.0%**

West Virginia's major forest types are predominantly hardwoods (oak/hickory, maple/beech/birch, and oak/pine) (Exhibit 5). Tree species with the greatest standing volume include red oak, white oak, yellow poplar, sugar maple, and red maple. West Virginia is internationally known for its high-quality red and white oak timber, which is prized for furniture manufacturing, cabinetry, flooring, and other visually appealing durable goods. West Virginia's diverse timber species support a variety of forest products industries, including office and fine furniture, cabinetry, pulp and paper manufacturing, paper and paperboard packaging, oriented strand board, laminated veneer lumber, parallel-strand lumber, hardwood-grade lumber, and a variety of industrial lumber and wood packaging and pallet products. There is also a thriving hardwood home-heating pellet industry, with three pellet manufacturers located in the state.

Exhibit 5. Forest Land Area by Forest Type Group in West Virginia (2017)

Forest Type Group	Acres	Percentage
Oak/hickory	8,837,906	73.2%
Maple/beech/birch	2,212,103	18.3%
Oak/pine	306,021	2.5%
Other	716,849	6.0%
Total	**12,072,879**	**100.0%**

The estimated volume of standing timber suitable for forest products (i.e., the marketable volume of growing stock) was about 32.3 billion cubic feet, or about 409 million standard cords[1] (Exhibit 6). Average annual net growth exceeded annual harvest removals by a ratio of about 2.3 to 1. That is, for every cubic foot of harvesting that took place, 2.3 cubic feet of timber was grown, after accounting for

[1] A standard cord is a unit of measurement for pulpwood or sawlogs, generally equivalent to a stack of wood measuring four feet wide by four feet tall by eight feet long. A stacked cord of wood typically contains about 79 cubic feet of solid wood, excluding air space.

mortality. Average annual harvest removals of growing stock were about 181.9 million cubic feet, or about 2.3 million cords—roughly 0.7 percent of standing volume.

Exhibit 6. Characteristics of Growing Stock in West Virginia, 2017 (million cubic feet)

Measure	Total	National Forest	Other Federal	State and Local Government	Private
Net volume	26,910.6	3,198.0	499.9	828.9	22,383.8
Average annual net growth	421.8	22.7	5.4	10.0	383.7
Average annual harvest removals	181.9	2.8	.1	2.6	176.3
Average annual mortality	224.1	27.4	4.9	6.5	185.3

Note: Net volume is merchantable volume, in cubic feet, of growing-stock trees for timber species (trees where diameter is measured at breast height) from a 1-foot stump to a minimum 4-inch top diameter, or to where the central stem breaks into limbs all of which are less than 4.0 inches in diameter. Volume loss due to rotten, missing, and form cull has been deducted. Growing stock is defined as live trees of commercial species that meet minimum merchantability standards and only includes trees at least 5 inches in diameter at breast height. Net growth is the average annual change (gross growth minus mortality) in merchantable volume, in cubic feet, of growing-stock trees on forestland. Harvest removals are the average annual merchantable volume, in cubic feet, of growing-stock trees at the time of removal from forest land. Annual mortality is the average annual merchantable volume, in cubic feet, of growing-stock trees at the time of mortality on forest land.

Forest Products Industries

Contribution analysis focuses on industries' role in an economy. The first step is often defining the region (e.g., a state). One of the next steps is to define exactly which economic sectors comprise the focus industries. To analyze the contributions of the forest industries, representatives from the U.S. Forest Service's northeastern and midwestern states and Nebraska selected 32 sectors by consensus for inclusion in the analysis. A description of the methods and data is presented in Appendix A. To concisely describe and communicate the economic contribution of the forest products industries, these 32 sectors were aggregated into seven broad groups (Appendix B):

- Forestry
- Logging
- Primary solid wood products
- Secondary solid wood products
- Wood furniture
- Pulp, paper, and paperboard mills
- Secondary paperboard and other paper products

In total, these sectors cover forest-specific manufacturing activities, including the conversion of trees into primary products and the manufacture of products used by other sectors and households. Primary

industries (e.g., sawmills, reconstituted wood products [such as oriented strand board], and power plants) use wood directly from the forest, including roundwood, chips, or similar forms. Secondary industries (e.g., trusses and furniture) use one or more primary forest products (e.g., lumber and paperboard) in their manufacturing processes. Value is added as the timber is processed through primary and secondary manufacturers. Several sectors included wood and non-wood products (e.g., institutional furniture manufacturing). Therefore, output and other measures were reduced to better reflect the wood-only component by using published government data or surveys (Gibson, Leefers, and Poudel 2020).

This report used IMPLAN to estimate economic contributions of the forest products industries. IMPLAN is a widely used input-output model that comprises economic data and software. IO models characterize financial linkages among and between sectors, households, and institutions. Within these models, various sectors have production functions that show the value of inputs used in production of outputs or commodities. West Virginia's economy was represented by 389 sectors in 2017, the most recent year available for IMPLAN data at the time of the analysis. These sectors are based on the North American Industrial Classification System (NAICS).

IMPLAN models can be constructed for different geographic areas.

Economic Contributions of West Virginia's Forest Products Industries

This section of the report includes four major subsections: Economic Contributions Defined, Economic Contribution Results, Importance of the Forest Products Industries in Context, and Supplemental Economic Contribution Information.

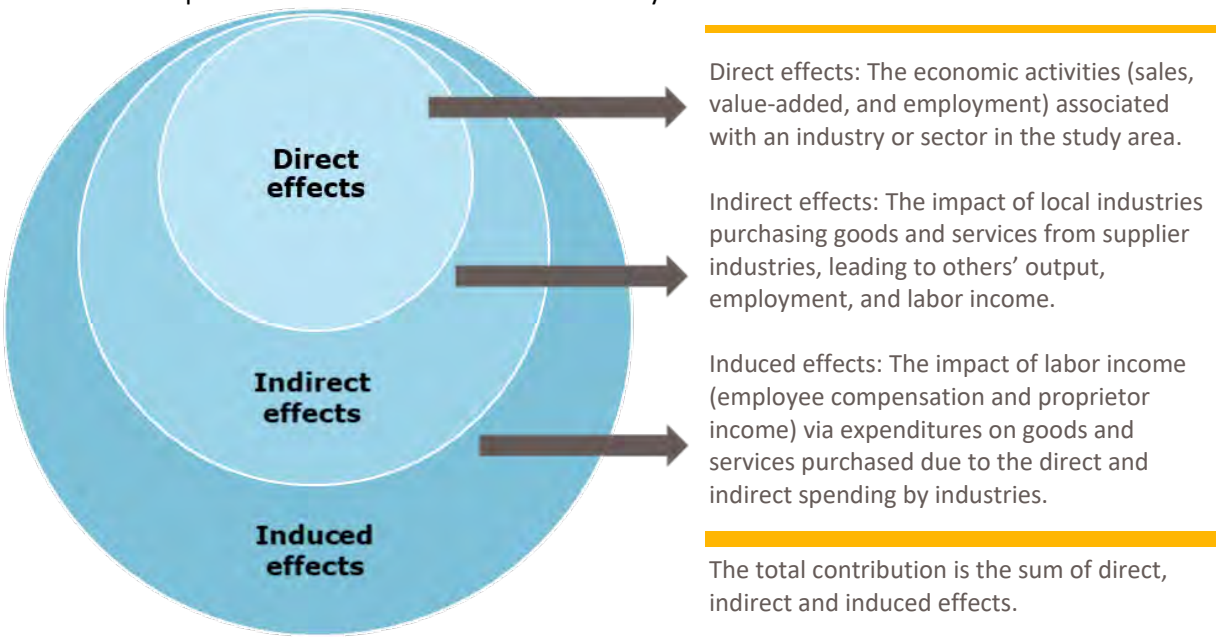
Forests and forest products industries are central for the transition to a greener and more sustainable economy. A green goods and services economy relies on the sustainable use of natural resources, and West Virginia's forest products industries are tightly bound to forests and the goods and ecosystem services that they provide (e.g., wildlife habitat, watershed protection, carbon sequestration, etc.).

Economic Contributions Defined

Input-Output Analysis and IMPLAN

Forest products industries influence the economy in three ways: direct effects (when industries sell commodities in response to demand), indirect effects (as suppliers to directly impacted sectors), and induced effects (household spending by employees in directly and indirectly impacted sectors) (Exhibit 7). The total economic contribution is the value of production required to meet all the needs stemming from the initial activity—in this case, forest product–related purchases.

Exhibit 7. Concept of Total Economic Contribution Analysis



IO modeling using IMPLAN software and data is a conventional approach for documenting forest products industries' economic contributions. This analysis used the matrix inversion approach with external IMPLAN model adjustment as a primary method for estimating economic contributions of forest products industries in West Virginia (Gibson, Leefers, and Poudel 2020). Major economic indicators generated by IMPLAN include employment (full- and part-time jobs), labor income, total output, and value-added.

Interaction Between State and Regional Analyses

IMPLAN models are based on interactions across the economy. One important aspect of these interactions is whether commodities are sourced locally or imported. In smaller areas (e.g., counties), fewer commodities are sourced locally. As a result, leakages occur when purchases are made—that is, fewer dollars stay in the local economy.

Larger economies have fewer leakages and more commodities are sourced locally. For example, an examination of the logging industries (IMPLAN sector 16) in West Virginia, Ohio, and Pennsylvania reveals that the direct employment for 2017 was 1,919, 3,069, and 4,740 jobs, respectively. Summing the individual state's total employment contributions (direct, indirect, and induced) yields 17,637 jobs. However, if the states are combined as one region, the total employment contribution increases to 17,719 jobs. This increase reflects less leakage and more local purchases.

The larger role is due to trade, but IMPLAN does not explicitly show trade with specific states, only overall imports and exports. The regional analysis highlights the larger role of forest products industries

in the region's economy. Consequently, the state-level analyses underestimate the actual contributions from a regional perspective.

Economic Contribution Results

This section presents direct and total contributions for all forest products industries, direct and total contributions by forest product industry groups (e.g., logging, furniture, etc.), the top forest products sectors, and the top non-forest products sectors affected by the forest products industries. Finally, this section compares forest industries in nearby states, other natural resources industries, and manufacturing industries within the state.

Direct and Total Contributions by Forest Products Industries

Contribution analysis provides a means to assess the role various industries play in a state's economy. West Virginia forest products industries' total economic contribution in terms of output was $3.2 billion, based on direct output of $2.2 billion (Exhibit 8). About 10,000 direct jobs were associated with this level of economic activity, supporting a total of 17,171 jobs. Direct labor income, which includes employee compensation and proprietor income, was $520.2 million, or $51,469 per job. Total labor income, which includes income paid directly to industry employees and proprietors, their suppliers, and other industries they support, totaled $853.1 million.

Exhibit 8. Economic Contribution of the Forest Products Industries in West Virginia, 2017 Dollars

Effect	Employment	Labor Income (Thousands of Dollars)	Value-added* (Thousands of Dollars)	Output (Thousands of Dollars)
Direct	10,108	$520,228	$747,027	$2,214,972
Total	17,171	$853,058	$1,311,223	$3,229,881

* Value-added in IMPLAN is equivalent to GSP.

Each direct job in the forest products industries supported 0.7 additional jobs, and every $1 million in direct labor income supported an additional $0.64 million in indirect and induced labor income.

Most state economies are large relative to any particular industry or group of industries. The forest products industries are no exception. In 2017, West Virginia's population was estimated at 1.8 million people, with total employment of 894,439. The gross state product was $78.5 billion from 389 economic sectors (of the possible 536 in the US). The GSP's largest component was labor income, which was $43.7 billion.

Direct value-added for forest products industries was $747.0 million, 0.95 percent of West Virginia's total GSP. The percentage almost doubles to 1.70 percent when considering total value-added effects. These percentages hold for other economic measures (e.g., jobs) as well.

Direct and Total Contributions by Forest Product Industry Groups

As previously noted, the 32 IMPLAN forest products sectors were combined into seven industry groups (Appendix B). In West Virginia, primary solid wood products was the largest of these groups in terms of direct employment, labor income, and output and the second largest in terms of value-added. Secondary solid wood products was the second largest group in terms of direct employment and output and the third largest group in terms of labor income and value-added. Forestry, which includes maple syrup production, timber tract operations, and forestry support activities, was the smallest group for value-added and output.

Two groups—primary and secondary solid wood products—accounted for over half the output, labor income, and employment of forest products industries.

Exhibit 9. Direct Economic Contributions in West Virginia, Industry Groups, 2017

Industry Group	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	701	$22,080	$19,292	$22,653
Logging	1,919	$135,237	$312,182	$354,327
Primary solid wood products	2,836	$137,582	$171,284	$878,920
Secondary solid wood products	2,613	$124,595	$152,837	$512,662
Wood furniture	1,527	$67,978	$49,522	$186,335
Pulp, paper, and paperboard mills	232	$16,495	$21,442	$150,748
Secondary paperboard and other paper products	281	$16,263	$20,468	$109,328
Total	**10,108**	**$520,228**	**$747,027**	**$2,214,972**

Exhibit 10. Total Economic Contributions in West Virginia, Industry Groups, 2017

Industry Group*	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	423	$22,562	$22,657	$29,071
Logging	1,846	$101,878	$221,507	$275,142
Primary solid wood products	6,238	$312,497	$502,009	$1,355,922
Secondary solid wood products	4,865	$231,274	$332,358	$857,271
Wood furniture	2,394	$107,061	$113,419	$307,387
Pulp, paper, and paperboard mills	858	$48,554	$77,196	$256,686
Secondary paperboard and other paper products	548	$29,232	$42,078	$148,403
Total	**17,171**	**$853,058**	**$1,311,223**	**$3,229,881**

*Forestry and logging are reported in this table, but most of their contributions are as indirect inputs or intermediate inputs used for production in the other five industry groups.

For the following sector-specific discussions, refer to Exhibit 9 for direct contribution details and Exhibit 10 for total contribution details. See Appendix C for detailed economic measures for industry groups and their component sectors.

Forestry

The forestry group includes timber tract operations, establishments primarily engaged in the operation of timber tracts for the purpose of selling standing timber, and support activities for forestry such as estimating timber; forest firefighting; forest pest control; treating burned forests from the air for reforestation or on an emergency basis; and consulting on wood attributes and reforestation related to timber production, wood technology, forestry economics and marketing, and forest protection.

Out of seven industry groups, forestry was the fifth largest in terms of direct contributions in 2017. Direct contributions were $22.7 million in output, 701 jobs, $22.1 million in labor income, and $19.3 million value-added. In most cases, value-added is greater than labor income, one of the value-added components. Often, this situation does not hold for agricultural sectors due to farm subsidies, which show up as “negative taxes.” Sector 19, support activities for agriculture and forestry, reflects this for West Virginia in 2017, contributing to the smaller value-added. Total contributions are based, in part, on backward linkages to suppliers. Total contributions for forestry can be lower than direct contributions (i.e., initial IMPLAN levels) because many of the contributions are inputs into other industries. For example, half (54 percent) of forestry jobs are counted as contributions in other industries, mostly logging and primary solid wood products (e.g., sawmills). Hence, the total contributions displayed in

Exhibit 10 underrepresent the industry's broader contributions—reporting total contributions for forestry is somewhat misleading because much of the forestry total contribution effects are hidden in the total contributions of other industries. The same holds true for logging below.

Logging

The logging industry group contains establishments primarily engaged in one or more of the following: cutting timber, cutting and transporting timber, and producing wood chips in the field. Logging was the third largest in terms of direct employment. The direct contributions of logging were $354.3 million in output, 1,919 jobs, $135.2 million in labor income, and $312.2 million in value-added. Most logging activity is an input into production in other industries, especially for manufacturing primary solid wood products (e.g., lumber), paper, and paperboard. In West Virginia, 41 percent of logging jobs are included in the total contributions of other industries. As with forestry, logging's total contributions are underrepresented due to their inclusion in other industries.

Primary Solid Wood Products

The primary solid wood products industry group was the largest group in terms of direct employment in West Virginia. Primary solid wood products sectors include wood-based electric power generation, sawmills, wood preservation, veneer and plywood manufacturing, and reconstituted and wood product manufacturing industries. The direct contributions of the group were $878.9 million in output, 2,836 jobs, $137.6 million in labor income, and $171.3 million in value-added. Total contributions for primary solid wood products, including direct, indirect and induced effects, were $1.4 billion in output, 6,238 jobs, $312.5 million in labor income, and $502.0 million in value-added. Many primary solid wood products (e.g., lumber and panels) are inputs in other industries, which counted in other industries' total contributions.

Secondary Solid Wood Products

Secondary solid wood products was the second largest group in terms of direct employment in West Virginia. This group contains engineered wood member and truss manufacturing; wood windows and doors manufacturing; cut stock, resawing lumber, and planing; other millwork, including flooring, wood container, and pallet manufacturing; manufactured home (mobile home) manufacturing; prefabricated wood building manufacturing; and all other miscellaneous wood product manufacturing. Direct contributions of secondary solid wood products were $512.7 million in output, 2,613 jobs, $124.6 million in labor income, and $152.8 million in value-added. Total contributions were $857.3 million in output, 4,865 jobs, $231.3 million in labor income, and $332.4 million in value-added.

Wood Furniture

Wood furniture was the fourth largest group in terms of direct employment in West Virginia. Wood furniture includes wood kitchen cabinet and countertop manufacturing; upholstered household furniture manufacturing; non-upholstered wood household furniture manufacturing; institutional wood

furniture manufacturing; wood office furniture manufacturing; custom architectural woodwork and millwork manufacturing; and showcase, partition, shelving, and locker manufacturing. Direct contributions of wood furniture were $186.3 million in output, 1,527 jobs, $68.0 million in labor income, and $49.5 million in value-added. Total contributions of wood furniture were $307.4 million in output, 2,394 jobs, $107.1 million in labor income, and $113.4 million in value-added.

Pulp, Paper, and Paperboard Mills

The pulp, paper, and paperboard mills industry group was the smallest in terms of direct employment in West Virginia. The group includes pulp mills, paper mills, and paperboard mills that make paper or pulp from raw wood and from purchased pulp. The pulp, paper, and paperboard mills group's direct contributions were $150.7 million in output, 232 jobs, $16.5 million in labor income, and $21.4 million in value-added. Total contributions were $256.7 million in output, 858 jobs, $48.6 million in labor income, and $77.2 million in value-added.

Secondary Paperboard and Other Paper Products

The secondary paperboard and other paper products group was the sixth largest in terms of direct employment in West Virginia. The group comprises paper and paperboard manufacturing, paper bag and coated and treated paper manufacturing, stationery product manufacturing, sanitary paper product manufacturing, and all other converted paper product manufacturing. Facilities in this group manufacture products from purchased pulp, paper, paperboard, or recycled materials. The direct contributions in 2017 were $109.3 million in output, 281 jobs, $16.3 million in labor income, and $20.5 million in value-added. Total contributions were $148.4 million in output, 548 jobs, $29.2 million in labor income, and $42.1 million value-added.

Top Forest Product Sectors

Among the 32 industry sectors that comprise the seven industry groups listed above, the leading sectors varied by the contribution measure examined. In terms of direct jobs, the four largest forest products sectors are sawmills (2,287 jobs), commercial logging (1,919 jobs), other millwork, including flooring (1,213 jobs), and wood kitchen cabinet and countertop manufacturing (1,169 jobs). These sectors reflect the diversity of manufacturing in the state.

The sawmills sector is comprised of establishments primarily engaged in sawing dimension lumber, boards, beams, timbers, poles, ties, shingles, shakes, siding, and wood chips from logs or bolts. Sawmills may plane the rough lumber that they make with a planing machine to achieve smoothness and uniformity of size.

The commercial logging sector has establishments primarily engaged in one or more of the following: cutting timber, cutting and transporting timber, and producing wood chips in the field. Loggers are a critical component of the forest products industries. Many people in the forest products industries are

concerned that the aging logger population, insufficient recruitment and retention, and the high cost of entry into the business may limit other industries in the future (Allred 2009; Conrad et al. 2018).

The other millwork sector, which includes flooring, comprises establishments primarily engaged in manufacturing millwork (except wood windows, wood doors, and cut stock).

The wood kitchen cabinet and countertop manufacturing sector has establishments primarily engaged in manufacturing wood or plastics laminated on wood kitchen cabinets, bathroom vanities, and countertops (except freestanding). The cabinets and counters may be made on a stock or custom basis.

In terms of labor income, commercial logging; sawmills; other millwork, including flooring; and wood kitchen cabinet and countertop manufacturing had the highest labor income, totaling $342.8 million; value-added, totaling $538.7 million; and output, totaling $1.4 billion.

Top Non-forest Industries Impacted

Contribution analysis using IMPLAN relies on backward linkages from forest products industries sectors among themselves and to other sectors in West Virginia. Including the 25 forest products industries present in West Virginia, 120 sectors were impacted in 2017 (counting sectors with ten or more jobs supported). The top ten sectors (excluding forest products sectors) included wholesale trade, real estate, restaurants, trucking, and hospitals (Exhibit 11). This set of sectors reflects indirect and induced spending by forest products companies, their suppliers, and individuals.

These data were at an aggregate level, so 310 jobs in truck transportation included log trucks, delivery trucks, and office jobs for some trucking companies, among others. Five of these sectors were among the top ten sectors in the state of West Virginia (hospitals were number one followed by limited-service restaurants and full-service restaurants—each had over 24,000 jobs).

Exhibit 11. Direct Jobs Impacted by the Forest Products Industries Among West Virginia's Top Ten Non-Forest Products Industries in 2017

Sector	Description	Jobs
395	Wholesale trade	653
502	Limited-service restaurants	368
411	Truck transportation	310
501	Full-service restaurants	309
482	Hospitals	296
440	Real estate	198
461	Management of companies and enterprises	189
468	Services to buildings	180
475	Offices of physicians	153
448	Accounting, tax preparation, bookkeeping, and payroll services	148
Total	**NA**	**2,805**

Neighboring States

West Virginia and the neighboring states of Pennsylvania, Maryland, and Ohio comprise an important region for forest products. Forest products industries employ over 305,000 workers across the region and account for $70.2 billion in direct output (Exhibits 12 and 13). Pennsylvania had the largest forest products economy with 152,698 direct jobs and output in excess of $36.5 billion, followed by Ohio, Maryland, and West Virginia. The three largest industry groups, each with over 59,000 employees, were secondary paperboard and other paper products, secondary solid wood products, and wood furniture.

Exhibit 12. Forest Products Industries Direct Employment in West Virginia, Pennsylvania, Maryland, and Ohio, 2017

Industry	West Virginia	Pennsylvania	Maryland	Ohio
Forestry	701	1,865	140	596
Logging	1,919	4,740	648	3,069
Primary solid wood products	2,836	6,812	643	3,178
Secondary solid wood products	2,613	18,638	2,167	12,516
Wood furniture	1,527	13,720	2,506	14,904
Pulp, paper, and paperboard mills	232	3,186	800	2,211
Secondary paperboard and other paper products	281	19,581	1,909	17,971
Sum of Direct Contributions	**10,108**	**68,541**	**8,813**	**54,445**

Exhibit 13. Forest Products Industries Direct Output in West Virginia, Pennsylvania, Maryland, and Ohio, 2017

Industry	West Virginia (Thousands of Dollars)	Pennsylvania (Thousands of Dollars)	Maryland (Thousands of Dollars)	Ohio (Thousands of Dollars)
Forestry	$22,653	$126,178	$8,425	$37,948
Logging	$354,327	$697,606	$53,294	$484,704
Primary solid wood products	$878,920	$2,151,337	$224,358	$987,376
Secondary solid wood products	$512,662	$3,613,125	$497,136	$2,379,878
Wood furniture	$186,335	$2,282,116	$441,018	$2,436,627
Pulp, paper, and paperboard mills	$150,748	$2,722,271	$584,636	$1,717,609
Secondary paperboard and other paper products	$109,328	$10,827,005	$825,013	$8,067,397
Sum of Direct Contributions	**$2,214,972**	**$22,419,639**	**$2,633,880**	**$16,111,539**

Importance of the Forest Products Industries in Context

To help contextualize the relative importance of the forest products industries, it is useful to compare the contribution of West Virginia's forest products industries with others. Natural resources and agricultural industries significantly contribute to the diversity of economic activities reflected in West Virginia's $78.5 billion GSP. The forest products industries provide the second highest direct labor income, value-added, and output when compared to commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries (Exhibit 14). West Virginia's forest products industries comprised 1.0 percent of the GSP in 2017.

Exhibit 14. Natural Resources and Agricultural Production Industries in West Virginia, 2017

Industry	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forest products	10,108	$520,228	$747,027	$2,214,972
Commercial fishing, hunting, and trapping	89	$176	$(2,842)	$1,044
Mining and oil and gas production	34,096	$2,156,406	$9,841,606	$15,109,810
Agricultural production (plant crop and animal)	22,749	$71,976	$448,295	$1,065,034
Total	**67,040**	**$2,748,787**	**$11,034,086**	**$18,390,860**

Labor income per job was the second highest in forest products ($51,469) and highest in mining and oil and gas ($63,246). The average per job was the smallest in commercial fishing, hunting, and trapping ($1,978). For agricultural production, the average per job was $3,164.

Most of the forest products industries are manufacturers, however, the forestry, logging, and biomass power groups are not. There were approximately 49,000 manufacturing jobs in West Virginia in 2017. 7,487 were in the forest products industries, 15.1 percent of the total. Of 16 industries, forest products manufacturing was second in terms of employment, behind chemical manufacturing. It was fourth in terms of labor income, sixth in terms of value-added, and fifth in terms of output (Exhibit 15).

Exhibit 15. Manufacturing Industries in West Virginia, 2017

Manufacturing Industries	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Chemical	8,555	$1,027,341	$2,952,533	$12,200,731
Forest Products	7,487	$362,912	$415,553	$1,837,993
Transportation equipment	5,859	$509,962	$1,041,978	$3,139,656
Fabricated metal	4,733	$308,633	$421,712	$1,103,947
Food	4,463	$166,856	$192,562	$1,222,937
Primary metal	4,220	$375,164	$616,719	$3,257,694
Plastics and rubber products	3,335	$185,727	$301,137	$1,054,783
Nonmetallic mineral product	2,903	$166,154	$332,406	$910,333
Machinery	1,922	$125,692	$132,456	$535,347
Printing	1,545	$56,734	$63,437	$202,866
Miscellaneous	1,456	$76,308	$134,971	$425,816
Computer and electronic product	829	$50,525	$66,977	$219,052
Petroleum and coal	720	$96,205	$690,898	$2,616,800
Electrical equipment	486	$37,359	$42,809	$163,836
Beverage and tobacco product	486	$23,480	$69,068	$422,268
Textiles and apparel	429	$8,816	$14,755	$68,327
Total	**49,428**	**$3,577,868**	**$7,489,970**	**$29,382,385**

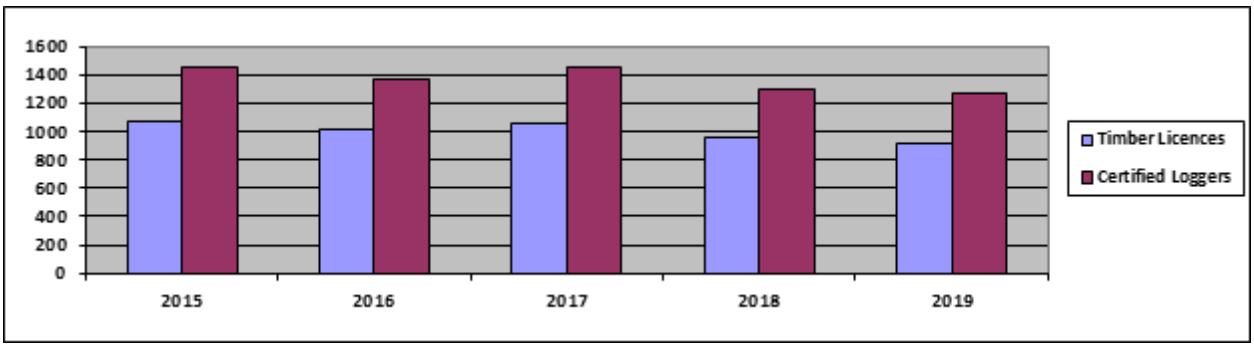
Supplemental State Information

West Virginia has a regulatory approach to forest harvests that allows for the collection of some data which may not be available in other states. Of course, there are always a small number of non-compliant operators who work illegally in the state, so the data is not wholly representative of the numbers, but it does offer a valuable insight into primary production and harvesting of the state's timber resources.

For a company in West Virginia to harvest timber, buy logs for resale, or to buy timber, it must first be licensed to do so with the West Virginia Division of Forestry. Though there was a slight dip in the number of license renewals in 2019 due to the industry turmoil from the trade sanctions with China, the five-year average has been relatively steady at around 1,000 licenses. It is important to note that these are significant reductions from the high point of the industry in and around 2003. The 2008 market collapse resulted in about a 40 percent reduction in nearly every aspect of logging statewide, although the traditional mountain counties retained a larger percentage of the industry than some other areas of the state.

In addition to timber licensing, each harvesting operation must also have a certified logger present on all active logging sites within the state. This logger must be trained and certified by the West Virginia Division of Forestry as well. The number of timber licenses and the number of active certified loggers have remained relatively stable, with around 1,000 licenses and approximately 1,300–1,400 certified loggers, with a slight decline last year (Exhibit 16). The decline from pre-2008 industry levels mirrors that of the timber licenses as well.

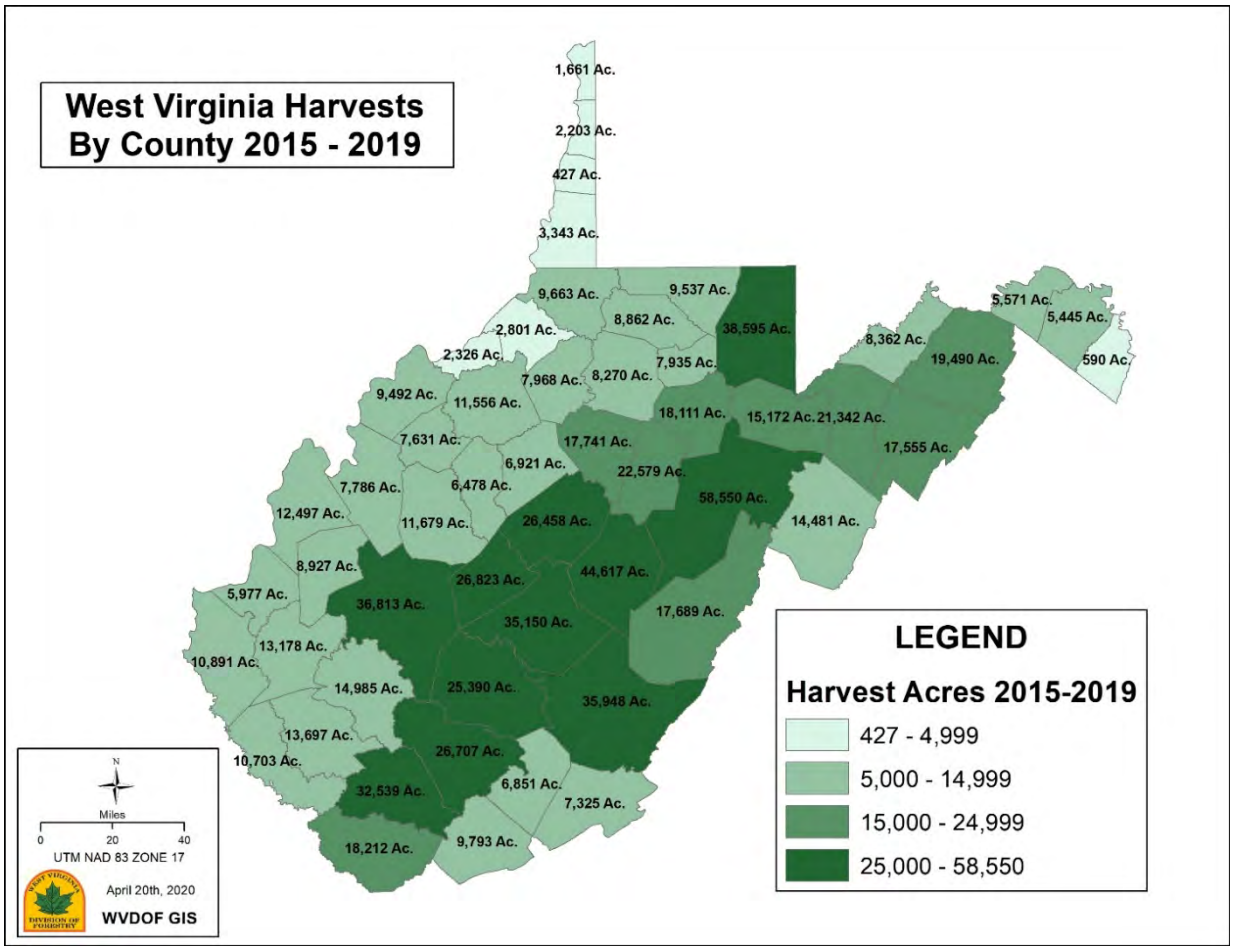
Exhibit 16. Number of Timber Licences and Certified Loggers, 2015–2019



Source: 2019 Logging Sediment Control Act Annual Report

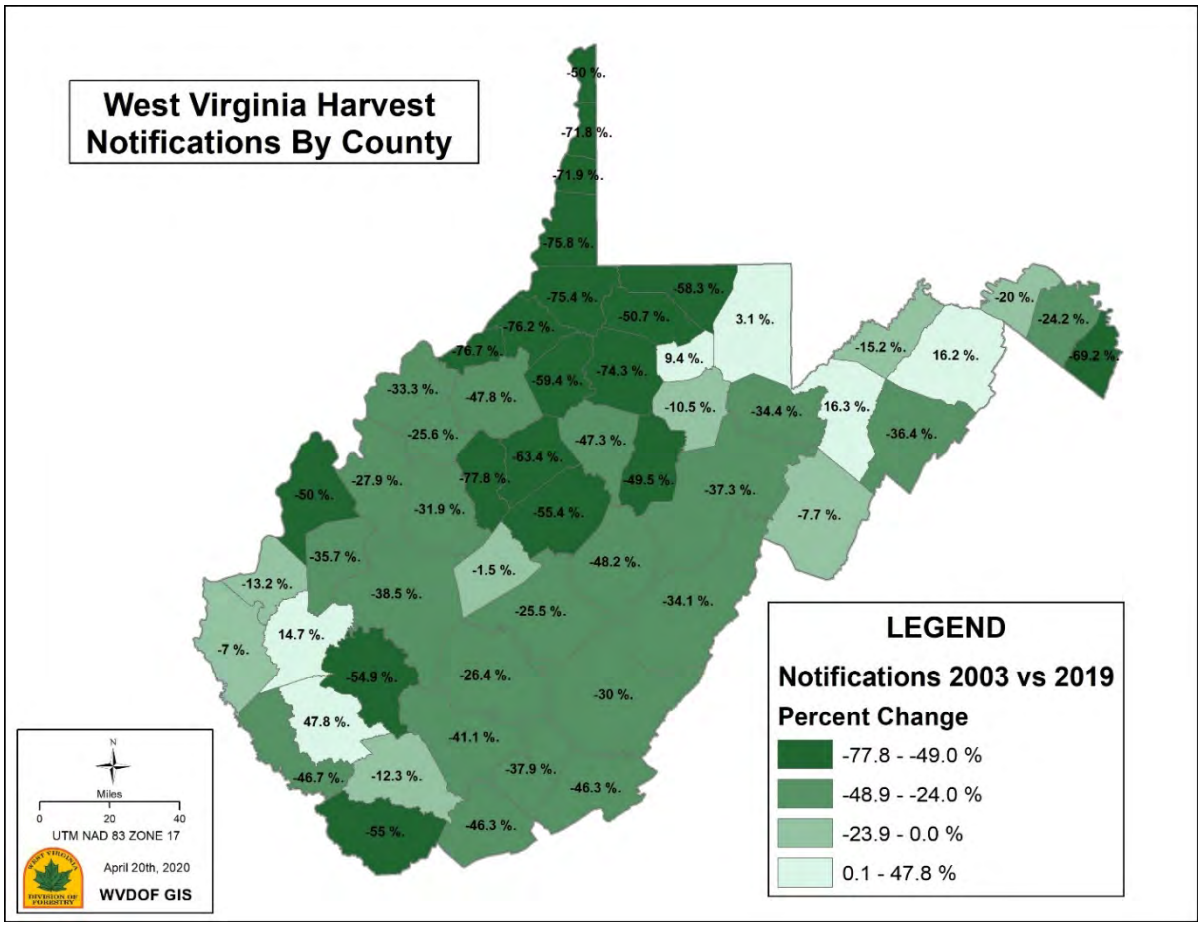
Another segment of data that offers insight into the activity and distribution of the industry across the state is the number of timbering notifications. Each harvesting operation is required to notify the West Virginia Division of Forestry of its activity. The Division uses the notifications primarily for tracking and enforcement purposes, but these also offer interesting insights into recent historical trends in timber production and harvest. In recent years, this number of registered operations has been holding relatively steady at 2,000 per year, but as with the numbers of timber licenses and certified loggers, this represents a significant decline from over 3,000 operations in 2003 during the peak of logging activity (Exhibit 18). The data also show the distribution of the forest products industries across the state, as most processing facilities are located near the logging sites due to the limiting factor of transportation cost.

Exhibit 17. Harvest Acres in West Virginia by County, 2015–2019



Source: West Virginia Division of Forestry

Exhibit 18. Percentage Change in Harvest Notifications in West Virginia, 2003–2019



Source: West Virginia Division of Forestry

Supplemental Economic Contribution Information

The report by Gibson, Leefers, and Poudel provides a detailed discussion of which sectors were included and excluded from this analysis (2020). Most economic data used in this report were derived from IMPLAN, with one notable exception.

For most of the partial sectors (Appendix B), ratios of published government data were used to identify a portion of the industry that would be treated as forest products. In cases where only part of an IMPLAN sector was associated with forest products, analysts faced three options. The most conservative option was to include only sectors viewed as 100 percent in forest products, excluding sectors where only part produced forest products. At the other end of the spectrum, analysts could have focused on sectors producing any forest products at all, even if the forest products represented a small part of total output. Between these extremes, analysts could choose a third option—selecting the portion of a sector

that produced forest products and include only that portion, mindful to include a means for assessing the magnitude of that portion. That is the approach used in this report.

Wood is used in many other products not covered by the 25 sectors highlighted in this report. For example, boats, blinds, musical instruments, burial caskets, organic chemicals, and pharmaceuticals may use wood directly or as an extract. However, the wood-only component of these product groups is difficult to quantify and was unable to be included in this report. Surveys could be designed and conducted to determine the forest products component of these sectors. In practice, the production functions, employment, output, and other metrics would need to be compiled and inserted into IMPLAN.

Summary

Over the last 20 years, individual states located in the midwestern and northeastern area of the United States have conducted statewide economic contributions studies of the forest products industries. However, these studies differed in approach, data used, and measures reported. Developing a consistent approach required funding that spanned multiple states. The Forest Markets & Utilization Committee of the Northeast—Midwest State Foresters Alliance (NMSFA) secured grant funds through the Landscape Scale Restoration Program within the U.S. Forest Service, Eastern Region, State and Private Forestry to support investigation of the economic contributions of the forest products industry in the 20 northeastern and midwestern states and Nebraska. To that end, the Michigan Department of Natural Resources Forest Resources Division (serving as the lead on the grant project) contracted with Public Sector Consultants to facilitate discussions among the project partner states and to reach consensus on an appropriate analysis methodology and report template for both the regional and state reports, in addition to conducting the analysis.

This report serves as a snapshot of economic contributions of the forest products industries in West Virginia for 2017, as well as a baseline report for future analyses. State data were used in this report, but given IMPLAN's structure, substate and multistate analyses can be developed. However, future analyses may again require funding from the U.S. Forest Service or other institutions for assessments across multiple states. Methods used in developing this report are consistent across the region. There were 10,108 direct jobs in the forest products industries, and overall, 17,171 jobs were supported. Direct labor income was $520.2 million with total labor income at $853.1 million. Direct value-added was $747.0 million, and the total contribution for value-added was $1.3 billion. Finally, direct output was $2.2 billion with a **total contribution of $3.2 billion in output**. Similar report findings are available from other states in the region and are summarized in a regional report.

References

Allred, Shorna. 2009. "Logging Firm Succession and Retention." *Forest Products Journal* 59(6): 31–26.

Conrad IV, Joseph, W. Dale Greene, and Patrick Hiesl. 2018. "A Review of Changes in US Logging Businesses 1980s–Present." *Journal of Forestry* 116(3): 291–303.

McGill, Jeremy. 2020. "2019 Logging Sediment Control Act Annual Report." Charleston: West Virginia Division of Forestry. Accessed June 4, 2020. http://wvlegislature.gov/legisdocs/reports/agency/F03_CY_2019_14581.pdf

Morin, Randall S. 2018. "Forests of West Virginia, 2017." Resource Update FS-174. Newtown Square, PA: United States Department of Agriculture, Forest Service, Northern Research Station. https://doi.org/10.2737/FS-RU-174

Parajuli, Rajan, James Henderson, Shaun Tanger, Omkar Joshi, and Ram Dahal. 2018. "Economic Contribution Analysis of the Forest-product Industry: A Comparison of the Two Methods for Multisector Contribution Analysis Using IMPLAN." *Journal of Forestry* 116(6): 513–519. https://doi.org/10.1093/jofore/fvy047

Gibson, Melissa, Larry Leefers, and Jagdish Poudel. 2020. *Forest Products Industry Regional Economic Analysis: Methods.* Lansing: Public Sector Consultants.

United States Department of Agriculture Forest Service. 2019. "Forest Inventory EVALIDator." *United States Department of Agriculture Forest Service Forest Inventory and Analysis Program.* Accessed October 22, 2019. http://apps.fs.usda.gov/Evalidator/evalidator.jsp

Watson, Philip, Joshua Wilson, Dawn Thilmany, and Susan Winter. 2007. "Determining Economic Contributions and Impacts: What Is the Difference and Why Do We Care?" *The Journal of Regional Analysis & Policy* 37(2): 1–15. Accessed March 12, 2020. https://www.researchgate.net/publication/280717869_Determining_Economic_Contributions_and_Impacts_What_is_the_difference_and_why_do_we_care

Appendix A: Methods and Data

Input-Output Analysis: IMPLAN

Several key decisions related to methods were developed through a consensus process (Gibson, Leefers, and Poudel 2020). The project team, in consultation with the states, made consensus decisions regarding the modeling method for estimating economic contributions, the forest products sectors to include in analysis (either in total or in part), the IMPLAN year for reporting results, and the use of an analysis spreadsheet for consistent reporting.

The economic contributions of the region and each state's forest products industries relied on 2017 IMPLAN software and data. IMPLAN is a widely used economic IO model that focuses on interdependence among various producing and consuming sectors in the economy. IMPLAN has 536 industry sectors for the 2017 data set and is based on the NAICS. IMPLAN data are compiled and linked by the IMPLAN software (Version 3.1.1001.12); data come from various government agencies, including the U.S. Census Bureau, the U.S. Bureau of Labor Statistics, and the U.S. Bureau of Economic Analysis. Economic measures in IMPLAN include employment, labor income, value-added, output, and others. More detailed information on data sources is available at the IMPLAN website.

Wassily Leontief developed IO modeling in the mid-20th century. Impact analysis examines the effects of changes in demand in a regional economy, while contribution analysis can evaluate the role of several related sectors in a region. IMPLAN provides the software and data to conduct such analyses. Each sector has a production function tracing the backward linkages (i.e., suppliers) to other sectors. Various sectors produce commodities (e.g., the logging sector produces logs). Leakages (e.g., foreign and domestic imports/exports) to and from other regions are also modeled. Social accounting flows among industries, households, government, and capital are included in IMPLAN.

The analysis process begins with creating an IMPLAN model. One or more geographic areas (e.g., counties or states) are selected as the region. Then, models are run through the creation of multipliers. This report uses Social Accounting Matrix (SAM) multipliers. Next, activities are selected to estimate either economic impacts or contributions. For example, analysts can estimate the impacts of expanding or contracting industries. In the case of contribution analysis, it is important to ensure that the level of production does not exceed the actual level of production in the region. Contribution analysis essentially counters the effects of the multipliers.

Contributions can be in terms of value-added, output, employment, and/or labor income. Value-added is commonly used to describe an industry's economic contributions and is a conservative measure of these contributions. Value-added is the difference between an industry's output, and the costs of intermediate inputs. When a sawmill sells a board, the value of the log and other inputs is not counted in value-added because they were counted when produced by loggers and others. Thus, only new additions to value (e.g., labor income) are included. Labor income is the major component of value-

added and includes employee compensation and proprietor income. Value-added, summed across all sectors, is equal to GSP.

Another measure of economic contribution is industry output. For example, if a log is sold to a sawmill that sells boards, both sales are counted as part of the overall region's output, as they are important economic activities. Another measure, employment, includes both full- and part-time jobs. As the number of sectors in an analysis increases, there can be overlap in the number of part-time jobs across sectors.

Methods

IMPLAN estimates economic impacts (i.e., effects of economic changes) and contributions (i.e., effects of existing industries). Two methods for multisector economic contribution analysis are available (Parajuli et al., 2018), both requiring significant data manipulation.

The first method customizes the IMPLAN model by changing selected endogenous tables, whereas the second method adjusts input values based on matrix inversion prior to analysis. In method one, the changes are internal to IMPLAN and difficult to monitor from a quality control perspective.

Method two relies mostly on spreadsheet-based manipulation and is easier to monitor. When the contribution analysis is completed, direct effects from the IMPLAN sectors of interest equal the amounts shown in IMPLAN's "Industry Detail" table, and the total contributions (direct plus indirect plus induced) are estimated. Both methods prevent over reporting of total effects, which can occur if standard economic impact analysis is used when contribution analysis results are desired.

IMPLAN was designed for economic impact analysis. Multipliers ensure that the ripple effect manifests across the economy. A portion of those effects often involve self-purchases within the sector of interest. That is, if the output from the logging sector is $1 million in a local economy, the economic impact of $1 million in sales would be greater than that amount due to self-purchases. The contribution methods are designed to yield the $1 million direct contribution and its associated effects. Put simply, the amount of sales (direct contribution) estimated cannot exceed the amount that actually exists. Methods one and two accomplish this.

The matrix inversion approach relies on developing a detailed social accounting matrix (SAM) output multipliers for each sector in the forest products industries. Hence, a 32x32 matrix is developed with the diagonal yielding a value close to 1.0 for the detailed multipliers relating each row-column sector to itself (e.g., logging to logging, sawmills to sawmills, etc.). The actual matrix can be developed in several ways. For example, the SAM matrix can be exported from IMPLAN and narrowed down to the appropriate row and columns for the forest products industries. Then, it can be used to develop detailed multipliers via matrix inversion. Alternatively, detailed multipliers can be exported and rearranged into a 32x32 matrix. The approach used in this report was to rely on a matrix developed by IMPLAN staff for

the state. Then, the matrix was inverted and multiplied the initial IMPLAN output values for forest industries sectors to yield inputs for IMPLAN analysis.

Appendix B: Forest Products Industries Groupings and IMPLAN Sectors

Exhibit B1. Forestry Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
10	Maple syrup production*
15	Forestry, forest products, and timber tract production
19	Support activities for forestry*

Note: Sectors with an "*" indicate that only a portion of the sector is included in the forest products industries.

Exhibit B2. Logging Industry Grouping and IMPLAN Sector

IMPLAN Sector	Sector Name
16	Commercial logging

Exhibit B3. Primary Solid Wood Products Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
47	Electric power generation—biomass*
134	Sawmills
135	Wood preservation
136	Veneer and plywood manufacturing
138	Reconstituted wood product manufacturing

Note: Sectors with an "*" indicate that only a portion of the sector is included in the forest products industries.

Exhibit B4. Secondary Solid Wood Products Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
137	Engineered wood member and truss manufacturing
139	Wood windows and doors manufacturing
140	Cut stock, resawing lumber, and planing
141	Other millwork, including flooring
142	Wood container and pallet manufacturing
143	Manufactured home (mobile home) manufacturing
144	Prefabricated wood building manufacturing
145	All other miscellaneous wood product manufacturing

Exhibit B5. Wood Furniture Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
368	Wood kitchen cabinet and countertop manufacturing
369	Upholstered household furniture manufacturing
370	Non-upholstered wood household furniture manufacturing
372	Institutional wood furniture manufacturing*
373	Wood office furniture manufacturing
374	Custom architectural woodwork and millwork manufacturing
376	Showcase, partition, shelving, and locker manufacturing*

Note: Sectors with an "*" indicate that only a portion of the sector is included in the forest products industries.

Exhibit B6. Pulp, Paper, and Paperboard Mills Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
146	Pulp mills
147	Paper mills
148	Paperboard mills

Exhibit B7. Secondary Paperboard and Other Paper Products Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
149	Paperboard container manufacturing
150	Paper bag and coated and treated paper manufacturing
151	Stationery product manufacturing
152	Sanitary paper product manufacturing
153	All other converted paper product manufacturing

Appendix C: Detailed Economic Contribution Results

Direct Economic Contribution by IMPLAN Sector

Exhibit C1. Direct Economic Contributions, Forestry Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry, forest products, and timber tract production	26	$2,456	$2,361	$3,043
Support activities for forestry	633	$19,624	$16,850	$19,280
Maple syrup production	42	$0	$82	$330
Subtotal	**701**	**$22,080**	**$19,292**	**$22,653**

Exhibit C2. Direct Economic Contributions, Logging Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Commercial logging	1,919	$135,237	$312,182	$354,327
Subtotal	**1,919**	**$135,237**	**$312,182**	**$354,327**

Exhibit C3. Direct Economic Contributions, Primary Solid Wood Products Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Electric power generation—biomass	-	-	-	-
Sawmills	2,287	$96,466	$109,641	$613,454
Wood preservation	167	$10,271	$19,114	$98,614
Veneer and plywood manufacturing	172	$11,687	$13,159	$49,091
Reconstituted wood product manufacturing	210	$19,157	$29,370	$117,762
Subtotal	**2,836**	**$137,582**	**$171,284**	**$878,920**

Exhibit C4. Direct Economic Contributions, Secondary Solid Wood Products Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Engineered wood member and truss manufacturing	491	$31,559	$33,486	$112,432
Wood windows and doors manufacturing	100	$5,331	$6,530	$22,325
Cut stock, resawing lumber, and planing	96	$4,015	$5,722	$21,303
Other millwork, including flooring	1,213	$58,380	$76,655	$246,286
Wood container and pallet manufacturing	315	$10,387	$12,060	$44,127
Manufactured home (mobile home) manufacturing	-	-	-	-
Prefabricated wood building manufacturing	39	$1,337	$1,456	$5,850
All other miscellaneous wood product manufacturing	358	$13,587	$16,929	$60,338
Subtotal	**2,613**	**$124,595**	**$152,837**	**$512,662**

Exhibit 16. Direct Economic Contributions, Wood Furniture Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Wood kitchen cabinet and countertop manufacturing	1,169	$52,700	$40,176	$145,795
Upholstered household furniture manufacturing	-	-	-	-
Non-upholstered wood household furniture manufacturing	239	$9,080	$4,816	$22,983
Institutional wood furniture manufacturing	48	$2,470	$1,756	$7,861
Wood office furniture manufacturing	-	-	-	-
Custom architectural woodwork and millwork manufacturing	65	$3,623	$2,698	$8,861
Showcase, partition, shelving, and locker manufacturing	6	$105	$76	$834
Subtotal	**1,527**	**$67,978**	**$49,522**	**$186,335**

Exhibit 17. Direct Economic Contributions, Pulp, Paper, and Paperboard Mills Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Pulp mills	148	$10,584	$13,161	$89,237
Paper mills	-	-	-	-
Paperboard mills	84	$5,911	$8,281	$61,511
Subtotal	**232**	**$16,495**	**$21,442**	**$150,748**

Exhibit C7. Direct Economic Contributions, Secondary Paperboard and Other Paper Products Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Paperboard container manufacturing	71	$4,374	$5,361	$31,174
Paper bag and coated and treated paper manufacturing	105	$6,319	$8,072	$42,713
Stationery product manufacturing	105	$5,569	$7,035	$35,440
Sanitary paper product manufacturing	-	-	-	-
All other converted paper product manufacturing	-	-	-	-
Subtotal	**281**	**$16,263**	**$20,468**	**$109,328**

Note: Value-added in IMPLAN is equivalent to gross state product.

U.S. Forest Service Non-discrimination Statement

“In accordance with Federal law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, disability, and reprisal or retaliation for prior civil rights activity. (Not all prohibited bases apply to all programs.)

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible State or local Agency that administers the program or USDA’s TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information is also available in languages other than English.

To file a complaint alleging discrimination, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/ complaint_filing_cust.html, or at any USDA office or write a letter addressed to USDA and provided in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250- 9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov

This institution is an equal opportunity provider.”