Economic Contribution of Timber Harvesting and Manufacturing to North Coast Redwood Region Counties[1]

James E. Henderson,[2] Richard B. Standiford,[3] and Samuel G. Evans[4]

Abstract

The ability to secure local government and public support for redwood timber sustainable redwood forest management can be enhanced by articulating local economic benefits resulting from harvesting and product manufacturing which ripples through the entire economy. Input-output modeling is used to estimate the economic contribution by summing the multiplier effect (i.e., ripple effect) of timber harvesting and manufacturing as measured by employment, wages and salaries, and value added in the local region. The activity and region of interest is redwood region timber harvesting and product manufacturing in California's North Coast counties (Del Norte, Humboldt, Mendocino, and Sonoma).

Input-output modeling and contribution analysis is conducted using IMPLAN software and 2013 data. The analysis examines how the direct effect (e.g., expenditure and employment related to harvesting, biomass, sawmill, and veneer operations) generates indirect effects (i.e., purchases by supporting sectors of the economy) and induced effects (i.e., household spending by direct effect and indirect effect employees) that result in a total effect or cumulative benefit to the local economy. Thus, the true economic benefit is greater than the value of timber harvesting and manufacturing alone as the multiplier effect of these activities impact many other sectors of the economy. This information can be used to communicate the economic benefit to North Coast counties that results from continued support of redwood region timber harvesting and product manufacturing.

Keywords: economic benefits, IMPLAN, multiplier effect, public policy, timber harvesting

Introduction

Timber harvesting and forest products manufacturing are part of the economic base for California's North Coast counties of Del Norte, Humboldt, Mendocino, and Sonoma. The predominant species harvested are coast redwood (*Sequoia sempervirens* (D.Don) Endl.) and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). Those involved in the forest products industry are intuitively aware that timber harvesting and associated manufacturing are "important" to the local economy; however, advocates of forestry need precise estimates of that economic importance when attempting to communicate the importance of forestry with policy makers, government officials, and the public. Input-output analysis can be used to quantify the economic importance of any sector of the economy by tracking the multiplier effect, which indicates how spending in one sector of the economy stimulates spending in other sectors. This study uses input-output analysis to provide an estimate of the economic importance or contribution that redwood timber harvesting and manufacturing has to the regional economy by quantifying the multiplier effect of this sector in terms of sales (total output), value added, employment, and wages and salaries. The economic contribution analysis was done using IMpact Analysis for PLANning (IMPLAN) economic impact assessment software originally developed by the U.S. Department of Agriculture, Forest Service and now maintained by IMPLAN LLC., formerly Minnesota IMPLAN Group (MIG) (MIG 2004). The forestry-related sectors (e.g., logging, wood energy, solid wood manufacturing, wood furniture manufacturing, etc.), as described

---

in the IMPLAN study area data, represent the direct effects (e.g., jobs and value of production in the forestry and forest products manufacturing sector) which is the starting point of the analysis.

The activity of the forestry sector (i.e., purchasing inputs such as utilities, parts, etc. and labor) generates a multiplier effect creating indirect effects (e.g., supporting sectors purchase more inputs to meet demand which supports jobs in other sectors of the economy as a result of forestry-related sector activity) and induced effects (e.g., purchases in other sectors benefiting from household spending by direct and indirect employees). The induced effect also includes inter-institutional transactions, such as transfers from businesses to households (e.g., interest and dividend payments), transfers from people to government (e.g., payment of taxes), and transfers from governments to people (e.g., social security) (MIG 2004). Impacts are generated by calculated multipliers and economic impacts are estimated in terms of direct, indirect, and induced impacts. These sum to a total effect which provides an estimate of the full economic contribution or importance of the redwood region forestry and forest products manufacturing sector to the regional economy. The reported metrics of the economic contribution analysis include sales (total output), value added, employment, and wages and salaries. Total industry output refers to total value of production. Value added, which is akin to Gross Domestic Product, is the sum of payments made by industry to workers, interest, profits and indirect business taxes. Employment refers to the total number of full-and part-time jobs which is calculated based on average output per employee; therefore, this is total employment needed to support any industry and is a combination of both full and part-time jobs. Wages and salaries represents all forms of employment income and is the sum of employee compensation and proprietor income indicated in the I-O model (MIG 2004).

Forestry and associated manufacturing sectors are important to regional economies that have abundant forest resources and forestry is one of the major contributors to employment in rural America (Alvarez 2007). Globally the forest products industry contributed to over 1.1 percent of gross domestic product (GDP) and 1.2 percent in total employment opportunities to the global economy in 2014 (FAO 2014). In 2012 there were approximately 52,200 workers, earning $3.3 billion annually, employed in the California forestry and forest products industry which included primary and secondary wood and paper products, private sector forestry and logging, and forestry sup-port activities (McIver et al. 2015). Given the importance of the forest products industry, numerous studies have been conducted in the United States at the regional and/or state level, with some regularity (Abt et al. 2002, Aruna et al. 1997, Brandeis et al. 2012, Dahal et al. 2012, Dahal et al. 2015, Deckard and Skurla 2011, Hodges et al. 2005, Joshi et al. 2014, McConnell et al. 2016, Laaksonen-Craig et al. 2003, Li and Carraway 2009, Tilley and Munn 2007, Young et al. 2007). Similar but few studies have also examined the economic importance of forestry at the county level (Henderson and Munn 2013, Jackson 2015, Jeuck et al. 2014). Economic impact assessments of redwood region timber harvesting to California's North Coast are occasionally conducted particularly in consideration of policy actions with major timber harvesting reductions (Agee 1980, Berck et al. 2000, Burton and Alpert 1981, Clatterbuck 2007, Fowler 1974, McKillop 1977, Stewart 2007, Vaux 1973) to better understand potential impacts to regional employment and income as well as impacts on government revenue (McKillop 1978).

Methods

Economic contribution of the redwood region forest products industry was estimated using IMPLAN, a non-survey-based computer software and modeling system that constructs regional economic accounts and regional input-output tables. Economic contribution analysis utilizes input-output (I-O) models to track the multiplier effect of an existing sector or group of sectors to a defined economy (i.e., national, state, or county level). IMPLAN can be used to construct I-O models that are used to depict economic benefits of contributions by specific industries or activities to a specified economy. I-O multipliers describe the response of an economy to some stimulus (i.e., a change in demand or production). The stimulus for this analysis is the total output and employment of redwood timber

harvesting and associated forest products manufacturing. IMPLAN models the multiplier effect or interconnections between industries, households and the government and tracks the flow of money from sector to sector. The Minnesota IMPLAN Group began developing IMPLAN databases since 1987 (MIG 2004) and provides yearly IMPLAN data and software. IMPLAN is now used in various fields to estimate impacts of economic activities for specified economies (e.g., county, state, nation). The forestry-related sectors in the IMPLAN study area data represent the direct effects (e.g., forestry jobs and value of production), which purchase goods and services from other sectors of the economy. These other producers, in turn, purchase goods and services to meet the demand of the direct effect. These indirect purchases or indirect effects continue until leakages from the economy (imports, wages, profits, etc.) end the cycle. The indirect effects and the effects of increased household spending (induced effects) can be mathematically calculated from model multipliers derived using the Leontief inverse (Leontief 1986). The resulting sets of multipliers describe the change of output for each industry caused by a change in final demand for any given industry. (MIG 2004).

Direct effect data on total output or sales for timber harvesting and related manufacturing were analyzed using IMPLAN V3.0 software which incorporates a 536-sector input-output transaction table based on North American Industrial Classification System (NAICS). Input-output models were constructed for each of California's North Coast counties and the combined four county region to examine direct effects and generate associated Social Accounting Matrix (SAM) multipliers. This type of multiplier accounts for household spending, social security and income tax leakage, institution savings, and commuting. It also accounts for inter-institutional transactions (e.g., transfers from businesses to households (interest and dividend payments), transfers from people to government (payment of taxes), and transfers from governments to people (social security, unemployment compensation among others) all result in an induced effect. These can be summed into a total effect, which is an estimate of the greater value or importance of the forestry and forest products industry to an economy. The four North Coast counties include Del Norte, Humboldt, Mendocino, and Sonoma. Forest-related industries were aggregated into three broad primary sectors: logging, lumber and wood products, and wood energy (table 1).

Table 1—Forestry products industry aggregated sector scheme and source IMPLAN sectors and description of each included in the four aggregated sectors indicating the corresponding NAICS sector classification (Note not all sectors exist in each county)

Sector aggregation	IMPLAN Sector	IMPLAN description	NAICS 2012
Forestry and logging	15	Forestry, forest products, and timber tract production	1131-2
	16	Commercial logging	1133
Wood biomass	47	Electric power generation - Biomass	221117
	134	Sawmills	321113
	135	Wood preservation	321114
	136	Veneer and plywood manufacturing	321211-2
	137	Engineered wood member and truss manufacturing	321213-4
	138	Reconstituted wood product manufacturing	321219
Solid wood	139	Wood windows and door manufacturing	321911
	140	Cut stock, resawing lumber, and planing	321912
	141	Other millwork, including flooring	321918
	142	Wood container and pallet manufacturing	32192
	144	Prefabricated wood building manufacturing	321992
	145	All other miscellaneous wood product manufacturing	321999
	368	Wood kitchen cabinet and countertop manufacturing	33711
	369	Upholstered household furniture manufacturing	337121
	370	Non-upholstered wood household furniture manufacturing	337122
Wood furniture	373	Wood office furniture manufacturing	337211
	374	Custom architectural woodwork and millwork	337212
	376	Showcase, partition, shelving, and locker manufacturing	337215

When more precise data is available, the IMPLAN study area values should be adjusted when possible. For this analysis the value of the logging (IMPLAN sector 16) was adjusted to reflect timber harvest values by county as reported by the California State Board of Equalization (2015).

Employment, wages and salaries, total output, value added and associated SAM multipliers were derived for each of forestry-related sectors. The 2013 data were used to examine the economic contribution of the North Coast's redwood forest products industry; economic contributions were measured in nominal values and reported in nominal dollars. Economic contribution analysis, not to be confused with economic impact analysis, examines the gross change in a region's existing economy that can be attributed to a given industry (e.g., redwood forest products industry) while economic impact analysis is used to examine net changes to the economic base of a region that can be attributed new revenues that otherwise would not occur (e.g., a new sawmill) (Watson et al. 2007).

This study examines the economic importance of the existing industry and is thus an economic contribution analysis. The direct effect will include the value of production and jobs for all redwood timber harvesting and forest products manufacturing sectors. The value of these sectors will be used to shock the input-output model to generate a multiplier effect to estimate the resulting indirect and induced effects. These will be summed to provide an estimate of the total effect of the industry to the regional economy. The economic contribution analysis was conducted for each of the four North Coast counties and for one regional model comprising the four counties.

Results

The study area data includes all sectors of the four county North Coast region economy and are presented in table 2. The forest products sector directly accounts for over 3,665 full- and part-time jobs with wages and salaries amounting to over $224 million and nearly $790 million in sales with value added in excess of $309 million.

Table 2—Study area data for California's North Coast four county region (Del Norte, Humboldt, Mendocino, and Sonoma) indicating values for sectors of the economy including forestry-related sectors and all other sectors aggregated at the 2 digit NAICS level

	Employment	Labor income ($M)	Output ($M)	Value added ($M)
Forestry and logging	1,316.3	85,282	149,746	92,908
Wood biomass	60.3	9,129	129,477	78,164
Solid wood	1,949.0	109,748	461,101	117,644
Wood furniture	339.6	20,257	49,224	20,707
Subtotal (forest products industry)	3,665.2	224,416	789,548	309,424
11 Ag, forestry, fish & hunting	17,217.7	1,179,511	1,874,007	1,231,859
21 Mining	856.5	81,775	206,868	114,797
22 Utilities	890.7	268,939	397,264	311,743
23 Construction	22,725.1	1,378,507	3,984,745	1,413,004
31-33 Manufacturing	24,593.3	2,714,859	9,580,141	3,101,738
42 Wholesale trade	11,873.3	1,250,485	2,692,315	1,755,887
44-45 Retail trade	43,346.3	1,887,695	3,652,533	2,420,901
48-49 Transportation & warehousing	9,878.5	572,521	1,268,252	599,105
51 Information	5,264.6	1,105,971	2,042,149	1,126,601
52 Finance & insurance	15,672.2	750,360	2,243,112	806,528
53 Real estate & rental	23,571.6	5,266,741	7,712,428	5,812,744
54 Professional- scientific & tech services	29,648.2	1,942,526	3,485,709	1,983,314
55 Management of companies	2,390.7	295,431	516,830	302,245
56 Administrative & waste services	20,299.7	838,260	1,298,809	862,259
61 Educational services	5,526.1	111,515	213,482	119,650
62 Health & social services	51,041.7	2,788,023	4,545,035	2,842,508
71 Arts- entertainment & recreation	11,884.3	353,171	734,706	368,650
72 Accommodation & food services	33,509.9	1,024,245	2,056,624	1,156,588
81 Other services	23,967.8	944,357	1,676,117	1,074,642
92 Government & non NAICS	50,687.4	4,315,910	5,304,670	4,246,492
Subtotal (rest of region economy)	404,845.7	29,070,803	55,485,797	31,651,253
Total economy	408,510.9	29,295,219	56,275,345	31,960,677

Monetary values in 2013 dollars and expressed in thousands ($M).

The study area data values for the forest products industry (table 2) indicated in the table row titled Subtotal Forest Products Industry represent the direct effect for the contribution analysis. This direct effect generates a multiplier effect resulting in indirect and induced effects on all other sectors of the economy (table 3). The economic contribution (i.e., total effect or the sum of the direct, indirect, and induced effects) of the forest products industry to the four county North Coast economy amounts to a $1.57 billion industry generating $787.9 million in value added and 10,073 full- and part-time jobs with wages and salaries of $517.3 million. Sectors of the economy that benefit most include construction, wholesale and retail trade, real estate, professional services, health services, and

government, with each realizing an additional $50 to $110 million in output because of the forest products industry (table 3).

Table 3—North Coast (Del Norte, Humboldt, Mendocino, and Sonoma) forest products industry's economic contribution indicating direct effect values for forestry-related sectors and resulting indirect and induced effects on all other sectors aggregated at the 2 digit NAICS level (The total effect is indicated along with the total county economy size, the total effect expressed as a percentage of the total county economy, and the multiplier value of the forest products industry)

	Employment	Labor income ($M)	Output ($M)	Value added ($M)
Forestry and logging	1,316.3	85,282	149,746	92,908
Wood biomass	60.3	9,129	129,477	78,164
Solid wood	1,949.0	109,748	461,101	117,644
Wood furniture	339.6	20,257	49,224	20,707
Subtotal (direct effect)	3,665.2	224,416	789,548	309,424
11 Ag, forestry, fish & hunting	147.5	6,048	11,296	7,833
21 Mining	7.6	300	1,822	1,017
22 Utilities	5.6	723	2,981	2,009
23 Construction	341.2	20,434	59,771	21,176
31-33 Manufacturing	34.7	2,250	14,410	3,641
42 Wholesale trade	242.6	16,390	55,013	35,878
44-45 Retail trade	695.3	23,756	58,914	39,019
48-49 Transportation & warehousing	246.1	13,528	32,385	14,750
51 Information	96.5	6,080	37,048	19,651
52 Finance & insurance	284.4	12,297	40,778	15,029
53 Real estate & rental	313.7	5,383	122,710	91,926
54 Professional- scientific & tech services	501.4	23,622	58,946	35,014
55 Management of companies	55.9	5,872	12,090	7,071
56 Administrative & waste services	367.4	11,180	23,482	15,489
61 Educational services	107.4	2,482	4,148	2,328
62 Health & social services	791.8	41,434	69,702	43,559
71 Arts- entertainment & recreation	175.1	3,055	10,483	5,198
72 Accommodation & food services	685.7	16,659	41,722	23,511
81 Other services	427.3	17,620	30,504	19,519
92 Government & non NAICS	880.5	63,806	87,504	74,834
Subtotal (indirect & induced effects)	6,407.7	292,919	775,709	478,453
Total (total effect)	**10,072.9**	**517,335**	**1,565,257**	**787,877**
Total county economy	408,510.9	29,295,219	56,275,345	31,960,677
Total as % of four county region	2.5%	1.8%	2.8%	2.5%
Multiplier	2.75	2.31	1.98	2.55

Monetary values in 2013 dollars and expressed in thousands ($M).

The economic contribution analysis for each of the four individual counties are reported in tables 4 to 7. Del Norte's forest products industry economic contribution amounted to over $9.08 million in sales or output, which was the smallest of the four counties, while Humboldt's economic contribution of forestry-related sectors amounts to nearly $657.4 million in sales and has the highest contribution

value of the North Coast counties. The Sonoma and Mendocino forest product industry generates an economic contribution amounting to $310.2 million and $329.7 million in sales, respectively.

Table 4—Del Norte forest products industry's economic contribution indicating direct effect values for forestry-related sectors and resulting indirect and induced effects on all other sectors (the total effect is indicated along with the total county economy size, the total effect expressed as a percentage of the total county economy, and the multiplier value of the forest products industry)

	Employment	Labor income ($M)	Output ($M)	Value added ($M)
Forestry and logging	25.0	1,252	2,452	1,397
Wood biomass	0.0	0	0	0
Solid wood	10.7	697	3,598	908
Wood furniture	0.0	0	0	0
Subtotal of direct effects	35.7	1,949	6,050	2,305
Indirect & induced effects	24.6	1,079	3,034	1,865
Total (total effect)	60.3	3,028	9,084	4,170
Total county economy	11,232.8	728,040	1,270,078	783,147
Total effect as % of county	0.5%	0.4%	0.7%	0.5%
Multiplier effect	1.69	1.55	1.50	1.81

Monetary values in 2013 dollars and expressed in thousands ($M).

Table 5—Humboldt forest products industry's economic contribution indicating direct effect values for forestry-related sectors and resulting indirect and induced effects on all other sectors aggregated at the 2 digit NAICS level (the total effect is indicated along with the total county economy size, the total effect expressed as a percentage of the total county economy, and the multiplier value of the forest products industry)

	Employment	Labor income ($M)	Output ($M)	Value added ($M)
Forestry and logging	769.1	42,002	79,030	46,462
Wood biomass	60.3	9,129	129,476	78,164
Solid wood	823.8	55,059	212,265	58,000
Wood furniture	65.4	2,703	8,460	2,807
Subtotal of direct effects	1,718.5	108,893	429,232	185,432
Subtotal (indirect & induced effects)	3,320.2	136,234	228,160	376,994
Total (total effect)	5,038.7	245,127	657,393	562,426
Total county economy	68,409.1	4,275,694	8,389,036	4,722,941
Total effect as % of county	7.4%	5.7%	7.8%	11.9%
Multiplier effect	2.93	2.25	1.53	3.03

Monetary values in 2013 dollars and expressed in thousands ($M).

Table 6—Mendocino forest products industry's economic contribution indicating direct effect values for forestry-related sectors and resulting indirect and induced effects on all other sectors (the total effect is indicated along with the total county economy size, the total effect expressed as a percentage of the total county economy, and the multiplier value of the forest products industry)

	Employment	Labor income ($M)	Output ($M)	Value added ($M)
Forestry and logging	394.6	38,409	57,597	40,696
Wood biomass	0.0	0	0	0
Solid wood	566.9	27,080	136,184	30,099
Wood furniture	12.0	474	1,476	492
Subtotal of direct effects	973.4	65,962	195,257	71,287
Subtotal (indirect & induced effects)	1,203.1	44,961	134,427	80,285
Total (total effect)	2,176.5	110,923	329,684	151,572
Total county economy	49,115.6	2,975,548	5,968,931	3,329,705
Total effect as % of county	4.4%	3.7%	5.5%	4.6%
Multiplier effect	2.24	1.68	1.69	2.13

Monetary values in 2013 dollars and expressed in thousands ($M).

Table 7—Sonoma forest products industry's economic contribution indicating direct effect values for forestry-related sectors and resulting indirect and induced effects on all other sectors (the total effect is indicated along with the total county economy size, the total effect expressed as a percentage of the total county economy, and the multiplier value of the forest products industry)

	Employment	Labor income ($M)	Output ($M)	Value added ($M)
Forestry and logging	127.7	3,620	10,667	4,353
Wood biomass	0.0	0	0	0
Solid wood	547.6	26,912	109,053	28,637
Wood furniture	262.3	17,080	39,288	17,409
Subtotal of direct effects	937.5	47,612	159,008	50,399
Subtotal (indirect & induced effects)	1,209.1	57,588	151,270	93,356
Total (total effect)	2,146.6	105,200	310,277	143,756
Total county economy	279,753.4	21,315,935	40,647,298	23,124,884
Total effect as % of county	0.8%	0.5%	0.8%	0.6%
Multiplier effect	2.29	2.21	1.95	2.85

Monetary values in 2013 dollars and expressed in thousands ($M).

Discussion and Conclusion

The economic contribution of the forest products industry differs greatly by county for two reasons. The total effect or contribution value is reflective of the direct effect value (i.e., size of the forest products industry) and the multiplier value (i.e., how the economy responds to spending). For example, Del Norte's direct effect from forestry-related sectors was about $3.6 million in sales or output with an associated output multiplier of only 1.31. Meaning that each $100 in forest products industry output generates another $31 in output form other sectors of the economy. Compare that with

Humboldt's direct effect of over $429 million and an output multiplier of 1.53. Thus, Del Norte's forest products industry has an economic contribution amounting to over $9.08 million output, while Humboldt's economic contribution of forestry-related sectors amounts to over $657 million in sales. Del Notre County, as compared with the other North Coast counties, has a smaller forest products industry and overall economy with fewer local businesses to capture expenditures by forest sector employees. As expected the multiplier effect for output, not surprisingly, is largest for Sonoma at 1.95 and lowest for Del Norte at 1.50. Sonoma realizes the largest multiplier effect and Del Norte the smallest of the 4 counties as each is the largest and smallest, respectively, of the North Coast county economies. This reflects that a larger economy is generally a more diverse economy with more opportunities to respond to changes in final demand rather than loosing input purchase spending as leakages when input purchasing occurs outside of the defined economy.

Humboldt has the largest employment multiplier at 2.93 indicating that each 100 jobs in the forest products sector contributes another 193 jobs in other sectors of the economy. The multiplier effect is larger for the four county North Coast regional economy than any individual county as a larger regional economy captures more potential leakage that would occur in a smaller county economy which cannot respond to all of the input purchases required by the forest products industry and its supporting sectors. As expected, Sonoma realizes some of the largest multiplier effects and Del Norte the smallest. Humboldt's multiplier values are also among the largest which is a reflection of the county having largest and most diversified forest products industry of the four North Coast counties but also an economy that is able to capture more potential leakage. This demonstrates that the Humboldt economy has a comparably greater share of sectors that are supportive of the forest products industry than other North Coast counties, which is to be expected given the size of Humboldt's forest products industry. The magnitude of the economic contribution differs as size of the forest products industry and the overall economy varies greatly across the four North Coast counties. However, the forest products industry makes an important economic contribution to each of the North Coast counties.

Forestry provides numerous economic benefits to local economies (e.g., sales, jobs, income), and the ability to practice forestry depends upon access to publicly maintained infrastructure (i.e., road and bridges) to transport harvested and manufactured forest products. However, the economic benefit that results because of forestry-related harvesting and manufacturing is not always understood or fully appreciated. Having access to periodic assessments of the economic contribution of forestry and forest products manufacturing can empower advocates to better communicate the economic importance of forestry to policy makers, elected officials, and the public. The economic contribution analysis of forestry and forest products manufacturing and associated economic multiplier effects expressed in terms of employment, wages and salaries, value added, and total output to California's North Coast counties of Del Norte, Humboldt, Mendocino, and Sonoma presented here can serve as a powerful aid in effectively communicating the economic importance of the practice of forestry.

Literature Cited

Abt, K.L.; Winter, S.A.; Huggett, R.J., Jr. 2002. Local economic impacts of forests. In: Wear, D.N.; Greis, J.G., eds. Southern forest resource assessment. Gen. Tech. Rep. SRS-53. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 239–267.

Agee, J.K. 1980. Issues and impacts of Redwood National Park expansion. Environmental Management. 4(5): 407–423.

Alvarez, M. 2007. The state of America's forests. Bethesda, MD: Society of American Foresters. 63 p.

Aruna, P.B.; Cubbage, F.W.; Lee, K.J.; Redmond, C. 1997. Regional economic contributions of the forest-based industries in the South. Forest Products Journal. 47(7/8):35–45.

Berck, P.; Costello, C.; Fortmann, L.; Hoffmann, S. 2000. Poverty and employment in timber-dependent counties. Discussion paper No. 00-52. Washington, DC: Resources for the Future. http://www.rff.org/documents/RFF-DP-00-52.pdf. (20 January 2017).

Brandeis, T.J.; Hartsell, A.J.; Bentley, J.W.; Brandeis, C. 2012. Economics dynamics of forests and forest industries in the southern United States. Gen. Tech. Rep. SRS-152. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 77 p.

Burton, D.J.; Alpert, I. 1981. The decline of California's North Coast redwood region. Policy Studies Journal. 10(2): 272–284.

California State Board of Equalization. 2015. California timber harvest by county, 2015. http://www.boe.ca.gov/proptaxes/pdf/ytr36_2015.pdf. (20 January 2017).

Clatterbuck, C.L. 2007. The effect of the roadless area conservation rule on timber employment. Durham, NC: Duke University. 35 p. MEM degree project.

Dahal, R.P.; Henderson, J.E.; Munn, I.A. 2015. Forest products industry size and economic multipliers in the US South. Forest Products Journal. 65(7/8): 372–380.

Dahal, R.P.; Munn, I.A.; Henderson, J.E. 2012. The impact of the forest and forest products industry on the Mississippi economy - an input-output analysis. Res. Bull. FO 438. Mississippi State University, MS: Forest and Wildlife Research Center. 22 p.

Deckard, C.L.; Skurla, J.A. 2011. Economic contribution of Minnesota's forest products industry. . St. Paul, MN: Minnesota Department of Natural Resources, Division of Forestry. 18 p.

Food and Agriculture Organization [FAO]. 2014. State of the world's forests, 2014. Rome: UN Food and Agriculture Organization. 142 p.

Fowler, K.S. 1974. Impacts of projected timber harvests in Humboldt County. Berkeley: University of California. Berkeley. 110 p. Ph.D. dissertation.

Henderson, J.E.; Munn, I.A. 2013. Economic importance of forestry and forest products to Mississippi counties: a publication series to help the forestry community educate local government officials and the public. Journal of Forestry. 111(6): 388–394.

Hodges, A.W.; Mulkey, W.D.; Alavalapati, J.R.; Carter, D.R.: Kiker, F.F. 2005. Economic impacts of the forest industry in Florida, 2003. Final report to the Florida Forestry Association. Gainsville, FL: The University of Florida, Institute of Food and Agricultural Sciences. 47 p.

Jackson, B. 2015. Economic contribution of forestry and forest products in Baldwin County, Georgia. Pub. No. WSFNR-15-30. Athens, GA: University of Georgia.

Jeuck, J.; Bardon, R.; Hazel, D.; Sugerik, C. 2014. Forestry impacts series. North Carolina University, Extension Forestry. https://forestry.ces.ncsu.edu/economic-impact-data/. (19 January 2017).

Joshi, O.; Edgar, C.; Zehnder, R.; Carraway, B. 2014. Economic impact of the Texas forest sector, 2012. College Station, TX: Texas A&M Forest Service. 12 p.

Laaksonen-Craig, S.; Goldman, G.E.; McKillop, W. 2003. Forestry, forest industry, and forest products consumption in California. Publication 8070. Davis, CA: University of California, Division of Agriculture and Natural Resources.

Leontief, W.W. 1986. Input-output economics. 2nd ed. Oxford: Oxford University Press.

Li, Y.; Carraway, B. 2009. Economic impact of the Texas forest sector, 2007. College Station, TX: Texas Forest Service. 12 p.

McConnell, E.; Jeuck, J.; Bardon, R.; Hazel, D.; New, B.; Altizer, C. 2016. North Carolina's forest and forest products industry by the numbers. Forestry impacts series. Raleigh, NC: North Carolina University Extension Forestry. http://content.ces.ncsu.edu/north-carolinas-forest-and-forest-products-industry-by-the-numbers. (19 January 2017).

McIver, C.P.; Meek, J.P.; Scudder, M.G.; Sorenson, C.B.; Morgan, T.A.; Christensen, G.A. 2015. California's forest products industry and timber harvest, 2012. Gen. Tech. Rep. PNW-GTR-908. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 49 p.

McKillop, W. 1977. Economic losses associated with reduction in timber output due to expansion of the Redwood National Park. Sacramento, CA: Department of Forestry and Conservation, University of California.

McKillop, W. 1978. Economic costs of withdrawing timber and timberland from commercial production. Journal of Forestry. 76(7): 414–417.

Minnesota IMPLAN Group [MIG]. 2004. IMPLAN professional: user's guide, analysis guide, data guide. Stillwater, MN: Minnesota IMPLAN Group, Inc. 409 p.

Stewart, W. 2007. The new economies of the redwood region in the 21st Century. Gen. Tech. Rep. PSW-GTR-194. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 393–401.

Tilley, B.K.; Munn, I.A. 2007. 2001 economic impacts of the forest products industry in the South. Southern Journal of Applied Forestry. 31(4): 181–186.

Vaux, H. 1973. Socioeconomic impact data for Redwood National Park: a report to the Denver Service Center of the National Park Service. University of California, Berkeley, School of Forestry.

Watson, P.; Wilson, J.; Thilmany, D.; Winter, S. 2007. Determining economic contributions and impacts: what is the difference and why do we care. Journal of Regional Analysis and Policy. 37(2): 140–146.

Young, T.M.; Hodges, D.G.; Rials, T.G. 2007. The forest products economy of Tennessee. Forest Products Journal. 57(4): 12–19.