

# The Economic Contribution of Natural Resources to a State Economy: A South Carolina Case Study

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## Abstract

The structure of state or sub-state regional economies is heavily influenced by its natural resource endowment. Input-output analysis is often used to estimate the economic contribution of various sectors to a state's economy. We apply input-output analysis to South Carolina's economy to estimate the contribution of natural resource-based sectors to the overall economy. The natural resource-based sectors consist of six mutually exclusive sectors: fishing, hunting, and wildlife viewing; coastal tourism; commercial fisheries; boat industry; mining; and forestry. The total economic contribution of these six natural resource-based sectors is \$33.4 billion, representing 8.3% of gross state product and 8.6% of all state employment.

## Keywords

Natural Resources, South Carolina, Input-Output Analysis, Economic Contribution

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## 1. Introduction

The level of regional economic activity and relative importance of specific industrial sectors within a region are heavily influenced by its natural resource endowment. South Carolina is a state with abundant natural resources distributed over an area of nearly 8.3 million ha. (94% is land and 6% is water bodies) [1]. Natural resources are raw materials extracted from the earth that provide the basic inputs for many economic sectors. This study estimates the economic contribution of both biological and physical natural resources to South Carolina's economy. However, instead of using broad definition of natural resource-based economic activity that includes much of the state's economy (for example, agribusiness is directly tied to the land), our emphasis is on the traditional natural

resource-based activities such as outdoor recreation (hunting, fishing, and wildlife watching), nature-based tourism, forestry, mining, boat manufacturing, and commercial fishing. This definition of natural resource-based industry was used in a prior study that evaluated the state's natural resource economy [2].

Outdoor recreation is a significant natural resource-based economic activity, and includes bicycling, camping, fishing, hunting, motorcycling, off-roading, snow sports, trail sports, water sports, and wildlife-viewing. Over half of all South Carolinians annually participate in outdoor recreation [3]. Outdoor recreation opportunities are provided by the state's four major river basins and 19 reservoirs larger than 400 ha. The Chattooga National Wild and Scenic River is shared with Georgia and North Carolina, and nine river segments in the state have been designated State Scenic Rivers [4]. South Carolina has 47 state parks [5], one national park [6], five state forests [7], two national forests [8], 445,000 ha of wildlife management areas [9], eight national wildlife refuges [10], and nearly 5000 km of trails [11].

Fishing, hunting, and wildlife-watching are significant sources of economic activity and approximately 1.7 million individuals annually participant in these wildlife-related recreational activities [12]. The individuals consist of South Carolina residents and nonresidents [12]. In 2011, 744,000 individuals fished, 254,000 hunted, and 1.1 million wildlife-watched (some participated in more than one activity). Total participation days in these wildlife-based activities were: 11.2 million days spent fishing, 4.4 million days spent hunting, and 4.3 million days spent wildlife-watching (away from home). The expenditures made by individuals pursuing these activities have a significant economic impact on state-wide economic activity. Average expenditures per angler were \$910, per hunter were \$1933, and per wildlife watcher were \$413 [12].

Forest lands dominate the state landscape and provide valuable resource inputs to the state's forest related manufacturing industries. Forests are renewable resources that contribute to the growth of the state, while providing its citizens desirable aesthetic, recreational, wildlife, water quality, and environmental values. Many of the vast outdoor recreation opportunities would not exist without these forests. Just over two-thirds of South Carolina's land area is forested (5.3 million ha). Almost all of that forestland is productive timberland [13]. South Carolina's area in forestland has remained relatively stable over the last 50 years, as land lost to urban development was replaced with reforested converted agricultural lands [14]. Due to active forest management, timber volumes have increased over the last 50 years [2] [15] [16] [17]. Despite the increase in timber volumes, urban development and increasing population continue to erode the forestland base and limited agricultural land will be reforested to make up the loss, and thus a decline in the future forestland base is expected [18].

About 88% of South Carolina's forest area is privately-owned [14]. Private forest ownerships provide 95% of the state's timber harvest [19]. Of the 12% that is publicly-owned, about two-thirds is federally-owned, about one-fifth is state-owned, and the remainder is locally-owned [20]. About 63% of the private fo-

restland is family-owned and the rest is owned by timberland management groups and forest industry [17]. Family forest owners represent the major forest ownership group and the largest source of timber in the state [21].

Our economic analysis focused on the economic contribution of South Carolina's natural resource base and recreational related activities to the state economy. In addition, to the three resource-based sectors that provide both industrial and direct recreational opportunities (outdoor recreation, tourism, and forestry), three additional industrial sectors are driven by the state's natural resource base and contribute to economic activity (mining, boat manufacturing, and commercial fishing). The mining sector comprises establishments that extract naturally-occurring mineral solids and liquid minerals. Mining includes quarrying, well operations, beneficiating (e.g., crushing, screening, washing, and flotation), and all other operations normally performed at a mine site. The recreational boating industry represents production and maintenance of boats, engines, trailers, accessories, and gear purchased by boaters and anglers in South Carolina and other states. In 2013, it was estimated that there were nearly 400,000 recreational boats in the state, and nearly 700 boating businesses [22]. Commercial fishing is important to South Carolina's economy. In 2012, commercial fishermen landed over 1000 metric tons of finfish and nearly 4500 metric tons of shellfish [23].

## 2. Input-Output Model and Contribution Analysis

Natural resources and natural resource-based products provide a significant economic contribution to the well-being of South Carolina residents. This contribution is derived through the economic activity associated with both extractive consumptive uses (such as harvesting trees, mining, hunting, and commercial fishing) and non-consumptive uses (such as hiking, bird watching, water skiing and camping) of the state's natural resources. Moreover, the direct expenditures on natural resource-based economic activities have spillover, or indirect and induced, effects on other sectors of the state economy which result in additional economic activity [24].

Input-Output (I-O) analysis is a technique commonly used to measure the total, or overall, economic impact of expenditures in one industry, or sector, of the economy on the overall level of economic activity. I-O models accomplish this task by tracing the economic linkages of consumer and/or industry expenditures in one or more industries to all other industries within the economy. I-O models also systematically capture expenditure linkages between industries and other economic agents, such as households and government. For example, consumer expenditures received by producers of natural resource-based products require those producers to purchase more inputs to produce additional natural resource-based products. This economic activity generates additional labor payments to both those employees working in the industry that supply the natural resource-based product or service, and those employees that supply the inputs used by natural resource-based industries to produce their final product. The additional labor payments received by households are then respent by the house-

holds and generate additional economic activity [25].

Expenditures tied directly to the primary economic activity or activities of interest are referred to as the direct effect in I-O analysis. For example the direct effect (expenditure) for a weekend fishing trip may consist of expenditures for transportation, dedicated fishing supplies, food, and lodging, but these direct effects only partially account for the total economic impact of the fishing trip. The direct effect generates indirect and induced effects which additionally contribute to the total level of economic activity. To continue with the fishing example, businesses affected by the direct fishing expenditure will purchase inputs from other businesses to produce the goods and services purchased by the fisherman. This secondary impact is referred to as the indirect effect. Moreover, the salaries and profits paid to employees and owners of the indirectly affected industries provide income for additional purchases of South Carolina products by those individuals, and thus setting off another round of economic activity that form the induced effect. The sum of the direct, indirect, and induced effects comprise the total economic impact of dollars directly injected into one sector of the state economy. This impact is summarized by the economic multiplier for the industry sector that translates one dollar of direct expenditure in the economic sector into a total statewide economic impact. To illustrate, an economic multiplier of 1.5 implies that a dollar of direct expenditure in a specific economic sector generates a total economic impact of \$1.50 on the state economy [26].

Due to its systematic accounting structure, I-O analysis is especially useful for capturing the total impact that direct expenditures in one industry (or sector) of the economy has on the overall state or sub-state economy. Relying on the multiplier effect, economic impact analysis is regularly used to estimate the total impact that a specific increase or decrease in demand (expenditures) within a given existing industry or set of industries will have on total economic activity in a state or sub-state region. I-O analysis is also regularly used to estimate the total economic impact attributable to the introduction of a new firm or new tax policy into a local or state economy in regional policy analysis. An emerging new use of I-O analysis is to assess the economic contribution of a particular industry sector or group of industries on total economic activity within a state or sub-state regional economy [27]. It is this latter I-O application that is used in this study. We use the contribution analysis interpretation to estimate the contribution that South Carolina's natural resource-based sectors have on the overall state economy. Specifically we estimated the reduction in economic activity that would occur in South Carolina if the natural resource sectors ceased to exist. Hence, the contribution analysis estimated the economic contribution that specific sets of natural resource-based industries contribute to the overall South Carolina economy when all direct, indirect, and induced effects are accounted for. Alternatively stated, an I-O contribution analysis captures the ripple effect of direct dollar expenditures in each resource-based sector of the economy have on the overall level of state economic activity.

We developed a South Carolina I-O model to estimate the economic contri-

bution of natural resource-based activities to the South Carolina's economy. The model was developed by using the IMPLAN (Impact Planning) modeling system [28]. IMPLAN is a highly-respected I-O model that is commonly used for state-level and sub-state level estimation of economic impacts. Other recent I-O analyses related to natural resources in the state have also used IMPLAN [29] [30], as did the prior study that addressed economic contribution of natural resources to South Carolina [2]. The most recent version of IMPLAN (2014 version) divides economic activity into one of 536 mutually exclusive economic sectors (industry types) [28]. Our contribution analysis used the IMPLAN industry structure to create six aggregate and mutually exclusive, natural resource-based sectors within the South Carolina economy. The six constructed natural resource-based industry sectors were: 1) Fishing, Hunting, and Wildlife Viewing; 2) Coastal Tourism; 3) Commercial Fisheries; 4) Boating Industry; 5) Mining; and 6) Forestry. Our contribution analysis of the economic contribution of each of the six resource-based economic sectors focused on several key economic variables to summarize the economic contribution of each of the six identified natural resource-based sectors to the overall economy. These key variables were value added (often called Gross State Product), employment (number of full-time and part-time jobs), earned income (labor and proprietor income), and total industry output (total dollar value of all sales) [24].

Value added measures each sector's net contribution to the state's economy. It is the difference between a sector's total output (revenue from sales) and the cost of its intermediate inputs (exclusive of labor cost). Value added is generated when productive inputs (man-made resources and natural resources) are efficiently combined to produce products that are valued by society. Value added has three major components: 1) earned income (labor and proprietor income); 2) property income (corporate profit); and 3) indirect business taxes. Earned income is employee compensation, primarily in the form of wages and salaries, plus net profits to proprietors (non-corporate owner operators). Earned income is a key component of value added (Gross State Product) and is also reported for each resource-based sector in this study because it is indicative of consumer purchasing power. Property income is another component of value added and includes returns to capital in the form of corporate profits, depreciation charges, and other accounting measures of corporate profitability. Indirect business taxes, the third value added component, consist of sales taxes, excise taxes and other business taxes. Total industry output is the value of total output or total sales revenue and is equal to the cost of intermediate inputs (exclusive of labor) plus value added [24].

This economic contribution analysis considered both consumptive and non-consumptive uses of the South Carolina natural resource base. Consumptive use involves the extraction of natural resources for additional processing and sale to either other industries for their further productive use or consumers for final purchase. For example, a logging company may harvest forest timber and subsequently process the timber into lumber. The lumber may in turn be sold to a

furniture manufacturer for final conversion into a table and sold to a consumer as a final purchase. An example of non-consumptive use of the forest is the economic value recreationists receive from camping, hiking, and bird watching in a forested area. In some cases, recreation-based natural resource activities can be tied to service providers (such as guide services for hunting or boating) while in other cases the activities are linked to direct purchases by households for recreational supplies and permits.

The primary data used in the contribution analysis were taken from the 2014 IMPLAN data base, the most recent IMPLAN data base which was released in January 2016 [28], and augmented with data collected from the *National Survey of Fishing, Hunting and Wildlife-Associated Recreation: South Carolina* [12] and *The Economic Impact of Travel on South Carolina Counties* [31]. Data taken from sources external to IMPLAN were converted from retail prices to producer prices and subsequently distributed to the appropriate IMPLAN industry in each constructed natural resource-based sector. Moreover retail expenditure data were margined using the IMPLAN default values to account for expenditure leakages outside South Carolina. Retail, wholesale, and transportation expenses must be margined to account for the fact that a portion of purchase expenditures leak out of the state economy when goods are produced outside of the state. These expenditure leakages do not contribute to either indirect or induced state spending and must be netted out before applying the multiplier to calculate total economic contribution. Each direct expenditure item in each direct expenditure impact vector is divided by their respective diagonal element of the Leontief inverse matrix to control for the fact that many industries purchase from themselves [27]. Failure to make this minor adjustment results in an overestimate of the total economic contribution. The IMPLAN GNP deflator tool was used to convert all reported dollar values into 2016 dollars using the consumer price index.

Data for the constructed fishing, hunting, and wildlife aggregate sectors were taken from tables 17, 20, and 31 in the *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: South Carolina* [12]. The default IMPLAN margins were applied to all retail and wholesale sales before developing the direct expenditure vector for this sector. Since all retail and wholesale expenditures were margined before constructing the direct industry output vector, the retail and wholesale sectors were not margined when calculating the total impact in IMPLAN because all prices had already been converted to producer prices and doing so would have inappropriately reduced the estimated total effect. Our constructed industry direct effect vector used in the IMPLAN analysis is consistent with the reported direct effect in the national survey. We did not include saltwater fishing in this sector, as it is included in the coastal tourism direct expenditure impact (this avoids double counting saltwater fishing).

Data for the coastal tourism sector were taken from Table 5 and appendix A of *The Economic Impact of Travel on South Carolina* [31]. The coastal region is defined as consisting of eight South Carolina counties: Beaufort, Berkeley, Char-

leston, Colleton, Dorchester, Georgetown, Jasper, and Horry. The tourism data are reported for five broad expenditure categories and the data were subsequently distributed over 30 IMPLAN industries and all prices in each industry were converted to producer prices. The direct impact vector represented 64% of all South Carolina tourism. This direct impact vector was directly inputted into IMPLAN and the model margin defaults were used on all retail sectors to control for economic leakage outside of the state. The margining activity restricts the economic contribution (impact) of the direct effect to the state of South Carolina.

Data for the commercial fisheries sector are the reported values of the 2014 IMPLAN model for industry sector 17. Data for the created aggregate mining sector are the summation of the 2014 IMPLAN output values for ten specific mining sectors. The ten mining sectors consist of IMPLAN sectors 20, 30, 31, 33, 35, 36, 37, 38, 39, and 40. All IMPLAN data used to construct the commercial fisheries sector and the mining sector were inflated to 2016 values and not margined.

The forestry sector consists of 29 highly interrelated IMPLAN sectors. The 29 sectors consist of the wood products production sectors, manufacturing sectors heavily dependent on wood resources as a production input, and two sectors that support the constructed aggregate forestry sector. Except for the two support sectors, all other sectors use the reported output values from the 2014 IMPLAN model inflated to 2016 values. The two support sectors: support activities for agriculture and forestry (IMPLAN sector 19) and commercial and industrial machinery & equipment repair and maintenance (IMPLAN sector 507) were rescaled to capture only their economic activity within the constructed forestry sector. The direct industry output value for IMPLAN Industry 19 (support activities for agriculture and forestry) was rescaled by multiplying the IMPLAN state value for this sector by the ratio of South Carolina forestry workers divided by sum of South Carolina forestry and agricultural workers. The data used to develop this ratio were provided by the US Department of Labor Quarterly Census of Employment and Wage data (QCEW 2015) and the calculated employment ratio used to rescale IMPLAN industry 19 are 0.3736 [32]. IMPLAN industry 507 (commercial and industrial machinery & equipment repair and maintenance) was also rescaled to measure only the proportion of this sector's total statewide economic activity related to the constructed forestry sector. The rescaling of this sector was accomplished by multiplying IMPLAN's statewide value for this sector by the ratio of the sum of the dollar output from all other industries in the constructed forestry sector to the total value of all state output. The calculated scale factor is 0.0304. All industry output values in the forestry sector are in producer prices and are not margined.

### 3. Economic Contribution Results

The economic contributions of the constructed six natural resource sectors to the South Carolina economy are reported in **Tables 1-6**. For all tables, employ-



**Table 1.** Annual economic impact of fishing, hunting, and wildlife viewing on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	23,582	3564	4812	31,958
Labor Income (\$)	686,777,000	152,588,179	188,904,885	1,028,270,064
Value Added (\$)	1,068,450,219	266,200,616	344,955,459	1,679,606,293
Total Output (\$)	1,618,670,877	496,770,066	621,445,610	2,736,866,553

**Table 2.** Annual economic impact of coastal tourism on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	71,702	14,157	13,467	99,325
Labor Income (\$)	1,753,820,258	595,178,676	528,754,487	2,877,753,420
Value Added (\$)	2,929,009,922	967,001,097	965,588,870	4,861,599,889
Total Output (\$)	5,390,047,354	1,866,273,416	1,739,545,696	8,995,866,466

**Table 3.** Annual economic impact of commercial fishing on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	720	63	57	840
Labor Income (\$)	6,748,846	3,270,117	2,247,978	12,266,940
Value Added (\$)	12,753,626	4,400,029	4,102,040	21,255,695
Total Output (\$)	25,371,754	9,603,013	7,388,915	42,363,682

**Table 4.** Annual economic impact of the boat sector on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	2450	1484	1466	5401
Labor Income (\$)	181,684,070	73,984,940	57,556,258	313,225,269
Value Added (\$)	200,203,644	102,940,617	105,107,228	408,251,490
Total Output (\$)	607,762,496	202,442,770	189,354,882	999,560,148

**Table 5.** Annual economic impact of the mining sector on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	3718	1324	931	5973
Labor Income (\$)	94,436,943	67,997,518	36,545,425	198,979,886
Value Added (\$)	250,673,478	103,454,705	66,729,565	420,857,748
Total Output (\$)	828,422,766	223,702,962	120,213,107	1,172,338,835

ment is the number of jobs supported by the specified industry sector. Labor income (wages paid to salaried employees and proprietors), value added (also referred to as Gross State Product is the sum of labor income, indirect business taxes, and property income), and output (sum of value added and intermediate



**Table 6.** Annual economic impact of the forestry sector on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	28,719	26,898	19,605	75,222
Labor Income (\$)	1,983,244,695	1,420,258,438	769,815,966	4,173,319,099
Value Added (\$)	3,874,123,350	2,216,179,921	1,405,850,874	7,496,154,145
Total Output (\$)	12,245,088,639	4,629,076,071	2,532,703,852	19,406,868,561

input cost) are reported in dollars. Within a row, the individual column effects (direct, indirect, and induced) sum to each reported total effect. However, within a column, the dollar values for labor income and value added do not sum to the total output value for two reasons. First, labor income is a component of value added. Second, the value (cost) of intermediate products purchased is not reported. Total sales (output) minus the value (cost) of intermediate goods used in production is equal to value added.

### 3.1. Fishing, Hunting, and Wildlife Viewing

In 2011, the United States Fish and Wildlife Service estimated 1.7 million individuals (total of in-state and out-of-state participants) over the age of 16 spent at least one day engaged in either fishing, hunting, or wildlife viewing. Many individuals participated in more than one of these three outdoor recreation activities as evidenced by the fact 774,000 individuals spent at least one day fishing, 244,000 individuals spent at least one day hunting, and 1.1 million individuals engage in wildlife viewing, which collectively sum to 2.1 million. Moreover, most individuals that participate in these natural resource dependent activities annually spend more than one day engaged in these activities.

Collectively, the annual direct effect (economic expenditure) by individuals engaged in fishing, hunting and wildlife viewing is over \$1.6 billion as reported in **Table 1**. In the multiplier analysis the direct output effect consists of the payment made by South Carolina recreationalists that remains in South Carolina and is subject to the within state multiplier effect. The numerical values for the four direct effect measures are reported in the left-most column of **Table 1**. In a row, the individual column effects (direct, indirect, and induced) sum to the total effect, or the total contribution of fishing, hunting, and wildlife viewing contribute to the South Carolina economy. The direct output effect supports 23,582 South Carolina jobs and provides \$687 million in labor income. Value added, or gross state product, is \$1.07 billion. The indirect effect, jobs and income created in South Carolina resulting from purchases of inputs and services from South Carolina industries to support the direct effect are reported in column 2. The indirect effect results in another 3564 jobs and \$0.50 billion of additional economic activity. The induced effect, which is primarily driven by additional household labor income generated by the direct and indirect effect, plus any government spending of tax payments received via the direct and indirect spending effects, adds another 4812 jobs and an additional increase in economic activity of \$0.62

billion. The overall effect, or total economic contribution, of fishing hunting and wildlife viewing to South Carolina is \$2.74 billion and 31,958 jobs. The contribution of saltwater fishing to the fishing, hunting and wildlife viewing total effect was excluded when estimating the total effect reported in **Table 1** to avoid double counting. The impact of saltwater fishing is accounted for in the coastal tourism impact measure. If saltwater fishing was included, the direct total output effect increases by \$195 million and the total effect for total output would increase by \$329 million.

### 3.2. Coastal Tourism

In addition to using South Carolina's abundant natural resources for freshwater fishing, hunting, and viewing wildlife, many individuals (both in-state and out-of-state) vacation and/or engage in salt-water fishing opportunities provided along the state's scenic coastline. Coastal tourists generally spend dollars on hotels, casinos, fishing supplies, gasoline, guide services, and food. Eight South Carolina counties share a geographic border with the Atlantic Ocean and are designated coastal tourism counties. These counties were identified above and accounted for 63.8% of all South Carolina tourism revenues in 2012 [29].

The total direct impact of coastal tourism is \$5.39 billion as reported in **Table 2**, resulting in 71,702 South Carolina jobs. The total annual economic contribution (effect) of coastal tourism on the South Carolina economy is \$8.96 billion and 99,325 jobs. Those jobs provide \$2.88 billion of labor income to South Carolina households at an average annual salary of \$29,000.

### 3.3. Commercial Fishing Industry

The annual economic use of the South Carolina natural resource base for commercial fishing is distinct from recreational fishing value and is an additional value that natural resources contribute to state economic activity. Moreover, maintaining a sustainable commercial fishing industry is essential to preserve the unique character of South Carolina's local seafood-base cuisine. The state's major fisheries are shrimp, shellfish, crabs, and offshore finfish. Sustaining an economic viable commercial fishing industry strongly compliments and promotes the long-run growth of South Carolina's growing coastal tourism industry.

The annual direct output contribution of the commercial fishing sector is \$25.37 million as reported in **Table 3**. This is the direct price paid to the first purchaser of the product and is commonly referred to as "ex-vessel" price. Thus the direct effect is not a margined value because it is in producer price. The direct output effect supports 720 jobs. After accounting for statewide re-spending of the direct effect, through the indirect and induced multiplier effect, the total economic contribution to the state economy is \$42.36 million dollars in output and 840 jobs of which \$21.3 million is in-state value added. Value added in the amount of \$12.27 million is received by South Carolina residents as labor income, approximately \$15,000 per job. The low annual average salary results from

the fact that a large portion of all workers comprising the total employment effect are seasonal fishery employees. The average salary for fisherman (calculated as direct effect labor income divided by direct effect employment) is slightly under \$10,000. Moreover the low average salary in the commercial fishery industry results in a small employment multiplier for the overall economy. Due to low purchasing power associated with the low salary, only 0.16 additional jobs are created in the broader state economy per job in the commercial fishery sector.

### 3.4. Boat Sector

South Carolina's varied natural resource base provides a cost-effective source of materials needed by the state's boat sector (lumber), in addition to stimulating demand for boat sector products and services. The states abundant rivers, marshes, lakes, and coastline enhance demand for the products produced by the boat sector. Over the last decade, South Carolina's boat sector experienced additional product growth due to emerging national markets built upon its growing national reputation for building quality boats. Two IMPLAN industries comprise the aggregate South Carolina boat sector: ship building and repair, and boat building. Neither industry was margined in the contribution analysis because the IMPLAN data base reports these industry output values in producer prices.

The boat sector produces 2450 direct jobs with an average salary of \$74,000 due to the skill required to work in this industry. Sector direct output (sales) is \$608 million and the total output effect (contribution) to the state economy is \$1 billion, which is 50% larger than the value reported in a prior 2009 study [2]. Overall, this sector contributes 5401 jobs to the state economy, more than twice the direct number of jobs within the boat sector. The high employment multiplier is partially a function of the high salaries paid in this sector which provide a relatively high level of purchasing power to employees in this sector. An additional 1.2 jobs are created in the broader state economy per job in the boat sector. The contribution analysis for the boat sector impact is summarized in **Table 4**.

### 3.5. Mining Sector

South Carolina's mining sector is concentrated in four broad mining industries. In descending order of current economic output (economic value) these industries are extracting natural gas and crude petroleum, stone mining and quarrying, sand and gravel mining, and the drilling of oil and gas wells. South Carolina's mines and quarries are distributed throughout the state and are found in both rural and urban areas. As opposed to biological natural resources, mining resources generally do not utilize renewable natural resources. Thus, there is no long-run sustainable steady state use value except for zero use because minerals extracted today are not available for future extraction. However, more than half of South Carolina's mining activities involve the quarrying sand gravel and stone which are very abundant resources.

The direct effect dollar value for the mining sector is \$828 million and the total economic contribution (total output effect) to the state economy is \$1.17 billion as reported in **Table 5**. The direct number of jobs in the mining sector is 3718, and the sector contributes a total of 5973 jobs to the overall economy. Relative to the 209 study, the mining sector contributes 133% more jobs (5973 versus 2558 jobs) and 197% more nominal dollars (\$1.17 billion versus \$0.39 billion) to the state economy.

### 3.6. Forestry Sector

Given South Carolina's heavy economic dependence on lumber and wood product production it is not surprising the forestry sector is the second largest natural resource-based sector in the state, behind only agriculture. The forestry sector consists of 29 tightly interrelated IMPLAN industries, two of which (Support Activities for Agriculture and Forestry (IMPLAN sector 19) and (Commercial and Industry Machinery Equipment and Repair (IMPLAN sector 507)) were modified from their original IMPLAN values as previously discussed. The largest industries in the forestry sector direct effect are paper and paperboard mills, paperboard container manufacturing, sanitary paper product manufacturing, commercial logging, sawmills, veneer and plywood manufacturing, and reconstituted wood products. As reported in **Table 6** the forestry sector has a direct output effect of \$12.2 billion and provides 28,719 jobs. The total contribution of the forestry sector to the South Carolina economy is \$19.4 billion and 75,222 jobs.

### 3.7. Overall Economic Contribution of South Carolina's Natural Resources

The total economic contribution of South Carolina's six natural resource-based economic sectors, as constructed in this study, is summarized in **Table 7**. Total direct output expenditure is \$20.7 billion and the total contribution to the state economy is \$33.3 billion. The total contribution value represents an increase of \$4.3 billion relative to the 2009 study, a 15% increase in total economic activity [2]. The six natural resource sectors are responsible for 8.3% of gross state product and 8.6% of all jobs in the state. Direct employment in the six natural resource sectors is 28,719 jobs at an average salary of \$35,959. Overall the six natural resource-based sectors contribute 75,222 jobs to the state economy at an average salary of \$39,337.

**Table 7.** Annual economic impact of all natural resource sectors on the South Carolina economy.

Impact	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment (jobs)	130,891	47,490	40,337	218,719
Labor Income (\$)	4,706,711,812	2,313,277,868	1,583,824,999	8,603,814,678
Value Added (\$)	8,335,214,239	3,660,176,986	2,892,334,036	14,887,725,260
Total Output (\$)	20,715,363,886	7,427,868,297	5,210,652,061	33,353,884,245

## 4. Conclusions

Over the last seven years, the collective economic contribution of South Carolina's natural resource-based sectors has grown by 15%. Today, the natural resource-based sectors contribute \$33.4 billion dollars economic activity and 218,719 jobs to state economy. This represents 8.3% of gross state product and 8.6% of all state employment. The state's valuable natural resource base needs to be managed in a sustainable manner to protect both long-run economic growth and the amenity values these resources provide.

Despite the significant economic contribution that the six natural resource-based sectors have on the South Carolina economy, the estimated impact is conservative because the value of the states' water resources is not directly included in the analysis. The direct economic value of the state's water supply was not analyzed due to limited research funds, time, and the complexity of water resource valuation. Both the water supply level and the quality of the supply level affect water valuation. For example, a hectare-millimeter of water appropriate for residential drinking has a much higher marginal value than a hectare-millimeter of water suitable for irrigation use. The timing of when water is available also effects economic valuation as different economic activities require water at different times of the year. Reservoir management policy can significantly influence the time when water can be utilized in alternative economic activities. Further compounding water resource valuation is some water uses are non-consumptive and thus the same water resource can support multiple economic activities.

However, some non-consumptive water uses are indirectly captured for fishing, hunting and wildlife viewing; coastal tourism; and the boating sectors. It is also important to note that over time, the absence of safe drinking water supplies would result in the outmigration of human capital and cause all economic activity within the state to cease. So it is imperative that water, our most essential natural resource, is carefully managed and attention is paid to assure that increasingly scarce water resources are used in their highest valued economic uses.

As estimated, most of the \$33.4 billion of economic activity related to natural resources is tied to the state's large timber-based manufacturing base, with well over half of that activity being derived from the forestry sector. Just over a quarter is derived from the coastal tourism sector. Fishing, hunting, and wildlife viewing account for 8% of natural resource-based economic activity. South Carolina's economy places a heavy reliance on its strong natural resource foundation.

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