Economic Contributions of Forestry Service Providers in Mississippi, USA

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Abstract
We used three comprehensive datasets to assess economic activities at as granular a level as possible for Support Activities for Forestry industry in Mississippi in 2019. The labor market company Emsi® provided the most current employment estimates by 6-digit North American Industrial Classification System (NAICS) codes along with a geographic listing of businesses by NAICS codes that contained employment, earnings, and sales data. Esri® further categorized the 6-digit codes into 8-digits, thus providing a more detailed view of this sub-sector’s businesses. However, since business listings do not comprehensively tabulate all businesses of each classification within a region, we developed a weighting method to estimate output, jobs, and earnings for the following industries using Emsi® data- Foresters Consulting, Government – Forestry Services, and Forest Restoration. A statewide input–output model, along with sub-regional models, were estimated using the IMPLAN® software to identify economic contributions to the state and regional economies. Total annual sales across Mississippi were $84.5 million; sales were greatest in the Central subregion, with the South, North close behind. Consulting Foresters was the largest industry by sales, jobs, and earnings. Total economic contributions were 1,140 jobs and $59.79 million in value added on total sales of $121.99 million. South Mississippi received the greatest regional contributions from Foresters Consulting, while Central Mississippi received the greatest benefits from Government – Forestry Services and Forest Restoration.

Keywords Consulting forester · Forest regeneration · IMPLAN · NAICS 1153 · Support services for forestry
Introduction

There has been a proliferation of publications regarding forest sector contributions across the United States over the past decade due to increased demand by advocacy groups and state and local governments along with improved reporting procedures and methodology (Henderson et al. 2017a; Joshi et al. 2017). Typically, the reports reference standard North American Industrial Classification System (NAICS) coded industries that exist within the economic contribution software IMPLAN, which is utilized by practitioners from state agencies, universities, and economic development offices (IMPLAN, LLC, Huntersville, NC). However, the IMPLAN software has the capability to produce non-standard reports for industries which either do not yet exist in the software package or are industries that are in their infancy and do not have an established industry with the NAICS coding system. In these cases, practitioners are tasked with providing information collected outside of the standard model framework and augmenting the pre-existing geographical area of interest (Joshi et al. 2017; Henderson et al. 2017b; Scouse et al. 2017; Poudyal et al. 2017; Scouse et al. 2020).

More recently, novel extensions of the modeling software have been developed to examine a wide range of topics related to the forest products industry. Some examples include the effect of insect related mortality in ash species in Louisiana (McConnell et al. 2019a), the impact international trade provides the forest products sector (McConnell et al. 2019b), and the impact of paycheck protection program loans on the forest products industry (Russell 2021). One area that has not been explored is how to disentangle the NAICS coded industries in the contribution software into smaller sub-industries. This is due primarily to data availability and/or suppression at sub-national levels for databases that serve as foundations for constructing regional economic models, e.g., the Quarterly Census of Employment and Wages produced by the U.S. Bureau of Labor Statistics. Aggregation effects caused by this issue can obfuscate the economic contribution of those smaller industries that are grouped into the forest industries typically described in economic contribution publications and reports. One such sector is Support Activities for Forestry (NAICS code 115,310). This sector is an umbrella for private industries, such as consulting foresters, forest planters, and timber cruisers, as well as government forestry service providers.

While their role is limited with respect to publicly owned forests, private consultants provide valuable services to non-industrial private forest landowners (NIPF), most typically those private forest landowners that are families and not institutional investment organizations or timber real estate investment trusts (Chettri et al. 2018; Grove et al. 2020). Assistance from consultants is particularly important in the US South, where only Florida has less than 80-plus percent of all forest ownership in private hands (Grove et al. 2020). Overall, the National Woodland Owner Survey

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1 Examples regarding forestry in the southern United States can be found at www.forestryimpacts.net.

2 The NAICS coding system is a joint arrangement between the governments of the United States under the U.S. Economic Classification Policy Committee, Canada, and Mexico.
(NWOS) reported 1.37 million of the 1.66 million family ownerships in the US South are less than 100 acres in size (Caputo and Butler 2022), which speaks to the decentralized decision-making practiced on these forestlands. This assistance can take many forms, but typically services include timber sales, reforestation, site preparation, and development of forest management plans (Munn and Watkins 2001; Arano et al. 2002). Generally, studies indicate increased profitability from the use of consulting services, although the premiums vary widely depending on the attributes of the property and products merchandised (Munn and Rucker 1994; Munn and Franklin 1995).

Number of acres owned influenced the degree to which silviculture was practiced by landowners (Haymond 1988). Cubbage’s (1982) review of economies of tract size included Wikstrom’s and Alley’s (1967) finding that national forest tracts smaller than 50 acres experienced significant cost increases per acre when forest practices were implemented. As such, over 50% of private consultants reported their average timber sales were between 50 and 99 acres (Grove et al. 2020). Many landowners may not seek private forestry consultant services due to ownership size or income (Zhang and Sun 2013), perceived expenses (Chettri et al. 2018), or lack of awareness about the benefits of hiring a consultant (Measells et al. 2005).

Rather than utilizing for-pay private consulting services, landowners seeking technical assistance instead may contact public service providers. This was particularly true among those owning 50 acres or less in Alabama (Zhang et al. 1998). State forestry agencies in the US South handle 100,000 NIPF technical requests per year (USDA NWOS Dashboard 2021). Many services are often provided at little or no charge, but they come with a caveat of either a time lag between filing and fulfilling a request or being denied service and referred elsewhere (Zhang and Sun 2013).

Public forest service providers assist with management plans, regeneration, site preparation, and several other typical forest management activities (Straka et al. 1986). Straka et al. (1986) suggested a conservative estimate at the time of $500,000 in total economic activity generated by a service forester in Mississippi through both direct and multiplier effects. This equated to about a 2 to 1 increase in economic activity due to earnings, contracting with vendors, equipment costs. Straka and Phillips (2016) found each additional state forester employed in South Carolina contributed an additional 12 jobs throughout the state economy. Cost sharing of forestry practices through the North Carolina Forest Service’s Forest Development Program generated total impacts of 197 jobs and $12.6 million in total sales in 2012. Over the long term, participation in state forestry programs can increase timber supplies, which could be attractive to industry expansion for growing states’ forest economies (Stoots et al. 2017).

Forty percent of the private timberlands in the US South, approximately 83 million acres, are covered under written management plans prepared by private and public forestry service providers (Wicker 2002; Oswalt et al. 2019). These professionals are not only critical to maintaining forestlands, but they are also a critical link in the broader forest products supply chain connecting landowners to loggers and forest industries. They warrant further investigation to recognize the economic contributions they provide to regional economies on their own merit. The purpose of this study was to develop estimates of the economic activity in the *Support Activities*
for Forestry sector at as granular a level as possible at the state and sub-state levels using Mississippi as an example case. These estimates then informed an input–output model to determine the economic contribution of individual components of this sector to state and sub-state geographies.

**Materials and Methods**

**Data**

While there are many variations of sub-state geographic classifications that could be meaningfully used for this analysis (e.g., planning and development district regions, multi-county economic development districts, etc.), we chose the USDA Forest Service Forest Inventory and Analysis (FIA) regions as the categorization that would be most meaningful. These regions are physiographic in nature, and the roundwood supply chain that includes foresters, loggers, and wood-using mills tends to locate close to its resource (Prestemon and Abt 2002). Figure 1 shows the individual counties contained in each of the five FIA regions in the state (USDA Forest Service
There are two widely used classification systems that categorize the activity of economic sectors. The Standard Occupational Classification (SOC) system classifies workers by the type of job that they hold (bls.gov/soc/2018/major_groups.htm). The SOC systems contains the most detail at the 5-digit level, but unfortunately does not provide information regarding the types of industries for which a particular occupation is employed and, depending on the source of the data, does not contain estimates for all occupation classifications in the state. For example, the Bureau of Labor Statistics provided no employment data for foresters (SOC Code 19–1032) in Mississippi in May 2020 (USDL Bureau of Labor Statistics 2021). While this data source does report the number of Forest and Conservation Technologies jobs (150; SOC Code 19–4071), it does not separate Forest Technicians from Conservation Technicians. Furthermore, there is no indicator of the industry sector or business type that hires these technicians.

In contrast, the NAICS classifies jobs by industry. Many public and private data sources (e.g., the Bureau of Economic Analysis) provide estimates of how many jobs are in a particular NAICS industry or business sector but do not provide information regarding the types of jobs that the sectors employ. For example, County Business Patterns show that estimates for the Support Activities for Forestry sector (NAICS code 115310) for 2018 include 88 establishments employing 267 persons with an annual payroll of $22,092,000 (USDC Census Bureau 2021).

While the NAICS classification is more suited to our purposes, there are still challenges with the way in which the data are reported. Even though most public and private data sources report industry jobs at the 6-digit NAICS code level, there are still several codes that contain multiple types of businesses. For example, the Support Activities for Forestry sector likely contains several business types that cannot be identified from the provided data. Second, the latest NAICS-based industry data available from County Business Patterns is for 2018. This type of lag is problematic for policy makers or economic developers when decisions are being made regarding specific industries. For instance, if policy makers were attempting to address the economic issues of the COVID-19 pandemic it would be very difficult to see which businesses were affected by looking at data from two years before the pandemic.

To mitigate this challenge, we chose to utilize two proprietary databases for which Mississippi State University has subscriptions. Emsi® is a proprietary economic indicator database that provides, among other variables, estimates of employment by NAICS and SOC classifications as well as a listing of individual businesses by NAICS Codes and geographic location that contain estimates of employment.
employee earnings, and sales estimates for the most recent completed year (Emsi® 2021). Emsi® provides estimates for economic variables of interest (other than the business listings) from 2001 to present and projects an additional ten years. While historical estimates do not replicate federal data, this data source has been validated by several studies (Munasib and Rickman 2015; Kumar et al. 2017; Pede 2013). While the Emsi® data does provide current year industry jobs estimates, the data only provide industry job estimates at the 6-digit NAICS code level and thus cannot provide information on the individual components of a grouped 6-digit NAICS code such as 115310, “Support Activities for Forestry” sector.

Esri®, a provider of geographic information systems (GIS) software and data through its ArcGIS platform, provides the Business Analyst service designed to assist community leaders and economic developers analyze markets, evaluate business locations, and understanding markets (Esri® 2021). The Business Analyst platform also contains a business listing with a one-year lag for sales and employment estimates (the latest business listing data is 2019), but these data further categorize the 6-digit NAICS codes into 8-digit codes for greater specificity of business activity, thus providing a more detailed view of businesses within a particular sector (Esri® Business Analyst 2021). For example, Esri® classifies the “Support Activities for Forestry” sector (NAICS Code 115310) into the eight business types presented in Table 1. Of the eight business types that Esri® classifies in the Support Activities for Forestry industry sector, Esri® reports economic activity for three types in Mississippi (Esri® -NAICS sectors 11531004 Foresters Consulting, 11531005 Government – Forestry Services, and 11531007 Forest Restoration). However, since this business listing is not a comprehensive tabulation of all businesses of each classification within a geographic area, we developed an innovative method to estimate the total economic activity for each Esri® -NAICS classification.

Allocation Method

Because different business types likely have varying revenue and cost structures, even across geographic regions within a state, we employed the following method to develop sales, employment, and labor earnings estimates that could be used to

| NAICS code | NAICS description          | Esri®-NAICS Business Analyst Code | Esri®-NAICS Business Analyst Description |
|------------|----------------------------|----------------------------------|-----------------------------------------|
| 115310     | Support activities for forestry | 11531001 Engineers – Forest       |
|            |                            | 11531002 Fire Lookout Stations    |
|            |                            | 11531003 Ranger Services          |
|            |                            | 11531004 Foresters Consulting     |
|            |                            | 11531005 Government – Forestry Services |
|            |                            | 11531006 Moss Control             |
|            |                            | 11531007 Forest Restoration       |
|            |                            | 11531008 Timber Cruisers          |
estimate the economic contribution of the Support Activities for Forestry sector to state and sub-state economies.

Because the Esri® business listing is not comprehensive but does provide a more granular classification of businesses than do other data sources, we used this data as a guide to determine the proportion of economic activity for each 8-digit classification that is contained in the 6-digit NAICS code data. First, business sales estimates for each Esri®-NAICS 8-digit code were summed by FIA region. By dividing the individual sales volume of each 8-digit sector within each FIA region by the total sales volume of the Esri®-NAICS classifications in each region, we obtained a percentage of sales for each Esri®-NAICS 8-digit code based on the individual FIA region. These percentages were then used to estimate sales for each of the Esri®-NAICS sectors by multiplying them by the total sales for NAICS sector 115310 as estimated by Emsi® in 2020. This methodology was also used to estimate the number of jobs in each Esri®-NAICS sector. The estimation of sales for the jth Esri®-NAICS sector is shown in Eq. 1 and the estimation of jobs for each Esri®-NAICS sector is presented in Eq. 2.

\[
Total Sales_j = \frac{\sum_{i=1}^{N} Total Sales_{j,i}}{\sum_{j=1}^{5} \sum_{i=1}^{N} Total Sales_{i,j}} \times Sales_{115310}  
\]

\[
Total Jobs_j = \frac{\sum_{i=1}^{N} Total Jobs_{j,i}}{\sum_{j=1}^{5} \sum_{i=1}^{N} Total Jobs_{i,j}} \times Jobs_{115310}  
\]

where:

\( j \) is the jth FIA region (North, Central, Delta, South, and Southwest, see Fig. 1).

\( i \) is the ith business within an Esri®-NAICS 8-digit classification.

\( Sales_{115310} \) is total sales for NAICS sector 115310 as estimated by Emsi® in 2020.

\( Jobs_{115310} \) is the total number of jobs for NAICS sector 115310 as estimated by Emsi® in 2020.

We estimated total employee earnings (wages and salaries plus employer taxes and fringe benefits) by calculating the average employee earnings for NAICS sector 115310 as estimated by Emsi® for each FIA region and then multiplying the average employee earnings by the number of jobs estimated in Eq. 2 as shown in Eq. 3.

\[
Total Earnings_j = \frac{Total Earnings_{115310}}{Jobs_{115310}} \times Total Jobs_j  
\]

where:

\( Total Earnings_{115310} \) is the level of total employee earnings for NAICS sector 115310 as estimated by Emsi® in 2020.

\( Jobs_{115310} \) is the number of jobs for NAICS sector 115310 as estimated by Emsi® in 2020.
Economic Contribution

To estimate the economic contribution of the individual Esri®-NAICS sectors to each FIA region and the state, we used IMPLAN®, a software package used to develop and estimate regional and state-level input–output models. Designed by the US Forest Service, it was created to estimate the regional economic contributions of management plans for national forests (Alward et al. 1985). Input–output models make use of the Leontief model developed by Wassily Leontief in the 1930’s. Using this input–output model allows us to see the flow of interdependent industries and how they contribute to the overall Mississippi economic output (Henderson and Evans 2017). IMPLAN® provides “current data and analytic support necessary to run the model” (MIG 1999; Tilley and Munn 2007). Because the model accounts for industries across many sectors, the IMPLAN® system is well suited to estimate the economic contributions of the Support Activities for Forestry sector.

We chose to calculate the economic contribution (an ex-post analysis based on actual industry data) of the individual Esri®-NAICS sectors rather than the economic impact of the sectors (an ex-ante analysis based upon forecasts) because (1) we are dealing with existing industry sectors rather than introducing new sectors into each economy and (2) we are eliminating the intra-sector linkages that would be present in an economic impact model and would demonstrate the demand that a specific sector has for its businesses (Watson et al. 2007). As such, economic contribution analysis focuses on economic sectors external to those being examined to present a more accurate assessment of the influence that the sector(s) under examination has on the local area or region. To develop the economic contribution estimates, we developed IMPLAN® models for each of the five FIA regions and for the state as shown in Fig. 1.

We divided the total sales for Esri®-NAICS sector by the IMPLAN® Social Accounting Matrix (SAM) multiplier for IMPLAN® Sector 19 – Support activities for agriculture and forestry (Henderson and Evans 2017; Lucas 2019). This mathematical operation ensures that the intra-sector linkages are eliminated for sales due to the SAM multiplier accounting for social security, tax leakages, institutional savings, and interinstitutional transfers (Tilly and Munn 2007). Eliminating these sales is critical to achieving results that are both accurate and respected (Oosterhaven and Stelder 2002; Watson et al. 2015). We then inputted the reduced sales estimations and the jobs and total earnings estimates described earlier into IMPLAN® events that consisted of IMPLAN® sector 19 Support activities for agriculture and forestry and were associated with Esri®-NAICS specific activities. The other modification that was made to each IMPLAN® model involved setting Proprietor Income (production-based earnings of sole proprietors, partnerships, and tax-exempt cooperatives) equal to “0” (zero) for each event to eliminate overestimating Labor Income (the sum of employee compensation and proprietor income).

Pearson correlation coefficients were lastly calculated between our economic contribution findings and regional forest inventory statistics from FIA (USDA Forest Service 2021). Timberland acres, net volume of growing stock trees, net annual growth of growing stock, and average annual removals of growing stock were obtained from EVALIDator for the most recent inventory cycle for Mississippi.
Net annual growth was then divided by average harvests to provide each region’s growth-to-drain ratio. Correlation coefficients were deemed highly correlated when at least 0.85, moderately correlated from 0.70 to 0.84, poorly correlated from 0.50 to 0.69, and uncorrelated when less than 0.50 (Luppold et al. 2014). Per Luppold et al. (2014), these criteria should be considered merely descriptive. No probabilities were connected to the correlation coefficients, as the samples were not collected at random.

Results

All results are for the 2019 calendar year; they were not adjusted by any inflation factor. The largest component within the Support Activities for Forestry sector was the Foresters Consulting (Table 2). Foresters Consulting comprised 63.0 percent ($53.3 million of $84.5 million) of the estimated sales reported for Support Activities for Forestry overall. The remaining 35.9 percent of sales was allocated to other public (Government-Forestry Services) and private (Forest Restoration) industries. Other individual industries listed in Table 1-Engineers-Forest, Fire Lookout Stations, Ranger Services, Moss Control, and Timber Cruisers-contained no business data. Table 3 presents the jobs estimates for each sector by FIA region. Not surprisingly, the percentages contained in this sector closely followed the same pattern exhibited in Table 2. Foresters Consulting possessed a greater number of jobs within Support Activities for Forestry. However, the allocation of jobs in for the Foresters Consulting sector was slightly different from the allocation of sales found in Table 2. Here, the North FIA region had the largest number of jobs in this sector, followed by the South and the Southwest regions. The patterns found in Table 3 virtually mirrored those of total earnings per sector and by FIA region in Table 4. This was primarily due to the method of determining total earnings per employee described above and the application of per employee earnings to the job totals described in Table 3. In terms of employment for Support Activities for Forestry overall, the Central FIA region had the largest share of employment, primarily due to the concentration of forest restoration services located in the region.

The estimates from Tables 2, 3, and 4 were the foundations for determining the economic contributions of the Support Activities for Forestry industries. Because the estimated levels of sales for Government-Forestry Services and Forest Restoration individually were relatively smaller than Foresters Consulting, these two industries were aggregated for analysis and reporting purposes. Table 5 presents summaries of this analysis by FIA region and impact type. Comparing Table 5 to Tables 2, 3, and 4 revealed the Direct Effect was the business-to-client activities for the Foresters Consulting sector in the respective regions. The Indirect Effect was the business-to-business activity conducted between the Foresters Consulting sector and other sectors outside the IMPLAN® Sector 19 (Support activities for agriculture and forestry). This effect captured supply chains fulfilling the input needs (demands) of Foresters Consulting; as previously mentioned, within-industry “own effects” must be eliminated to achieve this finding. The Induced Effect was the economic activity
Table 2  Allocated sales by the *Support Services for Forestry* sector in Mississippi in 2019 (rounded to the nearest thousand dollars, thus totals may not add)

| FIA region | Foresters consulting | Government-forestry services | Forest restoration | Support services for forestry |
|------------|----------------------|------------------------------|--------------------|------------------------------|
|            | Total sales          | Pct of sales (%)             | Total sales        | Pct of sales (%)             | Total sales          | Pct of sales (%)             |
| Central    | $5,145,000           | 9.7                          | $0                 | 0.0                         | $18,663,000          | 100.0                        | $23,808,000 | 28.2 |
| South      | $19,013,000          | 35.7                         | $4,672,000         | 37.2                        | $0                 | 0.0                         | $23,686,000 | 28.0 |
| North      | $15,780,000          | 29.6                         | $4,809,000         | 38.3                        | $0                 | 0.0                         | $20,589,000 | 24.4 |
| Southwest  | $11,558,000          | 21.7                         | $3,069,000         | 24.4                        | $0                 | 0.0                         | $14,627,000 | 17.3 |
| Delta      | $1,789,000           | 3.4                          | $0                 | 0.0                         | $0                 | 0.0                         | $1,789,000  | 2.1  |
| Mississippi Totals | $53,285,000 | 100.0                        | $12,551,000        | 100.0                       | $18,663,000          | 100.0                       | $84,498,000 | 100.0 |

Regions are sorted from highest sales to lowest. Within each region, summing *Foresters Consulting* (Esri®-NAICS Code 11531004), *Government-Forestry Services* (Esri®-NAICS Code 11531005) and *Forest Restoration* (Esri®-NAICS Code 11531007) equals the *Support Services for Forestry* figures.
of households making personal purchases, such as clothing, groceries, housing, etc., that can be attributed to Foresters Consulting activities (i.e., the direct effect).

We estimated the Foresters Consulting sector employed 530 full- and part-time jobs with total earnings of nearly $30.0 million in Mississippi. These businesses added $25.4 million in value added (contribution to the state’s Gross Domestic Product) and had total sales of $53.3 million. The economic “spillovers” (the sum of the indirect and induced effects) increased these benefits an additional 170 jobs earned $6.48 million. This resulted in an additional contribution to the state’s Gross Domestic product of $12.3 million and additional sales by businesses of $23.4 million.

Table 6 presents the same information for the collective economic contributions of aggregated Government-Forestry Services and Forest Restoration. The Delta FIA region contains no reported activity in these sectors, which was due to businesses being either established outside this region or categorized into a NAICS code beyond the scope of this study, while the Central FIA region contains the largest levels of economic activity and spillover benefits due to state and federal governmental forestry services units being primarily housed in and around the state capital of Jackson. The total effects for these industries in Central Mississippi were 281 jobs, $13.2 million in labor income, $13.6 million in total value added, and $27.5 million

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5 These direct effects included consulting activities conducted out of state by in-state businesses, i.e., the exporting of services. Any consulting services provided in Mississippi by businesses headquartered out of state are considered import leakages of money from the state.

6 In input–output accounting vernacular, “industries pay labor, labor pays households, and households purchase goods and services from industry.” Achieving the required balance that is fundamental to building input–output models, therefore, required the labor account to purchase a portion of the $30 million of earnings paid by industry to labor from out of state households, i.e., to be imported. Workers who work within a study region but live elsewhere are accounted for using journey-to-work data compiled by the US Census Bureau.
Table 4 Allocated Total Earnings by the Support Services for Forestry sector in Mississippi in 2019 (rounded to the nearest thousand dollars, thus totals may not add)

| FIA region | Foresters consulting | Government-forestry services | Forest restoration | Support services for forestry |
|------------|----------------------|------------------------------|--------------------|------------------------------|
|            | Total earnings | Pct of jobs (%) | Total earnings | Pct (%) | Total earnings | Pct (%) | Total earnings | Pct (%) |
| North      | $10,924,000  | 36.4 | $0 | 0.0 | $3,087,000  | 100.0 | $14,011,000  | 29.5 |
| Central    | $2,057,000   | 6.9  | $10,785,000 | 74.8 | $0 | 0.0 | $12,842,000 | 27.0 |
| South      | $10,332,000  | 34.5 | $2,325,000  | 16.1 | $0 | 0.0 | $12,657,000  | 26.7 |
| Southwest  | $6,041,000   | 20.1 | $1,313,000  | 9.1  | $0 | 0.0 | $7,354,000   | 15.5 |
| Delta      | $627,000     | 2.1  | $0 | 0.0 | $0 | 0.0 | $627,000     | 1.3  |
| Mississippi Totals | $29,981,000 | 100.0 | $14,423,000 | 100.0 | $3,087,000 | 100.0 | $47,491,000 | 100.0 |

Regions are sorted from highest sales to lowest. Summing Foresters Consulting (Esri®-NAICS Code 11531004), Government-Forestry Services (Esri®-NAICS Code 11531005) and Forest Restoration (Esri®-NAICS Code 11531007) were aggregated for reporting. Within each region, summing the Esri®-NAICS Code industries equals the Support Services for Forestry provided.
Table 5 *Foresters Consulting* (Esri®-NAICS Code 11531004) economic contributions in 2019, rounded to the nearest thousand dollars and job count

| FIA Region | Impact Type | Employment | Labor Income | Total Value Added | Output |
|------------|-------------|------------|--------------|------------------|--------|
| South      | Direct Effect | 185        | $10,332,000  | $8,377,000       | $19,009,000 |
|            | Indirect Effect | 9          | $426,000     | $582,000         | $1,395,000  |
|            | Induced Effect | 46         | $1,620,837   | $3,393,000       | $6,196,000  |
|            | **Total Effect** | **240**   | **$12,379,000** | **$12,352,000** | **$26,601,000** |
| North      | Direct Effect | 195        | $10,924,000  | $9,641,000       | $15,775,000 |
|            | Indirect Effect | 10         | $436,000     | $672,000         | $1,461,000  |
|            | Induced Effect | 55         | $1,984,000   | $3,905,000       | $7,237,000  |
|            | **Total Effect** | **260**   | **$13,344,000** | **$14,219,000** | **$24,473,000** |
| Southwest  | Direct Effect | 102        | $6,041,000   | $5,387,000       | $11,556,000 |
|            | Indirect Effect | 4          | $229,000     | $366,000         | $727,000    |
|            | Induced Effect | 29         | $1,156,000   | $2,223,000       | $3,991,000  |
|            | **Total Effect** | **135**   | **$7,426,000** | **$7,976,000** | **$16,275,000** |
| Central    | Direct Effect | 42         | $2,057,000   | $1,561,000       | $5,144,000  |
|            | Indirect Effect | 3          | $136,000     | $201,000         | $470,000    |
|            | Induced Effect | 10         | $369,000     | $746,000         | $1,386,000  |
|            | **Total Effect** | **55**     | **$2,561,000** | **$2,507,000** | **$7,000,000** |
| Delta      | Direct Effect | 11         | $627,000     | $443,000         | $1,789,000  |
|            | Indirect Effect | 1          | $48,000      | $95,000          | $208,000    |
|            | Induced Effect | 2          | $75,000      | $164,000         | $296,000    |
|            | **Total Effect** | **14**     | **$750,000** | **$702,000** | **$2,294,000** |
| Mississippi Totals | Direct Effect | 535 | $29,981,000 | $25,409,000 | $53,274,000 |
|            | Indirect Effect | 27 | $1,275,000 | $1,916,000 | $4,261,000 |
|            | Induced Effect | 142 | $5,205,000 | $10,431,000 | $19,107,000 |
|            | **Total Effect** | **703** | **$36,460,000** | **$37,756,000** | **$76,642,000** |

Output was the sum of labor income and value added within each region. Employment, labor income, total value added, and output total effects were the sum of the direct, indirect, and induced effects. Regions are sorted by their output total effect in output. This was more than the next region by a factor of about 4. It should also be pointed out that counties are grouped into similar physiographic units by the USDA Forest Service. Following that aggregation scheme here essentially split the economic effects of Jackson’s metropolitan area into the Delta, Central, and Southwest regions. No one region realized excessive economic benefits due to Jackson’s larger, more urban economy.

Table 7 presents a summary of the state and local fiscal (tax) effects for both the *Foresters Consulting* sector and the aggregated sector by FIA region. While economic activity within the *Foresters Consulting* sector generated an annual total of $6.25 million in fiscal revenue for state and local governments, most of these tax dollars ($5.39 million or 86.2 percent) accrue to the state. For all practical purposes, only the property taxes associated with the *Tax on Production and Imports* and *Households* revenue sources ($862,000) accrued to local governments. This
situation existed in the state and local fiscal revenues for the aggregated sector as well. Economic activity in this sector generated $3.77 million in total fiscal revenue for state and local governments with $492,000 (13.0 percent) of property tax accruing to local governments. Interestingly, the structure of these industries in Mississippi led to both the Foresters Consulting sector and the aggregated sector paying negative taxes (these corporate taxes are comprised of taxes on Dividends and Corporate Profits Tax) in multiple FIA regions.

Table 8 presents summaries of the tax revenue that accrued to the federal government because of the economic activity in the sectors examined. We estimated the statewide Foresters Consulting sector generated $6.75 million in federal taxes while the statewide aggregated sector produced federal fiscal revenues of $44.0 million. The largest federal revenue source for each FIA region was taxes on Employee
Compensation, which is defined by the Bureau of Economic Analysis (USDC BEA 2021) as “the total payroll cost of the employee including wages and salaries, all benefits (e.g., health, retirement), and payroll taxes.” As with the state and local tax revenue reported in Table 7, multiple FIA regions reported negative federal taxes from the Corporations revenue source. In the case of federal revenues, these corporate taxes are solely composed of Corporate Profits Tax.

The correlation coefficients between regional forest inventory statistics and the total output contributions for Foresters Consulting, Government-Forestry Services, and Forest Restoration, and Support Activities for Forestry overall by region are provided in Fig. 2. The absolute values of the coefficients ranged from 0.21 to 0.96. For the industries within Support Activities for Forestry the correlations were generally weak. Only the relationship between regional timberland acreage and Foresters Consulting economic contributions exhibited a moderate level of association ($r = 0.71$), while regional timber harvest volume and Government-Forestry Services and Forest Restoration economic contributions were highly correlated ($r = 0.87$). Regional Support Activities for Forestry economic contributions to the contrary were highly

| FIA region | Employee compensation | Proprietor income | Tax on production and imports | Households | Corporations |
|------------|----------------------|-------------------|------------------------------|------------|--------------|
| North      | $2,000               | $0                | $1,704,000                   | $564,00    | -$3,000      |
| South      | $2,000               | $0                | $1,642,000                   | $534,00    | -$30,000     |
| Southwest  | $1,000               | $0                | $845,00                      | $299,00    | $2,000       |
| Central    | $0                   | $0                | $423,000                     | $112,00    | -$9,000      |
| Delta      | $0                   | $0                | $136,000                     | $32,00     | -$4,000      |
| Mississippi Totals | $6,000                | $0               | $4,751,000                   | $1,541,000 | -$43,000     |

State and local tax revenue sources are defined in the following manner:

- **Employee Compensation** taxes include employee and employer contributions to social insurance taxes
- **Tax on Production and Imports** includes sales tax, property tax, motor vehicle licenses, severance taxes, other taxes, and state/local nontaxes (licenses and fees)
- **Household** taxes include personal income tax, personal nontaxes (licenses and fees), personal motor vehicle licenses, personal property taxes, and other taxes (i.e., fishing and hunting taxes)
- **Corporations** taxes include taxes on dividends and corporate profits tax

Dollar values were rounded to the nearest thousand dollars; thus, the regional totals may not add to the state totals for Mississippi. Regions are sorted by taxes on production and imports.
correlated with timber harvest level ($r=0.85$), growing stock volume ($r=0.92$), net annual timber growth ($r=0.95$), and timberland area ($r=0.96$).

**Discussion**

The methodology developed here allowed us to quantify a smaller scale industry than those practitioners are familiar with computing, yet it is one that critically influences the value of the forest economy as a whole. Findings showed that Mississippi consulting foresters contributed over $76 million (USD) to the state economy in 2019. Industrial output for Foresters Consulting was concentrated in the South, Southwest, and North FIA regions of the state. It should be noted that the North FIA region contained 26 counties, including affluent suburbs of Memphis, TN, while the other regions contained 11 to 17 counties each. Many of the aggregated Government-Forestry Services and Forest Restoration were concentrated...
in the Central FIA region, due to the presence of a very high level *Forestry Restoration* business activity originating from this region. When these sectors were compared to the total *Support Activities for Forestry* sector, the pattern for output followed closely resembled that of *Foresters Consulting*, thus demonstrating the importance of that sector to this portion of the state’s economy. The exception to this trend was the Central FIA region.

These estimates can also be examined in terms of multipliers, which are ratios of additional economic activity resulting from a direct effect or shock in the economy (Miller 2010; Riggs et al. 2011). Dividing the total effect by the direct effect for each economic measure presented in Table 5 under “Mississippi Totals” provides an employment multiplier of 1.31; a labor income multiplier of 1.21; a total value-added multiplier of 1.49; and an output (sales) multiplier of 1.44. This suggests that every 10 jobs in the *Foresters Consulting* sector created an additional 3.1 jobs in the state’s economy and each additional thousand dollars of employee earnings in this sector results in an additional $210 of earnings for the state’s economy. The same logic is used to interpret the value added and output multipliers.

It also can be applied to yield multipliers for the economic measures within each region (Fig. 3). These can be informative tools for framing economic development opportunities and potential policy impacts. While regional contribution levels were larger in the North and South portions of the state, the multipliers’ interpretations as marginal contributions per dollar (or job) revealed all regions but the South exhibited greater specific metrics as compared to those at the state level—regardless of size. For example, the Delta and Central regions possessed total value added multipliers greater than Mississippi’s state average. Thus, economic expansion that triggers value added generation by consulting foresters would have greater marginal impacts on other industries in those two regions. Conversely, the economic...
contraction of consulting foresters would have less impact on other industries in the South Mississippi region across all our economic measures.

Insights were also provided into the structure of both the Foresters Consulting sector and the entire economy within each of the FIA regions. The presence of any linear associations between the regions’ forest inventory data and our economic findings were, however, largely absent. Relationships between Forester Consulting output and timberland acreage along with Government-Forestry Services and Forest Restoration output to timber harvest volume were present. These carry some level of intuition—consulting foresters will typically practice their trade where timberland is present while forest restoration occurs where timberland is harvested, natural disasters aside.

The North FIA region had the largest estimates for employment, labor income, and value-added, the South FIA region had the largest estimate for output. The Delta FIA region had the smallest levels of economic activity in the state; this was not surprising given the current amount of cleared land typically used for intensive row crop farming. The Central region had the second lowest level of activity. This was somewhat unexpected because the region contained the second greatest merchantable timber inventory, and the 5-year moving average of harvest levels exceeded all regions from 2015 to 2019 (USDA Forest Service 2021). Yet the Central FIA region also contained only three towns with populations above 10,000 residents, Meridian and the Jackson suburbs of Brandon and Pearl. The mobility of consulting foresters was unknown, but the results suggested consulting foresters did not incorporate in this region. Perhaps businesses were instead headquartered in other regions and only conducted business in the Central region. Additional work will be required to further clarify this finding.

While the levels of economic activity resulting from Foresters Consulting, Government-Forestry Services, and Forest Restoration are important for the state’s economy,
of particular interest to policymakers and elected officials are the fiscal effects (tax revenues) that accrue to local, state, and federal governments. These revenues support many types of public-good programs and services. They are particularly important when dealing with forestry and agriculture sectors in a rural state like Mississippi. Although Mississippi has a relatively complement group of value-added manufacturing industries for raw timber products, the largest forest products manufacturing facilities, such as paper, plywood, and sawmills, often receive tax inducements to locate in areas. The bulk of fiscal effects are instead drawn from support sectors, such as the ones discussed in this paper, machinery and equipment manufacturers and dealerships, fuel distributors, and financial services, among others.

Recent mill announcements will see Mississippi adding over one billion board feet of lumber and potentially one million tons of pellets to its forest industry capacity over the next few years. Estimated roundwood demands could exceed five million tons (McConnell 2021), which will require hundreds of private family ownerships of the size discussed in this article (typically less than 100 acres). The implications can be extended to log trucking output (shorter distances allow for more loads to be delivered daily), wood utilization efficiency (diverse markets encourage more complete utilization), standing timber prices (lower processing costs accrue to stumpage), severance tax collections (twenty percent of which is returned to county governments), and consequently forestland value (present value of future income opportunities that can be furthered though cost sharing and tax credits). Each of these factors will improve forestry’s economic importance in the state. Coupling this with long-term changes to Mississippi’s forest and industrial structures warrant periodically reassessing these contributions.

Efforts such as this expand the forestry economic contributions literature and can also benefit regional development analyses for other industries. Regional contributions provided by private consulting foresters, public service foresters, and forester restoration contractors varied across Mississippi. Forests Consulting was dominant in the South and North Mississippi regions, while Central Mississippi benefitted from government and forest restoration activities. Forestry from a utilization perspective provided smaller levels of economic contributions in the Southwest and Delta regions. While it was beyond the scope of our work, some of Mississippi’s highest valued timberland is ironically located in the Delta region because of the habitat it provides for recreational fishing and hunting (American Society of Farm Managers and Rural Appraisers 2021). This could open a new line of inquiry to further illustrate the diversity forestry brings to communities and their economies. This can be particularly true in places where forestry’s impacts on environment, society, and economy may not be fully understood, such as the wildland urban interface in the US South that is becoming increasingly fragmented and parceled (Hermansen-Báez et al. 2006).

**Conclusions**

This was the first study to our knowledge to examine the economic contributions consulting foresters and other forestry supporting services provide to regional economies from the perspective of industry size. Foresters Consulting as an industry
contributed over $76 million in output to Mississippi. Another $45.3 million of output was generated in other forestry supporting services industries. Regional contributions were larger in the North and South Mississippi FIA regions, where the regional economies were larger and contained more urban areas. Regardless of size, each region provided non-trivial contributions on per dollar or job bases. By our estimations total sales by enterprises in the Support Activities for Forestry sector in Mississippi were $84.5 million. This output directly supported 874 jobs that earned $47.5 million in compensation. Accounting for the dependence other industries have on these firms for their business produced total contributions of 1,140 jobs, with earnings of $57.8 million. In sum, $59.8 million in value added was contributed to Mississippi’s Gross Domestic product on sales approaching $122 million. Total tax proceeds across federal, state, and local collections were $20.8 million. This information is critical when smaller industries must compete with other industries and commodity groups in lobbying elected officials during their formulating of policy positions.

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