Incremental Economic Impact of a South Carolina Forestry Commission Forester

Thomas J. Straka and Scott L. Phillips

Over two-thirds of South Carolina is forested. Not only do forests represent the primary landscape of the state, they also support its dominant manufacturing industry. South Carolina is fortunate in that its character, environment, and economy are based on a natural resource that is resilient and renewable. The South Carolina Forestry Commission (SCFC) represents a state investment to ensure that forest renewal, health, and development continue to contribute to the growth of the state, while providing its citizens valuable aesthetic, recreational, wildlife, water quality, and other environmental values.

Most of the focus of the investment in the SCFC involves direct forester to forestland owner contact in terms of technical assistance, education, forest management planning, and protection from wildfire, insects, and diseases. These are vital services that are fundamental to maintaining the vibrant, healthy forest that covers most of the state. These SCFC foresters represent an investment of state resources and an analysis of the return from that investment is the subject of this report. The key question addressed is the incremental value to the state of an additional SCFC forester. How much does one additional forester contribute to the management, health, and growth of the state's forests and eventually to the state's economy?

Courtesy of South Carolina Forestry Commission

acreage has steadily been lost to urban development (averaging roughly 36,000 acres per year). Afforestation of agricultural lands partially accounts for the relative stability of the forestland base (Harper and Rominger 2013). Urban development will continue to erode both the forest and agricultural land base and a stable forestland area cannot be expected in the long-run. A recent study of Southern Piedmont forests supported this conclusion with expectation of a declining forestland area due to increasing population and urban development (Rummer and Hafer 2014).

Slightly more than half of the state's forest area is hardwood forest type and the rest is mainly loblolly-shortleaf pine forest type. Roughly one-quarter of the state's forestland is artificially-regenerated (planted) and the rest is naturally-regenerated. These planted forest acres produce about half of the state's timber harvest (Harper and Rominger 2013). The planted forest area receives more intensive forest management and makes a disproportionate contribution to the state's timber supply, allowing for preservation of more sensitive natural areas (Conner et al. 2004). Retaining and expanding the high timber production potential provided by the planted forests is the key to maintaining the environmental and economic health of the state's forests and forest industry.

Forest Area of South Carolina

The total land area of South Carolina (not including water bodies) is 19.3 million acres and just over two-thirds of that area, 13.0 million acres, is forested. Almost all of that forestland is productive timberland (Rose 2015). The acreage of forestland in the state has been relatively stable over the last fifty years. This has occurred while forestland

> **Two-thirds of South Carolina is forested. That equates to 13 million acres of forestland that will decrease over time as forests are replaced with urban, suburban, and commercial uses.**
>
> **One-quarter of the forest is planted and these plantations produce more than half of the state's timber harvest.**

Ownership of South Carolina's Forests

About 88 percent of South Carolina's forest area is privately-owned (Rose 2015). The private forest ownership produces roughly 95 percent of the state's timber harvest (Mo, Straka, and Harper 2013). Of the 12 percent that is publicly-owned, about two-thirds is federally-owned, about one-fifth is state-owned, and the rest is locally-owned (Butler 2008). Of the private forestland, about 63 percent is owned by family forest owners and the rest is owned by timberland investment management groups, corporations, and forest industry (Conner 2011). Family forest owners represent the major ownership group and the largest source of timber in the state (Williams, Straka, and Harper 2012).

Family forest owners have diverse objectives and are the primary group that can benefit from additional professional forestry advice. That advice typically comes from forestry commission, consulting, extension, and other foresters. The National Woodland Owner Survey found that in South Carolina only 14 percent of family owners received forest management advice, but these same owners controlled just over half the forest area (Butler 2008). This makes sense, as it suggests owners of larger forest holdings are more likely to seek management advice.

In terms of actual sources of forest management advice from forestry professionals, private consultants provided the most advice relative to acres owned and forestry commission foresters provided the most advice relative to actual owners (Butler 2008). This suggests the owners of large forest holdings receive advice from consultants, while, in general, when forests of all sizes are considered, forestry commission foresters give the most advice. Over the past twenty years the SCFC has provided technical assistance to more than 51,000 landowners. Unfortunately, state budget cuts, particularly during 1998, 2001, and 2008, have reduced the Forestry Commission's capacity to deliver technical assistance. Figure 1 illustrates that significant drop in SCFC project forester capacity and the corresponding decrease in technical assistance to the state's family forest owners.

One recent study addressed the impact of forest owner assistance on forest management activities, tree planting, and timber harvesting intentions. Increases in assistance to family forest owners (advice, management plans, and cost-share) tended to increase their investment in forest management. Family forest owners were approximately twice as likely to carry out active forest management activities when landowner

> **Family forest owners control most of South Carolina's forest area.**
>
> **Family forest owners who have received forest management advice indicate that their preferred source for this advice is the South Carolina Forestry Commission (SCFC).**

assistance was utilized (Kilgore et al. 2015). Data in South Carolina indicate that these relationships hold true for the state's family forest owners; for example, landowner assistance is strongly correlated with tree planting efforts in the state. Figure 2 illustrates a decline in tree planting within South Carolina as technical assistance has decreased.

These trends among family forest owners have important implications for the long-term viability of the state's forests. These forest holdings are subject to parcelization, a process whereby changes in ownership result in tracts being broken into smaller holdings (Hatcher, Straka, and Greene 2013). Forest tract size for family forest owners has been decreasing. Over 90 percent of family forest owners own tracts of 99 acres or less (Butler 2008). These small tracts are where professional forestry advice from state forestry organizations, like the SCFC, is most valuable and is the focus of their foresters' attention. Parcelization will make this need even more critical (Williams, Straka, and Harper 2012).

Active forest management has been instrumental in reestablishing the forest resources that exist today. Since the first forest inventory in 1936 the forest area of South Carolina has increased by more than two million acres (Conner et al. 2004; Harper and Rominger 2013). The state's forest inventory is nearly 25 billion cubic feet of timber, the highest level it has been in the past century. South Carolina is growing more timber annually than it harvests. Annual timber growth is nearly a billion cubic feet per year (Rose 2015). These well-managed forests provide protection to the state's watersheds and are the source of clean public water. In addition, they are vital to the state's wildlife, provide significant outdoor recreation, and are a crucial component of the state's environment.

> **Forest parcelization has increased the need for foresters that focus on family forest owners with small acreages.**
>
> **Active forest management has produced a healthy, productive forest in the state, with 2.3 million more acres in forestland since the first forest inventory in 1936.**
>
> **As tract size decreases, forestry advice will become even more important to ensure family forest owners continue to use active forest management that will retain working forests and provide the wood needed for a healthy forest industry.**

Forest Industry in South Carolina

South Carolina's forests provide the natural resource-based inputs for the largest manufacturing sector in the state (Division of Research 2009). This manufacturing sector includes primary industries that purchase roundwood or wood chips and manufacture
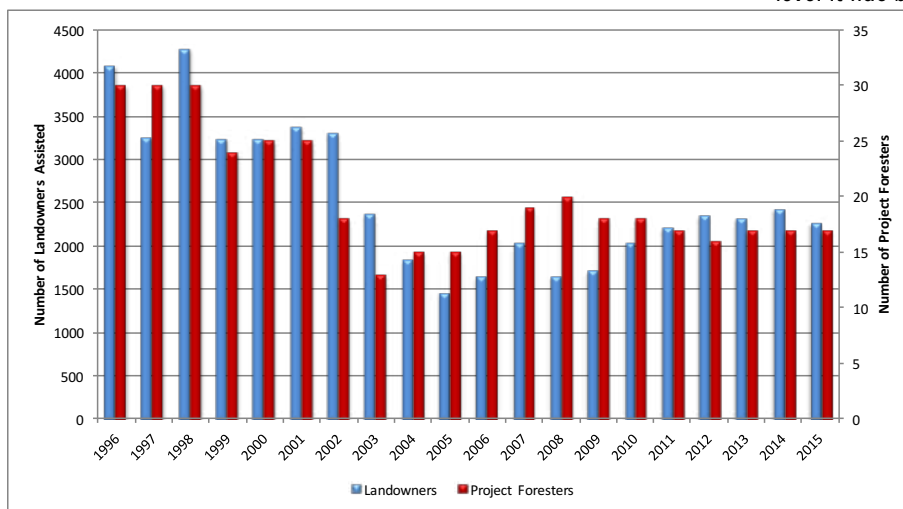

Figure 1. South Carolina landowners assisted and project forester capacity by fiscal year (SCFC unpublished internal data).
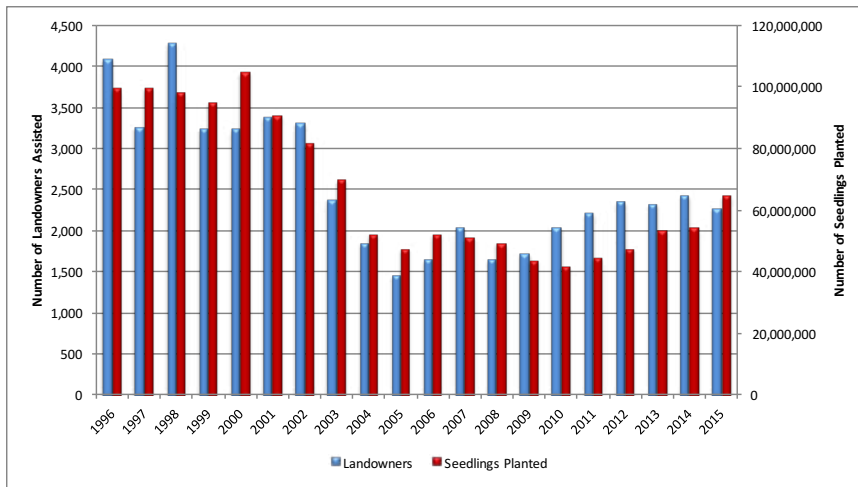
Figure 2. South Carolina forest landowners assisted tree planting activity by fiscal year (SCFC unpublished internal data).

products like pulp and paper, lumber, plywood, oriented-strand board, poles, posts, shavings/mulch, and pellets and biomass for energy. In addition, value is added by secondary industries supported by these forests when they purchase primary products for further processing to produce products like cabinetry, millwork, particleboard, flooring, furniture, and log homes. These mills are scattered across the state, with locations based on the timber resource and transportation routes (Johnson and Smith 2007; Bentley, Cooper, and Howell 2014). Table 1 shows the magnitude of the forest industry in the state. In addition to these 93 primary wood-using plants, there are five log export yards and 18 portable sawmills operating in the state. Figure 3 illustrates the distribution of this industry across the entire state. This primary industry supports 731 secondary wood-using mills that manufacture products like furniture, cabinets, buildings and structures, and pallets and crates. Their economic impact affects all of the state's citizens and helps to form the character of the state.

The supply of commodities from South Carolina's forests to fuel these industries constitutes the state's largest cash crop, with an estimated value of $759 million in 2011 (the last year the timber product output in the

South Carolina has 93 primary wood-using industries and 731 secondary processing firms that produce wood products.

Timber is the state's number one cash crop.

state was surveyed). Most of this value came from pulpwood ($371 million); sawtimber contributed $271 million (SCFC 2013).

Impact of Forestry on South Carolina's Economy

Recent input-output analyses—a method that considers the economic contribution of South Carolina's industrial sectors and how they relate to each other—specifically looked at the impact of natural resources, including the forestry sector, on the state's economy (Division of Research 2009; London 2015; Hughes 2015). Input-output analysis considers income, employment, wages, and value-added that contribute to economic activity in the state.

The forest products industrial sector was found to be the most significant manufacturing sector in terms of value-added in the state. The traditional manufacturing sectors create nearly 73,000 jobs with a payroll of $3.9 billion and about $16.9 billion in economic impact (London 2015). If additional forestry-related activity is considered (e.g., forest recreation, woody biomass energy production, pine straw, and firewood) those estimates increase to over 90,000 jobs with a payroll of $4.5 billion and about $18.6 billion of economic impact (Hughes 2015). Forest product exports from South Carolina are valued at $1.5 billion (SCFC 2015c). Forestry is the top-ranked industry in the state in terms of employment and is one of the pillars of South Carolina's economy.

Forestry-related manufacturing and activities contribute nearly $19 billion annually to the state's economy, support over 90,000 jobs, and generate labor income of $4.5 billion.
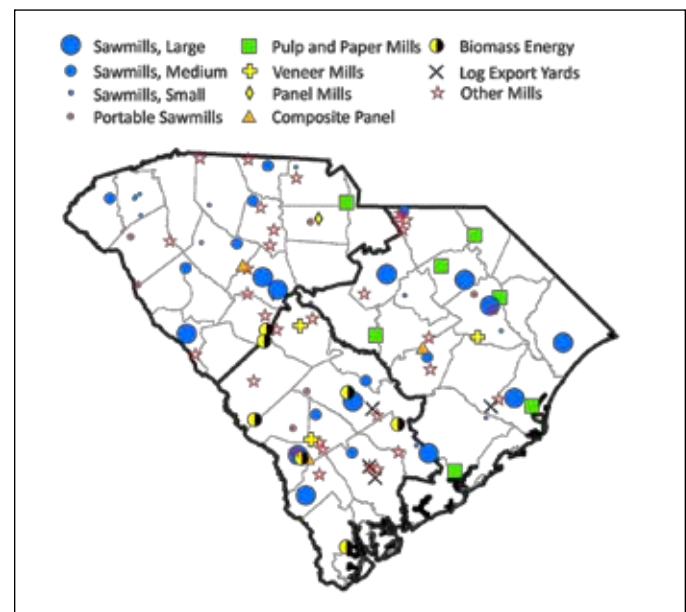
Figure 3. Primary wood-using facilities by region, South Carolina, 2015 (SCFC 2015b)

Table 1. Primary Wood-Using Mils in SC, 2015 (SCFC 2015a).	
Type of Mill	**Number**
Pulp and Paper Mills	7
Sawmills (large)	39
Chip Mills	9
Veneer Mills	5
Composite Mills	3
Other Mills	30

An Additional SCFC Forester: The Benefit/Cost Ratio

A 1986 research study in Mississippi determined the incremental economic return of an additional forestry commission forester (Straka, Anderson, and Bullard 1986). The model was based on the additional forest landowner contacts generated by that forester and the resulting additional acres reforested, eventually leading to additional long-term timber supply. The incremental timber yield was based on the difference between natural regeneration and the artificial reforestation that would result from increased landowner contacts. The study found that the benefit/cost ratios for an additional forestry commission forester were 20:1, 8:1, and 3:1 at 4 percent, 7percent and 10 percent interest rates, respectively. While benefits did include acres managed with natural regeneration, timber stand improvement, management plan development, and timber sale marketing, the predominate value from the landowner contacts was from acres that were reforested with improved genetic stock managed with intensive silvicultural practices. These estimates were based on direct benefits only and did not include multiplier effects or tax effects.

The framework of that model was used to estimate similar benefit/cost ratios for an additional forestry commission forester in South Carolina. The Mississippi study used forestry commission records to estimate the incremental acres reforested due to professional forester contact with the forest owners. That study relied on the relationship that forest owners who receive this assistance are much more apt to reforest after timber harvesting (Kilgore et al. 2015). SCFC records were utilized to obtain similar estimates for South Carolina forest owners, and allowed for estimation of basic relationships between professional forester advice and forest owner reforestation activity. SCFC cost records allow for an accurate estimate of the cost for an additional forester. Considering salary, fringe benefits, operating, and marketing costs, each additional forester is expected to cost $109,375 annually. That estimate will be used in the benefit/cost (B/C) calculation.

SCFC landowner records from 1993 to 2013 (21 years) were used to determine the average number of landowners contacted annually by a project forester. The agency assisted an average of 2,847 family forest owners annually. During that time period the number of project foresters available to assist landowners was quite variable, ranging from a high of 30 in the late 1990's to a low of 13 in the early 2000s. As would be expected the number of landowners assisted has fluctuated, ranging from a high of over 4,700 landowners in the late 1990s to a low of approximately 1,400 in the early 2000s. A simple linear regression analysis (R^2 = 0.77, with significance at the 95 percent confidence level) established that an additional project forester would be expected to assist 147 forest owners annually. A second regression established the relationship between the availability of SCFC project foresters and reforestation acres in the state (R^2 = 0.70, with significance at the 95 percent confidence level). These results indicated each additional SCFC project forester resulted in 5,500 acres annually in increased reforestation. Confidence limits on that estimate at the 95 percent level were 3,751 to 7,249 acres.

Conventional growth and yield models were used to estimate the expected yields on average sites in the state. The yields for the planted stands were generated using FASTLOB (Amateis et al. 2001) and the yields for the natural stands were grown to age 25 in NATLOB (Burk and Burkhart 2001) and then passed to FASTLOB to be thinned and grown to harvest (as NATLOB does not include a thinning option). Tables 2 and 3 summarize the yields and cash flows for planted and natural loblolly pine stands on average sites in South Carolina. Planted stands are based on 544 trees per acre, the most commonly used spacing in South Carolina (Nicholson 2015). Average statewide stumpage prices for South Carolina in 2014 were obtained from a Timber Mart-South quarterly report (Siry, Baldwin, and Smith 2014) and costs were obtained from the *Forest Landowner* Cost of Forest Practices semiannual survey (Dooley and Barlow 2013). Revenues are calculated in constant dollars.

Courtesy of South Carolina Forestry Commission

Table 2. Estimated timber yields and cash flows for loblolly pine plantation grown on an average site in South Carolina.

Year	Practice	Timber Yield (tons per acre)			Revenue ($ per acre)
		Pulpwood	Chip-n-Saw	Sawtimber	
0	Plant				(190.27)
15	First Thinning	38.3	2.7	0	490.50
20	Second thinning	7.5	13.9	0	337.45
30	Final Harvest	4.5	4.9	98.8	2,696.26

Table 3. Estimated timber yields and cash flows for naturally-regenerated loblolly pine grown on an average site in South Carolina.

Year	Practice	Timber Yield (tons per acre)			Revenue ($ per acre)
		Pulpwood	Chip-n-Saw	Sawtimber	
25	Thinning	38.3	0	0	441.88
35	Final Harvest	25.4	37.8	37.4	1,943.03

Incremental analysis is the proper analytical technique to determine the benefit of an additional project forester. That forester will make landowner contacts that result in additional forest acreage being planted in stands with improved genetic stock and silvicultural practices. The result will be increased yields over time and enhanced long-term timber supply. The incremental increase in timber supply is represented by the difference in cash flows between a loblolly pine plantation and natural stand (i.e., the difference between Table 2 and Table 3). This incremental cash flow is shown in Table 4. Table 4 also includes the calculations for B/C ratios at various interest rates.

The framework used in Table 4 is the full regulation model of forest management. The assumption is that the forester is responsible for 5,500 acres of improved reforestation annually and the cash flow reflects that pattern. The full regulation model implies that the forester accomplishes improved reforestation on 5,500 acres annually over a career that spans roughly a full rotation of loblolly pine plantations. At the end of the 30 year career the total acreage impacted would be 165,000 acres (5,500 acres times 30 years). After 30 years, one-thirtieth of 165,000 acres (or 5,500 acres) is harvested and thinned annually.

For the first 15 years only reforestation cost is shown, then thinning revenue begins from the plantation, meanwhile new plantations begin at a cost of $190.27 per acre, so net revenue generated is $300.23 for the next five years. The pattern follows along for perpetuity as in the standard forest management calculation. Since net present value (NPV) is on a perpetual basis, multiplying it by the interest rate will generate equal annual income (EAI). EAI is on a per acre basis, and it is multiplied by 5,500 to obtain the total equal annual income generated. That income is divided by the cost of a forester per year to produce the B/C ratio. These ratios are very similar to those in the earlier Mississippi study. The current study is limited to impacts from reforestation, while the Mississippi study considered broader impacts, so it is not surprising that the B/C ratios are slightly smaller in the South Carolina results. Both studies did not consider indirect and tax impacts, so both sets of B/C ratios are conservative estimates.

> Each additional project forester will produce a benefit/cost ratio of 20 to 1 at a 4 percent interest rate. The rate of return on the forester "investment" is just over 10 percent.

The B/C ratio is a standard forestry investment analysis criterion. NPV is simply the discounted revenues minus the discounted costs. A positive NPV indicates that the investment has positive cash flows considering the carrying charge for interest. Since the B/C ratio is discounted benefits divided by discounted costs, if it is greater than one, then benefits also exceed costs. When the B/C ratio equals one, benefits equal costs, and the investor has a rate of return equal to the interest rate used in the calculation. Thus, from Table 4 we can easily discern that the incremental investment in reforestation has a rate of return slightly higher than 10 percent (since the B/C ratio is very close to one).

The B/C ratios show that investment in project foresters produce significant economic benefits for the state in terms of value of timber supply enhanced. Any B/C ratio greater than one indicates that an investment is earning a rate of return greater than the interest rate used in the calculation. Project foresters provide technical assistance and education to family forest owners that often result in more intensive or effective forest management, and thus increased forest growth, adding to the timber growing stock that supports the forestry manufacturing sector. The B/C ratios show that this impact creates value well beyond the initial investment in a forester.

Table 4. Incremental cash flows from loblolly pine plantations versus natural stands, NPV at 4, 7, and 10 percent, with calculations for the B/C ratios.

Year	Cash Flow ($)	Present Value ($)		
		4%	7%	10%
1-15	(190.27)	(2,115.50)	(1,732.96)	(1,447.21)
15-20	300.23	742.15	446.17	272.45
20-25	637.68	1,295.61	675.66	359.32
25-30	195.80	326.98	147.92	68.51
30-35	2,892.06	3,969.58	1,557.75	628.28
35+	949.03	6,012.47	1,269.84	337.70
NPV		10,231.29	2,364.38	219.05
EAI		409.25	165.51	21.91
EAI/5,500 ac.		2,250,875	910,305	120,505
B/C Ratio		20.6	8.3	1.1

The Economic Impact of an Additional SCFC Forester

Data from the simple comparison of yields can lead to broad estimates of economic impact from employment of an additional project forester based on increased landowner contacts and additional acres reforested. What about the impact on South Carolina's economy? Recent economic impact studies produced state-level annual economic impact estimates for the entire forestry industrial sector: $18.6 billion of economic activity, resulting in 90,320 jobs, labor income of $4.5 billion, and a harvested timber crop worth $759 million (Division of Research 2009; Hughes 2015). These estimates are based on the IMPLAN input-output model that develops these estimates for each industry sector in the state. It is not possible to develop specific estimates for the contribution of a forester as an input, but some simple estimates are possible to approximate these impacts.

SCFC project foresters at the county-level on average assist 147 family forest owners annually and this results in an additional 5,500 acres of reforestation (as explained above). This direct assistance results in increased timber output that contributes to the state's timber output. These efforts eventually equate to more timber supply to support the state's forest industry. Economists call this a "shift in the supply curve to the right." At any market price, more timber will be supplied. What about timber demand? South Carolina's economy has expanded to an increasing timber supply and increased timber demand has resulted from an expanding forest industry base. This analysis assumes that primary wood-using mills will continue to accommodate expanding timber supply.

General relationships can be derived from the economic impacts established by the input-output model studies. The delivered value of South Carolina's timber harvest was $759 million and this was from a timber output of 23,400,000 tons. Since that timber output resulted in 90,320 jobs, then 259 tons of timber output roughly produced one job (23,400,000 tons ÷ 90,320 jobs). Economic impact of $795 would be generated per ton produced ($18 billion ÷ 23,400,000 tons). These ratios of 259 tons/job and $795/ton provide general indications of the impact resulting from additional timber output produced.

Gradational mean annual increment (average annual growth) for reforested acres rather than naturally-regenerated acres can easily be calculated from Tables 2 and 3 as 1.72 tons/acre/year. Thus, a basic assumption is that the forest area involved would grow crops of planted trees, rather than naturally-regenerated stands, and would, conservatively, produce an extra 1.72 tons per acre per year of pine timber yield. The increased timber volumes gradually occur as the new plantations mature and produce steady increased yields.

Timber supply is characterized by three temporal frameworks. Stock timber supply is essentially timber inventory at any point in time. Forestry decision makers have no time to respond to market changes. In the short-run, forest managers can make changes

Courtesy of South Carolina Forestry Commission

to silvicultural inputs (like increased thinnings, fertilization, or chemical control of undesirable species). However, in the long-run, all inputs can be changed, including the land base devoted to forestry (Straka 2010). The impact of the SCFC project forester is a long-run timber supply response and the impacts will be felt through incremental yield increases.

These incremental timber yields occur in the future as the plantations become merchantable. Yields start with the first thinnings after 15 years of landowner assistance and produce steady streams of wood at full impact after 30 years. After 30 years the forester has assisted landowners with a combined total forest area of 165,000 acres (5,500 acre per year over 30 years). This forest area would produce an incremental 1.72 tons per year, and the eventual steady incremental sustainable timber harvest would be 283,800 tons per year. The pine plantations would have produced an additional 283,800 tons/acre/year over the original natural forests. Dividing the sustainable timber harvest by the natural stand yields (283,800 tons/year ÷ 138.9 tons/acre) provides an estimate of the equivalent acres of forest productivity produced. The result of a 30-year career of a project forester would be equivalent to an additional 2,043 acres of timberland. That equates to a 0.016 percent in productive timberland in the state.

Note that this percentage increase occurs gradually as the new plantations grow and mature. An increase in timber supply would not necessarily result in a corresponding increase in timber demand; those are two separate relationships. However, gradually increasing forest productivity and increased timber inventory could be expected to attract new forest industry. This in turn would expand the economic impacts established by the recent input-output analyses. Assuming that the foundation of forest products industry and related impacts is the timberland base, then those estimates would increase by 0.016 percent.

Considering only the $16.9 billion of economic impact in South Carolina from the forestry manufacturing sectors (Hughes 2015; London 2015), the 0.016 percent incremental increase in "effective" timberland resulting from an additional SCFC project forester equates to $2.7 million dollars of annual incremental economic impact in terms of long-run timber supply. In addition, using that same proportionate increase, about 12 additional jobs would be added to the economy, $120,000 of delivered value would be added to the state's wood supply, and nearly $12,000 of additional state and local tax revenue would be generated.

> **A SCFC project forester assists, on average, 147 forest owners each year and this results in 5,500 additional acres of reforestation annually in South Carolina.**

> **In the long-run, this "investment" creates $2.7 million of economic impact annually and 12 additional jobs. Each dollar invested in a project forester annually results in over a dollar of increased wood supply and has an economic impact of $24. Additional local and state income taxes of $12,000 are also generated.**

Summary

This analysis is based on published estimates of economic activity, employment, and valued-added by the forestry sector and other sectors in the state economy. These estimates were the best available in the literature. Like all estimates, they have a range of possible values and vary over time with the general economy. The calculations in the analysis are simple and easy to understand. This is a strength many analyses lack.

We note that economic impact analyses are demand-based; that means they assume the incremental output produced will be utilized. One could argue this analysis is primarily supply-driven (additional foresters create additional wood inventory that ends up being harvested and manufactured into products of some sort, creating jobs and economic activity). Our analysis is based on an assumption that the increased long-term timber supply will occur in an environment where that increased timber demand will continue to develop as timber supply expands. The South is expected to continue to be the "wood basket" of the nation and long-term studies of timber demand support this assumption (Haynes 2003).

An earlier more-detailed study in Mississippi that looked at the economic impact of forestry commission foresters supports the results of this analysis. Without considering local economic impacts and increased tax revenues that study found benefit cost ratios for additional foresters to vary from 20:1 to 8:1, using a 4 percent and 8 percent interest rate, respectively. That 20:1 ratio means $20 of benefit for every $1 of cost. Considering that study looked just at direct impacts from the additional forester, our estimates are certainly consistent with those results.

That the B/C ratio of additional SCFC foresters is positive (benefits outweigh costs) is easily supported by this analysis. Additional foresters result in increased employment, timber product output, economic impact, and tax revenue generated. Investment in timber-related industries in South Carolina has increased with the economy and is expected to produce more demand for timber within the state. While this analysis looks at long-term consequences and a modest increase in additional SCFC project foresters, it considers that the basic staffing levels of these foresters decreased over the last few decades. Certainly, in South Carolina, the case can be made that additional SCFC foresters will provide more opportunities for technical assistance for family forest owners. With the additional technical assistance, it is expected that, at the margin, these levels of economic impact will easily be achieved by increasing timber supply production, raising rates of return family forest owners can expect from their timber investments, helping reduce the tendency towards forest parcelization, and growing South Carolina jobs and tax revenue.

In summary, over the long-run, each additional SCFC forester was found to have a substantial impact on the state's economy. Each additional SCFC forester generated an annual impact of:
- Over $24 of additional economic activity for each dollar of salary and expense,
- About 12 additional jobs added to the state's economy,
- Over a dollar of additional wood supply for each dollar of salary and expense, and
- Nearly $12,000 of additional state and local tax revenues.

Authors: Thomas J. Straka is a professor in the Department of Forestry and Environmental Conservation at Clemson University and Scott L. Phillips is the Rural Forestry Programs Manager at the South Carolina Forestry Commission.

References

Amateis, R.L., H.E. Burkhart, H.L. Allen, and C. Montees. 2001. *FASTLOB: A Stand-Level Growth and Yield Model for Thinned and Fertilized Loblolly Pine Plantations* (Users Manual). Blacksburg, VA: Virginia Tech Department of Forestry. 27 p.

Bentley, James W., Jason A. Cooper, and Michael Howell. 2014. *South Carolina's Timber Industry—Timber Product Output and Use, 2011—Forest Inventory and Analysis Factsheet.* e-Science Update SRS-096. Asheville, NC: USDA Forest Service, Southern Research Station. 4 p.

Burk, T.E. and H. E. Burkhart. 2001. *Diameter Distributions and Yields of Natural Stands of Loblolly Pine.* Publication No. FWS-1-84. Blacksburg, VA: Virginia Tech School of Forestry and Wildlife Resources. 28 p.

Butler, B.J. 2008. *Family Forest Owners of the United States, 2006.* General Technical Report NRS-27. Newtown Square, PA: USDA Forest Service, Northern Research Station. 72 p.

Conner, R.C. 2011. *South Carolina, 2010. Forest Inventory and Analysis Fact Sheet.* e-Science Update SRS-041. Asheville, NC: USDA Forest Service, Southern Research Station. 4 p.

Conner, R.C., T. Adams, B.J. Butler, W.A. Bechtold, T.G. Johnson, S.N. Oswalt, G. Smith, S. Will-Wolf, and C.W. Woodall. 2004. *The State of South Carolina's Forests, 2001.* Research Bulletin SRS-96. Asheville, NC: USDA Forest Service, Southern Research Station. 67 p.

Division of Research. 2009. *Underappreciated Assets: The Economic Impact of South Carolina's Natural Resources.* Columbia, SC: University of South Carolina, Moore School of Business, Division of Research. 19 p.

Dooley, E., and R. Barlow. 2013. Special report: 2012 costs and cost trends for forestry practices in the South. *Forest Landowner* 72(4):22-28.

Harper, R.A., and B.E. Rominger. 2013. *South Carolina, 2012—Forest Inventory and Analysis Factsheet.* e-Science Update SRS-083. Asheville, NC: U.S.D.A. Forest Service, Southern Research Station. 5 p.

Hatcher, J.E., Jr., T.J. Straka, and J.L. Greene. 2013. The size of forest holding/parcelization problem in forestry: A literature review. *Resources* 2(2):39-57.

Haynes, R.W., tech. coord. 2003. *An Analysis of the Timber Situation in the United States: 1952 to 2050.* General Technical Report PNW-GTR-569. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 254 p.

Hughes, D.W. 2015. *Economic Impact Analysis of SC's Forestry Sector: Contributions of Forests and Forest Products to the South Carolina Economy.* Columbia, SC: South Carolina Forestry Commission. 21 p.

Johnson, Tony G., and Nathan Smith. 2007. *South Carolina's Timber Industry—An Assessment of Timber Product Output and Use, 2005.* Resource Bulletin SRS-121. Asheville, NC: USDA Forest Service, Southern Research Station. 28 p.

Kilgore, M.A., S.A. Snyder, D. Eryilmaz, M.A. Markowski-Lindsay, B.J. Butler, D.B. Kittredge, P.F. Catanzaro, J.H. Hewes and K. Andrejczyk. 2015. Assessing the relationships between different forms of landowner assistance and family forest owner behaviors and intentions. *Journal of Forestry* 113(1): 12-19.

London, J.B. 2015. *The Impact of the Agribusiness Sector on the South Carolina Economy.* Clemson, SC: London & Associates. 27 p.

Mo., J., T.J. Straka, and R.A. Harper. 2013. Impacts on South Carolina's timber production over the last five decades. *Carolina Forestry Journal* 2013(1): 6-7.

Rose, A.K. 2015. *Forests of South Carolina, 2014.* Resource Update FS-53. Asheville, NC: U.S.D.A. Forest Service, Southern Research Station. 4 p.

Nicholson, H. 2015. *Forestry BMPs in South Carolina: Compliance and Implementation Monitoring Report, 2011-2014* (Best Practices Monitoring Report BMP-9). Columbia, SC: South Carolina Forestry Commission. 16 p.

Rummer, R.B., and M.L. Hafer. 2014. *Outlook for Piedmont Forests: A Subregional Report from the Southern Futures Project.* General Technical Report SRS-GTR-195. Asheville, NC: USDA Forest Service, Southern Research Station. 84 p.

Siry, J., S. Baldwin, and J. Smith (eds.). 2014. *Timber Mart-South Market New Quarterly* (1st, 2nd, 3rd, and 4th quarters 2014) 19(1-4).

South Carolina Forestry Commission (SCFC). 2013. *Value of South Carolina's Timber Delivered to Forest Product Mills in 2011.* Online at: http://www.state.sc.us/forest/dtv11.pdf (accessed 10 December 2015).

South Carolina Forestry Commission (SCFC). 2015a. *The Number of Primary Wood-Using Plants by Type of Mill, South Carolina 1989 – Present.* Online at: http://www.state.sc.us/forest/millcount2015.pdf (accessed 10 December 2015).

South Carolina Forestry Commission (SCFC). 2015b. *Forest Products Mill Directory for South Carolina.* Online at: http://www.state.sc.us/forest/refind.htm.

South Carolina Forestry Commission (SCFC). 2015c. *The State of South Carolina's Forests.* Online at: http://www.state.sc.us/forest/stateofsc.pdf (accessed 10 December 2015).

Straka, T.J., W.C. Anderson, and S.H. Bullard. 1986. *An Economic Appraisal of Service Forester Activities in Mississippi.* Mississippi Agricultural and Forestry Experiment Station Technical Bulletin 137. 15 p.

Straka, T.J. 2010. Timber supply fundamentals for extension forestry professionals. *Journal of Extension* 48(4): Article 4TOT7.

Williams, B.L, T.J. Straka, and R.A. Harper. 2012. Size of forest holding and family forests: Implications for forest management in South Carolina. *Carolina Forestry Journal* 2012(3):4-5.