Timber Procurement Practices and Mill-Logger Relationships in the US South

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Abstract

The US South's forest products industry employs nearly 500,000 people and generates more than US$100 billion in economic output annually. Landowners, foresters, and forest products mills rely on thousands of independent logging businesses to implement silvicultural prescriptions and deliver raw materials. Mill timber procurement practices in the region are unique, having developed over 100 years since the establishment of the first pulp and paper mills. The purpose of this study was to document timber procurement practices in the South, evaluate the relationships between mills and logging businesses, and identify strategies to encourage the formation and retention of logging businesses. We conducted a mail survey of 636 primary forest products mills in the US South. We received 95 responses, yielding an adjusted response rate of 16 percent after accounting for undeliverable questionnaires. Wood dealers were the most common source of raw materials for all mill types except for wood pellet mills. The median number of logging businesses delivering to mills ranged from 15 for hardwood sawmills to 85 for pulp and paper mills. Eighty percent of supply contracts had a duration of less than 1 year. A majority of mill representatives were satisfied with the operational performance of logging businesses but expressed concerns about business management, financial stability, and timber transportation. Respondents identified trucking regulatory reform, additional logger education, financial assistance to purchase equipment, and higher logging and hauling rates as potential solutions to promote the formation and retention of logging businesses.

Forestry and the forest products industry are crucial to the US South's economy, especially in rural areas. The forest sector employs almost 500,000 people in the region (Pelkki and Sherman 2020). The forest products industry accounts for at least 2 percent of all jobs in four southern states and generates over US$130 billion of economic output (Dahal et al. 2015). Including direct and indirect impacts, the forest sector supports 1.2 million jobs, US $109 billion in value-added, and US$59 billion in employee compensation (Pelkki and Sherman 2020).

Wood fiber is the largest direct manufacturing cost component for primary forest products mills (Siry et al. 2006). Consequently, timber procurement practices can have a major impact on the competitiveness of individual mills and regional forest economies. Mill closures are often based on the delivered cost of wood to those mills (e.g., Clarke 2023, Urness 2024, West Fraser 2024). While many studies have evaluated bidding and stumpage prices (e.g., Shaffer 1985, Kilgore and Blinn 2005, Klepacka et al. 2017), relatively few have examined mill procurement practices.

Timber procurement practices encompass the strategies employed by mills to obtain raw material, including specifications (i.e., species, diameters, lengths), wood form (e.g., roundwood, chips), sourcing, and raw material inventory levels. Sources of roundwood raw material include company-owned land (i.e., fee land), leased land, family forest assistance program land, and open market purchases (Kronrad et al. 1985). Open market purchases have always accounted for the majority of timber purchases, and following the sale of company land during the 1990s and 2000s and the termination of most landowner assistance programs, open market purchases from logging businesses and wood dealers became even more important (Conrad et al. 2018, 2024; Bowman et al. 2023). In addition to roundwood, pulp mills and wood pellet mills also purchase chips from logging businesses and wood dealers, as gatewood, and residual chips from sawmills.

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Transportation costs can account for 25 percent or more of the delivered cost of timber (TimberMart-South 2023), which limits transportation distance and has a major impact on timber markets (White and Carver 2004, da Silva et al. 2019, Pokharel and Latta 2020, Lamica and Parajuli 2023). In the US South, timber is transported approximately 50 miles from harvest sites to mills (TimberMart-South 2023). Transportation distances in the Lake States (Michigan, Minnesota, and Wisconsin) are generally longer, due to fewer markets (Stier et al. 1986, Conrad et al. 2018, Blinn and Nolle 2023). In addition, transportation distance is positively related to timber purchase volumes by individual mills (Stier et al. 1986, Conrad et al. 2018). The rapid escalation in fuel costs in 2022 exacerbated the issue of transportation distance, increased costs to the supply chain by more than US$1 billion, and forced mills to increase logging and hauling rates (Blinn 2022, Gutierrez-Castillo et al. 2022).

Mills in the Lake States purchase most of their timber directly from logging businesses, with purchases directly from forest landowners being the second most common source (Stier et al. 1986, Conrad et al. 2018, Gc et al. 2020). In contrast, southern mills rely heavily on wood dealers (Flick 1985, Kittler et al. 2020, Conrad et al. 2024). Wood dealers serve as middlemen, purchasing timber from landowners, marketing it to mills, and often subcontracting timber harvesting and transportation to independent businesses (Flick 1985).

Mills in the Lake States and US Northeast typically hold 30 to 60 days of raw material inventories at mills and satellite wood yards (Stier et al. 1986, Todd and Rice 2005, Conrad et al. 2018), whereas southern mills often hold less than 2 weeks of inventory and have largely eliminated satellite wood yards (Ulmer et al. 2004). High inventory levels in the Northeast and Lakes States reflect seasonal timber harvesting patterns resulting from climate and seasonal restrictions on timber harvesting (Demchik et al. 2018, Blinn and Nolle 2023). The low inventory levels in the South reduce raw material costs because of the lower opportunity cost of capital invested in inventory and reduced risk of blue stain fungus and log-quality deterioration during storage. However, southern mills' insistence on low inventory levels results in frequent restrictive quotas on suppliers, which increase harvesting costs and lower logging capacity utilization (Greene et al. 2004, Ulmer et al. 2004).

Foresters, landowners, and the forest products industry rely on thousands of independent logging businesses to implement silvicultural prescriptions and harvest and deliver raw materials to mills. Logging businesses are struggling with rising costs, limited profitability, shortages of qualified labor, and losses of markets in some areas (McConnell 2020, Conrad and Blinn 2024, Conrad et al. 2024). Nearly 40 percent of logging business owners are over 60 years old (Blinn and Nolle 2023, Conrad et al. 2024), succession planning is limited (Ellis 2023), and there are significant barriers to the establishment of new logging businesses (Ellis et al. 2024). Consolidation in the logging sector is not a problem per se; indeed, increases in labor productivity and output per business have largely offset losses of logging businesses and workers (Conrad and Blinn 2024, Conrad et al. 2024). However, the demographics of logging business owners and the lack of recruitment of new businesses suggest logging capacity may be on the verge of decline, which will challenge mills' ability to procure raw materials at planned volumes and prices.

Mill procurement practices have major implications for logging business success, yet little is known about the relationship between these independent yet interdependent businesses. Therefore, the objectives of this study were to 1) document timber procurement practices in the US South, 2) assess the relationship between mills and logging businesses, 3) evaluate mills' satisfaction with the performance of logging businesses, and 4) identify strategies to encourage the formation and retention of logging businesses.

Methods

We conducted a mail survey of primary forest products mills in the southern states of Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina during the fall of 2022. The survey employed a modified Tailored Design Method (Dillman et al. 2014) with three contacts. Participants received a questionnaire and cover letter, followed 3 weeks later by a postcard thanking respondents for participating and encouraging nonrespondents to complete the questionnaire. Finally, a second cover letter and questionnaire were mailed to nonrespondents approximately 5 weeks after the initial mailing.

Participants were identified from the Primary Forest Products Network listing (Southern Group of State Foresters, USDA Forest Service, and Southern Regional Extension Forestry. et al. 2024). In total, 636 unique mills were included in the sample. The mailings were targeted to individuals responsible for making timber purchasing decisions. For most mills, the mailings were addressed to a procurement forester. For small mills without a dedicated procurement forester, the mailings were addressed to the owner or mill manager. Individual mill contacts were identified from state lists of timber buyers and personal contacts with mills.

The questionnaire was developed to address the following topics: procurement practices, trends in timber prices and the availability of timber and logging businesses, satisfaction with logging businesses, relationships with logging businesses, and ideas for encouraging the formation of logging businesses. The questionnaire included 34 questions, including 19 closed-ended, 10 five-point Likert scale, and five open-ended questions. The questionnaire was pretested by current and former procurement foresters and a Sustainable Forestry Initiative State Implementation Committee Program Coordinator.

Mills self-classified into the following categories: pulp and paper, composite (e.g., oriented strand board), hardwood sawmill, softwood sawmill, plywood/veneer, pole, pellet, and "other." These classifications were retained when reporting descriptive statistics for mill procurement practices. To increase statistical power during analysis, these categories were consolidated into fiber mills and solid wood mills, consistent with previous research (Conrad et al. 2011). Fiber mills were defined as those that typically purchase small-diameter roundwood or chips, and this category included pulp and paper, composite, and pellet mills. Solid wood mills were defined as those typically purchasing larger-diameter roundwood and included hardwood and softwood sawmills, plywood/veneer mills, and pole mills.

Means between mill types were compared using independent sample *t* tests assuming unequal variance. Nonresponse bias was assessed using wave analysis (Armstrong and Overton 1977), which compared responses to the first mailing to the responses following the second mailing on annual wood consumption, procurement radius, and number of loggers delivering timber to the mill. Statistical analysis was performed using JMP Pro 17.0.0 (JMP Statistical Discovery LLC 2022) at $\alpha = 0.05$.

Results

Fifty-two questionnaires were undeliverable, reducing the number of mills to 584. We received 95 usable responses, yielding an adjusted response rate of 16 percent, which is comparable to previous studies in the region (Regmi et al. 2022, Conrad et al. 2024). There were 46 responses from softwood sawmills, 14 from hardwood sawmills, nine from pulp and paper facilities, eight from utility pole mills, five from composite mills (e.g., oriented strand board), four from plywood/veneer mills, two from wood pellet mills, and seven from other types of mills. There were no significant differences between early and late respondents on annual wood consumption ($p > 0.25$), procurement radius ($p > 0.5$), or number of logging businesses delivering timber to the mill ($p = 0.17$), which suggests nonresponse bias was not present.

Timber procurement practices

Median annual wood consumption ranged from 65,000 short tons yr^{-1} for hardwood sawmills to 2 million tons yr^{-1} for pulp and paper mills (Table 1). Roundwood made up an average of at least 50 percent of raw material purchases for all mill types (Fig. 1). Roundwood was purchased exclusively by pole mills and plywood/veneer mills. Sawmills that did not purchase roundwood exclusively purchased raw material in other forms for functions co-located with the sawmill, such as a pellet mill or energy facility. Pulp and paper mills purchased more than 80 percent of their raw material as roundwood. Pellet mills purchased half of their raw material as roundwood and half as whole-tree chips (i.e., wood and bark). Median procurement radii, defined as the area within which the mill purchased 90 percent of its raw material, were 100 miles (plywood/veneer), 82 miles (pellet mills), 75 miles (pulp and paper mills, hardwood sawmills, and pole mills), 65 miles (composite mills), and 60 miles (softwood sawmills).

Predictably, large mills relied on more logging businesses to harvest and deliver timber than small mills. For example, pulp and paper mills reported relying on a median of 85 logging businesses compared to 51 for composite mills, 30 for softwood sawmills, and 15 for hardwood sawmills (Table 1).

The majority of pulp and paper mills and composite mills held at least one third-party certification regarding their timber purchasing practices. All composite mills held the Sustainable Forestry Initiative (SFI) Fiber Sourcing Standard (Fig. 2). The majority of pulp and paper facilities held SFI Fiber Sourcing, SFI Chain-of-Custody, Forest Stewardship Council (FSC) Controlled Wood, FSC Chain-of-Custody, and at least one other third-party certification (e.g., Program for the Endorsement of Forest Certification). Half of wood pellet mills held SFI Fiber Sourcing, SFI Chain-of-Custody, FSC Controlled Wood, and FSC Chain-of-Custody. Fewer than half of the other mill types held a particular type of certification.

Timber and logging business trends

The consensus among respondents was that delivered timber prices had increased between 2012 and 2022 (Table 2). One respondent stated that "logging and transportation costs have increased 30 percent. Stumpage has increased 40 percent in the past 10 years." Over 90 percent of fiber mills and solid wood products mills agreed that delivered timber prices had increased during the period. The mean response was significantly higher than neutral for both mill types ($p < 0.01$). According to respondents, the primary causes for higher prices were market forces (i.e., supply/demand, increased competition; 20% of respondents), fuel costs (13%), transportation costs (12%), logging costs (12%), and labor costs (11%).

Both fiber mills and solid wood mills ranked hauling costs as the most important factor affecting delivered timber prices (Table 3). The mean response exceeded the important response ($\bar{x} = 4.0$) for both mill types on hauling costs, harvesting costs, fuel costs, and driver availability. Three of the top four highest-rated factors were related to timber transportation, highlighting the importance and cost of this variable. The mean ratings were consistent between mill types on six of the twelve factors; however, fiber mills rated hauling costs, harvesting costs, fuel costs, driver availability,

Table 1.—Annual wood consumption, logging businesses delivering timber, and most common wood sources by mill type in the US South in 2022. For a mill type, wood sources may not total 100% because of rounding.

			Sources of wood (% of total)						
Mill type	Median wood consumption (tons yr^{-1})	Median number of logging businesses delivering timber to mill	Direct purchases from family forest landowners	Logging businesses	Wood dealers	Gatewood	Chip mills	Sawmills	TIMO/ REIT[a]
Pulp and Paper	2,000,000	85	8	13	41	15	1	12	10
Composite	950,000	51	2	4	88	0	0	2	4
Softwood Sawmill	400,000	30	15	21	32	22	2	1	8
Hardwood Sawmill	65,000	15	37	12	27	18	0	4	2
Plywood/Veneer	117,500	18	24	13	50	3	0	10	0
Pole	120,000	18	3	8	73	14	0	0	3
Pellet	190,000	23	0	0	0	50	1	44	5

[a] TIMO/REIT = timber investment management organization/real estate investment trust.

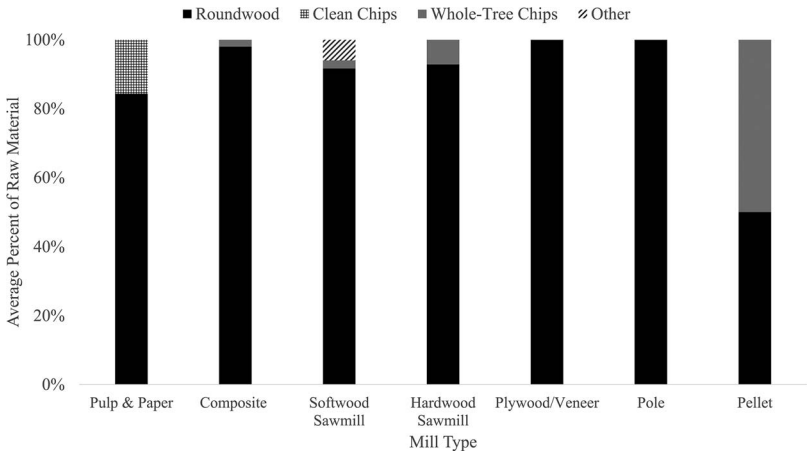

Figure 1.—Form of raw material purchased by seven mill types in the US South in 2022.

weather, and tree size and quality as more important than solid wood mills. Moreover, the rankings of the most important factors were generally consistent between mill types; however, tree size and quality was the fifth-ranked factor for solid wood mills compared to the tenth-ranked factor for fiber mills.

Responses were mixed regarding trends in timber availability. A plurality of fiber mills and solid wood products mills reported that timber availability had neither increased nor decreased, and the mean response was not significantly different from neutral for either mill type ($p \geq 0.11$; Table 2). Most fiber mills perceived an increase in timber quality between 2012 and 2022. The mean response was significantly higher than neutral ($p < 0.01$). Timber quality in this context refers to factors associated with timber dimensions, species, growth characteristics, etc., that affect product yield or cost of production. A plurality of solid wood products mills reported that timber quality had neither increased nor decreased, and the mean response was not significantly different from neutral ($p = 0.11$).

The overwhelming majority of each mill type perceived a reduction in the number of logging businesses in their area between 2017 and 2022 (Table 4). Ninety-three percent of fiber mills and 89 percent of solid wood mills reported a reduction in the number of logging businesses in their area between 2017 and 2022, and the mean response was significantly lower than neutral for both mill types ($p < 0.01$). Approximately 75 percent of fiber mills and solid wood mills expected further declines in the number of logging businesses in their area between 2022 and 2027. There were no statistically significant differences in the mean responses between fiber mills and solid wood mills ($p \geq 0.20$).

Relationships between mills, loggers, and suppliers

Mills generally reported high levels of satisfaction with the logging businesses harvesting and delivering timber to their facility. A majority of both fiber mills and solid wood mills reported satisfaction with logging businesses on operational efficiency, reliability, communication, production consistency, and negotiation skills (Table 5). Fewer than half of fiber mills were satisfied with logging businesses in terms of logging capacity, business management, technology implementation, innovation, and financial stability. At least half of solid wood mills were satisfied with logging businesses in every category examined except for financial stability. There were no statistically significant differences in the mean response between the two types of mills on any of the variables analyzed.

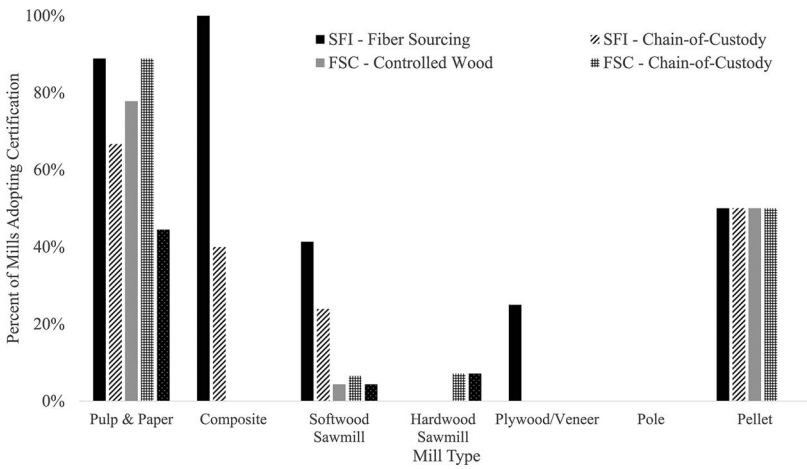

Figure 2.—Third-party certifications held by mills in the US South in 2022.

Table 2.—Perceived trends in delivered timber prices, availability, and quality 2012 to 2022. Within rows, percentages may not sum to 100% because of rounding.

Mill type	Percent of responses					Mean response
	Decreased significantly (1)	Decreased somewhat (2)	Neither increased nor decreased (3)	Increased somewhat (4)	Increased significantly (5)	
Timber prices						
Fiber mills	0	7	0	40	53	4.40* A
Solid wood mills	0	6	3	46	46	4.31* A
Timber availability						
Fiber mills	13	25	38	6	19	2.94 A
Solid wood mills	11	17	33	11	27	3.26 A
Timber quality						
Fiber mills	0	0	43	50	7	3.64* A
Solid wood mills	3	21	39	29	9	3.19 B

* indicates mean response was statistically significantly different from the neutral response ($\bar{x} = 3.0$) at $\alpha = 0.05$.

A, B indicates that within each category, means not connected by the same letter were statistically significantly different using a two-tailed, two-sample t test at $\alpha = 0.05$.

Approximately 25 percent of respondents offered suggestions to help loggers improve their business. The following suggestions were offered by multiple respondents: improve business management and/or pursue training in business management/taxes/finances (7% of respondents), improve log processing and merchandizing (5%), understand costs (3%), maintain constant communication with mills (3%), and work to reduce insurance rates (2%).

Given the demographics of logging business owners, it will be necessary to add new logging businesses to the wood supply chain. A majority of mills agreed or strongly agreed that new logging businesses choose suitable locations for their companies and are easy to work with (Table 6). In addition, a majority of fiber mills agreed or strongly agreed that new logging businesses understand competition among logging businesses, understand their major competitors, are aware of possible challenges and threats to their profitability, choose a suitable legal structure, obtain necessary professional certifications, and are skillful negotiators. Fewer than half of both types of mills agreed or strongly agreed that new logging businesses understand the industry, conduct market research and feasibility studies before investing in their business, and understand logging costs.

Mill respondents were asked to suggest what, if anything, local, state, and federal governments could do to encourage the formation of new logging businesses. The most popular suggestions were to take actions to reform and reduce the cost of insurance (13% of respondents), increase weight limits for log trucks, especially on interstate highways (12%), provide tax and other incentives to logging businesses (9%), and tort reform (7%). Mill respondents were also asked what, if anything, the forest products industry could do to encourage the formation of new logging businesses. The most common suggestions were to encourage additional logger education and training at vocational schools and elsewhere (14% of respondents), provide financial assistance for equipment purchases (5%), and increase logging and hauling rates (5%).

While logging businesses harvest and deliver timber to mills, the majority of mills' timber purchases were from entities other than logging businesses (Table 1). The entities from whom mills purchase timber are collectively referred to as suppliers. Suppliers include landowners, logging businesses, and wood dealers. For fiber mills, other mills (e.g., sawmills) may be suppliers.

Only 13 percent of fiber mills and 18 percent of solid wood mills reported reducing production during the previous year because their suppliers did not deliver the agreed upon amount of timber. During the previous 5 years, in response to insufficient deliveries from regular suppliers, 63 percent of fiber mills had purchased timber from suppliers that did not typically deliver timber to the mill, 25 percent had purchased timber directly from landowners, 13 percent had reduced mill production, and 13 percent had transferred timber from other facilities that the company owned. Eighty-eight percent of solid wood mills had transferred timber from other facilities, 76 percent had reduced mill production, 72 percent had purchased timber directly from forest landowners, and 36 percent had purchased timber from suppliers that did not typically deliver timber to the mill when regular suppliers did not deliver enough timber to meet mill demand.

The average contract length with a supplier was 1.4 years for fiber mills and 1.6 years for solid wood mills ($p > 0.5$). For both mill types, 80 percent of supplier contracts expired in one year or less. Eighty-six percent of fiber mills conducted formal evaluations of their suppliers, with 57 percent conducting in-person evaluations and 29 percent conducting written evaluations that were shared with suppliers. Among those conducting evaluations, 12 percent conducted weekly evaluations, 22 percent conducted monthly evaluations, 33 percent conducted annual evaluations, and 34 percent conducted evaluations when problems arose. In contrast, only 41 percent of solid wood mills conducted formal evaluations of suppliers, with 35 percent conducting in-person evaluations, 3 percent conducting written evaluations that were shared with suppliers, and 3 percent conducting written evaluations that were not shared. Of those solid wood mills that performed evaluations, 6 percent conducted weekly evaluations, 6 percent monthly, 11 percent quarterly, 11 percent annually, 2 percent randomly, 11 percent when contracts were negotiated, and 52 percent whenever

Table 3.—Perceived importance of twelve factors that influence the delivered price of timber. Within rows, percentages may not sum to 100% because of rounding.

Mill type	Percent of responses					Mean response	Rank
	Not important (1)	Little importance (2)	Moderately important (3)	Important (4)	Very important (5)		
Hauling costs							
Fiber mills	0	0	0	19	81	4.81 A	1
Solid wood mills	0	1	13	34	52	4.37 B	1
Harvesting costs							
Fiber mills	0	0	6	19	75	4.69 A	2
Solid wood mills	1	1	14	39	44	4.22 B	3
Fuel costs							
Fiber mills	0	0	0	33	67	4.67 A	3
Solid wood mills	0	4	8	38	50	4.33 B	2
Driver availability							
Fiber mills	0	0	13	13	75	4.63 A	4
Solid wood mills	0	6	21	31	43	4.11 B	4
Weather							
Fiber mills	0	0	19	31	50	4.31 A	5
Solid wood mills	1	7	35	31	26	3.74 A	9
Log truck insurance							
Fiber mills	0	0	25	31	44	4.19 A	6
Solid wood mills	6	10	15	33	36	3.85 A	8
Stumpage prices							
Fiber mills	6	6	6	50	31	3.94 A	7
Solid wood mills	3	0	23	45	30	3.99 A	6
Mill competition							
Fiber mills	0	7	33	33	27	3.80 A	8
Solid wood mills	1	8	29	38	24	3.74 A	9
Federal and state regulations							
Fiber mills	0	25	25	44	6	3.31 A	9
Solid wood mills	3	24	28	31	15	3.32 A	10
Tree size and quality							
Fiber mills	0	6	63	31	0	3.25 A	10
Solid wood mills	0	6	24	36	35	4.00 B	5
Seasonality							
Fiber mills	0	25	44	25	6	3.13 A	11
Solid wood mills	7	22	26	38	7	3.15 A	11
Harvest tract size							
Fiber mills	0	43	36	14	7	2.86 A	12
Solid wood mills	9	22	43	22	4	2.91 A	12

A, B indicates that within each category, means not connected by the same letter were statistically significantly different using a two-tailed, two-sample *t* test at $\alpha = 0.05$.

problems arose. Percentages do not sum to 100 percent because of rounding.

Eighty-nine percent of solid wood mills considered their suppliers to be trustworthy or very trustworthy, compared to 67 percent for fiber mills. Only 6 percent of solid wood mills perceived that their suppliers were untrustworthy or very untrustworthy, compared to 27 percent of fiber mills.

Timber quantity, quality, and timing of delivery are three critical variables for mills. Fiber mills reported that an average of 90 percent, 89 percent, and 85 percent of suppliers were performing satisfactorily in terms of quality, quantity, and timing of deliveries, respectively. Likewise, solid wood mills reported that 84 percent of suppliers were performing satisfactorily on timber quality and quantity, and 82 percent were performing satisfactorily on the timing of deliveries. There were no statistically significant differences in the average percent of suppliers performing satisfactorily on any of the three variables ($p \geq 0.08$) among the different mill types.

Discussion

Timber procurement practices

Timber procurement practices vary regionally, having developed over a century based on the spatial distribution of forests, species present and associated silvicultural

Table 4.—Perceived trends in the number of logging businesses 2017 to 2022 and anticipated changes in logging businesses 2022 to 2027. Within rows, percentages may not sum to 100% because of rounding.

Mill type	Percent of responses					Mean response[a]
	Decrease significantly (1)	Decrease slightly (2)	Stay the same (3)	Increase slightly (4)	Increase significantly (5)	
2017–2022						
Fiber mills	53	40	7	0	0	1.53* A
Solid wood mills	35	54	10	1	0	1.78* A
2022–2027						
Fiber mills	33	40	13	13	0	2.07* A
Solid wood mills	22	53	17	7	1	2.12* A

* indicates mean response was statistically significantly different from the neutral response ($\bar{x} = 3.0$) at $\alpha = 0.05$.

A indicates that within each category, means not connected by the same letter were statistically significantly different using a two-tailed, two-sample *t* test at $\alpha = 0.05$.

practices, weather and climate, forestland ownership patterns, laws and regulations, and local customs (Flick 1985, Lang and Mendell 2012). This study documented the procurement practices employed by mills in the US South and provided unique insight into the relationship between mills, logging businesses, and other suppliers.

Southern mills had higher annual wood consumption than mills in other regions. For example, large sawmills in Wisconsin purchased an average of less than 100,000 tons annually (Conrad et al. 2018), and northeastern US sawmills purchased an average of fewer than 50,000 tons of timber per year (Anderson and Germain 2007), compared to median wood consumption of 400,000 tons for softwood sawmills and 65,000 tons for hardwood sawmills in this study. Likewise, southern pulp and paper mills' annual wood consumption was more than double that of pulp and paper mills in the Northeast and Wisconsin (Todd and Rice 2005, Conrad et al. 2018).

The reliance on the wood dealer system is unique to the US South. Historically, timber purchases from wood dealers accounted for less than 5 percent of timber purchases by pulp and paper mills and small sawmills in Wisconsin, and wood dealers were not identified as a source of raw material in the Northeast (Anderson and Germain 2007, Conrad et al. 2018). The wood dealer system evolved in the South based on local customs and the reluctance of private forest landowners to sell timber to large, corporate mills employing foresters from outside the region (Flick 1985).

Softwood sawmills and fiber mills relied on more than 30 logging businesses per mill to harvest and deliver timber to their facilities, implying a strong dependence on these businesses. However, fewer than 20 percent of timber purchases involved a direct contractual relationship with the logging businesses delivering timber to the mill. The lack of a direct contractual relationship between mills and logging businesses may limit the ability of mills to develop policies and relationships that encourage the formation and retention of logging businesses. The success or failure of logging businesses depends as much or more on the relationships between logging businesses, wood dealers, and large landowners as it does on the relationship between logging businesses and mills.

Hardwood sawmills were the only mill type reporting direct purchases from family forest landowners as their largest source of timber. Hardwood sawmills often have very specific species, quality, and size requirements, and so purchasing timber directly from landowners with stands of timber meeting these requirements may help to ensure a consistent supply, whereas purchasers of large volumes of commodity pine pulpwood and sawtimber may find it advantageous to rely on wood dealers or logging businesses to purchase timber from private landowners.

Timber and logging business trends

More than 90 percent of respondents reported that nominal timber prices had increased over the previous ten years. This response is consistent with data from TimberMart-South (2022). However, in 2012 stumpage and delivered prices for most products remained depressed due to the Great Recession. Nominal delivered prices for pine sawtimber and Chip-N-Saw were lower in 2022 than during the late 1990s.

Timber transportation was recognized as a primary cause of rising delivered prices. Indeed, haul rates increased by approximately 50 percent between 2013 and 2023 (TimberMart-South 2013, 2023). During this decade, nearly all trucking cost components increased, including driver wages (Turoski et al. 2023), liability insurance premiums (Conrad 2023a), fuel prices (EIA 2024), tractor prices (Leslie and Murray 2023), and repair and maintenance costs (Leslie and Murray 2023). In addition, poorly maintained infrastructure forces log trucks to take costly detours, which increases haul distances and costs (Attreya et al. 2024). Timber transportation costs are not only increasing costs for forest products mills but have also been identified as a major challenge for both established logging businesses and new logging businesses (Conrad and Blinn 2024, Ellis et al. 2024), and logging businesses often lose money hauling timber (Conrad 2021). Therefore, it is logical that several of the solutions to encourage the formation and retention of logging businesses were related to timber transportation.

Perceived declines in the number of logging businesses are consistent with data collected by the US Bureau of Labor Statistics (BLS 2024). The majority of mill representatives expected further declines in the number of logging businesses in the coming years. The Bureau of Labor Statistics does not forecast changes in the number of logging businesses; however, they projected a 5 percent decline in the number of logging workers between 2022 and 2032. To date, losses of logging businesses and workers have been

Table 5.—Level of satisfaction with logging businesses that deliver timber to their mill on ten factors. Within rows, percentages may not sum to 100% because of rounding.

Mill type	Percent of responses					Mean response	Rank
	Very dissatisfied (1)	Dissatisfied (2)	Neutral (3)	Satisfied (4)	Very satisfied (5)		
Operational efficiency							
Fiber mills	0	6	13	69	13	3.88* A	1
Solid wood mills	0	1	17	64	18	3.99* A	1
Reliability							
Fiber mills	0	13	19	56	13	3.69* A	2
Solid wood mills	1	13	11	63	13	3.72* A	2
Communication							
Fiber mills	0	19	19	56	6	3.50* A	3
Solid wood mills	1	10	21	57	11	3.67* A	3
Production consistency							
Fiber mills	0	19	25	44	13	3.50 A	3
Solid wood mills	1	14	24	57	4	3.49* A	6
Negotiation skills							
Fiber mills	0	19	25	50	6	3.44 A	5
Solid wood mills	0	3	39	54	4	3.60* A	4
Logging capacity							
Fiber mills	0	25	19	56	0	3.31 A	6
Solid wood mills	1	9	27	59	4	3.56* A	5
Business management							
Fiber mills	0	31	25	44	0	3.13 A	7
Solid wood mills	3	15	32	40	10	3.39* A	9
Technology implementation							
Fiber mills	0	25	44	25	6	3.13 A	7
Solid wood mills	0	13	32	50	6	3.49* A	6
Innovation							
Fiber mills	0	38	25	31	6	3.06 A	9
Solid wood mills	0	10	39	49	3	3.44* A	8
Financial stability							
Fiber mills	7	33	27	27	7	2.93 A	10
Solid wood mills	0	17	38	35	10	3.38* A	10

* indicates mean response was statistically significantly different from the neutral response ($\bar{x} = 3.0$) at $\alpha = 0.05$.

A indicates that within each category, means not connected by the same letter were statistically significantly different using a two-tailed, two-sample *t* test at $\alpha = 0.05$.

offset by increases in labor productivity and the growth of surviving logging businesses (Conrad and Blinn 2024). The rate of increase in labor productivity has been declining in recent years, and so it remains to be seen whether logging capacity can be maintained with further losses of logging businesses and workers. In all likelihood, a combination of increasing labor productivity through better business management, implementation of technology, and employee training; growth of surviving logging businesses; and the addition of new businesses will all be necessary to maintain logging capacity.

Relationships between mills, loggers, and suppliers

Mill representatives were generally satisfied with logging businesses' performance at harvesting timber. Logging businesses were performing at a high level on the essential tasks of harvesting timber with consistent quantity and quality while protecting water and site quality by implementing best management practices. Unfortunately, fewer than half of mill representatives were satisfied with the business management, financial stability, and innovation exhibited by logging businesses. Given the concerns expressed about trucking, timber transportation could also be considered a shortcoming of logging business owners. Indeed, previous research indicates that log truck insurance premium increases result from rising claim costs associated with high crash rates among southern log trucks (Conrad 2023a, 2023b). Trucking is a heavily regulated industry that requires attentive management to comply with state and federal regulations. Log truck owners have been slow to innovate and adopt technologies to improve transportation safety, such as dash cameras, global positioning system truck tracking, in-woods scales, automatic emergency braking, and lane departure and forward collision warning systems (Conrad 2023a). There are many logging businesses that are well

Table 6.—Mill representatives' agreement or disagreement with eleven statements regarding new logging businesses. Within rows, percentages may not sum to 100% because of rounding.

New logging businesses . . .	Mill type	Percent of responses					Mean response
		Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	
Understand the industry.	Fiber mill	0	15	46	38	0	3.23 A
	Solid wood	5	15	38	41	2	3.20 A
Conduct market research and feasibility studies before investing in their business.	Fiber mill	8	46	31	15	0	2.54 A
	Solid wood	14	30	32	21	4	2.70* A
Understand competition among local logging businesses.	Fiber mill	0	15	15	62	8	3.62* A
	Solid wood	2	18	38	36	7	3.28* A
Understand their major competitors.	Fiber mill	0	8	15	54	23	3.86* A
	Solid wood	2	13	39	41	5	3.34* B
Understand logging costs.	Fiber mill	8	15	31	31	15	3.31 A
	Solid wood	7	23	34	33	3	3.03 A
Are aware of possible challenges and threats to their profitability.	Fiber mill	0	15	23	54	8	3.54* A
	Solid wood	2	22	33	40	3	3.22 A
Choose a suitable legal structure (e.g., LLC, C Corp., partnership, etc.).	Fiber mill	0	15	23	54	8	3.54* A
	Solid wood	3	22	32	40	3	3.18 A
Obtain necessary professional certification(s).	Fiber mill	0	8	38	46	8	3.54* A
	Solid wood	0	12	44	33	12	3.44* A
Choose suitable locations for their businesses.	Fiber mill	0	0	31	54	15	3.85* A
	Solid wood	0	4	46	37	14	3.61* A
Are skillful negotiators.	Fiber mill	0	8	38	38	15	3.62* A
	Solid wood	2	7	55	34	2	3.28* A
Are easy to work with.	Fiber mill	0	8	23	62	8	3.69* A
	Solid wood	2	7	36	49	7	3.52* A

* indicates mean response was statistically significantly different from the neutral response ($\bar{x} = 3.0$) at $\alpha = 0.05$.

A, B indicates that within each category, means not connected by the same letter were statistically significantly different using a two-tailed, two-sample *t* test at $\alpha = 0.05$.

managed; however, many logging businesses need better management. This is especially true of new logging businesses, which typically have a smaller margin for error than established businesses.

It may be necessary for mills to be proactive to promote the establishment and retention of logging businesses. For example, mills could sponsor business management training for logging companies and suppliers that deliver to their mill. The Forest Resources Association hosts supplier–consumer workshops to improve communication between mills and loggers (Monkevich 2023). Many large mills already sponsor continuing education workshops associated with SFI logger training programs. The Carolina Loggers Association and North Carolina Forestry Association have held *Logging Cost Analysis* short courses every year since 2022 with sponsorship from industry partners (Carolina Loggers Association 2022). Additional sponsorships targeting areas of need could benefit logging businesses. Training sessions should be voluntary or sponsored through state loggers or forestry associations to avoid employee versus independent contractor legal concerns. Mills can also participate in the political process and advocate for favorable business climates for logging businesses. For example, respondents in this study highlighted the importance of advocating for reasonable trucking regulations. These actions are relatively low-cost and low-risk activities for mills.

Higher-cost and higher-risk strategies to encourage the formation of logging businesses include contracting directly with logging businesses, extending the length of contracts, and providing financial assistance to logging businesses for equipment purchases. The length of 80 percent of supplier contracts was 1 year or less. In contrast, logging businesses typically finance equipment for 3 to 5 years. The equipment necessary for one logging crew can easily exceed $1 million, and lenders are understandably hesitant to finance equipment when the future income of a logging business is uncertain. Mills should consider having contractual relationships with more logging businesses that deliver timber to their mills. This is not to advocate for the abolition of the wood dealer system; however, when the mill only has a contract with the dealer, the mill is at the dealer's mercy to treat contract logging businesses fairly and promote the retention of these businesses. Mills could also promote the establishment and retention of logging businesses by providing financial assistance to purchase equipment. This could take the form of loans directly to logging businesses, purchasing the equipment and leasing it to logging businesses, or providing loan guarantees to lenders that offer financing to logging businesses. Direct financial assistance is risky for both the mill and the logging business but may be appropriate under some circumstances.

Conclusion

This study documented timber procurement practices in the US South and examined relationships between mills, logging businesses, and other suppliers. The average annual wood consumption was much higher among southern mills compared to other regions. Mills rely on 15 (hardwood sawmills) to 85 (pulp and paper mills) independent logging businesses to deliver timber to mills. Most mill representatives were satisfied with the in-woods operational performance of logging

businesses delivering timber to their facilities; however, they were concerned about the management and financial security of logging businesses, especially new logging businesses.

Formation and retention of logging businesses are critical to landowners, foresters, and forest industry mills. The number of logging businesses in the region has been on a steep decline, and mill representatives in this study expected this trend to continue. The ability of mills to influence the future stability of logging businesses is limited to some extent because of the reliance on intermediaries such as wood dealers and large landowners and the lack of a direct contractual relationship with logging businesses.

While the challenges facing logging businesses (Blinn and Nolle 2023, Conrad and Blinn 2024, Conrad et al. 2024, Ellis et al. 2024) are multifaceted and cannot all be solved by mills, there are actions that mills can take to encourage the formation and retention of logging businesses. Mills can sponsor training in documented areas of concern, such as business and financial management and trucking. They can support legislation and regulatory changes that create a business-friendly environment for logging businesses. They can also extend the length of supply contracts, provide more consistent wood orders, and/or provide direct financial support for logging businesses to purchase equipment.

It is uncertain how receptive logging business owners are to changing their way of doing business. Logging businesses pride themselves on their independence (Egan and Taggart 2004) and may be hesitant to seek training on business, financial management, and fleet management. While some research suggests logging businesses are innovative (Stone et al. 2011a, 2011b), they are perceived to be slow to adopt new technology (Nolle 2024), especially in timber transportation (Conrad 2023a). Likewise, the forest products sector has historically failed to invest sufficiently in innovation (Hansen et al. 2014). The future of the wood supply chain depends on logging businesses and mills seeking proactive solutions to the challenges they face.

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