

Society & Natural Resources

An International Journal

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/usnr20

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To cite this article: Sonia R. Bruck, Stephanie Chizmar, Rajan Parajuli, Gregory E. Frey, Austin Lamica & Erin O. Sills (2024) A Qualitative Assessment of Interrelated Impacts of the Coronavirus Disease 2019 Pandemic on the Timber Supply Chain in the Southern United States, *Society & Natural Resources*, 37:10, 1491-1507, DOI: [10.1080/08941920.2024.2380451](https://doi.org/10.1080/08941920.2024.2380451)

To link to this article: <https://doi.org/10.1080/08941920.2024.2380451>



Published online: 21 Jul 2024.



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PERSPECTIVES



A Qualitative Assessment of Interrelated Impacts of the Coronavirus Disease 2019 Pandemic on the Timber Supply Chain in the Southern United States

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ABSTRACT

The southern United States (U.S.) produces approximately 60% of the Nation's timber products, almost entirely from private forests. This work explores the perspectives of stakeholders with regards to the interrelated impacts of the COVID-19 pandemic (SARS-CoV-2) on the timber supply chain in the U.S. South. Four focus groups were held with key stakeholders to explore the effects of the pandemic on forest landowners, loggers, and wood mill workers. We compared focus group participant insights to published research and other summary information from reputable sources. We found that supply, demand, and government factors were interdependent and affected the timber supply chain heterogeneously during the pandemic. Focus group participant discussions generated many new hypotheses, which can be empirically or qualitatively tested in future analyses.

ARTICLE HISTORY

Received 21 November 2023

Accepted 16 June 2024

KEYWORDS

Focus groups; pandemic challenges; post-pandemic opportunity; SARS-CoV-2; Southern forestry

Introduction

The timber supply chain in the United States is diverse and multi-faceted (Ning and Sun 2014; Wear, Prestemon, and Foster 2016; Riddle 2021). Producers along the timber supply chain include forest landowners, loggers, and primary and secondary mills (Wear, Prestemon, and Foster 2016; Riddle 2021). While industries along the timber supply chain have increased mechanization over the last few decades, the chain as a whole remains dependent on labor for harvesting, transporting, and processing wood (Stier 1980; Rummer 1994; Wear, Prestemon, and Foster 2016; He et al. 2021). This labor-intensity in the first stages of the timber supply chain made it vulnerable to COVID-19 disruptions. We examine how this played out in the U.S. South, which produces approximately 60% of the Nation's timber products, almost entirely from private forests (Dahal, Henderson, and Munn 2015). With 245 million acres of forest-land, of which 87% is privately owned (Oswalt et al. 2019), the U.S. South supports a timber supply chain that generates over \$317 billion of total economic output annually (Parajuli 2021).

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The Coronavirus Disease 2019 (COVID-19) pandemic interrupted worldwide supply chains due to both the public health effects and the public policies put in place to contain those effects (Magableh 2021; Redlin 2022; Bruck et al. 2023). Magableh (2021) reviewed the literature and designed a novel framework to examine how global supply chains were impacted by and responded to the COVID-19 pandemic. The three primary drivers of COVID-19 impacts included: demand volatility, supply disruptions, and governments' response. The framework categorized the causes of supply chain disruptions, challenges related to the COVID-19 pandemic, and trends during the crisis (Magableh 2021).

Specifically, increasing cases of illness along with policy responses such as mandatory lockdown orders and social distancing constrained the labor force (Chetty et al. 2022; Opportunity Insights 2023). Labor disruptions and lockdown orders related to the COVID-19 pandemic altered consumption early in the pandemic (Muhammad and Taylor 2020). Nevertheless, economic impact payments associated with the Coronavirus Aid, Relief, and Economic Security Act increased household spending (Baker et al. 2020). Following, demand for certain wood products such as lumber for housing construction starts and home repairs increased, which aided in the recovery of the timber industry in the last quarter of 2020 (Riddle 2021; Kline, Dale, and Rose 2021; Prestemon and Guo 2022; U.S. Census Bureau 2023b). The combination of high demand and relatively low supply contributed to record high prices for southern pine sawn lumber, while prices for southern softwood and hardwood sawtimber remained relatively stable (Riddle 2021; Fastmarkets RISI 2021; Prestemon and Guo 2022; van Kooten and Schmitz 2022).

Impacts to the forest sector in the U.S. South have previously been explored through quantitative methods (Bruck et al. 2023; Chizmar et al. 2023), survey analysis (Hilsenroth et al. 2021), and a review of the literature (Kline, Dale, and Rose 2021; Jayasundara, Kadam, and Dwivedi 2024); however, to the best of our knowledge, there has not been any research utilizing focus group discussions to further elaborate on potential long-term impacts of the pandemic, examine interrelated effects, or highlight perceptions of key stakeholders. These impacts may have interacted with preexisting trends in unexpected ways.

In this perspectives paper, we explored impacts and adaptations of the COVID-19 pandemic through focus group discussions around nine sub-themes with non-industrial private forest landowners, contractors and consultants, and agency and association employees. We compared perceptions of focus group participants with previously published literature, or other reputable sources of statistics, and highlighted new hypotheses that could be explored further in the future. Our findings shed light on the strengths and vulnerabilities of the timber supply chain in the U.S. South, which could in turn guide preparations for future economic shocks.

Methods

We utilized focus group discussions with forestry supply chain participants and other knowledgeable stakeholders to understand their varied perspectives on the impacts of the COVID-19 pandemic. Starting with the framework established by Magableh (2021), we identified nine timber supply chain specific sub-themes related to supply

disruptions, government response, and demand volatility: On-hold production, logging changes, wood-mill changes, delivery changes, policy changes, education and outreach, shopping preference changes, forest products demand changes, and landowner-ship values.

We recruited participants from four states for three key informant groups: 1. land-owners, 2. contractors and consultants, and 3. agency and association employees. These three broad participant groupings were purposefully chosen to acquire a range of perspectives and knowledge about how COVID-19 impacted the timber supply chain. Four focus groups were scheduled: one with landowners, one with contractors and consultants, and two with agency and association employees (a and b) (Table 1). All focus groups took place remotely in August 2022. The entire focus group protocol was reviewed and assigned exempt status by North Carolina State University Institutional Review Board (25008).

We developed a semi-structured interview guide with twenty-two questions, both drawn from literature (Hilsenroth et al. 2021; Prestemon and Guo 2022) and intended to fill gaps in the literature (See Appendix A). For example, relatively little has been documented about COVID-19 induced changes or confounding factors prior to COVID-19 that compounded the effects of the pandemic for forestland management and financial planning, generational turnover in forestland management, and new business opportunities in the U.S. South (Hilsenroth et al. 2021).

After focus groups were completed, we constructed a qualitative codebook,¹ coded focus group transcriptions, and conducted inter-rater reliability calculations. There were three total raters, and each focus group was independently coded by two separate raters. Our frameworks differ from Magableh (2021), in that: the impacts of the COVID-19 pandemic pertain primarily to the timber supply chain in the U.S. South as described by focus group participants; and we organized the framework in such a way that the drivers correspond within the framework to each factor discussed (Figure 1).

In Table 2, we present the pairwise agreement and Krippendorff's (2011) alpha based on coders agreement of sub-themes². We conduct this test to assess the coding of raters to ensure participant perceptions were reliably categorized. The lower bound of reliability is typically considered 0.60, with the norm for acceptable reliability around 0.80 (De Swert 2012).

We acknowledge the limited number of participants in this study. However, the purpose of the focus group discussions was to solicit rich information about understudied forestry sector changes from the full range of supply chain actors due to the COVID-19 pandemic (Maxwell 2012).

Table 1. Groupings and numbers of focus group participants.

Focus group	Participant group	Number of participants (N = 15)	State representation
Group 1	Contractors and consultants	3	AL, NC
Group 2	Landowners	2	AL, NC
Group 3	Forestry agency and association employees (a)	5	NC, VA
Group 4	Forestry agency and association employees (b)	5	GA, NC

Participants were represented from four states: Alabama (AL), Georgia (GA), North Carolina (NC), and Virginia (VA).

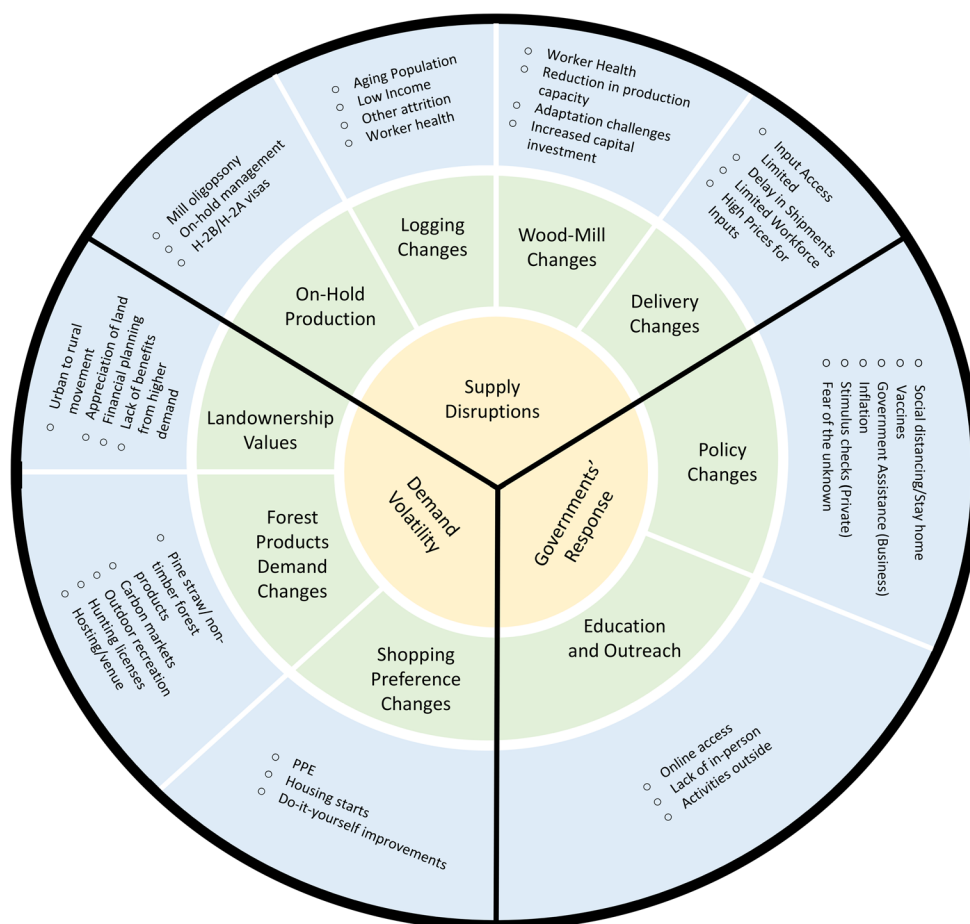


Figure 1. Framework of the impacts of the COVID-19 pandemic on the timber supply chain. The yellow or center ring (governments' response, demand volatility, and supply disruptions) are the drivers of pandemic changes. This is the starting point based off Magableh (2021). The green or Middle ring includes the primary changes to the timber supply chain discussed by focus group participants and corresponds with the center ring. For example, governments' response corresponds with education and outreach and policy changes. Finally, the blue or outer ring describes the most discussed factors corresponding with each primary change. For example, topics discussed in relation to education and outreach include online access, lack of in-person events, and a change in preference for activities outside.

Table 2. Coding reliability indices.

Participant group	Pairwise agreement (%)	Krippendorff's alpha	Raters
Contractors and consultants	86.8	0.85	A, B
Landowners	94.3	0.93	A, C
Association and agency employees (a)	91.3	0.90	B, C
Association and agency employees (b)	95.8	0.95	A, B

There were three separate raters (A, B, and C), who each independently coded two to three focus groups.

Results and Discussion

Figure 1 presents the framework of COVID-19 impacts on the timber supply chain. We focus on COVID-19 pandemic impacts on the timber supply chain in the U.S. South, in contrast to the overarching framework of global supply chain impacts described by Magableh (2021).

Supply Disruptions

On-Hold Production

The pandemic resulted in a slowdown of timber harvests and limited landowners' ability to appropriately manage forests. Furthermore, once timber was harvested, landowners faced mill oligopsony, or a limited number of mills in a region purchasing stumpage (Murray and Prestemon 2003). Mill oligopsony was an issue prior to COVID-19, especially after the 2008 Great Recession, and as reported by focus group participants, continues to be a primary issue for landowners and loggers today. Recent research (Silva et al. 2019), found that there is modest oligopsony power in the southern U.S., but perhaps less than previous studies have found. Furthermore, since there were reduced numbers of buyers, wood mills became a bottleneck in lumber production and ultimately drove up prices for milled wood products. In addition, wood mills did not consume much more stumpage because the production capacity was significantly reduced during COVID-19 from shutdowns (Prestemon and Guo 2022).

Focus group participants believed that COVID-19 constrained the workforce, as well as increased logger and Christmas tree producer fears that immigrant labor would become less available, e.g. due to suspension of H2-A and H2-B visas, which might have caused a slowing of certain production activities. Furthermore, participants noted that an increase in sick workers might have resulted in a shift for forest industries, who changed their worker management practices through social distancing, use of additional personal protective equipment (PPE) such as face coverings, and sanitization of shared spaces and surfaces. Due to government recommendations, demand for PPE drastically increased (Badillo-Goicoechea et al. 2021). Thus, participants noted that acquiring PPE became a challenge as well as perhaps increased the cost of labor. Rowan and Laffey (2020) describes the challenges associated with acquiring PPE during the pandemic. Focus group participants emphasized that forest industries took these health precautions to show their ability to manage virus spread, and believed precautions could potentially reduce the likelihood of a halt to visa issuing.

The U.S. Department of Homeland Security (2020b, 2021) recorded that the annual cap for H-2B visas was met in 2019 (66,000 visas) and received an additional approval of 31,431 visas (for a total of 97,431 visas in 2019). The annual cap remained the same in 2020, yet approximately 4,000 visas remained un-filled, resulting in over 35,000 fewer visas from 2019 to 2020 (U.S. Department of Homeland Security 2020b, 2021). In addition, H-2B visas for new workers attempting to enter the U.S. were suspended on June 22, 2020 to help limit the spread of COVID-19. Exceptions to the proclamation allowed contractors to hire H-2B workers already in the U.S. (Blinn, O'Hara, and Russell 2021).

Logging Changes

A participant noted that loggers might have been short-staffed, which they believed could have resulted in increased injuries and fatalities. The general trend was that fatalities in sectors such as fishing and hunting, roofers, aircraft, and flight engineers, refuse and recyclable materials, and truck drivers decreased in 2020 as compared to 2019. In comparison, fatal work injuries in logging, structural iron and steel, and construction and trade increased. However, this two-year comparison may not be statistically significant, especially considering longer trends through time (U.S. Bureau of Labor Statistics 2021a).

Furthermore, the main reason discussed by focus group participants for loggers exiting the workforce during the pandemic was low income. Prestemon and Guo (2022) described the high prices of dimensional lumber and higher incomes to mills and large box-stores mid-pandemic; however, loggers may have not benefited from higher lumber prices due to bottlenecks described under supply disruptions. Other reasons cited by participants for logger attrition included the inability to hire enough workers and the relatively high prices of diesel fuel, machinery, and replacement parts. In fact, average prices for gasoline and automotive diesel decreased early in the pandemic (for example: 11 percent decrease for gasoline and 8 percent decrease for diesel in March 2020 compared to March 2019). Average prices for each product increased substantially in subsequent years (for example: 68 percent increase for gasoline and 57 percent increase for diesel in March 2022 compared to March 2019) (U.S. Bureau of Labor Statistics 2024). Since focus group discussions occurred in August 2022, price increases happening near that time may have influenced the responses of participants.

Delivery Changes

COVID-19 disrupted shipping and freight services, which led to port delays and shipping container shortages (United States International Trade Commission 2023). These delays significantly increased the price of inputs including fertilizers (Ilinova, Dmitrieva, and Kraslawski 2021), technology chips (Casper et al. 2021), replacement parts for equipment (Russell, Ruamsook, and Roso 2020), and other inputs. Participants cited these delivery challenges as a major hardship for loggers and those working at tree nurseries.

Furthermore, compared to 2019, worker illnesses were up in 2020 by 16% in the wood products sector and 42% in the paper products sector (U.S. Bureau of Labor Statistics 2021b, Prestemon and Guo 2022). Chizmar et al. (2023) also revealed significant decreases to forest-based employment due to state lockdown policies in the U.S. South. Mills were labor constrained and available inventories were quickly exhausted (Prestemon and Guo 2022). A contractors and consultants participant recalled that the labor shortages extended to scarcities for loggers and timber haulers. Yet, a direct causal relationship has not been established for this claim.

Wood-Mill Changes

Wood mills faced worker health and adaptation challenges within the mill, or directly on the job site. One association and employee participant described how it was difficult

to socially distance. Starting on March 15, 2020, many industries, including wood mills, temporarily shut down their operations completely due to lockdown policies. Wood mills were shuttered for almost one business week before resuming operations as an essential service (U.S. Department of Homeland Security 2020a). Once mills re-opened, focus group participants described how it was difficult to keep mills staffed and running at optimal production capacity due to quarantining and isolation needs. Furthermore, in anticipation of consumer demand decreases in wood products, mills reduced their capacity. Yet, demand for wood products did not decrease (van Kooten and Schmitz 2022). Prices of southern pine composite increased by 140% from the end of 2019 to the end of 2020 (Fastmarkets RISI 2021). Focus group participants commented on how wood mills were able to allocate income to previously deferred improvements. Statistics from the United States Census, indicate that in 2021 the wood product industry increased new capital investments by 6 billion dollars, a 16% increase over 2019 levels. However, the paper products sector shrank from 2019 to 2021 (U.S. Census Bureau 2023a; Korhonen and Frey 2023).

Demand Volatility

Landownership Values

Focus group participants suggested that forest management planning and implementation of management practices may have been “low on the priority list” for those worried about job-losses or delayed management due to labor shortages and other inputs. Forest management does not always necessitate frequent and/or immediate applications of treatments. One participant in the contractors and consultants group described that landowners have “quiet periods,” where they are not actively managing. Thus, during the pandemic landowners could generally postpone management activities.

Additionally, during COVID-19, prices for forest products such as lumber from southern yellow pine surged (Fastmarkets RISI 2021), potentially due to increased demand for lumber for home constructions and improvements amidst reduced production of sawmills (Prestemon and Guo 2022; van Kooten and Schmitz 2022). However, participants noted that most landowners did not realize higher benefits related to the increased prices of finished wood products. The surplus of standing timber and bottleneck in mill capacity in the U.S. likely prevented landowners from being able to experience higher stumpage prices (Prestemon and Guo 2022).

Furthermore, multiple focus group participants discussed an increase in urban to rural migration during the pandemic. Many jobs allowed employees to work remotely from anywhere including rural locations, as long as employees had internet access (Howe et al. 2021). Participants surmised this could lead to forest parcelization and fragmentation in the future. Haines et al. (2019) conducted a case study in Wisconsin prior to the pandemic and found that parcelization and development was increasing in rural forested areas. Further analyses could be conducted to assess nation-wide rural migration post-pandemic.

Forest Products Demand Changes

Focus group participants discussed that some landowners may have contemplated new business ventures throughout the pandemic to “maximize” use of their lands, such as carbon markets³. Yet, there was also an increase in the supply of carbon credit programs for landowners with smaller land endowments (Sass, Caputo, and Butler 2022). Therefore, it is difficult to know how much of this interest was spurred on by the pandemic, and how much was due to the development of carbon markets for private landowners. For example, Sass, Caputo, and Butler (2022) used data collected in 2017 and 2018 from the National Woodland Owner Survey and found that less than 0.1% of family forest landowners were enrolled in carbon sequestration programs, and that most landowners were unaware of potential programs, or would be too small to qualify.

Furthermore, according to one of the association and agency employee participants, outdoor recreation and tourism increased in demand during the pandemic. It has been documented that demand for outdoor recreation on public lands increased (Beery, Olsson, and Vitestam 2021; Ferguson et al. 2022), yet the literature lacks information about private land demand changes to recreation and tourism. For example, a participant highlighted that North Carolina had two record years of wild turkey harvests. According to the N.C. Wildlife Resources Commission, in 2020 and 2021 96% and 95% of wild turkey harvest occurred on private land, and more than 4,500 more turkeys were harvested in 2020 compared to 2019 (N.C. Wildlife Resources Commission 2023). It is important to note that while some new opportunities in outdoor recreation on private lands arose during the pandemic, these opportunities may have been relatively infrequent for the public. Nevertheless, a contractors and consultants participant discussed how landowners utilized their lands for personal uses, such as recreation and personal enjoyment, more during the pandemic than before the pandemic.

Shopping Preference Changes

Association and agency participants discussed a surge in shopping preference changes, new home constructions, especially in rural areas, as another example of consumer preference changes. The number of new privately-owned single-unit housing starts in the U.S. South increased from approximately 497,000 housing units in 2019 to approximately 553,000 housing units in 2020, an 11.6% increase (U.S. Census Bureau 2023c). Compared to the previous year, the inflation-adjusted price of new single-unit houses under construction in the U.S. increased in price by approximately 4% in 2020, 12% in 2021, and 16% in 2022 (U.S. Census Bureau 2022).

Governments' Response

Policy Changes

Most of society had never experienced wide-scale stay-at-home and social distancing orders before the COVID-19 pandemic. An association and agency participant indicated it was a challenge getting loggers to adapt to new policies. Focus group participants believed that the public was not fearful of COVID-19 until government policies, such as lockdowns, were put in place. A participant in the contractors and consultants group mentioned fear throughout the pandemic affected the availability of labor to

perform forest management activities. It is possible that COVID-19 related policies may have updated worker assessment of the risk of serious illness, which led in-part to the adjustment of their labor-leisure tradeoff decision. In addition, some factories and mills closed, and logging operations shut down either as a precaution or as a result of government policies. Increasing space and distance, also known as “social distancing,” was recommended by the Center for Disease Control. Bans on large gatherings were put in place and enforced by state and local governments (Wellenius et al. 2021).

The U.S. government established the Paycheck Protection Program (PPP) to provide loans to small businesses to fund up to eight weeks of payroll costs (U.S. Department of Treasury 2023). There were approximately \$2.3 billion (initially approved amount) in PPP loans in 2020 and 2021 to businesses in the forestry sector in the 13 southern states, supporting nearly 250,000 jobs (U.S. Small Business Administration 2022). Further, through the PPP, there were additional outreach efforts early in the pandemic to educate loggers about assistance opportunities. Additional government assistance for loggers and timber haulers was available through the Pandemic Assistance to Timber Harvesters and Haulers (PATHH) program (Russell 2022; Farmers.gov 2023). A participant suspected that some loggers may not have taken the program assistance, “out of principle.” Yet, all \$200 million of PATHH funds were disbursed to loggers and haulers, indicating many took advantage of the program (USDA Release No. 0262.21).

Education and Outreach

During the pandemic all in-person educational activities stopped, which a participant identified as the pandemic’s biggest disruption. This impact was particularly difficult for older landowners, who constitute a large proportion of private landowners in the U.S. (Butler et al. 2020; Peters 2021). Further, certification programs were not able to perform on-the-ground inspections and moved to performing inspections and training remotely.

Focus group participants suggested that there may have been some benefits to transitioning technical assistance and educational programs to online, such as reaching a larger and wider audience. One participant in the contractors and consultants focus group indicated they thought the change to online benefited younger learners with families that may have not been able to attend in-person meetings in the past. Another participant suggested they observed more absentee landowners attend online educational experiences than before the pandemic at in-person gatherings. Pratama et al. (2020) found that there was an overall positive impact on in-depth learning using online meeting applications during the COVID-19 period, with some technical obstacles such as access to quality internet and bandwidth.

Conclusion

We reported the potential impacts of the COVID-19 pandemic on the timber supply chain in the U.S. South based on focus group discussions with key stakeholders. Focus group participants discussed trends prior-to and during the pandemic. Prior trends,

such as mill oligopsony, surplus of standing timber, persistently low stumpage prices, and an aging logger workforce compounded the effects perceived by participants during the pandemic.

Furthermore, we identified that initial stages of the timber supply chain tended to be more labor intensive and thus may have been more vulnerable to virus impacts. For example, mill closures, illness throughout the labor force, and immediate lack of in-person events prevailed at the start of the pandemic. Those along the timber supply chain were able to find a new-normal, incorporating PPE and social distancing protocols, as well as online education events. Delivery challenges and potential pauses in forest management activities continued in the midst of the pandemic. Long term impacts of the pandemic are potentially changes to forest management planning and the continued use of online education and outreach.

Focus group participants were able to substantiate some of the findings in the literature, while other perceptions were not demonstrated via statistical testing or summary information. Nevertheless, participants provided contextual support for some of the published findings, and suggested interdependencies of many time-related factors. Furthermore, and perhaps most importantly, focus group participants provided insights to many avenues for future research. We provide a list below in no specific order:

- Assess a causal relationship between labor shortages from H-2A and H-2B reductions, and increased worker illnesses for logging and hauling businesses. This could be accomplished using similar methods as Chizmar et al. (2023), who quantified the impacts of pandemic lockdown policies on employment in the wood product manufacturing and aggregate forest sectors.
- Quantify the relationship between the pandemic and new investments in the wood products sector, such as new investments to wood mills beyond the initial analysis of Korhonen and Frey (2023).
- Determine heterogenous changes (areas in the south or nation-wide), which had increasing forest fragmentation due to urban out-migration on rural landscapes during the pandemic. Focus group participants discussed the urban to rural shift in housing demand during the pandemic, due to a rise in remote work, which has been found in previous research (Bartik et al. 2020; Liu and Su 2021; Delventhal, Kwon, and Parkhomenko 2022). However, forest parcelization and land use change due to the pandemic has not yet been assessed.
- Measure small forest landowners' preference for rentals or venues on their property during and post-pandemic to support claims of increased interest in these alternative revenue streams. Recreation demand changes due to the pandemic have been explored in the literature (Beery, Olsson, and Vitestam 2021; Hansen et al. 2023; Taff et al. 2021), particularly on public lands. Focus group participants generally agreed that recreation, such as hiking or biking, did not increase on private lands during or due to the pandemic. However, changes in demand for short-term rentals or venues have yet to be quantitatively explored in the literature.
- Qualitatively explore the level of personal enjoyment of landownership for small landowner's pre-, during, and post-pandemic. Focus group participants suggested that the requirement to stay-at-home increased appreciation for landownership.

- Assess a potential causal relationship between COVID-19 policies and increased hunting leases on private land beyond simple two-year summary statistics (N.C. Wildlife Resources Commission), and the lasting effect of a potential increase.
- Explore characteristics of loggers and haulers who did not take advantage of government assistance programs, as compared to those who did take advantage of programs (such as PPP and PATHH), to quantify who may have benefited.
- Determine the characteristics of participants who favor online forestry forums, versus in-person, to substantiate claims about younger, more diverse, and absentee landowners preferring online.

In summary, our communication with key informants provided context to interdependent supply, demand, and government factors that impacted the timber supply chain during the COVID-19 pandemic. Ideas proposed by focus group participants generated new quantifiable hypotheses, which may be beneficial to understand when preparing for future market shocks.

Notes

1. The rubric used for coding focus groups can be found in [Appendix B](#).
2. Focus groups were recorded and transcribed verbatim. Participants then were encouraged to review transcripts and allowed to edit their own words to improve the validity and credibility of study results (Candela 2019). This type of respondent validation (“member checks”) helps avoid misinterpretations (Maxwell 2012).
3. Participants also noted new establishments of silvopastoral systems, harvesting pine straw, and growing timber on shorter rotations for chip n’ saw.

Acknowledgements

We would like to thank the pre-reviewers, Dr. Stella Schons and Dr. Kristin Floress, for providing comments on an earlier draft of this perceptions article. We would also like to express our gratitude to the anonymous reviewers for their recommendations.

IRB Approval

North Carolina State University 25008.

Funding

We would like to acknowledge the National Institute of Food and Agriculture (NIFA) Grant 2022-68006-36430 for funding this research.

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Appendix A. Focus group question guide

1. What do you think were the main struggles faced by forestland owners during 2020 (may or may not be related to COVID-19)?
 - a. What strategies did forest landowners use to manage these hardships?
2. During the Pandemic, did landowners have to adjust their land management plans or practices?
 - a. By liquidating timber sooner than expected?
 - b. By changing or delaying management applications?
 - c. When trees were cut?
 - d. When trees are going to be cut in the future?
 - e. When other management practices will take place, such as thinning?
 - f. Non-timber forest product management?
 - g. Other management practices?
3. During the Pandemic, did any new business opportunities arise?
 - a. New socially distanced recreation enterprises?
 - b. Increased demand for hunting leases?
 - c. Other new business opportunities?
4. Did any government assistance programs, such as paycheck protection or stimulus payments, help ease the struggles associated with COVID-19 and/or with adaptations or new opportunities?
 - a. Did monitoring of existing programs change?
5. Because of the Pandemic, have reasons for land ownership and/or have ownership objectives changed?
6. Because of the Pandemic, have there been changes in landowners’ financial planning? Please elaborate.
7. As a result of the Pandemic, has there been more generational turnover in land ownership? To what extent?
8. As a result of the Pandemic, has there been more attention to estate planning
 - a. Is this due to the higher mortality of the elderly, or other reasons?
9. Has access to government assistance programs, such as cost-share programs, put in place due to COVID-19 vary by race, gender, or age?

10. Did access to consultation for forestland management vary by race, gender or age during COVID-19?
11. Did labor shortages influence forestland management or forestland management plans? If so, how?
12. Did disruptions to supply chains influence forestland management or forestland management plans? If so, how?
13. Did the opening and closing of institutions (for example extension services) influence forestland management or forestland management plans? If so, how?
14. How do you think COVID-19 has influenced future land management planning, if at all?
15. How do you think landowners are dealing with current COVID-19 waves? Are they different strategies than when the pandemic first began?
16. At what time was COVID the most influential factor? When did it not become so influential with forestland management anymore?
17. *The H-2B program is administered through the U.S. department of labor. H-2B is a nonimmigrant program that permits employers to temporarily hire nonimmigrants to perform non-agricultural labor or services in the United States.*
18. How did the Pandemic influence the recruiting, numbers, and supply of H-2B labor in the forest industry?
19. What were the additional costs to H-2B workers and/or contractors a result of the pandemic?
20. Did changes in H-2B labor change or delay any landowner scheduled 2020–2021 management practices such as:
 - a. Tree planting
 - b. Pre-commercial thinning
 - c. Selective herbicide applications
 - d. Pine straw raking
 - e. Boundary line painting
 - f. Nursery production
21. Was there a switch to alternative labor sources or mechanization to cover forest management practices traditionally done with H-2B labor?
22. How was the health of immigrant labor managed or not managed (in relation to COVID-19 and the spread of the disease)?

Appendix B.

Below is the coding rubric used to categorize focus group participant responses. For example, a participant in the landowner focus group considered revenue streams from a venue for recreation, “...I’ve thought about the possibility of having a cabin on the creek, and maybe renting that out to folks like a VRBO...” This quote was categorized under “Step 1” as “demand volatility,” and then “hosting/venue.” Furthermore, we categorized different quotes into various short, medium, and long-term time impacts to discern between initial pandemic impacts and impacts that may have continued past the pandemic. Short term changes were considered a new change, or short-term shock, such as the demand for new wood products (for example: desks for stay-at-home work.) Medium term changes were factors considered a “new normal” for the pandemic period, such as the use of PPE. Long term changes were factors that likely will continue after the pandemic, such as online education and access.

Finally, we categorized quotes into “Step A,” or impacts that were happening before the pandemic which compounded the impacts of COVID-19 effects. For example, the quote, “There’s not too many of them (loggers) that would tell their kids to go into the business right now, you know... But across the board, the age... the amount of loggers coming up is not making up for those leaving and there’s going to be an issue at some point,” was categorized as “Step A,” since an aging labor pool was occurring prior the pandemic but was discussed in the context of difficulties during the pandemic.

Study limitation code: Anything where an individual talks about how it "wasn't just COVID"										
Step A										
Step 1:	Supply disruptions (S)	Government response (G)	Demand volatility (D)							
Step 2:	Delivery changes (S)	Shopping preference changes (D)	Wood-mill changes (S)	Logging changes (S)	On-hold production (S)	Education and outreach (G)	Policies (G)	Forest products demand changes (D)	Landownership values (D)	
Step 3:	Inputs delivered (seedlings/herbicide/fertilizer/machinery)	PPE	Workers health	Aging population	Mill monopsony/oligopsony	Online access	Social distancing/stay at home	Pine straw	Urban to rural movement	
	Delay in shipments (cargo, border closing)	Decks	Lack of information (about COVID)	Low income	On-hold forest management activities	Lack of in-person	Vaccines	Agriculture	Appreciation of landownership (ecosystem services)	
	Limited workforce (COVID-19 limitations)	Housing starts	Reduction in production capacity	Other attrition	H-2B Visas	Activities outside	Government assistance (business)	Carbon markets	Financial planning (objectives)	
	Price high for inputs	Office furniture	Adaptation challenges (social distancing)	Worker health			Inflation	Christmas trees	Lack of benefits from higher wood demand (Landowners)	
Step 4:		Do-it-yourself improvements	Increased capital investment (back into the mill)				Stimulus checks (private)	Outdoor Recreation		
		Food delivery					Fear of the unknown	Longleaf pine		
								Hunting licenses		
								Hosting/venue		