



Perceived Impacts of the COVID-19 Pandemic on Private-Sector Urban and Community Forestry in the Southern United States

By Rajan Parajuli, Stella Zucchetti Schons, Puskar Khanal, P. Eric Wiseman, Stephanie Chizmar, Austin Lamica, Jason Gordon, Thomas Ochuodho, James E. Henderson, Sayeed Mehmood, and Lara Johnson

Abstract. Background. Private-sector urban and community forestry (U&CF) is a major segment of the green industry with substantial socio-ecological and economic contributions to urban and sub-urban communities. The COVID-19 pandemic reportedly caused heterogeneous impacts on businesses, the workforce, and various sectors of the overall economy. The purpose of this study was to evaluate the perceived impacts of the COVID-19 pandemic on private businesses carrying out U&CF activities in the Southern United States. Methods. Using data collected through an online survey distributed across the Southern USA in 2021, we developed and estimated an empirical model to evaluate the factors describing the perceived impacts of the COVID-19 pandemic on U&CF businesses in the region. Results. Results suggest that COVID-19 had, on average, a neutral impact on the U&CF activities performed by the private sector in the study region, but the perceived impacts varied by the industry types. Results from the ordered logistic regression suggest that nursery and garden supply stores were more likely than other businesses to have a positive impact of COVID-19 on the U&CF segment of their business. Similarly, business metrics such as the size of the company in terms of annual sales and revenues or longevity in the business were found to be significant factors explaining the COVID-19 impacts on U&CF business. Conclusion. Our study findings are useful for U&CF decisionmakers for better planning, preparedness, and programming of U&CF activities and businesses in the southern USA.

Keywords. COVID-19 Pandemic; Green Industry; Ordered Logistic Regression; Private Businesses.

INTRODUCTION

The COVID-19 pandemic and corresponding interventions to control the spread, such as mandatory lockdowns, contributed to increased nature-based activities in urban places (Spotswood et al. 2021; Davies and Sanesi 2022). This in turn highlighted the contribution of urban forests (the ecological mosaic of tree canopy and other green and blue spaces) to individual wellbeing and mental health, along with the many other ecosystem services of urban forests (Grima et al. 2020; Davies and Sanesi 2022). The pandemic further exposed distributive and procedural inequities in less green neighborhoods in the United States (Spotswood et al. 2021), highlighting the importance of urban forestry (Campbell et al. 2022). Abundance and access of urban forests and their related benefits

are a result of a series of concerted decisions made by public and private actors and groups in the form of urban and community forestry (U&CF) policies and projects. Private businesses constitute one of these groups of stakeholders, providing not only financing for such policies and projects through local and state tax payments, but also stimulating local economic activities through equipment and material purchases and generating income through jobs and investments (Hall et al. 2020; Parajuli et al. 2022).

Urban forests and green spaces constitute an important and dynamic component of the urban space, providing numerous benefits in the form of ecosystem services, some of which generate fungible benefits such as cost-of-living reduction, for example, through energy conservation and enhanced physical

and mental health (O'Brien et al. 2022). A recent and thorough review of ecological and human benefits of urban forests is presented in O'Brien et al. (2022). Besides the additional hedonic values to the adjacent properties, it has been estimated that urban forests provide external benefits in the order of \$73 billion to the national economy in the USA, and that the urban forestry sector contributes \$64 billion in economic benefits (Thompson et al. 2021).

The planning, establishment, and management of urban forests entail a series of activities that are carried out by public and private stakeholders which, together, comprise the U&CF sector, the ultimate providers of urban forest ecosystem services to society. Public stakeholders comprise federal, state, and local government agencies dictating urban and community forestry policies and guidelines to be implemented in publicly owned spaces, as well as universities that undertake the research and generate the knowledge to inform such policies and guidelines (Parajuli et al. 2022). This knowledge also guides the private actors carrying out tree care and urban canopy management, such as non-profit organizations and urban forestry professionals (consulting foresters, commercial arborists, landscape contractors, among others), in a landscape that is predominantly privately owned such as residential yards, woodlots, corporate parks, and industrial sites (Miller et al. 2015).

The COVID-19 pandemic caused significant, yet heterogeneous, overall impacts on businesses, the workforce, and therefore, on consumer spending throughout the US (Chetty et al. 2020; Padhan and Prabheesh 2021; Roman et al. 2022). In an early assessment, Chetty et al. (2020) showed that, despite a 67% reduction in total consumer spending due to the COVID-19 shock, there was a slight increase in seasonally adjusted consumer spending on luxury services that do not require contact as opposed to demand for services and goods that required contact (such as the food and accommodation services). Moreover, they suggested that the main driver of residual decline in spending on non-interaction services was the trickle-down effect related to the ability of businesses to supply such services—a factor that may be more prominent among small businesses that have lower ability to find substitutes for scarce resources, such as labor and inputs, across sectors and a restricted geographical area (Yagan 2019). Roman et al. (2022), based on the U.S. Census Bureau's

economic surveys, reported that there was a dip in overall business sales and shipments in 2020 due primarily to the pandemic, but by the end of fourth quarter of 2021, the economic indicators in the U.S. fully recovered to the pre-pandemic level.

With the prospects of increased potential for further pandemic events in the future (Grima et al. 2020), understanding the organizational capacity to carry out U&CF activities—including the prevalent work of private-sector U&CF businesses—is necessary for provision of urban forest ecosystem services and urban forestry policy going forward. The entrepreneurship that comes with small businesses is key in community rebound after disasters (Storr et al. 2015), such that understanding how small businesses perceive the impacts after a pandemic shock, and how it relates to challenges they face, may be informative of their ability to deal with pandemic shocks and to help communities recover.

The purpose of this study was to evaluate the perceived impacts of the COVID-19 pandemic on private businesses carrying out U&CF activities in the Southern USA using data collected through an online survey in 2021. We were specifically interested in the private businesses involved in U&CF in the region, since they play a large role in implementing U&CF across the region's predominantly private urban forestlands. In this paper, we relate the perceived impacts of the COVID-19 pandemic to the challenges faced by these businesses as well as to characteristics of the businesses in an attempt to understand how U&CF policies may prepare the private sector for future pandemic and economic shocks, such that it continues to provide the services for human wellbeing and the overall environment in urban areas in times of distress.

Besides Marwah et al. (2021), who looked at the impacts of COVID-19 on the broader green industry using a small sample from Texas, this is the only study, to the best of our knowledge, that investigates the impacts of COVID-19 on the private-sector U&CF industry, which is likely due to the low availability of sector-wide data, in general, and around COVID-19, specifically. Moreover, most of the studies looking at urban forests and COVID-19 have focused on the importance of access to urban green spaces during that time and at the equity issues surrounding it (Ugolini et al. 2020; Venter et al. 2020; Poortinga et al. 2021; Ugolini et al. 2021; Marconi et

al. 2022). Our analysis contributes to the discussion of the challenges encountered by one of the mediators of urban forest ecosystem services—a partner that can affect the provision of such services. The role of private businesses in U&CF goes far beyond the mere provision of financing for U&CF projects and activities as suggested, for example, by Jones et al. (2005), and their relevance has been understudied.

MATERIALS AND METHODS

Study Area and Data Collection

The study region for this analysis included 13 states in the Southern United States (SUS): Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia (Figure 1). This region aligns with the U.S. Forest Service Region 8. The 13-state region shares similar socioeconomic, cultural, and policy landscapes, and all 13 states put together efforts to develop the U&CF economic analysis project and solicited the multistate U.S. Forest Service funding via Landscape Scale Restoration grants.

The data for this study was obtained through a regional survey of private, for-profit U&CF businesses that was part of the larger data collection effort

aimed at analyzing the overall economic contribution of U&CF to the regional economy in the SUS (Parajuli et al. 2023). The survey contained mostly closed-ended questions related to business characteristics such as the type of business, business segment, time of establishment, owner demographics, and business metrics such as total sales and employment as well as the perceived business challenges and the perceived impacts of the COVID-19 pandemic on the U&CF portion of their total business. Prior to its implementation, the survey instrument was pre-tested by a few selected U&CF professionals that represented the study population and not included in the final sample.

The Institutional Review Board at North Carolina State University (IRB protocol 23973) approved the survey instrument and the administration procedure as exempt from the policy as outlined in the Code of Federal Regulations. The emails of businesses located in the study region and operating in the broader green industry as defined by the North American Industry Classification System (NAICS) were purchased from Exact Data (Exact Data 2022). In terms of business types as classified by NAICS, similar to Parajuli et al. (2022), this study included: nursery, greenhouse, and tree production (NAICS 111421), farm and garden

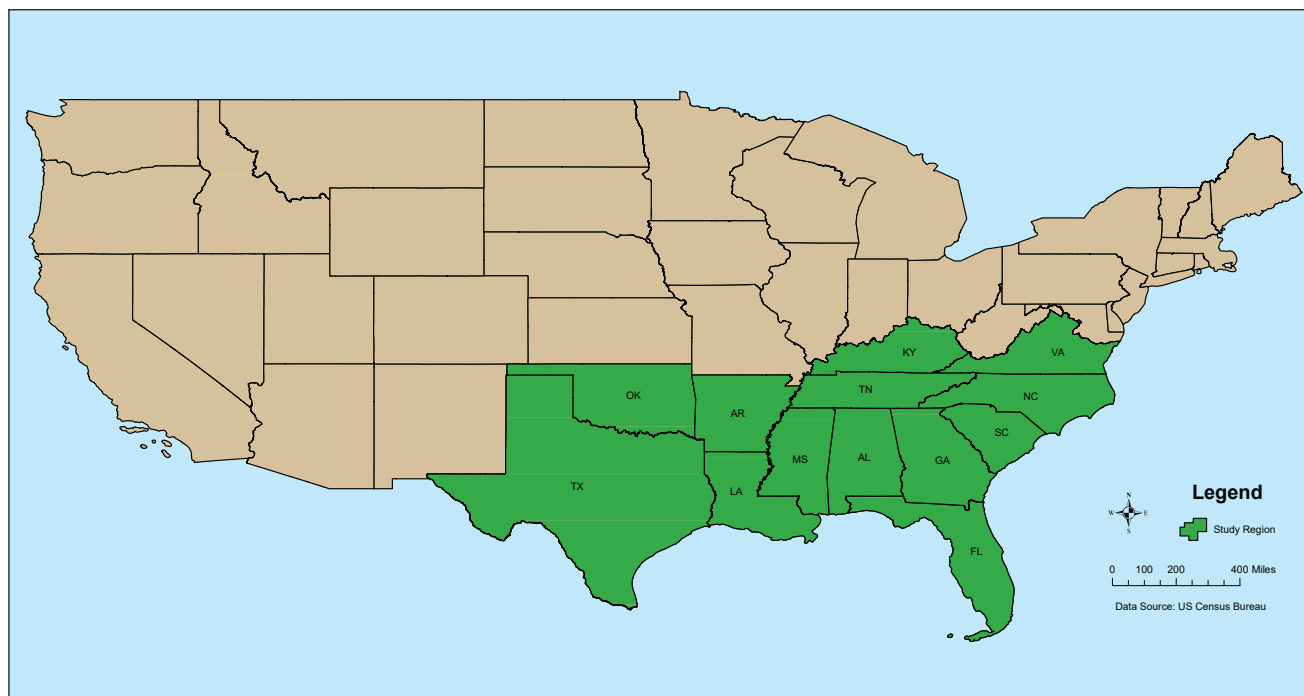


Figure 1. Map of the study region: 13 states in the Southern United States

equipment wholesalers (423820), nursery and florist's supplies merchant wholesalers (NAICS 424930), nursery and garden supplies stores (NAICS 444220), landscape architectural services (NAICS 541320), and landscaping services, which includes tree care services (NAICS 561730). U&CF businesses are a segment of the broader green industry; thus, we specifically asked the survey respondents to distinguish the U&CF portion of their business from other green industry services they might offer. In general, the U&CF business sector or "industry" comprises the provision of services by the professionals listed above and firms providing the material inputs for U&CF activities.

Following Dillman et al. (2014), we employed the Qualtrics email distribution feature to send out mass emails to the contact lists of each U&CF group. The non-respondents were followed up with 3 email reminders with no incentives after the initial email invitation. During the survey administration period from 2021 July 27 to 2021 December 31, 384 fully and partially completed survey responses out of 14,543 contacted businesses (about 3% response rate) were recorded in Qualtrics. To check for the presence of

non-response bias, we conducted the paired 2-sampled *t*-test (Peck et al. 2012) between the first 10% (early) and the last 10% (late) of responses for a few variables in the survey. The statistically insignificant *t*-statistics of full-time employment and organization structure between the early and late responders indicate that non-response bias was unlikely to be a critical issue in our dataset. Figure 2 presents the number of valid responses by state used for modeling purposes in this study. We received about 48% of the total responses from Florida, Georgia, and North Carolina, with approximately 16% of responses coming from each of those states.

Empirical Model

To answer our research question regarding what factors could explain the perceived impacts of the COVID-19 pandemic on the businesses that comprise the private U&CF segment of the green industry within our study area, we developed an empirical model integrating industry types, business metrics, business entity, and the demographics of business owners. As explained in detail by Bellitski et al.

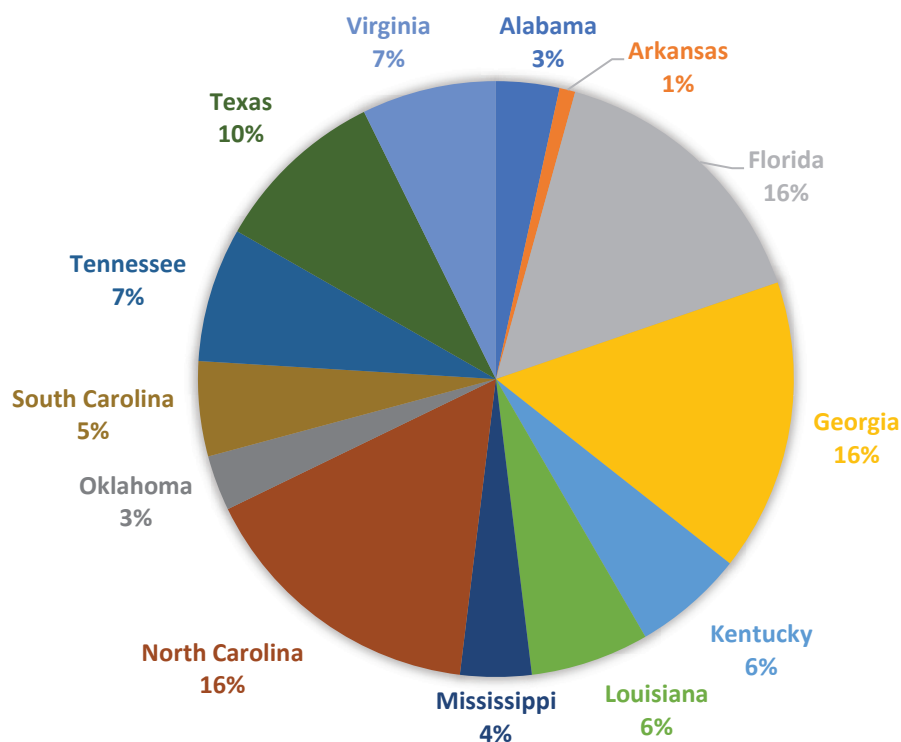


Figure 2. Percentage of survey responses by private-sector urban and community forestry (U&CF) businesses in the Southern USA, broken out by each of the 13 states ($n = 233$).

(2022), our empirical model is primarily based on the disaster theory (Torres et al. 2018) that focuses on the firm's size and resiliency, and the resilience theory (Marshall and Schrank 2014) that focuses on post-disaster business resilience. We also included demographic variables because several studies reported that gender, race, and ethnicity of business owners play a critical role in their performance, business outcomes, and risk-taking behavior (Carland and Carland 1991; Fairlie and Robb 2009; Farlie 2020; Farrell et al. 2020). The empirical model is specified as:

$$\begin{aligned} covid = f(\textit{landscaping}, \textit{nursery} \\ - \textit{tree}, \textit{nursery} - \textit{stores}, \textit{large} \\ - \textit{firm}, \textit{longevity}, \textit{large} \\ - \textit{sales}, \textit{llc}, \textit{training}, \textit{turnover}, \\ \textit{uncertainty}, \textit{edu}, \textit{male}, \textit{white}) \end{aligned} \quad (1)$$

Where, *covid* represents the perceived impacts of the COVID-19 pandemic on business performance collected through the question “How has the COVID-19 pandemic impacted the urban and community forestry segment of your business?” and were recorded on a 5-point ordinal scale: (1) very negative impact, (2) somewhat negative, (3) neutral, (4) somewhat positive, and (5) very positive. Similarly, the binary variables *landscaping*, *nursery-tree*, and *nursery-stores* indicate NAICS industry types related to private landscaping services, nursery and tree production, and nursery retail stores, respectively. We hypothesized that COVID-19 affected different U&CF industry types heterogeneously, depending on the level of physical interaction with customers and according to the level of restrictions they had to abide by during the pandemic.

The variables *large-firm*, *longevity*, and *large-sales* denote various business metrics representing each respondent's firm size in terms of the number of employees, years in business, and the total annual gross sales, respectively. These business metrics should help understand the variation in the perception of COVID-19 impacts on U&CF businesses, as they are usually a reflection of a firm's size and success in the U&CF industry. The variable, *llc*, represents the legal structure or entity of the company, where the value “1” represents a limited liability corporation business or “0” otherwise.

Additionally, we included a few variables representing respondents' perceptions of several challenges

related to their U&CF business—access to employee training (*training*), personnel turnover (*turnover*), and market uncertainty (*uncertainty*)—to assess how the variation in the COVID-19 impacts is explained by the respondents' perceived challenges to their U&CF business. These variables were recorded on a 5-point ordinal Likert scale to gauge the perception of the severity of the challenge: (1) not at all, (2) slightly, (3) moderately, (4) very, and (5) extremely. We also incorporated a few demographic variables of the business owner that we believe reflect business owners' level of risk aversion and perception of risk, thus affecting how they perceive COVID-19 has impacted their business. The variables *edu*, *male*, and *white* denote if the business owner has at least a bachelor's degree of formal education, if the gender was male, and if the race was white, 0 otherwise, respectively. Table 1 presents a detailed description of the variables used in our empirical modeling.

Estimation Method: Ordered Logit Model

Given that the dependent variable was on a 5-category ordinal scale, we employed the ordered logistic regression model to evaluate the factors explaining the perceived COVID-19 pandemic impacts on the U&CF business of the private green industry in the SUS. With various cut points as the probabilities of negative or positive impacts of COVID-19 on U&CF business, the ordered logistic regression model estimates a score, which should be a linear function of the explanatory variables (Torres-Reyna 2008; Williams 2021). The same relationship between each pair results in just one set of coefficients. Let y_i be the variable representing the response of each respondent and let η_i be an associate latent variable that crosses a series of increasing unknown thresholds, represented by α_j and which will be estimated. Additionally, let $j \in \{1, 2, 3, 4 \text{ or } 5\}$ represent the set of alternative responses such that $y_i = j$ if $\alpha_{j-1} < \eta_i^* \leq \alpha_j$, where $\alpha_0 = -\infty$ and $\alpha_5 = \infty$. The latent response variable may be modeled as per Equation 1 (Cameron and Trivedi 2005):

$$y_i^* = \mathbf{x}'_i \boldsymbol{\beta} + u_i \quad (2)$$

where, \mathbf{x}'_i represents a vector of the variables listed in Table 1, explaining the unknown response latent variable, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, and

Table 1. Variables used in the model explaining the COVID-19 pandemic impacts on the urban and community forestry (U&CF) segment of the green industry in the Southern United States.

Variable	Description	No. of Obs.	Mean
covid	Categorical variable, how respondents described the impact of the COVID-19 pandemic on the U&CF segment of their business: (1) very negative impact, (2) somewhat negative, (3) neutral, (4) somewhat positive, (5) very positive	232	3.03
Industry types			
landscaping	Binary variable: (1) business engaged in landscaping services (NAICS 561730), (0) otherwise	236	0.78
nursery-tree	Binary variable: (1) business engaged in nursery and tree production (NAICS 111421), (0) otherwise	236	0.13
nursery-stores	Binary variable: (1) business engaged in nursery retail stores (NAICS 44422), (0) otherwise	236	0.10
Business metrics			
large-firm	Binary variable: (1) business which employed at least 10 total employees, (0) otherwise	236	0.38
longevity	Numerical variable: years in active business	236	26.18
large-sales	Binary variable: (1) business which had at least \$500,000 annual gross, pre-tax sales and revenue, (0) otherwise	236	0.45
llc	Binary variable representing the limited liability company as a structure of the business: (1) llc, (0) otherwise	236	0.35
Perception rating on challenges to the profitability of U&CF business			
training	Categorical variable: how respondents rated the severity of the issue about access to employee training on their profitability of U&CF business: (1) not at all, (5) extremely	233	2.11
turnover	Categorical variable: how respondents rated the severity of the issue about personnel turnover on their profitability of U&CF business: (1) not at all, (5) extremely	231	2.76
uncertainty	Categorical variable: how respondents rated the severity of the issue about market uncertainty on the profitability of their U&CF business: (1) not at all, (5) extremely	232	2.47
Business owner characteristics			
edu	Binary variable representing the education level of the business owner: (1) owner at least with bachelor's degree, (0) otherwise	236	0.65
male	Binary variable representing the gender of the business owner: (1) owner is male, (0) otherwise	236	0.76
white	Binary variable representing the race of the business owner: (1) owner is white, (0) otherwise	236	0.78

u_i is the idiosyncratic error term. Then, the probability that response y_i is equal to alternative j is:

$$\begin{aligned}
 p_{ij} &= \Pr(y_i = j) = \Pr[\alpha_{j-1} < y_i^* \leq \alpha_j] \\
 &= \Pr[\alpha_{j-1} < \mathbf{x}'_i \beta + u_i \leq \alpha_j] \\
 &= \Pr[\alpha_{j-1} - \mathbf{x}'_i \beta < u_i \leq \alpha_j - \mathbf{x}'_i \beta] \\
 &= F(\alpha_j - \mathbf{x}'_i \beta) - F(\alpha_{j-1} - \mathbf{x}'_i \beta)
 \end{aligned}$$

where F is the cumulative distribution function of the error term u_i , which follows a logistic distribution for the ordered logit model, such that:

$$p_{ij} = \Pr(y_i = j) = \frac{1}{1 + [\exp(-\alpha_j + \mathbf{x}_i \beta)]} - \frac{1}{1 + [\exp(-\alpha_{j-1} + \mathbf{x}_i \beta)]} \quad (3)$$

Equation (2) was used to estimate the log likelihood function:

$$\mathcal{L} = \sum_{i=1}^N \sum_{j=1}^5 y_{ij} \ln p_{ij} \quad (4)$$

We estimated the ordered logistic coefficients along with the category thresholds using the 'ologit'

STATA command. We also estimated the odds ratio statistics of each variable, which describe the odds that a unit increase in each explanatory variable leads to a more positive perceived impact of COVID-19 on U&CF businesses in the SUS. The main underlying assumption of the ordered logistic regression model is the proportional odds or parallel regression assumption, which means the relationship between every possible pair of outcome groups should be the same, indicating that there is only one model (Greene 2011). In other words, all levels of the response variable (perceived impacts of COVID-19 on one's business operations) are explained by the same group of variables. The Brant test (Brant 1990) is a common way to evaluate the parallel regression assumption in ordered logit models. We used the STATA command post-estimation 'omodel logit' to examine the Brant statistics of proportionality of odds (Brant 1990) across response categories.

RESULTS

The Green Industry in the Southern United States and Its U&CF Segment

Figure 3 shows the proportion of responses from each NAICS business category surveyed in our sample. Among businesses working in U&CF in our sample, approximately 68% of the observations belong to landscaping services, including tree care and arboricultural businesses (NAICS 561730). In a similar survey undertaken by Parajuli et al. (2022) in the Northeastern and Midwest states, those figures were 54% out of the total number of observations. Nursery,

greenhouse, and tree production companies (NAICS 111421) and landscape architectural services constituted about 10% and 9% of the total responses, respectively. Meanwhile, nursery and florists' supplies merchant wholesalers (NAICS 424930) and farm and garden machinery businesses (NAICS 423820) comprised the smallest share of our dataset, with 3% and 1% of the total number of observations, respectively.

Most of the surveyed businesses in our sample can be classified as small or medium businesses, both according to the number of employees and by the size of their annual gross sales and revenue. Nursery and garden supply stores reported the highest average number of employees (including full-time, part-time, and seasonal employees) in 2019—55 total employees per business (Figure 4). Businesses in landscaping services (including tree care services) were reported to have on average 25 total employees, 19 of which were full-time, 2 were part-time, and 4 were seasonal employees in 2019. Meanwhile, nursery and tree producers averaged approximately 13 total employees per business, 9 of which were full-time, 2 part-time, and 2 seasonal. Farm and garden machinery wholesalers had the lowest average number of employees according to the regional survey with approximately 6 employees per business. These average numbers are comparable to Parajuli et al. (2022).

Table 2 presents average annual gross sales and revenues in 2019 for each industry type as a measure of their business size. Among the surveyed industry types, farm and garden supply stores reported the highest average annual sales of approximately \$750,000.

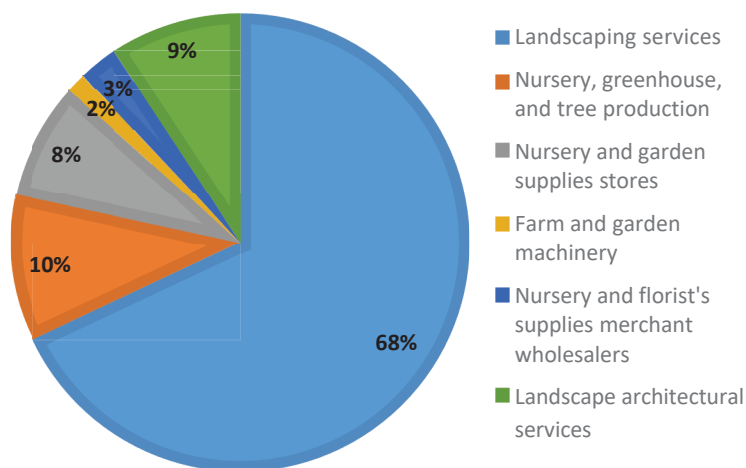


Figure 3. Percentage of survey responses by urban and community forestry (U&CF) business in the Southern USA broken out by green industry business type ($n = 236$).

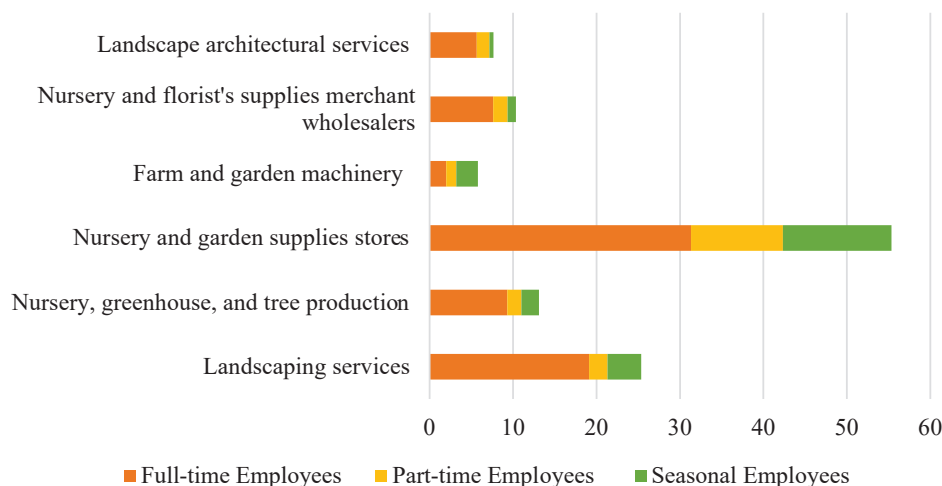


Figure 4. Average number of full-time, part-time, and seasonal employees per organization of urban and community forestry (U&CF) business in the Southern USA during 2019, broken out by the green industry business type ($n = 236$).

Table 2. Average annual sales of surveyed urban and community (U&CF) businesses in the Southern United States by business type in 2019 ($n = 236$).

Business type	Average annual sales* (\$ thousand) (standard deviation)	Average percentage of annual sales in U&CF (%) (standard deviation)
Landscaping services (including tree care services)	\$375 (42.6)	55.71 (40.38)
Nursery, greenhouse, and tree production	\$375 (44.7)	44.07 (38.71)
Nursery and garden supplies stores	\$750 (43.5)	31.33 (34.59)
Farm and garden machinery	\$75 (5.73)	27.67 (21.94)
Nursery and florist's supplies merchant wholesalers	\$375 (40.80)	33.00 (34.36)
Landscape architectural services	\$175 (9.71)	39.07 (34.84)
Overall green industry	\$375 (43.2)	51.16 (40.39)

*Since annual sales and revenues were recorded in ranges, we presented the midpoints of the ranges as average annual values.

Businesses representing landscaping services, nursery and tree production, and nursery and florist's supplies merchant wholesalers reported average annual sales and revenues of about \$375,000. Table 2 also depicts the average percentage of each business's annual sales in U&CF related activities. The largest average percentage sales and revenues in U&CF activities was reported by landscaping services (56%) with a standard deviation of 40.38%, followed by nursery and tree production businesses (44%), and landscape architectural services (39%). Farm and garden machinery wholesalers reported the lowest percentage sales in U&CF activities (28%). All the average U&CF percentage values have a high standard deviation.

In terms of the organizational structure or business entity type, most of the private green businesses in

the study region were corporations (39%), followed by limited liability companies (LLC)(38%). Sole proprietorships represented about 23% of the surveyed businesses. In terms of sociodemographic characteristics of the owners of the businesses surveyed, about 76% reported to be male, 77% reported to be white, and over 64% of the respondents reported to have a bachelor's degree or higher.

Figure 5 presents the perceived impacts of the COVID-19 pandemic on U&CF activities, which varied by business type. The impacts related to COVID-19 were rated using a 5-point ordinal scale where a value of "1" corresponds to a 'very negative' impact and a value of "5" corresponds with a 'very positive' impact. Interestingly, COVID-19 had an overall 'neutral' perceived impact on the U&CF activities performed by the

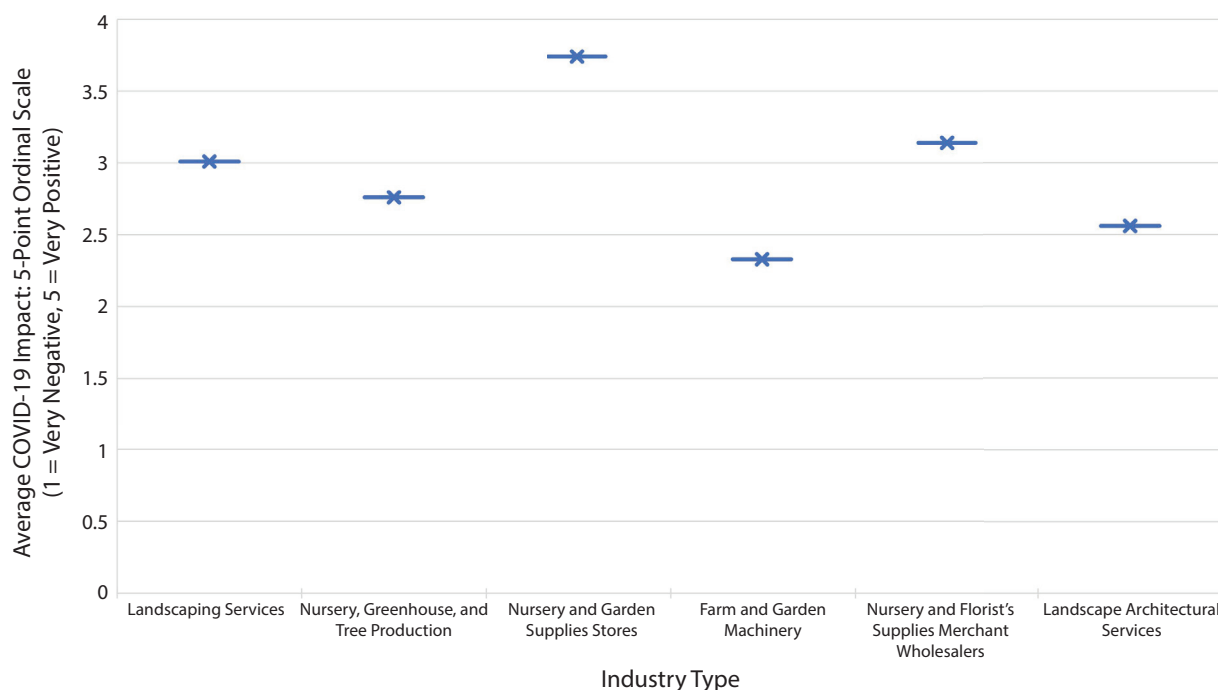


Figure 5. Average perceived impact of the COVID-19 pandemic on the U&CF activities performed by surveyed businesses in the study region. (1) very negative, (2) somewhat negative, (3) neutral, (4) somewhat positive, and (5) very positive.

Table 3. Average decreases in urban and community forestry (U&CF) businesses in the Southern United States during 2020 due to COVID-19 among the respondents reporting ‘somewhat negative’ and ‘very negative’ impact.

Business type	Temporary decline (%) in sales and revenues	Permanent decline (%) in sales and revenues
Landscaping services	27.73	12.50
Nursery, greenhouse, and tree production	41.36	37.64
Nursery and garden supplies stores	22.50	20.00
Farm and garden machinery	20.00	10.00
Nursery and florist’s supplies merchant wholesalers	45.00	17.50
Landscape architectural services	45.83	31.00
Kruskal-Wallis equality-of-populations rank test (χ^2 statistics) [<i>P</i> -value]	8.99 [0.11]	9.40 [0.09]

private industry sector in the study region, on average. Businesses in the nursery and garden supply stores noted an average score of over 3.74, indicating a somewhat positive impact of COVID-19 on their U&CF businesses activities. On the other hand, respondents representing farm and garden machinery equipment wholesalers reported the lowest average rating of 2.33, which was aligned with ‘somewhat negative.’

For the respondents reporting ‘somewhat negative’ and ‘very negative’ COVID-19 impacts (33% of the

total responses), we further asked to identify whether the decline in their businesses was temporary or permanent and to report the magnitude of the decline in their annual sales and revenues (Table 3). According to the survey, the largest temporary decline in business was realized by landscape architectural services (46% on average), followed by nursery and florists’ supplies merchant wholesalers (45%). Nursery and tree production businesses reportedly had the largest permanent decline with an average value of about

38%, followed by landscape architectural services (31% on average). Businesses in landscaping and tree care services reported the lowest average decline in their business in terms of long-term negative effects of COVID-19. The Kruskal-Wallis rank test (Kruskal and Wallis 1952) suggests that the average perceived permanent decline in U&CF business was significantly different by industry types at the 10% level of significance, and the average perceived temporary decline was on the borderline (11%) in terms of the statistically different among the U&CF industry types.

Ordered Logistic Regression Results: Perceived COVID-19 Impacts on Private U&CF Businesses

Table 4 presents the ordered logistic regression results obtained from the model presented in Equation 1. In terms of the validity of the ordered logistic model as an appropriate empirical strategy for the data, an insignificant test statistic (P -value = 0.11) from the likelihood ratio test of proportionality of odds suggests that the estimated model does not violate the proportional odds assumption. All the variables

representing the demographic information of business owners were found to be statistically insignificant.

Most of the statistically significant variables, except the perception rating of respondents on personnel turnover (*turnover*) and market uncertainty (*uncertainty*), were found to be positively associated with the likelihood of the perceived COVID-19 impacts on the U&CF segment of the green industry business (Table 4). Among the variables representing industry classes, only the variable representing nursery and garden supply stores was found to be statistically significant at the 5% level. The estimated odds ratio value of 3.18 associated with *nursery-stores* suggested that nursery and garden supply stores were 218% more likely to perceive positive pandemic impacts on their U&CF related businesses, compared to other industry types. Similarly, the older private businesses operating for a longer time (*longevity*) were found 2% more likely to have positive perceived COVID-19 impacts. Results also suggest that the variable representing a business with at least \$500,000 annual sales and revenue (*large-sale*) was about 108% more likely to have positive perceived pandemic impacts, compared to the smaller businesses.

Table 4. Ordered logistic regression results highlighting the factors explaining the perceived COVID-19 pandemic impacts on the urban and community forestry segment of the private green industry in the Southern United States ($n = 221$)

Variable	Coefficient (standard error)	P -value ($P > z $)	Odds Ratio
landscaping	0.191 (0.386)	0.620	1.211
nursery-tree	-0.266 (0.466)	0.569	0.767
nursery-stores	1.157 (0.489)	0.018	3.179**
longevity	0.021 (0.008)	0.013	1.021**
large-firm	-0.276 (0.336)	0.410	0.758
large-sale	0.735 (0.328)	0.025	2.085**
llc	0.501 (0.276)	0.070	1.645*
training	0.220 (0.128)	0.086	1.246*
turnover	-0.226 (0.099)	0.023	0.798**
uncertainty	-0.294 (0.116)	0.012	0.745**
edu	0.039 (0.274)	0.885	1.040
male	0.124 (0.309)	0.688	1.132
white	-0.231(0.332)	0.487	0.793
The likelihood ratio test of proportionality of odds	49.90	0.11	

* significant at 10%

** significant at 5%

Additionally, compared to other organizational structures, respondents representing limited liability companies (*llc*) were found to be about 65% more likely to realize the positive perceived pandemic effects on their U&CF businesses.

Three variables representing the respondent's rating on potential challenges to the profitability of U&CF business were found to be statistically significant predictors explaining the perceived COVID-19 impacts on UC&F businesses in the study region (Table 4). A variable representing the challenges related to access to employee training (*training*) was found to have a positive relationship with perceived COVID-19 impacts. The odds ratio value of 1.25 associated with training indicates that private businesses which rated the challenge of access to employee training higher were 25% more likely to realize positive perceived COVID-19 impacts on their U&CF business. On the other hand, respondents that identified the issue of personnel turnover (*turn-over*) or market uncertainty (*uncertainty*) were found less likely to have positive perceived COVID-19 impacts on their U&CF businesses in the study region.

DISCUSSION AND CONCLUSIONS

This study evaluated the impact of the COVID-19 pandemic on U&CF business activities as perceived by the owners of a range of businesses in the private green industry across the 13 southern states in the USA. About 74% of the participating businesses represented the landscaping and tree care services industry while the remaining 26% were in the nursery tree production, nursery and garden stores, farm and machinery supplies, nursery wholesalers, and landscape services industries. Most of the surveyed businesses were small or medium in size, employing about 20 workers on average, and grossing an average of \$375,000 in sales and revenue annually. Results from this study inform the stakeholders preparedness and future planning of U&CF businesses during disaster events such as the COVID-19 pandemic. In particular, the findings may help to identify and prioritize operations that benefit local urban communities in the immediate and long-term recovery processes following an economic shock of a similar magnitude.

Our survey results revealed a great variation in the perception of the impacts of the COVID-19 pandemic

on U&CF business activities among the 6 green industry sectors in the study region. The resulting overall average perceived impact of COVID-19 on private U&CF, however, is neutral. Over 36% of the respondents reported 'somewhat positive' or 'very positive' impacts of COVID-19 on their U&CF activities, some of them emphasizing stable or even increased activities during the pandemic. Among the business types, only nursery and garden supply stores were found more likely to have experienced positive business impacts from the pandemic, according to the results from the ordered logistic regression. Marwah et al. (2021) also reported that over 46% of green industry businesses in the U.S. reported positive COVID-19 impacts on their sales in 2020.

Two possible explanations may be attributed to the neutral to somewhat positive perceived impact of the COVID-19 pandemic on their U&CF businesses, specifically nursery and garden supply stores. First, several green industry sectors were qualified as essential businesses during the early period of the pandemic, which allowed them to remain open as long as social distancing and proper hygiene strategies were practiced (CDC 2021). Several studies reported that the uses of urban forests and green spaces increased significantly during the pandemic (da Schio et al. 2021; Ugolini et al. 2021; Weinbrenner et al. 2021). Second, yard care constituted a psychological and morale-boosting activity during a time when individuals had few in-person leisure options, resulting in homeowners' increased spare time for yard maintenance and gardening activities, which led to an increase the demand for green industry products (Fratello et al. 2021). Future studies should explore further if there has been a permanent shift in consumer behavior with regards to urban forests and green space activities to determine the need for increasing the scope and prospects of green industry businesses.

Our ordered logistic regression results suggest that older businesses, larger annual sales and revenues, and those that are in the LLC business category were more likely to realize a positive perceived impact of the COVID-19 pandemic on their U&CF activities. Businesses reporting greater challenges related to business uncertainty and personnel turnover were less likely to report positive COVID-19 pandemic impacts, whereas those who face difficulties finding personnel specifically trained in U&CF were more

likely to report positive impacts. Surprisingly, unlike the previous studies (Carland and Carland 1991; Fairlie and Robb 2009; Farlie 2020), none of the demographic variables were found to be significant in the regression analysis, which may be due to the lack of variation in these variables within our sample.

Our ordered logistic regression results suggest that among industry types, only businesses in the nursery and garden supply stores were found more likely to realize positive perceived impacts of the pandemic. The perceived COVID-19 impact on nursery and garden supply stores was statistically significant and had a relatively higher odds ratio than other industry types, indicating higher sensitivity to the pandemic environment. Supply chain problems such as the timely availability of fertilizer and other landscape supplies that might have been categorized as non-essential during pandemic lockdowns may have contributed to this sensitivity. Along with the supply chain restrictions and the changes in consumer behavior, these stores had to manage significant challenges in matching inventory with consumer demand and in operating at reduced capacity (Marwah et al. 2021).

Employee turnover and business uncertainty were found to be significant challenges with negative perceived impacts on U&CF businesses in the Southern United States. The US federal government, through the Coronavirus Aid, Relief, and Economic Security (CARES) Act and the Paycheck Protection Program, provided payments to workers impacted by the COVID-19 pandemic that were competitive with their actual pay, making some employees prefer the government checks over working as employees during the public health crisis. Small- and medium-size businesses had challenges keeping their employees at work. Meanwhile, high demand for labor in some sectors led workers still in the labor market to switch jobs in pursuit of better-paying opportunities. Meanwhile, Chetty et al. (2020) found that COVID-19 had a V-shaped impact on trained and experienced employees, meaning that the pandemic-induced, uncertain business environment led to widespread job losses for more extended periods for the untrained and inexperienced employees, while the trained employees were quickly rehired after layoffs. For this reason, relief programs and governmental assistance targeted to small- and medium-size businesses in the U&CF sector might have mitigated the pandemic impacts to some extent. Such targeted programs would be

particularly impactful for businesses that are not designated as “essential” but are still vital in maintaining the supply of and demand for U&CF products and services. For instance, Rihn and Jensen (2022) reported that the Paycheck Protection Program allowed businesses in the green industry in North Carolina, Georgia, Virginia, Tennessee, Alabama, and South Carolina to retain 8,516 jobs, equating to approximately 9.5 to 18.3 jobs per firm on average. Future research should explore the impacts of government assistance programs such as the Paycheck Protection Program on the various industries within the larger green industry to compare how benefits were distributed and realized among different sectors, regions, and business types.

Lastly, a couple of research caveats are worth noting. First, despite our multiple survey advertising efforts to recruit and motivate private businesses to participate in the survey, we were able to achieve only a 3% response rate from the total contacted private businesses. The low response rate has become a common trend in recent years (Cleary et al. 2021; Hoy et al. 2022), due probably to the proliferation of survey requests that have come with increased technology and mobile device use (Manfreda et al. 2008). Allocating time to work on the survey without any monetary or in-kind incentives may not be an attractive option for private company personnel who were extra busy meeting the growing demand for their businesses during the pandemic. Moreover, our survey included questions asking some sensitive information such as annual sales and revenue, which most private companies might be reluctant to share with others through an online survey. Second, the perceived COVID-19 impacts would have been worse in the first few weeks of the pandemic when strict lockdowns were imposed, compared to the first half of 2021 when the pandemic was more normalized with vaccination and other recommended policies. These private businesses could have realized a swift negative impact during the lockdown periods, but the overall impacts could have been stabilized over the following year in 2021. Our study did not attempt to separate the perceived pandemic impacts between these 2 different periods, which might have resulted in the perception of an average neutral impact of the pandemic on the U&CF businesses by the time our study was conducted.

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Rajan Parajuli (corresponding author)
Assistant Professor
Department of Forestry and Environmental Resources
North Carolina State University
Raleigh, NC, USA
+1-919-515-1553
rparaju@ncsu.edu

Stella Zucchetti Schons
Assistant Professor
Virginia Tech
Blacksburg, VA, USA

Puskar Khanal
Assistant Professor
Clemson University
Clemson, SC, USA

Eric Wiseman
Associate Professor
Virginia Tech
Blacksburg, VA, USA

Stephanie Chizmar
Research Economist
USDA Forest Service, Southern Research Station
Asheville, NC, USA

Austin Lamica
Graduate Student
North Carolina State University
Raleigh, NC, USA

Jason Gordon
Associate Professor
University of Georgia
Athens, GA, USA

Thomas Ochuodho
Assistant Professor
University of Kentucky
Lexington, KY, USA

James E. Henderson
Professor
Mississippi State University
Mississippi State, MS, USA

Sayeed Mehmood
Associate Professor
The Ohio State University
Columbus, OH, USA

Lara Johnson
Urban and Community Forestry Program Manager
Virginia Department of Forestry
Charlottesville, VA, USA

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