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Effects of Hurricane Katrina on the Structure, Performance, Capacity, and Future of the Lumber Industry in U.S. Gulf States

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ABSTRACT

The focus of this research was the lumber industry in the area impacted by Hurricane Katrina. The investigation method was a survey of both hardwood and softwood lumber mills in Mississippi, Louisiana, and Alabama. The total response rate was 42.4 percent. Results showed that the storm had both a significant and negative effect on lumber production. Contributing factors to this included the disruption of the wood supply system and the damage sustained by the mill; additionally, there were productivity and quality issues. Mill type and location were not significant indicators of lost productivity. Mills that owned timberland experienced output declines to a greater extent than those that did not. A facility's future outlook is dependent upon its location in relation to the storm. Raw material security will be paramount in remaining competitive in the industry.

Keywords: Hurricane Katrina, lumber industry, Gulf States, mill operations, lumber quality

Introduction

On August 29, 2005, the eye of Hurricane Katrina landed along the gulf coasts of Louisiana and Mississippi bringing mass destruction. The storm wreaked havoc in many ways, including the devastation brought to the region's forests. Broken timber was documented over a range extending 400 miles east and west. The volume of damaged wood was equivalent to that needed for the construction of 800,000 single-family homes (USFS 2005).

Forests dominate the landscape of the South with 50 percent of Louisiana, 62 percent of Mississippi, and 71 percent of Alabama designated as forestland (Smith et al. 2004). These lands are vital to the economies of these states. Employment levels for Louisiana, Mississippi, and Alabama in the wood products sector total over 42,000 workers with shipment values in excess of \$9 billion according to the American Forest & Paper Association (2004a, 2004b, 2004c).

This research focused on the effects Hurricane Katrina had on the structure, performance, capacity, and future of the lumber industry in Louisiana, Mississippi, and Alabama. The method of investigation consisted of a questionnaire which was mailed to both softwood and hardwood mills.

Literature Review

In the 1980s, changes in national forest policy led to the reduction of timber sales from public lands, forcing timber supplies and revenues from the national forests to shrink. In the ten years 1989–1998, national forest proceeds decreased 64 percent (Rey 2005). Demand for timber began to shift from the publicly owned lands of the West to the privately held lands of the South where 4.9 million landowners possessed forested land (Birch 1997). In the early 1990s, over 50 percent of the forested land was held by “other private.” The “farmer” category had decreased during the last half of the century to nearly 15 percent. The forest industry owned or managed roughly 20 percent of the forest land. Public control accounted for a minority share of forest ownership in the South (less than 10%), and forested land in federal possession was enmeshed in the same controversies surrounding federal lands in the Pacific Northwest.

The late 1990s and early 2000s saw a major change in the forest industry. The custody of land by forest products manufacturers was questioned from a financial basis due to weak shareholder performance, increased debt from consolidation, and challenges to the belief that owning timber was necessary to ensure a steady wood supply. From a tax standpoint Generally Accepted Accounting Principles (GAAP) prevented companies from taking advantage of the rising land values until harvest. Also, federal tax policies taxed forest income at both the corporate and shareholder level. A major program of selling land or transferring it to other ownerships followed. Two new major players came on stage, Timberland Investment Management Organizations (TIMOs) and Timberland Real Estate Investment Trusts (REITs). TIMOs located and bundled timberlands for sale to shareholders, often assuming management responsibilities after the sale for a period of 10 to 15 years; positive returns, lower risk, and inflation protection attracted investors. REITs raised investment funds for timberland purchases. It then administered the trust and assumed land management responsibilities after purchase. Land values were more reasonably assessed (GAAP do not apply), and no corporate income tax was levied. These entities and the forest products companies would normally enter into long-term supply agreements for wood on these lands to maintain corporate supply objectives. What was not under supply agreement was harvested under favorable market conditions and sold to the highest bidder. Industrial ownerships declined to the point that only one large integrated company currently owns and manages forest land (Fernholz et al. 2007, Harris 2007, Hickman 2007, Stuart 2007, Yin and Izlar 2001, Zinkhan 1993).

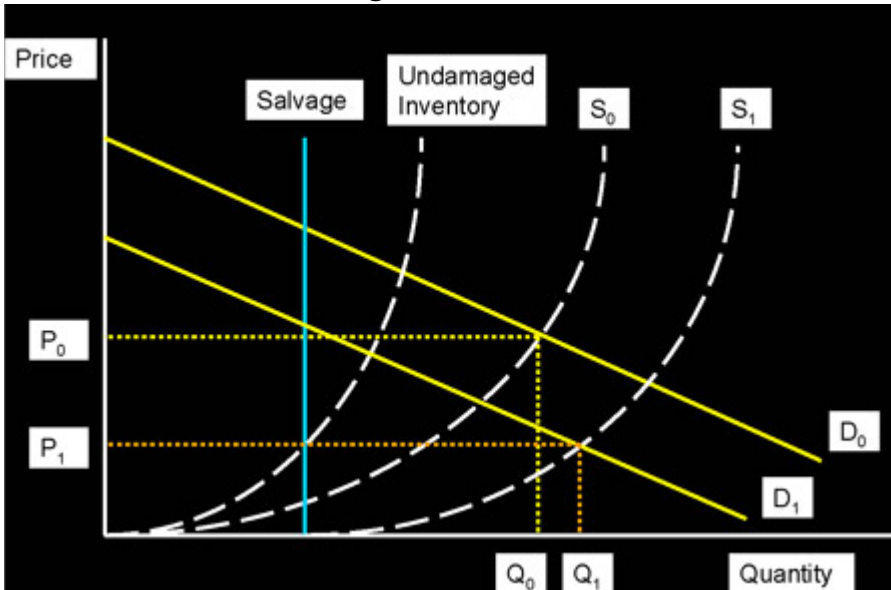
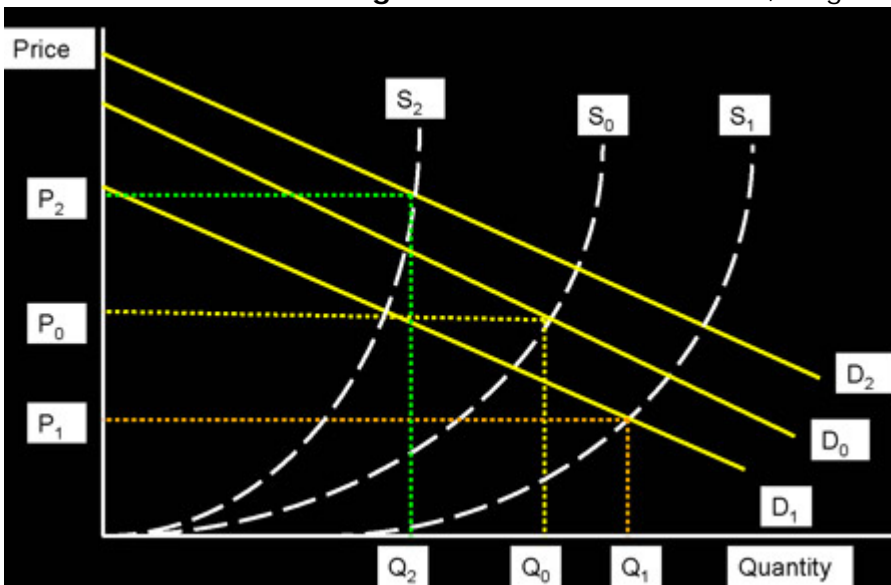
The development of southern forest products manufacturing after the Great Depression was spurred by low land prices, fertile soils, available labor, a need for economic development, and the increased demand for Kraft paper. By the 1950s competition and technology began transforming what started as an aggregation of small, independent operations into larger, often vertically integrated, corporate entities. The number of sawmills declined while mill capacity increased as new manufacturing methods, optimization technologies, utilization of the raw material, specialization of the workforce, and industrial development increased (Granskog 1978, Schmoldt 1992, Shuler and Ince 2005, Smith et al. 2005, Stuart 2007). The transition has followed from thousands of small, portable lumber mills (over 2,000 in Mississippi alone in 1946) to just hundreds of fixed-site facilities that are producing more precisely manufactured products than ever before (Johnson and Stratton 1998, Howell et al. 2005). In 2002–2003, sawlog production for Mississippi, Alabama, and Louisiana totaled approximately 6.66 billion board feet, International 0.25-inch rule, at 245 sawmills (Bentley et al. 2005, Howell et al. 2005, Bentley and Cartwright 2006). Overall, production remained steady even

though the number of mills had decreased slightly in the five years before Hurricane Katrina (Stuart 2007).

Each sawmill is driven by competition – its ability to compete for raw material in the local market and for market share in national and international markets. Wood products demand is changing in response to changes in resource availability, demographics, and competition (Shuler 2005). Southern mills are generally turning to younger, faster growing trees to satisfy their productive output (Harper 2004). Moreover, pine plantations will make up two-thirds of the southern forests in the next 30 years (Prestemon and Abt 2002). As inventories hold firm along with new technologies coming online, the power to compete on the global scale will be present (Harper 2004).

These forces keep the forest products industry in a constant environment of change, and the stimuli of change were strong when Hurricane Katrina struck on August 29, 2005, as a category III storm. Final landfall occurred in Hancock and Pearl River counties, Mississippi, with winds of 125 miles per hour (Glass and Oswald 2006). According to the United States Forest Service (USFS 2005) over 5 million acres of timberland suffered damage. This amounts to 30 percent of the forested land in the affected area and over 9 percent of the total woodland areas of Mississippi, Alabama, and Louisiana (Stone 2005). Approximately 80 percent of the merchantable sawtimber volume in the hurricane zone was injured to some degree (Stuber IV and Twillmann 2005).

Past research into natural disaster recoveries in the South has focused on quantifying the damage inflicted upon the timber supply (Halverson and Guldin 1995, Jacobs 2000, Mercer et al. 2000, Pye et al. 2005, Sheffield and Thompson 1992). The supply elasticity of damaged timber, especially in the South with its warmer temperatures and higher humidity levels, becomes inelastic due to the immediate threat of insects, stain, and rot (**Fig. 1**). Landowners with damaged stands will accept any price above zero to recoup their investment (Prestemon and Holmes 2004). The influx of salvaged timber along with the remaining undamaged inventory temporarily shifts the supply curve to S_1 producing a surplus of raw material on the market, depressing timber prices (P_1). At the same time, an immediate, but short lived, price spike occurs in the retail market. These short-term economic fluctuations due to market shock and recovery operations, for example, have been noted to favor the consumers, i.e., lumber mills, directly after a catastrophe (Prestemon and Holmes 2000). After salvage supplies are terminated, a correction in the long-term, post-storm inventory takes place (**Fig. 2**). Factors hindering lumber mills include the depletion of resources (S_2), increased competition for those resources (D_2), and the eventual rise in timber price (P_2) (Prestemon and Holmes 2004). The dynamics of the timber market will eventually return both supply and demand to pre-storm levels, S_0 and D_0 , as forest regeneration and growth occur. Resource recovery, however, is dependent upon time, environmental factors impacted by the disaster, and management strategies.

Figure 1. Post-natural disaster, short term.**Figure 2.** Post-natural disaster, long term.

The rehabilitation of the forest industry after Hurricane Hugo, which affected over 4.5 million acres of timber from South Carolina into Virginia, was well documented and has served as a useful source of information for analyzing the industry's recovery from a natural catastrophe (Sheffield and Thompson 1992). There, 37 percent of all of the damaged timber was reclaimed through salvage operations. This was a high recovery because much of the land was in the Francis Marion National Forest and corporate ownership. The Forest Service had funds for recovery costs, and the affected industries focused on asset recovery to keep the mills operating. For each percent of timber salvaged, consumers earned an average of \$2.9 million, while producers of salvaged timber gained an average of \$2.3 million. Those possessing undamaged timber, however, lost \$2.3 million for each percent salvaged due to depressed prices or being unwilling to enter the market (Prestemon and Holmes 2004). The effects were expected to be long-lasting. A survey of primary wood manufacturers in South Carolina indicated that the survival of mills depended on their ability to pay higher raw material prices and at the same time compete over

larger procurement areas for an inadequate wood supply that was of lower quality (Syme and Saucier 1992).

Methods and Materials

Following Hurricane Katrina, many off-the-cuff observations were made with respect to the regional lumber industry. Tangible, reliable information was lacking. Therefore, it was felt that a survey of lumber mills could provide insight into the reactions of the industry following the storm.

The mail survey contained ten sections labeled A–J. The sections were:

- A. Sources of timber
- B. Logging and trucking capacity
- C. Woodyard operations
- D. Storm damage to the plant
- E. Storm related variations to mill operations
- F. Effect on lumber quality
- G. Effect on the workforce
- H. External effects
- I. The future
- J. General information about your facility

Each section ranged in length from 5 to 15 questions. In total the survey contained 73 questions. Questions requiring specific values were asked regarding mill employment and capacity. Questions were also asked in an ordinal form (yes/no) and as Likert items; answers to these were treated as ordinal data for analysis.

Mill directories for Mississippi, Louisiana, and Alabama were used to compile a list of candidates for the survey (Mississippi Forestry Commission 2005). A criterion employed for all three states is that participating mills must have at least ten employees. Ten was chosen because mills of this size are fixed-site and accounted for over 94 percent of the total sawlog output in 2002–2003 for the three states (Bentley et al. 2005, Howell et al. 2005, Bentley and Cartwright 2006). All of the sawmills in Mississippi meeting this qualification were solicited to participate.

A second criterion, location, was used for Alabama and Louisiana. Alabama's area of recruitment included all of the counties from the Mississippi state line eastward to Interstate 65. Louisiana's area contained all parishes from the Mississippi state line westward to State Highway 165 and Interstate 49 at Alexandria. A total of 144 hardwood and softwood mills qualified as potential participants in the survey.

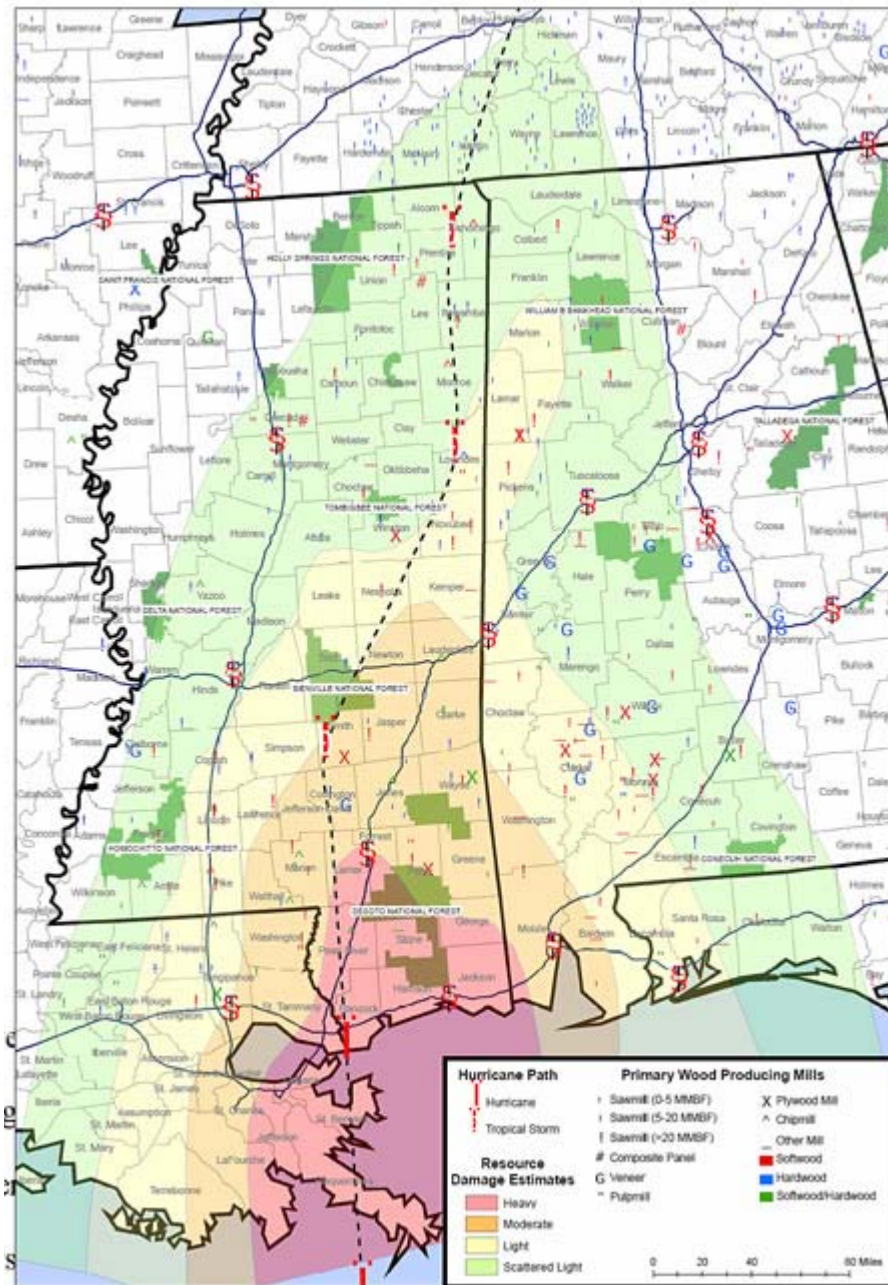
A recruitment letter on official letterhead was mailed on January 8, 2007, to contacts of candidate mills. Contacts were provided in the directories; job titles included mill manager, production manager, procurement manager, and forester. The letter explained the background of the survey, the impacts and relevance of the survey, and the gains to be made from the results of the research. Recruits were informed that participation was voluntary, and questions could be skipped if they wished. Assurances of confidentiality were also made. The letter noted that the survey would be mailed in seven days and provided a phone number for recruits to call should they have any questions regarding the research.

The survey was mailed to the mill contacts on January 16, 2007. Each survey contained a code number on the title page to serve as the identifier for that particular mill. The code allowed personal identifiers, such as name and location, to be removed from the data during analysis. A self-addressed, stamped envelope was included along with a consent form on university letterhead for participants to keep for their records. On February 12, 2007, a letter was mailed to non-respondents asking for their participation. Two weeks later a third letter, consent form, self-addressed, stamped envelope, and survey was mailed to each non-respondent. As the surveys were returned, a thank you letter was mailed to all of the mills that participated in the project. It should be noted that the survey was not pretested prior to mailing. A poll of non-respondents to check for non-response bias was not conducted; however, first wave responders were compared to second wave responders to test for any prejudice in responses.

One goal in analyzing the overall effect of Hurricane Katrina on the lumber industry in Mississippi, Louisiana, and Alabama was to test the hypothesis that there was no effect on mean lumber production from the storm versus the one-tailed alternative that the storm negatively affected mean lumber production. The survey asked respondents for their mill's daily production both before and after the storm. A paired t-test was used to test for differences.

Other objectives included comparing respondents by mill type, location, and land ownership within the affected area. Hypothesis testing of this nature allowed for more insight concerning the effects of the storm. Respondents were divided into hardwood mills versus softwood mills; those mills that owned timber versus those that did not; and geographic zones based on USFS (2005) areas of timber damage – heavy, moderate, light, and scattered light (**Fig. 3**). A Wilcoxon-Mann-Whitney test was used to compare mill type and land ownership while a Kruskal-Wallis test was used to evaluate location. A correction factor for multiple ties was applied. A final goal was to get a sense of how these mills collectively and by group comparison perceived their future. Significance was tested at $\alpha = 0.05$ while moderate differences were reported up to $\alpha = 0.10$.

Figure 3. Geographic zones (USFS Southern Research Station 2005).



Results and Discussion

Respondents

Total response rate for the population was 42.4 percent with 61 mills of the 144 surveyed responding. Of the respondents, six mills were deemed undeliverable with two mailing attempts resulting in a “Return to Sender.” Four mills had gone out of business between the time of the hurricane and the mailing of the survey. Four mills returned surveys that were deemed unusable. This resulted in a total of 47 returned and usable surveys for a 36.2 percent effective response rate (Dillman 1978). For self-administered, mailed questionnaires this response rate is not unexpected (Dillman

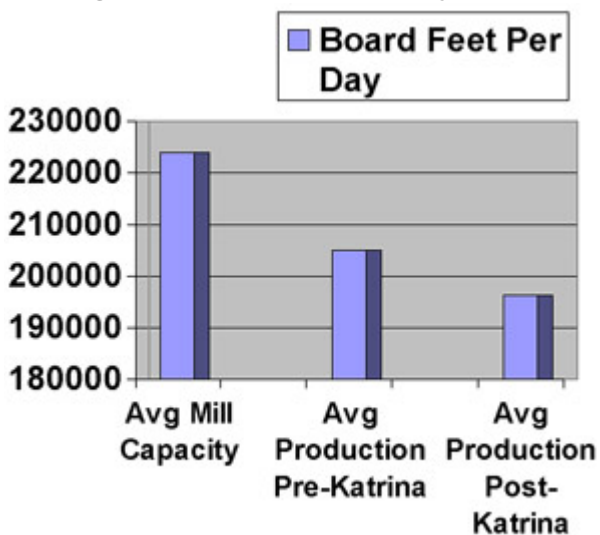
1991). Thirty surveys were returned after the first mailing. Seventeen were returned after the second mailing.

Combined the respondents employed over 3,700 employees with a manufacturing capacity exceeding 9 million board feet of pine and hardwood lumber per day. The average number of employees at a facility was 92 persons with a median of 73. The sample consisted of 24 hardwood mills and 23 pine mills. No mills were located in the heavily impacted zone, Zone 1. Seven mills were located in Zone 2, the moderately impacted zone; 20 mills were in Zone 3, the lightly impacted zone; and 16 mills were in Zone 4, the scattered lightly impacted zone. Four responses were received from Zone 5, the zone with no damage. Twenty-eight of the mills owned some timberland. Nineteen of the mills were totally dependent on the open market for wood.

Mill Productivity

Daily capacity for the sample averages 224,725 board feet (BF) with a median of 115,000 BF. Before Hurricane Katrina struck, mills manufactured an average of 204,887 BF per day at a production efficiency (production rate divided by mill capacity) of 90.9 percent. Thirty mills reported downtime. The maximum Hurricane Katrina related downtime reported was 14 days with 22 mills reporting losses of 7 days or less. Those mills reporting a loss in productivity replied that the loss was no more than 15 percent of its daily production. All of the other facilities reported no loss in productivity. After Hurricane Katrina, the respondents' production efficiency dropped by an average of 3.4 percent, resulting in a post-storm production efficiency of 87.5 percent. This production change decreased mean daily output to 196,297 BF/day, a mean loss of 8,590 BF/day (**Fig. 4**).

Figure 4. Mean mill capacity; mean mill production pre- and post-Hurricane Katrina.



A paired t-test of pre- and post-Hurricane Katrina production found the loss to be statistically significant ($t = 3.33$, $p = 0.00095$). Both hardwood and pine mills showed significant losses in production: pine mills lost 15,317 BF of lumber per day ($t = 3.17$, $p = 0.0053$) and hardwood mills lost 2,200 BF per day ($t = 2.95$, $p = 0.0083$). Significant production losses were found in Zone 3 ($t = 2.34$, $p = 0.0338$), while moderate losses occurred in Zone 4 ($t = 1.83$, $p = 0.0947$). Significant drops were experienced by both timber owners ($t = 3.22$, $p = 0.0037$) and non-owners ($t = 2.38$, $p = 0.0333$).

Pine Mills and Hardwood Mills

No differences in production losses were found between pine and hardwood mills ($Z = 0.8216$, $p = 0.2057$). Hurricane Katrina's effect on productivity was felt equally across both mill types. Differences, however, were discovered in mill operations in the three-state region. Pine mills responded that they received more of their wood supply from company-owned timberland ($Z = 2.02$, $p = 0.0217$) and from wood dealers ($Z = 2.21$, $p = 0.0137$) than did hardwood mills. While 78.7 percent of all of the respondents stated that logging capacity was sufficient to meet their needs through Winter 2005 and Spring 2006, hardwood mills tended to report that logging capacity was not sufficient ($Z = -2.03$, $p = 0.0214$). The two groups also differed in response to the question, "Will you still accept wood from wet storage?" Hardwood mills stated that they would accept this wood 17 months after the storm while pine mills said they would not ($Z = 3.40$, $p = 0.0004$). This could be the result of pine's high susceptibility to stain (Haygreen and Bowyer 1996). Or, the pine mills could have been "quota-ed out" due to the salvage operations.

Grade reduction of finished lumber was a problem; 48.8 percent reported a mill grade recovery decrease. Grade reduction was a bigger factor in the grade-based hardwood sector than in pine ($Z = -2.10$, $p = 0.0180$). Stems suffered internal damage that may have been difficult to detect in harvesting and crept into the mill furnish. Lower quality hardwood logs may also have been accepted to keep these facilities operating. These mills could be at a competitive disadvantage in the future as it may take many years to entirely purge the undetected damaged material from the wood supply.

Geography

While differences in location existed, Hurricane Katrina's effect on mill productivity was felt equally across the entire region ($\chi^2 = 3.40$, $p = 0.3340$). Geographical divisions aided in illustrating the damage to the raw material and the storm's effect on mill operations. The degree of damage to company woodlands varied significantly across the geographical divisions ($\chi^2 = 11.49$, $p = 0.0093$) ranging from severe to none. This led to a moderate deviation in inventory levels as the salvage operation proceeded ($\chi^2 = 6.61$, $p = 0.0589$). While 76.6 percent responded affirmatively to the question, "Following the hurricane, did you accept timber from storm-damaged stands?" there were differences across zones ($\chi^2 = 9.18$, $p = 0.0270$). There was also moderate geographical differences in the degree to which mills used this wood ($\chi^2 = 7.72$, $p = 0.0523$). The occurrence of a storm-related shutdown depended upon a mill's location as well ($\chi^2 = 13.24$, $p = 0.0042$). Indications were exhibited of a geographical change in log cost as a percent of product sold ($\chi^2 = 7.42$, $p = 0.0598$) as well. Human resource issues were exhibited, but none were significant or moderate across geographic zones.

Timberland Owners and Non-Owners

Comparing mills that owned timberland to those that did not revealed moderate differences ($Z = -1.23$, $p = 0.1000$). Facilities that owned forestland reported higher production losses than those that did not. Those mills that owned timber were found to be of larger capacity ($Z = -1.98$, $p = 0.0240$), possess a greater production efficiency ($Z = -2.58$, $p = 0.0050$), and employ more people ($Z = -2.17$, $p = 0.0149$). They may, however, have been under additional pressure to recover and use damaged

timber assets. A majority of both pine and hardwood mills in each geographic zone reported that they owned timberland.

After the storm struck, timber owners moved quickly to protect their investment and limit losses; 88.9 percent of respondents who owned timberland reported timber damage of some degree. Logging capacity was found to be insufficient for this group immediately after the storm ($Z = -2.66, p = 0.0039$). The lack of logging capacity continued to hamper them 1 year after the storm ($Z = -1.66, p = 0.0482$). The increase in fuel costs also affected their salvage operations ($Z = 2.45, p = 0.0071$). Seventy-one percent of these firms reported that they were able to salvage at least 20 percent of their damaged volume; their mill inventories rose significantly compared to non-timber owners ($Z = 2.12, p = 0.0168$), thereby tying up company assets. Timberland owners also invested in the construction and operation of additional wet storage facilities to preserve salvaged wood, further tying up business capital. Wet storage did not prevent stain from occurring ($Z = 3.53, p = 0.0001$). These mills, as opposed to non-owning mills, had a tendency to cap the amount of storm wood allowed into the plant from outside sources to minimize losses on company-owned lands ($Z = 2.35, p = 0.0094$).

The ramifications of processing this storm-damaged timber seemed to ripple throughout the entire system for owners rather than for non-owners. Both the quantity and the quality of the finished product suffered at mills that owned timberland as they tried to recover some of their investment. The product value per ton of roundwood decreased significantly ($Z = 1.65, p = 0.0496$) due to a considerable decline in their lumber recovery factor ($Z = -1.97, p = 0.0246$) as damaged logs were processed. The quality of the lumber being sawn from these logs also suffered a substantial decline ($Z = 3.93, p = 0.0001$). These factors, magnified by being forced to process their own damaged logs, likely caused the facilities that owned timber to change their product mix compared with the non-timber owners ($Z = 2.79, p = 0.0027$).

The Future

While storm damage is immediate and noticeable, effects can take time, sometimes years, before they can be truly quantified. As for the local lumber industry, 81 percent of the respondents felt the worst was over with regard to the storm; however, 70.5 percent also reported that Hurricane Katrina had somewhat affected their sense of the business future. The difference in outlook was greatest across geographic zones ($\chi^2 = 9.59, p = 0.0224$). Mills in Zone 2 were the most pessimistic. Seventy-five percent of hardwood mills and 76.9 percent of pine mills that own timber said their sense of the future was to some extent affected. Future impressions of the overall lumber market were guarded as well; 93 percent of all of the respondents replied that the market will hold level at best. The mills owning timberland were less optimistic than non-owners ($Z = -2.42, p = 0.0078$).

Nine factors were provided that could have an impact on the industry's future in the coming years. Respondents were asked to choose which, if any, they felt will influence their operations. The top four factors influencing mills' outlooks were market demand, raw material supply, raw material cost, and foreign competition (**Fig. 5**). Respondents were invited to rank areas of change that they were considering in order of importance on a declining scale of 1 to 8. Raw material procurement was reported to be the most important factor as companies move forward into this new era of lumber production. Hardwood mills were more concerned about this than pine mills ($Z = 1.93, p = 0.0268$).

Seeking new markets and solidifying existing ones, producing value-added products, and modification/automation of existing operations rounded out the top four options stated by the sample (**Table 1**). The next 3 to 5 years will be of greatest importance for the 69 percent that intend, at best, to maintain pre-Hurricane Katrina production levels.

Figure 5. Factors influencing sense of business future and impression of future lumber market.

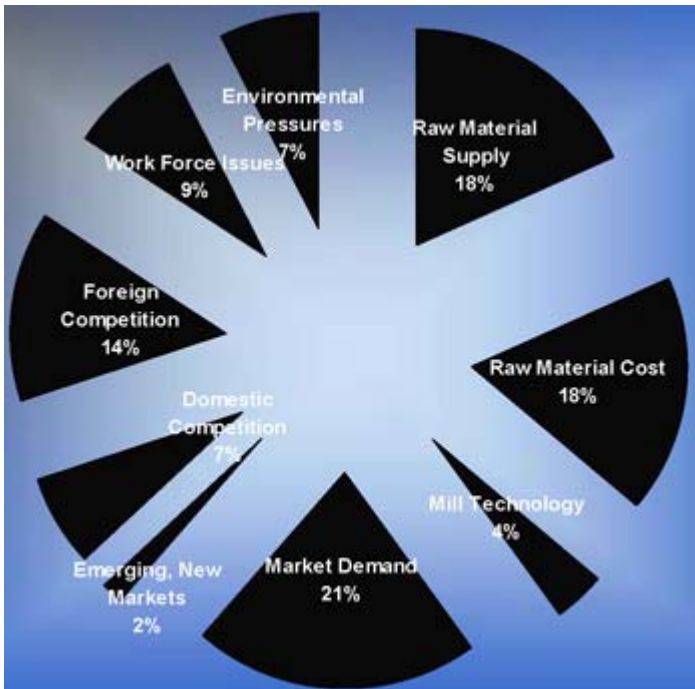


Table 1. Average rank for possible changes to facilities' business models.^a

Variable	Rank
Raw material procurement	2.35
Seek new markets	3.13
Produce value-added products	3.96
Modify/automate existing operations	4.42
Produce different products	4.58
Ramp up/down production	4.96
Purchase new equipment	5.57
Increase marketing and advertising	6.35

^a 1 = highly important or likely; 8 = not important or unlikely.

Conclusion

Mills in the area most impacted by Hurricane Katrina were surveyed to develop an insight concerning the effect of the storm on the natural, social, and economic segments of the lumber manufacturing sector of production forestry. As expected, overall mean lumber production was significantly and negatively affected. Mills that owned timberland experienced output declines to a

greater extent than those that did not. Mill type and location, however, were not significant indicators of lost production, leading to a general assumption that the reach of Hurricane Katrina's impact on lumber manufacturing was more evenly distributed across mill types and location. A common assumption is that an event of this kind has a ripple effect that causes disturbances far beyond the immediate point of impact. The security, in normal times, of owning timberland may have proven to be a disadvantage as these facilities struggled to limit their losses by manufacturing products from their damaged timber supply.

Following Hurricane Hugo, it was predicted by wood-using mills that in three years, purchased logs at the gate would make up over half of their raw material supply; purchased stumpage would account for another third while contributions from company lands would decrease (Syme and Saucier 1992). Changes in land ownership and management objectives since Hurricane Hugo have influenced decades of stability. Legal battles have shrunk the public sector's contribution to the timber supply. Corporate timberland owners began shifting to the open market for wood as their forest holdings were sold to TIMOs or transferred to REITs, often with supply agreements attached. In addition, individuals' knowledge of land and timber values has increased demand for those assets, making the nonindustrial private landowner the predominant wood supplier of the South (Davis and Johnson 1987). Earning a profit for shareholders or appealing to personal preference was the management objective, not maintaining the wood supply system. Many companies were faced with competing, searching for new markets, manufacturing different products, or closing.

A system already in flux was impacted suddenly. While mill operations were affected by structural damage, power outages, and workforce issues, the major concerns in the immediate aftermath were the timber resource and the wood supply system. Hurricane Katrina caused an immediate surplus in available wood. Weight limits were eased, idled mills were reopened, and additional wet storage yards were constructed to handle the excess timber. The median facility in this sample pre-Hurricane Katrina received between 40 and 60 percent of their mill's supply from gatewood. Over one-third obtained more than 60 percent of their wood from this source. Purchased stumpage and wood supply agreements made up the remaining share. Those mills that relied on gatewood tended to be smaller in size and supplied local or niche markets. The trend for timber-owning mills was larger size and volume-based production. Seventy-four percent of mills that own timberland reported that company furnish contributed less than 20 percent to their plant's log inventory. This percentage increased following Hurricane Katrina in order to realize some value from their damaged stands.

Timber must be of appropriate quality, available for harvest, affordable, and accessible in order to sustain efficient mill production (Grala et al. 2005). Such conditions have been difficult to meet in the aftermath of Hurricane Katrina and will lead to even more competition for the open market supply. Higher prices will have to be paid for delivered wood, and supply radius will likely increase for purchased stumpage as timber producers' attitudes change with market forces. Those that own lightly or undamaged timberland will still have an available resource. Non-timber owning mills and those possessing moderately or severely damaged timberland will have to be shrewd and innovative to survive the long-term effects of this storm. Raw material security will be the overriding issue.

The initial recovery has now concluded with a "letdown" phase currently setting in as post-Hurricane Katrina raw material inventories have shifted (Stuart 2007). Decisions being made now will

affect the future of southern production forestry. Tax breaks and clean up allowances have aided both industrial and nonindustrial private timberland owners. A critical next step is deciding whether to make the large front-end investment and long-term commitment that forestry requires. They are in a better position to rebound should they choose to reinvest in forestry. The trees may be gone, but the primary investment, the land, is still intact. Legislation has provided some relief to companies for future investment but little assistance in recovering lost revenues. The main issue facing lumber facilities is whether to stay or leave. These mills need to evaluate what the future market will look like, what their place is in that market, the wood supply of that market to support competition, and the investment in technology needed to actively participate in this post-Hurricane Katrina environment.

The estimated loss from timber in Mississippi, Alabama, and Louisiana has been estimated at \$1.3 billion (Jose 2005). In 2006, the value of Mississippi's timber harvest alone decreased 16.6 percent to \$1.21 billion from \$1.45 billion in 2005 (Measells 2007). The recovery challenges for lumber mills in this region have been compounded by national economic issues. The housing slump and the weakening dollar have pushed finished lumber prices down since Hurricane Katrina (Timber Mart-South 2007). Market related shutdowns and closures have resulted for some facilities as housing starts are not predicted to rebound until mid-2009 (Seiders 2008). Fuel costs, which were affecting 75 percent of respondents, have fallen, but will likely be an overriding concern until the supply stabilizes.

The purpose of this survey was to investigate the state of the regional lumber industry at the end of the salvage period 17 months after the storm and determine the attitudes of the survey participants for their future and the future of the industry. Projecting from the current state into the future is difficult under the best conditions and especially so after a traumatic event. Given time and resources, the questions of this survey could perhaps have been polished or reconfigured to gain more statistically reliable information. But, considering that the intended responders were still actively involved in the recovery of their businesses, a more complex survey was thought inappropriate. Including mills from states bordering the three Gulf Coast states might have helped to indicate the economic extent to which the storm impacted the larger industry versus the three-state region alone. Utilizing a different medium to distribute the survey (telephone, Internet, etc.) might have increased response although mailed surveys usually perform the best (Dillman 1991). Decreasing the length of the survey may have created a higher rate of reply.

The results of the study may include some nonresponse bias due to the overall response rate. Geographical nonresponse bias was lessened by delineating location according to timber damage zones rather than state lines; Louisiana represented a much smaller percentage of the solicited population. In the first wave of responders, no statistical differences in returning a survey were detected between the various group divisions; all replied fairly equally. The same can be stated for the second wave. There was no difference in mill size between first and second responders. No differences in the occurrence of downtime were detected. Production losses were significant for both. Comparing the two groups' lost productivity pointed to a difference – the first responders tended to have a higher loss. First wave responders, however, were not producing as efficiently as second wave responders prior to Hurricane Katrina. Moreover, this difference was neither significant nor moderate. No other differences were present between these two groups.

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