CURRENT AND FUTURE CONDITIONS
OF THE TIMBER RESOURCES OF THE GULF SOUTH
(LOUISIANA, MISSISSIPPI, TEXAS)

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Abstract: Currently, southern timber harvests are at their highest levels in decades, and softwood harvests now exceed growth for the first time this century in many areas. Furthermore, it is not clear whether these removal rates in the South can be sustained. The Southern Timber Resource and Inventory Projection System (STRIPS) provides insight into current and future forest resource inventories in the Gulf South. This model provides annual projections of the forest type and volume by species group for each Forest Inventory and Analysis (FIA) plot in the projection region to the year 2010. Even with conservative removals estimates, projections for East Texas and Louisiana indicate declining inventories of both hardwoods and softwoods. The majority of this decline occurs in the pine inventory. The situation in Mississippi appears more optimistic than the situation in either Louisiana or Texas. Growth is projected to exceed removals for both hardwoods and softwoods in Mississippi throughout the projection. The removals estimates on which all these projections are based are conservative, however.

Introduction

The U.S. forest products industry is becoming increasingly dependent on southern forests. Harvest restrictions on federal land in the Pacific Northwest have increased the demand for timber in the southern United States. Currently, harvests in the South are at their highest levels in decades, and softwood harvests now exceed growth for the first time this century in many areas. However, it is not clear whether higher removal rates in the South can be sustained. Although the USDA Forest Service Forest Inventory and Analysis (FIA) unit conducts periodic surveys of each of the southern states, these surveys do not provide annual updates of inventory levels. With survey cycles of seven to ten years, inventory information is typically several years old.

The Southern Timber Inventory and Resource Projection System (STRIPS) was developed to analyze different supply scenarios at the state level on an annual basis. A key feature of the model is that it can be calibrated to accurately predict forest inventory changes from one inventory cycle to the next. Projections with the STRIPS model assume that forest management practices will remain similar to those applied during the calibration period. This paper discusses the current forest resource conditions and projections for East Texas, Louisiana, and Mississippi. Total timber volume and timber growth are projected using conservative removals assumptions. These projections provide a picture of the three states' timber resources from the present to the year 2010.

Current Resource Conditions

The FIA conducts periodic surveys of each state. During each of the past three decades surveys have been completed for Louisiana, Mississippi, and Texas: one for each state in the mid-1970s, in the mid-1980s, and most recently in the early 1990s. Figure 1 shows the total timberland acreage for each of

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the three previous Louisiana, Mississippi and Texas surveys. In Louisiana the timberland acreage held up well between 1984 and 1991 with a decline of only 90,000 acres (less than 1%). Similarly, in Texas timberland acreage remained relatively constant between the 1986 and 1992 surveys, with an increase of 202,000 acres (1.75%). In contrast, Mississippi's timberland acreage increased significantly between the past two surveys, from 17.0 to 18.6 million acres (9.4%).

Figure 2 compares the acreage for each state in three major ownership classes: non-industrial private (NIPF), forest industry, and public. Nonindustrial private landowners own the majority of timberland in each of the three states, followed by industry holdings. Only a small proportion of the timberland in each state is in public ownership. Mississippi has the largest proportion of timberland in the NIPF category, while Louisiana holds the largest proportion of industry land.

Figures 3 and 4 compare upland and lowland forest acreage in the three states, and show trends in these areas over the last three surveys. Louisiana has a larger proportion of hardwood lowlands than either Mississippi or Texas because it includes the Mississippi delta and other large river systems. The acreage of lowland hardwood forests decreased in all three states between the 1970s surveys and the 1980s surveys. These acreages rebounded in Mississippi and Texas by the 1990s surveys, while in Louisiana the decline in lowland hardwood acreage was stopped. The area of upland forest types has been nearly constant in Louisiana and Texas, while it has increased significantly (7.7% since 1987 and 13.6% since 1977) in Mississippi. A constant or increasing upland acreage is important for a continuing source of pine timber sites.
Figure 2. Timberland ownership, by state.

Figure 3. Upland area, by state and survey year.
Figures 5 and 6 compare the areas of mixed pine-hardwood and upland hardwood. The mixed pine-hardwood type has remained fairly stable in each state over the past three surveys. Much of this area would be well suited for conversion to planted pine in order to provide greater yields. Upland hardwood areas increased in all three states between the 1970s and the 1980s surveys. These areas have declined slightly in Louisiana and Texas between the 1980s and 1990s survey cycles. The area in upland hardwoods increased substantially (34.4%) in Mississippi between 1977 and 1994.

Figures 7 and 8 compare the areas in natural and planted pine by state and survey year. In each of the three states the area in natural pine has been declining, while the area in planted pine has been on the rise. The increase in the area of planted pine has been particularly dramatic in Mississippi, where the planted pine area increased by 1.3 million acres between 1977 and 1994. In percentage terms, Texas has achieved the greatest increase in planted pine acreage. The area of planted pine has tripled in Texas since 1975.

Figures 9 and 10 compare softwood and hardwood growing stock volume trends in the three states. Louisiana was the only state among the three where pine growing stock volumes increased between the 1970s and 1980s. Mississippi's pine growing stock inventory decreased substantially over this period. In contrast, Louisiana's pine growing stock inventory declined significantly between the 1984 survey and the 1991 survey, while pine growing stock inventories remained fairly stable in Texas and Mississippi during this period. Hardwood growing stock increased in both Louisiana and Texas between the 1970s and 1980s surveys and again between the 1980s and 1990s surveys. Mississippi's hardwood growing stock inventory declined significantly between the 1977 survey and the 1987
Figure 5. Mixed pine-hardwood, by state and survey year.

Figure 6. Upland hardwood, by state and survey year.
Figure 7. Natural pine area, by state and survey year.

Figure 8. Planted pine area, by state and survey year.
Figure 9. Softwood growing stock, by state and survey year.

Figure 10. Hardwood growing stock, by state and survey year.
survey, followed by a slight increase between the 1987 and 1994 survey. Mississippi's hardwood growing stock still remains well below the 1977 level, however.

Southern Timber Resource and Inventory Projection System

STRIPS is an applied state timber inventory projection model, which does not require economic inputs such as supply, demand, or price data. STRIPS is similar to the Georgia Regional Timber Supply model (GRITS; Cubbage et al. 1990). Unlike GRITS, which projects aggregate timber volumes through age classes, STRIPS projects the forest type and volume of four species groups: pine, cypress, soft hardwoods, and hard hardwoods of individual FIA plots. Stand age is a difficult variable to use in the South Central FIA region. The FIA data include a stand age variable for each plot for each survey. However, the age field for the majority of the plots in the South Central region has been classified as "92," which is a code that means "mixed age." For example, 74 percent of the plots in the 1991 Louisiana survey are assigned a stand age code of 92. Therefore, this variable is of little use for the South Central states. Without accurate age class data, projections for the South Central region could not be made by management type, species group and age class as required by GRITS.

STRIPS was developed and used to analyze different supply scenarios at the state level. The model begins with the existing volume of each species group for each plot and adds an estimate of annual growth for each of the four species groups. The growth estimate is based on average growth rates between the previous two FIA survey cycles for each species group on plots of the given forest type and volume class. After growth has been added to each plot for the current year of the projection, removals are simulated as either clearcuts or partial harvests. Historical removals rates for each forest type, volume class, and harvest type (clearcut or partial harvest) are determined from FIA data based on the level of removals between the previous two surveys. These harvest rates are adjusted during a projection in order to meet an exogenously determined harvest target for each year. After growth and removals have been modeled, the forest type of each FIA plot may be changed to simulate shifts in the acreage of each forest type over the projection period. The rates at which plots are shifted from one forest type to another are based on historical transition matrices. Separate transition matrices are calculated for four categories of plots: 1) plots that have been clearcut, 2) plots that have been partially harvested, 3) undisturbed plots with less than 500 cubic feet per acre, and 4) undisturbed plots with more than 500 cubic feet per acre.

Before a projection is run, the model is first calibrated by projecting the previous survey to the date of the current survey. The projection results are then compared with the known state of the forest at the time of the current survey. For example, the 1984 Louisiana survey was projected to 1991 and the projection results were compared with the survey results for 1991. Adjustment factors are estimated to eliminate any discrepancies between the projected and the known state of the forest. The model is then run repeatedly with re-estimates of these adjustment factors until the model predicts nearly perfectly the known state of the forest based on the current survey. Once the model is calibrated, a projection is run to predict the conditions of the forest in the future.

Harvest targets for both calibration and projection runs were determined using a combination of severance tax data (when available) and FIA data. Severance tax data were used because FIA data do not give annual removals estimates, only an average level between survey cycles. FIA removals are typically higher than average severance tax removals over the corresponding period. Severance tax data may underestimate timber removals due to harvested but unutilized timber and unreported harvests. On the other hand, FIA removals estimates may overestimate actual harvests. To correct for this discrepancy, annual severance tax removals were adjusted upward so that the average removal rate
was closer to FIA removals. The size of this adjustment varied from state to state depending on the results from the calibration runs.

We assume that management intensity and growth will remain the same during the projection period as during the historical period between the past two surveys (the calibration period). Removals are difficult to predict. Therefore, to provide for a conservative estimate of removals over the projection period, removals targets were set at a level equal to the average of removals over the previous four or five years, depending upon the state, and held constant throughout the projection. This estimate is not a prediction of timber removals. Rather, these levels of removals illustrate the likely consequences of one situation which may be viewed as a conservative scenario.

**Louisiana Results**

Figures 11 through 14 show the projection results for Louisiana from the year 1991 through 2010. Figure 11 summarizes the projection results, showing projections of inventory, growth and removals for all species combined. The period in which severance tax data are available (1991-1994) is separated from the remaining projection period by a dotted line. Removals following this time period are projected at a flat level (919.8 million cu. ft./yr.) to the year 2010. Removals exceed growth throughout the entire projection period, resulting in a projected decline in total inventory of 2.6 billion cu. ft. (14.4%) between 1991 and 2010.

Figure 12 shows the projected area in each forest type. The area in natural loblolly/shortleaf pine forest types is projected to decline by 1.2 million acres, while the area in planted loblolly/shortleaf
Figure 12. Projected forest type area for Louisiana.

Pine is projected to increase by over 1.5 million acres by the end of the projection period. The total timberland area is projected to remain constant at 13.8 million acres over the projection period, which is consistent with the land area change between the previous two surveys a decline of less than 1 percent over seven years.

Figure 13 shows the projected inventory, growth, and removals for pine. Pine inventory is projected to decline by 30 percent over the 19 year period from over 8 billion cu. ft. to less than 6 billion cu. ft. The transition of the natural pine forest type into the planted pine forest type is primarily responsible for pine growth remaining stable throughout the projection, even though total inventory is declining. Pine growth as a percent of inventory is projected to increase from 5.5 percent in 1991 to 8.2 percent in 2010. Unfortunately, even with our conservative removals assumptions, projected pine removals are over 9 percent of inventory in 2010.

Figure 14 shows the projected inventory, growth and removals for hardwood. Hardwood inventory is projected to remain stable throughout the projection period with a decline by 2010 of 180 million cu. ft. from the 1991 level. This slight decline is projected to begin at the turn of the century when removals begin to exceed growth. Projected hardwood growth also begins to decline at this point.

Note that while the assumed level of total removals is constant for 1994 and later years, pine removals decline and hardwood removals increase. This is because the model assigns removals targets proportionate to inventory. As the pine inventory becomes a smaller component of the total inventory, pine removals decline. Similarly, hardwood removals increase because hardwoods constitute a growing proportion of the total inventory.
Figure 13. Projections of pine inventory, growth, and removals for Louisiana.

Figure 14. Projections of hardwood inventory, growth, and removals for Louisiana.
Texas Results

Figures 15 through 18 show the projection results for Texas from 1992 through 2010. Figure 15 shows the projections of inventory, growth, and removals for all species. Timber removals data are available through 1993 from the Texas Forest Service and were used in combination with FIA removals data for the first two years of the projection. Removals following 1993 are projected at a flat level (778.8 million cu. ft. per yr.) to the year 2010. The dotted line in Figure 15 shows the separation between the period when removals are known and the period when future removals are estimated. Removals exceed growth throughout the entire projection causing a decline in total inventory of 1.8 billion cu. ft. (14.1%) between 1992 and 2010.

Figure 16 shows the projected area in each forest type. Much like Louisiana, the area of the planted loblolly/shortleaf pine forest type is projected to increase, with most of this increase coming from the natural loblolly/shortleaf pine forest type. Total timberland area is projected to remain relatively constant, with a slight increase of about 600,000 acres (5.7%) over the projection period. Recall that between the previous two surveys, the timberland area in Texas increased by 1.75 percent. Therefore, this increase is consistent with the timberland area change between the previous two surveys.

Figure 17 shows the inventory, growth and removals projections for pine. Currently in Texas and throughout the projection, pine removals exceed growth. By the end of the projection period, pine removals total more than 9 percent of total inventory. This projected trend will cause the pine inventory in Texas to decline by 1.76 billion cu. ft. over the nineteen year projection period from 7.62 billion cu. ft. to 5.85 billion cu. ft., a 23 percent decline.
Figure 16. Projected forest type area for Texas.

Figure 17. Projections of pine inventory, growth, and removals for Texas.
Figure 18. Projections of hardwood inventory, growth, and removals for Texas.

Figure 18 shows the projections of hardwood inventory, growth and removals for Texas. Hardwood inventories are expected to remain stable throughout the projection period with a decline of 200 million cu. ft. (3.8%) from the 1992 level. Current hardwood removals are less than growth. The decline in hardwood inventory is not projected to occur until just before the turn of the century when projected removals begin to exceed growth.

Mississippi Results

Figures 19 through 22 show the projected results for Mississippi from the year 1994 through 2010. The Mississippi situation appears more optimistic than in Louisiana and Texas. Currently and throughout the projection, growth exceeds removals for both hardwoods and softwoods in Mississippi. Recall that in Mississippi the total amount of timberland area has increased by 9.4 percent between the previous two surveys and that Mississippi also has had the largest increase in the area of planted pine of the three states. We assumed that the timberland area in the state would continue to increase, but at a somewhat slower rate. Although both softwood and hardwood growing stock inventories have declined in the state from the 1977 level, Mississippi could increase harvest levels while maintaining a total inventory in excess of 20 billion cu. ft.

Figure 19 summarizes the projection results, showing projections of inventory, growth and removals for all species. Severance tax removals data are available for Mississippi only through 1993. Therefore, projected removals for the entire projection period for Mississippi are at a flat level (1.04 billion cu. ft.). Figure 19 shows a projected increase in the total inventory of 2.2 billion cu. ft. (10.5%) between 1994 and 2010.
Figure 19. Projections of inventory, growth, and removals for Mississippi.

Figure 20 shows the projected area in each forest type. The total area of timberland is projected to increase from 18.6 million acres to 20.5 million acres (10.4%) over the projection period. The area in planted longleaf, planted loblolly, oak-gum-cypress, elm-ash-cottonwood, and bottomland hardwoods are all projected to increase throughout the projection period. The majority of this increase is in the planted loblolly pine forest type, with a projected increase of over 2.5 million acres by the year 2010. This trend is the primary reason for the increasing growth shown in both Figures 19 and 21.

Figure 21 shows the inventory, growth and removals projections for pine. Pine inventory in Mississippi is projected to increase by 650 million cu. ft. over the seventeen year period from 8.91 billion cu. ft. to 9.57 billion cu. ft. Throughout the projection, pine growth exceeds removals by an increasing margin. By the end of the projection, pine growth totals approximately 8 percent of total inventory. Figure 22 shows the inventory, growth and removals projections for hardwood. The hardwood inventory is projected to increase from 11.4 to 13.1 billion cu. ft. between 1994 and 2010. Figure 22 shows this increase to be a steady trend throughout the projection period, with an increase of 1.7 billion cu. ft. above the 1994 level.

**Literature Cited**

Figure 20. Projected forest type area for Mississippi.

Figure 21. Projections of pine inventory, growth, and removals for Mississippi.
Figure 22. Projections of hardwood inventory, growth, and removals for Mississippi.


