Harvest Volumes and Product Yields

Many years ago, I was told by an institutional timberland investor that they were surprised to find out that not all the timber harvested from a mature stand is sawtimber.

However, most investors have (probably) been shown a chart like the one in Figure 1. This shows stand growth and the volumes of pulpwood, chip-n-saw and sawtimber that might be available from that stand at any given age.

This particular curve is for a hypothetical stand and was engineered by combining yield data from two different models. The model is simplistic in that it does not include any thinnings, while, in the real world, southern pine stands are usually thinned once, and often twice.

If we apply prices to the volumes and we account for the costs of establishing and maintaining the stand, we can calculate which age produces the highest present value—and that will be the age at which we harvest the stand. Depending on those assumed prices and costs, this stand will likely be harvested sometime around age 25. At that time, the harvest volume will be 41 percent sawtimber, 33 percent chip-n-saw and 25 percent pulpwood.

But Figure 1 is an idealized picture of a hypothetical stand. What can we expect from actual stands in actual places?

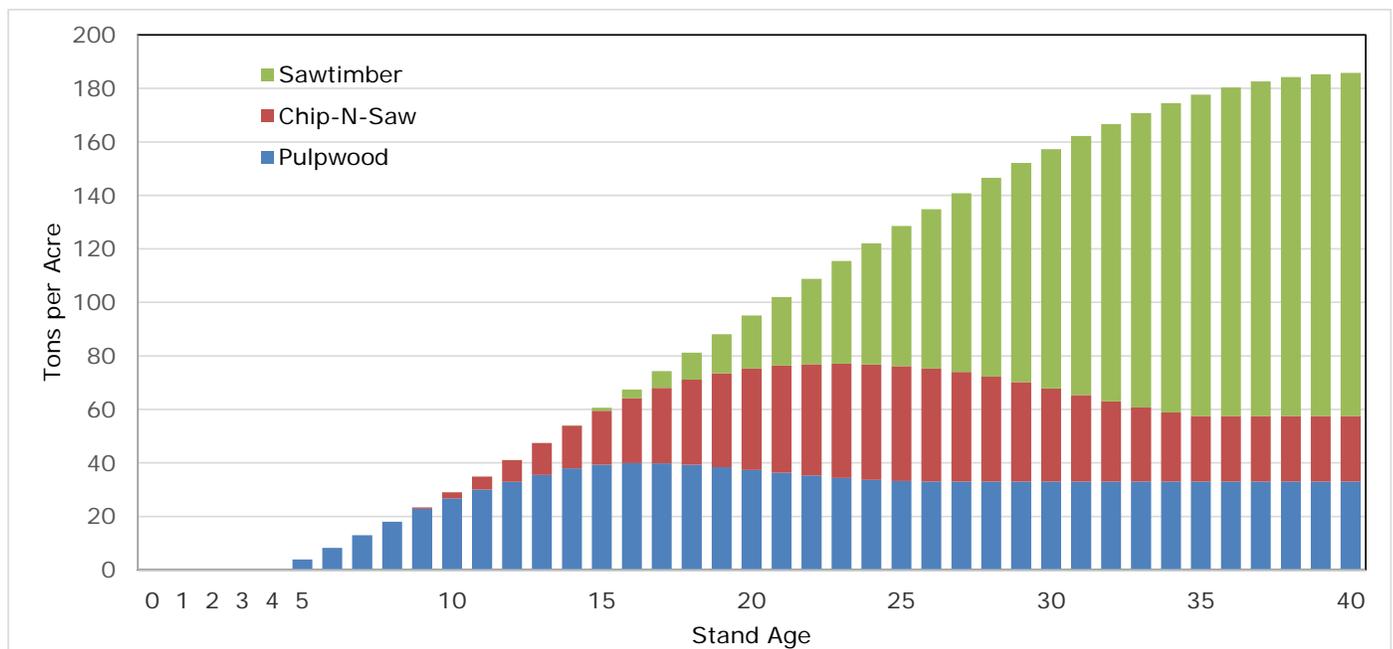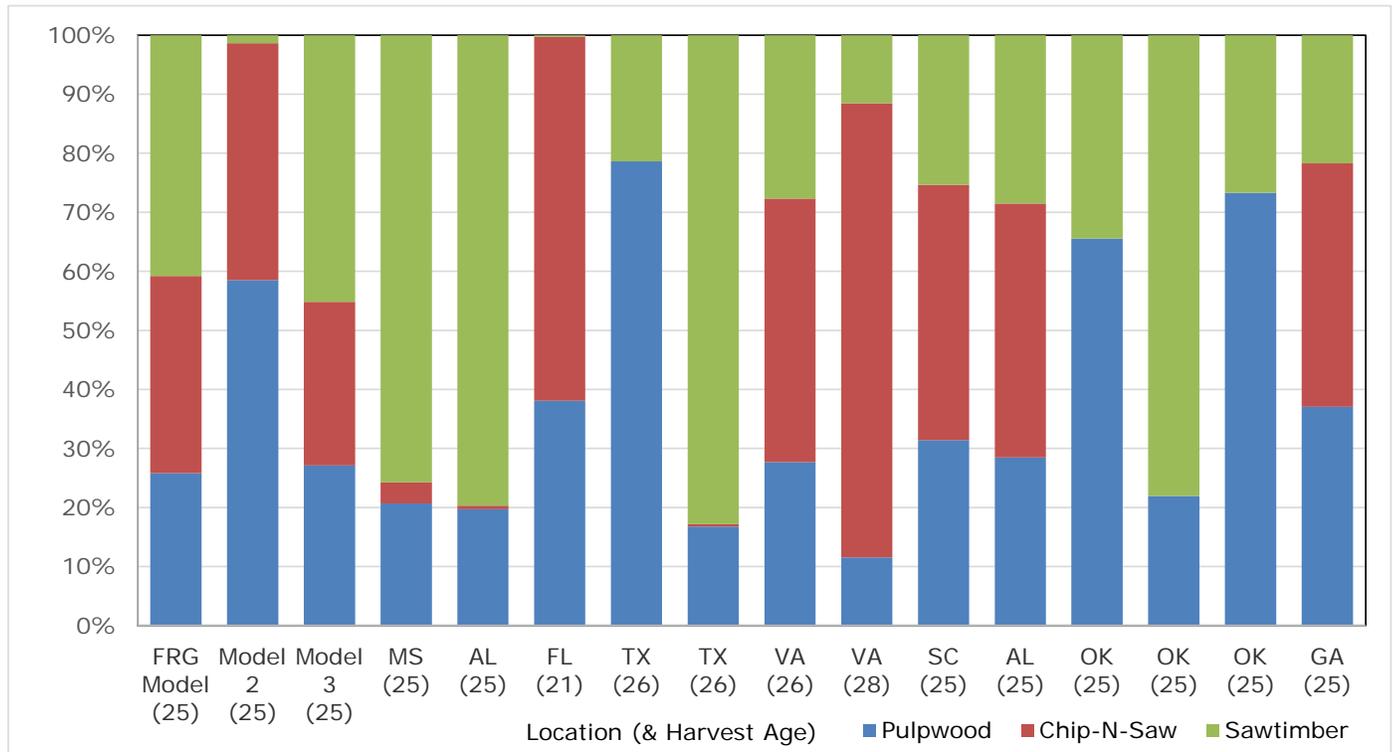**Figure 1. Yield Curve for a Hypothetical Southern Pine Stand**

Figure 2. Yield of Pine at Harvest from Models and Real-World Stands, Allocation by Product

Source: Forest Research Group files

Figure 2 shows the distribution of pine products at harvest age for three models and 13 properties from across the South. The numbers in parentheses are the harvest or rotation age. The property data come from various sources, including inventories, appraisals and acquisition analyses scattered throughout our files. In some cases these are small properties and the harvest data are from a single stand. In others, the properties are larger and the harvest data are a weighted average of more than one stand.

There is a wide variation in the product distributions. Note that one of the Texas stands is 83 percent sawtimber, but the other produced only 21 percent sawtimber. The Alabama stand was 80 percent sawtimber at harvest and one of the Oklahoma stands produced 78 percent sawtimber.

Notice also that there is no chip-n-saw on the Oklahoma stands, and very little on the Texas

stands. This is due to the lack of chip-n-saw markets at the time these stands were harvested, not because there are no trees of chip-n-saw size. If we dug these stands up and moved them to another part of the country, some of the harvest volume would be hauled to a chip-n-saw mill.

The Florida forest illustrates a unique situation in the northeast part of that state. Pulpwood demand has historically been high enough that the area has had some of the highest pulpwood prices in the South, and many landowners grow their trees on "pulpwood rotations"—shorter rotations that produce very little sawtimber. This particular set of stands contains a large portion of chip-n-saw.

We've shown that the distribution of products can vary widely in southern pine stands. But, there is another important point to consider.
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Figure 3. Yield of Pine at Harvest from Models and Real-World Stands, Volume by Product
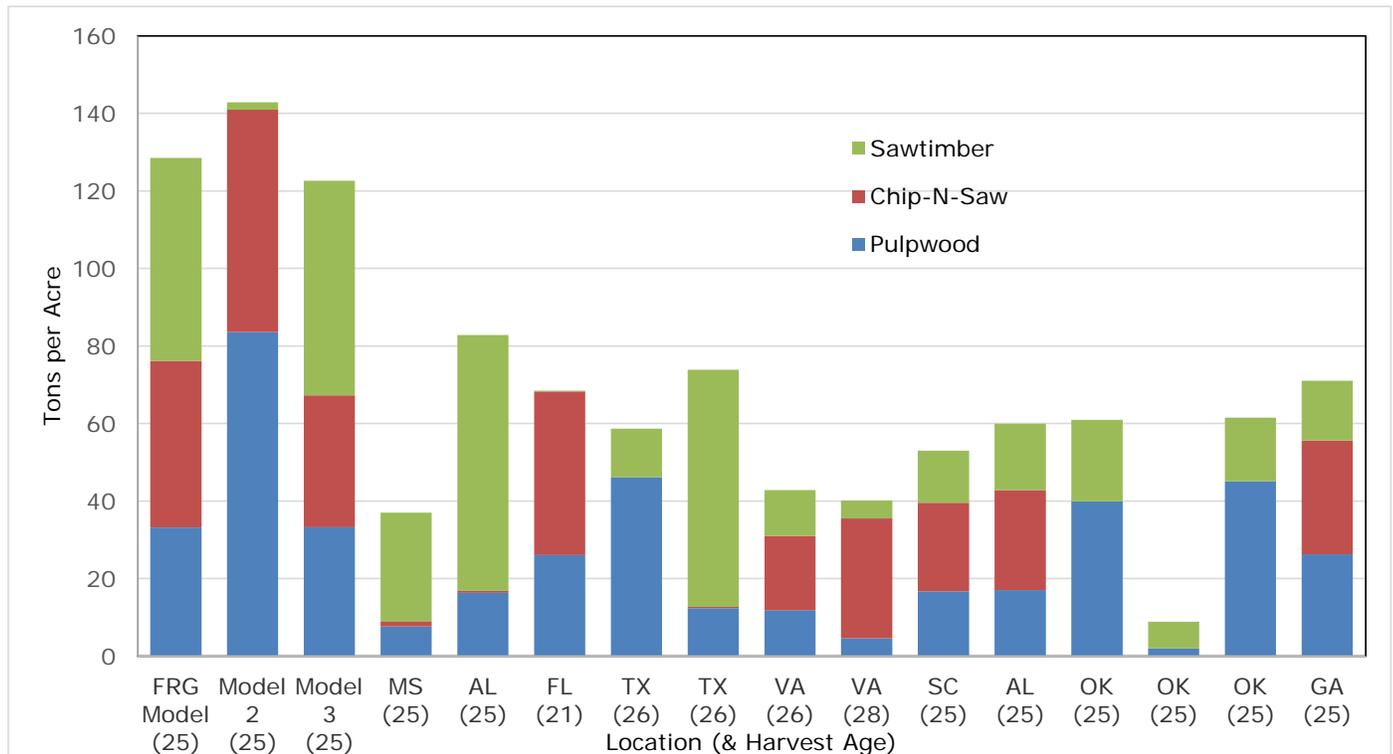
Source: Forest Research Group files

Product distribution is part of the story, but volumes are another part. Figure 3 shows the volumes of the stands in Figure 2.

The average pine yield of the 13 real-world properties is just over 55 tons per acre with an unusual low of less than 9. The forest in Mississippi was just below 40, but most of the rest produced between 40 and 70 tons of pine per acre.

The stands that were 78 percent sawtimber in Oklahoma may look impressive in Figure 2, given its high proportion of sawtimber, but it only produced 8.9 tons of pine per acre. This harvest came from two different stands. The larger stand—which dominates the weighted average calculation on the harvest—contained more hardwood than pine. The total harvest volume on this stand even with the hardwood was a still-unimpressive 20 tons per acre. The (much) smaller stand produced 27 tons per acre of pine and another 5 tons per acre of hardwoods.

What this analysis does not show is the variation among different age classes on a single property. For example, the volume per acre in the following year on that low-yielding Oklahoma property was much higher.

Yields Have Improved Over Time
Why are the model yields so much higher than the actual yields?

The actual stands shown in the chart were harvested between 1995 and 2005. They would have been planted in the 1970s and 1980s. 60 tons per acre was a common expectation back when these stands were planted.

The models are much more recent, and incorporate assumptions that include better seedlings and more advanced silvicultural techniques than were available or applied 40 and 50 years ago.

How much have southern pine yields increased over time?

Figure 4. Southern Pine Growth Rates Over Time
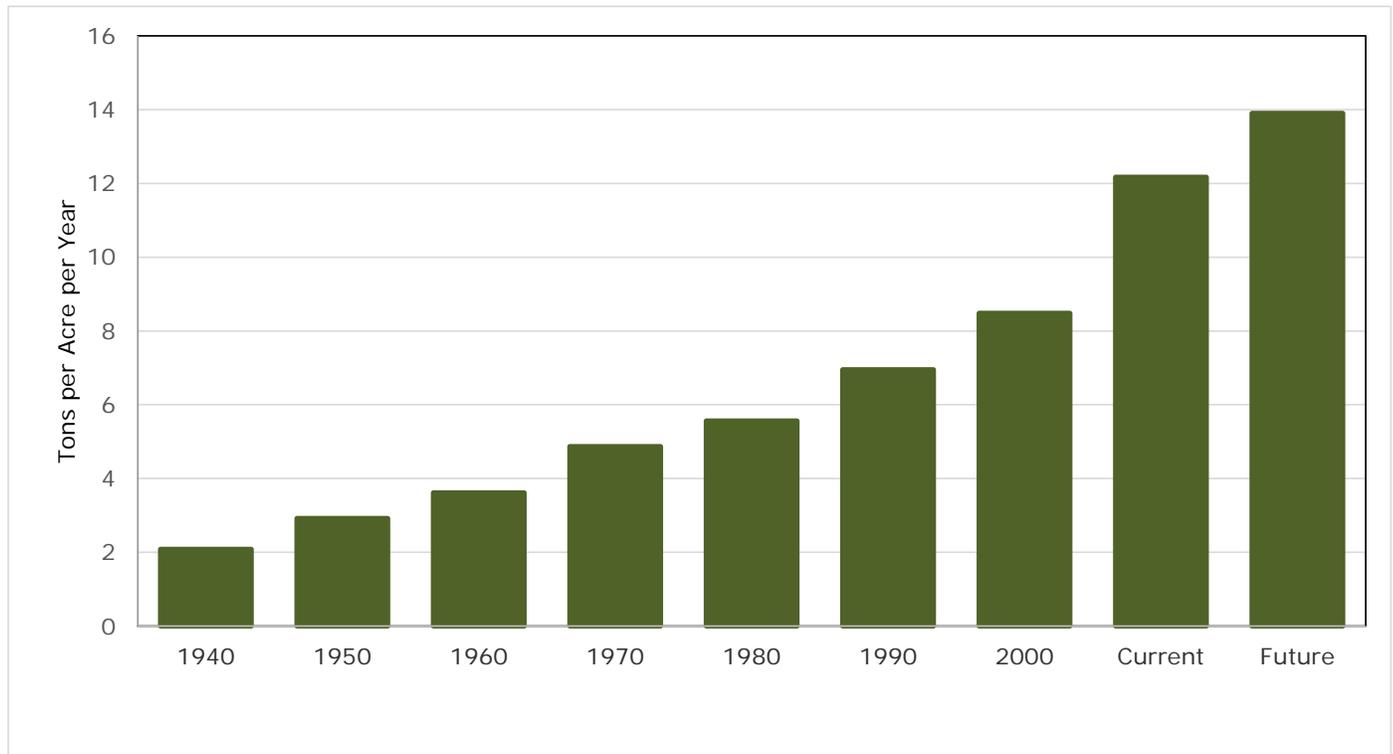
Source: Fox, et al, 2007

One indicator of changes in yields is the change in growth rates shown in Figure 4 (Fox et al) [1]. With growth rates in 1940 of about 2 tons per acre per year and growth rates in the mid-2000s at about 12 tons per acre per year, we have seen growth rate increasing at an annual average rate of about 2.8 percent.

- Our charts show yields of stands that had been planted 30-40 years ago.
- Research over those 30-40 years has produced genetically improved seedlings and silvicultural practices that have doubled growth rates since those stands were planted.

Summary

To summarize what we have shown:

- Not all the timber harvested of a mature southern pine stand will be sawtimber.
- The proportion of the harvested timber that *is* sawtimber can vary widely by forest.
- The *volumes* that can be harvested from a southern pine stand can also vary greatly.

[1] Fox, Thomas R. Eric J. Jokela and H. Lee Allen, 2007, *The Development of Pine Plantation Silviculture in the Southern United States*, Journal of Forestry, 105(7):337-347.