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I have received a few requests to provide a basic introduction to forest investment. To accomplish this, we will use an example for loblolly pine plantations. Remember though, for many landowners, timber financial returns are not the only concern, and thus landowners will have concerns for other forest attributes such as wildlife habitat, hunting, bird watching, hiking, hunting and recreational leases, carbon sequestration and financial credits/offsets, wildfires, an attachment to certain trees.

Variables Of Interest

As part of this particular analysis, there are several things that need to be determined, or specified.

Site Quality

For most forest investment analyses, quantifying a site's ability to produce timber is essential. Higher quality sites should produce more timber than a lower quality site. For loblolly pine plantations, a measure referred to as site index is commonly used to quantify a site's ability to produce timber. For these plantations, site index is defined as the average height of the dominant and co-dominant trees in terms of tree height. A base age, or standardized age, of 25 years is often used. Higher quality sites should have taller trees than lower quality sites at age 25. Although here we are specifying site quality, in reality and in practice, site quality is inherent to the site and thus predetermined.

Here, we will assume a site quality of 65 feet (base age 25), which is a good site (not poor and not great).

Interest Rate

Forestry is a long-term investment, and thus we have various costs and revenues occurring at vastly different times. We need a way to put the relative values of these operations on a constant time scale. Thus, interest rates allow us to discount back or to compound ahead such that economic values are at a constant point in time. Here, we will discount back future revenues to compare with costs occurring essentially in today's money.

For this analysis, we will utilize a common interest rate of 5%.

Stumpage Values

Stumpage can be defined as the amount of wood within the merchantable stem of a tree prior to the severing (cutting) of that tree from its stump. What is the value of standing timber? What are the revenues per ton of pulpwood, chip-n-saw, and sawlog sized and quality trees? Pulpwood trees are the least valuable, and sawlog trees are the most valuable.

To get some idea of what are reasonable stumpage values, Mississippi State has regularly published stumpage values and these can be found here:

<https://extension.msstate.edu/content/timber-prices-2013-present>

For this analysis, we will use 2022 4th quarter stumpage values as reported by Mississippi State for southwestern Mississippi. Stumpage values for pulpwood, chip-n-saw, and sawlogs are \$2.81, \$12.00, and \$24.56 per ton.

Planting Stock

Should we plant bareroot or container seedlings, should we plant open-pollinated (OP) or mass control pollinated (MCP, CMP) seedlings? Should we plant 2nd-gen or 3rd-gen? More recently, the terminology has changed to descriptors such as elite, select, and advanced.

For this example, we are concerned about establishing a forest to provide some future revenue for our children, but hunting is very important and recreational experiences are also important.

Thus, we are going to plant 2nd-gen open-pollinated (OP) bareroot seedlings. The table below, based on prices reported by several leading forest nurseries, shows the cost per thousand of various seedling types. The seedlings selected will cost \$64 per thousand.

	Bareroot	Containerized
OP Advanced	\$64	\$176
MCP Advanced	\$170	\$278
MCP Select	\$200	\$308
MCP Elite	\$241	\$350

Planting Density

How many seedlings per acre should I plant? More seedlings per acre means more seedlings need to be purchased, hence more costs. Plus, more seedlings per acre means I need to plant more seedlings, further increasing costs.

For this analysis, we will use a planting density of 454 seedlings per acre. Thus, based on the cost of \$64 per 1,000 seedlings, the seedlings will cost us \$29.06 per acre ($454/1000 * \64).

We will also incur costs associated with putting the seedlings in the ground. We can either hand plant or machine plant. To get some idea of the costs involved per acre, we can use the very useful publication entitled “Costs & Trends of Southern Forestry Practices 2020” published by Adam Maggard of Auburn University.

When looking at Table 2, on page 3, machine planting per seedling will cost us \$0.17. Thus, it will cost us \$77.18 per acre to place the seedlings into the ground.

Site Preparation and First-Year Herbaceous Weed Control Treatments

Some amount of site preparation is required on almost all sites prior to planting. Site preparation can be either chemical or mechanical, and often a third choice is the use of a site preparation burn. Chemical site preparation helps to eliminate existing vegetation, helping to provide access for planters, and can provide some short-term control of vegetation in early spring following planting. Mechanical site preparation can be useful to remove debris, address drainage and compaction issues, help provide access for planters, and can provide some amount of vegetation control. Here, we will assume that only chemical site preparation is needed.

Based on “Costs & Trends of Southern Forestry Practices 2020” and Table 4 on page 4 (Chemical Aerial Site Preparation), and assuming we are in the Northern Coastal Plain region (see Figure 1 on page 1), this will cost us \$79.54 per acre.

Following planting, on most sites, during the spring, there can be intense competition between our planted seedlings and non-planted vegetation (e.g. grasses, sedges, and forbs) for site resources of **MOISTURE**, nutrients, and perhaps light. If site preparation was conducted adequately, there should be little competition from non-planted woody vegetation, but there can still be strong competition from herbaceous vegetation (e.g. grasses, sedges, forbs). Thus, most sites require some amount of early herbaceous vegetation control during the spring, often called first-year herbaceous weed control.

Based on “Costs & Trends of Southern Forestry Practices 2020” and Table 4 on page 4 (Herbaceous weed control - All), we will assume a cost of \$54.39 per acre.

Growth and Yield

Following planting, we need a way to **project** our forest into the future. How many tons are we going to have at a particular age and what are the relative amounts of the pulpwood, chip-n-saw, and sawlog product classes through time? Growth is the change in yield (tons) over a specified time while yield itself (tons) is the amount that can be harvested at any time.

We will use a freely available forest simulator entitled GulfLOB. It is largely based on equations found in a USDA Forest Service publication entitled “Loblolly Pine Growth and Yield Prediction for Managed West Gulf Plantations” published by V.C. Baldwin, Jr. and D.P. Feduccia (1987).

Below is a timeline of operations and the associated costs (bold red) and revenues (black). The amount of pulpwood (\$2.81 per ton), chip-n-saw (\$12.00 per ton), and sawlog (\$24.56 per ton) tons per acre at the financially optimum age of 30 years are also shown. Discounted values based on the 5% interest rate are also shown.

Year	Activity	Costs	Tons	Stumpage		Discounted Values	
				Values	Revenues	Cost	Revenue
0	Chemical Site Preparation	\$79.54	-	-	-	\$79.54	-
0	Seedlings	\$29.06	-	-	-	\$29.06	-
0	Planting costs	\$77.18	-	-	-	\$77.18	-
0	1st-year herbaceous weed control	\$54.39	-	-	-	\$54.39	-
30	Pulpwood	-	6	\$2.81	\$16.86	-	\$3.90
30	Chip-n-saw	-	44	\$12.00	\$528.00	-	\$122.17
30	Sawlogs	-	102	\$24.56	\$2,505.12	-	\$579.63
	Total	\$240.17				\$240.17	\$705.70
	Net Present Value (NPV)					\$465.53	

Results of The Financial Analysis

Figure 1 below shows that the lower valued pulpwood (**\$2.81 per ton**) is gradually replaced by the more valuable chip-n-saw product class (**\$12.00 per ton**), and that eventually the majority of total yield is in the most valuable sawlog product class (**\$24.56 per ton**). Based on the assumed interest rate of 5%, and all of our growth and yield and economic assumptions, for this unthinned plantation, the Net Present Value (NPV) of costs and financial returns is maximized at age 30 (Figure 2).

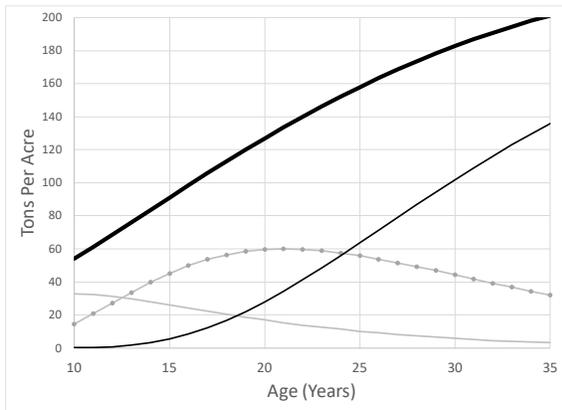


Figure 1. Tons per acre. Bold black curve is total tons per acre. Black curve is sawlog tons per acre (minimum dbh of 11 inches to an 8-inch top dob), gray diamond curve is chip-n-saw tons per acre (minimum dbh of 8 inches to 11 inches to an 6-inch top dob), and gray line is pulpwood tons per acre (minimum dbh of 5 inches to 8 inches to an 2-inch top dob).

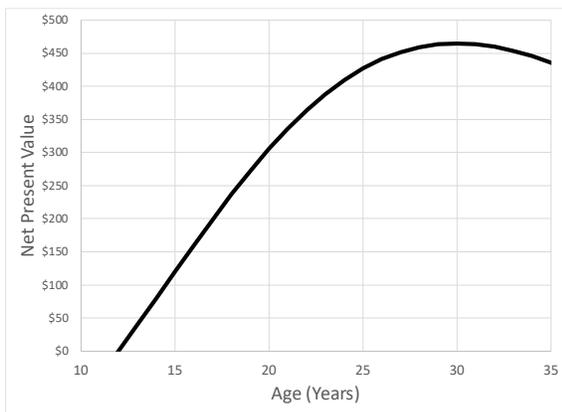


Figure 2. Net present value (NPV) per acre. 5% interest rate.



A load of pulpwood (on the top - **\$2.81 per ton**) heading to a paper mill and a load of sawlogs (on the bottom - **\$24.56 per ton**) heading to a sawmill. We obviously want more tons per acre and truckloads of sawlogs. By varying planting densities, the number and timing of thinnings, and the severity of thinnings, we can alter the tons per acre by product class at certain ages to our benefit.

Operationally, most plantations in Mississippi will receive a thinning. A thinning is an operation where the number of trees is reduced, in part to keep trees growing vigorously. High tree vigor helps to reduce the chance of infestation by the Southern Pine Beetle (SPB). Plus, a thinning provides an early return on an investment. A first thinning is commonly conducted around age 15. Figure 3 shows that this unthinned plantation will not be considered a high risk for infestation by the Southern Pine Beetle (SPB) until age 20. Given that many landowners are struggling to get their forests thinned around age 15, a planting density of 454 seedlings per acre provides some buffer in case a thinning cannot be conducted at that age.

Figure 4 shows the amount of understory vegetation production through time. For this example, since we have a strong interest in hunting on our property, understory vegetation is of importance to us. A thinning would open up the tree canopy allowing for more sunlight to reach the understory, and more nutrients and moisture would become available to the understory, thereby increasing production.

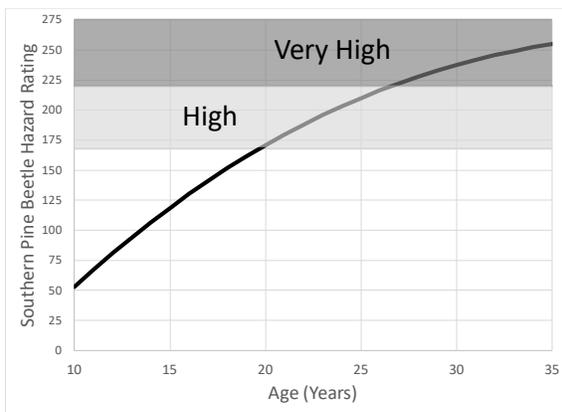


Figure 3. Southern Pine Beetle (SPB) hazard rating (2022 Guide to Southern Pine Beetle Cost-Share for pine thinning operations in Mississippi, page 5). The High rating begins at a value of 168 and the Very High rating begins at a value of 220.

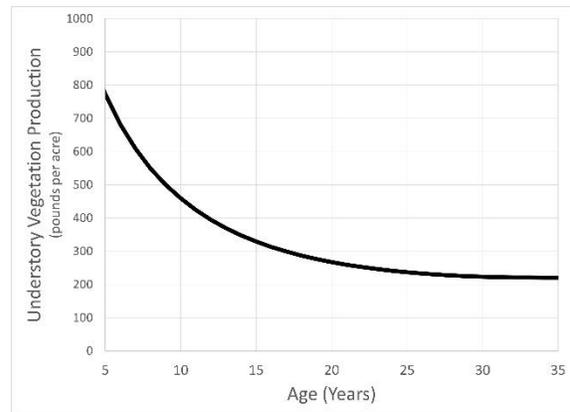


Figure 4. Understory vegetation production of an unfertilized, and unthinned, plantation.



Lower planting densities can lengthen the time to crown closure and this forested condition, plus provide an extended buffer against SPB. Beyond that, lower planting densities will result in more chip-n-saw and less pulpwood at the time of a first thinning.

In the forest on the left, there is intense competition for moisture, nutrients, and light among our planted pines, and there is essentially no understory vegetation. Thinnings can alleviate many of these issues, provide an early financial return, and maintain good growth rates to produce larger, more valuable trees for future harvests.

CAVEATS

1. There are many other considerations when conducting pine plantation financial assessments. This is just a basic analysis to help everyone gain knowledge about some very important things to consider when establishing pine plantations. I strongly encourage you to talk with your consulting forester, and other foresters, and to consider the tax implications related to these issues.
2. Future newsletters will use these basic financial concepts to examine how various forest management activities can impact financial returns and rotation ages, as well as other landowner concerns such as understory vegetation and Southern Pine Beetle infestations.
3. Hopefully an updated version of the “Costs & Trends of Southern Forestry Practices 2020” will be available soon and that Mississippi State University can once again report regional and statewide stumpage values.
4. I also encourage you to join your local County Forestry Association (CFA). These CFAs provide excellent opportunities to attend presentations on many aspects of forestry, meet and talk with consulting foresters and other foresters, and talk with other landowners about their experiences, among many other benefits. More information about CFAs can be found here:

<https://www.msforestry.net/page/CFAs>

Other sources of stumpage values for Mississippi and the southeastern US are:

TimberMart-South

<http://timbermart-south.com/msprices.html>

TimberUpdate

<https://timberupdate.com/timber-prices/mississippi-prices/>



Pulpwood: commonly trees with 5-8 inches at diameter breast height (4.5 feet above the ground). Diameter breast height is abbreviated as dbh. Pulpwood trees can be chipped into small pieces, chemically treated, and made into paper. These trees can also be made into strands/flakes/wafers for the production of Oriented Strand Board (OSB), or these trees can be used for the production of biomass pellets to produce energy. Of these three product classes, pulpwood trees are considered to be of the lowest quality in terms of size, but also the amount of branching, stem straightness, and issues associated with forking. **\$2.81 per ton.**

Chip-n-saw: commonly trees with 8-11 inches DBH. By using a combination of techniques, these mid-sized trees produce chips for pulpwood as well as small dimension lumber. Due to the production of lumber, chip-n-saw trees must be of higher quality than trees sold exclusively as pulpwood. **\$12.00 per ton.**

Sawtimber: commonly trees with 11 inches or greater DBH. These trees are cut into lumber. Therefore, of these three product classes, these trees must be of higher quality; straight logs with few branches. **\$24.56 per ton.**

The picture on the right shows the measuring of a tree's dbh (4.5 feet above the ground) using a diameter tape.