Loblolly pine rotation age economic comparisons using four stumpage price sets

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Abstract

The objective of this paper is to address and compare two site prepared and planted loblolly pine rotation scenarios: a one thin, 24-year rotation age and a two thin, 33-year rotation age economically using four pine stumpage price sets. The pine stumpage prices used are from Timber Mart South (TM-S 1976-2013, and 2017) and from recent state or region within a state (Mississippi 2016, Georgia Piedmont 2017) unit values. The reasoning for addressing the a shorter (24-year) mostly pulpwood and chip-n-saw production (86% of total wood produced was pulpwood and chip-n-saw) versus a longer (33-year) with more sawtimber (30% of total wood production was sawtimber) loblolly pine rotation is, in part, due to many forest landowners and land managers questioning growing pines out to sawtimber sized trees with multiple thinnings due to recent (2011 – 2017) lower sawtimber prices. Southeastern US and Georgia pine stumpage prices have change dramatically since 1976 (Figure 1). The primary financial measure of profitability used in this paper is Soil Expectation Value (SEV) also known as Bare Land Value (BLV) and Land Expectation Value (LEV) since different rotation ages are in this paper. The discount rates used are 4 and 6 percent. Merchantable wood mean annual increments, gross wood dollar per acre incomes and total wood incomes over the rotation and internal rate of return (IRR) are also presented.

Introduction

Private non-industrial forest (NIPF) landowners in the from Virginia to East Texas may question whether to site prep and plant loblolly pine (artificial regeneration) to a shorter, one thin, mostly pulpwood and chip-n-saw mid-20s years old rotation or a more traditional, two thin, early to mid-30s years old rotation with a reasonable amount of sawtimber. To address this question, we used the Georgia Pine Plantation (GaPPs 4.20) growth and yield Model developed by Bailey and Zhao (1998) for an artificial loblolly regeneration (site prep and plant good genetically improved seedlings) wood yields in a 24-year, one thin (thin at age 15-years old) versus a 33-year, two thin (at ages 15- and 24-years to 65 square feet basal area per acre thinning from below).

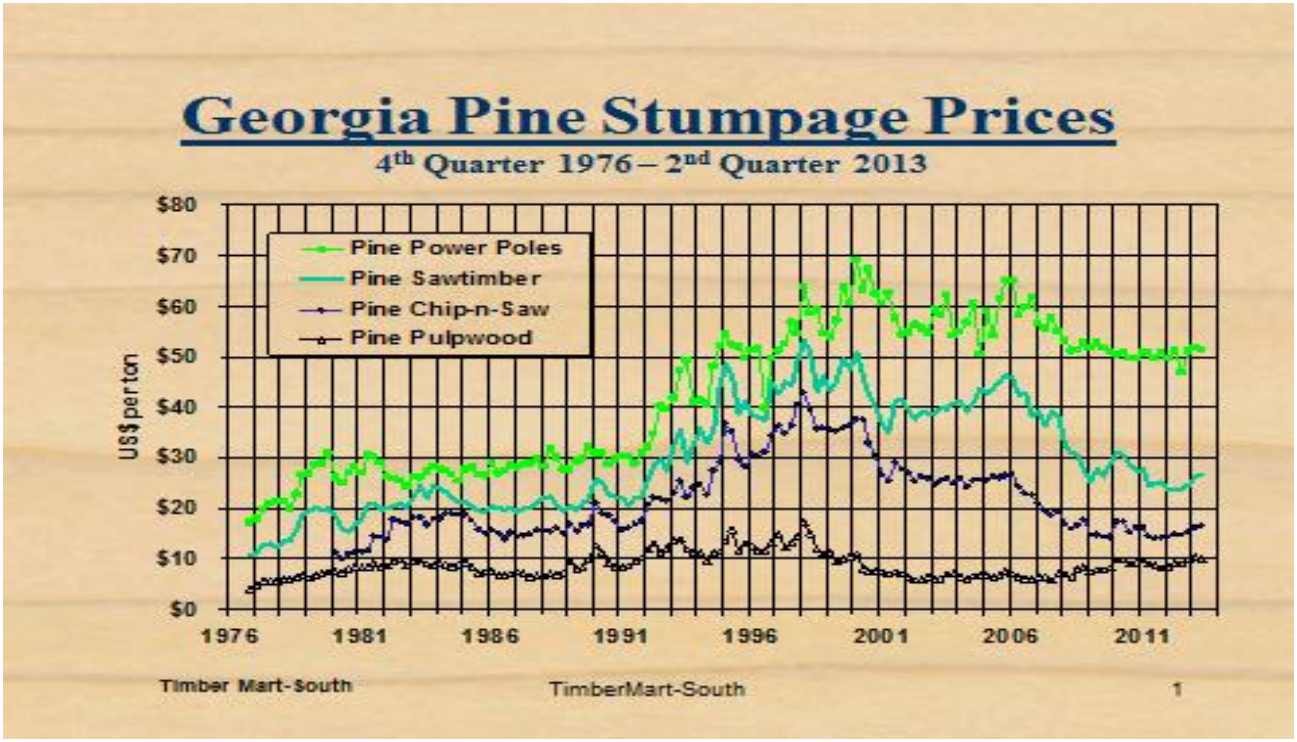

Figure 1. Georgia state-wide average pine stumpage prices from 4th quarter 1976 through 2nd quarter 2013 by product class

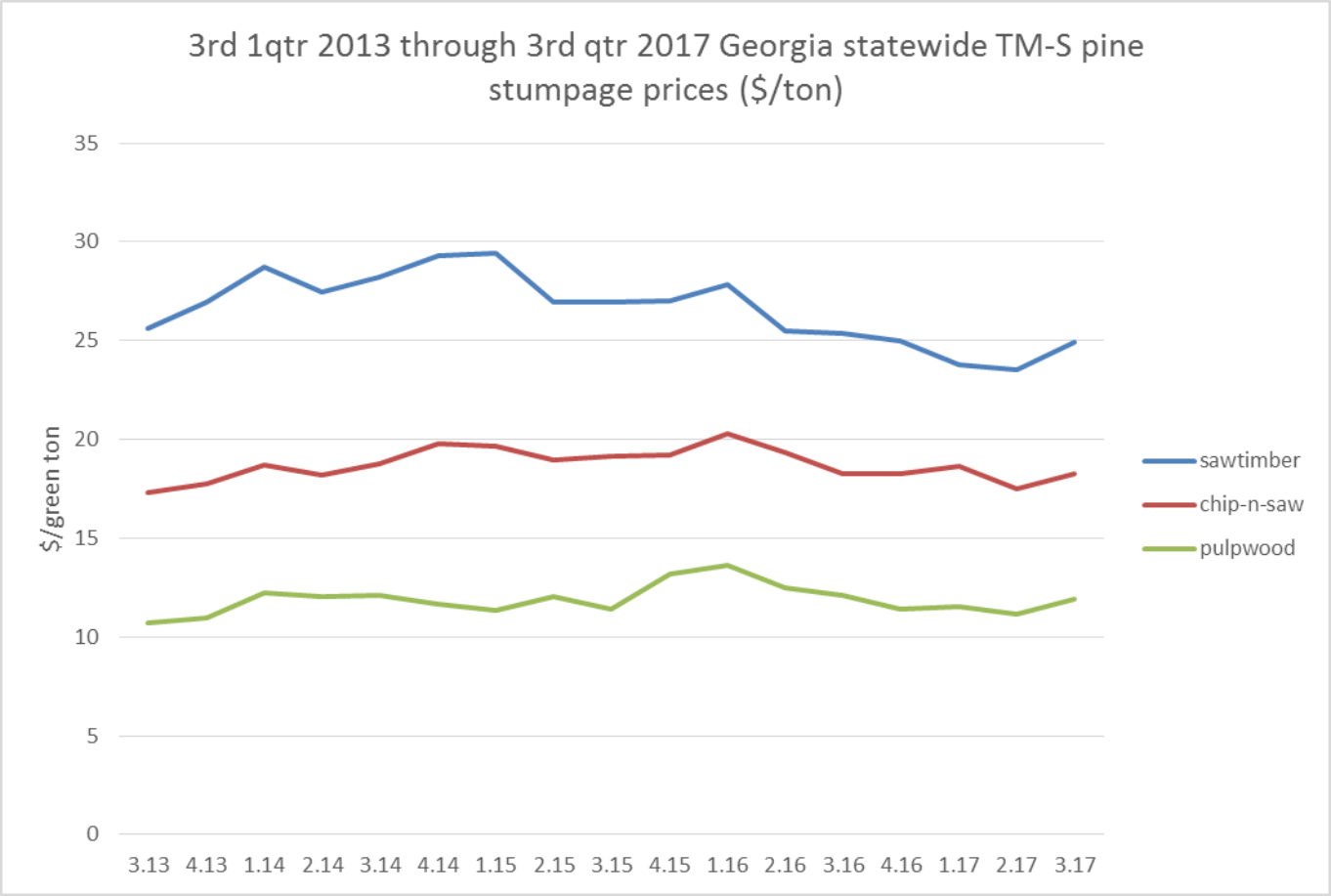

Figure 2. Third quarter 2013 through third quarter 2017 Georgia statewide pine stumpage prices ($/ton) reported from Timber Mart South (2013-2017).

Financial Calculations

Soil expectation value (SEV) is also known as bare land value (BLV) or land expectation value (LEV). SEV is the present value of an infinite series of identical rotations calculated at a discount rate. Put another way, SEV uses the present value of a perpetual periodic series formula to calculate the present value of an infinite series of identical rotations (Bullard and Straka 1993). At a given discount rate various tree species' rotation ages can be compared with the highest SEV being the most attractive and the lowest SEV being least attractive. SEVs were calculated using the Biomass Green Weight Estimation and Financial Analysis Tool (Love, 2011) and checked for accuracy using FORVAL online (Bullard and others. 2001) and an excel spreadsheet developed by Li and Dickens (2017). Gross wood revenues per acre are straightforward economic calculations of adding up all thinning and clearcut sale incomes for a total revenue per acre. The gross wood revenue for each loblolly scenario is calculated with no

discounting of costs or returns back to time zero or compounding forward costs and returns to the end of the rotation.

The Internal Rate or return (IRR) for a given scenario is the rate of compound interest that is earned by costs invested. IRR is the average rate of appreciation during the life of the project (Bullard and Straka 1993). IRR is calculated by finding the compound interest rate that is equal to the total present value of costs with the total present value of revenues; the interest rate where Net Present Value is equal to zero. IRR is also known as Rate of Return (ROR) and Return on Investment (ROI). Internal Rate of Returns were calculated using the Biomass Green Weight Estimation and Financial Analysis Tool (Love, 2011) and checked for accuracy using FORVAL online (Bullard and others. 2001) and an excel spreadsheet created by Li and Dickens (2017).

Gross wood revenues and Internal Rate or Return are useful when comparing scenarios of the same time duration (rotation age). A shortcoming of gross wood revenue values is that they lack the time value of money. Some of the shortcomings of Internal Rate or Return values are: (1) they lack scale (how large or small investments amounts are returning or losing for each scenario) and (2) due to the mathematics to calculate IRR, intermediate costs and returns are assumed to be re-invested at the IRR interest rate calculated which may not be achievable in real-world scenarios.

Methodology

Assumptions

The two loblolly pine scenarios (chemical site preparation, a site prep burn, buying quality genetically improved seedlings and planting) rotation age were set at either a 24-year, one thin at age 15-years (thinning back to 65 square feet basal area per acre from below removing defects and smaller diameter and shorter trees) or 33-year, two thin rotation (at ages 15- and 24-years thinning from below to the same basal area as the 24-year rotation). The GaPPS model (Bailey and Zhao 1998) was used for both the 24- and 33-year rotations. The 24-year rotation had a mean annual increment (MAI) of 6.20 tons/acre/year and the 33-year rotation had a MAI of 5.85 tons/acre/year (Table 1).

Costs for the two site prepared and planted loblolly pine scenarios:

► The artificial loblolly pine regeneration site preparation cost of $110/acre included chemical site preparation @ $75/acre and a site prep burn @ $35/acre (current average costs for these activities in Georgia). This site prep cost was for those acreages where a mechanical treatment was not warranted.

Loblolly seedlings were assumed to cost $75 per 1000 and planted at 726/acre (6x10 ft spacing) for a per acre cost of $55. Planting cost per acre was assumed to be $80.

The total cost per acre for the site preparation, seedlings and planting for the artificial loblolly pine regeneration scenario was $245. Other combinations of site preparation, burning (on no burning) and/or

mechanical site preparation, seedlings and planting scenarios may also, cost-wise, be approximately equal to the total cost presented and used here. Site preparation options and associated costs vary extensively by location, prior stand history, harvesting utilization, and contractor competition. Landowner objectives, monies available, and anticipated future stumpage value and demand also affect the site preparation method(s) chosen. The assumption used was that level of site preparation intensity was matched to level of competition control needed so that wood-flows were comparable within site productivity levels, after site preparation and planting.

Product class specifications

Pine Product class specifications are:

- ► pulpwood (PW) at a d.b.h. of 4.6 to 9 inches to a 3 inch top;
- ► chip-n-saw (CNS) at a d.b.h of 9 through 12 inches to 6 inch top; and,
- ► sawtimber (ST) with a d.b.h greater than 12 inches to a 10 inch top were assumed.

Four sets of pine stumpage prices were used in this economic paper (Table 4).

(1) The Georgia statewide historic average (4th quarter 1976 through 2nd qtr 2013)
(2) The Georgia statewide 1999 four quarters averaged
(3) The Georgia statewide 1st, 2nd and 3rd quarter 2017
(4) A Mississippi 2016 and Georgia Piedmont 2017 price quotes sets

Merchantable Wood Yields

Table 1. The 24-year, one thin site prepped and planted loblolly pine harvested wood yields by age.

Age	---------- tons/acre ----------		
(years)	pulpwood	chip-n-saw	sawtimber
15	34		
24	33	61	21

Mean annual increment = 6.20 tons/acre/year

Table 2. The 33-year, two thin site prepped and planted loblolly pine harvested wood yields by age.

Age	---------- tons/acre ----------		
(years)	pulpwood	chip-n-saw	sawtimber
15	25		
24	21	24	2
33	23	43	55

Mean annual increment = 5.85 tons/acre/year

Stumpage price sets

Table 3. Pine stumpage price sets used in economic analysis ($/ton); GA statewide TM-S, MS 2016, GA Piedmont 2017.

Pine prices	1976-2013(pine) average	1999 average	2017 average	MS 2016, GA Piedmont 2017
Pulpwood	9	10	12	7
Chip-n-saw	22	36	18	14
Sawtimber	30	46	24	21

Table 4. Scenario Soil Expectation Values ($/acre) using a 4% discount rate using three stumpage price sets.

Scenario	1976 – 2013 ave.	1999 average	2017 average	MS 2016, GA 2017
	$9, $22, $30/ton	$10, $36, $46/ton	$12, $18, $24/ton	$7, $14, $21/ton
24-year, one thin @ age 15-years	1085	1898	1004	548
33-year, two thin @ ages 15- and 24-years	1064	1861	934	556

Pine and hardwood stumpage price sets used are from Table 3.

Table 5. Scenario Soil Expectation Values ($/acre) using a 6% discount rate using three stumpage price sets.

Scenario	1976 – 2013 ave.	1999 average	2017 average	MS 2016, GA 2017
	$9, $22, $30/ton	$10, $36, $46/ton	$12, $18, $24/ton	$7, $14, $21/ton
24-year, one thin @ age 15-years	425	845	393	144
33-year, two thin @ ages 15- and 24-years	363	745	312	114

Pine and hardwood stumpage price sets used are from Table 3.

Table 6. Loblolly pine internal rate of return by scenario.

Scenario				
	1976 – 2013 ave.	1999 average	2017 average	MS 2016, GA P 2017
	$9, $22, $30/ton	$10, $36, $46/ton	$12, $18, $24/ton	$7, $14, $21/ton
24-year, one thin rotation	9.5%	11.5%	9.4%	7.4%
33-year, two thin rotation	8.6%	10.3%	8.5%	7.0%

Pine and hardwood stumpage price sets used are from Table 4.

Table 7. Loblolly pine rotation mean annual increments (tons/acre/year) and gross merchantable wood revenues by scenario using 2017 average prices.

Scenario			
	1st thin income $/acre	2nd thin income $/acre	Final harvest & (total) $/acre income
24-year, one thin rotation MAI=6.20	408	--	1998 (2406)
33-year, two thin rotation MAI = 5.85	300	732	2370 (3402)

Results

Soil Expectation Values by Scenario and Stumpage Price Set at the two discount rates

4% discount rate

The 24-year, one thin loblolly scenario produced slightly higher SEVs by margins of $21, $37, and $70/acre compared to the 33-year, two thin loblolly scenario using the Georgia statewide historic (1976-2013) average, 1999 average, and the 2017 average, respectively at the 4% discount rate (Table 4). The 33-year, two thin loblolly scenario produced a slightly higher SEV ($8/acre) than the 24-year rotation at the 4% discount rate using the MS 2016 and GA Piedmont 2017 prices (Table 4). These SEV differences at amounted to less than 2% between the two rotation scenarios using the Georgia statewide historic average, the 1999 average and the MS 2016, GA Piedmont 2017 prices but a 7% difference using the 2017 average price set in favor of the 24-year rotation (Table 4).

6% discount rate

The SEV $/acre differences between the two rotation scenarios were larger at the 6% discount rate than the 4% discount rate (Table 4 and 5). The 24-year loblolly rotation had SEV $/acre values that were $62, $100, $81, and $30/acre greater than the 33-year loblolly rotation using the Georgia statewide historic average, the 1999 average, the 2017 average and the MS 2016, GA Piedmont 2017 price sets,

respectively (Table 5). The 33-year rotation SEVs were 15, 12, 21, and 21% less than the 24-year rotation using the 6% discount rate.

Internal Rate of Return values and gross wood revenues

The loblolly pine 24-year, one thin rotation produced IRRs of 9.5, 11.5, 9.4 and 7.4 percent compared to the 33-year, two thin rotation's IRRs of 8.6, 10.3, 8.5, and 7.0 percent using the Georgia statewide historic (1976-2013) average, 1999 average, the 2017 average, and the MS 2016, GA Piedmont 2017 pine stumpage prices, respectively (Table 6).

Using the most recent Georgia statewide pine stumpage prices (TM-S 2017, Table 3), gross wood revenue was greatest for the site prepped and planted 33-year, two thin loblolly pine scenario at $3402/acre ($300/acre at age 15-years, $732/acre at age 24-years and $2370/acre at age 33-years, Table 7). The 24-year, on thin loblolly scenario had a gross wood revenue of $2406/acre ($408/acre at age 15years and $1998/acre at age 24-years, Table 7). While the 33-year rotation produced almost $1000/acre more in total revenue than the 24-year rotation, the 24-year rotation produced $1374/acre more income in the first 24-years ($2406 versus $1032/acre, Table 7).

Impact of loblolly pine growth rate and rotation age on sawtimber production, gross wood revenue, and Internal Rate of Return

The site prepped and planted loblolly pine, 24-year, one thin scenario had a wood production mean annual increment of 6.2 tons/acre/year, which was 6% (0.35 tons/acre/year) greater than the 33-year, two thin rotation scenario. Loblolly pine's maximum MAI tends to occur around age 19-25 years depending on a number of factors, so the 24-year rotation's final harvest occurs around the maximum MAI. The 33-year, two thin rotation produced 57 tons/acre of sawtimber sized trees (2 tons/acre captured at age 24-years in the second thinning and 55 tons/acre captured at final harvest) whereas the 24-year rotation produced 21 tons/acre of sawtimber sized trees (all 21 tons/acre of sawtimber value captured at age 24-years). Gross wood revenue was approximately $1000/acre greater for the 33-year rotation versus the 24-year rotation but it took nine more years to get the $1000/acre difference (Table 7). IRRs were greater for the 24-year, one thin rotation than the 33-year, two thin loblolly pine rotation (Table 6) by a range of 0.40 to 1.3 percentage points.

Summary and Discussion

Non-industrial private forest landowners do have some attractive rotation age options for site prepped and planted loblolly pine. At the 4% discount rate the SEV value differences were small between the 24-year one thin and the 33-year, two thin rotation scenarios. Using the 6% discount rate, the SEV value differences were larger (12 to 21% less for the 33-year versus the 24-year rotation), in favor of the shorter 24-year, one thin rotation. Major keys to maximizing financial returns on pine timber sales are: (1) be flexible on timber sale timing. Have a 3-5 year window for each timber sale rather than a 1-2 year window. (2) Know local market conditions, both historically and currently. Stay in constant touch with a reputable forestry consultant that is aware of local market conditions and prices. These consultants can let landowners know when pulpwood, chip-n-saw or sawtimber prices are high, modest or low in relative terms. (3) The first thinning cutting job quality is very important, leaving the best (no

visible stem defects) and larger trees to respond to the thinning. Smaller diameter trees that occupy the lower canopy positions do not respond as dramatically to thinnings as the larger diameter, higher canopy position trees. (4) When it is time for a second timber sale (clearcut versus second thin), are pulpwood and chip-saw prices strong or not? If these prices are strong then a clearcut may be financially more attractive than a second thinning. What are the anticipated sawtimber prices 6-10 years from that second cut if the stand is thinned? Or is it better to clearcut and have 8-9 year old trees versus a 33-year old stand about to be clearcut?

If the 33-year, two thin rotation can produce some poles, which have been 2-fold greater in value per ton than sawtimber in the last 5+ years, then the 33-year rotation can look more financially attractive. The findings in this paper are specific to the assumptions made. Changes in assumptions will alter the results which can alter scenario attractiveness when compared than others. In this paper growth rates, establishment costs, and stumpage price sets may be different than what some forest landowners would use. Familiarize yourself with financial tools like the Biomass Green Weight Estimation and Financial Analysis Tool (Love, 2011) that was used here or FORVAL online (Bullard and others. 2001).

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