Series paper #4

Economics of growing slash and loblolly pine to a 24-year rotation with and without thinning and pine straw – net present value

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Abstract

This economic series of papers is a follow-up to an economic series published in 2007 (Dickens and others. 2007). The reasoning for this new economic series is due to changing pine stumpage prices since the last series of papers and to dramatic changes in forest industry, forestland ownership, global markets, and wood supply and demand (pulpwood, sawtimber, chips, etc.) regionally and world-wide since for late 1990's. Non-industrial private forest (NIPF) landowners in some areas have realized reduced product market availability and increased price uncertainty during this period in the southeastern United States. Lower Atlantic and Gulf Coastal Plain NIPF landowners seek management options utilizing three commonly available pine species; loblolly (*Pinus taeda* L.), longleaf (*Pinus palustris*, Mill.) and slash (*Pinus elliottii*, Engelm.) to enhance feasibility, profitability, and cash-flow of production forestry enterprises. At the same time, NIPF landowner's desire heightened flexibility across time required to achieve marketable forest products. This paper examines feasibility, profitability, and cash-flow of relatively short-rotation (24-year) management options affecting wood-flow for slash and loblolly pine plantations including with and without a thinning, competition control and fertilization, with and without pine straw harvests, two different site preparation and planting costs, and three different stumpage price sets. Longleaf pine will be compared to loblolly and slash pine financially using a 33-year rotation in series papers #5 and 6. The financial measure of profitability used in this paper is net present value (NPV) calculated at four, six, eight, and ten percent. The mean annual increments of 5.7 to 6.3 tons/acre/year used for loblolly and slash pine for these 24-year rotations are considered somewhat conservative by today's standards under moderate to intensive management or growing on old-field sites.

Introduction

Private non-industrial forest (NIPF) landowners in the Atlantic and Gulf Coastal Plain from South Carolina to Mississippi question whether to plant slash or loblolly pine on cut-over and old-field sites under relatively short rotation management. They also question spending moderate to relatively large sums of money in intensive forest management under the current and anticipated stumpage prices and economic uncertainty. To address these questions, we used the Georgia Pine Plantation (GaPPs 4.20) growth and yield Model developed by Bailey and Zhao (1998). The majority of stand and tree data to develop the GaPPs growth and yield models for slash and loblolly were in the 10- to 25-year age classes. Therefore we used a 24-year rotation age that had a mixed product class distribution of pulpwood, chip&saw, and sawtimber. Generally culmination of merchantable volume mean annual

increment occurs for both species on average to good sites and soils and moderate levels of management in the early 20-years (Pienaar and others 1996). Recent loblolly and slash pine growth studies (Zhao and Kane 2012) using intensive management indicate that culmination of mean annual increment may occur sooner than the early 20 years. Depending on establishment costs, intermediate costs, growth rates, and other sources of income (in this paper series; pine straw), shorter or longer rotation ages are often financially attractive and will be addressed in companion papers in this series of economic manuscripts.

Financial Calculations

Net present value (NPV) was the financial measure of profitability used for this economic paper. NPV is a common financial indicator defined as the difference between all the cash inflows and cash outflows over the investment period, discounted back to present day. The interest rate used in the calculation, known as the discount rate, is based on the estimated rate of return under an alternative investment with similar risks. NPV is useful in helping investors decide between two or more investment alternatives with the same length of time. At a given discount rate, NPVs for different pine species and scenarios can be compared to each other with the highest ranking NPV being the highest value per acre and the lowest ranking NPV being the lowest value per acre. Generally a positive NPV indicates that the investment is attractive at the interest rate used while a negative NPV indicates that the investment is not financially attractive. NPVs 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).

Methodology

Common assumptions

The rotation age was set at 24-years for slash and loblolly pine plantations. Net present value (NPV) was calculated at four, six, eight, and ten percent. Fire protection cost was assumed$2/acre/year, stand management at $2/acre/year, and property taxes at $6/acre/year. Thus, the total annual costs for each year of the rotation were $10/acre. Results are reported in constant dollars, before federal and state income or capital gains taxes. It is assumed that land is already owned.

Site Preparation and Planting Costs

Two site preparation and planting (SP+PL) costs were assumed:

► The “average” site preparation cost of $110/acre included chemical site preparation @ $75/acre and a site prep burn @ $35/acre. This site prep cost was for those acreages where a mechanical treatment was not warranted.

► The “high” site preparation cost of $320/acre includes a chemical site preparation treatment as in the “average” treatment listed above plus a mechanical site prep treatment of shearing, piling and bedding ($210/acre) assuming the site needs both treatments and a site prep burn for $35/acre (Dubois and others. 2013).

Seedlings were assumed to cost $75/1000 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 "average" site preparation plus planting was $245 and the total cost for the "high" site preparation and planting cost was $455. 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 of the "average" or "high" establishment costs per are 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

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 (inside bark) were assumed (Table 1).

Three sets of pine stumpage prices were used in this economic series. A "low", "medium" and "high" pine pulpwood, chip-n-saw, and sawtimber set of prices were established using Timber Mart-South© (TM-S) stumpage values for Georgia for the period of 4th quarter 1976 through 2nd quarter 2013 (Figure 1); a total of 107 quarters of prices. The "low" set of stumpage prices were the means of the 15 lowest price quarters of each of the product classes. The "average" set of stumpage prices were the mean of all the stumpage prices for each product class for the period from 4th quarter 1976 through 2nd quarter 2013. The "high" stumpage prices were the means of the 15 highest price quarters of each of the product classes. Loblolly and slash stumpage values were net of property taxes at harvest (2.5 percent) and net of marketing costs (7.5 percent). Cash and net converted prices are found in Table 2.

Species specific assumptions

The slash pine mean annual increment was 5.6 tons/acre/year @ age 24-years-old without thinning (Table 3) and 5.4 tons/acre/year for the thin scenarios were assumed. The no thin slash scenario woodflow was approximately 11 percent less than base loblolly woodflow (Shiver and others 1999) at age 24-years. The assumed the fertilizer application at age 15-years enhanced pine merchantable volume for eight years following treatment as well as improve pine straw production for the pine straw scenarios.

The loblolly pine mean annual increment for loblolly was 6.3 tons/acre/year (Table 3) through age 24-years-old without thinning and 6.1 tons/acre/year with a thinning at age 15-years were assumed. The base loblolly woodflow was approximately 12.5 percent greater than the slash base woodflow (Shiver and others 2000) at age 24-years. The assumed fertilizer application at age 15-years increased merchantable volume for eight years (NCSUFNC 1998) and improve pine straw production for the pine straw scenarios.

All the loblolly and slash pine scenarios had one woody control herbicide application at age 6-years and a single 170 N + 25 P per acre fertilizer treatment at age 15-years at a July 2013 cost of $55/acre and $165/acre, respectively. These prices are common prices for Georgia during 2010-2013.

Scenarios for the 24-year Rotation

The following are the loblolly (Table 5 and 6) and slash (Table 7 and 8) pine scenarios:
(1) no thinning, no pine straw, $245/acre establishment cost
(2) no thinning, no pine straw, $455/acre establishment cost
(3) no thinning, rake pine straw @ $50 (loblolly) or $75/ac/yr (slash) from age 8- through 24-yrs , $245/acre establishment cost
(4) no thinning, rake pine straw @ $50 (loblolly) or $75/ac/yr (slash) from age 8- through 24-yrs , $455/acre establishment cost
(5) thin, (at age 15-years to 65 ft^2/ac), no pine straw, $245/acre establishment cost
(6) thin at age 15-years, no pine straw, $455/acre establishment cost
(7) thin at age 15-years,rake straw @ $50 (loblolly) or $75/acre/year (slash) from age 8- through 15-years, $245/acre establishment cost
(8) thin at age 15-years,rake straw @ $50 (loblolly) or $75/acre/year (slash) from age 8- through 15-years, $455/acre establishment cost

Forest management activities

Woody competition control

Woody competition control with a single herbicide application occurred at age 6-years to get the stand into pine straw production in the pine straw scenarios or to reduce under- and mid-story woody competition to enhance pine growth in the no pine straw scenarios. The cost was assumed to be $55/acre, a price often quoted for a single herbicide application in pine stands prior to canopy closure in Georgia since 2010.

Thinning

The thinning scenarios include no thinning or one thinning at 15-years-old. Total woodflow of scenario with thinning is approximately 95 percent of total woodflow of scenario without thinning for slash and loblolly without fertilization. Residual basal area (RBA), after thinning (5^{th} row with selection from below) was set at 65 sq. ft/ac.

Fertilization

A single 175 N + 25 P fertilizer and application cost of $165/acre for slash and loblolly at age 15-years-old was assumed (a relatively common average N+P mid-rotation cost in Georgia since 2010). Fertilization with 175 N + 25 P (as diammonium phosphate and urea) per acre was part of this scenario to maintain pine straw production rates (Dickens 1999), to enhance wood volume (NCSUFNC 1998), and change product class distribution (Peinaar and Rheney 1996, Dickens 2001). The fertilizer application was just after a thinning in the thinning scenario to put extra wood on the best trees or to maintain pine straw production in the unthinned scenario.

Pine straw

The pine straw income assumptions included were as follows: $50 and $75/acre/year raking income for the slash and loblolly scenarios, respectively have been noted in south (slash) and central (loblolly) Georgia between 1998 and 2010 (Doherty 2004, Dickens and others. 2012). Pine straw is raked starting in year 8 (approximating canopy closure) for slash and loblolly pine (Table 4).

Typically pine straw raking in Georgia ceases after the first thinning due to large understory vegetation growth in thinned stands and the abundance of unthinned, relatively clean loblolly and slash pine stands available. Yet many acres of thinned loblolly and longleaf stands in South and North Carolina are raked. In this paper we assumed that pine straw income occurred in unthinned loblolly and slash stands from age 8- through age 24-years and in the thinned stands from age 8-years through age 15-years. Some pine straw contractors in Georgia anticipate that some thinned loblolly, longleaf, and slash pine stands may be rakeable in the future (supply and demand).

Results

Net present value ranges

Across the eight scenarios for loblolly and slash pine net present values (NPVs) ranged from lows of -$492 and -$507/acre (Table 5 and 7; loblolly and slash pine scenarios with high establishment cost, no pine straw, no thin at 10% discount rate, respectively) to highs of $1261 and $1403/acre (Table 6 and 7; slash, low establishment cost, with pine straw, no thin and the loblolly, average establishment cost, with pine straw, thin at age 15-years at 4% discount rate, respectively).

Impact of thinning on net present values

Thinning, without pine straw income, (scenario #5) improved loblolly pine NPVs at the 4% discount rate by $128/acre (from -$59 to +$69/acre using the average establishment cost and low stumpage price set) to $420/acre (from $727 to $1147/acre using the average establishment cost and high stumpage price set when compared to the no-thin, no pine straw scenario #1 (Table 5 and 6). Thinning, with pine straw income (scenario #7) had a $78/acre lower loblolly pine NPV at the 4% discount rate when using the low stumpage price set when compared to the no-thin scenario #3 with pine straw income ($403 versus $325/acre using the average establishment cost; Table 5 and 6). When using the high stumpage price set with pine straw income at the 4% discount rate, NPV was improved by $213/acre ($1190 versus $1403/acre using the average establishment cost; Table 5 and 6) with thinning (scenario #7) versus no thinning scenario (#3). Using the 10% discount rate, without pine straw and the average establishment cost, thinning (scenario #7) improved NPVs by $57, $103, and $171/acre using the low, average, and high stumpage price sets for loblolly pine versus the no thin scenario #3 (Table 5 and 6). With pine straw at the 10% discount rate and average establishment cost, thinning (scenario #7) had a slightly lower NPV ($12/acre) less than the no thin scenario (scenario #3) using the low stumpage price set, and had $34 and $103/acre higher NPVs using the average and high stumpage price sets for loblolly pine (Table 5 and 6).

Thinning, without pine straw income (scenario #5), improved slash pine NPVs at the 4% discount rate by $116/acre (from -$156 to -$40/acre using the average establishment cost and low stumpage price set) to $256/acre (from $568 to $824/acre using the average establishment cost and high stumpage price set) compared to the no thin, no pine straw scenario #1 (Table 7 and 8). Thinning, with pine straw income using the average establishment cost (scenario #7), decreased slash pine NPVs at the 4% discount rate by $53, $156, and $234/acre when using the high, average, or low stumpage price sets, respectively when compared to the no thin with pine straw income scenario #3 (Table 7 and 8). Using the 10% discount rate, without pine straw and the average establishment cost, thinning (scenario #5) improved slash NPVs by $35, $65, and $106/acre using the low, average, and high stumpage price sets, respectively when compared to the no thin scenario #1 (Table 7 and 8). Slash pine with pine straw at the 10% discount rate and average establishment cost, thinning (scenario # 7) had lower NPVs ($39 and $68/acre) less than the no thin scenario #3 using the average and low stumpage price set, and had a slightly ($2/acre) higher NPV using the high stumpage price set. The high establishment cost

scenarios followed the same pattern as the average establishment cost when comparing the no thin to thin scenarios for loblolly and slash pine with $210/acre less NPVs (scenarios #2, 4, 6, and 8).

Impact of pine straw income on net present values

The pine straw income prior to thinning (age 8- through 15-yrs, at $50/acre/year) in the thin loblolly pine scenarios (#7 and 8) increased NPVs by $256, $207, $168, and $137/acre using the 4, 6, 8, and 10% discount rates, respectively when compared to the no pine straw scenarios #5 and 6 (Table 6). NPV values improved in the no thin loblolly pine scenario #3 and 4 with pine straw income from age 8- through age 24-years by $462, $348, $267, and $206/acre at the 4, 6, 8, and 10% discount rates, respectively when compared to the no pine straw income scenarios #1 and 2 (Table 5).

Pine straw income prior to thinning (age 8- through 15-yrs, at $75/acre/year) in the thin slash pine scenarios #7 and 8 increased NPVs by $384, $309, $252, and $206/acre using the 4, 6, 8, and 10% discount rates, respectively when compared to the thin with no pine straw income scenarios #5 and 6 (Table 8). NPV values improved in the no thin slash pine scenarios with pine straw (scenarios # 3 and 4) by $734, $522, $399, and $309/acre at the 4, 6, 8, and 10% discount rates, respectively when compared to the no thin, no pine straw income scenarios #1 and 2 (Table 7).

Impact of establishment costs on net present values

The impact of establishment costs (site preparation and planting; SP+PL) was straight-forward with NPVs differing by $210/acre since these costs are incurred at time zero. The impact of establishment costs within a management level (scenario) was large enough ($210/acre) to illustrate the importance of choosing the right SP+PL for a given site. The impact of SP+PL in the loblolly scenarios showed the same trend as the slash pine scenarios.

Impact of using the low, average, or high pine stumpage price sets on net present values

The impact of using the low, average and high stumpage price sets on NPV values in the thinned or unthinned 24-year loblolly or slash pine rotation scenarios were generally large, especially at the lower discount rates. Examples of the impacts are as follows:

(1) Using loblolly pine scenario #1 and NPV @ 4%, the differences in the NPVs were $301/acre between the low (-$59/acre) and average (+$242/acre) and $485/acre between the average and high ($727/acre) stumpage price sets (Table 5).

(2) Using loblolly pine scenario #4 and NPV @ 8%, the differences in NPVs were $118/acre between the low (-$189/acre) and average (-$68/acre) and $196/acre between the average and high (+$128/acre) stumpage price sets (Table 5).

(3) Using loblolly pine scenario #6 at NPV @ 8%, the differences in NPVs were $278/acre between the low (-$84/acre) and average (+$194/acre) and $430/acre between the average and high ($624/acre) price set (Table 6).

(4) Using slash pine scenario #2 and NPV @ 6%, the differences in the NPVs were $163/acre between the low (-$424/acre) and average (-$261/acre) and $270/acre between the average and high (+$9/acre) stumpage price sets (Table 7).

(5) Using the slash pine scenario #3 and NPV @ 8%, the differences in the NPVs were $104/acre between the low (+$131/acre) and average (+$235/acre) stumpage price sets and $172/acre between the average and high (+$407/acre) stumpage price sets (Table 7).

(6) Using slash pine scenario #7 and NPV @ 4%, the differences in the NPVs were $336/acre between the low (+$344/acre) and average (+$680/acre) stumpage price sets and $528/acre between the average and high (+$1208/acre) stumpage price sets (Table 8).

Generally the NPV differences between the three stumpage prices lessened as the discount rate increased from 4 to 6 to 8 and to 10%. The NPV differences between discount rates used generally increased as stumpage prices used increased (Table 5-8).

Impact of discount rates on net present values

The impact of changing discount rates from 4 to 6 to 8 or 10% had a relatively large effect on NPV values. The highest NPV values were achieved when using the lowest discount rate. NPV values decreased as the discount rate used increased. Examples of NPV differences are as follows:
(1) Using loblolly pine scenario #1 @ the low stumpage price set, NPVs decreased by $119, $68, and $36/acre between the 4 and 6, 6 and 8, and 8 and 10% discount rates, respectively (Table 5).

(2) Using loblolly pine scenario #3 @ the average stumpage price set, NPVs decreased by $344, $218, and $140/acre between the 4 and 6, 6 and 8, and 8 and 10% discount rates, respectively (Table 5).

(3) Using loblolly pine scenario #8 @ the high stumpage price set, NPVs decreased by $569, $365, and $239/acre, between the 4 and 6, 6 and 8, and 8 and 10% discount rates, respectively (Table 6).

(4) Using slash pine scenario #2 @ the high stumpage price set NPVs decreased by $349, $211, and $127/acre, between the 4 and 6, 6 and 8, and 8 and 10% discount rates, respectively (Table 7).

(5) Using slash pine scenario #5 @ the average stumpage price set, NPVs decreased by $233, $142, and $86/acre, between the 4 and 6, 6 and 8, and 8 and 10% discount rates, respectively (Table 8).

(6) Using the slash pine scenario #6 @ the low stumpage price set, NPVs decreased by $115, $68, and $39/acre, between the 4 and 6, 6 and 8, and 8 and 10% discount rates (Table 8).

Summary

Wood flows, thinning, and pine straw

The slash pine 5.4 and 5.6tons/ac/yr) and the loblolly pine 6.1 and 6.3 tons/ac/yr) productivity levels at age 24-years-old are very realistic on most cut-over sites with chemical site preparation and post-plant herbaceous weed control (Pienaar and Rheney 1996) and is conservative on most old-field sites or with the genetic improved seedlings and better management. Exceptions would be problem soils such as excessively well drained, deep sands (Typic Quartzipssamments) of the Sand Hills or shallow, rocky soils of the Piedmont physiographic region.

These scenarios do illustrate that if the aforementioned base growth rates for slash pine and loblolly pine are assumed, then the establishment expenditures (site preparation, seedling, and planting costs) and intermediate management activities (herbicide use and fertilization) need to be used wisely. In

many cases the establishment phase decisions (site preparation type, timing, and quality, site preparation effects on near- or long-tern site productivity, woody and herbaceous weed control efficacy, species selection, seedling genetics and size, seedling survival) can improve growth rates above those used here, therefore improving net present values.

The woody vegetation release treatment at age 6-years @ $55/acre cost and the single N+P fertilization at age 15-years @ $165/acre cost were employed in these scenarios to improve loblolly and slash pine wood yields and get the stands ready for pine straw (woody vegetation control) in the pine straw scenarios (Jokela and Stearns-Smith 1993, Martin and others. 1999, NCSFNC 1999). No increase in pine straw income per acre was assumed with fertilization. Fertilization studies (Blevins and others. 1996, Dickens 1999) illustrate that pine straw production can be increased by an average of 40 to 50 percent over unfertilized stands on marginal fertility soils. Fertilization was included in the pine straw production scenarios to maintain straw production as nutrients are removed/displaced with each raking.

When wood value only is considered, loblolly produced more wood, more wood value, and higher NPVs with the aforementioned assumptions. Recent studies (Shiver and others. 1999, Zhao and Kane 2012) have shown that loblolly will grow more wood than slash on a number of soils where both species are grown. Loblolly's superior wood volume yields do not necessarily equate to higher per acre or per unit wood stumpage prices. Clark (2002) noted that slash pine yielded more number one lumber, had a slightly greater (4 to 11 percent greater) density, and 4 percent less moisture content than loblolly pine in growing in the same stand.

Discussion

Non-industrial private forest landowners do have some attractive forest management options with both slash and loblolly pine using relatively short rotations. To maximize NPVs, landowners need to be flexible when thinning or clearcutting their stands, possibly looking into a 3 to 5 year horizon and closely following local pine stumpage prices. Selling wood when stumpages are relatively high in these planning horizons can improve NPVs. Including pine straw income can improve NPVs for loblolly and slash pine.

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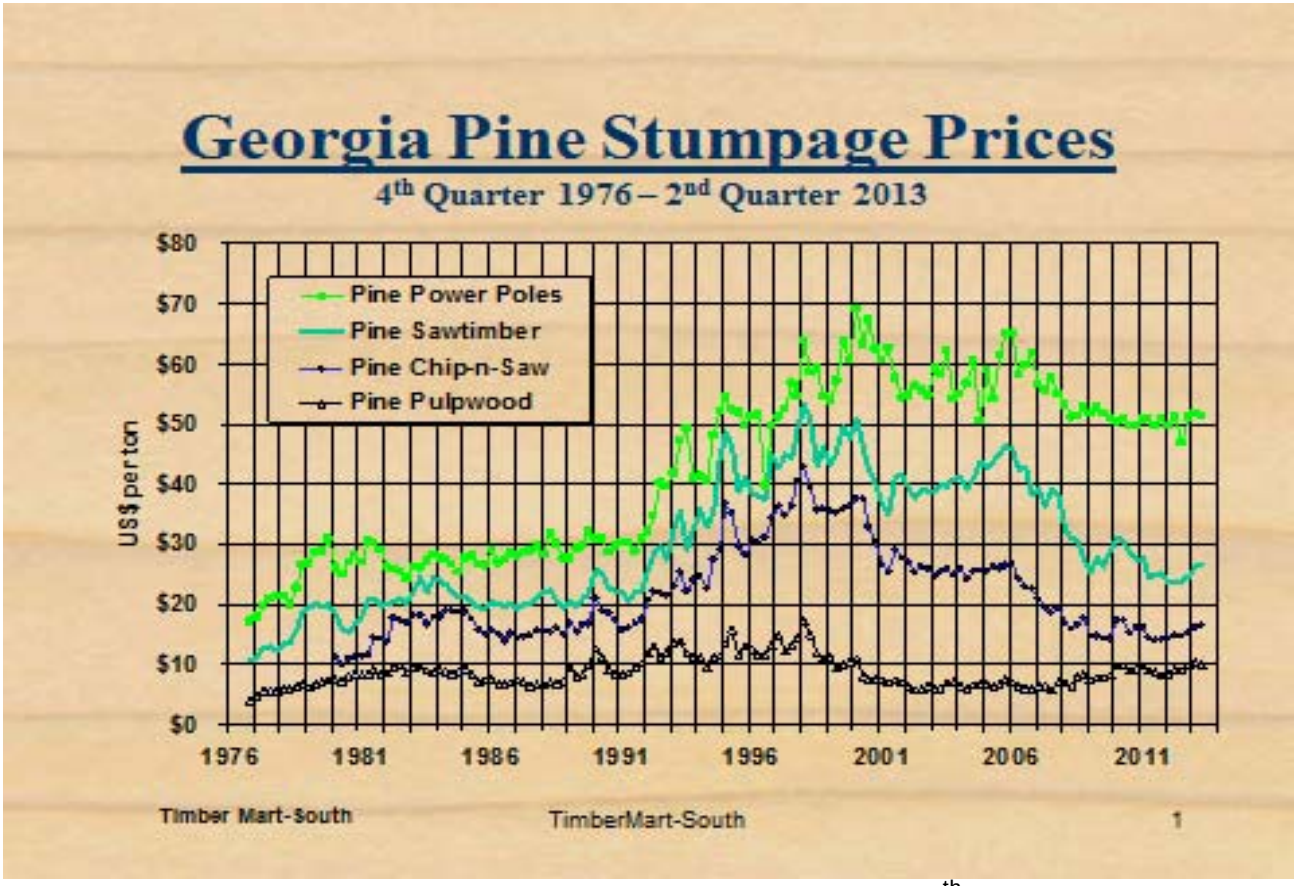

Figure 1. Georgia state-wide average pine stumpage prices from 4th quarter 1976 through 2nd quarter 2013 by product class

Table 1. Product class specifications.

Product/Item	Pulpwood	Chip-N-Saw	Sawtimber
Small end diameter (inches)	3	6	10
Minimum length (feet)	5	8	8
Length Increment (feet)	1	4	8

Table 2. Product prices, cash and net (90% of cash; net of property taxes and marketing costs) per ton stumpage prices used in the profitability analysis of slash and loblolly scenarios, Georgia state average, price per ton (4th Q 1976 through 2ndQ 2013 TM-S).

Item, Price level	Cash or net	Pulpwood ($/Ton)	Chip-N-Saw ($/Ton)	Sawtimber ($/Ton)
Low	cash	6.00	13.00	15.00
	net	5.40	11.70	13.50
Average	cash	9.00	22.00	30.00
	net	8.10	19.80	27.00
High	cash	14.00	37.00	48.00
	net	12.60	33.30	43.20

Table 3. Loblolly and slash pine mean annual increment (MAI) and product class wood yields in the 24-year rotation scenarios.

Species	Thin (Y/N)	MAI (tons/ac/r)	Pulpwood	Chip-n-saw	Sawtimber
			---------- tons/acre ----------		
loblolly	N	6.3	92.3	54	6.2
	Y @ age 15-yrs	6.1	23.8	10.5	0
	CC @ 24-yrs		32.9	62.1	20.8
slash	N	5.6	82.9	50.5	2.2
	Y @ age 15-yrs	5.4	19.7	4.9	0
	CC @ 24-yrs		35.9	57.2	12.4

Table 4. Pine straw periodic per acre income levels used in the profitability analysis of slash and loblolly pine scenarios over a 24-year rotation.

Rotation age	Thin scenario	Annual income/acre ($)
24 yrs.	Thin at age 15 years	50 or 0[1]
		75 or 0[2]
	No thin	50 or 0[3]
		75 or 0[4]

[1] With thinning, pinestraw raked in years 8-15, for 24-year rotation for loblolly pine.
[2] With thinning, pinestraw raked in years 8-15 for 24-year rotation for slash pine.
[3] With no thinning, pinestraw raked in years 8-24, for 24-year rotation for loblolly pine.
[4] With no thinning, pinestraw raked in years 8-24, for 24-year rotation for slash pine.

Table 5. Net present values (NPV) at discount rates of four, six, eight, and ten percent for the no thin 24-year loblolly pine scenarios 1, 2, 3 and 4 at a mean annual increment of 6.3 tons/acre/year.

Scenario #	Est. Costs $/ac	Pine Straw Y/N	Stumpage Price sets	NPV @ 4% $/ac	NPV @ 6% $/ac	NPV @ 8% $/ac	NPV @10% $/ac
1	$245	N	Low	-59	-178	-246	-282
			Average	+242	+12	-124	-204
			High	+727	+319	+72	-78
2	$455	N	Low	-269	-388	-456	-492
			Average	+32	-198	-334	-414
			High	+517	+109	-138	-288
3	$245	Y	Low	+403	+170	+21	-76
			Average	+704	+360	+142	+2
			High	+1190	+668	+338	+128
4	$455	Y	Low	+193	-40	-189	-286
			Average	+494	+150	-68	-208
			High	+980	+458	+128	-82

Table 6. Net present values (NPV) at discount rates of four, six, eight, and ten percent for 24-year rotation loblolly pine, thin @ age 15-years scenarios 5, 6, 7, and 8, at a mean annual increment of 6.1 tons/acre/year.

Scenario #	Est. Costs $/ac	Pine Straw Y/N	Stumpage Price sets	NPV @ 4% $/ac	NPV @ 6% $/ac	NPV @ 8% $/ac	NPV @10% $/ac
5	$245	N	Low	+69	-81	-171	-225
			Average	+493	+197	+14	-101
			High	+1147	+628	+301	+93
6	$455	N	Low	-141	-291	-381	-435
			Average	+283	-13	-196	-435
			High	+937	+418	+91	-117
7	$245	Y	Low	+325	+126	-3	-88
			Average	+748	+404	+182	+36
			High	+1403	+834	+469	+230
8	$455	Y	Low	+115	-84	-213	-298
			Average	+538	+194	-29	-174
			High	+1193	+624	+259	+20

Table 7. Net present values (NPV) at discount rates of four, six, eight, and ten percent for the no thin 24-year slash pine scenarios 1, 2, 3, and 4 at a mean annual increment of 5.6 tons/acre/year.

Scenario #	Est. Costs $/ac	Pine Straw Y/N	Stumpage Price sets	NPV @ 4% $/ac	NPV @ 6% $/ac	NPV @ 8% $/ac	NPV @10% $/ac
1	$245	N	Low	-156	-214	-269	-297
			Average	+143	-51	-164	-230
			High	+568	+219	+8	-119
2	$455	N	Low	-366	-424	-479	-507
			Average	-67	-261	-374	-440
			High	+358	+9	-202	-329
3	$245	Y	Low	+578	+308	+131	+12
			Average	+836	+472	+235	+79
			High	+1261	+741	+407	+190
4	$455	Y	Low	+368	+98	-80	-198
			Average	+626	+262	+25	-131
			High	+1051	+531	+197	-20

Table 8. Net present values (NPV) at discount rates of four, six, eight, and ten percent for the 24-year slash pine, thin at age 15-years scenarios 1, 2, 3, and 4 at a mean annual increment of 5.6 tons/acre/year.

Scenario #	Est. Costs $/ac	Pine Straw Y/N	Stumpage Price sets	NPV @ 4% $/ac	NPV @ 6% $/ac	NPV @ 8% $/ac	NPV @10% $/ac
5	$245	N	Low	-40	-155	-223	-262
			Average	+296	+63	-79	-165
			High	+824	+408	+149	-13
6	$455	N	Low	-250	-365	-433	-472
			Average	+86	-147	-289	-375
			High	+614	+198	-61	-223
7	$245	Y	Low	+344	+154	+29	-56
			Average	+680	+373	+173	+40
			High	+1208	+717	+499	+192
8	$455	Y	Low	+134	-56	-181	-266
			Average	+470	+163	_-37	-170
			High	+988	+508	+290	-18

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