Series paper #3
Economics of growing slash and loblolly pine to a 24-year rotation with and without thinning – impact of thinning at various stumpage prices
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E. David Dickens, Coleman W. Dangerfield Jr., and David J. Moorhead; Forest Productivity Associate Professor, Forest Economics Professor-Emeritus, and Silviculture Professor, respectively, with the Daniel B. Warnell School of Forest Resources The University of Georgia, Athens, Georgia 30602-2152

Abstract

Since early 1998 forest industry, forestland ownership, global markets, and wood supply and demand (pulpwood, sawtimber, chips, etc.) regionally and world-wide have changed dramatically. Non-industrial private forest (NIPF) landowners 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 two commonly available pine species; loblolly (*Pinus taeda* L.) and slash (*Pinus elliottii*, Engelm.) to enhance feasibility, profitability, and cash-flow of production forestry enterprises. At the same time, NIPF landowners desire heightened flexibility across time required to achieve marketable forest products. This paper examines feasibility, profitability, and cash flow of short-rotation management options affecting wood-flow for slash and loblolly pine plantations including no thinning and thinning at various stumpage prices. Financial measures of profitability calculated include net cash flow, soil expectation value, annual equivalent value, and rate of return.

Introduction

Pine sawtimber (ST) is down approximately 23%, chip-n-saw (CNS) is down 28%, and pulpwood (PW) down 60% since historic highs in 1997-98 (Figure 1). Private non-industrial forest landowners (NIPFLs) question whether thinning their stands with today's depressed pulpwood prices makes economic sense. To address this question, we used the Georgia Pine Plantation Simulator (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-years age classes. Therefore, we used a 24-year rotation age that had a mixed product class distribution of pulpwood, chip&saw, and small sawtimber with a thinning at various stumpage prices compared to a no thin scenario. Generally, culmination of merchantable volume mean annual increment occurs for both species on average to good sites and management in the early 20-years (Pienaar and others 1996). Longer rotation ages are often financially attractive, which we address in companion papers in this series of economic manuscripts.

Methodology

Common assumptions

The rotation age was set at 24-years for slash and loblolly pine plantations. Net cash flow was calculated in this paper as the present value of returns minus the present value of costs. A discount rate of 8 percent was used to calculate soil expectation value (SEV) and annual equivalent value (AEV). Rate of return (ROR) was also calculated. Annual costs included fire protection at $2/ac/yr., stand management at $2/ac/yr., and property taxes at $5/ac/yr. Thus, the total annual cost for each year of the rotation was $9/acre. This value cost goes in the transaction table as an annual cost during the rotation. The present value of this net, annual cost flow was $94.75 during the 24-year rotation. Results were reported in constant dollars, before taxes. Land was assumed to be owned throughout the scenarios.

Site Preparation and Planting Costs
► The relatively low site preparation and planting cost of $125/acre could include machine planting and the use of a post plant herbicide to control herbaceous weeds on an old-field site or glyphosate @ 1 gallon/ac or prescribe burning (low level) site preparation and roughland planting on a cutover site.

Site preparation options and associated costs vary extensively by location, prior stand history, harvesting utilization, landowner objectives, monies available, and anticipated future stumpage value and demand. The assumption used was that level of site preparation intensity matched the 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).

Georgia stumpage prices, reported through Timber Mart-South$^©$ (TM-S) for 1st quarter year 2004 average, used in this analysis for loblolly and slash, were net of property taxes at harvest (2.5%) and net of marketing costs (8%). The low TM-S prices for pulpwood and chip&saw were used for thinning prices and average TM-S prices for pulpwood, CNS, and ST are used for the clearcut. Net converted prices are found in Table 2.

Thinning
The thinning scenarios include no thinning or one thinning at 15-years-old at various stumpage prices. Total woodflow of scenario with thinning is approximately 95 percent of total woodflow of scenario without thinning for slash and loblolly without fertilization

(Figure 2 & 3). Residual basal area (RBA), after thinning (5th row with selection from below) is set at 65 sq. ft/ac. Thinning stumpage prices started at $5.04/ton (PW) and $21.36/ton (CNS sized trees) , Table 1 and 2. Stumpage prices were reduced starting at $4.50/ton and decreased by $1/ton to -$4.50/ton for all wood harvested in the thinning. Soil expectation value, AEV, and IRR were calculated for each of these reduced price scenarios and compared to the base (no thin, no fertilize, no straw) scenario for slash and loblolly pine (Table 3 and 4).

Species-specific assumptions
The slash pine scenarios assumed 500 living trees per acre (TPA) at age 5-years-old. A base mean annual increment of 2.09 cd/ac/yr (5.77 tons/ac/yr) through age 24-years without fertilization and thinning was assumed. The base slash scenario woodflow was 15 percent less than base loblolly woodflow (Shiver and others 1999) at age 24-years (Table 3).

The loblolly pine survival is assumed to be 500 TPA at age 5-years-old. The base mean annual increment for loblolly is assumed to be 2.35 cds/ac/yr (6.48 tons/ac/yr) through age 24-years without fertilization or thinning. The base loblolly woodflow is approximately 15 percent greater than the slash base woodflow (Shiver and others 2000) at age 24-years (Table 4).

Scenarios
The following are the eleven slash (Table 3) and loblolly (Table 4) pine scenarios:
(1) no thinning,
(2) thin (at age 15-years to an RBA of 65 ft^2/ac) @ $5.04/ton for pulpwood and $21.36/ton (cash, before taxes and fees) for chip-n-saw sized trees,
(3) thin (as #2) @ $4.50/ton for all thinned wood,
(4) thin (as #2) @ $3.50/ton for all thinned wood,
(5) thin (as #2) @ $2.50/ton for all thinned wood,
(6) thin (as #2) @ $1.50/ton for all thinned wood,
(7) thin (as #2) @ $0.00/ton for all thinned wood,
(8) thin (as #2) @ -$1.50/ton for all thinned wood,
(9) thin (as #2) @ -$2.50/ton for all thinned wood,
(10) thin (as #2) @ -$3.50/ton for all thinned wood,
(11) and thin (as #2) @ -$4.50/ton for all thinned wood
with a clear-cut @ age 24-years-old using medium stumpage prices for pulpwood, CNS, and ST (Table 2).

Results

Impact of thinning at various prices on net cash flow
Thinning at age 15-years-old @ $5.04/ton and $21.36/ton (cash before taxes and fees) improved net cash flow by $349/acre and $409/acre compared to the no thin scenario for slash (Table 3) and loblolly pine (Table 4), respectively. Net cash flow for the thinning scenarios with across the board stumpage prices from -$4.50/ton to $4.50/ton

(slash pine) and -$2.50/ton to $4.50/ton (loblolly) were greater than the no thin scenario.

Impact of thinning at various prices on soil expectation value (SEV)
Thinning at age 15-years-old at low TM-S 1st quarter Georgia 2004 stumpage prices for pulpwood and chip-n-saw improved SEVs by $99/acre and $126/acre for slash and loblolly pine, respectively compared to the unthinned scenario (Table 3 and 4). SEVs for thinning at $0/ton to $4.50/ton were greater than the no thin scenario for both pine species. Negative (paying a logger to thin one's stand) thinning prices of -$1.50 (slash and loblolly) and -$2.50/ton (slash pine) still had slightly greater SEVs than the no thin scenarios (Table 3 and 4). The "break-even" point for slash pine was -$3.50/ton and approximately -$2.00/ton for loblolly pine when comparing the no thin to thinning at various stumpage prices under the assumptions used.

Impact of thinning at various prices on annual equivalent value (AEV)
Thinning at age 15-years-old at low TM-S 1st quarter Georgia 2004 stumpage prices for pulpwood and chip-n-saw improved AEVs by $8/acre/yr and $10/acre/yr for slash and loblolly pine, respectively compared to the unthinned scenario (Table 3 and 4). AEVs for thinning at $0/ton to $4.50/ton were greater than the no thin scenario for both pine species. Negative (paying a logger to thin one's stand) thinning prices of -$1.50 (slash and loblolly) still had slightly greater AEVs than the no thin scenarios (Table 3 and 4). The "break-even" point for slash pine was -$3.50/ton and -$1.50/ton for loblolly pine when comparing the no thin to thinning at various stumpage prices using AEV under the assumptions used.

Impact of thinning at various prices on rate of return (ROR)
Thinning at age 15-years-old at low TM-S 1st quarter Georgia 2004 stumpage prices for pulpwood and chip-n-saw improved RORs by 1.59% and 1.87% for slash and loblolly pine, respectively compared to the unthinned scenario (Table 3 and 4). RORs for thinning at $4.50/ton were 1.20% and 1.27% greater than the no thin scenario for slash and loblolly pine, respectively. The thinning with no income (at $0.00/ton) RORs were 0.50% and 0.37% greater than the no thin scenarios for slash and loblolly pine, respectively (Table 3 and 4). The "break-even" point for slash and loblolly pine was approximately -$2.00/ton when comparing the no thin to thinning at various stumpage prices using ROR under the assumptions used.

Summary

Wood flow
The 2.01 (5.55 tons/ac/yr) to 2.35 cd/ac/yr (6.48 tons/ac/yr) productivity levels at age 24-years-old for slash and loblolly, respectively, are realistic on most cut-over sites with sufficient site preparation (Pienaar and Rheney 1996) and stand management is conservative on most old-field sites. Exceptions would be the deep sands (Typic Quartzipssamments) of the Sand Hills or shallow, rocky soils of the Piedmont physiographic region.

Thinning at reduced prices ($4.50 to $0.00/ton) had greater net cash flows, SEVs, AEVs, and IRRs than the no thin scenario for slash and loblolly pine (Table 3 and 4). Greater net cash flows, SEVs, AEVs, and RORs are realized under these scenarios due to crop trees being able to grow at a faster rate after the thinning due to less competition for the site resources (water, nutrients, and sunlight). More wood moved into the more valuable CNS and ST product classes with thinning than with the no thin scenario (Figure 2 and 3).

Discussion

Non-industrial private forest landowners do have some attractive forest management options with both slash and loblolly pine when using low to medium stumpage prices. Thinning, even using low stumpage prices, still makes sound financial sense under the aforementioned assumptions. The financial measures of profitability calculated in this paper (SEV, AEV, and ROR) would change with different establishment costs, pine stand growth rates, product class distributions, and stumpage values.

Literature Cited

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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 (net of property taxes and marketing costs) per cord stumpage prices used in the profitability analysis of slash and loblolly scenarios, Georgia State average, price per ton (1stQ TM-S 2004).

Item, Price level	Cash or net	Pulpwood ($/Ton)	Chip-N-Saw ($/Ton)	Sawtimber ($/Ton)
Low	cash	5.04	21.36	35.91
	net	4.51	19.12	32.14
Medium	cash	6.42	25.80	40.97
	net	5.75	23.09	36.51

Table 3. Slash 24-year rotation financial results [1], mean annual increment ≈ 2.01cds/ac/yr (5.55 tons/ac/yr) for thin scenarios and 2.09 cds/ac/yr (5.77 tons/ac/yr) for no thin scenario, site prep. and plant at $125/Ac., low, net prices [2] at thinning, medium net prices [3] at clear-cut. Then, examine thin all at $4.50, $3.50, $2.50, $1.50, $0, -$1.50, -$2.50, -$3.50, and -$4.50/Ton ($12.36, $9.60, $6.86, $4.11, a $0, -$4.11, -$6.86, -$9.60, and -$12.37/cd.).

Harvest Schedule	Harvest Price Schedule	Net cash flow[4] $/ac.	SEV [5] $/Ac.	AEV [6] $/Ac./Yr.	ROR [7] %
No thin cc@24	Clear-cut (CC) @ medium net prices[3]	$1557	$72	$6	9.30%
Thin @ 15 [8] cc@24	Thin @ low, net prices [2] CC @ medium net prices [3]	1906	171	14	10.89
	Thin all @ $4.50/Ton ($12.36/cd.) CC @ medium net prices [3]	1842	147	12	10.50
	Thin all @ $3.50/Ton CC @ medium net prices [3]	1817	137	11	10.34
	Thin all @ $2.50/Ton CC @ medium net prices [3]	1792	128	10	10.19
	Thin all @ $1.50/Ton CC @ medium net prices [3]	1767	118	9	10.03
	Thin all @ $0.00/Ton CC @ medium net prices [3]	1730	104	8	9.80
	Thin all @ - $1.50/Ton CC @ medium net prices [3]	1692	91	7	9.56
	Thin all @ - $2.50/Ton CC @ medium net prices [3]	1667	82	6	9.40
	Thin all @ - $3.50/Ton CC @ medium net prices [3]	1642	72	6	9.24
	Thin all @ - $4.50/Ton CC @ medium net prices [3]	1618	63	5	9.08

[1] Uninflated, 8% discount rate, before taxes, GaPPS v 4.20

[2] Low, net prices at thin, $4.51 PW, $9.51 CNS, $32.14 ST/Ton (Net of property taxes (2.5%) and marketing costs (8%)).

[3] Medium net prices at clearcut, $5.75 PW, $23.09 CNS, and $36.51 ST.

[4] Net cash flow = PV receipts – PV expenses.

[5] SEV = Soil Expectation Value, calculated from perpetual rotations.

[6] AEV = Net Annual Equivalent Value, net present worth as annuity.

[7] ROR = Rate of Return of the investment scenario (percent).

[8] 5th-row thinning to residual basal area (RBA) = 65 ft²/ac. with selection from below

Table 4. Loblolly 24-year rotation financial results [1], mean annual increment ≈ 2.26 cds/ac/yr (6.24 tons/ac/yr) for the thin scenarios and 2.35 cds/ac/yr (6.48 tons/ac/yr) for the no thin scenario, site prep. and plant at $125/Ac., low, net prices [2] at thinning, medium net prices [3] at clear-cut. Then, examine thin all at $4.51, $3.50, $2.50, $1.50, $0, -$1.50, -$2.50, -$3.50, and -$4.50/Ton ($12.37, $9.60, $6.86, $4.11, a $0, -$4.11, -$6.86, -$9.60, and -$12.37/cd.).

Harvest Schedule	Harvest Price Schedule	Net cash flow[4] $/ac.	SEV [5] $/Ac.	AEV [6] $/Ac./Yr.	ROR [7] %
No thin cc@24	Clear-cut (CC) @ medium net prices[3]	$1821	121	10	10.04
Thin @ 15 [8] cc@24	Thin @ low, net prices [2] CC @ medium net prices [3]	2230	247	20	11.91
	Thin all @ $4.50/Ton ($12.36/cd.) CC @ medium net prices [3]	2123	207	17	11.31
	Thin all @ $3.50/Ton CC @ medium net prices [3]	2088	194	16	11.11
	Thin all @ $2.50/Ton CC @ medium net prices [3]	2054	181	14	10.91
	Thin all @ $1.50/Ton CC @ medium net prices [3]	2020	168	13	10.71
	Thin all @ $0.00/Ton CC @ medium net prices [3]	1968	149	12	10.41
	Thin all @ - $1.50/Ton CC @ medium net prices [3]	1916	130	10	10.11
	Thin all @ - $2.50/Ton CC @ medium net prices [3]	1822	117	9	9.90
	Thin all @ - $3.50/Ton CC @ medium net prices [3]	1848	104	8	9.70
	Thin all @ - $4.50/Ton CC @ medium net prices [3]	1813	91	7	9.49

[1] Uninflated, 8% discount rate, before taxes, GaPPS v 4.20

[2] Low, net prices at thin, $4.51 PW, $9.51 CNS, $32.14 ST/Ton (Net of property taxes (2.5%) and marketing costs (8%)).

[3] Medium net prices at clearcut, $5.75 PW, $23.09 CNS, and $36.51 ST.

[4] Net cash flow = PV receipts – PV expenses.

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[6] AEV = Net Annual Equivalent Value, net present worth as annuity.

[7] ROR = Rate of Return of the investment scenario (percent).

[8] 5th-row thinning to residual basal area (RBA) = 65 ft^2/ac. with selection from below.
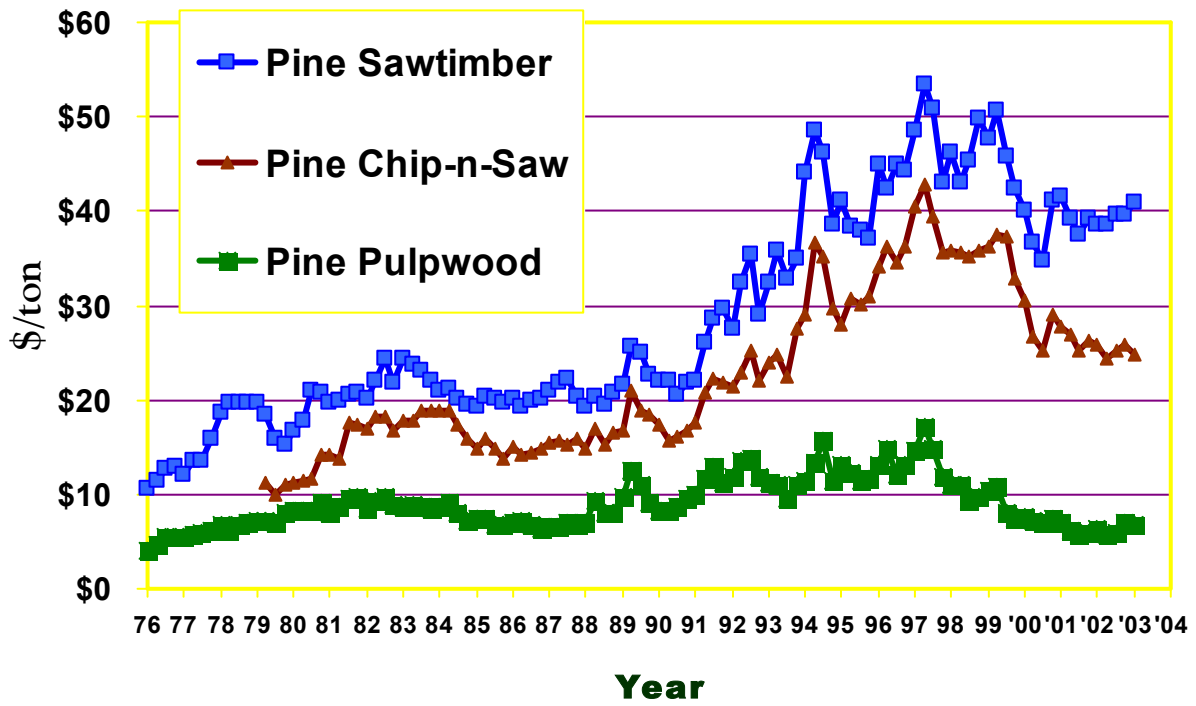
Figure 1. **Historic pine stumpage prices for Georgia (1976 – 2003, TM-S 2004)**
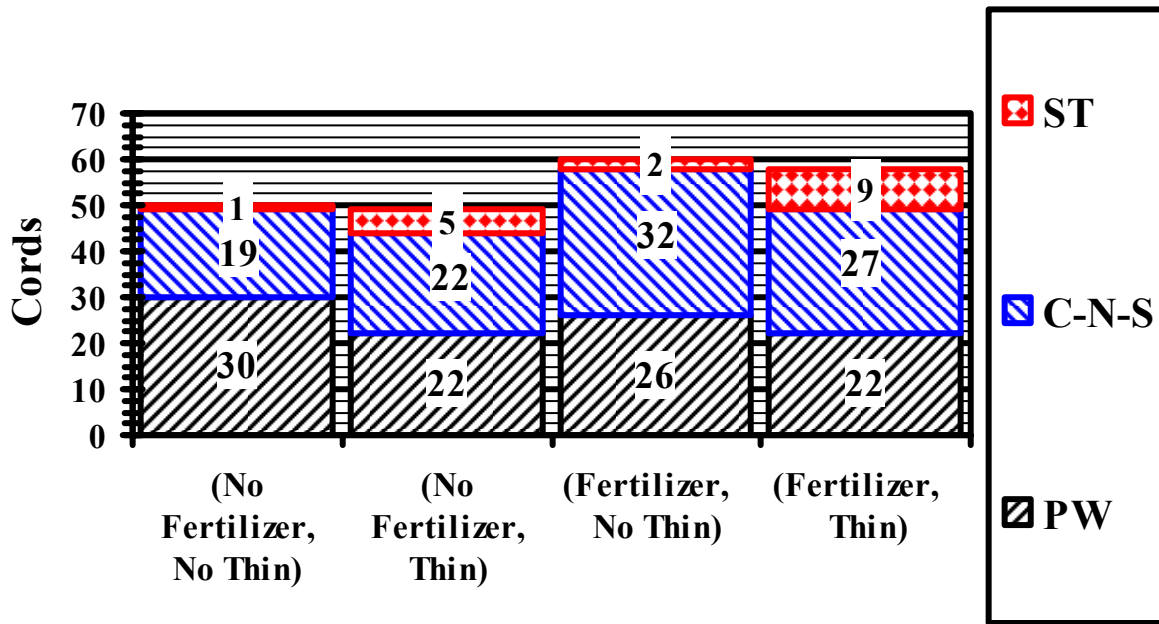
Figure 2. Slash pine product class distributions @ age 24-years by forest management level
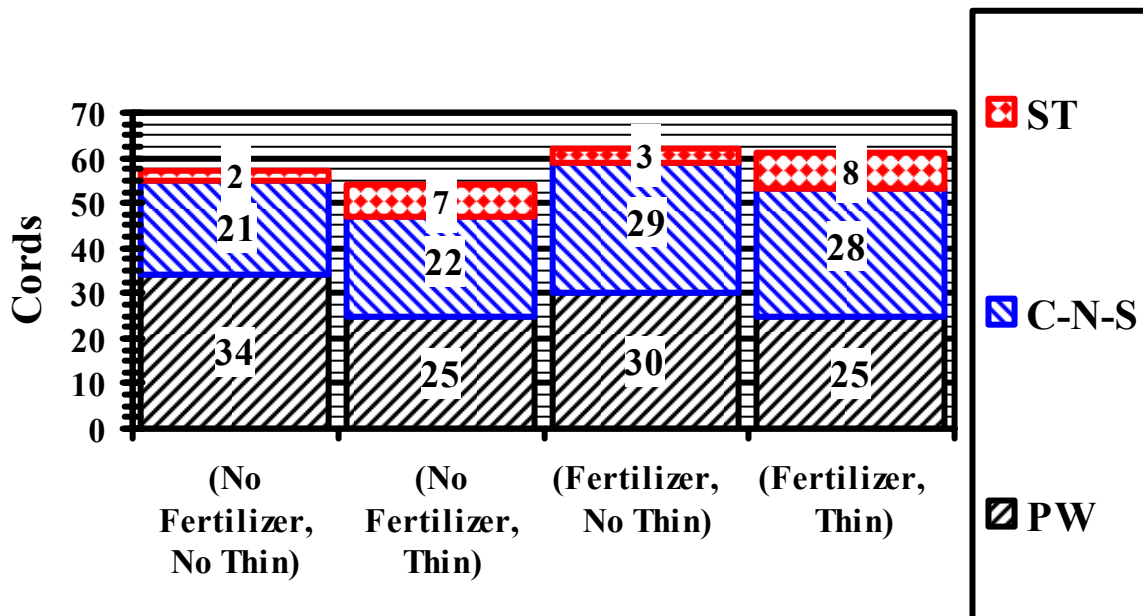

Figure 3. Loblolly pine product class distributions @ age 24-years by forest management level