Financial Performance of Loblolly and Longleaf Pine Plantations

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Abstract

The past decade has seen significant shifts in timberland ownership, particularly in the southern United States. Integrated forest product companies have sold many of their land assets, which have subsequently been acquired by institutional investors. Along with shifts in forest ownership, the past decade has also seen increased interest in longleaf pine management. In recent years, various organizations have begun encouraging longleaf plantation establishment with much of their effort directed at private landowners whose objectives include factors such as wildlife habitat and aesthetics in addition to economics. Little work has been done examining the economic viability of longleaf pine management on investment properties. Much of the literature about longleaf pine focuses on a diversity of management objectives, including wildlife and endangered species. This analysis differs in that the focus is solely on the economics of plantation management. While longleaf pine forests may provide additional wildlife or aesthetic benefits, this analysis ignores such amenity values.

The financial performance of selected management regimes for loblolly and longleaf pine plantations were compared for four cases, each with low and high site productivity levels and each evaluated using 5% and 7% real discount rates. In all cases, longleaf pine was considered both with and without pine straw harvesting as part of the management regime. Results indicate that longleaf pine regimes that do not incorporate pine straw raking yield financial results that are inferior to those from intensive loblolly management. However, with the addition of pine straw revenues, longleaf management can yield returns that are comparable to typical loblolly pine regimes (-16% to +3%, depending on site quality and discount rate). With little to no direct return on reforestation investments before 20-25 years longleaf pine may be a more attractive alternative, due to lower establishment costs up front and favorable LEV comparisons.

Introduction

The past decade has seen significant shifts in timberland ownership, particularly in the southern U.S. Integrated forest product companies have sold many of their land assets, which have subsequently been acquired by institutional investors. The reasons behind corporate land sales are diverse, but investors are attracted to timberland for several key reasons, including strong historical risk adjusted returns (Binkley et al. 2001; Caulfield 1999; Carroll 2003), low correlation with other asset classes (Binkley et al. 2001; Carroll 2003), and an apparent correlation with inflation (Clutter et al. 2005). The interest in timberland investment is apparent by the inflow of capital into the sector, with approximately two billion dollars invested annually over the past decade (Clutter et al. 2005). Timberland investments are often made by Timberland Investment Management Organizations (TIMOs), who both acquire and manage property on the behalf of institutional investors.

Many TIMOs function as closed-end funds, meaning a key aspect of TIMO management is a short time horizon relative to integrated forest products companies. While forest product companies have traditionally held land 'forever', TIMOs are organized with a broader set of expected land tenures and management foci. In general, TIMOs are more focused on financial returns over the length of the investment, while forest products companies traditionally concentrated on wood supply (i.e., harvest volume) and environmental objectives (Clutter et al. 2005). Many TIMOs plan to hold land for no more than 10-15 years (closed-end funds), but others intend to hold forest land 'forever'. In all cases, the justification for forest management activities undertaken by TIMOs is higher returns for investors; many TIMOs focus on intensive, short rotation silviculture but not all. With the proliferation of TIMOs and timberland investors has come differentiation, including TIMOs with an emphasis on natural regeneration, or high-yield plantations to offset losses to natural forests throughout the world, or other objectives.

Along with shifts in forest ownership, the past decade has also seen increased interest in longleaf pine management. Longleaf pine once dominated forests from Virginia to Texas, but over-exploitation resulted in its widespread decline. In recent years, various organizations have begun encouraging longleaf plantation establishment with much of their effort directed towards private landowners whose objectives include factors such as wildlife habitat and aesthetics in addition to economics.

Little work has been done examining the economic viability of longleaf pine management on investment properties. This can be attributed to the commonly-held belief that returns from longleaf management cannot compare to those from loblolly pine plantations. Traditionally, longleaf has been a difficult species to plant and successfully establish (Johnson 2008). The persistent and variable grass stage translated into longer rotation lengths (Johnson 2008) and hampered planning efforts. As a result, longleaf was often relegated to poor sites, only perpetuating its reputation for slow growth (Johnson 2008). Improvements in nursery techniques and silvicultural practices, however, challenge these old assumptions (Johnson 2008), such that longleaf and loblolly plantation economics may compare more favorably than previously believed. TIMOs may be able to justify investments in longleaf pine plantations if they can show returns comparable to those from intensive loblolly pine management. This is particularly true given the higher amenity values attributed to longleaf pine.

The remainder of this paper focuses on a detailed economic comparison of longleaf and loblolly pine plantation management. Much of the literature about longleaf pine focuses on a diversity of management objectives, including wildlife and endangered species. This analysis differs in that the focus is solely on the economics of plantation management. While longleaf pine forests may provide additional wildlife or aesthetic benefits, this analysis ignores such amenity values.

Methodology

Selected Cases

The financial performance of selected loblolly and longleaf pine plantation management regimes were compared for four cases, outlined in Table 1. Loblolly and longleaf pine plantations were projected with low and high site productivity levels. For the comparison, the loblolly pine site index values (base age 25 years) were converted to equivalent site index values for longleaf pine (base age 50 years. Discounted cash flows were generated using 5% and 7% real discount rates. In all cases, longleaf pine was considered both with and without pine straw harvesting. Pine straw harvesting can add substantially to overall returns from a given rotation (Johnson 2008), making its inclusion an important consideration.

Table 1. Selected Case/Species combinations.

Case	Species	Site Index (ft)	Discount Rate (%)	Straw Harvest
1	Loblolly (LP)	60	5	no
	Longleaf (LL)	85	5	no
	Longleaf (LL-S)	85	5	yes
2	Loblolly (LP)	60	7	no
	Longleaf (LL)	85	7	no
	Longleaf (LL-S)	85	7	yes
3	Loblolly (LP)	80	5	no
	Longleaf (LL)	110	5	no
	Longleaf (LL-S)	110	5	yes
4	Loblolly (LP)	80	7	no
	Longleaf (LL)	110	7	no
	Longleaf (LL-S)	110	7	yes

Management Regimes

Management regimes were selected from a reduced set of acceptable alternatives, which were constrained by management intensity and treatment timing. Reforestation activities follow those commonly used in loblolly and longleaf pine plantations. Planting density and first-year survival were assumed to be identical for both species. Mid-rotation treatment timings were restricted to ranges considered biologically reasonable and commercially feasible, with management intensities based on commonly implemented rates. The regimes that maximized Land Expectation Value (LEV)[1] for each site/discount

[1] This may also be referred to as bare land value (BLV) or soil expectation value (SEV).

rate combination were chosen for further analysis. LEV is the present value per acre of the projected costs and revenues from an infinite series of identical rotations starting from bare ground.

Loblolly Pine – Loblolly pine plantations were projected using the Forest Nutrition Cooperative Decision Support System (LobDSS) (Amateis et al., 2005). LobDSS interfaces with FASTLOB2, a whole stand growth and yield model developed by the Loblolly Pine Growth and Yield Research Cooperative at Virginia Tech. This model provides options for evaluating thinning and/or mid-rotation fertilization treatments (Amateis and others, 2001). The effects of site conditions, site preparation, and first year silvicultural treatments on loblolly pine plantation survival and growth are also modeled.

The LobDSS optimization routine was used for evaluating the impacts of mid-rotation fertilization and thinning timing and rotation length on economic valuation. Searches were constrained to one thinning treatment between ages 12 and 20 years, with a mid-rotation fertilization one year post-thin. The thinning treatment was a 1-in-5 row / thin from below combination to 75 ft^2/ac residual basal area. Thinned plantations were fertilized with urea at a rate of 200 lbs of nitrogen per acre.

Longleaf Pine – The FORSim Longleaf Pine Growth Simulator (LPGS) was used for projecting longleaf pine plantations (FORSight Resources, 2007a & b). LPGS serves as an interface to the longleaf pine growth engine, a stand-level model that simulates longleaf pine survival and growth, including the ability to simulate up to five thinning treatments during stand development.

Longleaf pine management regimes with either one or two thinning treatments were considered. Two thinning regimes, common in the longer rotations typical of longleaf management, were included in this analysis. The first thin was a 1-in-5 row / thin from below combination to 80 ft^2/ac residual basal area. The second thin was from below to 70 ft^2/ac residual basal area. The operational window for the first thin was between ages 15 and 30 years, and a second thin was considered after age 19 years. A minimum four years was required between thinning entries. The final harvest was allowed no earlier than four years after the final thinning treatment. Based on the level of site preparation, the number of years for the plantation to emerge from the grass stage and reach breast height (4.5 feet) was set at 3 years.

In addition to thinning treatments, longleaf pine management regimes with and without pine straw raking cycles were examined. A pine straw raking cycle includes a four year enhancement period followed by a series of rakings (see Figure 1). The operational window for cycle commencement was limited to biologically feasible age ranges; ages 12 to 15 years for the first cycle and 23 to 32 years for the second. Thinning activities were not allowed during a raking cycle, and cycles could not commence until two years post-thin.

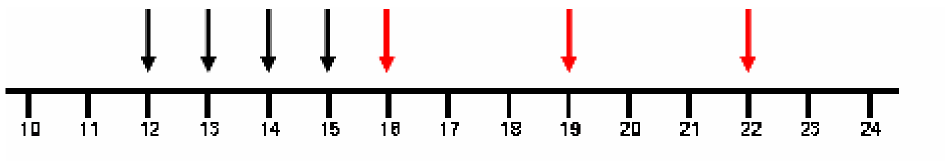

Figure 1. Time line illustration of a typical pine straw raking cycle. Black arrows indicate enhancement activities and red lines indicate pine straw rakings.

Financial Analysis

Harvest volumes were merchandized using the product specifications shown in Table 2. All harvested volumes were measured in tons. Site preparation, planting, and mid-rotation treatments are outlined in Table 3, including treatment timing, application rate, and associated cost. All site preparation and planting activities are assumed to occur during the same year. Net revenues from longleaf pine straw harvest are based on typical contracts with local straw producers.

Table 2. Product specifications and stumpage prices.

Product	Min Dbh (in)	Top Dib (in)	Price ($/ton)[2]
Pulpwood	5	3	8.05
Chip-n-Saw	9	5	18.98
Sawlog	12	8	36.82

Table 3. Costs and revenues for loblolly and longleaf pine treatment regimes.

Description	Value ($/ac)
Loblolly Pine	
Chemical hardwood control (CHEM) @ establishment	100.00 [3]
Hand plant[4] @ 622 TPA with 95% 1st yr survival	81.10 [4]
Herbaceous weed control (HWC) @ yr 1	57.50 [3]
Establishment fertilization w/250 lbs DAP/ac @ yr 1	47.50 [3]
Mid-rotation fertilization w/urea @ 200 lbs N/ac	47.50 [3]
Longleaf Pine	
Chemical hardwood control (CHEM) @ establishment	100.00 [3]
Broadcast burn @ establishment	15.00 [5]
Hand plant[4] @ 622 TPA with 95% 1st yr survival	102.87 [4]
Pine straw harvest net revenue per raking	150.00 [6]
Annual Costs/Revenue	
Management Fee Costs (yearly)	5.00
Hunting Lease Revenues (yearly)	7.00

Land expectation value (LEV) and present net worth (PNW) for the first rotation were calculated for each selected management regime using both 5% and 7% real discount rates. Because loblolly and longleaf rotation lengths differ, LEV provides the only means for directly comparing results. Present net worth provides a means for analyzing cash flows over the short term. Product prices and treatment costs and revenues were applied

[2] Timber Mart-South (2007).
[3] United Agri Products (2008).
[4] Hand planting - Georgia Forestry Commission (2008); Seedling cost - South Carolina Forestry Commission (2008).
[5] South Carolina Forestry Commission (2008).
[6] North Carolina Cooperative Extension Service (1995).

as outlined in Tables 2 and 3. In all cases, activities were assumed to occur at the start of each year (i.e., January 1).

Results

Selected Regimes

Table 4 shows the chosen regime for each case. The associated present net worth (PNW) for the first rotation and LEV are shown in Table 5. Harvest removals for each case are reported in Table 6. The percent product recovery from all harvest operations and cumulative PNW over stand age by Case/Species combination are shown in Figures 2 through 4, respectively. Species-level results are analyzed in the following sections.

Table 4. Silvicultural treatment regimes by Case/Species.

Case (Disc rate)	Species	#1 Straw Cycle (yr)[7]	#1 Thin/Fert Age (yrs)	#2 Straw Cycle (yr)[7]	#2 Thin/ Fert Age (yrs)	Final Harvest (yr)
1 (5%)	LP	--	15/16	--	--	35
	LL	--	25/--	--	--	33
	LL-S	12	23/--	25	38/--	52
2 (7%)	LP	--	15/16	--	--	28
	LL	--	25/--	--	--	33
	LL-S	12	23/--	25	38/--	52
3 (5%)	LP	--	12/13	--	--	29
	LL	--	23/--	--	--	32
	LL-S	12	23/--	25	38/--	42
4 (7%)	LP	--	12/13	--	--	24
	LL	--	23/--	--	--	27
	LL-S	12	23/--	--	--	27

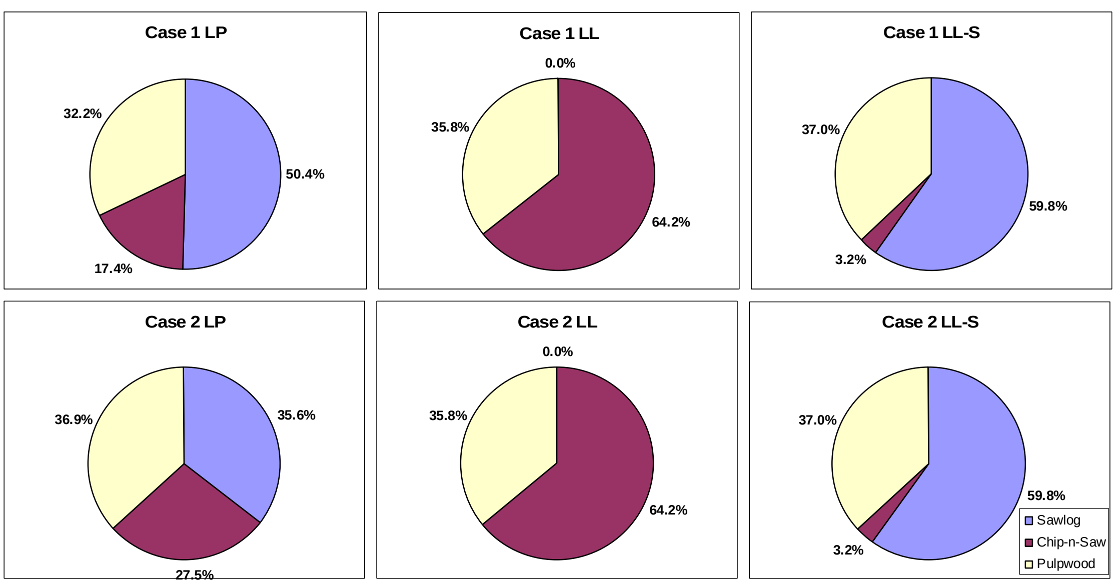

Figure 2. Percent product recovery, cases 1and 2 (all species and regimes).

[7] Indicates age at which pine straw cycle begins.

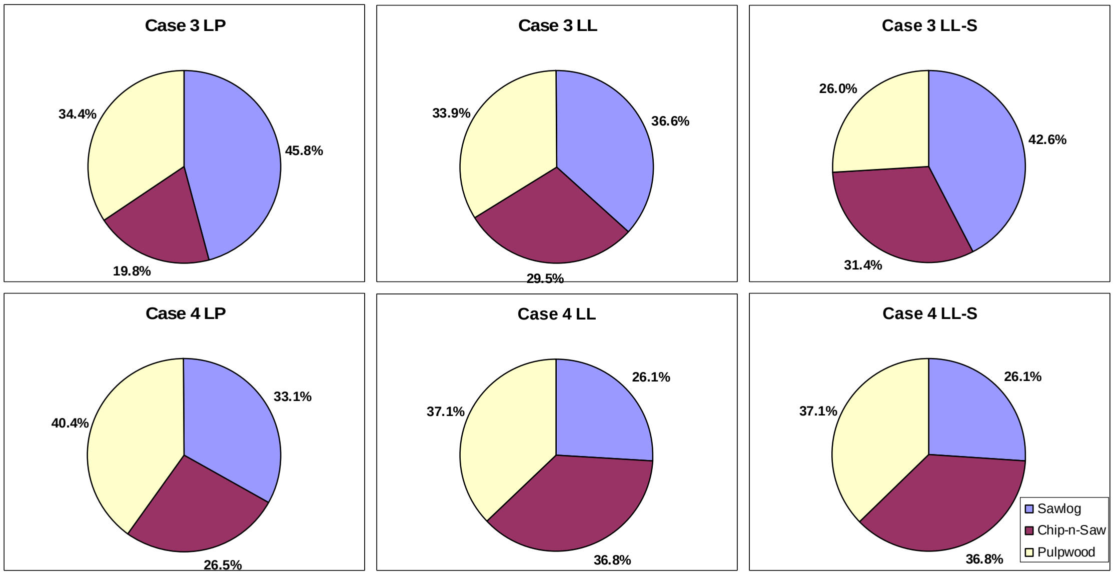

Figure 3. Percent product recovery, cases 3and 4 (all species and regimes).

Table 5. PNW and LEV by Case/Species.

Case (Disc rate)	Species	PNW (1st rotation) ($/ac)	LEV ($/ac)
1 (5%)	LP	501.93	**610.64**
	LL	245.23	307.83
	LL-S	548.02	592.91
2 (7%)	LP	182.75	**212.75**
	LL	49.25	53.37
	LL-S	174.82	178.11
3 (5%)	LP	895.10	**1,179.70**
	LL	765.82	966.69
	LL-S	968.24	1,109.14
4 (7%)	LP	469.74	582.60
	LL	385.42	456.96
	LL-S	503.31	**597.46**

Table 6. Thinning and final harvest volume removals by Case/Species.

Case (Disc rate)	Species	1st Thin (tons/ac)	2nd Thin (tons/ac)	Final Harvest (tons/ac)	Total (tons/ac)
1 (5%)	LP	25.80	--	132.30	158.10
	LL	27.27	--	108.08	135.35
	LL-S	15.43	55.23	120.21	190.88
2 (7%)	LP	25.80	--	97.40	123.20
	LL	27.27	--	108.08	135.35
	LL-S	15.43	55.23	120.21	190.88
3 (5%)	LP	31.90	--	158.30	190.20
	LL	64.13	--	135.78	199.91
	LL-S	56.16	51.50	126.04	233.70
4 (7%)	LP	31.90	--	135.10	167.00
	LL	64.13	--	116.84	180.97
	LL-S	56.16	--	116.64	172.80

Loblolly Pine

Discount rate had no effect on thinning age but did result in an earlier final harvest (see Table 4). A comparison of case 1 to case 3 (and case 2 to case 4) indicates that reductions in both thinning and final harvest ages were associated with higher site. Figure 1 reveals that changes in site quality had little influence on product proportions removed from stands: sawable volume (sawtimber and chip-n-saw) is about 65% in all cases. However, with a 5% discount rate, the optimum rotation produced about 50% sawtimber, while only 35% sawtimber is produced using a 7% discount rate. The lowest ($212.75/ac) and highest ($1,179.70/ac) LEV were associated with cases 2 and 3, respectively.

Longleaf Pine – Without Pine Straw

In all cases, regimes for longleaf pine plantations without pine straw harvests incorporated a single thinning treatment, and although the longleaf final harvests occurred slightly later than in loblolly, the economic rotations that resulted were shorter than those typically associated with longleaf management. This is expected since this study considers only economic factors and does not consider the amenity values that are often an important consideration elsewhere.

As with loblolly plantations, site quality was the driving factor behind thinning age. On the poorer site, longleaf plantations produced no sawtimber, but on the higher site sawtimber yield increased to 26-35% of total removal volume. As was the case for loblolly, total sawable volume (sawtimber and chip-n-saw) was about 65% in all cases. The lowest ($53.37/ac) and highest ($966.69/ac) LEVs were associated with cases 2 and 3, respectively (Table 5).

Longleaf Pine – With Pine Straw

For all cases, adding pine straw harvests greatly improved the financial performance of longleaf pine plantations. Management regimes included two thins and two pine straw raking cycles in all cases except case 4. The first pine straw raking cycle began at the earliest feasible age in all cases, indicating the importance of early revenues to overall net present worth. Regimes were identical for the first three cases, indicating that pine straw revenues dominated the economic impacts of site and discount rate. Because of the higher discount rate used in case 4, the carrying costs of holding the stand long enough to produce a second straw raking exceeded the revenues attributed to that longer rotation. Site quality had the largest impact on product recovery percentages. Virtually all of the sawable material produced on the low site was sawtimber, with a much more even breakdown among products on the high site. On the high site, more sawable wood (sawtimber and chip-n-saw) was produced than either loblolly or longleaf without pine straw raking (75% sawable compared to 65%). Minimum ($178.11/ac) and maximum ($1,109.14/ac) LEV were associated with cases 2 and 3, respectively (Table 5).

Species Comparison

The addition of pine-straw raking to longleaf pine management regimes resulted in greatly improved financial results (13-70% higher) that compared favorably with the loblolly pine management regimes (Table 5). The loblolly regimes produced LEV values

3-16% higher than longleaf in all cases except case 4, which exceeded the corresponding loblolly LEV by 2.6%.

An examination of the cash flows in Figure 4 reveals that the cumulative PNW ($/acre) from loblolly pine plantations remained negative until the final harvest in all cases. However, pine straw harvests yield positive cash flows earlier in the rotation, especially for longleaf pine plantations on lower sites and evaluated using lower discount rates. In terms of product recovery percentages, longleaf pine plantations with pine straw harvests and longer rotations produced a higher percentage of sawable wood compared to short rotations for loblolly pine plantations (Figures 2 and 3).

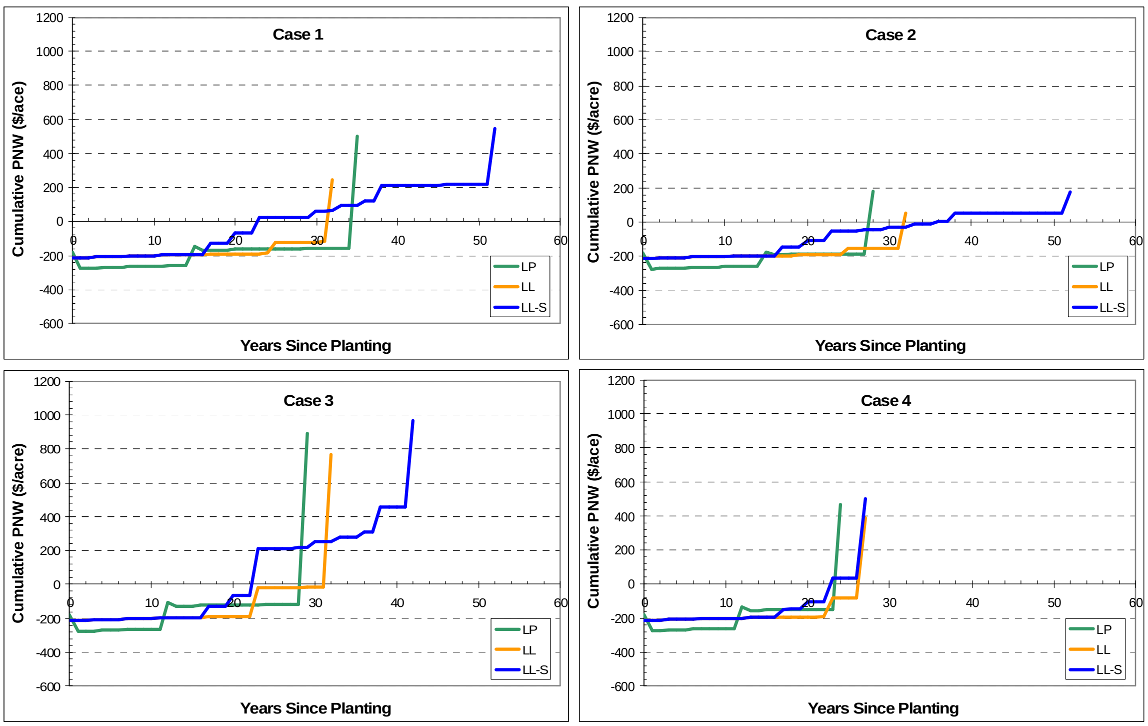

Figure 4. Cumulative PNW ($/acre) by stand age for Cases 1-4.

Discussion

Results indicate that longleaf pine regimes that do not incorporate pine straw raking yield financial results that are inferior to those from intensive loblolly management. However, with the addition of pine straw revenues, longleaf management can yield returns that are comparable to typical loblolly pine regimes (-16% to +3%, depending on site quality and discount rate). Longleaf pine plantations with pine straw harvests produced greater LEV than loblolly plantations on lands with higher site index (80 and 110 feet for loblolly pine and longleaf pine, respectively) when using the higher discount rate (7%). Other longleaf pine management regimes produced lower but comparable financial performance.

It should be noted that LobDSS downgrades a portion of loblolly sawtimber trees into the pulpwood class; such a behavior is absent from FORSim LPGS. This may have caused an elevated sawtimber proportion in the longleaf product recovery. Furthermore, while this study assumes equal seedling survival between longleaf and loblolly pine, longleaf seedling survival may in fact be lower.

Several factors seem to indicate that longleaf may perform even better than indicated in this analysis. Citing a report by John Guthrie and Son's, Inc., Johnson (2008) points to evidence that average timber sale prices were 10-20% higher when species composition was primarily longleaf pine. Given that longleaf regimes consistently produce higher total yield (see Table 6), this may lead to even more favorable comparisons between the species. A longleaf price premium was not included in this analysis due to a lack of widespread, documented evidence that such a premium exists. In addition, some authors have indicated that current site preparation practices may reduce time to leave grass stage below the three years used in this paper (Johnson 2008). Reducing the length of time spent in the grass stage shortens the overall rotation length with commensurate improvements in PNV and LEV.

At lower discount rates longleaf pine regimes with pine straw raking provided positive cash flows sooner than loblolly (see Figures 3 and 4). In all cases, however, positive cash flows were not achieved with any regime until after age 23. This result is noteworthy because this may be longer than the land tenure of closed-end funded TIMO ownerships. Because there is likely to be little to no direct return on reforestation investments under these short land tenures, a logical consequence may be the minimization of reforestation expenses. Thus, longleaf pine may be a more attractive alternative, given the 25% lower initial investment ($217/ac vs. $286/ac for loblolly) and the favorable LEV comparison.

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