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PINE STRAW YIELDS AND ECONOMIC BENEFITS WHEN ADDED TO TRADITIONAL WOOD PRODUCTS IN LOBLOLLY, LONGLEAF AND SLASH PINE STANDS

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ABSTRACT

Many forest landowners have the opportunity to manage their loblolly, longleaf and slash pine stands for pine straw (fresh undecomposed needles; the litter layer) for additional revenues. Pine straw is used primarily as mulch in landscaping and has grown in revenues paid to landowners from $15.5 million in 1999 to $81 million in 2009 in Georgia. Pine straw is typically sold by the acre or by the bale. Selling pine straw by the acre is advantageous for absentee landowners. Selling pine straw by the bale can generate more annual income but bale counts need to be accurate and bale size must be clearly defined. Recent (2005-09) per acre revenues range from $50 to $125/year. Rectangular (13x13x28 inches) bale prices range from $0.25 to $0.40 for loblolly, $0.50 to $1.25 for longleaf, and $0.50 to $0.65 for slash pine in Georgia. Per rake yields from loblolly stands tend to be 15 to 30% greater (150 to 425 bales/acre) than slash (120 to 375 bales/acre) and longleaf pine (100 to 350 bales/acre). Pine straw raking starts at canopy closure continuing to the first thinning, generating from $300/acre to over $1000/acre in new income.

INTRODUCTION

Pine straw, the uppermost forest floor layer of undecayed needles, is raked, baled, and sold as landscaping mulch in the southeastern U.S. The value of pine straw as a forest product has increased in Georgia, North Carolina, and South Carolina. Pine straw income received by forest landowners i has increased by five-fold in the last ten years (2000 through 2009, Boatright and McKissick 2001-2010), conversely annual timber revenues in have declined by over 40% during this same period in Georgia. Pine straw revenues have helped many landowners maintain

reasonable cash flows to achieve attractive rates of return on their forestland. Rates of return can be increased, from 5.5 to 9.8% without pine straw production, to 8.8 to 16.2 % with annual pine straw income in loblolly, longleaf, and slash pine stands (Dickens et al. 2007). Pine straw can be sold by the bale or by the acre. Current per acre reported prices in the Southeastern US range from $50 to $125 per acre per year. Revenues for a single rake have been as high as $300 to $400 per acre in high quality longleaf pine stands. Pine straw can also be sold by the bale. Per bale prices range from $0.25 to $0.40 per bale for loblolly, from $0.50 to $0.65 per bale for slash, and from $0.50 to $1.25 per bale for longleaf paid to the forest landowner in Georgia. Selling pine straw by the bale can generate more annual income but bale counts need to be accurate and bale size must be clearly defined.

PINE STRAW PRODUCTION FACTORS AND RATES

A number of factors affect pine straw production rates. These factors are: species, site productivity, stand density (basal area), age, hand versus mechanical baling (packing density), hand versus mechanical raking (mechanical raking often leaves pine straw in the rows), percent rakeable stand (level and type of competing vegetation), raking intensity (semi-annual, annual, or periodic) and interval between rakes, competition control, and the use of fertilizers.

All the above factors affect pine straw production rates with the most intensively managed stands and best sites producing the most straw and the poor sites (deep sands of the Sand Hills or shallow soils of the Piedmont with low fertility) with low or no inputs producing the least straw. Competition control (the use of forest herbicides and mowing) and fertilization are two commonly used forest management tools to improve (1) stand conditions for raking, (2) increase the acreage of a stand that can be raked, and (3) increase pine straw production (on low fertility sites). Pine straw yields are somewhat closely related to stand basal area. Pine straw yields tend to peak in the early- to mid-teens for slash and loblolly pine (Morris et al. 1992, Gholz et al. 1985) and the late teens for longleaf pine (Dickens et al. 2010). Table 1 lists pine straw bale/acre production rates by species. Pine straw yields from loblolly pine stands tend to be 15 to 30% greater than yields from slash and longleaf stands.

Table 1. Common annual pine straw production rates based on fourteen studies and operational raking in the Southeastern U.S.

Species	Low bales/acre	High bales/acre	5- to 10-yr average/acre
Loblolly*	100 to 120	275 to 450	175 to 275
Longleaf*	60 to 80	150 to 350	100 to 250
Slash*	80 to 100	250 to 400	150 to 250

*Bale weights range from 16 lbs to 19 lbs on an oven dry basis (Morris et al. 1992, Dickens and McElvany 2010 unpublished data), the approximate weight of common rectangular bales (13x13x28 or 13x13x30 inches). There are currently no standard bale sizes in Georgia.

PINE STRAW YIELDS AND ECONOMICS

Figures 1a and b illustrate loblolly pine straw yield estimates from two sites in the Coastal Plain of Georgia. The single NPK fertilizer application (200N+50P+50K lbs/ac) at the cut-over Louisville and Rincon loblolly pine sites improved yields by an average of 30 and 50 bales/ac/yr,

respectively (Ogden and Morris 2004). The pine straw income estimates (@ $0.40/bale) are as follows: the Rincon unfertilized value was $412/acre, the Rincon fertilized value was $472/acre (less the fertilizer cost), the Louisville unfertilized value was $619/acre and the Louisville fertilized value was $795/acre (less the fertilizer cost). Pine straw income would have added from $412 to $795/acre at these two sites in the first 21 years prior to the stands' first thinning.

Fertilization (150N+65P+124K lbs/ac) at the two Sand Hills State Forest, South Carolina longleaf pine sites on deep, excessively well drained, low fertility soils, improved yields over the unfertilized plot trees by 43 (144 vs 187 bales/ac/yr average) in the unthinned, younger stand and 53 bales/ac/yr (114 vs 167 bales/ac/yr average) in the older thinned stand over the four and five year study periods (Figures 2a and b). The single NPK fertilizer application benefit lasted three to four years on these soils (Dickens 2000). Pine straw income estimates (@ $0.80/bale) for the young longleaf stand are $461/acre without fertilization and $576/acre with fertilization (less the fertilizer cost) from age 9- through age 13-years and $456/acre without fertilization and $668/acre with fertilization (less the fertilizer cost) in the older thinned longleaf stand from age 32- through age 36-years.

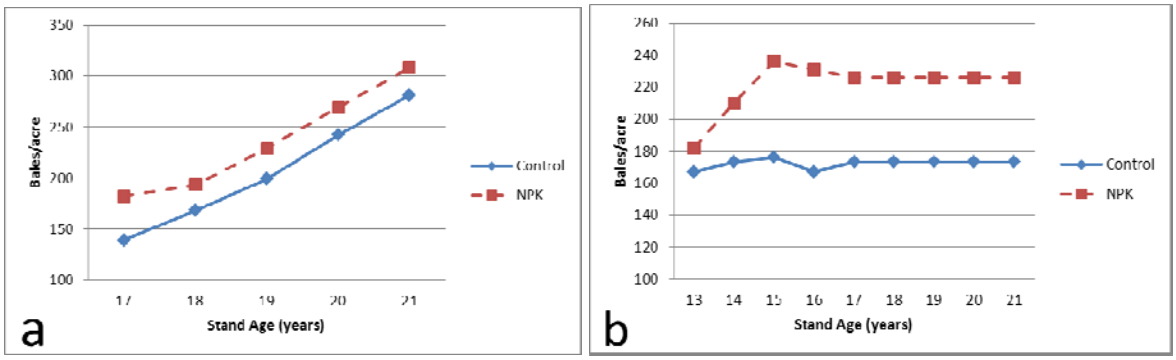

Figure 1 a & b. Cut-over loblolly pine straw estimated/modeled yields from the Louisville (graph a on left; Dothan and Faceville soils) and Rincon, Georgia (graph b on right; Rigdon and Olustee soils) sites without (control) and with (single NPK dose) fertilization (Ogden and Morris 2004). One bale equals 17 lbs dry weight.

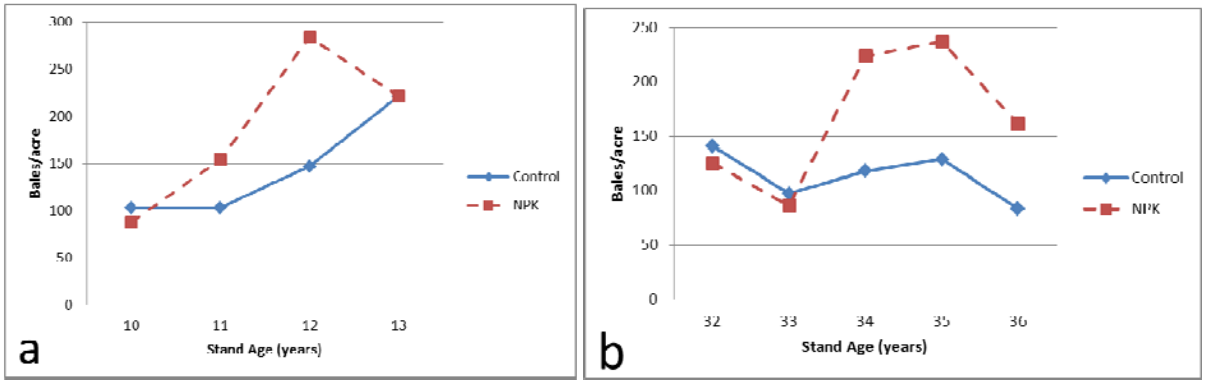

Figure 2 a & b. Sand Hills State Forest, South Carolina unthinned (graph a on left) and thinned (graph b on right; 2nd thinning at age 31-years) longleaf pine straw yield study area means (Alpin soil series) without (control) and a single NPK fertilizer application (NPK) on low fertility sites (bale = 17 lbs dry weight). Stands were fertilized at ages 9- (graph a) and 32-years (graph b) (Dickens 2000).

Pine straw yields from two moderate to high fertility old-field longleaf stands averaged 247 and 209 bales/ac/yr at the Screven and Tift County, Georgia sites, respectively (Figures 3 a and b) without fertilization. The ½ + ½ dose of NPK fertilization (65N+25P+25K lbs/ac at age 17- and again at age 20-years) improved yields by an average of 30 bales/ac/yr at both sites or 277 and 240 bales/ac/yr at the Screven and Tift County sites, respectively (Dickens et al. 2010). Pine straw income estimates for the Screven County site are $986/ac without fertilization and $1109/acre with fertilization (less fertilization costs) for the five rakes from age 15- through age 23-years. Pine straw income estimates for the Tift County site are $1172/acre without fertilization and $1346/acre with fertilization for the seven rakes from age 17- through age 23-years; these incomes occurring prior to the first thinning.

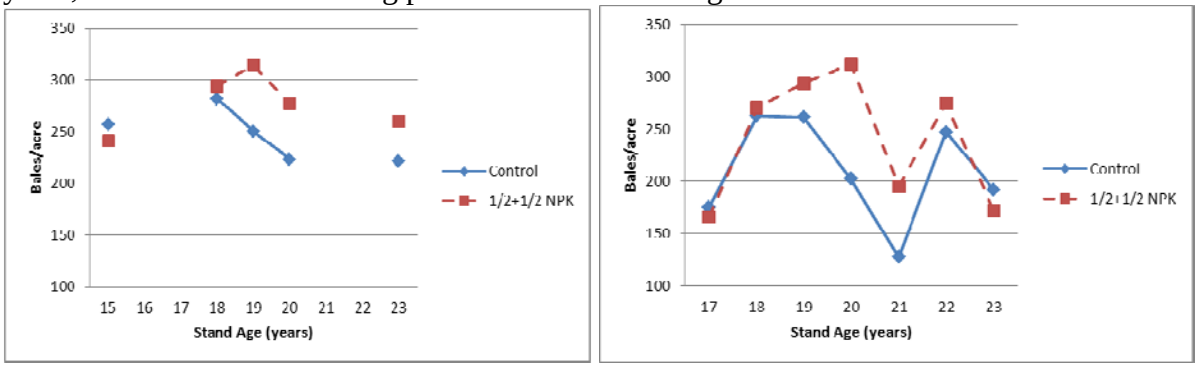

Figure 3 a & b. Old-field (moderate to high fertility), unthinned longleaf pine straw study area mean yields without (control) and with a split application of NPK (two ½ doses three years apart; ½+ ½NPK; applied at both sites at age 17- and 20-years). Graph a on the left are yields from the Screven County, Georgia study site (Bonneau and Blanton soils; no raking in years 16, 17, 21, and 22) and graph b on the right are yields from the Tift County, Georgia study site (Albany and Leefield soils). One bale equals 17 lbs dry weight (Dickens et al 2010).

Slash pine straw yields from two old-field sites in Bulloch and Wheeler County, Georgia averaged 260 and 215 bales/ac/yr, respectively (Figures 4 a and b) without fertilization. The peak yields occurred at age 13-years at the Bulloch County site (294 bales/acre) and 15-years at the Wheeler County site (385 bales/acre). Slash pine straw income estimates (@ $0.60/bale) from the Bulloch County site is $936/acre from age 9- through age 14- years and $1288/acre from the Wheeler County site from age 10- through age 19-years. Pine straw yields were more variable at the Wheeler County site as the slash pine stand was raked semi-annually in some years and annually (age 10-, 16- and 19-years) in others (Hayes et al. 2009).

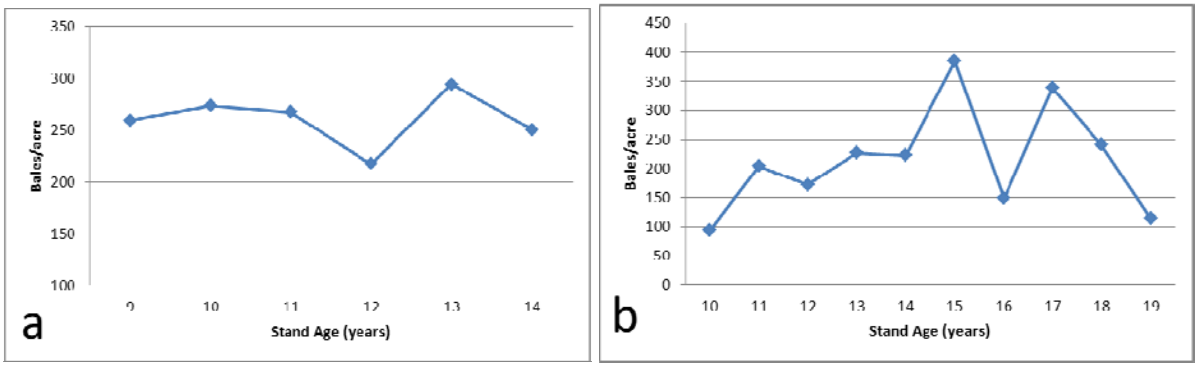

Figure 4a & b. Old-field (moderate to high fertility) slash pine straw yields without fertilization at a Bulloch County (graph a on left; Leefield and Albany soils) and Wheeler County, Georgia site (graph b on right; Fuquay, Cowarts and Troup soils). One bale was approximately 13x13x 28 to 30 inches or approximately 17 lbs dry weight.

Adding pine straw income and a higher level of management to modeled wood flow yields of slash and loblolly pine on a relatively short 24-year rotation improved net revenues by $350 to $1600/acre (Tables 2 and 3) and rates of return (RORs) from 5.5% to 8.8% without pine straw to 9.8% to 16.2% with pine straw (Dickens et al. 2007). Old-field longleaf pine straw yield values after five rakes at the Screven and Tift County, Georgia sites were 35% ($815/acre in pine straw) of the gross wood+straw values/acre ($2300/acre for wood+straw) by age 21-years (Dickens et al. 2010).

SPECIES PREFERENCE, RAKING PERIODS, AND STAND CONDITIONS IN SOUTHERN PINE STANDS

Loblolly, longleaf, and slash pine stands are commonly raked in the southeastern U.S. The order of preference in Georgia is longleaf, then slash, and then loblolly straw. Pine species differences in longer needle length, better color retention, and slower rate of deterioration are factors for this order of reference.

Southern pine stands that are clean of understory vegetation and debris (dead stems, branches, and cones), good road access (all weather roads, graveled roads, wide roads, good turn-around areas), and proximity to local markets are important factors in making pine straw harvesting attractive to pine straw buyers or contractors. Longleaf, slash and loblolly pine stands that are suitable to rake are commonly raked starting at canopy closure (age 6- to 10-years-old depending on stocking, species, and growth rate) until the first thinning. If the stand is attractive to a contractor, the contractor may negotiate a 3- to 7-year (5-years is common) written agreement with the landowner to rake the stand. If a pine stand is under a Conservation Reserve Program (CRP) contract, it cannot be raked until the contract has expired.

Site factors that may preclude intensive annual raking include: slopes greater than 4 to 8% (excessive erosion) and marginal soils. Excessively well drained deep sands may be best to be raked on a three year cycle to conserve soil moisture, organic matter, nutrients, and to minimize soil erosion. In general, thinned stands are less attractive due to new understory growth and reduced needle production. Thinned stands are sometimes raked once crowns rebuild and understory vegetation is controlled.

PROS AND CONS OF PINE STRAW RAKING IN SOUTHERN PINE STANDS

The pros of pine straw raking include: (1) an annual income for a period of 5 to 10 or more years, (2) an initial income 5 to 10 or more years prior to the first income from a thinning (the traditional first income from pine stands), (3) an earlier return on one's investment in site preparation and planting, (4) a higher net revenue ($300 to over $1000 per acre) and rate of return (from three to over six percentage points, Tables 2 and 3), and (5) the pine stand is easier to walk through and may be more aesthetically pleasing to some.

The cons of pine straw raking include: (1) reduced soil moisture due to increased evaporation rates, (2) increased soil erosion under intensive raking regimes (no cover on the bare soil after frequent repeated rakings), (3) nutrient removals with annual pine straw raking may reduce site productivity if performed for a prolonged period of time, (4) reduced near-term diameter growth

due to intensive raking in some cases without ameliorative treatments, and (5) minimal cover and food for wildlife species.

MARKETING PINE STRAW

Demand for pine straw raking will vary by location. Get a list of pine straw vendors from your local County Extension office or State Forestry Commission or ask neighbors who have pine straw raked for their contractor name and contact information. If a landowner's pine stand is producing a lot of straw, has a clean understory for easy raking, a good road system, and is in an area of contractor demand, his/her pine acreage should be easy to sell. Make sure the contract clearly states type of payment (by the bale with bale specifications clearly defined or by the acre), frequency/time of payment (100% at completion of each rake, 50% every ½ year, etc.), contract length with start and end time, who is responsible for herbicide and fertilizer application (where needed) and mowing, and that road, fence, and other property items are found in the same condition after the last rake as prior to the first rake.

SUMMARY

The addition of pine straw management to traditional forest management can greatly improve overall financial performance and give many landowners early annual incomes from their pine stands. Managing for pine straw along with wood products entails good road access, getting the stands clean for raking (the use of herbicides and mowing where needed), finding local straw contractors and entering into a contract (either selling by the acre or by the bale with bale specifications clearly defined in the contract), and fertilizing those low fertility sites that would respond dramatically to fertilization for a number or years. Pine straw is typically raked starting at canopy closure (age 6- to 10-years) until the first thinning, offering an annual income for a period of 3- to 10-years or more. Pine straw yields tend to increase with basal area growth peaking in the early- to mid-teens for loblolly and slash pine and late teens for longleaf pine. Annual pine straw average yields from 14 study sites in Georgia and South Carolina range from 172 to 290 bales/ac/yr for loblolly with a mean of 240 bales/ac/yr (Ogden and Morris 2004, Dickens et al. 2005), from 148 to 260 bales/ac for slash pine with a mean of 202 bales/ac/yr, (Ogden and Morris 2004, Hayes et al. 2009, Dickens 2011 unpublished data) and from 114 to 277 bales/ac/yr for longleaf pine with a mean of 198 bales/ac/yr (Dickens 2000, Dickens et al. 2010). Pine straw income can range from $300/ac to over $1200/ac depending on the species, age, basal area, number of raking years, site productivity, and price per bale or price per acre.

Table 3. A comparison of slash pine plantation management scenarios[1] under a 24-year rotation and their effect on net revenue and rate of return (ROR), with site prep and plant (SP&PL) cost of $250 and $375/acre (from Dickens et al 2007).

Treatment					SP&PL @ $250		SP&PL @ $375	
Scenario # Fert. @ Yr.	Thin yr 15	Pine straw ($/ac)	% PW	MIA[2] Tons/Cords	Net Revenue [3] ($/ac)	ROR[4] (%)	Net Revenue [3] ($/ac)	ROR[4] (%)
1 N	N	N	60	5.77, 2.09	1312	6.96	1187	5.48
2 N	Y		46	5.55, 2.01	1662	8.28	1537	6.67
3 Y, 16	N	N	48	6.28, 2.28	1787	7.96	1662	6.53
4 Y, 6		50[5]	52		2480	10.95	2355	8.77
5 Y, 6, 16		100[5]	43	6.82, 2.48	3561	15.71	3436	12.27
6 Y, 16	Y	N	40	6.16, 2.23	2037	9.00	1912	7.43
7 Y, 6		50 & 0[6]	43		2322	10.46	2197	8.53
8 Y, 6		100 & 0[6]			2672	12.87	2547	10.31
9 Y, 6, 16		100 & 50[7]	38	6.57, 2.38	3177	13.80	3052	11.12

Table 3. A comparison of loblolly pine plantation management scenarios[1] under a 24-year rotation and their effect on net revenue and rate of return (ROR), with site prep and plant (SP&PL) cost of $250 and $375/acre (from Dickens et al 2007).

Treatments					SP&PL @ $250		SP&PL @ $375	
Scenario # Fert. @ Yr.	Thin yr 15	Pine straw ($/ac)	% PW	MIA[2] Tons/Cords	Net Revenue[3] ($/ac)	ROR[4] (%)	Net Revenue[3] ($/ac)	ROR[4] (%)
1 N	N	N	60	6.48, 2.35	1576	7.66	1451	6.16
2 N	Y		46	6.24, 2.26	1985	9.18	1860	7.51
3 Y, 16	N	N	48	7.15, 2.59	2048	8.50	1923	7.05
4 Y, 6		50[5]	52		2746	11.42	2621	9.24
5 Y, 6, 16		100[5]	43	7.94, 2.88	4046	16.24	3921	12.85
6 Y, 16	Y	N	40	6.99, 2.53	2356	9.81	2231	8.17
7 Y, 6		50 & 0[6]	43		2626	11.16	2501	9.18
8 Y, 6		100 & 0[6]			2976	13.51	2851	10.91
9 Y, 6, 16		100 & 50[7]	38	7.68, 2.78	3706	14.83	3581	12.08

[1] Uninflated, 8% discount rate, before income taxes, GaPPS v 4.20; Pulpwood @ $4.51 and $5.75/ton net, Chip-n-saw @ $19.12 and $23.09/ton, and Sawtimber @ $32.14 and $36.51/ton thin and clear-cut prices.
[2] MAI = Mean Annual Increment of wood growth, Tons & Cords/A/yr.
[3] Net Revenue = Harvest revenue(s) – SP+PL cost – (annual cost x 24 yrs) – fert cost(s) – clean up cost + pine straw revenues (today's $).
[4] ROR = Rate of Return (percent).
[5] With no thinning, pinestraw raked years 8-23.
[6] With thinning, pinestraw raked years 8-14.
[7] With thinning, pinestraw raked years 8-14 and 17-23.

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