Series paper #7

Economics of growing longleaf pine to a 33- and 45-year rotation with three stumpage price sets, two establishment cost sets, with and without pine straw - net revenue and rate of return

October 2014

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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 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 longleaf (Pinus palustris, Mill.) a pine species which is more conducive to longer rotations than loblolly (Pinus taeda L.) or slash pine (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 the feasibility, profitability, and cash-flow of a 33-year rotation with management options for loblolly, longleaf, and slash pine plantations including competition control, fertilization (loblolly and slash only), with and without pine straw harvests, two different site preparation and planting costs, and three different stumpage price sets. The financial measure of profitability used in this paper is net revenue and rate of return (ROR). The mean annual increments of 4.64 and 4.43 tons/acre/year used for longleaf pine, for these 33- and 45-year rotations are considered somewhat conservative by today’s standards under moderate 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 longleaf pine on cut-over and old-field sites with the objective of sawtimber rotations. They also question spending moderate to relatively large sums of money on management under the current and anticipated stumpage prices and economic uncertainty. To address these questions, we used the SIMS growth and yield Model developed by Shiver and Borders (2010) for longleaf pine wood yields. Depending on establishment costs, growth rates, other sources of income (in this paper series; pine straw), and stumpage prices shorter rotations for loblolly
and slash pine are often financially attractive and are addressed in companion papers in this series of economic manuscripts.

**Financial Calculations**

Net revenue (NR) per acre is a straightforward economic calculation of adding up all revenues, adding up all costs, and then subtracting the total cost from the total revenue. The net revenue for each 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. For a scenario to be attractive, the net revenue has to be positive (total revenue > total cost). If a scenario net revenue is negative, then the net cash flow is negative (total cost > total revenue) equating to scenario being financially unattractive.

The rate or return (ROR) for a given scenario is the rate of compound interest that is earned by costs invested. ROR is the average rate of appreciation during the life of the project (Bullard and Straka 1993). ROR 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. ROR is also known as Internal Rate of Return (IRR) and Return on Investment (ROI). 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).

Net Revenue and Rate or Return are useful economic decision-making tools to rank forest management scenarios especially when comparing scenarios of the same time duration (rotation age). A companion paper (Econ Series Paper #8, Dickens and others 2014), calculating for soil expectation value (SEV), an economic decision-making tool considered to be one of the best tools to compare different rotation ages, was written to compare longleaf, loblolly and slash pine using different rotation ages. A shortcoming of Net Revenue values is that they lack the time value of money. Some of the shortcomings of 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 ROR, intermediate costs and returns are assumed to be re-invested at the ROR interest rate calculated which may not be achievable in real-world scenarios.

**Methodology**

**Common assumptions**

The rotation age was set at 33- or 45-years for longleaf pine plantations. 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 (current average costs for these activities in Georgia). This “average” 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).

Longleaf seedlings were assumed to cost $210 per 1000 and planted at 726/acre (6x0 feet spacing) for a cost per acre of $152. Planting cost per acre was assumed to be $80.

The total cost per acre for the “average” site preparation plus planting was $342 for the “average” and $552 for the “high” site prep cost. 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:
► pulpwod (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 pulpwod, 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). There were a total of 107 quarters of reported prices during this period. The “low” set of stumpage prices were the means of the 15 lowest price quarters for 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 for 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.

**Assumptions**
The longleaf pine MAI was 4.64 tons/acre/year through age 33-years with one thinning at age 20 years. The longleaf pine MAI was 4.43 tons/acre/year through age 45-years with two thinnings at age 20, and 32-years.

Longleaf pine scenarios had herbaceous weed control at age 1 years, and woody release at age 7-years at costs of $35 and $55/acre, respectively.
Scenarios for the 33-year Rotation
(1) thin at age 20-years to 65 ft\(^2\)/ac, no pine straw, $342/acre establishment cost
(2) thin at age 20-years, no pine straw, $552/acre establishment cost
(3) thin at age 20-years, rake straw @ $100/acre/year from age 8- through age 20-years, $342/acre establishment cost
(4) thin at age 20-years, rake straw @ $100/acre/year from age 8- through age 20-years, $532/acre establishment cost

Scenarios for the 45-year Rotation
(5) thin at age 20- and 32-years to 65 ft\(^2\)/ac, no pine straw, $342/acre establishment cost
(6) thin at age 20- and 32-years, no pine straw, $552/acre establishment cost
(7) thin at age 20- and 32-years, rake straw @ $100/acre/year from age 8- through age 20-years, $342/acre establishment cost
(8) thin at age 20- and 32-years, rake straw @ $100/acre/year from age 8- through age 20-years, $532/acre establishment cost

Forest management activities

Woody competition control
Woody competition control with a single herbicide application occurred at age 7-years (longleaf pine) 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 (Table 3). 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 in the last three years (2010-2013).

Thinning
The thinning scenarios include one thinning at age 20-years for the 33-year rotation and two thinnings at 20- and 32-years-old for longleaf pine. Residual basal area (RBA), after thinning (5th row with selection from below) was set at 65 sq. ft/ac. Longleaf pine scenarios were not fertilized due to a lower N+P wood gain response than loblolly or slash pine.

Pine straw
The pine straw income assumptions included were as follows $100/acre/year raking income for the longleaf scenarios have been noted in south and central Georgia between 1998 and 2010 (Doherty 2004, Dickens and others. 2012). Pine straw is raked starting in year 8 (approximating canopy closure) through the first thinning (age 20-years) for longleaf pine (Table 5).

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 longleaf stands in South and North Carolina are raked. 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 revenue and rate of return value ranges

In all cases net revenues were positive meaning the total revenue was greater than the total cost for all longleaf pine scenarios. Across the scenarios for longleaf pine, net revenues (NRs) ranged from lows of $191 and $401/acre (Table 6 and 7; scenarios 1 and 2, no pine straw and low stumpage price set) to highs of $4749, $4959, $6049, and $6259/acre (Table 7; 45-year rotation high and average establishment costs using the high stumpage price set, without and with pine straw).

Longleaf pine ROR's ranged from lows of 0.73% and 1.83% (Table 6, 33-year rotation, scenarios 2 and 1, using low stumpage prices, no pine straw income, and high or average establishment costs, respectively) to highs of 8.80%, 9.78%, and 10.74% for the 45-year rotation (Table 7, scenario 7 using the average establishment cost with pine straw) and 8.90%, 9.77%, and 10.75% (Table 6, scenario 3 using the average establishment cost with pine straw).

Impact of pine straw income on net revenues and rate or return

Net revenue per acre values improved the longleaf pine scenarios by $1300 per acre (rake income from age 8- through age 20-years @ $100/acre/year), when comparing rake versus no rake cases. Examples of impact on net revenues with the addition of pine straw income are as follows:

33-year rotation

(1) Longleaf pine net revenue increased from $401/acre (scenario 1, using low stumpage prices, no pine straw income) to $1701/acre (scenario 3, using low stumpage prices with pine straw income)

(2) Longleaf pine net revenue increased from $993/acre (scenario 2, using average stumpage prices, no pine straw income) to $2293/acre (scenario 4, using average stumpage prices with pine straw income, Table 6).

45-year rotation

(3) Longleaf pine net revenue increased from $2755/acre (scenario 5, using average stumpage prices, no pine straw income) to $4055/acre (scenario 7, using average stumpage prices with pine straw income)

(4) Longleaf pine net revenue increased from $892/acre (scenario 6, using low stumpage prices, no pine straw income) to $2192/acre (scenario 8, using low stumpage prices with pine straw income, Table 7).

It is interesting to note that when comparing pine species (Series paper #5, Dickens and others 2014) their corresponding wood yields, annual pine straw income per acre and number of years raked we found the following: on a percentage point difference basis rate of return values were improved by a low 1.23 percentage points (loblolly pine scenario 2 high stumpage price, no pine straw ROR of 7.59% compared to loblolly pine scenario 4, high stumpage price with pine straw ROR of 8.82%) to a high of 7.07 percentage points (longleaf pine scenario 5 using low stumpage prices and no pine straw income ROR of 1.83% compared to longleaf pine scenario 7 using low stumpage prices with pine straw income ROR of 8.90%). Longleaf pine ROR percentage point differences for the 33-year rotation were a low of 3.73 (scenario 2, using high stumpage prices of 4.64% without pine straw versus 8.37% scenario 4.
using high stumpage prices with pine straw, Table 6) and an average difference of 5.24 comparing
scenarios 1 to 3 and 2 to 4 (Table 6). Longleaf pine ROR percentage point differences for the 45-year
rotation were a low of 3.08 (scenario 6, using high stumpage prices of 5.45% without pine straw versus
8.53% scenario 8 using high stumpage prices with pine straw, Table 7), a high difference of 5.98
percentage points (2.90% ROR; scenario 5 using low stumpage prices and average establishment cost
without pine straw compared scenario 7, an 8.88% ROR using low stumpage prices and average
establishment cost with pine straw, Table 7). The average percentage point difference for the 45-year
rotation was 4.36 when comparing the no straw to the straw scenarios. Basically the lower the wood
yield, the lower the stumpage prices used, and the higher the pine straw value (longleaf pine at
$1300/acre over 13 years) the greater the pine straw income impact is on ROR. Conversely, the higher
the wood yields, (loblolly and slash pine) and the higher the stumpage prices used, and the lower the
pine straw value (loblolly being lowest, then slash pine), the less the impact on ROR.

Impact of establishment costs on net revenues and rate or returns

The impact of site preparation was straight-forward with net revenues differing by $210/acre since
these costs are incurred at time zero for longleaf pine (Tables 3, 6-7). The longleaf site preparation and
planting cost per acre were $342 for the average establishment regime and $552 for the high
establishment regime. The longleaf seedling cost per acre ($152) versus loblolly and slash seedling cost
per acre ($55) also had a minor impact on overall establishment costs when comparing these species as
noted in series paper #5 (Dickens and others 2014). The impact of establishment costs within a
management level (scenario) was large enough ($210/acre for site prep and $97/acre seedling cost
differences) to illustrate the importance of choosing the right species, site prep and planting method for
a given site.

Six examples of the impact of the establishment costs on RORs are as follows using average stumpage
prices.

33-year rotation
(1) The longleaf pine with no pine straw ROR was 3.99% using the average establishment cost
(scenario 1, Table 6) and 2.80% using the high establishment cost (scenario 2, Table 6).

(2) The longleaf pine with pine straw ROR was 9.77% using the average establishment cost (scenario 3,
Table 6) and 7.29% using the high establishment cost (scenario 4, Table 6).

45-year rotation
(1) The longleaf pine with no pine straw ROR was 4.88% using the average establishment cost
(scenario 5, Table 7) and 3.90% using the high establishment cost (scenario 6, Table 7).

(2) The longleaf pine with pine straw ROR was 9.78% using the average establishment cost (scenario 7,
Table 7) and 7.48% using the high establishment cost (scenario 8, Table 7).

Using Table 6 for longleaf pine 33-year rotation, the average establishment cost RORs were 1.84
percentage points greater than the corresponding high establishment cost and the 45-year rotation
(Table 7) average ROR difference between the average and high establishment cost was 1.66
percentage points.
Impact of using the low, average, or high pine stumpage price sets on net revenue and rate of return

The impact of using low, average, and high stumpage price sets on net revenue and rate or return values in the 33-year and 45-year longleaf pine rotation scenarios were generally large. Examples of the impacts on net revenue are as follows:

33-year rotation
(1) Using scenario 1 the differences in the net revenues were $803/acre between the low ($401/acre) and average ($1203/acre) and $1173/acre between the average and high ($2376/acre) stumpage price sets (Table 6). The $/acre differences were the same for scenario 2, 3 and 4 (Table 6).

45-year rotation
(2) Using scenario 6 the differences in net revenues were $1653/acre between the low ($892/acre) and average ($2545/acre) and $2204/acre between the average and high ($4749/acre) stumpage price sets (Table 7). The differences were the same for scenarios 5, 7 and 8 (Table 7).

Examples of rate of return changes as a function of changing stumpage price sets are as follows with low, average, and high RORs listed in this respective order.

33-year rotation
(1) Longleaf pine scenario 1 (average establishment cost, no pine straw) had RORs of 1.83%, 3.99% and 5.91% (Table 6).

(2) Longleaf pine scenario 3 (average establishment cost with pine straw) had RORs of 8.90%, 9.77% and 10.75% (Table 6).

(3) Longleaf pine scenario 4 (high establishment cost with pine straw) had RORs of 6.28%, 7.29%, and 8.37% (Table 6).

45-year rotation
(4) Longleaf pine scenario 5 (average establishment cost, no pine straw) had RORs of 2.90%, 4.88% and 6.52% (Table 7).

(5) Longleaf pine scenario 7 (average establishment cost with pine straw) had RORs of 8.88%, 9.77% and 10.74% (Table 7).

(6) Longleaf pine scenario 8 (high establishment cost with pine straw) had RORs of 6.41%, 7.48%, and 8.53% (Table 7).

Summary

Wood flows, thinning, and pine straw
The longleaf pine 33-year rotation mean annual increment of 4.64 tons/acre/year and the 45-year rotation of 4.43 tons/acre/year are realistic on most cut-over sites with chemical site preparation, planting quality, good quality seedlings, post-plant herbaceous weed control, and woody competition
control and are conservative on most old-field sites in most cases. Exceptions would be problem soils such as deep sands (Typic Quartzipsammments) of the Sand Hills or shallow, rocky soils of the Piedmont physiographic region.

These scenarios do illustrate that if the aforementioned base growth rates and product class distributions for each harvest for longleaf pine are assumed then the establishment expenditures (site preparation, seedling, and planting costs) 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, seedling quality and size, and seedling survival) may improve growth rates above those used here, therefore improving net revenue and rate of return values.

The woody vegetation release treatment at age 7-years @ $55/acre cost and a single post-plant herbaceous weed control herbicide treatment for longleaf pine @ $35/acre were employed in these scenarios to improve survival and wood yields.

Pine straw gave higher net revenues and RORs for longleaf pine compared to the no pine straw counterpart. The net revenue differences were $1300 for longleaf pine. Rates of Return improved by 3.08 to 7.07 percentage points when pine straw income was included in the three pine species scenarios.

Discussion

Non-industrial private forest landowners do have some attractive forest management options with longleaf pine. To maximize net revenues and RORs, 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 net revenues and RORs. Including pine straw income can improve net revenues for longleaf pine. 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, pine straw income (when raked), 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).

Literature Cited

Bailey, R.L.; Zhao, B. 1998. GaPPS 4.20 Model. Warnell School of Forest Resources- UGA, Athens, GA.


![Georgia Pine Stumpage Prices](image)

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

### Table 1. Product class specifications.

<table>
<thead>
<tr>
<th>Product/Item</th>
<th>Pulpwood</th>
<th>Chip-N-Saw</th>
<th>Sawtimber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small end diameter (inches)</td>
<td>3</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Minimum length (feet)</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Length Increment (feet)</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>
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 2nd Q 2013 TM-S).

<table>
<thead>
<tr>
<th>Item, Price level</th>
<th>Cash or net</th>
<th>Pulpwood ($/Ton)</th>
<th>Chip-N-Saw ($/Ton)</th>
<th>Sawtimber ($/Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>cash</td>
<td>6.00</td>
<td>13.00</td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>net</td>
<td>5.40</td>
<td>11.70</td>
<td>13.50</td>
</tr>
<tr>
<td>Average</td>
<td>cash</td>
<td>9.00</td>
<td>22.00</td>
<td>30.00</td>
</tr>
<tr>
<td></td>
<td>net</td>
<td>8.10</td>
<td>19.80</td>
<td>27.00</td>
</tr>
<tr>
<td>High</td>
<td>cash</td>
<td>14.00</td>
<td>37.00</td>
<td>48.00</td>
</tr>
<tr>
<td></td>
<td>net</td>
<td>12.60</td>
<td>33.30</td>
<td>43.20</td>
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Table 3. Costs for the 33- and 45-year longleaf rotations

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost time (yr)</th>
<th>33-year rotation costs ($/acre)</th>
<th>45-year rotation costs ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average SP+PL</td>
<td>High SP+PL</td>
</tr>
<tr>
<td>annual mgmt fee</td>
<td>1 through rotation age</td>
<td>330</td>
<td>330</td>
</tr>
<tr>
<td>site prep and plant</td>
<td>0</td>
<td>342</td>
<td>552</td>
</tr>
<tr>
<td>herbaceous weed control</td>
<td>1</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>herbicide</td>
<td>7</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Total cost per acre</td>
<td></td>
<td>$ 762</td>
<td>$ 972</td>
</tr>
</tbody>
</table>

Table 4. Longleaf pine wood yields in the 33- and 45-year rotation scenarios.

<table>
<thead>
<tr>
<th>Rotation age (yrs)</th>
<th>Cut age (yrs)</th>
<th>MAI (tons/ac/r)</th>
<th>Pulpwood</th>
<th>Chip-n-saw</th>
<th>Sawtimber</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
<td></td>
<td>4.64</td>
<td>39.2</td>
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<td></td>
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<td>33</td>
<td>20</td>
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<td>39.2</td>
<td>0.15</td>
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<td></td>
<td>33</td>
<td>68.1</td>
<td>19.5</td>
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<td>26.2</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>18.6</td>
<td></td>
<td>25.1</td>
<td>7.05</td>
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<tr>
<td>45</td>
<td>20</td>
<td>4.43</td>
<td>39.2</td>
<td>0.15</td>
<td>0</td>
</tr>
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<td></td>
<td>32</td>
<td>18.6</td>
<td></td>
<td>25.1</td>
<td>7.05</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>22.7</td>
<td>6.58</td>
<td>80.2</td>
<td></td>
</tr>
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</table>
**Table 5.** Pine straw periodic per acre income levels used in the profitability analysis of longleaf pine scenarios over a 33- or 45-year rotation.

<table>
<thead>
<tr>
<th>Rotation age yrs.</th>
<th>Annual income/acre ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>33- or 45-</td>
<td>100 or 0¹</td>
</tr>
</tbody>
</table>

¹ Pine straw raked in years 8-20 for 33- and 45-year rotation for longleaf pine.

**Table 6.** Net Revenue and Rate of Return values for the one thinning (at age 20-years) 33-year longleaf pine scenarios 1, 2, 3 and 4 at a mean annual increment of 4.64 tons/acre/year.

<table>
<thead>
<tr>
<th>Scenario #</th>
<th>Est. Costs $/ac</th>
<th>Pine Straw Y/N</th>
<th>Stumpage Price sets</th>
<th>Net Revenue $/ac</th>
<th>Rate of Return %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$342</td>
<td>N</td>
<td>Low</td>
<td>401</td>
<td>1.83</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Average</td>
<td>1203</td>
<td>3.99</td>
</tr>
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<td></td>
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<td>High</td>
<td>2376</td>
<td>5.91</td>
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Table 7. Net Revenue and Rate of Return values for the 45-year rotation longleaf with two thinnings @ age 20- and 32-years scenarios 5, 6, 7, and 8 at a mean annual increment of 4.43 tons/acre/year.

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<th>Pine Straw Y/N</th>
<th>Stumpage Price sets</th>
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Key words: Forest economics, longleaf pine, net revenue, Rate of Return, pine straw