UT Extension
SP677

Professional Hardwood Notes
Technical Information on Hardwood Silviculture for Foresters

Hardwood Plantations as an Investment

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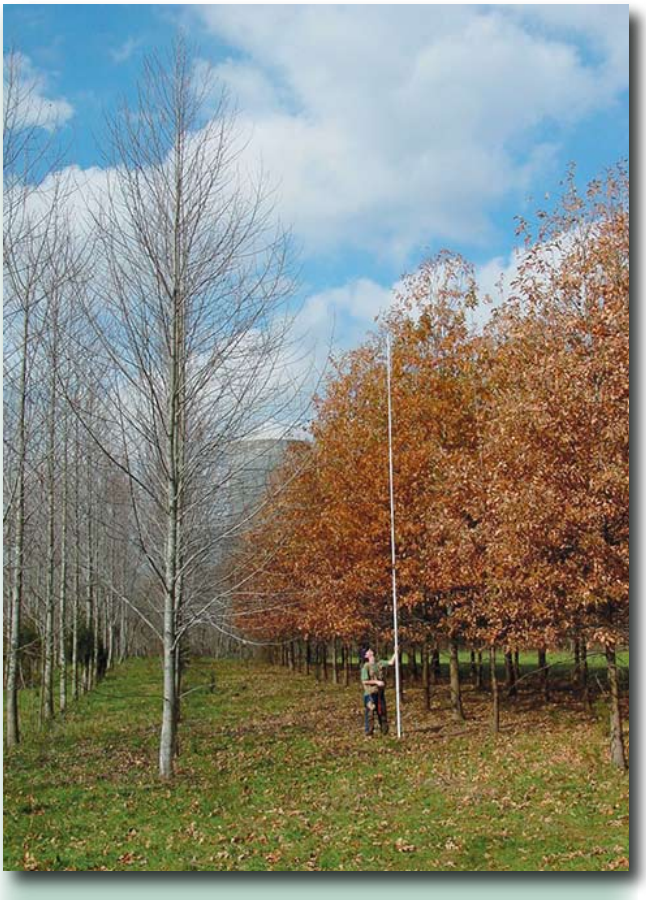
Deciding what to do with a piece of land is not always easy. Appraisers use the phrase "highest and best use," which implies that one should use the land for its maximum "economic/monetary value." For example, would the landowner make more money by building a new shopping center or residential subdivision (with a substantial investment required) or would he or she do "better" renting to a livestock producer for grazing or cutting hay? Many acres are valuable as cropland growing annual crops such as soybeans, wheat or cotton. The choices for using land are many.

One choice that should be considered is the planting of tree crops intended for the timber market. Although a large number of acres are required for an annual income from timber crops, owners with more modest-sized properties, and who do not require annual income from their land, can ultimately achieve profits from growing trees.

Several factors should be assessed when planting tree crops. Trees grow at varying rates, depending on the species present and the productive capacity of the soil. Timber values have increased in the past and are expected to do so in the future. Once tree crops are established, they require minimal inputs/costs relative to other land uses such as farming or producing livestock.



Wayne Clatterbuck

8-year-old planting of yellow-poplar (left) and cherrybark oak (right)

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Tax treatment of tree crops is also favorable relative to other investments. The Internal Revenue Service allows the deduction of certain timber establishment costs according to Reforestation Tax Incentives. Income from timber sales is taxed at long-term capital gains rates when the trees are ultimately harvested. Cost-sharing programs are also available for many tree-planting efforts.

Tree crops/forests are not for all landowners, but can be profitably managed and enjoyed as they grow into timber/wood products. As planted trees become forests, they become habitat for a variety of wildlife species and places of beauty and solitude, while protecting soil and water for years to come. For many landowners, these non-market values become greater than the monetary return originally considered when deciding what to do with their land.

Does tree planting pay? For many, it pays several times over in personal satisfaction even before profit is realized. For others with an interest in potential financial returns, let's look at the factors involved.

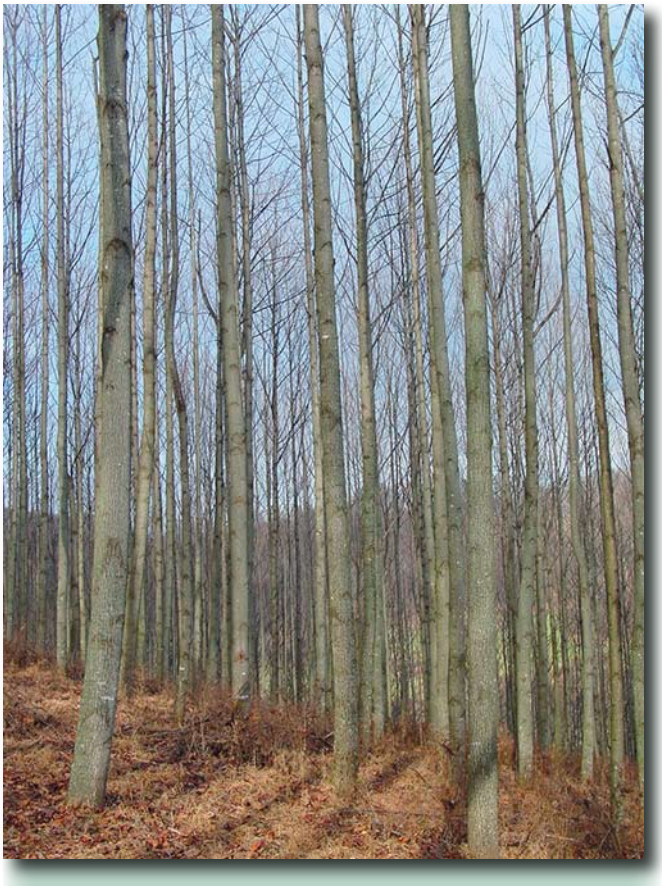
Timber Investment Analysis

Timber is appraised like any other property. With merchantable timber, it is often a matter of measuring the trees to determine the volume/weight and the quality. Once these numbers are estimated, a price is determined from local sources or from the Tennessee Forest Products Bulletin to get a "ball park" price. Usually, evidence of what similar timber sold for in the same area and time period is available. This is the "comparable sales" approach common with other real estate appraisals.

Timber too small to sell, termed premerchantable, is appraised using an income capitalization approach. This is the approach used to determine the value of a recently planted or regenerated stand of trees.

The income capitalization approach is a set of procedures through which a value for income-producing property is derived by converting its anticipated cash flows into value. The annual cash flows for the holding period are discounted at the specified yield rate.

An income approach valuation requires the assumption of a timber management plan to forecast the timing and yield from existing stands. In selecting an appropriate plan, various options in managing the property are considered. Will the property be clearcut, thinned and cut later or managed in some other way? In the examples given later in this publication, it is assumed that trees are established and clearcut at age 45. Other management scenarios, such as thinning and carrying the residual trees to older ages, will yield different results. The best bet is to contact a forester and consider other management regimens/scenarios.



Wayne Clatterbuck

An 18-year-old yellow poplar plantation near Carthage, TN

The income capitalization approach to appraisal of forestland is complicated. In outline form, the system commonly used for income projections is as follows:

1. Project future prices
2. Project future timber volumes
3. Determine order of cutting
4. Forecast cash flow by years
   a. Projected timber sale revenue
   b. Projected costs
   c. Projected taxes
      1. Federal income tax computations
5. Determine present worth of net cash flow using two or more discount rates
6. Select one discounted cash flow as the income capitalization approach indicator of value.

Values for hardwood plantations are presented using the income capitalization approach in this publication. When the subject plantations are pre-merchantable, the value of the potential cash flow by planting the trees is recognized. Other indications of value may be different.

WinYield

To perform the calculations necessary to generate value(s) according to the above outline, software developed by Tennessee Valley Authority (TVA) called WinYield is used. WinYield is designed to assist forestry professionals and landowners in analyzing various timber management strategies. WinYield previews the simulated effects of various forest management strategies on financial profitability. Information derived from the program is useful for evaluating proposed timber management activities.

WinYield is particularly useful for evaluating investment opportunities. Landowners determine management objectives such as a required rate of return on investment and cash flow timing, as well as the general productivity of their land.

WinYield is an event-driven program that allows users to enter data representing their particular situation.

Assumptions and Other Information

Selling Prices. It is important to know the expected selling price of trees when they are sold. In the timber business, the price received is called "stumpage" – or the price paid for the trees as they stand in the forest. Each product – pulpwood, sawtimber, etc. – has a stumpage price.

The average price for hardwood sawtimber stumpage in Tennessee during the first quarter of 2006 is greater than $175 per thousand board feet (MBF) Doyle log rule. This price will be used in this publication for analysis. Local prices can be substituted to better reflect conditions in other areas. The current stumpage price is needed to project future prices when trees are sold.

Future Stumpage Price. Current prices have already been mentioned as important information in investment analysis. What is needed, however, is the future price of timber 45 years or longer from now. This price must be projected. This analysis conservatively assumes that hardwood sawtimber prices will increase at the rate of inflation, or an average of 3 percent per year. Many analysts assume price increases greater than the rate of inflation.

Tree Growth. The volume of wood that can be grown on an acre of land during a given amount of time depends on the capacity of the land. This is termed "site quality." A local natural resources professional may suggest a yield for specific land. For this analysis, the assumption is that 4,000 to 12,000 board feet could be produced per acre in 45 years. Sawtimber is assumed to be the only product produced. Smaller trees and "tops" could produce pulpwood, which would increase the value of the timber harvest.

Investment Period. As with any investment, a time period for the investment must be known. Timber can be managed for a year or for 30 or more years. In this publication, the assumption is that trees will be managed for 45 years, and then they will be clearcut for sawtimber. Forty-five years was chosen because it seems to be the shortest amount of time required to grow a stand of hardwood sawtimber profitably in Tennessee. Holding trees longer can result in higher-valued products and usually higher returns. Thinning starting around age 20 may produce periodic income and shorten the time needed to produce higher-valued products.

Assumptions Used in the Investment Analysis for Hardwood Plantings

1. $175 MBF present stumpage price
2. Stumpage price increases at the rate of inflation – 3 percent annually
3. Investment period of 45 years
4. Establishment costs of $90/acre, includes site preparation, seedlings and planting
5. Products – sawtimber only
6. Yields 4,000 to 12,000 board feet per acre in 45 years, both 4,000 and 6,000 used in various analyses
7. Long-term capital gain rate of 15 percent
8. 25 percent marginal tax bracket
9. Up to $10,000 deduction in year of planting based on Reforestation Tax Incentives
10. Discount rate of either 4 or 6 percent used in various analyses

David Mercker

Machine planting black walnut on a prepared site in West Tennessee

Thinning is advised, but may or may not take place depending on markets for smaller-dimension trees. Thinning typically improves profitability by providing an "early" positive cash transaction and improving growing conditions for the residual trees, improving the value of the remaining stand and potentially shortening the time until the next harvest can occur.

Costs. In establishing a plantation of trees, the major costs are site preparation, and buying and planting seedlings. These costs usually range from $90 to $300 per acre. Costs are best estimated by a natural resources professional after examining the site. Annual management costs and property taxes are not considered in this analysis, as they are typically minimal with little effect on the ultimate rate of return. Property taxes are not considered part of the timber analysis, as they will be paid regardless of the selected land use. Forest owners in Tennessee are encouraged to participate in the state use valuation program known as "Greenbelt" to reduce property taxes (Smith 1997).

Land. The cost of land is not included in this analysis. Land alone is typically a profitable investment. Investing in timber production is assumed a separate investment from the land.

Tax Effects. The value of an investment in tree planting is best evaluated after taxes, as the federal tax code has several incentives designed to encourage investment in timber production. Taxpayers investing in planting trees are encouraged to examine the benefits of Reforestation Tax Incentives where reforestation costs (site preparation, purchasing and planting seedlings) up to $10,000 per year are tax deductible. Analyses in this publication assume that establishment costs for the taxpayer are less than $10,000 and are therefore deducted in the year the trees are planted.

Expenditures of more than $10,000 per year qualify for an 84-month amortization and are not covered as part of this analysis.

A distinct advantage of a forestry investment is that profits qualify for capital gains treatment. Under present law (2006), the maximum long-term capital gains tax rate of 15 percent applies for taxpayers in marginal brackets above 14.5 percent (taxpayers in the 14.5 percent bracket or less pay 5 percent on long-term capital gains. Analyses in this publication assume the taxpayer is in the 25 percent marginal tax bracket and timber income is taxed as a long-term capital gain at 15 percent.

Decision Criteria

Analyses using WinYield generated several common financial decision criteria that are used in the following tables and graphs. Each of these criteria requires the selection of a "discount rate," sometimes referred to as a capitalization "cap rate." This rate is the price of money, i.e., the minimum expected rate of return. Selecting a discount rate always generates a variety of comments and is often unique to each decision-maker. A common reference for a long-term rate is the 30-year Treasury bond (T-bond) posted daily by the U.S. federal government. Note that the T-bond, however, is guaranteed, where a hardwood plantation may be subject to limited but greater risk.

With the appropriate cap rate and projected net income, we can obtain an indication of value.

Net Present Value (NPV) is defined as the present value of expected future returns minus the present value of expected future costs, with costs and revenues discounted at the selected discount rate. Investments with a positive NPV should be accepted. A negative NPV should be rejected. When choosing between two investment opportunities, the one with higher NPV should be chosen. NPV is the

estimate of value generated using the income capitalization approach to appraisal.

Internal Rate of Return (IRR) is the rate that balances the present value of the income and costs. It is the interest rate at which the NPV is zero. The idea is to accept investments having an IRR greater than the minimum acceptable rate of return while rejecting those that do not. When ranking opportunities, the higher IRR is preferred.

Annual Equivalent (AE) combines all costs and returns into a single annual sum that is equivalent to all cash flows during an analysis period, spread uniformly over the period. It can be viewed as the amount of an annual payment that will just pay off the NPV during the life of the stand of trees. AE is useful when comparing investments that yield periodic incomes, such as trees, with those that yield annual income, such as livestock or annual crops. AE is similar to an installment payment formula. It is important to understand that the annual equivalent is steady, while annual incomes from other enterprises may make more money in some years and lose money in others. Options with high annual equivalents are more valuable than those with lower AE.

Investment Examples

The following tables and graphs are presented to display estimated values and show relationships among the factors that influence the financial profitability of establishing hardwood plantations.

Figure 1 demonstrates the general effects of increasing establishment costs associated with tree planting on net present value using the following assumptions.

- Yield of 4,000 board feet/acre
- 45-year rotation
- Present stumpage value of $175/MBF
- 3% inflation rate per year
- 4% discount rate
- 15% long-term capital gains rate

Table 1 shows a similar trend with establishment costs using a 6 percent discount rate increasing expected yield to 6,000 board feet per acre in 45 years and assuming current stumpage value ($175/MBF) inflated at 3 percent.

As a general rule, the more it costs to establish a plantation, the lower the financial profitability. This is assuming that these costs do not improve the expected yield. There is a minimum establishment cost (investment) for each planting site to achieve success. Some sites will require higher establishment costs than others to be successful.

Cost-sharing can be used to double the amount invested. Table 1 could be used to consider "out-of-pocket" rate of return while actually spending more, which could (theoretically) improve yield. With 50 percent cost sharing, the landowner could spend $180/acre and still achieve the $90/acre rate of return for his or her out-of-pocket cost.

The difference in the values between the calculations in Figure 1 and in Table 1 is that the discount

Table 1. Net present value (NPV), internal rate of return (IRR) and annual equivalent (AE) investments at various establishment costs after 45 years.

Establishment Costs ($/acre)	NPV ($/acre)	IRR (%)	AE ($/acre/year)
$90	$398.14	9.09	$20.78
130	368.14	8.19	19.22
175	334.39	7.48	17.46
225	296.89	6.88	15.50
275	259.39	6.41	13.54

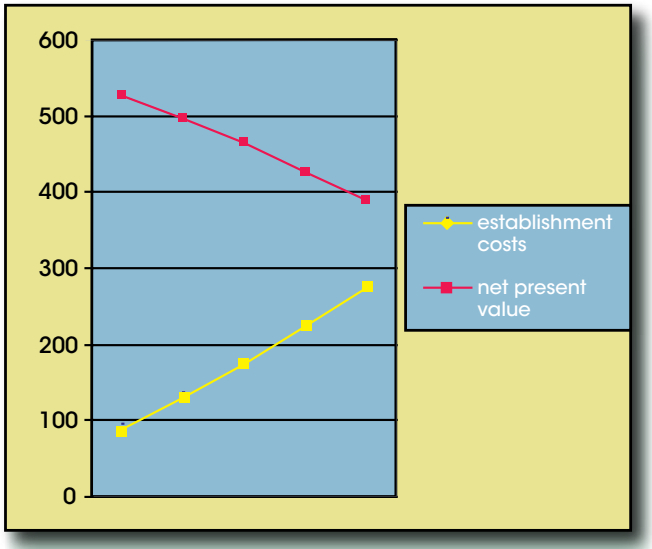


Figure 1. Relationship of establishment costs on the net present value of tree planting.

rate was increased from 4 percent to 6 percent and the yield was increased from 4,000 board feet per acre to 6,000 board feet per acre. The increase in yield did not compensate for the "strong" effect of discount rate on the financial profitability of the plantation.

Table 2 demonstrates the effect of discount rate on profitability. Assumptions are a current stumpage value of $175/MBF inflated at 3 percent and establishment costs of $90/acre. Yield is assumed to be 4,000 board feet per acre at 45 years.

Figure 2 illustrates the NPV from Table 2 in chart form to indicate the effects of discount/cap rate on a tree-planting investment.

Investors in timberland generally expect returns or discount rates of between 6 and 8 percent. In May 2006, 30-year U.S. T-bonds were paying 5.1 percent. Considering the T-bond rate is guaranteed at a fixed rate, the discount rate of 6 to 8 percent is reasonable allowing for the additional risk associated with hardwood plantings. A range of discount rates are presented in Figure 2 to show the relationships with NPV.

It is important that a "good" market will exist for the trees to be planted. Current demand and price are the best indicators of relative value. Investment in tree planting is more valuable in areas with active timber markets. Higher-valued species should be planted if planting sites are suitable.

Table 3 demonstrates that profitability increases as current prices increase. The discount rate is 6

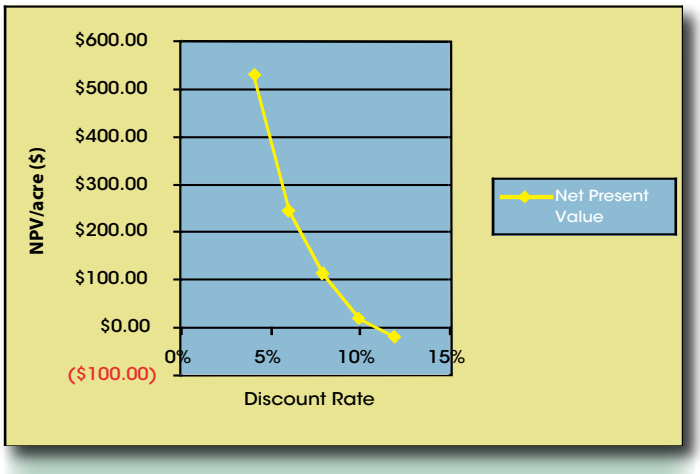


Figure 2. Net present value (NPV) at various discount rates.

Table 2. Net present value (NPV), internal rate of return (IRR) and annual equivalent (AE) investments at various discount rates after 45 years.

Discount rate	NPV ($/acre)	IRR (%)	Annual Equivalent ($/acre/year)
4%	$527.50	8.09	$21.50/ac/yr
6%	242.93	8.09	12.68
8%	110.47	8.09	6.96 Before tax is negative
10%	19.36	8.09	-1.51 Before tax is negative
12%	-20.94	8.09	-1.92 Before tax is negative

Table 3. Net present value (NPV), internal rate of return (IRR) and annual equivalent (AE) investments at various stumpage prices after 45 years.

$/MBF	NPV ($/acre)	IRR (%)	Annual Equivalent ($/acre/year)
$175	$398.14	9.09%	$20.78
225	531.18	9.69	27.73
275	664.22	10.18	34.67
325	797.26	10.60	41.62

Table 4. Net present value (NPV), internal rate of return (IRR) and annual equivalent (AE) investments at various yield rates after 45 years.

Yield (bd ft/acre)	NPV ($/acre)	IRR (%)	AE ($/acre/year)
4,000	$242.93	8.09%	$12.68
6,000	398.14	9.09	20.78
8,000	553.35	9.79	28.89
10,000	708.57	10.33	36.99
12,000	863.78	10.79	45.00

percent. Current prices are inflated at a rate of 3 percent annually. The assumption is a $90 per-acre establishment cost and a yield of 6,000 board feet per acre at age 45 years.

Yield is a time-honored and reliable indicator of the profitability of any agricultural pursuit. Growing trees is no exception. Table 4 demonstrates the effect on profitability of improved yield at 45 years. Assume a 6 percent discount rate and current stumpage of $175/MBF inflated at 3 percent annually, and $90/acre establishment cost. Trees planted on better sites will be more profitable than those planted on less productive sites.

Hardwood species are extremely variable in their form and growth rates. These characteristics are also very sensitive to growing conditions. Planting the right tree for the site is important. Initial spacing and weed control at establishment will also influence yield. The range of yields presented in Table 4 is common for natural hardwood stands in Tennessee and Kentucky. A local forester can help determine a probable future yield for a specific planting site(s).

Summary

This publication has discussed factors commonly used to determine financial profitability of hardwood plantations. The variety of assumptions affecting the financial profitability of investments in hardwood tree planting render the process unique to the facts and circumstances of each individual planting situation.

In general,

- Higher discount rates reduce financial profitability,
- Excessive establishment costs can reduce profitability,
- More valuable species in good markets increase profitability,
- Higher yields from better sites and species increase profitability.

References

Gunter, John E. and Harry L. Haney, Jr. 1984. Essentials of Forestry Investment Analysis. Oregon State Publishing, Corvallis, OR.

Hepp, T. 1996. WINYIELD, Version 1.11, Timber Yield Forecasting and Planning Tool. Tennessee Valley Authority, Norris, TN.

Kessler, George D. and Jack B. Cody. 1982. Forestry as an Investment, How to Compare Pine Trees to Other Investments. Circular 600, Clemson University Cooperative Extension Service, Clemson, SC.

Sizemore and Sizemore, Inc. 2000. Forest Appraisal, What's It Worth? Student Handbook, course, ENV 258, Duke University, Nicholas School of Environment, Durham, NC.

Smith, G.F. 1997. The Agricultural, Forestry and Open Space Land Act (Or "The Greenbelt Law"). University of Tennessee, Institute of Agriculture, Agricultural Extension Service, Dept. of Agricultural Economics and Rural Development, AE&RD No. 74. (http://economics.ag.utk.edu/pubs/policy/greenbelt.pdf).

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Successive annual plantings of cottonwood, current year and 2-years-old.

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