Changes in the Rate of Return Caused by Increased Cost of Red Pine Nursery Stock in Wisconsin

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The rate of return was compared between six costs of red pine (Pinus resinosa Ait.) *2 + 0 seedlings and three rotation lengths. An increase of $100 per thousand seedlings causes the real rate of return before taxes to drop almost 1% for a 40-year rotation and more than 0.5% for a 95-year rotation.* Tree Planters' Notes 40(1):11-14: 1989.

Trees produced by the State-operated nurseries in Wisconsin are sold for the cost of producing the trees with no additional margin added for profit, risk, insurance, or other charges normally added by private tree nurseries. Low-cost trees offer an economic incentive to encourage reforestation projects. As with any investment made where, capital resources are committed for the long term, such as real estate or business ventures, the initial capital cost of the investment influences the potential earning power and income produced for the investor.

This condition also holds true for investments in growing timber. A small change in the initial cost of establishing a pine plantation, for example, can have important impacts on the economic attractiveness of this investment as well as force adjustments to the forest management practices planned for this plantation. The size of these impacts depends on many factors.

This paper examines the economic impacts to an investment in a red pine *(Pinus resinosa* Ait.) plantation in Wisconsin that result from an increase in the cost of planting stock. This impact would be comparable to a situation where tree costs were held constant but other initial establishment costs were increased a similar amount. For simplicity, only red pine is considered here, but similar trends would occur with other species.

In Wisconsin, nursery trees for reforestation are grown by three State-owned nurseries, as well as by several forest products companies and many private tree nurseries. Both public and private forest landowners purchase trees from the State nurseries for reforestation. In 1987, the State-owned nurseries sold 19.1 million trees and shrubs. Orders for red pine seedlings accounted for 11.6 million of this total.

Analysis of the Investment

There are several investment criteria that can be used to evaluate the effect of changes in the price of planting stock on a forest investment. Probably one of the easiest criteria to understand is the rate *of return on investment,* also called the *internal rate of return.* Simply stated, the rate of return is the annual percentage rate at which an investment grows towards the income it eventually generates. All income earned by this investment is measured against all costs, and an annual rate of return is calculated for the term. Most people understand the concept of rate of return, because many other forms of investments, such as passbook savings, money market funds, and IRA accounts, are measured or expressed as a percentage rate. Rate of return also allows easier comparisons between forest investments with different rotation lengths or against other non-forestry-related investments.

WORTH (a forest investment analysis program written for IBM PC's, XT's, AT's, and other compatible computers) was used to calculate the rate of return for the options considered in this analysis *(2)*. All values were calculated and listed as before income taxes, both Federal and State. All costs, yields, and incomes for this analysis were made on a per-acre basis.

This analysis examines a typical red pine investment for Wisconsin. A private or industrial landowner elects to establish a red pine plantation on a

site with an estimated site index of 65 (50 years). The prescribed planting spacing is 6 by 8 feet, or approximately 900 trees/acre. This example assumes that the land has been entered under Wisconsin's Managed Forest Law, which offers property tax relief to forest landowners enrolled in the program. Over the enrollment period of 25 or 50 years, the landowner must follow a mandatory management plan, pay a 5% severance tax on the value of stumpage cut, and pay an annual property tax currently set at $0.74/acre.

The following investment schedule was used in our analysis:

- Site preparation costs = $75.00/acre.
- 2 + 0 planting stock (900 trees/acre at $36.00/thousand) = $32.40/acre.
- Hand planting or machine planting charge = $40.00/acre.
- Control of brush competition (fifth year) = $50.00/acre.
- Annual administrative costs =$1.00/acre/year.
- Annual Managed Forest Law taxes = $0.74/acre/year.

Three different rotation lengths are considered here: 40 years, 60 years, and 95 years. The shorter lengths are included because some landowners are considering shorter rotations than generally prescribed. Yields for these different rotation lengths are listed in table 1.

Table 1—*Estimated volume yields for a Wisconsin red pine plantation with a site index of 65 for rotation lengths of 40, 60, and 95 years*

	40-yr rotation		60-yr rotation		95-yr rotation	
Stand age (yr)	cords	thousand bd ft	cords	thousand bd ft	cords	thousand bd ft
30	11.0	—	11.0	—	11.0	—
40	25.0	.25	8.0	—	8.0	—
50			8.0	—	8.0	—
60			2.5	12.5	1.5	3.0
70					1.5	3.0
80					—	3.0
90					2.0	18.0

Yields are based on a site index 65 with an initial survival of 800 trees/acre. At the first thinning (age 30) trees in every other row are harvested. All later harvests are selective thinnings, leaving 100 ft^2/acre of basal area except for the last cutting, when all merchantable timber is harvested.

TWIGS (the woodsman's ideal growth projection system) was used to project future yields. Stand information from a 22--year-old red pine plantation on the Washburn County Forest in Wisconsin was used as the basis for this TWIGS projection *(3)*. TWIGS 3.0 is a distance-independent, individual tree growth model designed for use on personal computers. Stands can be grown under selected management options to project stand conditions in the future.

Future revenues from harvests are estimated using the following stumpage values: $12.00/cord for first thinnings, $16.00/cord for second and later thinnings, and $52.00/thousand board feet for all sawtimber. The effects of inflation on stumpage prices were ignored, because discounting back to the present would cancel out future increases caused by inflation. A 5% yield tax against all income from stumpage reduced income received by the landowner participating in MFL program.

As of 1988, the cost per thousand trees for 2 + 0 red pine purchased from the State of Wisconsin for reforestation is $36.00 per thousand for bulk orders. Five higher prices, $50, $100, $136, $150, and $200 per thousand were tested to show the impact on the rate of return if higher prices were charged for planting stock.

This analysis focuses on the change in the rate of return before income taxes to landowners assuming they do not alter any other factor in management of their plantations. Other options not examined here that offer logical choices for landowners to recapture income lost to higher tree costs include rais-

ing the minimum acceptable stumpage prices to achieve the same rate of return as before the increased tree cost. Landowners could also elect to plant fewer trees per acre, plant improved or hybrid stock, reduce other site preparation costs, change harvest schedules, or alter other practices to offset the higher cost of planting stock.

Table 2 shows the estimated rates of return for the three rotation lengths and six tree costs. Under the assumptions used here and using 1988 tree prices, forest landowners can expect to earn between 2.09% and 2.94% real rate of return, depending on the rotation period they chose. As the cost for trees increases, the rate of return drops. Under a 40-year rotation, an increase of $100 per thousand seedlings in costs reduces the rate of return by almost 1% (0.96%). The same increase causes the rate of return for a 60-year rotation to drop 0.73% and for a 95-year rotation to decrease 0.58%. Even small increases in the cost for planting stock cause important changes in the rate of return earned by an investment in a red pine plantation (fig. 1).

The final impacts of these changes depend on the intentions and size of investment made by each landowner. For a small landowner, a change of 0.5% to 1.0% may not have much impact because personal satisfaction or other goals may

Table 2—*Real rate of return on investment for a Wisconsin red pine plantation with a site index of 65 before income taxes for rotation lengths of 40, 60, and 95 years (rates do not include inflation)*

Cost of 2 + 0 seedlings per thousand	Real rate of return (%)		
	40-yr rotation	60-yr rotation	95-yr rotation
$ 36	2.09	2.90	2.94
$ 50	1.93	2.78	2.84
$100	1.44	2.40	2.54
$136	1.13	2.17	2.36
$150	1.03	2.09	2.30
$200	0.67	1.83	2.09

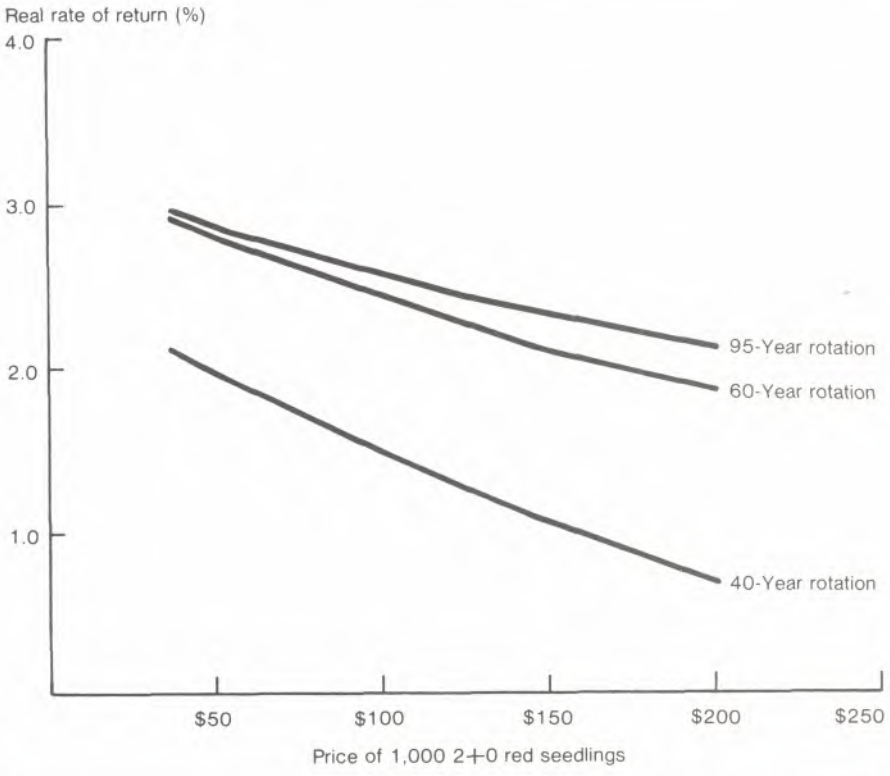

Figure 1—*Real rate of return on investment in a Wisconsin red pine plantation before income taxes.*

offset increased costs. But for other landowners, particularly large industrial or public landowners, where investment capital is borrowed or in short supply, or many acres are involved, a change as small as 0.1% may force changes to the investment or management schedules.

All rates of return shown here represent real rates that do not include any inflation or risk. In recent years, inflation has fluctuated between 2 to 4% annually. A simple way to compare these real rates of return to currently known markets rates is to add the inflation rate to the calculated rate of return. For example, a calculated real rate of return of 2.5% would be comparable to a market rate of 4.5 to 6.5%, which currently reflects rates available to investors in money market funds. These rates may not be acceptable rates for some investors in forest land, particularly the forest products industry, where higher rates can be earned with lower risk. Several reforestation tax incentives (Public Law 96-451; 1980), cost-sharing programs, and other incentives such as the Conservation Reserve Program may help some investors realize a higher rate of return after taxes than shown here.

Conclusion

The price of red pine planting stock influences the real rate of return earned by this investment. Establishment and planting costs occur 20 to 30 years before any income is earned from thinnings. Therefore, any increase in the price of planting stock without compensating increases in faster growth or added volume and no reduction in other establishment costs causes the real rate of return to drop.

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