G3521

Wisconsin Woodlands

A selection of forest investment evaluations

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As a woodland owner you may want to know more about the economic potential of your forest land—perhaps to satisfy your curiosity or to help solve practical problems encountered as you manage your woodlands. In some cases, you may want to verify that the expense of owning and managing land has economic justification beyond the commitment to proper stewardship. Or you may be planning on timber revenues to supplement retirement income or to build an estate for younger relatives or friends. You may be hoping to generate income to support other developments on the land. Or you may be looking for management options that allow the forest land to pay its way or to produce enough income to buy more land. Whatever the circumstances, you will want to rely on investment criteria to help evaluate these management decisions.

The forest investment analyses described in this bulletin show the economic worthiness of several forest investments that are common in the Lake States. We encourage you to use these examples as a guide or model in preparing other evaluations.

You will need to have a basic understanding of compounding and discounting, as well as present net value (PNV) and internal rate of return (IRR), since these calculations are routinely used in this publication. We recommend that you use this publication alongside the Extension bulletin *How to Evaluate Forestry Investments* (G3476), which covers basic investment concepts, including evaluation criteria (PNV and IRR), information collection, and stepwise calculations. It also offers guidance on selecting the interest rate and contains compound interest tables needed in these analyses.

A pocket calculator can handle the PNV calculations, but you will find a computer more useful for IRR calculations.

Some of the examples used here may be similar to your own situation. You may be satisfied with the assumptions and accept the results. Or, with a slight change, you may be able to customize one of the examples to match your situation better. Perhaps none of the examples are appropriate as written. In that case, however, you can still use an example as a pattern or recipe to follow as you prepare your own analysis. In each of the examples shown, review all assumptions before applying any of the conclusions to your own woodlands. Slight differences in assumptions may result in conclusions that are not acceptable to you. All calculations exclude the effects of income taxes. Since tax obligations vary for each individual, income tax considerations will not be covered here. If you are planning a large investment or income-producing decision, a consultation with an accountant or tax specialist is recommended.

The discount factor, shown in each Investment Summary, is $1/(1+i)^n$ for a periodic cost or income, and $[(1 + i)^t - 1]/[i(1+i)^t]$ for a cost or income occurring in each year of the investment period. In these factors i is the discount rate divided by 100, n is the year in the investment period (year 0, 1,.....20, etc.) when a periodic cost or income occurs, and t is the length of the investment period in years. The appropriate factor is then multiplied by the cost or income to obtain the present value of each. (Note: The values for $(1+i)^n$ and $(1+i)^t$ are taken directly from the Appendix A table in *How to Evaluate Forestry Investments* (G3476).

For step-by-step calculations of forest investment evaluations and a detailed explanation, refer to that publication.

Example 1—A young aspen forest

Mr. Anderson owns 20 acres of aspen. Last year, he cut the entire 20 acres, harvesting all aspen and mixed hardwoods to stimulate full aspen resprouting. Since this new aspen stand won't be ready to harvest for another 45 years, Mr. Anderson is now evaluating whether he should continue to own the land or sell it. He wonders whether his investment would increase faster if he sold the land and put the money in a passbook savings account which currently pays 6% (a real rate of 2% when adjusted for 4% inflation). A real rate must be used because the evaluation is made using current prices for future yields. Mr. Anderson estimates that the next aspen harvest will average 20 cords of aspen (at $6/cord) and 5 cords of mixed hardwoods (at $4/cord) per acre at maturity and produce $140/ acre of income. Property taxes on his woodlands average $2.50/acre/ year.

The investment profile for continued forest ownership (and management) is shown in the summary below.

With these assumptions, the rate of return earned by the passbook savings account would accumulate greater value. Continuing to own this young aspen stand for another 45 years would generate a negative present net value, indicating a rate of return less than 2% (6% with inflation). To earn a higher rate of return, Mr. Anderson must either reduce his annual costs (taxes) or increase the income earned by his woodlands. Leasing out the hunting rights to his woodlands for as little as $.55/acre/year would raise the PNV at 2% to $0. At this point his investment would exactly earn his goal of 2% real rate of return (6% with inflation).

At first glance, you might think that land values should be included in the analysis, since in one option Mr. Anderson could sell and reinvest elsewhere. However, the land value would still be in his possession. He would simply convert it to another form—cash. Thus, the value of his land is owned in both cases and therefore can be ignored in the analysis.

Example 2—Northern hardwoods

Sarah Olson owns 40 acres in northern Wisconsin. A consulting forester recently examined her woodlands. Northern hardwoods are the predominant timber type with a good composition of hardwood sawtimber as well as poletimber. Based on the forester's management plan for her property, she knows a selection thinning will be needed in 5 years and approximately every 15 years thereafter. Since property taxes are becoming a burden, Sarah is trying to decide whether to enter her woodlands under Wisconsin's Managed Forest Law (MFL). This law offers a reduced annual property tax but requires mandatory management practices and a 5% yield tax on timber harvested. To help with her decision, she wants to compare the financial worthiness of two options for a 25-year period: A) no change in property tax status; and B) entry under the MFL. Sarah's guiding rate of return is 4% above the current inflation rate.

When making investment decisions past management activities and costs are usually ignored. The analyses and Sarah's decision will be based on predicted future events only and will not evaluate an entire rotation. The stand is growing well and has some trees more than 90 years old. The "year of occurrence" in the calculation summaries are not years from seed but represent years from today, the time of the decision.

Option A

Sarah's woodlands maintain the same property tax status as before and she continues to pay $4/acre annually. In five years a selection thinning will be made harvesting 1500 board feet (1.5 MBF) of hardwood sawtimber (worth $80/MBF) and 8 cords of pulpwood (worth $5/cord) per acre. The consulting forester's fee for preparing and administering the timber sale is 20% of the stumpage income. A similar harvest will occur 15 years after the first.

Option B

This option uses the same management schedule as above except that annual property taxes decrease from $4/acre to $.74/acre and a 5% yield tax is deducted from the stumpage income.

In this comparison, entering her woodlands under the MFL program would have a positive impact on Sarah's forestry investment. Income diverted from paying annual property taxes in Option A now adds to the present value in Option B.

Investment calculation summary: Example 1—Aspen

Year of occurrence	Activity	Costs/income per acre	Discount factor (2%)	Present value per acre
0-45	Property taxes	-$2.50/year	29.4902	-$73.73
45	Harvest	140.00	0.4102	57.43

Present net value at 2% is -$16.30/acre

Option B earns a present net value $40.70 larger than Option A. In each case, the PNV is positive, indicating that both real rates of return for these options exceed Sarah's goal of earning at least 4% annually. If Sarah is satisfied with the assumptions used in each option, she should choose the plan outlined by Option B since it offers a larger PNV and IRR.

In this example, the IRR is in fact very high, exceeding 50%. This often happens in marginal analyses of forestry activities because all investment costs are not included. In general, most costs occur in early years and incomes follow later on. If you ignore the early years, you will have an artificially high rate of return that probably should not be used for comparing investments. The situation is similar to the extreme case of computing an IRR when you sell something received as a gift—you have income, but no cost or investment to recoup.

This example also points to the importance of incomes early in the investment period. Note that the estimated value of the timber sale income in year 5 and year 20 is the same but the present value of each is substantially different ($131.50 and $73.02, respectively). The earlier thinning has a larger present value because it is discounted over fewer years and the wait to receive the income is shorter. Longer discount periods lead to reduced present values.

Computations in this example could be simplified somewhat by ignoring all costs and returns that are common to both options. This would leave only the property and yield tax items; however, the PNV results would be identical. The items were retained to illustrate how the yield tax values were determined. In general, the rule-of-thumb is to consider only the differences among alternatives; items in common can usually be ignored.

Investment calculation summary: Example 2—Northern hardwoods (Option A)

Year of occurrence	Activity	Costs/income per acre	Discount factor (4%)	Present value per acre
0-25	Property taxes	-$ 4.00/year	15.6220	-$62.49
5	Timber sale income	l60.00	0.8219	131.50
5	Consultant's fee	-32.00	0.8219	-26.30
5	Road repair and seeding	-10.00	0.8219	-8.22
20	Timber sale income	160.00	0.4564	73.02
20	Consultant's fee	-32.00	0.4564	-14.60
20	Road repair and seeding	-10.00	0.4564	-4.56

Present net value at 4% is $88.35/acre

Investment calculation summary: Example 2—Northern hardwoods (Option B)

Year of occurrence	Activity	Costs/income per acre	Discount factor (4%)	Present value per acre
0-25	Taxes under MFL	-$.74/YR	15.6220	-$11.56
5	Timber sale income	160.00	0.8219	131.50
5	MFL yield tax 5%	-8.00	0.8219	-6.58
5	Consultant's fee	-32.00	0.8219	-26.30
5	Road repair and seeding	-10.00	0.8219	-8.22
20	Timber sale income	160.00	0.4564	73.02
20	MFL yield tax 5%	-8.00	0.4564	-3.65
20	Consultant's fee	-32.00	0.4564	-14.60
20	Road repair and seeding	-10.00	0.4564	-4.56

Present net value at 4% is $129.05/acre

Example 3—Christmas tree production

Christmas tree production takes commitment, time, labor and financial resources. Jim and Lois have three young boys who could provide the labor to culture the trees but they are not sure they can afford the initial investment. Before talking to the bank about a loan, Jim wants to test on paper the financial worthiness of growing Christmas trees.

He particularly wants to know if he can afford to borrow funds to grow the trees. In his analysis he chooses to use a real interest rate of 15%, large enough to retire his loan and allow a margin for risk.

Jim plans to plant a variety of Scotch pine suitable for his area and use a 10-year rotation length. He estimates annual taxes and overhead costs at $75/acre. Site preparation, nursery stock, and planting costs amount to $410/acre. Annual weed, fungus and insect control is expected to total $30/acre/year. Shearing costs will start in the 4th year and continue through the 9th year. Jim plans to plant 1200 trees/acre and hopes for 85% survival through the end of the 4th growing season. He'll harvest 140 trees/acre in year 8; 275 trees/acre in year 9; and 505 trees/acre in the last year. Approximately 100 trees/acre will be unsuitable for sale. Prices for 6-8' trees standing in the field (stumpage) range from $6-$10/tree, so Jim uses an average price of $8/tree to estimate income from selling Christmas tree stumpage. Jim wants to know if the PNV of his management plan is positive and if the IRR will be greater than 15%. Therefore, he prepares the following investment summary.

In this example, the Christmas tree operation earns a real rate of return greater than 15% since the PNV is positive. The PNV of $914.81 also indicates that Jim's costs in year 0 could increase by as much as $914.81/acre and he still would earn at least 15% real rate of return. Perhaps he could buy more land or spend more for better site preparation or older nursery stock. Some unexpected costs also could be covered.

This is a good opportunity to show how Jim can test the sensitivity of one of his assumptions. This is done by changing one variable in the analysis, holding all other assumptions the same, and observing what happens to the PNV. For example, Jim is uncertain about using an average stumpage price of $8/tree. Jim determined that the PNV at 15% fell to $0/acre when the average stumpage price was reduced to $4.32/tree. This indicates that if the price of sheared trees dropped from $8 to $4.32/tree and all else remained the same, he would earn a 15% real rate of return. Other factors could also be changed to test their impacts. The IRR can be estimated this way by changing only the discount factor until the PNV equals $0/acre. At that point, the discount rate equals the IRR. In the original example, the IRR is approximately 26% annually.

Investment calculation summary: Example 3—Christmas tree production

Year of occurrence	Activity	Costs/income per acre	Discount factor (15%)	Present value per acre
0-10	Annual taxes and overhead costs	-$75.00	5.0188	-$376.41
0	Site prep, trees and planting costs	-410.00	1.0000	-410.00
0-10	Weed, fungus and insect control	-30.00	5.0188	-150.56
4	Shearing costs	-40.00	0.5718	-22.87
5	Shearing costs	-50.00	0.4972	-24.86
6	Shearing costs	-60.00	0.4323	-25.94
7	Shearing costs	-70.00	0.3759	-26.31
8	Shearing costs	-70.00	0.3269	-22.88
9	Shearing costs	-55.00	0.2843	-15.64
8	Stumpage sales	1120.00	0.3269	366.13
9	Stumpage sales	2200.00	0.2843	625.46
10	Stumpage sales	4040.00	0.2472	998.69

Net present value at 15% is $914.81/acre

Example 4—Red pine rotation analysis

The Great Lakes Pulp and Paper Corporation is reevaluating the company's policy on rotation lengths of recently planted red pine stands. The company has narrowed its options to two rotation lengths—40 years or 60 years. The company now wants to consider the financial difference between the two. In both cases, the cost to prepare the site and then purchase and plant the trees amounts to $125/acre. A brush control operation ($50/acre) will occur in the fifth year. Annual administrative costs, overhead and taxes average $3/acre/year. Stumpage values for red pine are estimated at $12/cord for the first two thinnings of pulpwood, $18/cord thereafter, and $55/MBF for sawtimber. The company aims for a 10% rate of return before taxes from its forest lands operations (10% minus 4% inflation = 6% real rate of return).

The 40-year rotation is expected to yield 12 cords/acre at age 30. At age 40, the company expects 35 cords of pulpwood and 500 board feet of sawtimber per acre.

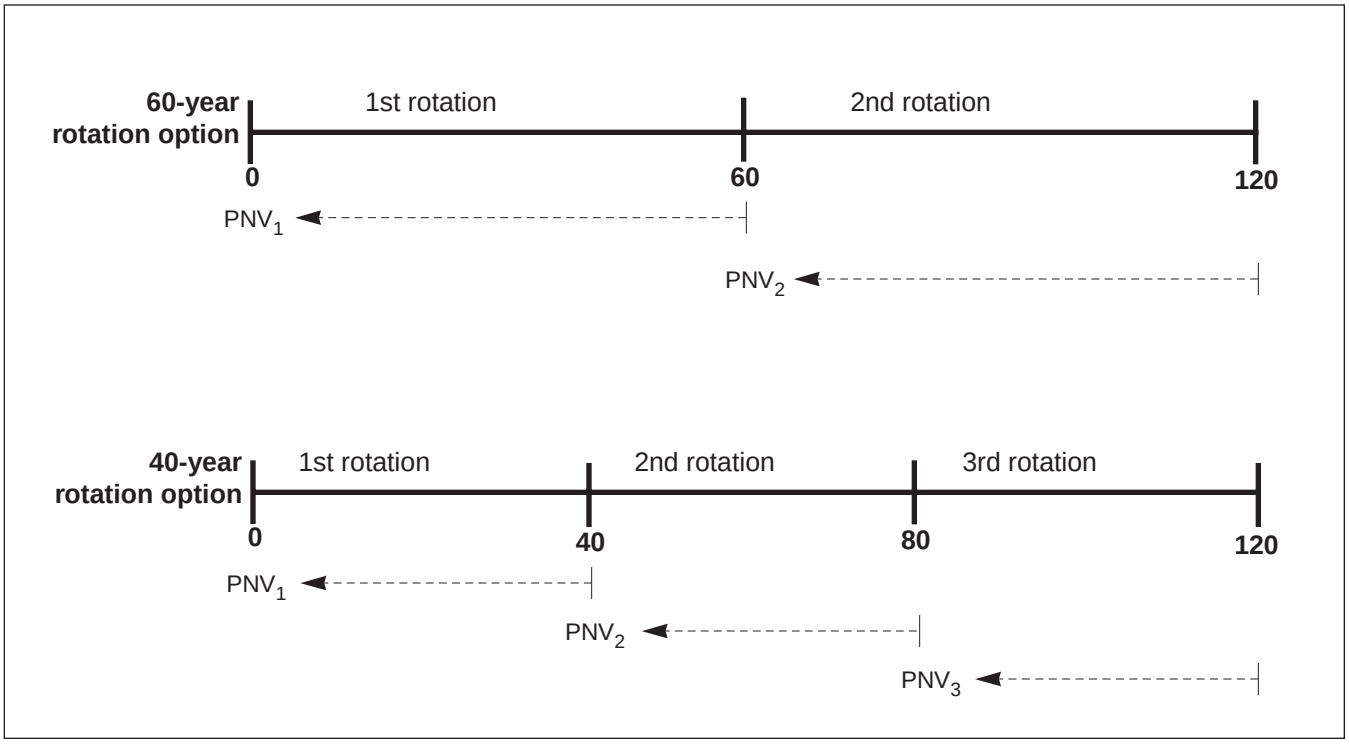
The 60-year rotation schedule produces 12 cords/acre at age 30; 15 cords/acre at age 40; 12 cords of pulpwood and 1,000 board feet of sawtimber per acre at age 50; and 10 cords and 15,000 board feet per acre at age 60.

These two different rotation lengths can be compared by examining two 120-year time periods: three 40-year rotation periods for the first option and two 60-year rotation periods for the second option (figure 1). For valid comparisons investments should always reflect the same time period. *How to Evaluate Forestry Investments* (G3476) explains in greater detail why these extra periods are needed in this type of comparison.

Under the assumptions used here, neither rotation period earned 6% real rate of return before taxes since both PNV's were negative (IRR's were between 3-4%). But if the company based their decision strictly on the results shown here, comparing the PNV at 6% for both rotations over equal 120-year periods, the 60-year rotation is slightly better. In practical terms, since the difference between the two is small ($4.39/acre), other factors should be included in the evaluation before selecting a rotation period.

This example also shows the relatively low present value of future rotations. The second and third rotations are worth only a small fraction of the first rotation, demonstrating the higher value associated with incomes closer to the present.

Figure 1. Graphical comparison of the two rotation options in Example 4 over 120-year period.



Investment calculation summary: Example 4—Red pine (40-year rotation)

Year of occurrence	Activity	Costs/income per acre	Discount factor (6%)	Present value per acre
0-40	Annual taxes and overhead	-$3.00	15.0643	-$45.19
0	Site prep, trees and planting costs	-125.00	1.0000	-125.00
5	Brush control	-50.00	0.7473	-37.37
30	1st thinning	144.00	0.1741	25.07
40	Final harvest	657.50	0.0972	63.91
			Present net value at 6% is	-$118.58/acre
	Present net value of 2nd rotation discounted 40 years to year 0	-$118.58	0.0972	-$11.53/acre
	Present net value of 3rd rotation discounted 80 years to year 0	-118.58	0.0095	-$1.13/acre
			Present net value at 6% for 120-year period is	-$131.24/acre

Investment calculation summary: Example 4—Red pine (60-year rotation)

Year of occurrence	Activity	Costs/income per acre	Discount factor (6%)	Present value per acre
0-60	Annual taxes and overhead	-$3.00	16.1614	-$48.48
0	Site prep, trees and planting costs	-125.00	1.0000	-125.00
5	Brush control	-50.00	0.7473	-37.37
30	1st thinning	144.00	0.1741	25.07
40	2nd thinning	180.00	0.0972	17.50
50	3rd thinning	271.00	0.0543	14.71
60	Final harvest	1,005.00	0.0303	30.45
			Present net value at 6% is	-$123.12/acre
	Present net value of 2nd rotation discounted 60 years to year 0	-$123.12	0.0303	-$3.73/acre
			Present net value at 6% for 120-year period is	-$126.85/acre

Example 5—Red oak

Since red oak has value both as a source of quality sawtimber and wildlife habitat, Chris Winther plans to continue managing his 20-acre woodlot for red oak. Due to the advanced age of the oak on this woodlot, he recently had a timber sale and sold all the standing timber. The sale was completed this past winter.

To reduce competition from brush and other tree species, Chris treated the stand with herbicide last growing season, prior to the harvest. That treatment cost $40/acre. There was a good acorn crop last fall and he hopes some natural oak regeneration will occur. But to insure adequate stocking of red oak Chris plans to hand plant 750 red oak seedlings per acre this spring at a cost of $180/acre. Cost sharing of 65% is available for the site preparation and planting (Chris will pay the other 35%). His other costs include annual taxes and overhead of $6/acre and a timber stand improvement in 20 years. He thinks the rotation period for this next stand will be 90 years.

Current stumpage prices for oak average $160/MBF for sawtimber and $6/cord for firewood. Stumpage prices for oak sawtimber have been increasing faster than inflation, so he projects future sawtimber stumpage prices to increase 1%/year (in real terms) throughout the next rotation. Thinnings will begin in year 40 and continue every 10 years until final harvest at age 90. Yields per acre are estimated to be: 2.3 cords at 40 years; 4.0 cords and 200 board feet at 50 years; 3.6 cords and 280 board feet at 60 years; 3.7 cords and 710 board feet at 70 years; 4.0 cords and 1050 board feet at 80 years; and 30.6 cords and 12,340 board feet at 90 years. Chris wonders, "Can I earn a 4% real rate of return on this investment?"

Before completing the investment summary shown below, Chris had to first project future sawtimber stumpage prices using his assumption of 1% increase per year. He did this by applying the present value formula with 1% compound interest to the base price of $160/MBF for each harvest occurrence. For example, the sawtimber stumpage price in year 90 was calculated as follows:

$(1 + .01)^{90}$ x $160 = 2.4486 x 160 = $391.78/MBF

Note that 1% was divided by 100 (= .01) before the formula was used. Then the final harvest return was estimated as follows:

$391.78 x 12.34 MBF + $6.00 x 30.6 cords = $50l8.l7

If Chris's assumptions hold true, he will nearly earn his goal of 4% real rate of return annually before income taxes (the estimated IRR is 3.9%). The biggest obstacles he faces are the costs early in the rotation period and the long wait for income.

Another consideration is the assumption that oak sawtimber stumpage will increase 1% annually above the rate of inflation over 90 years. If sawtimber prices increase faster than this rate (as they have in some locations during recent years), the PNV and IRR will be higher. The opposite also holds.

This example also points to the economic advantage of developing a cost effective method to regenerate red oak. Reducing these early costs will make the effort and time to grow oak more attractive.

Investment calculation summary: Example 5—Red oak

Year of occurrence	Activity	Costs/income per acre	Discount factor (4%)	Present value per acre
-1	Brush control (35%)	-$14.00	1.0400	-$14.56
0-90	Annual taxes and overhead	-6.00/YR	24.2673	-145.60
0	Planting stock and labor (35%)	-63.00	1.0000	-63.00
20	Timber stand improvement (35%)	-8.75	0.4564	-3.99
40	1st thinning	13.80	0.2083	2.87
50	2nd thinning	76.63	0.1407	10.78
60	3rd thinning	102.99	0.0951	9.79
70	4th thinning	250.17	0.0642	16.06
80	5th thinning	396.40	0.0434	17.20
90	Final harvest	5018.17	0.0293	147.03

Present net value at 4% is -$23.42/acre

Summary

The examples used here reflect a narrow glimpse of the analyses that can be made. Forest management in the Lake States is dynamic and will continue so as markets change and demands on the resource intensify. We hope this bulletin helps you become more knowledgeable about management decisions on your woodlands. These analyses are just one of many guides to assist you in managing your forest land. If your ownership goals are not driven by financial justifications, PNV and IRR won't be applicable. But if financial goals are relevant to your management, periodic review and analysis may be useful.

One of our examples may be similar to your situation, but most likely you'll have somewhat different conditions. If you want specific estimates for your property, you'll need to write down your assumptions, collect appropriate cost and revenue estimates, and make your own calculations. However, if you want to learn more about forestry investment possibilities in the Lake States, these examples should provide a representative cross-section.

This bulletin does not provide guides or tables to estimate yields from harvesting activities nor cost or value estimates. Your forester can provide you with guidelines for local conditions or refer you to other sources of information. Published reports and computer growth models are also available through the USDA Forest Service, North Central Forest Experiment Station, 1992 Folwell Avenue, St. Paul, Minnesota 55108.

Today's best assumptions (predictions) may not match existing conditions when a future decision must be made. But when used as a guide in making investment decisions, investment analysis in forest management can add a tangible criteria that we all understand: How much will I earn or how much will I lose?

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