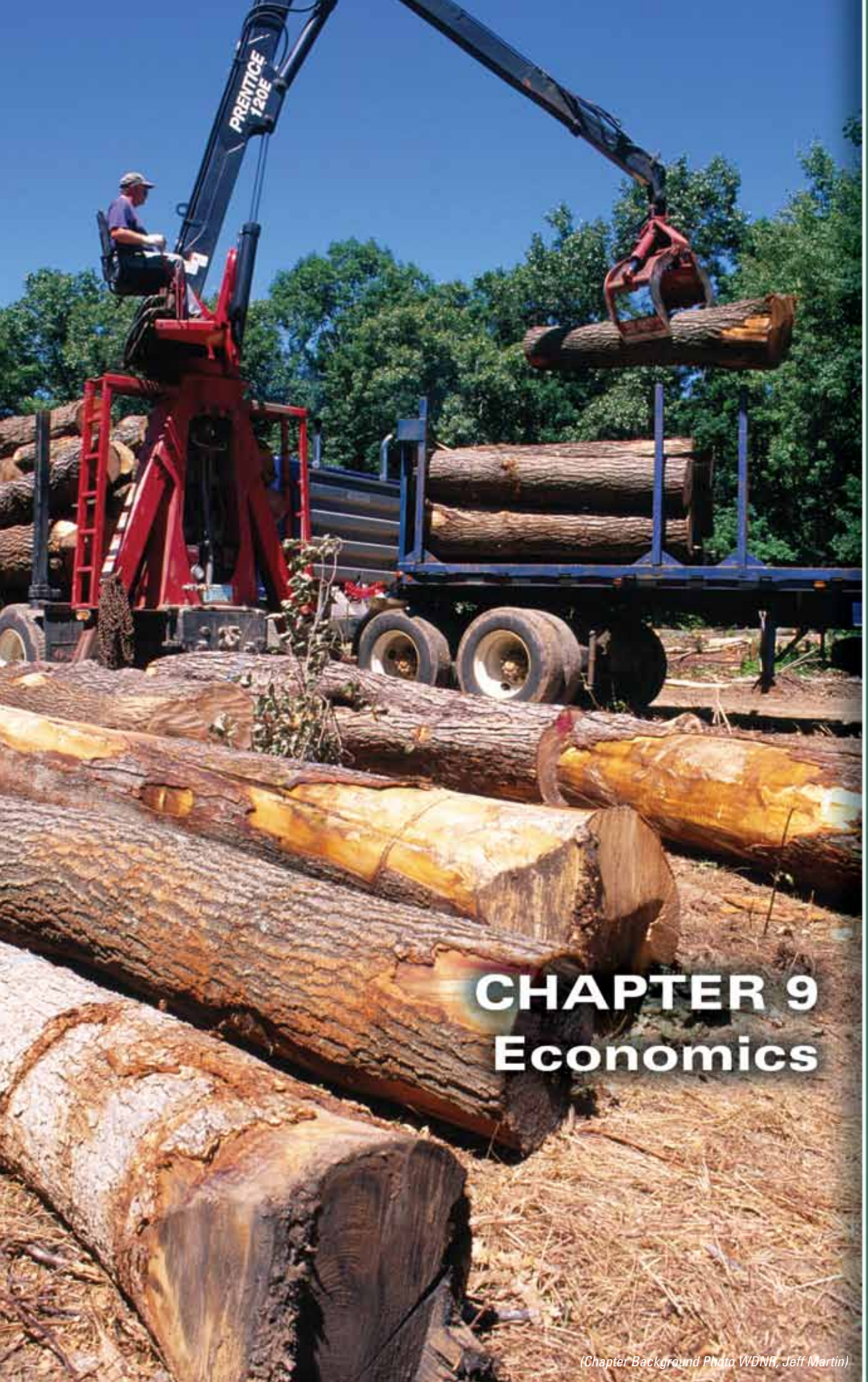


9

CHAPTER 9
Economics

(Chapter Background Photo WDNR, Jeff Martin)

CHAPTER 9
ECONOMICS

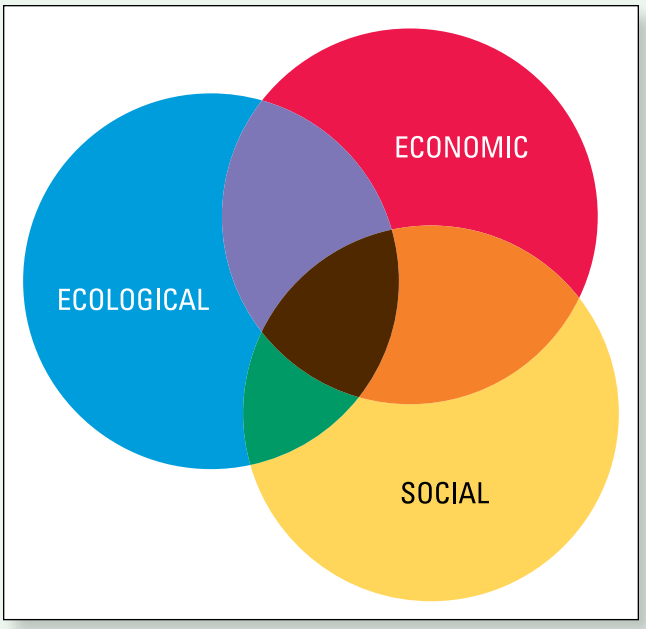


Figure 9-1: Sustainable forestry is based on the three pillars of ecological, economic, and social sustainability. All three must be met for practices to be truly sustainable.

A COUPLE WORDS OF CAUTION

First, when investing in financial markets, most people combine their own research with the advice of a broker or financial planner before making an investment decision. In a similar vein, landowners can usually benefit from the information and assistance of a professional forester, when making decisions about how to manage their forests.

Second, "economic" arguments are sometimes presented as justification for engaging in unsustainable forestry practices, such as high grading, that "takes the best and leaves the rest." Not all management that is financially attractive is sustainable, and not all practices that maximize forest growth are necessarily good financial investments (see Figure 9-1). Many practices will cost money, either out-of-pocket, or in the form of reduced income. Forest management is a lot like maintaining an automobile – you can skimp on routine maintenance to save a few dollars in the short run, but you usually pay for it later with more expensive repair bills!

Figure 9-2: Large, high quality trees, such as this walnut, have a very high value. However, the time required to reach this size should also be considered by the wise investor.

About 360,000 Wisconsinites own forestland, mostly for its recreational and aesthetic values. While producing timber or managing the forest as an investment are not the primary reasons most people own forestland, landowners are sensitive to what it costs them, and at some point, they usually have an opportunity to realize income from their forest. Like everyone else, forest landowners also invest in stocks, bonds or mutual funds. Yet all too often, forestry investments are not scrutinized as critically as other financial investments. As a result, forestry investments capable of generating a favorable rate of return are not recognized, or conversely, investments are made that are sometimes not justified financially. Just as forestry involves good stewardship of natural resources so, too, sound financial management requires careful stewardship of investment capital. This chapter provides an overview of the basic principles and methods of investment analysis, and a number of tips on how to help maximize the returns from your forestry investments.

BALANCING ECONOMIC CONSIDERATIONS AND OTHER FOREST VALUES

Figure 9-3: Harvesting on steep terrain affects both skidding and road construction costs. In addition, extensive measures (BMPs) are needed to prevent soil erosion. This translates into higher logging costs which mean lower stumpage returns to the landowner.

There are many benefits from owning and managing forests. Stocks and bonds are usually purchased for the sole purpose of making money, and their financial performance is judged on that basis alone. But forests are more than mere collections of trees, and landowners benefit from a wide array of non-timber goods and services like berries and mushrooms, recreational enjoyment, aesthetics, water quality, and wildlife. Some of these are traded in the marketplace, for example income from leasing hunting rights, but most are not, and there is no easy way to determine their value to the landowner. These non-market benefits can have significant value though, as evidenced by the prices paid for forestland. Even land that is a long distance from a population center and has no unusual attractions, such as lakes or streams, will typically be bought and sold for much more than its value for timber production alone.

Investment analysis that focuses only on costs and returns from timber production will ignore important non-market benefits, and will provide an incomplete measure of total investment performance. In theory, it would seem easy to incorporate non-market benefits into the calculations, but in reality it is often difficult even for economists to value such benefits.

One way to address this inability to deal directly with non-market benefits is to evaluate proposed projects in a two step process. The first step is to analyze the investment based only on measurable costs and revenues. If the investment meets the investment performance criteria established, then the project is financially sound. If the project does not meet traditional investment criteria, but the landowner feels that the enjoyment and other non-market benefits associated with establishing and managing their forest offset the shortfall in revenue, it may still be a sound investment.

ECONOMIC COMPARISON EXAMPLE

Family Forest owners purchase and manage their woodland properties for a number of reasons including hunting, recreation, and generating income. A timber harvest provides landowners with the opportunity to generate income as well as opportunities to improve fish or wildlife habitat, develop recreational trails, or improve the quality and quantity of wood that comes from the land. Sustainable forest management is managing woodlands to provide for multiple uses of the forest by balancing a diversity of both present and future needs. It is a process of informed decision-making that takes into account resource needs, landowner objectives, site capabilities, existing regulations, economics, and the best information available at any given time. Let's consider the case of two landowners managing similar 40-acre aspen stands. These stands are mature and ready for harvest. We will assume, for simplicity sake that markets for aspen are competitive and that stumpage prices are the same. However, one landowner is interested in managing for wildlife habitat and wants to maintain the aesthetics of the stand while the other is interested in generating income.

LANDOWNER A

The primary objective of this landowner is economic. This landowner wishes to maximize the potential income from their property while maintaining its productivity and the ability to generate income at regular intervals in the future. However, focusing solely on generating income could limit potential water quality, fish and wildlife habitat, forest health, and aesthetics benefits the landowner would also receive. This landowner chooses to implement a simple coppice harvest that will maximize economic returns. Assuming a gross yield of 40 cords per acre and stumpage price of $28.00 per cord; this landowner would receive $44,800 for the timber.

LANDOWNER B

The primary objective of this landowner is to improve wildlife habitat. This individual is looking to harvest timber as part of an overall plan to improve wildlife habitat and recreation opportunities while maintaining the aesthetics of the property. By focusing on improving wildlife habitat and maintaining the aesthetics of the woodlands this landowner is willing to accept a reduced economic benefit. The landowner chooses to implement a coppice with standards (reserve trees) harvest that will leave approximately 15 percent of the stand. These trees will be left on the site as individuals and in small groups and will not be harvested. Assuming a gross yield of 34 cords per acre and stumpage price of $28.00 per cord; this landowner would receive $ 38,080 for the timber.

Each of the landowners in this example is practicing sustainable forest management and is managing their lands to meet their individual goals and objectives. The difference in the income each landowner received provides a simple way to evaluate the cost of investing in wildlife habitat. Landowner B was willing to forgo $6,720 in income to improve the wildlife habitat and maintain the aesthetics of their woodland property. It could also be said that Landowner A was willing to forgo $6,720 of wildlife habitat and aesthetic benefits to maximize the income from their woodlands. Another way to look at this is that it would take approximately $6,800 in tax relief or supplemental payments to encourage Landowner A to manage for improved wildlife habitat and enhanced aesthetics that would directly benefit society but would not help Landowner A meet their goals.

BASIC FOREST MANAGEMENT AND ECONOMICS: THREE THINGS EVERY LANDOWNER SHOULD KNOW

1. How to Increase the Returns from Forestry Investments

Forests grow without the assistance of humans. The whole point of management is to meet the landowner's objectives, whether they are for wildlife habitat, recreation, or timber production. When it comes to timber production, a number of management strategies can improve economic returns.

PROTECT AND UTILIZE THE SITE FULLY

Any given plot of ground has a defined productive capacity, and it is important to avoid practices that degrade that production potential. Simply said, an acre will grow about the same volume of wood, regardless of the number of trees on it, as long as there are enough to occupy the site fully. Other things being equal, the fewer the number of trees, the larger they are likely to be; the greater the number of trees, the smaller they will be in diameter. Interestingly, height growth is largely independent of stocking levels except at extremes. This ability to focus diameter growth on fewer trees is the underlying principle behind many forest management treatments.

Stocking charts (see Chapter 16: Intermediate Silvicultural Treatments) have been developed to identify the relationships between diameter growth and various levels of stand density. If a landowner is interested in increasing the stand's value for sawlog production, careful attention should be paid to thinning periodically. Periodic thinnings will keep residual basal area densities at the recommended levels, maximize diameter growth, and concentrate growth on high quality trees with the greatest potential for grade increase (see Figure 9-4). Thinning can also maintain vigorous, healthy trees that can defend themselves from insect and disease attacks.

MANAGE FOR QUALITY

Higher quality products bring higher prices. Tree diameter is an important determinant of product value and tree quality, particularly in the case of sawlogs. Pulpwood is ground up and reconstituted into paper, flake board, and other similar products. Sawtimber, on the other hand, is cut into solid boards, making it necessary for trees to be of a certain minimum **diameter at breast height (DBH)**. Normally a nine to 11 inch DBH is required (depending on the species) to have any sawlog value at all. Tree grade also relates directly to DBH. The current U.S. Forest Service minimum DBH for grades 1, 2, and 3 trees are 16 inches, 13 inches, and 10 inches, respectively.

The typical product progression from pulpwood to sawlogs to veneer logs is based largely on size and quality, and this translates into a price function with dramatic increases as trees reach the specifications for different products (see Figure 9-5, page 9-6).

DIAMETER RESPONSE TO THINNING IN NORTHERN HARDWOODS

Thinning does not increase total volume produced, but thinning "frees up" resources for the residual trees, thereby concentrating growth on the remaining trees, improving their diameter, quality and value. One study conducted on the Argonne Experimental Forest in northeastern Wisconsin to measure the growth response of second growth northern hardwoods at different residual stocking levels had the following results:

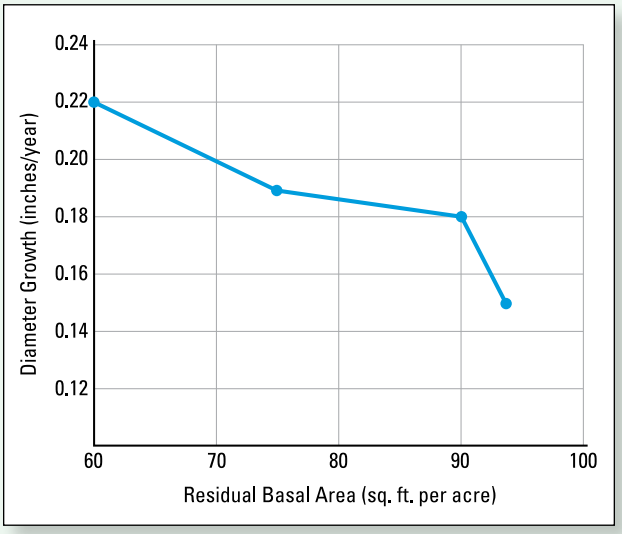


Figure 9-4: Periodic annual sawtimber diameter growth rates in relation to residual stocking for northern hardwoods. (Erdmann and Oberg, 1977)

Numerous researchers have reported that timely thinning can also improve tree quality in northern hardwoods, sometimes by as much as one grade.

Figure 9-6 further illustrates the impact of grade change on tree value. Notice that early internal rates of return are particularly dramatic as a tree passes from pulpwood to sawlog size. This is a function of both the large difference in product value (pulp versus lumber), and the minimal current investment. As a tree gets larger and produces higher grade logs, it experiences its largest increases in absolute value, even though internal rates of return decline due to the higher investment in growing stock being carried. As trees reach their maximum grade potential, whether that be prime veneer or one of the lower grades, the value increases come only from the additional volume produced. As a result, absolute value increases decline, dramatically reducing the internal rates of return, even though overall individual tree value is at its peak. Since the butt log (the lowest, or "first log") normally makes up such a large percentage of a trees total value, its grade potential is particularly important when evaluating whether to harvest a particular tree, or let it continue to grow.

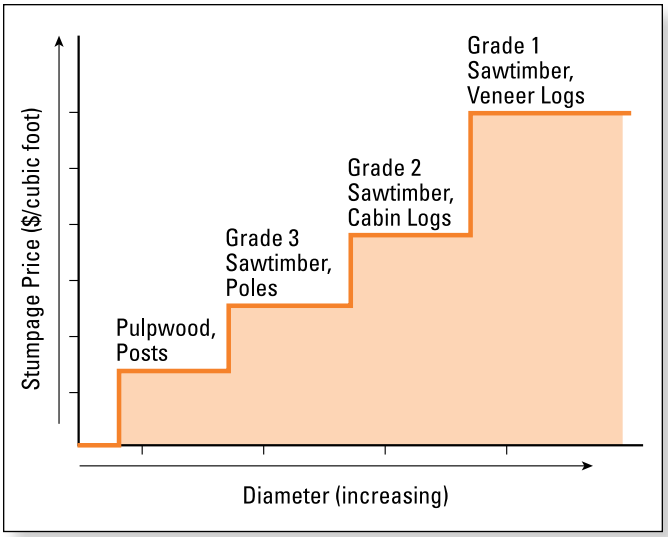


Figure 9-5: Schematic representation of the increase in stumpage price for timber as diameter increases. Note that very small diameter trees have no product value.

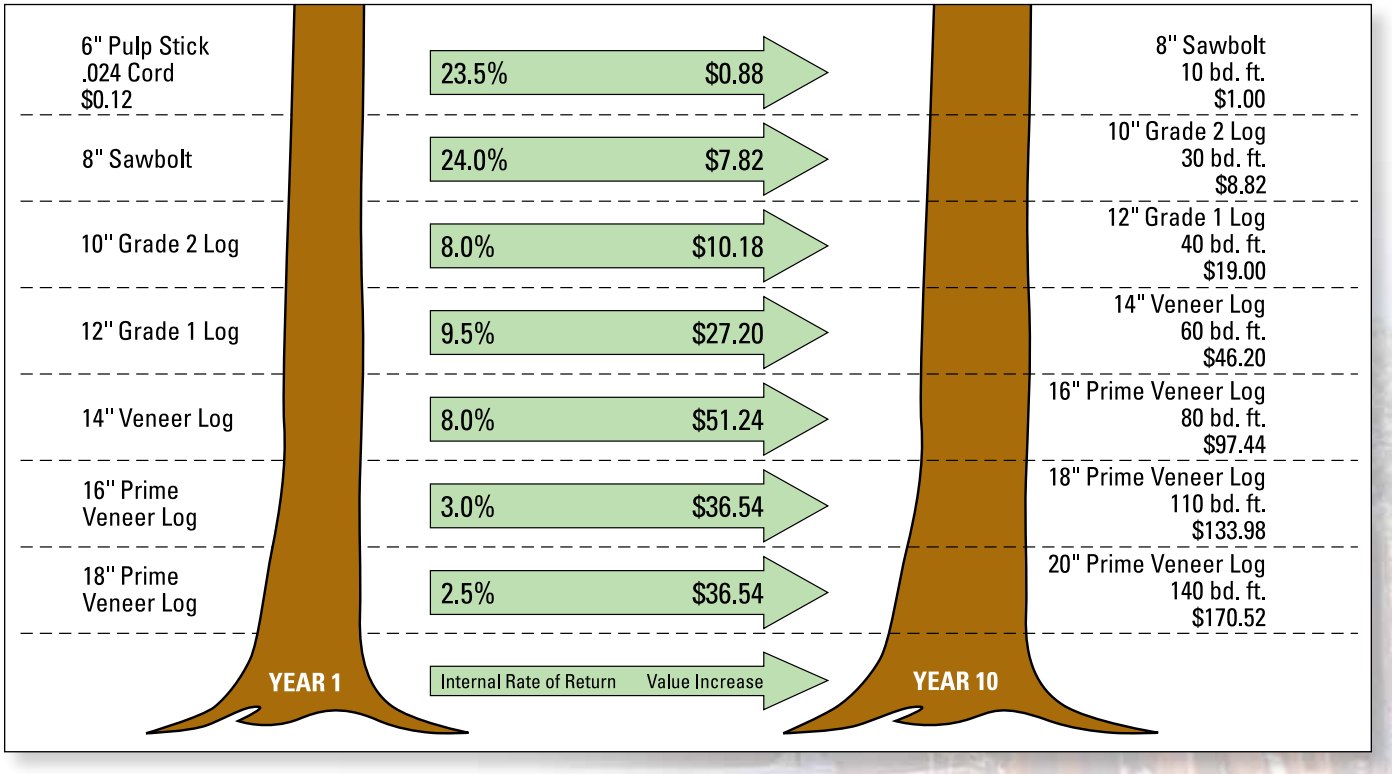


Figure 9-6: Relationship between grade change, volume growth, value increase and Internal Rate of Return for red oak. The volumes and values used in this example are based on one 100 inch pulp stick, or eight foot sawlog and are intended only to illustrate relative changes as trees increase in size and/or grade. For purposes of this example, red oak stumpage prices were estimated as follows: pulpwood $5/cord; sawbolts $25/cord; grade 3 logs $122/MBF; grade 2 logs $294/MBF; grade 1 logs $475/MBF; veneer logs $770/MBF; prime veneer logs $1,218/MBF.

DIVERSIFY AND GROW MULTIPLE PRODUCTS

Trees can be grown and marketed for many different products, and the relative value of these products is reflected in their prices. For example, pine can be grown for sawtimber, which is more valuable than pulpwood, but trees in the sawtimber size class can also be used for utility poles or cabin logs. On a per unit volume basis, these products can be even more valuable than sawlogs. Researchers report that utility poles are the most valuable products that can be produced from red pine, and that trees that qualify for poles sell for twice their value as sawtimber. Utility poles can be produced from trees 10 inches to 16 inches in diameter, but trees need to have minimal sweep and few knots, especially in the bottom portion of the pole. Some stands will yield a few trees that qualify for utility poles by happenstance, but not all sites are capable of growing poles.

Involve a forester early in your decision-making relative to your product goals. Management practices for producing poles, for example, differ from those for more typical pulpwood-sawtimber products, so landowners need to consider what their final product objectives are carefully from the very start. Some early management decisions can limit later opportunities.

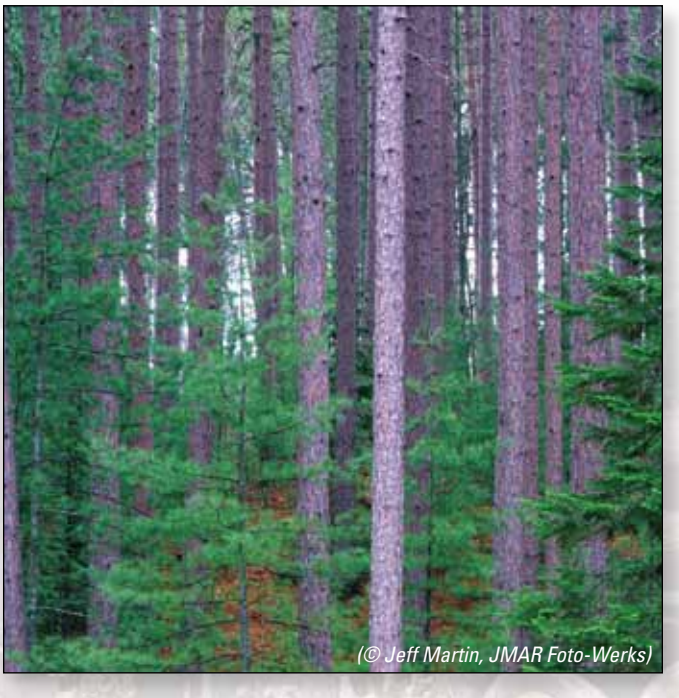
Planting too few red pine seedlings per acre, for example, could result in too many knots and too much taper to qualify trees for utility poles when they are harvested decades later. A forester can help landowners think through management objectives.

EARLY INVESTMENTS AND RETURNS

Forestry is a long-term venture, and as a result, the financial returns from forestry investments are greatly influenced by interest rates. Costs incurred at the start of a project reduce profitability on a dollar-for-dollar basis, whereas costs that can be delayed until later in the life of the project are discounted significantly and do not weigh as heavily in the calculations.

Early investments can often be reduced by matching goals with the capability of the site (see Chapter 2: Generally Accepted Silvicultural Principles). Not "fighting mother nature," but rather growing those forest types best suited to a site can minimize the need for costly intensive site preparation, and non-commercial intermediate treatments.

On the other hand, early revenues start earning interest sooner. Early thinnings, followed by regular follow-up thinnings, also have the benefit of increasing diameter growth, and shortening the time until higher value products are produced.



Figures 9-7 and 9-8: These tall straight red pines, having little taper, will make high quality utility poles and generate excellent financial returns to the landowner.

2. How Forest Products Are Sold

- Forest products are normally sold on the basis of their **stumpage value**, which is the value of a tree still standing on the stump. This value is lower than the price a logger receives when the cut logs or pulpwood are delivered to the mill. The price difference is a result of the sawing, bucking, skidding, road building, hauling, and other costs of production incurred by the logger, as well as the need to make a profit. Different stumpage prices are established for each different type of cut product – pulpwood, posts, poles, sawlogs, cabin logs, and veneer logs. Stumpage prices also vary by species. In a few cases, products are cut, skidded, and piled along the road by the landowner, and sold as **cut products**. Since much of the production cost is borne by the landowner, prices for cut products are higher than the normal stumpage price, but still lower than a delivered price. The price paid for cut products is normally negotiated on a case-by-case basis by product and/or grade.

- Stumpage can be sold on a "lump sum" or "scaled" basis. In the case of **lump sum sales**, the buyer submits one bid for all the stumpage available on the sale. A single payment or series of partial payments are normally made depending on the size of the sale, before any harvesting is done. In the case of a **scaled sale**, the buyer submits a bid based on a unit of volume (piece, cord, or board foot) by species, product, and sometimes grade. The products are paid for as they are removed, based on a scale (actual measurement of the cords and/or board feet removed) by the landowner, or a cooperating mill. Each method of sale has advantages and disadvantages relative to the time and expertise required to establish the sale, and administer the cutting operation.

3. How to Get Fair Market Value for Your Timber

If you want to get the best price for your timber, you need to do your homework, and that includes developing a rough idea of what it might be worth and why.

- The first step is to investigate stumpage price levels in your area. There are several sources of information on stumpage prices for Wisconsin timber.

  The Wisconsin DNR collects stumpage price information for the purpose of assessing the yield tax under the Forest Crop Law and Managed Forest Law programs. The stumpage rate schedule is published in chapter NR 46, Wisconsin Administrative Code, and is also posted on the Wisconsin DNR Division of Forestry's private forestry web site. The schedule is updated annually after public hearings. Stumpage prices are reported for each of 13 regions to provide more localized information.

  County, State and National Forests can also provide stumpage price information on the timber they sell, and in some instances, these data might also be applicable to nearby private lands.

  Consulting foresters operating in your area are also a valuable source of stumpage rate information. Some firms even produce detailed reports on stumpage prices. An example would be Prentiss & Carlisle, which publishes the *Timber Mart North Price Report*©. It is available separately for Michigan, Minnesota and Wisconsin on a subscription basis at a modest cost, and is published twice annually. Wisconsin statewide average prices are reported, as well as for each of three regions within the state. Information is available by product and species, and for stumpage as well as for delivered cordwood and sawlogs.

- Regardless of the source, the next step is to adjust average price information to reflect the specific "production factors" associated with each timber stand:
  - **Felling and Bucking:** This step involves severing the tree from the stump and cutting it up into products. Felling and bucking costs are affected by the volume to be removed per acre, average diameter, and the number of pulp sticks or logs per tree, thinning versus clearcut, limbiness, and slash control needs. In general, stands with more removable volume per acre, larger trees, with fewer limbs command a higher stumpage value.

- **Skidding:** Skidding involves moving the cut product from the stump to a landing or roadside for hauling. Skidding costs are affected by hilliness, wetness, the amount of residual stand to work around, sale design, skidding distance, and any equipment restrictions that might be required. Timber stands on flat, dry land with few residual trees or clumps to work around, and with shorter skidding distances bring a higher price.
- **Road Construction and Maintenance:** Normally road construction costs are borne by the contractor, so the length of roads, rockiness, soil type, wetness, need for extensive BMP work, and stream crossings needs, all factor into a contractors stumpage bid.
- **Hauling:** Distance to the nearest mill, road quality, and seasonal road restrictions, as well as distance to the nearest available mill, will also affect the cost of getting the products to market, and therefore, what a buyer can afford to pay for a stand of timber.
- **Marketability:** Each species normally commands a different price. In addition, seasonal fluctuations in price may result from supply and demand and/or weather patterns. If every farmer has a pile of pulpwood behind the barn following a winter with unusually good access to lowland stands, it might be best to hold off selling your black spruce for a while, likewise if the local sawmill is full of logs from a recent windstorm.
- **Quality:** The amount of defect, crook, and quality affect the value of both pulpwood and sawtimber. The quality premium is usually much higher for hardwood species than for softwoods. For example, the price of delivered grade 2 hardwood sawlogs in Wisconsin is typically 150 to 200 percent the price of grade 3 logs, and grade 1 logs bring a similar premium compared to grade 2 logs (George Banzhaf & Company, 2002). Since it costs about the same to cut a log out of a tree and deliver it to the mill regardless of the log grade, quality differentials for logs can translate into big differences in the value of standing trees.

The evaluation of these production factors requires a lot of local knowledge as to what is "average" in a given area. Some above-average factors may offset the impact of below-average factors. A forester can be a great help to a landowner trying to assess how the particular timber and harvesting factors for their situation will affect the value of their timber.

COMPETITIVE BIDDING CAN MAKE A BIG DIFFERENCE

The competitive bidding process is an important tool a landowner can use to ensure a realistic, fair price for their timber. Values offered for timber may vary for a number of reasons. Contractors do not all have the same equipment. Some may be very busy when you want to sell while others are looking for work. Some may have markets for specific products. Stumpage appraisal based on production factors is not an exact science. For these and many other reasons, try to get as many bids on your timber as possible.

Several studies report both increased income and satisfaction from competitively bid sales. One of the studies that analyzed 164 lump sum timber sales in Massachusetts found that the average difference between the high and low bid on sales that had two or more bids was $11,000. (Kittredge, D. B. and W. Halsam, 2000).

The example below shows the difference in prices offered in 1999 for one Wisconsin landowner's stumpage involving 107,980 board feet of sawtimber, and 260 cords of hardwood pulpwood. The actual submitted total bids were $42,077, $42,948, $48,262 and $65,044.

The forest owner hired a consulting forester to handle this sale. The consultant charged $4,590 for services. In addition to securing top value through competitive bids, the forestry consultant marked the timber, planned best management practices to protect water quality, assembled the bid packet, advertised the sale, negotiated the timber sale contract, collected harvest payments, and monitored contract compliance. Professional attention to these timber sale details help maximize returns, and minimize expenses over the long-term.

In addition to the bid price, remember that it is important to select a contractor that will do a quality job in a timely manner!

SOME SPECIES ARE MORE VALUABLE THAN OTHERS

The unique wood properties and characteristics of different tree species govern their suitability for specific uses. Size, structural strength, appearance and "workability" are important considerations. Red oak sawlogs, for example, command a higher lumber price than weaker, plainer, less workable basswood. Red pine and jack pine, with their longer fibers, command a higher price for pulpwood than shorter fiber aspen. The straightness, strength and the amenability to preservative treatment makes pine more valuable for posts and poles, while white pine, with its traditional appearance, commands top prices for cabin logs. Relative prices may change as a result of technology, consumer preferences, and availability, but in general, products that require larger diameter trees, and lend themselves less to substitution tend to bring higher prices, and increase in real price over time. On the other hand, many of the more valuable species are only suitable for a limited number of sites, and require higher establishment and maintenance investments, which may offset some of their increased value.

Figure 9-10: High quality hardwood trees should be carefully bucked to maximize the yield of high value veneer and sawlogs.

Figure 9-9: All the production factors involved in getting timber from the stump to the millyard affect its stumpage value.

SOFTWOOD LOG GRADES

Veneer Grade	• Logs must be 16" or larger, 8'8" or longer. Surface clear.
No. 1 Grade	• Logs must be 12" or larger, 8' or longer, with a net scale after deduction for defect of at least 50% of the gross contents of the log, 6" trim. • Three faces surface clear. • 3" maximum knot size, or no larger than 1/6 scaling diameter. • No black knots allowed.
No. 2 Grade	• All logs must be 10" or larger, 8' or longer, and a net scale after deduction for defect of at least 50% of the gross contents of the log. 6" trim, 3" maximum knot size or 1/6 scaling diameter.
No. 3 Grade	• Logs must be nine inches or larger, 8' and longer. 50% of gross scale. 4" maximum knot size, 6" trim.

Table 9-1: Softwood Logs Grading (see also Tables 9-2 and 9-3, page 9-11)

NOTE: Tables 9-1, 9-2 and 9-3: Official Grading Rules for Softwood Logs, Northern Hardwoods, and Tie Cuts, Updated June 1, 2003. *(Adopted and published by the Timber Producers Association of Michigan and Wisconsin, Inc.)*

HARDWOOD VENEER LOG GRADING RULES

Grade Factors	Prime Veneer	Veneer
Min. Diameter	14″	12″
Log Length	8′8″ to 17′6″; other lengths specified; 8″ trim allowance.	
Surface Defects	None	• 8′8″; one allowed. • 17′6″; two if one falls in each half of the log. • Two defects allowed as one if perfectly in line. • Knots not to exceed 3″. • Bark distortion is a surface defect. • Seam straight and tight up to 4′ considered as one standard defect. • 10′ and 12′; two defects in line. • 14′ and 16′; two defects if one in each half.
End Defects	• Well-centered doze and holes individually or in combination is allowed. • 12″ and 13″ diameter up to 2″ 14″ diameter up to 3″ 5″ diameter up to 4″ • Logs must be free of mineral, ring shake and heavy bird peck. • One worm hole allowed in one end. • 50% heart allowed in hard maple. • Starred hearts, bark pockets, ring shakes, and fluted butts will not be accepted.	
Straightness	• Logs 13″ or under must be straight. • 14″ and up allowable sweep is 1/6 the diameter of the small end of the log.	
Grain Directions	• No wavy, curly, figured, or cross grain logs accepted. • Spiral grain allowed only if not more than 1″ in 12″ length.	
Additional Notes	• Variations of this standard should be agreed upon by both buyer and seller. • Veneer logs graded on four faces.	

Table 9-2: Hardwood Log Grading Rules

HARDWOOD SAWLOG GRADES FOR STANDARD LUMBER

GRADE FACTORS	Grade 1	Grade 2	Grade 3
Minimum Diameter	12″	10″	10″
Minimum Length* (including trim)	8′4″	8′4″	8′4″
Clear Cuttings (on the three best faces)			
Length *(minimum)*		3′	2′
12″-15″ Diameter**	7′		
16″-19″ Diameter	5′		
20″+ Diameter	3′		
Number on Face *(maximum)*	2		No Limit
8′-11′		3	
12′+		3	
Yield in Face Length (minimum)	5/6	4/6	3/6
Sweep and Crook Deduction (maximum)	15%	30%	50%
Cull Deduction, Including Sweep (maximum)	40%	50%	50%

Sound End Defects, Area (maximum)

Specific end defects such as bird peck, worm holes, spot worm holes, stain, mineral spots or streaks and unsound defects as grub holes and bark pockets are considered when in the quality section. When these defects occur in the quality section in three faces of the log at one end, or two faces at both ends, a log grade 1 or grade 2 shall be dropped one grade.

Exceptions

- Grade 2: 10″ d.i.b. must be one grade; surface quality.
- Grade 2: 11″ d.i.b. limited to two cuttings.
- Sweep and crook allowance reduced 1/3 in logs with more than 1/4 diameter in sound end defects.
- 60% cull deduction permitted in grade 2 if otherwise or grade 1 quality.
- 60% cull deduction permitted in grade 3 if otherwise of grade 2 quality.

* Unless mill requires more trim.

** Grade 1: 8′ long logs must be 5/6 clear (6-2/3′) in one cutting on three best faces. Two cuttings 3′+ admitted to logs 20″ and up in diameter.

Table 9-3: Hardwood Sawlog Grades for Standard Lumber

EMERGING MARKETS

CARBON MARKETS

Societal interest in reducing the concentration of carbon dioxide in our air, to slow climate change, has opened the door for an additional economic opportunity and benefit from managed forests.

Economic markets have developed to exchange the value of the carbon stored in forests to offset carbon dioxide emissions from generating power, industrial activity and other fossil fuel use. These voluntary carbon markets connect those who own forests that are storing carbon with individuals and businesses interested in reducing their net carbon dioxide emissions. The interested individual or business enters into a contract to compensate the forest owner for the amount of carbon their forest is storing and that storage is measured and audited according to a system defined in the contract, usually referred to as a protocol. These contracts are legally binding, and commonly have language that requires third party forest certification and a long term commitment to manage the forest to sequester carbon. It is recommended that landowners work with a consulting forester specializing in forest carbon to measure the carbon stored in their forest and negotiate the terms of any customer purchase agreements.

BIOMASS MARKETS

Wisconsin has seen an increased interest in wood-based bio-energy such as wood pellets and bio-diesel. Woody biomass offers Wisconsin woodland owners and timber producers a potential new market for previously underutilized product – small diameter trees and the branches, tops and limbs of harvested trees.

Harvesting woody biomass typically removes more woody material from forests than traditional harvest methods. The emergence of this new market raised concerns about sustainability including the potential loss of soil nutrients, reduced wildlife habitat, and compaction of forest soils. The Biomass Harvesting Guidelines, developed at the request of the Council on Forestry, provide guidance to help ensure that woody biomass harvests do not compromise the long-term productivity of Wisconsin's forestland, and that woody biomass can be a sustainable, reliable forest product for landowners and timber producers.

(HVS Advertising, Jerry Horen)


(HVS Advertising, Jerry Horen)

Figures 9-11 and 9-12: Woody biomass being processed by a chipper (in-woods) and being loaded into a chip trailer for transport to a wood energy facility. These fuel chips can be used for electricity generation, manufacturing process heat, building heating, or a combination of these uses.

ADVANCED FOREST ECONOMICS: AN INVESTMENT ANALYSIS PRIMER

The successful operation of a forest property requires the integration of business methods, and technical knowledge in the management of a complex biological entity – a forest – to achieve a desired result. A forest landowner is continually faced with choices:

- **To plant or not to plant?** How would an investment in growing trees compare with the rate of return on savings bonds or other investment opportunities (see Example 1, page 9-15)?
- **Do it now, or do it later?** Would it be better to invest some money up front, or wait and later spend a little more on projects needed to ensure tree survival and enhance future growth and quality (see Example 2, page 9-16)?
- **To cut or leave?** Which tree should be marked for harvest (see Example 3, page 9-17)?

There are many such questions, but they all revolve around the relationship between inputs and outputs. **Forest financial analysis** is a particular form of investment analysis conducted from the perspective of the forest landowner. It takes into account the costs and revenues that the landowner expects to realize as a consequence of implementing a proposed action.

While a financial analysis can provide useful guidance, it must be remembered that the future is never certain, and management decisions should be flexible enough to adjust to changes in conditions over time. Forest management is a long-term proposition. For example, a stand regenerated this year may not be ready for final harvest (and subsequent regeneration) for 100 to 200 years. Projecting long-term financial performance is an inexact science based in part on historical information, but it requires a lot of assumptions about forest health, interest rates, costs, revenues, rate of inflation, and socioeconomic conditions.

All investment analyses require information about 1) the physical **inputs and outputs** associated with a project, 2) the **expenditures and revenues** these inputs and outputs generate, and 3) the timing when each will occur. In addition, an appropriate **discount rate** must be selected as well as **investment performance criteria**.

INPUTS AND OUTPUTS

Inputs and outputs are the physical resource flows that the project entails. Inputs might include such things as hours of labor or machinery rental, number of seedlings planted, and the amount of fertilizer or pesticide spread. Outputs in most cases will be the volumes of timber produced, but can also include non-timber forest products such as berries, nuts, mushrooms, hunting leases, or recreational user fees.

In some cases, it is possible to bypass estimating the units of physical resource used. For example, it is common to use an average per acre cost for mechanical or chemical site preparation, without going through the process of estimating the actual hours of machinery use, chemicals and labor that determine the cost.

Figure 9-13: The rate of return on initial investments, like tree planting, can be weighed against later timber revenues by conducting a financial analysis.

EXPENDITURES AND REVENUES

Expenditures and revenues are the monetary costs, and incomes, associated with the physical inputs or outputs. Landowners who invest their own labor in forestry projects should include the cost of their labor if they want to get a true picture of the financial soundness of their investment. In practice, though, many landowners derive significant recreational or other benefit from such work, and do not consider it a cost at all. If no earnings are forfeited when working in the forest, the landowner's personal labor cost can be excluded from the analysis.

Since most investment analyses involve estimating incomes and costs at some future date, it is necessary to project what they will be in **nominal**, also called market or current dollar, or **real**, also called constant dollar, terms. Nominal prices and costs contain inflation; real prices and costs have the inflation removed. The long-term rate of inflation over the period 1926 to 2000 was approximately three percent, which also happens to be what it averaged during the decade of the 1990s. Either real or nominal values can be used so long as they are used consistently throughout the analysis. It is usually easier to work with real values, though, and all examples in this chapter will be presented in real terms.

THE DISCOUNT RATE

The discount rate is similar in concept to an interest rate. Interest is the "rent" one pays, or gets paid, for the use of capital. The discount rate represents the rate of return on money invested.

Financial analysis involves adjusting expenditures and revenues for the effects of interest over time. Interest is **discounted** (subtracted), or **compounded** (added) as needed to reflect the value of revenues and expenditures at the same point in time. For example, the present value of a dollar to be received 10 years from now after being invested at five percent interest is only $0.61 (see Table 9-4), while the future value of one dollar invested for 10 years at five percent interest is $1.63 (see Table 9-5).

A very quick way to obtain a rough estimate of the effect of compounding and discounting is based on "the rule of 72." This rule states that the time it takes money to double when compounded (or halved when discounted) at a fixed interest rate is given by dividing the interest rate into 72. For example, money invested at 10 percent interest will double in just over seven years; at five percent, it will take about 14.5 years.

Years in Investment Period	INTEREST RATE				
	3%	4%	5%	6%	7%
10 Years	$0.74	$0.68	$0.61	$0.56	$0.51
20 Years	$0.55	$0.46	$0.38	$0.31	$0.26
30 Years	$0.41	$0.31	$0.23	$0.17	$0.13
40 Years	$0.31	$0.21	$0.14	$0.10	$0.07
50 Years	$0.23	$0.14	$0.09	$0.05	$0.03
60 Years	$0.17	$0.10	$0.05	$0.03	$0.02
70 Years	$0.13	$0.06	$0.03	$0.02	$0.01
80 Years	$0.09	$0.04	$0.02	$0.01	$0.00
90 Years	$0.07	$0.03	$0.01	$0.01	$0.00
100 Years	$0.05	$0.02	$0.01	$0.00	$0.00

Table 9-4: Discounted value of one dollar for different interest rates and time periods.

Years in Investment Period	INTEREST RATE				
	3%	4%	5%	6%	7%
10 Years	$1.34	$1.48	$1.63	$1.79	$1.97
20 Years	$1.81	$2.19	$2.65	$3.21	$3.87
30 Years	$2.43	$3.24	$4.32	$5.74	$7.61
40 Years	$3.26	$4.80	$7.04	$10.29	$14.97
50 Years	$4.38	$7.11	$11.47	$18.42	$29.46
60 Years	$5.89	$10.52	$18.68	$32.99	$57.95
70 Years	$7.92	$15.57	$30.43	$59.08	$113.99
80 Years	$10.64	$23.05	$49.56	$105.80	$224.23
90 Years	$14.30	$34.12	$80.73	$189.46	$441.10
100 Years	$19.22	$50.50	$131.50	$339.30	$867.72

Table 9-5: Compounded value of one dollar for different interest rates and time periods.

• EXAMPLE 1 •

Can I get a 5% or greater rate of return on a $250 per acre investment to plant a stand of trees, if I expect an income of $450 per acre to be generated by a thinning at age 30, and an additional $2,025 per acre to be generated in the final harvest at age 50 (assume there are no other costs or revenues, and all values are in real terms)?

ACTIVITY	YEAR OCCURRED	COSTS	REVENUES	YEARS IN INVESTMENT PERIOD	DISCOUNTING FACTOR[1]	CURRENT VALUE[2]
Planting	0	$250/acre		1	1.00	$250/acre
Thinning	30		$450/acre	30	0.23	$103.50/acre
Harvest	50		$2,025/acre	50	0.09	$182.25/acre

1 Discounted value of one dollar at five percent interest rate; from Table 9-4, page 9-14 • 2 Actual value of all costs and revenues in year one.

Since, in this example, the total revenues ($285.75) exceed the total costs ($250), this investment would yield a rate of return greater than 5%. Note that if the final harvest was put off until year 60 (only another 10 years), the value of the final harvest would only be $101.25 (assuming no change in the type of product harvested), and the total revenue ($204.75) would no longer exceed costs, which means the rate of return would be less than 5%.

INVESTMENT PERFORMANCE CRITERIA

A number of criteria can be used to evaluate the financial performance of forestry investments. Net present value, internal rate of return, and payback period, are normally used when deciding whether or not to make a specific investment. When analyzing the relative merits of a number of alternative actions, however, the criterion might simply be which alternative offers the greatest expected rate of return (see the Wisconsin DNR *Silviculture Handbook, 2431.5* for a more detailed discussion of these and other investment criteria).

Figure 9-14: The planting of trees is just one of a number of forestry investments that can be evaluated using investment analysis techniques.

• EXAMPLE 2 •

You plan to replant a poor quality mixed hardwood stand with oak following a harvest. You expect quite a bit of competition from the brush and red maple spouts on the site, and feel something might need to be done to ensure the new oak seedlings are not shaded out. One option would be to spray the area with a herbicide prior to planting, but you are not sure it is absolutely necessary. Another option would be to wait 10 years, and then hand cut the competing brush and sprouts if necessary. The first option would be much less expensive, but it will be a wasted investment if it turns out not to be needed. Should you go ahead and spray now, and not take a chance on having to do the more expensive treatment later? You expect to make the final harvest in the stand at age 80, and whichever option you choose, you want a 5% rate of return on your investment.

ACTIVITY	YEAR OCCURRED	COSTS	YEARS IN INVESTMENT PERIOD	COMPOUNDING FACTOR[1]	FUTURE VALUE[2]
Herbicide Release	0	$70/acre	80	49.46	$3,469.92
Hand Release	10	$110/acre	70	30.43	$3,347.30

1 Compounded value of one dollar at five percent interest rate; from Table 9-5, page 9-14

2 Actual cost of the investment at the end of the time of final harvest in year 80.

In this case, it would make more financial sense to wait and conduct the hand release later, if it is needed. The reduced interest charged on the shorter investment period associated with the hand release (70 years versus 80 years) more than offsets the increased cost of the treatment. If it turns out the treatment is not necessary, even more money will have been saved. Finally, it is important to remember that trying to forego needed investments, such as the ones illustrated in this example, is really false economy, since the entire initial investment in planting may well be lost.

This analysis only tells us which of the two release options has the lowest overall cost over the entire investment period. In order to evaluate the rate of return on the entire planting project, revenues would also have to be estimated and included in the analysis, as in Example 1. (The long-time intervals and the risk and uncertainty involved in forestry investments also help explain why governmental cost-sharing programs can be helpful incentives to motivate some landowners to engage in forest management activities.)


(WDNR, Jeff Martin)


(WDNR, Jeff Martin)

Figures 9-15 and 9-16: Conducting a site preparation treatment before planting to ensure survival of planted trees versus a more costly herbicide release operation later, are typical of economic investment choices faced by forest landowners.

• EXAMPLE 3 •

One-third of Wisconsin's forests are northern hardwoods. Most stands were once or still are even-aged, but many landowners are converting them to uneven-aged stands. Long-term studies conducted on the Argonne Experimental Forest showed that the single-tree selection system with a medium level of residual basal area (75 square feet per acre) economically outperformed both unmanaged stands, and stands that had been subjected to a diameter limit harvest.

A landowner who is practicing uneven-aged management asks a consultant forester to mark trees for harvest under the selection system, and to administer the timber sale. The forester does not expect that the stand will be ready for another harvest until 10 years have passed. As the forester begins marking the stand, she decides that one of two sugar maple trees needs to be removed in order to meet the stocking guidelines. Both trees are 15 inches in diameter, have two merchantable logs, and a volume of 135 board feet worth $50 today. Both trees are also of comparable risk and vigor (see Chapter 2: Generally Accepted Silvicultural Principles).

Each of the two trees is expected to add two inches of diameter growth over the next 10 years, if the other one is removed to provide extra growing space. Both trees will therefore have a volume of 180 board feet in 10 years if they are left to grow, but tree 2 will improve its butt log to grade 1, whereas in tree 1 the butt log will remain grade 2. The estimated value ten years in the future is $68 for tree 1 and $90 for tree 2.

Which tree should the forester mark for removal?

Even without doing any calculations, it is pretty obvious that tree 2 is the better investment, and makes the better crop tree. The actual rate of return for each tree is as follows:

TREE 1

$$\frac{\text{Discount}}{\text{Factor}} = \frac{\text{Future Value}}{\text{Present Value}} = \frac{\$68}{\$50} = 1.36$$

3% Rate of Return over a 10-year investment paid (see Table 9-5 page 9-14)

TREE 2

$$\frac{\text{Discount}}{\text{Factor}} = \frac{\text{Future Value}}{\text{Present Value}} = \frac{\$90}{\$50} = 1.80$$

6% Rate of Return over a 10-year investment paid (see Table 9-5 page 9-14)

Cutting tree 1 and leaving tree 2 makes the most economic sense, and also illustrates the powerful influence that quality has on timber value. This situation also demonstrates how many times what makes the most sense from a silvicultural viewpoint can also makes good economic sense. Of course, this will not always be the case, but economics is all about making trade-offs.

TAX AND RECORD-KEEPING CONSIDERATIONS

Forestry is subject to numerous risks and uncertainties, most of which are beyond the control of the owner. But one factor that can either contribute to or detract from financial success is under the direct control of the owner/manager – income taxes. There are a number of sound business practices that landowners should consider relative to taxes:

- **Have a forest management plan.** A management plan, complete with projections of future growth and yield, and associated anticipated costs and revenues, provides strong evidence that you are treating your forestland as a business, should you be questioned by tax authorities.
- **Build tax planning into your management,** including estate tax considerations.
- **Utilize the tax advantages available to forest landowners.** Tax advantages, such as the reforestation tax treatment and amortization provisions of the federal income tax code, can reduce the after-tax cost of early investments. Similarly, cost-sharing programs provide help with the costs of a wide range of forestry practices.
- **Keep good financial records,** not just because they are required by the IRS, but also because it is good business practice. It is hard to determine if past management and investment decisions were sound if you have no information with which to evaluate them. The difference between financial success and failure often depends directly upon whether adequate records have been kept to document expenditures and deductions, and the best place to start keeping good records is when you first acquire forestland assets.

The Original Basis: A Key Tax Consideration

One of the first important tasks a new landowner should undertake is the establishment of the **original basis**, or value, of all land and merchantable timber at the time of acquisition. Later, when income is received from a timber harvest, the adjusted (updated) basis for that portion of the timber sold can be claimed as a depletion allowance when computing income tax. Timber sale income can also qualify for more favorable capital gains tax treatment if the sale is structured correctly, and other requirements, such as the length of the holding period (typically one year), are met. Capital gains are also exempt from self-employment (Social Security) tax.

CALCULATION OF THE ORIGINAL BASIS

Exactly what constitutes the basis depends upon how the assets were acquired, for example, whether they were purchased, inherited, or received as a gift. Since the details of the tax code are complicated, no general discussion can be sure to cover the specifics of an individual landowner's situation.

In most cases, however, the original basis of assets purchased is their acquisition cost, plus any additional expenses directly associated with the purchase, such as legal and accounting fees, closing costs, recording fees, costs of surveys, and even real estate taxes, if they are not otherwise deductible. The important point is that **the basis usually includes more than just the purchase price**.

The basis should be established when the assets are acquired, but often landowners do not become aware of this requirement until some time later. The cost basis can be established at a later date in certain situations, but it is more difficult technically, and could invite closer scrutiny by the IRS than if it were done at the time of acquisition. When considerable time has passed since the acquisition occurred, it simply might not be worth the bother trying to establish the original cost basis, because it will cost more than will be saved in taxes.

ALLOCATION OF THE BASIS

The procedure for establishing the initial or original cost basis each of the assets included in the acquisition is called **allocating the basis**.

Essentially, it involves allocating the total acquisition costs among the assets in proportion to their fair market value on the date of acquisition relative to the total fair market value of all the assets acquired. For example, if on the date of acquisition the fair market value of land represents 50 percent of the total fair market value of all the assets acquired, then 50 percent of the total original cost basis of the assets should be allocated to the land (see Example 4).

• EXAMPLE 4 •

Mr. and Mrs. Jones just purchased a 40-acre parcel of forestland. It is stocked with an average of 3,000 board feet per acre of hardwood sawtimber. A barbed wire fence surrounds the property. The Jones' paid $55,000 for the parcel. Closing costs were $250, and they also paid their attorney $270 to review the paperwork.

The estimated fair market value of the timber on the date of acquisition, if sold as stumpage, is $275/mbf, the bare land is worth $500/acre, and the fence has a value of one dollar per linear foot.

STEP 1: DETERMINE THE TOTAL COST OF THE ACQUISITION, THE ORIGINAL BASIS.

ASSETS ACQUIRED	**ACQUISITION COST**
40 Acres of Forestland	$55,000
Attorney's Fees	$275
Closing Costs	$250
Total Acquisition Costs (Original Cost Basis)	**$55,525**

STEP 2: ESTIMATE OF FAIR MARKET VALUE OF THE THREE ASSETS ON THE DATE THEY WERE ACQUIRED.

ASSET	AMOUNT	UNITS	FAIR MARKET VALUE PER UNIT	TOTAL FAIR MARKET VALUE	PROPORTION OF TOTAL FAIR MARKET VALUE
Land	40	Acres	$500	$20,000	34.3%
Timber	120	MBF	$275	$33,000	56.6%
Fence	5,280	Feet	$1.00	$5,280	9.1%
				$58,280	**100.0%**

NOTE: It is very common for the total acquisition cost to be different from the fair market value of the assets. Markets are not always perfect, and the fair market value could be greater or less than the acquisition costs.

STEP 3: ALLOCATE THE ORIGINAL COST BASIS AMONG THE THREE ASSETS.

ASSET	AMOUNT	UNITS	PROPORTION OF TOTAL FAIR MARKET VALUE	ORIGINAL COST BASIS	ORIGINAL COST BASIS PER UNIT
Land	40	Acres	34.3%	$19,045	$476.12
Timber	120	MBF	56.6%	$31,427	$261.89
Fence	5,280	Feet	9.1%	$5,053	$0.96
			100.0%	**$55,525**	

As timber volumes increase over time, Mr. and Mrs. Jones will need to update their records by calculating the **adjusted cost basis** of the timber, as shown below.

Initial Timber Volume	120 MBF	Original Cost Basis	$31,427
Adjustment for Growth	80 MBF	**Adjusted Cost Basis Per Unit**	**$157.14/MBF**
Adjusted Timber Volume	**200 MBF**		

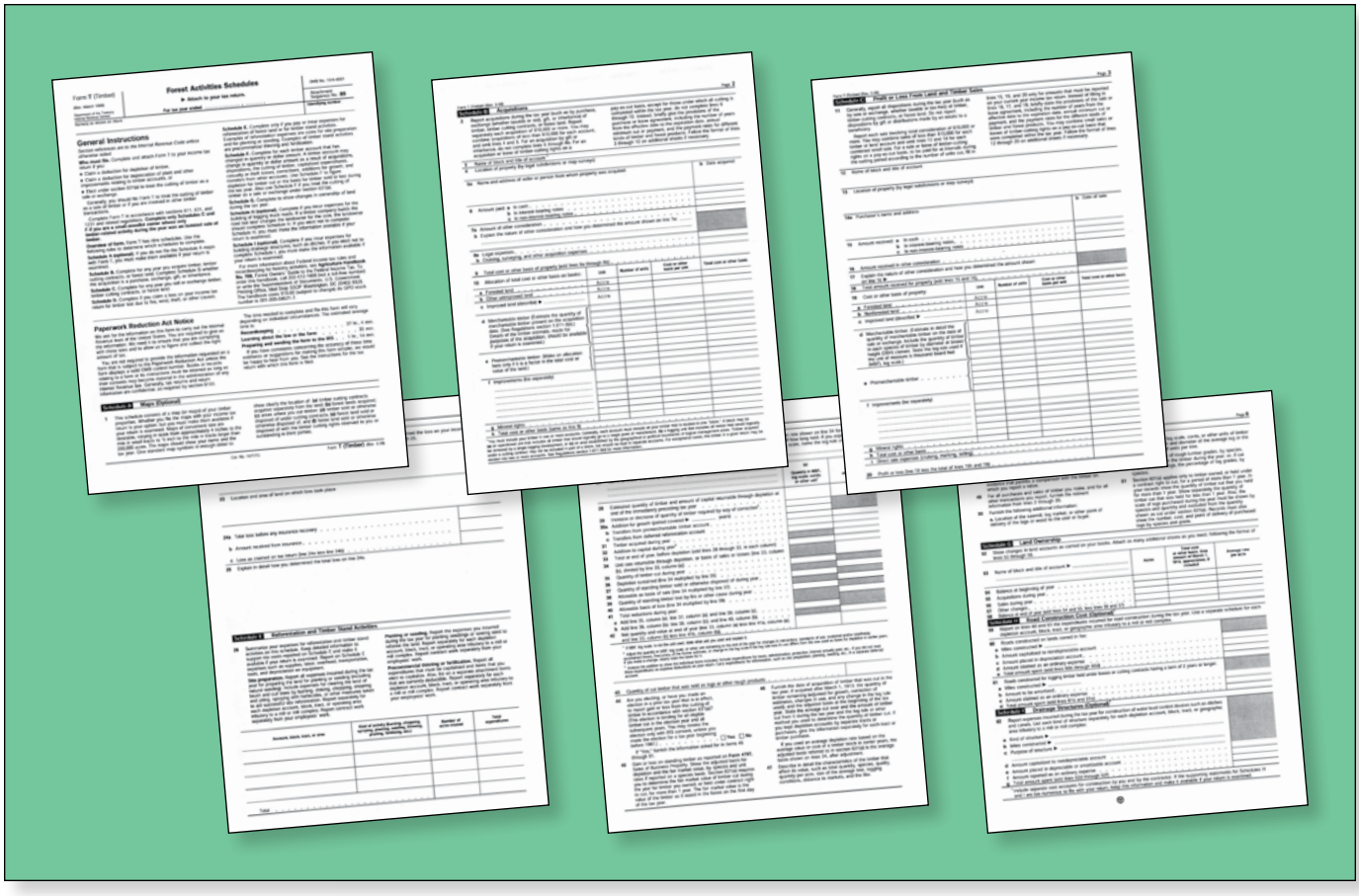


Figure 9-17: Complete and accurate records are key to managing a successful forestry business. IRS Form T categorizes the types of records that are critical.

THE IRS DOES NOT SPECIFY WHAT KIND OF BOOKKEEPING SYSTEM A TAXPAYER MUST USE

At a minimum, however, your records should include accounts with the amounts and cost basis of land, merchantable timber volume, and merchantable timber value. In Example 4 (see page 9-19), the landowners should also maintain a depreciation account to keep track of the cost basis of their fence, and how it changes as the depreciation allowances are claimed.

Perhaps the best guide to what kinds of records are useful is **IRS Form T: Forest Activities Schedule** (see **www.timbertax.org** for a copy of Form T). While not all items of information on Form T will be needed by all landowners, the form is a good guide both to the kinds of information larger forestry businesses must document, and how the information is used when filing tax returns.

Forestry-related Tax Deductions

- Timber is subject to **damage and loss** as a result of tornados, ice storms, fire, and even theft. The basic rule under the income tax code, however, is that if a taxpayer cannot demonstrate a cost basis in the damaged asset, no income tax deduction will be permitted. The deduction is the lesser of the decrease in value caused by the loss or the basis in the timber depletion account. A competent appraisal is required.
- One of the most beneficial provisions of the federal tax code relates to the r**eforestation tax credit and amortization**. You can deduct outright the first $10,000 per year per qualified property. The amortization provision permits expenses to be recovered over eight tax years.

Exactly which forest management expenses may be deducted when calculating taxable income depends on how the forestry operation is structured. An active business is the best option, but many landowners do not meet the IRS requirements for "active participation," and instead participate only passively or treat their forestland as an investment. Others fall into the "hobby farm" category. Each of these situations has different implications under the tax code for how income and expenses can be treated (for more information, see the references listed in the Resources for Additional Information section on page 9-23).

AMORTIZING REFORESTATION EXPENSES

In 2009, a landowner spends $20,000 on reforestation. In 2009, the landowner can deduct outright $10,000 ($5,000 for married couples filing separately), plus 1/14th of the remaining $10,000. The amortization for each subsequent tax year is calculated by applying an annual amortization factor to the remainder. The calculations are illustrated below.

YEAR	DEDUCTION FOR AMORTIZATION (FRACTION)	DEDUCTION FOR AMORTIZATION (AMOUNT)
2009	1/14th	$712
2010	1/7th	$1,429
2011	1/7th	$1,429
2012	1/7th	$1,429
2013	1/7th	$1,429
2014	1/7th	$1,429
2015	1/7th	$1,429
2016	1/14th	$712
Total		**$10,000**

Figure 9-18: Forest management plans are often modified by natural disturbances like this major wind storm in a northern Wisconsin hemlock stand.

NOTES

RESOURCES FOR ADDITIONAL INFORMATION

These resources are specific to the information in this chapter only. Refer to the Resource Directory for additional resources related to this chapter.

CASUALTIES, THEFTS AND INVOLUNTARY CONVERSIONS: SOME INCOME TAX TIPS FOR WOODLAND OWNERS

Casualties, Thefts and Involuntary Conversions: Some Income Tax Tips for Woodland Owners. Stier, J. C., University of Wisconsin-Madison, Department of Forest and Wildlife Ecology, Forestry Fact Number 16, 8 pages, 2001.

DETERMINE YOUR BASIS…AND KEEP MORE TIMBER INCOME

Determine Your Basis…and Keep More Timber Income. Martin, J., University of Wisconsin-Madison, Department of Forest and Wildlife Ecology, Forestry Fact Number 71, 4 pages, 1994.

ESTATE PLANNING FOR FOREST LANDOWNERS: WHAT WILL BECOME OF YOUR TIMBERLAND

Estate Planning for Forest Landowners: What Will Become of Your Timberland. Siegel, W. C., Haney, Harry L., and Greene, J. L., U.S. Department of Agriculture Forest Service General Technical Report SRS-112, *General Technical Report SRS-112*, 2009.
www.srs.fs.usda.gov/pubs/gtr/gtr_srs112.pdf

FOREST LANDOWNERS' GUIDE TO THE FEDERAL INCOME TAX

Forest Landowners' Guide to the Federal Income Tax. Haney, H. L., Jr., Hoover, W. L., Siegel, W. C., and Greene, J. L., U.S. Department of Agriculture Forest Service Agricultural Handbook 718, 2001.
www.timbertax.org/publications/aghandbook

NATIONAL TIMBER TAX WEB SITE

This web site was developed to be used by timberland owners, and for accountants, attorneys, consulting foresters and other professionals who work with timberland owners by answering specific questions regarding the tax treatment of timber related activities.
www.timbertax.org

WHAT WILL A FOREST TREE EARN?

What Will a Forest Tree Earn? Stier, J. C. and A. J. Martin, University of Wisconsin-Madison, Department of Forest and Wildlife Ecology, Forestry Fact Number 38, 3 pages, 1988.

WHAT'S A FOREST TREE WORTH?

What's a Forest Tree Worth? Stier, J. C. and A. J. Martin, University of Wisconsin-Madison, Department of Forest and Wildlife Ecology, Forestry Fact Number 39, 5 pages, 2003.

WHEN TO HARVEST TIMBER – NOW…OR LATER?

When to Harvest Timber – Now…or Later? Martin, J. University of Wisconsin-Madison, Department of Forest and Wildlife Ecology, Forestry Fact Number 53, 8 pages, 2003.