

AGRICULTURAL ALTERNATIVES

Managing Small Woodlots

As a woodlot owner, you may have thought from time to time about your lot's future and what you might do to improve its condition and value. Most Pennsylvania woodlot owners use their lots for recreation, a place to hunt, or something to pass on to the next generation. Sometimes, though, woodlot owners want or need to harvest some timber from their woods. This is the time when you can improve your woods for the future or cause real damage from which it might not recover for generations.

This publication will help you understand how our forests grow, provide steps to planning for their management, and describe how to sell and market trees. You should carefully consider your decisions and seek assistance from a professional forester who can represent your interests in the selling and harvesting process. The investments you make at this point will pay great dividends in the future health and value of your woodlot.

Pennsylvania's Forests Today

Forests cover more than 17 million acres in Pennsylvania, representing about 60 percent of the state's land area. Private landowners own about 70 percent of the forests (12 million

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acres). County, state, and federal governments control much of the remaining forests (4.5 million acres, 23 percent). The forest products industry—once a significant landowner—now holds less than one million acres of Pennsylvania's forests. Now, timber investment management organizations (TIMOs) and real estate investment trusts (REITs) own and manage the larger privately owned forest tracts in the state.

Forests are important to Pennsylvania's economy. The forest product industry is the fourth largest manufacturing segment in the state, employing nearly 90,000 people and contributing more than \$15 billion to the economy annually. The Commonwealth is the nation's largest producer of hardwood lumber at over one billion board feet every year. Forests are also the source of millions of days of outdoor recreation that contribute an additional \$10–12 billion to the state's economy. Beyond their economic benefits, forests contribute to our quality of life by providing clean air and water, aesthetic views, stormwater control, and wildlife habitat.

Because private forests are a dominant land ownership class, it is clear that the decisions made by the estimated 600,000 private owners of one or more acres have a major impact on the economic, social, and ecological health of the state. Over time, as forest ownership has changed, most of these sales have tended to break holdings into increasingly small parcels. This process, now called parcelization, is another major threat to many of the values we associate with forests.

Forest History and Current Condition

Timber production has been a part of Pennsylvania's economic history since the first Europeans arrived, with the first sawmill established by Swedish settlers in Philadelphia in 1662. When Pennsylvania was given to William Penn by Charles II of England in 1681, about 90 percent of the province was covered by forests. At that time, Penn recommended that "care be taken to leave one acre of trees for every five acres cleared." During the next 200 years large tracts of land were cleared to produce charcoal for the iron industry and provide land for farms.

At the peak of land clearing in the 1890s, about two-thirds of the state was cleared. From the late 1880s through the 1920s, forest clearing provided essential farmland and met the nation's appetite for wood. During this period of forest exploitation, the area of forestland was reduced to less than 11 million acres. At the end of this period, forest-dependent industries such as leather tanning, wood chemical manufacturing, charcoaling, and sawmilling collapsed and economic conditions led to farmland abandonment. The forests then began the slow process of recovery.

Today our state's hardwood forests contain world-class oak, maple, and cherry. Gone are the extensive forests of white pine, hemlock, and American chestnut, which were either harvested or taken by blight. Forest inventories conducted by the U.S. Forest Service suggest that we have more tree volume growing in the state today than we have had in more than 100 years.

However, not all is good in the forest. Data suggest that about half of the forests in the state are in poor condition, unable to regenerate with desirable tree species. Insects, diseases, and harvesting practices are driving tree species composition change. Less desirable tree species such as red maple, black birch, and black gum are more common. All of our oak species are much less common. Invasive exotic plants such as multiflora rose, bush honeysuckle, ailanthus (aka, tree of heaven), autumn olive, and garlic mustard are severe competitors with native trees and plants. Competing native plants such as ferns, spicebush, and mountain laurel are also increasing in forest understories. Poorly conceived harvesting practices, known as selective cutting and diameter limit cutting, are shifting overstory species composition, removing desirable seed sources, leaving poorer quality

trees, and generally reducing forest economic and ecological values. Use of carefully applied science-based forestry practices is needed to restore forest health and provide future value to those landowners who will own and manage our forests tomorrow.

Managing Your Small Woodlot

The most important thing to consider as a woodlot owner is how you value your woodlot. Specifically, how do you currently use your woodlot, what do you value most (recreation, income potential, etc.), and what would you like to have for retirement or the next generation?

First, consider this question: How do you use your woodlot? Many people think about their forests primarily as recreational resources. Woodlots are a place to hunt, walk, or get away. You may also consider it part of your legacy, something to pass on to the next generation. When asked to rank the values they attach to forest, few people rank timber or the economic value of forested land as very important. A Penn State study conducted in 2006 asked landowners about the economic value of their woodlot. Unexpectedly, they had a reasonable idea of the value of the timber, but they were less well informed about the best way to manage their property for multiple uses. Landowners often find that woodlots have already been picked over, are in poor condition, and were unlikely to continue to pay reliable dividends without some care.

So, what do you value? Do you want to cash in on your trees from time to time? This can actually increase your woodlot's future value if it is done with attention to sustainability and proper forest management practices. Do you value hunting, seeing the big buck, or taking a turkey? Cutting timber will affect wildlife habitat, food sources, and possibly access to water. It is important to carefully think about your objectives and consider how decisions to manage your woodlot might change the things you value.

The Dynamic Forest

Forests change on their own every day in small and cumulative ways. Eventually, you become aware of these changes. A basic understanding of forest processes depends on a study of ecology. This helps us understand how forests change and how management decisions affect forest values.

Trees and all plants require certain amounts of water, nutrients, light, and space to grow. Every tree requires space to ensure that it can capture enough light, water, and nutrients. Forest management involves controlling the space around your trees so they can retain or increase their leaf surface and grow. Without proper management, "decisions" about how trees compete for growth resources are left entirely to natural competition.

Management Planning

To increase the value of your woodlot, careful planning is required. Writing a management plan will help you consider what you value about your woods and what you hope to achieve, and provides a schedule of activities to achieve your vision. Many woodland owners find they benefit from involving their family in these discussions and working with a forester who can translate their objectives into actions. The management plan should involve everyone concerned with the current operation and take into account future generations. If you plan to sell timber, a professional forester who understands your vision and works for you will ensure you market your wood well and conserve your woodland values. Many studies have concluded that professional foresters representing the seller are involved in less than one-fifth of timber sales.

Steps of the Management Plan

1. Determine both your short- and long-term objectives. What do you want from this woodland?
2. Assess the physical and biological characteristics of your woodland. Can this land meet your objectives? If not, what options do you have?
3. Develop a written management plan, which should include a time table for meeting your objectives.
4. Follow the management plan to ensure that you achieve your objectives.

Evaluating Your Woodlot

Before any marketing activities take place, you should be certain about your property boundaries. An accurate survey may be necessary. Your deed contains a written description of your boundary corners and is available from your county courthouse. An aerial photograph from your local Farm Service Agency office with the property boundaries is also helpful. A topographical map is useful for showing elevation changes, streams, and other landmarks. A soils map from your local extension office or conservation district will provide information for determining what tree species may be on your property.

There are two primary forest types in Pennsylvania: (1) oak/hickory (about 47 percent of forested land) and (2) northern hardwoods (about 40 percent of forested land). The oak/hickory type on deep, fertile soils includes red, black, and white oaks. Poorer sites in this type will also include chestnut oak. Red maple, black birch, hickory, ash, black gum, and white pine are also common in these woodlands. The northern hardwoods forest type is commonly associated with the Allegheny Plateau and with lower and northern-facing slopes in the central parts of the state. Tree species include sugar maple, beech, yellow birch, black cherry, ash, yellow poplar, and red maple.

Tree species, quality, board foot volume, and logging “chance” all contribute to the value of trees in your woodlot. Quality has a major impact on the income you will get from your woodlot and is determined by log form and length, presence of surface and internal defects, growing site (soil types), and location. Logically, proximity to mills and markets should affect price; however, if you have enough volume of high-quality logs, this is less of a problem.

Logging chance involves a lot of considerations. Site conditions—such as well-drained soils, for example—will permit logging during wet periods. Very steep areas that make road building or log skidding difficult will lower prices offered, as will flat sites with poor drainage. Proximity to water and stream crossings can increase logging costs. The volume of trees per acre, the shape of the sale area, distance to roads, time of year, owner-imposed restrictions on cutting, equipment needs, and myriad other factors all affect the price offered.

Saw and veneer logs are bought and sold on their board foot volume and grade. Three log rules are used in Pennsylvania for measuring the number of board feet in a tree: the International, Scribner, and Doyle. You should always know which log rule a buyer is using to ensure that you understand the price offered. As shown in Table 1, the volume estimate for smaller logs varies considerably depending on the log rule used. When the trees are about 20 inches in diameter at breast height (DBH; approximately 4.5 feet), the rules come together somewhat but still give different estimates.

Table 1. Comparison of board foot estimates from commonly used log rules for 16-foot logs in standing trees.*

TREE DBH (INCHES)	LOG RULE		
	INTERNATIONAL	SCRIBNER (BOARD FEET)	DOYLE
12	56	47	29
14	78	69	48
16	106	95	72
18	136	123	100
20	171	157	135
22	211	194	174
24	251	234	216
26	299	281	266
28	347	327	317
30	403	382	376

*Form Class 78.

Source: Daniel Cassens, “Log and Tree Scaling Techniques” (West Lafayette: Purdue University Cooperative Extension, 2001), www.extension.purdue.edu/extmedia/FNR/FNR-191.pdf.

Timber Marketing

If your management plan includes selling timber, approach the market thoughtfully. Selling timber is often a once-in-a-lifetime event that will have long-term impacts on your forests and what it provides to you and your family today and tomorrow. A good source of regional price information based on recent sales is the *Pennsylvania Timber Market Report*, which is produced quarterly. It is available from your local extension office or online at extension.psu.edu/timber-market-report. To help ensure the best possible outcome, take into account both price and forest health and productivity, and consider hiring a professional forester to work on your behalf.

Consulting foresters will charge a fee, which may be on a lump-sum basis, a percentage of the sale price, an hourly rate, or on units of work completed. Your consulting forester will mark the trees to be cut, determine the value of the marked trees, assist with the bid process, and inspect the woodland during the logging process. Fees charged by your consultant are an expense of sale and you can deduct them from the gross income, reducing your tax liability. To learn more about this, visit National Timber Tax Website (www.timbertax.org).

Your professional forester has two primary obligations: (1) to help you get the best return from your timber and (2) to leave the best possible residual forest to protect your management options. To do this, your forester will:

1. Negotiate a contract with you covering his/her responsibilities in preparing and administering the timber sale
2. Determine the volume, quality, and approximate value of the standing timber
3. Devise a plan to control the harvest procedure
4. Develop an erosion and sedimentation plan
5. Notify potential buyers of the impending sale and solicit bids
6. Collect and hold any completion bonds
7. Negotiate a contract on your behalf and keep your management plan in mind
8. Inspect the harvest operation frequently
9. Conduct a postharvest follow-up before closing the contract and releasing the bond

In preparation for a timber sale, your forester will prepare the documents used to solicit bids from potential buyers. He or she will also know which buyers are reputable and help you find the best possible price and harvesting outcome that protects your future investments.

You should also consult with your legal counsel during the contracting process when selling timber. Have your lawyer review the contract when you hire your forester and the resulting contract for the timber sale. These added steps may save you time and money in the future. Contracts should include all the details relating to the sale, logging, and any follow-up work the buyer is responsible for before closing the operation.

Table 2. Minimum size requirements for hardwood log grades.

LOG GRADE	LOG DIAMETER AT BREAST HEIGHT (AT 4.5 FEET)	LOG DIAMETER TOP OF BUTT LOG (AT 17 FEET)
Grade 3	12	9
Grade 2	14	11
Grade 1	16	13
Veneer	18	15

After the logging and follow-up are complete, inspect the woodlot with your forester to determine that all agreements have been fulfilled. Are there any roads to grade? Are there any places requiring stabilization to prevent erosion? Did the loggers remove any unmarked trees? All such questions need to be answered prior to the final settlement of the contract.

Sawtimber

Selling sawtimber, including veneer, provides the best economic return from your woods. The market for sawlogs has been quite volatile in recent years with changing economic conditions. Knowing exactly what you want to sell should be an essential part of a marketing plan. Your forester will help you in this process by reviewing your management plan and understanding how you wish to manage your woodlot. The forester will measure and mark trees for removal. As a rule of thumb you will need between 20,000 and 50,000 board feet of lumber to attract qualified buyers.

Marketable sawtimber trees will measure at least 12 inches DBH and have at least one 16-foot log before any major branching of limbs. In the marking process, trees to be cut should be marked at DBH and below the stump. Doing this ensures that the correct trees were harvested.

The quality of your timber or logs has a dramatic impact on the income you can realize from the sale. Log grades directly relate to lumber grades and greatly influence the price you will receive. Generally accepted log grades are grade 3 (low quality), grade 2 (medium quality), grade 1 (high quality), and veneer (the highest quality). Lumber grades project the yield of clear (knot free) boards of specific sizes. Several factors affecting the log or lumber grade are log straightness, size (see Table 2), and spacing of defects such as holes, knots, and splits. The grading rules for veneer are very specific. Veneer logs must be at least 18 inches DBH with no exterior defects. Red oak, white oak, and black cherry are our primary veneer species. Markets for veneer are seasonal and vary by location.

Pulpwood

Pennsylvania has markets for hardwood and softwood trees for pulp. Most pulpwood comes from trees between 4 and 12 inches DBH with a maximum of 20 inches DBH. Pulpwood harvesting is usually part of an integrated sale, which also involves sawtimber cutting. A well-planned, integrated sale

will focus on leaving the best growing and most desirable trees and removing their competitors. The amount of wood removed in a typical pulpwood sale might be 15–30 tons per acre, with hardwoods selling for \$1.50–3.00 per ton and softwoods for \$3.00–6.00 per ton. Clearly, the income generated from pulpwood harvesting is not large; but, if done correctly it can greatly improve forest health and growth.

Fuelwood

Fuelwood or firewood cutting is one of the lowest value crops you can take from your woods. Done carefully and as part of a thinning operation where cutting provides more crowning space for the remaining trees, it will improve your woodlot. You may sell wood on the stump or deliver it to the consumer as cut and split. Selling firewood on the stump involves the least amount of effort, but it also yields the lowest income. If you do not have experience felling, skidding, and processing trees, this is the safest option. In Pennsylvania, firewood must be sold by the cord (or fraction of a cord), which is a stack of wood 4 by 4 by 8 feet (approximately 128 cubic feet). Firewood on the stump may sell for between \$10 and \$25 per cord, depending on species and your location. If you have not previously removed wood from your woodlot, the first thinning may yield 3–8 cords per acre.

If you choose to cut, split, haul, and stack the firewood, you will need the proper equipment. This equipment may include a chainsaw, safety equipment (i.e., safety chaps, helmet, face shield, ear protection, and safety shoes), wedges, a splitting maul or mechanical splitter, and a pickup or trailer. A cord of wood split, delivered, and stacked may sell for \$100–200 (and sometimes more) depending on species, location, alternative energy prices, and demand.

Silviculture Practices

Silviculture is the theory (science) and practice (art) of controlling forest establishment, composition, structure, and growth. Establishment involves either planting or naturally regenerating the next tree crop. Composition involves matching the tree species to site and management objectives. Structure reflects the arrangement of the trees in and below the canopy in a woodlot. Growth addresses how individual trees and all trees receive site resources (i.e., light, moisture, and nutrients). A forester who understands your management objectives will use silvicultural practices to design and implement a plan to meet your short- and long-term goals.

Silviculture treatments promote the growth of the most desirable tree species. This normally requires cutting trees that are competing for light and space with the trees you want to grow. Allowing nature to “decide” which trees to remove will not necessarily result in a healthy or productive woodlot.

Because of the history of cutting in Pennsylvania, many of our woodlots contain trees that are roughly the same age. That means that the trees comprising the upper canopy all started at about the same time. This is often a difficult

Table 3. Distribution of trees by diameter class before and after an improvement cut in a 70-year-old, even-aged oak/hickory stand.

DBH CLASS (INCHES)	TREES PER ACRE		
	BEFORE CUT	AFTER CUT	TREES CUT
4	12	12	0
6	24	8	16
8	12	2	10
10	24	10	14
12	30	10	20
14	36	30	6
16	20	14	6
18	12	6	6
20	2	2	0
22	4	4	0
Totals	176	98	78
Average DBH	11.7	12.4	10.8

concept to grasp as the individual tree diameters vary greatly in any given woodlot. Relatively few truly mixed-age stands in Pennsylvania have three or more age classes comprising the stand. In even-aged woods, intermediate cutting is the primary silvicultural tool for improving the woodlot. Intermediate cutting removes the least desirable trees and allows room for the more desirable trees to reach their full potential.

An example of a silvicultural thinning that removed trees from the lower and middle part of the diameter distribution in the stand is shown in Table 3. In such a thinning you tend to retain the larger trees and cut trees that are in competition with one another to increase the average stand diameter. In this example, the average stand diameter before the cut was 11.7 inches and after the cut was 12.4 inches. By cutting this way, you keep the fastest growing trees, shorten the time to the next cut, and redistribute the growth in the stand to the more valuable trees.

Crown Classes

Because trees compete with one another for light, moisture, and nutrients, your management plan should focus on redistributing light to those trees that meet your objectives and respond with increased growth. In even-aged woods, understanding how trees compete in the forest canopy is important. Knowing where individual tree crowns are in the canopy and how they will respond to increased light is basic to implementing intermediate treatments or thinnings.

The crown is the uppermost part of the tree. It contains the smaller limbs and the leaves that collect sunlight and enable the tree to carry on photosynthesis. Crown classes are referred to as being dominate, codominate, intermediate, and

suppressed or overtopped. Dominate crowns are the largest in the forest. They receive sunlight from the top and some from all sides. Usually, when you look up, they are fully round. Codominate crowns receive full sunlight from the top and very little to no sunlight on the sides. These crowns are often flattened on one or more sides where they compete with other codominate crowns. Intermediate crowns are shorter but extend into the upper canopy of the forest. They receive limited sunlight from the top and no sunlight from the sides. Suppressed or overtopped crowns are the smallest trees and receive no direct sunlight from any angle.

Intermediate thinning harvests seek to improve conditions for the codominate trees by removing competition and encouraging them to develop fuller, more balanced crowns. Intermediate crowns, depending on the tree species and its shade tolerance, may also respond to thinning. Shade-tolerant species, such as hemlock and sugar maple, will also increase their crown size with more sun. Intermediate shade-tolerant species, such as red and white oak and red maple, may increase crown size, but you need to evaluate the percentage of the crown relative to the total height and its overall health. If these trees have less than 30 percent of their total height in leaf surface, they will likely respond very poorly.

The important point when conducting intermediate treatments is to avoid diameter- or species-driven cutting decisions. Select trees to improve the overall quality of the forest or woodlot. If you select trees only on size or species (for example, all the red and white oak), this is termed high grading. Tree DBH does not represent age well. Harvests designed to cut just big trees to release smaller DBH trees are likely poorly designed and will remove the best trees and leave only weak trees. Using these practices will greatly reduce overall productivity and future income, as well as greatly extend the time it takes to grow large, high-quality trees.

Eventually, after several intermediate thinnings in an even-aged woodlot, you will have to consider when to regenerate. If you have scheduled your thinning operations well, you should have advanced regeneration in place under the large overstory crowns. Your forester will help you achieve this outcome and advise you on when to do an overstory removal, releasing the next forest.

Crop Trees

Crop trees are those you wish to retain until later in the stand's development. It is often a good idea to select and mark these trees. By doing this, you focus on the trees you want to keep and can more easily decide which trees need to be cut because they are competing for light and nutrients with your crop trees. Crop trees should be desirable species, with healthy intermediate and codominate crowns, and have clean, defect-free trunks of good form. Avoid selecting crop trees with weak crowns or obvious defects. Crop trees should be evenly spaced when the stand matures, with 80–120 trees per acre. This is approximately one tree every 20 feet by 20

feet. These are only general guidelines; sometimes trees will be closer together. Always look up and consider how you can remove competition and help balance or round out the crowns. Providing room to grow is your target.

Conclusion

A properly managed woodlot can be viewed as a valuable savings account. Making sure that it provides income when you need it involves having an up-to-date management plan and working with a professional forester. Having a chainsaw and knowing how to fell trees does not make you a professional logger. Woodlots represent a commitment to stewardship. It takes four or five generations to grow a high-quality woodlot in Pennsylvania. One or two poorly planned and implemented harvests can destroy that woodlot for generations to come.

Sample Budget

Following are two tables that may help you predict future income from timber. Working with a consulting forester before making any decisions about timber harvest is highly recommended.

Budgeted costs and returns are often difficult to estimate because they are numerous and variable. Therefore, consider these yield and price estimates as an approximation

Table 4. Example yield per acre and stumpage value for an intermediate hardwood thinning.

DBH (INCHES)	NUMBER OF TREES CUT	VOLUME ¹	TOTAL VOLUME	TIMBER MARKET PRICE ²	STUMPAGE VALUE
6	16	0.11	1.76	\$1.44	\$2.53
8	10	0.16	1.6	\$1.44	\$2.30
10	14	0.24	3.36	\$1.44	\$4.83
12	20	56	1,120	\$221	\$247.52
14	6	78	468	\$221	\$103.43
16	6	106	636	\$368	\$234.05
18	6	136	816	\$368	\$300.29
20	0	290	0		
22	0	355	0		
Total	78				\$892.43 per acre

1. For trees 12 inches and larger with a log height of 16 feet. Measured with a 1/4-inch International rule. Volume is in tons per tree. Source: Richard G. Oderwald and James E. Johnson, "Measuring Standing Trees and Logs" (Blacksburg: Virginia Cooperative Extension, 2009), <http://pubs.ext.vt.edu/420/420-560/420-560.html>.

2. Based on Pennsylvania Timber Market Report, First Quarter 2010, Northwest Region private sales using low prices for 12 through 14 inches DBH and average prices for 16 and 18 inches DBH.

and make appropriate adjustments in the “Your Estimate” column to reflect your specific production and resource situation. More information on using crop budgets is available in *Agricultural Alternatives: Enterprise Budget Analysis*.

The income from an improvement cutting like that in Table 3 is used as an example. It represents removals from one acre of hardwoods following a typical thinning prescription that focuses on thinning in the smaller diameter classes and retaining larger trees. While this does not provide the highest immediate return, it will yield higher returns in the long term.

The assumption in this example is that all trees were scaled as only containing one 16-foot log. While this is not likely the case, it allows for using the volumes provided in Table 1 for standing tree volumes. To find volumes for other log lengths, refer to “Log and Tree Scaling Techniques” at www.extension.purdue.edu/extmedia/FNR/FNR-191.pdf. The estimated yields are based on measurement with an International log rule. To further simplify this example, red oak is the only species considered, which is an unlikely scenario for Pennsylvania forests. Harvest of a single high-value species such as red oak would be considered high grading and is not recommended. The second table, which lists a range of sawmill prices for various tree species, can be used to further refine the estimated income potential from your woodlot. Consult the most recent version of the *Pennsylvania Timber Report* (extension.psu.edu/timber-market-report) for the latest prices.

For More Information

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Online Resources

Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry:

www.dcnr.state.pa.us/forestry/index.aspx

Penn State Extension publications on private forests:
extension.psu.edu/private-forests/tools-resources/publications

United States Forest Service:

www.fs.fed.us

Table 5. Average log prices, by species and grade, reported by sawmills for delivered logs in northwestern Pennsylvania (early 2010 prices).

SPECIES	QUALITY				YOUR ESTIMATE
	GRADE 3 (LOW)	GRADE 2 (MED.)	GRADE 1 (HIGH)	VENEER (VERY HIGH)	
	(\$/MBF, INTERNATIONAL ¼-INCH RULE)*				
Red oak	189	380	571	700+	
White oak	124	255	386	700+	
Black cherry	372	702	1,032	2,000+	
White ash	78	138	197	350+	
Hard maple	166	260	354	—	
Soft maple	82	186	290	—	
Yellow poplar	59	144	229	—	
Misc. hardwoods**	38	58	78	—	
Pine and hemlock	17	27	35	—	

*MBF = thousand board feet.

**Miscellaneous hardwoods include beech, hickory, basswood, and black gum.

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