Chapter 1

Undervalued Hardwood Utilization from the Forest Manager's Perspective

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If new or expanded opportunities for adding value to species, sizes, and qualities of hardwood timber are to be successful, development efforts must be congruent with the needs of the front end of the supply chain—the hardwood forest resource and the owners and managers of that resource. Undervalued hardwood utilization will be feasible only where the current and future hardwood resource will support the development and where forest management objectives of forestland owners and managers will be supported.

The forest resources and decision makers that are part of this discussion are those in the Eastern United States. Western forest resources are omitted from this analysis due to the predominance of softwoods in the Rocky Mountain and Pacific Coast regions, where hardwood volume is less than 10% of total volume (Oswalt et al. 2014). The first edition of this book focused on hardwoods in the northern states (Erickson and Ross 2005). In this edition, we expand our discussion to include southern hardwoods because the South also has a higher volume of hardwoods than softwoods on timberland (Oswalt et al. 2014). In the North (20 states bounded by Minnesota, Missouri, West Virginia, and Maine), 80% of volume on timberland and 77% of roundwood harvest volume (such as sawlogs, veneer logs, pulpwood, fuelwood) is hardwood. In the South (13 states bounded by Texas, Kentucky, Virginia, and Florida), 58% of growing stock volume on forestland is hardwoods (Hartsell and Conner 2013), but hardwoods represent only 29% of roundwood harvest volume (Ince et al.2011, Oswalt et al. 2014).

When combined, the regions defined by the USDA Forest Service's Forest Inventory and Analysis program as the "North" and the "South" are referred to as the Eastern United States. The makeup of the "undervalued" hardwood component of the eastern forest can change meaningfully over time. These changes are brought about by changes in (1) the resource, (2) markets and trade, (3) the relative value of different species, (4) harvesting and processing technologies, and (5) landowner management objectives. Since the first edition of this book appeared, changes in markets and technologies have occurred that merit attention here.

Estimating the potential for and impact of expanded utilization of undervalued hardwoods in the Eastern United States is not an easy task. A reliable estimate of the potentials associated with a specific project in a defined location can be flawed—something we have seen repeatedly when a new manufacturing operation has started up only to shut down within a few years. For this reason, the goal of this chapter is simply to provide a broad overview of the range of forest management concerns that will come into play whenever and wherever undervalued hardwood utilization opportunities are deliberated.

In the context of this book, undervalued hardwoods are hardwoods that are not widely utilized in high-end consumer markets (such as cabinets, furniture, moulding). In addition, hardwood species that have a notable market share of high-end markets but for which that share is substantially lower than the species representation in the forest may be undervalued.

Eastern Forest Resource

Forests in the North are expanding. The land area of northern forests continues to increase, with 38 million acres of added forest land over the past century (Smith et al. 2009). Today, forests cover 42% of the land area in the 20 northern states. In the South, 40% of the land area is forested, whereas average forest coverage across the entire United States is only 33% (Smith et al. 2009). This trend, however, is expected to slow as the effects of urbanization in the North and South will impinge on forest land to a significant extent. By 2050, 21 of the 33 eastern states are projected to see the conversion of 9% or more of their forest land to urban areas (Nowak and Walton 2005). Six states that have large forest estates in the southeast are each likely to lose more than a million acres to urbanization by 2050. Awareness of these demographic shifts must be part of the planning process for new forest products manufacturing initiatives.

In addition, the ratio of forest growth to removals (such as harvesting, land conversion) is 1.9:1 in the North—the highest of any region in the country (Shifley et al. 2012). In the South, this ratio is 1.4:1 for all species and 1.7:1 for hardwoods (Hartsell and Conner 2013). The positive

growth-to-removals ratio that we have experienced for many decades has led to a situation in which the proportion of timberland in the sawtimber size classification is large and growing while the proportional distribution of poletimber and seedling/sapling forest area has been declining. In the North, this decline in smaller size classes has been especially noteworthy (Oswalt et al. 2014). This trend means that significant volumes of sawtimber are available and that eastern forests would benefit from increased harvest levels to diversify forest landscapes. A more diverse distribution of age classes and successional types is desirable for many reasons—forest health, wildlife habitat, and sustained forest productivity are among the most frequently cited.

Growth-to-removal ratios for species groups are particularly informative in considering the utilization potential of undervalued hardwoods. Three ways of measuring the availability of hardwood species groups are presented in Table 1.1. Change in sawtimber volume between 1963 and 2011 gives a meaningful long-term view of the changing structure of eastern forests. Using this measure, yellow-poplar, soft maple, cottonwood/aspen, and ash all showed increases in sawtimber volume of more than 300% (Luppold and Miller 2014). The relative utilization coefficient provides a means of comparing relative species harvest rates and sawtimber inventory levels (Luppold and Miller 2014). Based on this measure, the "other white oak" and soft maple groups are underutilized (Table 1, Luppold ad Miller 2014). The growth-to-harvest-removal ratios again point to soft maple, "other white oaks," and ash as having a growing presence on eastern timberland (Table 1.1). The only species group with a growth-to-removals ratio that raises concern is quaking aspen, with a ratio of 1; this ratio is expected to rise because several large plants that used aspen in the Lake States have shut down in the past decade (Luppold and Miller 2014). These ratios and results vary regionally and locally, which is why the Forest Inventory and Analysis's EVALidator tool is heavily used for planning purposes by forest products companies, consultants, and state and federal land managers (USDA 2015).

An important forest-based factor that may affect demand (and associated value) for different species is species availability. Species that are more sparsely distributed in the forest are less likely to be developed into high-end consumer products because obtaining sufficient volumes for fulfilling orders can be difficult. Examples of species that fit this description include basswood, sycamore, and beech. In contrast, there are species that represent only a small proportion of the timber volume in eastern forests but are high-valued—black walnut and black cherry are examples. The difference between these undervalued and highly valued low-volume species is that there are regions in which you can find a heavy concentration of walnut and cherry, and thus it is feasible for manufacturers in those regions to develop products and product lines made from these species.

Table 1.1—Three measures of utilization rates compared to changes in sawtimber volume for important hardwood species in the eastern United States[a,b]

Species/species group	Sawtimber volume change between 1963 and 2011 (%)	Ratio of growth to harvest removals	Relative utilization coefficient[c]
Yellow-poplar	+554	2.6	**1.2**
Soft maple	+464	4.0	**0.7**
Cottonwood/aspen	+322	1.4	**1.5**
Ash	+302	2.9	0.8
Black walnut	+272	NC	NC
Select red oaks	+233	2.9	0.8
Other red oaks	+224	1.7	1.3
Select white oaks	+211	2.4	0.9
Hard maple	+202	2.3	1.1
Basswood	+177	NC	NC
Other white oaks	+162	3.0	**0.7**
Hickory	+152	2.8	0.8
Sweetgum	+139	1.6	**1.5**
Beech	+44	NC	NC
Tupelo/blackgum	+30	NC	NC
Yellow birch	+13	NC	NC
Black cherry	NC	2.4	1.1
Quaking aspen	NC	1.0	**2.4**

[a]Adapted from tables in Luppold and Miller (2014).
[b]NC, not calculated.
[c]The relative utilization coefficient is based on a comparison of the relative rate of harvest compared to the species' relative sawtimber abundance, with underutilized species having a coefficient below 0.8 (in blue) and overutilized species having a coefficient above 1.2 (in red) (Luppold and Miller 2014).

Developing significant market opportunities for species that are sparsely distributed in the forest can be accomplished by incorporating them into products that can be made from a mix of species—laminated veneer lumber, I-Joists, and cross-laminated timbers, for example.

Another forest-based factor that influences utilization options is whether the species is one that tends to grow on upland or lowland sites. Harvesting of species growing on lowland sites can have additional costs and restrictions due to site accessibility challenges and environmental precautions that need to be taken to prevent degradation of the landscape and watersheds. Many hardwoods in the South that may be considered undervalued, even though they are found in high concentrations locally and regionally, fall into this category (such as swamp tupelo, green ash). Because of these harvesting constraints, using these species in products that can be made from a mix of species is the best option here as well.

Forest Ownership Considerations

Opportunities for expanded utilization of undervalued hardwoods are dependent on the forest ownership objectives and management plans of the forest landowners. In the eastern United States, this means the objectives of family and "other private" forest owners—such as timber investment management organizations (TIMOs), real estate investment trusts (REITs), forest industry—are relevant. In the northern 20 states and southern 13 states that comprise the eastern region, 55% and 58% of the forest land area, respectively, is owned by family forest landowners (Butler 2008). An additional 20% and 28% of the forest land area in the North and South are owned by "other private" entities. In sum, only 13% of forest land in the South and 25% in the North is publicly managed.

Family forest ownerships in the North have been shrinking in size, on average. This parcelization of forest properties is a concern. In the North, the average size of family forests is about 26 acres (Shifley et al. 2012). In the South, the average acreage of these family forest holdings is slightly larger, 29 acres, but further parcelization resulting from urbanization is a concern here as well (Butler and Wear 2013). About 60% of family forest lands in the eastern United States are less than 10 acres in size; conversely, about 60% of the acreage on these family forests is contained in holdings of more than 100 acres (Butler and Wear 2013).

The size of these ownerships is important because we know that the owners of larger forest land parcels are more likely to include timber harvesting as a management objective. Smaller forest areas are more expensive to manage, and harvesting activities become inefficient on smaller acreages. Nationally, 26% of landowners who own 47% of family forestland are motivated to harvest timber from their forests, whereas a substantially larger percentage of family forest landowners (37%) owning a much smaller percentage of the family forest acreage (21%) have nontimber management objectives including, for example, aesthetics, privacy, and wildlife (Majumdar et al. 2008). It is worth noting that family forest landowners in the South, overall, are more motivated by timber growth and yield objectives than are those in other parts of the country. Larger forest holdings may explain this to some extent, but the long history of forest industry activity in the South likely contributes to forest owners in the region having a stronger timber management orientation.

The types of harvests conducted by family forest landowners and how those harvests might impact the future forest are of interest here, too. Two intensive studies of recently harvested sites in West Virginia and New York paint a picture that matches the story told throughout the eastern hardwood regions (Fajvan et al. 1998, Munsell and Germain 2007). Based on reductions in average stand diameters, 80% of these harvests would be classified as diameter-limit cuts in which larger, higher value species were removed. Only 4% of stands received silvicultural enhancement treatments—in this case crown thinnings (Fajvan et al. 1998). With this type of "forest management" on family forest land having repeated itself over time and throughout the region, species shifts to less valuable species are occurring in the understory of many forests throughout the Eastern United States. If markets for small-diameter and undervalued species were available, the hope is that these markets would compel forest landowners to conduct intermediate and clean-up harvests that would enhance or rehabilitate the forest (Munsell and Germain 2007).

Markets

Owing to changes in consumer preferences, markets, international trade, economic activity levels, and new product development, the species, sizes, and qualities of timber that fit the definition of undervalued hardwoods will change over time. Currently, cottonwood/aspen, other red oaks, yellow-poplar, other white oaks, and sweetgum are significant eastern species or species groups that may be considered lower value. Of these, only yellow-poplar and other white oaks have growth to removals ratios that are 2.0 or greater (Luppold and Miller 2014). As recently as 2000, red maple would have been included on this list of lesser value eastern hardwoods—an example of how changing markets can recalibrate this discussion.

The use of lower value species has historically been for pallets and pulpwood. The development and growth of important engineered wood products markets—oriented strandboard (OSB) and laminated veneer lumber—in the 1990s allowed for increased utilization of several low- and medium-density hardwoods of lesser value. However, in the case of OSB, overcapacity and then the collapse of the housing market during the 2007–2012 time frame led to many plant closures. This means that areas where yellow-poplar, red maple, and other species were being well-utilized for a decade or more are once again underutilized.

Demand for hardwood roundwood in pulpwood markets has diminished significantly since 1997. In the Southern Region, which today produces about three-quarters of total U.S. pulpwood, the hardwood roundwood component makes up only 19% of that production (Bentley and Cooper 2015). In fact, hardwood roundwood amounts harvested for pulpwood in the South declined 40% from 1997 when production peaked (Bentley and Cooper 2015). The Bentley and Cooper (2015) map (their fig. 6) of pulpwood mills competing for hardwood roundwood in the South shows that most areas of Kentucky and south Florida lack demand for hardwood pulpwood and demand is comparatively light in Tennessee, North Carolina, Georgia, and the northern counties of Florida. It is expected that this map has a strong correspondence with regions in the South where landowners

lack meaningful markets for undervalued and small-diameter hardwoods. Lacking these markets, incentives for intermediate harvesting activities as well as stumpage prices per acre for terminal harvests will be depressed.

In the Northern Region, which produces only 15% of the Nation's pulpwood, hardwood roundwood is a larger component of pulpwood production than in the South, making up about 57% of volume (Piva et al. 2014). However, given the much lower levels of pulpwood production in this region compared with the South, only Maine, northern Wisconsin, northern Minnesota, and several counties along the spine of the Appalachians in Pennsylvania and West Virginia produced roundwood amounts comparable to those produced across the southern states (Piva et al. 2014, fig. 5). Current pulp market opportunities for undervalued hardwood roundwood are weak.

A discussion of hardwood roundwood use in pulpwood production must now be extended to include consideration of hardwood roundwood use in pellet production. Pellet production in the United States grew from almost 0 to nearly 20 million green short tons in 2013 (Abt et al. 2014). Sixty-two percent of pellet production capacity is in the South and about 28% in the North. Plans for new pellet manufacturing facilities are heavily concentrated in the South (82% of announced projects) (Abt et al. 2014), with almost all these targeting export pellet markets. The largest pellet plants are almost exclusively producing for European export markets, with smaller plants serving domestic and more local and regional markets (FutureMetrics LLC 2015).

Most pellet plants in the North utilize "clean" hardwood residues (sawdust, chips) from sawmills and other sources. This was true in the South as well until 2011, when both hardwood and softwood pulpwood showed up as part of the feedstock of several newly built, very large pellet plants targeting European pellet demand (Abt et al. 2014). In the South, the anticipated continued growth in pellet capacity indicates future price increases in both pine and hardwood non-sawtimber (poletimber/pulpwood) (Abt et al. 2014). For hardwoods, increased harvests in the South are not expected to exceed volume growth levels, but concerns about bottomland hardwood ecosystems being exploited (the export-oriented plants are located proximal to the coast and ports) are being raised (Drouin 2015). Growth of the pellet industry in the Southern Region has started to ramp up demand for undervalued hardwoods on forest land near large pellet plants, so demand for undervalued hardwoods will likely raise prices in the coastal states where these operations are locating.

On the horizon and covered in a subsequent chapter of this book is the development of cross-laminated timber (CLT) manufacturing capacity in the United States, including development of hardwood-based or mixed hardwood and softwood CLT panels. In Europe, CLT production has flourished much as wood pellet manufacturing has flourished in the United States since the turn of the century. The American standard for CLT inclusion in construction was published in 2012 (ANSI/APA 2012), but the standard allows for only certain softwoods to be used in manufacture. Research is being conducted to examine the technical feasibility of expanding the standard to include yellow-poplar, red maple, and possibly other lesser value hardwoods. An important difference to note in comparing CLT's potential with that of wood pellets is that we can expect the value-added margin in producing CLT to be greater than for wood pellets.

A final forest product market that is not now impacting the supply and utilization potential of undervalued hardwoods, but could in the future, is forest carbon offset payments. Carbon offset programs, especially ones that are tied to property tax reductions (Miller et al. 2012), could increase the participation rate of landowners in forest management planning and forest improvement projects. This, in turn, could lead to a change in stand structures and species distributions.

Ecological Impacts

Expanded use of undervalued hardwoods with the development of new and expanded engineered product markets should be positive for a wide spectrum of forest ecological outcomes. The risk of negative impacts on some measures of forest sustainability cannot be dismissed; especially if the harvests are conducted in an exploitive, unplanned fashion without regard for future ecological, economic, and social benefits.

Comparing different intensities of terminal harvests to natural disturbances such a wind and fire offers several insights (Berger et al. 2013):

- Soil nutrient retention impacts of conventional clearcutting (CC) practices are minimal, but the impacts of an energy-wood (EW) type harvest of shorter rotation stands can lead to declines in Ca, K, and Mg.
- Ground layer plant species richness impacts of CC and EW harvest can lead to a minor increase in vascular plant species richness and a potential minor decrease in nonvascular plant species richness.
- Bird and small mammal populations may decline minimally to significantly after a CC, depending on the size of the harvested area, but most species will recover. An EW harvest with shorter rotation stands can lead to significant impacts due to loss of ground cover, ground nutrients, and mast.
- Aboveground carbon losses are large with CC but recover over about 100 years. With EW harvest they are large and can recover but also could lead to decline in site productivity.

- Soil carbon losses are minimal for a CC but can potentially decline and lead to reduced site productivity with an EW harvest.
- Aquatic system nutrients, sediment, and water impacts after a CC leads to an increase in nutrients, sediment, and water yields that recover with vegetation regrowth. EW harvest impacts are larger and can lead to acidification.

Summary

The positive growth-to-removals ratio that we have experienced for many decades has led to a situation in which the proportion of timberland in the sawtimber size classification is large and growing while the proportional distribution of poletimber and seedling/sapling forest area has been declining. This trend means that significant volumes of sawtimber are available and eastern forests would benefit from increased harvest levels to diversify forest landscapes. A more diverse distribution of age classes and successional types is desirable for many reasons—forest health, wildlife habitat, and sustained forest productivity are among the most frequently cited.

In the northern 20 states and southern 13 states that comprise the eastern region, 55% and 58% of the forest land area, respectively, is owned by family forest landowners (Butler 2008). An additional 20% and 28% of the forest land area in the North and South are owned by "other private" entities. Family forest ownerships in the North have been shrinking in size, on average. This parcelization of forest properties is a concern. The size of these ownerships is important because we know that the owners of larger forestland parcels are more likely to include timber harvesting as a management objective. Smaller forest areas are more expensive to manage and harvesting activities become inefficient on smaller acreages.

The use of lower value species has historically been for pallets and pulpwood. The development and growth of important engineered wood products markets— OSB and laminated veneer lumber—in the 1990s allowed for increased utilization of several low- and medium-density hardwoods of lesser value. However, in the case of OSB, overcapacity and then the collapse of the housing market during the 2007–2012 timeframe led to many plant closures. This means there are areas where yellow-poplar, red maple, and other species that were being well utilized for a decade or more, are once again underutilized.

Demand for hardwood roundwood in pulpwood markets has diminished significantly since 1997, especially in the South. However, the advent of the pellet manufacturing industry has provided a new market option for some of the same hardwood pulpwood material.

Expanded use of undervalued hardwoods with the development of new and expanded engineered product markets should be positive for a wide spectrum of forest ecological outcomes; however, the risk of negative impacts on some measures of forest sustainability cannot be dismissed.

Undervalued hardwood utilization will be feasible only where the current and future hardwood resource will support the development and where the forest management objectives of forest landowners and managers will be supported.

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Abstract

This report summarizes information on the use of wood from hardwood species in engineered materials, components, and structures. It includes information on use in a wide variety of engineering products and applications.

Keywords: Wood; hardwoods; engineered products

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