Woodlot Management for Fuelwood
Michigan State University
Cooperative Extension Service
M.R. Koelling, Department of Forestry
D.I. Dickmann, Department of Forestry
March 1981
6 pages

Extension Bulletin E-1486, March 1981, FILE 24.71

WOODLOT MANAGEMENT FOR FUELWOOD

M.R. Koelling and D.I. Dickmann
Department of Forestry

Wood, long used as a principal source of energy, supplying warmth for the home and heat for cooking, is once again gaining popularity as a fuel. Renewed interest and emphasis on fuelwood results from continuing increases in the price of fossil fuels, primarily oil and natural gas, which have been the standard fuel sources for most American homes. Electricity, whether generated from natural gas, oil, or coal, has also experienced rapid increases in price.

At the same time, concern that all fossil fuel supplies will eventually be depleted has contributed to interest in wood, because it is renewable. An additional factor is the development by many manufacturers of wood-burning units of improved design and efficiency.

With increased demand for wood, the question of future availability has often been asked. Concern exists that the forest resource is insufficient to supply expected demand. This potential does exist; however, the hardwood forest resource in Michigan is large. Presently, growth of hardwood species exceeds amounts harvested by nearly a three-to-one ratio*. Total net volume of available hardwood trees suitable for fuelwood and other commercial uses is increasing annually.

While the present hardwood resource is adequate, it must be managed properly. Careful judgement should be used in selecting those trees to be harvested for fuelwood and those trees which should be left for producing sawlog and veneer log materials. When managed properly, most hardwood woodlots can produce large amounts of fuelwood as well as other products, including veneer and sawlogs (Fig. 1).

**In the past two decades, the net annual growth of timber in Michigan has been considerably higher than removals of timber. In 1954, net growth exceeded removals by 314 million cubic feet, or by 176 percent. In 1965, net growth exceeded removals by 373 million cubic feet, or by 180 percent. Growth of sawtimber surpassed removals by 593 million board feet, 108 percent, in 1954, and by 1,165 million board feet, 141 percent in 1965. For 1975, these differences were even larger due in part to a slow-down in the forest products economy (Michigan Forest Resources 1979 - An Assessment, Michigan Department of Natural Resources.)*

Figure 1. A well-managed woodlot, such as this northern hardwood stand, can produce both fuelwood and high quality sawlog and veneer material.

What is Woodlot Management?

A forest does not require management to produce usable products. However, if concern exists about the efficiency of production, the quality and quantity of products produced, and regeneration of the forest, then some management practices are necessary.

A woodlot should be managed to grow products which have the highest economic value, unless the landowner has other objectives. Even though logs may be your ultimate objective, other products (such as fuelwood) can be produced along the way. To do this, certain management practices, such as periodic thinning, are necessary. The material removed in these thinnings, plus damaged or defective trees, is an excellent source of fuelwood.

Specifically, three objectives should be considered as a part of woodlot management. These are:

1. Influence the species composition of the woodlot. Nature is prolific and most hardwood woodlots contain an adequate number of species. However, not all have equal value for the production of high quality products. Certain species, including sugar maple, American basswood, black walnut, white ash, yellow birch, black cherry, yellow poplar, red maple, and white, red and black oak represent the most valuable hardwood species. These species should generally be favored in all hardwood forest stands. Ironwood, sassafras, various hickories, elm, cottonwood, pin cherry, American beech, aspen and white birch have lower value and generally are discriminated against in mixed hardwood stands managed for timber products.

2. Regulate stand density to maintain maximum tree growth rate. Each acre of forest land has a certain potential for producing an annual volume of wood. This potential is the result of soil fertility properties, moisture relationships and other factors which contribute to the productivity of a particular site. In an unmanaged stand, this growth potential is distributed on all individual trees present, including those of desirable as well as undesirable species, and on trees of both good and poor form. To encourage maximum growth rates on desirable species, it is necessary to reduce the stocking of the stand so that the annual growth potential of the site is distributed on few trees. Often, this requires that the woodlot be thinned. Thinning usually results in removal of undesirable species as well as some desirable species which are too close together to permit maximum growth. This thinning process must be repeated at periodic intervals in the life of the stand to compensate for increases in the size of trees.

3. Provide for regeneration of the forest. An essential component of forest management is making provisions for the forest stand to regenerate itself. The concept of a renewable forest resource is based on the continual re-establishment of young trees to replace mature and harvested trees. Under ideal conditions, most hardwood forests contain many seedlings and small saplings. There are fewer trees present as size increases. Obviously, not all seedlings will mature into merchantable trees; however, enough must be present to maintain a stable, well-stocked forest. Regeneration of desirable species in hardwood stands is usually influenced by the type of harvesting methods used. Hardwood woodlots must be protected from grazing by livestock to permit the establishment of new seedlings.

How to Practice Woodlot Management

The management practices needed in a particular woodlot will depend on its specific condition. This will be influenced by what has happened previously in the woodlot (past logging practices, insect and/or disease problems, grazing history, fire, etc.). Most Michigan woodlots have not been managed as a renewable crop; instead they have been harvested periodically with little or no thought given to improving the condition of the woodlot. Only the most desirable trees have been removed, leaving defective

Figure 5. Trees harvested during thinning operations can be used to produce fuelwood.

to tree diameter. Multiply the diameter of the tree (measured in inches at 4.5 feet above the ground) by 1.67 to find the proper radius in feet around the tree within which competing trees should be cut. As an example, an 8-inch diameter tree should be spaced approximately 13.4 feet (8 x 1.67 = 13.36) from adjacent trees for maximum growth on that tree and throughout the entire forest stand.

Since trees of varying sizes are usually present, different spacing requirements are necessary. Determine the average diameter for all trees in the stand and then compute an average spacing diameter. For example, if 6-inch, 8-inch and 10-inch trees are present, the average spacing distance would be 13.4 feet (the sum of (6 x 1.67) + (8 x 1.67) + (10 x 1.67) divided by 3 or (10.0 + 13.4 + 16.7)/3 = 13.4). Some adjustments within the woodlot may be necessary if groups of larger and/or smaller trees are present.

Using this approach, the following table has been prepared to indicate proper spacing and numbers of trees present for forest stands with trees of varying diameters:

Diameter (inches)	Distance Between Any Two Trees (feet)	Number of Trees Per Acre
3	5.0	1742
4	6.7	970
5	8.4	617
6	10.0	435
7	11.7	318
8	13.4	243
9	15.0	194
10	16.7	156
11	18.4	129
12	20.0	109
13	21.7	93
14	23.4	80
15	25.0	70

These values represent ideal spacing which in practice may be difficult to achieve. Individual tree characteristics and position within the stand will probably not permit this type of distribution. This is not a serious problem. Remember that growth will occur following thinning and trees will increase in size. Within a few years, depending on how fast the trees respond, it will be necessary to re-thin the stand. In this and later thinnings, spacing adjustments can be made.

Fuelwood Production

Once selection and marking of desirable trees (crop trees) has been completed, the remaining stems (3-inches and larger in diameter) should be removed. (Fig. 5). In many woodlots, these trees will be up to 10 inches or more in diameter. These sizes are excellent for fuel. After cutting into 16- to 24-inch lengths (depending on the size of burning units) split, and stack the wood to permit rapid drying (Fig. 6). Most wood should be allowed to dry for 6 months or more, depending on the species and season of cutting. It is best to stack wood off the ground in a location exposed to the sun. It is also advisable to cover the top of the stack.

In second and subsequent thinning operations in the same stand, some material may be produced with a greater value than fuelwood, especially in stands with larger diameter trees. Trees 12 inches or larger in diameter can usually be sold as sawlogs and generally, should not be converted into fuelwood. However, many other smaller trees or trees unsuitable for sawlogs will be available for fuel. In addition, the tops of all harvested trees will contain large amounts of material suitable for fuelwood.

Figure 6. Splitting and stacking fuelwood will significantly reduce the amount of time required for drying.

Suggestions for Managing Specific Forest Types

There are several hardwood types present in Michigan, and fuelwood of high quality can be produced from each. Some management suggestions are given below which can help you keep woodlots of these forest types in continued production.

NORTHERN HARDWOODS - Several species in this forest type are excellent for fuel, including sugar maple, white ash, American beech, yellow birch and northern red oak. These species are also of high value for sawlogs and veneer and should be favored in any management operation. Species in this group such as sugar maple and beech are very tolerant of low light; thus, reproduction of new trees is usually not a problem. Other species require openings to allow light to penetrate to the forest floor. Species like yellow birch also require some soil disturbance before seeds will germinate. Northern hardwood forests are very susceptible to injury from grazing, which, unfortunately has been a common practice in the past. These stands tend to be all-aged with trees of varying sizes present. Most stands are too dense and should be thinned. Ironwood is a common weed species which should be removed in the fuelwood harvesting and thinning operations.

MIXED OAK-HICKORY - Oak stands are present in both southern and northern portions of the State. In southern Michigan, black, red and white oaks occur together with hickory, black cherry and sassafras. All species are suitable for fuelwood, with hickory and white oak especially desirable. Reproduction is often difficult to obtain in many oak stands. Adequate regeneration can be encouraged by cutting trees in small groups to create small openings in the stand.

In northern Michigan, oak is often present on sandy soils which tend to be drouthy. These oaks generally are of low quality for commercial lumber production but are excellent for fuel. They are also valued for acorn production, an important source of food for many species of wildlife. Reproduction from seed is difficult to obtain. Oaks should generally be clear-cut in small patches with regeneration developing in part from stump sprouts.

In some areas, pine may be growing on the same site. Pines should usually be favored because of higher economic values.

LOWLAND HARDWOODS - Many areas of poorly drained soil support hardwood forests composed of red and silver maple, swamp white oak, white and black ash, cottonwood and black willow. American and slippery elm were formerly important species in this type. White ash, swamp white oak and red and silver maple are valuable for commercial products and should be favored. Often these stands are very heavily stocked and contain large numbers of trees. Wood of species like cottonwood and willow does not provide a long-lasting fire; however, when burned in stoves with a controlled draft such wood is satisfactory. To encourage reproduction of desirable species like oak, clear-cutting in small patches is recommended. Where other species are present, individual tree selection is suggested. Access may be a problem in many areas at certain times of the year due to wet soil conditions.

ASPEN-BIRCH - In the northern portion of the state, many areas consist of nearly pure stands of aspen and birch. These stands tend to be even-aged with many trees of nearly the same size. These species are not usually valued for fuelwood because of their low heat value. However, the light, nearly white color of both aspen and birch makes for visually attractive fuelwood. Both aspen and birch need an exposed soil for maximum regeneration. Thus, clear-cutting in small groups is recommended. Aspen sprouts prolifically from the roots, whereas birch is a vigorous stump-sprouter. Therefore, both will very quickly re-establish themselves. An individual tree selection method of harvest will not allow for regeneration of either aspen or birch stands. Both trees are generally short-lived (40 to 60 years) and should not be expected to attain large size. If not harvested by a clear-cutting system, other species including sugar maple, American basswood and white pine may eventually replace aspen and birch.

Figure 2. Many Michigan woodlots contain a scattering of older, mature and often defective trees with few trees of sapling or small pole size present.

and low-value trees to occupy an increasingly larger portion of the stand. Until recently, most farm woodlots have been grazed by livestock. Accordingly, the typical woodlot contains much low-grade, often defective, older material. Few mature, merchantable trees are present although reproduction of desirable species is generally adequate. (Fig. 2). Likewise, a large number of potentially high quality stems may be present, although they are usually of small size. Most of these younger-aged stands need to be thinned.

A few Michigan woodlots developed following total harvest of the original forest or after a fire. These hardwood stands are usually even-aged, with many stems approximately equal in size. These woodlots are generally overstocked and may contain very few large-diameter trees. Their greatest need is for thinning to encourage more rapid growth of the remaining stems.

Figure 3. Large, defective trees, such as these beech, should be harvested to permit the establishment of desirable reproduction.

Priorities for Management

One of the first management steps is to remove defective, damaged and otherwise undesirable trees. (Fig. 3). Such trees, regardless of how long they are permitted to grow, do not have the potential of developing into high value material. Quite often, they occupy a large amount of growing space which could be used to produce trees of higher value. In addition, their crowns are usually large and reduce the amount of sunlight reaching the forest floor, preventing reproduction of desirable species. These trees are often quite big and contain large amounts of excellent fuelwood. For example, it is common for large trees of species like American beech or northern red oak to yield 1½ to 2 standard cords (4 to 6 face cords) of fuelwood.

Following removal of defective larger trees, most woodlots still need to be thinned. (Fig. 4). The first step in thinning is to select and mark those trees in the woodlot which are of a desirable species and of good form. These trees, often referred to as crop trees, make up the stand which should be managed to produce the highest value products possible, usually sawlogs and veneer logs. The following guidelines should be helpful in selecting these trees:

1. Select trees of species with high potential commercial value.
2. Choose individual trees which have a straight single stem and are free of apparent defects.
3. When possible select trees that are at least three inches in diameter.

The total number of trees left on each acre will vary, depending on the size of the individual trees present and other conditions of the site. Since more growing space is required as a tree increases in size, larger diameter trees must be spaced farther apart than trees of smaller diameters. One approach to spacing is to use a constant-multiplier factor related

Figure 4. The first step in thinning is selection and marking those trees of desirable species and form which will be permitted to develop into high value products.

Figure 7. It is possible to establish fuelwood plantations of relatively fast growing species; however, present economic conditions may not make this feasible.

CONIFERS - Generally speaking, conifers such as pines, spruces, tamarack, cedar and fir are not widely used in Michigan for fuelwood. This is largely the result of the ready availability of dense hardwoods which have higher fuel values per unit volume. The wood of most conifers burns rapidly when dry, producing a hot fire, but one which does not last very long. However, when split into small pieces, coniferous woods make excellent kindling.

If it is necessary to use any of the several cone-bearing species in the state as fuelwood, tamarack, jack pine and red pine are preferred over white pine, white spruce, balsam fir or white cedar because they have higher heat values per unit volume. This is due in part to increased density and greater resin contents. When compared to hardwood, most conifers have a tendency to produce sparks, a fair amount of smoke, and generally have poor coaling qualities.

Fuelwood Plantations

With continuing increases in the price of fossil fuels and firewood, interest is often expressed in the possibility of establishing fuelwood plantations. Such plantations can be established; (Fig. 7) however, at current land and fuelwood values, it is doubtful if they are economically feasible, especially on a small scale. The primary difficulty is the length of time required to produce a product of a size large enough for conventional fuel. A minimum of 10 to 12 years would be required for rapid-growing species, whereas slower-growing species with denser wood may require 20 years or more to develop conventional size fuelwood. Most individuals thinking of establishing a fuelwood plantation are better advised to purchase an existing hardwood woodlot. Such a forest of 10 acres or more in size, if actively managed, should provide enough fuel annually to heat an average-sized home on a continuing basis.

While commercial concerns, with equipment for converting standing trees to chips, may find fuel plantations profitable, it is doubtful if individuals can. The financial return on the investment required is too small at present. However, if land is available and the total cost of the planting is not to be charged solely to fuel production, it is possible to supplement future fuelwood supplies by planting trees. The satisfaction associated with growing one's own fuelwood and assurance of supply may also partly offset the costs involved. Species which will grow rapidly include hybrid poplars, cottonwood, sycamore, silver maple, box elder, tree-of-heaven, green and white ash, and Chinese elm. English oak, red oak, and black locust also grow rapidly and produce a wood of high density. Growth will be most rapid on well-drained loamy soils. A spacing distribution of no closer than 8 x 8 feet should be used. Adequate preparation of the site before planting, together with the use of intensive weed control practices during the first few years following planting are necessary to assure high survival and encourage rapid growth.

MICHIGAN STATE UNIVERSITY
CES
COOPERATIVE EXTENSION SERVICE

MSU is an Affirmative Action/Equal Opportunity Institution. Cooperative Extension Service programs are open to all without regard to race, color, national origin, or sex.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

1P-10M-3:81 TP, Price 20¢, Single copy free to Michigan Residents