Timber Income Potential from Small Forests in the Missouri Ozarks

John H. Farrell

PAY TO THE ORDER OF _Woodland Owner_ ____s ?

? ? ? and no/100 ____

DOLLAR

A. Timber Buyer

THE AUTHOR

DR. JOHN H. FARRELL joined the Central States Station staff in 1957 as a forest economist. He was assigned to work on forest ownership, forest industry economics, and forest production economics studies in Missouri. He authored five publications in this field as well as others in economics and silviculture before joining the Station staff. John studied forestry and public administration at Syracuse University, receiving his doctorate in 1952. He has been an officer in the U.S. Air Force, an instructor in forest management and silviculture at Syracuse, and a Supervising Forest Appraiser for the New York State Board of Equalization and Assessment. John is now Staff Assistant in the Division of Programs and Special Projects in the Washington office of the Forest Service. He is a member of American Society for Public Administration, Society of American Foresters, Sigma Xi (National science honorary society), American Association for the Advancement of Science, and Alpha Xi Sigma and Xi Sigma Pi (forestry honorary societies).

Foreword

This study originated in the late 1950's because of the growing belief among public leaders in Missouri that Ozark forest resources could contribute more toward the economy only if more were known about them. The importance of forests to low-income areas in the Region was recognized by many.

People who lived, worked, traveled, and played in the Ozarks were also aware of its great problems. They sensed that a vast potential was not being fully utilized. But more often than not the conservation-minded among them were troubled for lack of a measure to use in their judgment.

On parts of the land an old paradox puzzled many thoughtful persons too — extensive land clearing progressed alongside land abandonment and reversion.

It wasn't thought that all the Ozark's problems could be answered at once, but it was judged necessary to take a look at some basic ones. Fundamental to this effort was a measurement of forest production potential on the many small tracts of the Region. Comparison with other land-use alternatives could come later once a yardstick was available. The yardstick might also serve other uses within public forestry programs. The search for answers led to this result.

Small forests dominate the Region and have economic factors which differ from those of large tracts or public land. While parts of this study apply to most forests in the Region (yield data for example), the evaluation here aims specifically at the small forest (less than 5,000 acres). Comparison in any other context should be made cautiously because factors of scale, integration, taxation, and law alter the economic framework.

In the research an understanding was sought of the regional pattern of the past as an indication of what might reasonably be expected ahead. Prediction, however, was neither the aim of the study nor its result. Instead, a tool was fashioned that might be revised, updated, or rebuilt in the future as needed but one that would be useful in some degree whatever the existing state of knowledge.

The type of problem involved dictates a broad view of the subject. The reader seeking his special case here won't find it, but he will find a means to analyze his case deeply and gauge his own resources more closely.

Acknowledgments

Briefly Speaking

Owners of many small forests in the Missouri Ozarks face an economic question: What is the potential for timber production on land where forage may offer an alternative income? This study sought information to assist in answering this question where timber production was a realistic possibility. The main points learned were:

IN MANAGED TIMBER STANDS

At today's stumpage prices with low production costs, Site 2 hardwood land in the Missouri Ozarks can yield a profit to the owners of about $80 to $380 per acre per rotation period.

With high stumpage prices in the range of $30 to $40 per thousand board feet, which might be realized in future markets, and a hardwood pulp market for thinnings, net returns of about $380 to $630 per acre appear possible from such sites.

Even with high costs of management sometimes encountered in the Region today, if stumpage prices up to $40 are realized, hardwood stands on medium sites can net up to $265 per acre per rotation, depending on price.

High management costs can be sustained by Ozark timber stands under some conditions. Because of potentially greater yields, more can be spent for production on the good timber sites than on poor ones. Cumulative total costs, including interest charges, may range from about $90 to $530 per acre over a rotation period for common management expenses encountered in the Region. Gross potential returns may range from $170 to about $725 per acre on Site 2 hardwood land and about $410 to $1,300 on similar-quality pine land under intensive management.

Ozark landowners who have managed their timber under a variety of conditions short of a full rotation, show net returns at maturity ranging from about $10 to $240 per acre.

IN UNMANAGED TIMBER STANDS

Owners of typical hardwood timber stands on Site 2 land in the Ozarks today should not expect profit at present costs and stumpage prices over a rotation period if all they do is invest in land and pay taxes, without managing the timber for greater production.

On the other hand, pure pine stands under similar conditions on Site 2 land can return a profit even without timber management. This is indicated where timber yield as low as 40 percent of potential occurs. However, the acreage of pure pine stands in the Region is small.

At moderate costs, unmanaged hardwood stands producing as much as 3,500 board feet per acre at harvest would be marginal under the best conditions. Stumpage prices must rise more than threefold before a break-even point is reached.

Where fully stocked hardwood stands capable of producing maximum sawtimber yields can be found, stumpage prices greater than $15 per thousand board feet must still be realized, along with moderate costs, before net returns without management exceed the break-even point. Such yield potential is not common on many unmanaged small forests in the Region today.

Hardwood land with trees averaging only one 16-foot log at maturity (Site 1) is submarginal for timber production without management under present-day cost and price conditions. Stumpage prices of $26 or more are required before these stands will yield returns equal to interest on Government bonds under medium cost levels. What Site 1 land can do under timber management awaits further research on timber yield.

MANAGEMENT OPPORTUNITY

Owners of well-stocked forests who bought the land at low prices and pay low to average taxes are in an excellent investment position. Comparatively high net gains are possible at present cost-return ratios, particularly if investment periods are short and timber stands are managed. The cost-return ratio possible under management was about 1:3 on the small forests within this study.

Contents

Timber Income Potential from Small Forests in the Missouri Ozarks

John H. Farrell

The feasibility of growing timber on forested sites in the Ozarks where forage may be an alternative use has often been questioned. This report provides the means to help answer this question.

This analysis is primarily for foresters, landowners, and public officials who are interested in land management, land use, and land policy. It approaches the question by presenting the general economic situation in which the appraisal is made, the specific market pattern of the Region and its strength, the general management system that governs forest production, and a means of estimating timber-production returns. Technical detail is held to a minimum. For sake of clarity and understanding, however, some that is essential is given.

The data were obtained from numerous sources, published and original. Actual cases of managed forests are used along with information from field measurements on these tracts and on the Clark and Mark Twain National Forests. To complete the analysis forest managers and owners were interviewed and empirical estimates of timber yield applicable to the Ozark Region were used.

Underlying the method used in this evaluation is one basic assumption: timber stands are scientifically managed to the time of final sawtimber harvest. That some owners may not carry management this far, or conduct it in this manner, is irrelevant. The study is directed at the question: What is the income-producing potential of Ozark forest land used or suitable for growing sawtimber?

In the major sections that follow, a specific pattern is developed to guide the reader. Each section discusses in depth one aspect of the broad subject; the combined sections make up the economic "model" followed in the analysis. First, land-management history and habits peculiar to the Region explain the social and economic backdrop against which production must take place and which influences the development and operation of the production system. Next, the resource and the management techniques believed essential for timber production are described. This sets the stage for discussing the timber volumes that can be expected with and without management. Then, the market pattern, strength, and present and potential value are reviewed. A comparison of cost and returns concludes the analysis by relating all elements specifically for expected Ozark conditions. This is followed by a general estimate of the future outlook for timber production in the light of today's knowledge. And finally, a Practical Application section at the end shows the reader how to apply the information and principles presented to a specific case of his own.

The Ozark Situation

The Missouri Ozark Region is a natural forest area (fig. 1). Forest cover still occupies more than 60 percent of the land after a century and a half of effort to clear it (29, 32).[1] The Region is a hilly, heavily dissected former plateau extending across Missouri in a northeast-southwest belt that separates the northwest prairies from the southeast bottomlands.
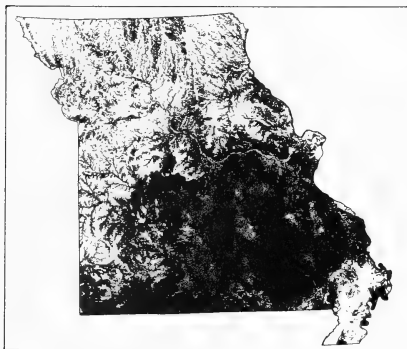
FIGURE 1.—The Missouri Ozark Region occupies the southern part of the State where forest land predominates. (Compiled from aerial photographs by Missouri Conservation Commission.)

ECONOMIC RESOURCES

Production resources in the Ozarks come mainly from farm and forest, although other activities, including recreation and mining, are also encountered. Farm production is largely geared to the livestock industry; forest production depends upon the lumber industry (35, 56). Both are widely established. Recreational use of forest land can also be expected to ex-

pand in the future, further increasing pressure on available timberland for alternative uses. A large mining industry in the eastern counties of the Region, although important, is not in competition with these three uses for major areas of land.

LAND-USE PROBLEMS

Land Clearing

Before the 1930's, most Ozark forests were badly abused. Heavily cut for all salable timber, most areas of forest remaining after early logging were stocked with trees too small or too seriously defective to be marketable. An estimated one-third of the land area burned over each year. Cattle and hogs, first brought into the Region during the early 1800's by settlers from Kentucky, Tennessee, and Virginia, freely ranged the woods.

Public forestry and conservation programs begun during the 1930's marked the beginning of improved land-use. From that beginning, fire protection has been extended to 11½ million acres of forest land. Managed timber cutting on public land has increased widely. Free ranging of livestock in the forest has dwindled to less than half of its former proportions. Service programs have been established to aid private landowners make their forest land productive. And today some landowners are actively engaged in managing timber. The area they control is small but growing.

Land clearing is still common practice. Cleared forest land makes good range under some circumstances. Some efforts at clearing the forests are successful and others are not. One owner interviewed turned 160 acres of forest into open pasture by chopping, girdling, and goating the tree cover until the conversion was complete. It took him 20 years. As many as 100 goats were used at one time to chew back the hardwood sprouts.

---

[1]Numbers in parenthesis refer to References beginning on page 35.

FIGURE 2. — *Cleared forest land makes good rangeland under some circumstances.*

FIGURE 3. — *Land abandonment proceeds apace with land clearing. (Missouri Conservation Commission photo.)*

Examples of such conversion are to be found in most every Ozark county (fig. 2). Chopping, burning, girdling, and goating will convert forest to grassland with repeated attacks over a long period of time. But hardwood sprouts quickly reclaim areas where continuous effort is relaxed. Recent conversion methods include repeated aerial spraying with herbicides, bulldozing to mineral soil, and windrowing and burning downed trees and brush. Abandonment in each case starts the reversion process back to brush and finally to trees.

Land Abandonment

Land abandonment today proceeds apace with land clearing (fig. 3). Unlike the depression years of the 1930's, it is not abandonment to the tax collector but abandonment to a less demanding use or to idleness. Estimates of land-clearing and land-reversion trends suggest that the two are in balance *(33)*. Nevertheless, even though land is abandoned at the same rate it is cleared, the result is a gradual deterioration of the forests. This fact, unfortunately, receives little attention.

Forest-Land Owners

Most forest land in the Ozarks is privately owned. The average size of privately owned forest tracts, other than a few large ownerships, is slightly over 500 acres. The bulk of the timber resource is in holdings of 100 to 5,000 acres *(18, 30)*.

Many small tracts of timberland change hands frequently — about once every 16 years *(18)*. More than half the land changed hands two to nine times in 10 years *(69)*.

Land-Use Choices

Small owners face several practical choices with timber areas they own. By conscious choice or by default, most small forests move in one direction or another. The evidence is strong that many owners choose by default without knowing it. One study indicated that 85 percent of small-forest owners intend no use of their forest land likely to result in increased timber production.

A forest tract can be ignored by the owner — treated as an appendage to the total property, with no particular use recognized. This is the course followed by many Ozark owners. Tracts on the back edge of the farm, those held by nonresidents for a summer place in the mountains, for example, fall in this category.

On the other hand, a tract can be considered as business capital justifying development for its own sake. Implicit in this view is recognition of the profit-making potential and the need for scientific forest management. The trend in this direction is increasing, but the movement is slow. Owning forest land can also be considered a speculative venture, either consciously or unconsciously. Here too the hope is to make money, but only when and if the value of the land increases.

And finally, forest land can be turned over completely to another use, such as grazing or cropping. Many owners choose this course.

Owners with a clear intent to "manage" their land in some productive fashion have less difficulty deciding what to do and how to do it. Choices are mainly related to the suitability of their particular tracts for management and their ability to invest. In forest production, management "know how" can be obtained without years of personal trial and error. The critical element is the decision to manage.

Landowners favoring uses other than timber growing but wishing to evaluate timber-production potential have been able to do so only by trial and error. Some method is needed for judging Ozark timberland potential before land is committed to another use. Estimating costs and returns for specific conditions will do this. Present costs and prices, present management systems, known and estimated timber yields, and the tools of economic analysis provide a means for evaluating timber potential that an untrained owner can use with a forester's help.

As a first step in describing this method let's look at the resource and its management.

The Forest Resource and How It Is Managed

Understanding Ozark timber production as an economic system requires knowing the resource and the techniques of its management. Today this resource has undergone its second intensive study since World War II and can be pretty thoroughly described. Management methods have been developed from experience and research and have been accepted by timber management specialists, land managers and owners. Research continues to supply new knowledge as time to observe managed timber stands increases. The resource and the knowledge required to manage it are described in this section of the report. They form the framework around which economic analysis is constructed.

THE OZARK FOREST

Ozark forests cover nearly 12 million acres of land in about 55 counties and contain about 3.5 billion cubic feet of timber (fig. 1). Thirty-nine counties are more commonly considered the economic and sociological limits of the Region. These counties contain about 10 million acres of commercial forest land and supply the great bulk of Missouri's timber production (24, 31).

Rapid changes are occurring in these forests. The effects of sustained protection programs begun in the 1930's are just now becoming strongly felt. But Ozark forests are mostly immature. The most recent Forest Survey made in 1959, classed the commercial forest area as approximately 29 percent poletimber, 27 percent sawtimber,[2] 24 percent seedling and sapling stands, and 20 percent nonstocked (31).

Development potential is great in these forests, nevertheless. The many young stands in which the Region abounds are about to become merchantable (46).

Many overstory trees in present Ozark timber stands need to be eliminated. The repeated slashing and burning of residual stands following early logging of the big pines and oaks have left mixtures of vigorous young trees and old cull and low-grade trees competing for space, light, and moisture. In some areas clear cutting of oak to produce charcoal resulted in dense second-growth stands (67) that now require thinning.

Even-aged silviculture is the accepted practice for establishing oak or pine timber stands in the Ozarks (49, 91). Regeneration requires clear cutting in the mature stand at rotation age to open the stand for seedling and sprout establishment (49).

OAK MANAGEMENT

The oak-hickory type is the most widespread forest type in Missouri (fig. 4). It occurs on a variety of sites ranging from Site Index 35[3] to Site Index 70 and above (table 1). On dry sites and shallow soils the stands are usually poor, and composition runs heavily to the less desirable species. Trees are runty and heavily branched. On more moist sites and deeper soils black oak, white oak, and the red oaks dominate the mixture and tree form is noticeably better.

---

[2]Sawtimber stands have a minimum net volume of 1,500 board feet per acre, International 1/4-Inch Rule, in live merchantable trees of commercial species. Poletimber stands have at least 10 percent of the area covered by crowns of live merchantable trees pole size (5 to 10 inches in diameter) or larger but less than 1,500 board feet per acre.

[3]Site index is the average total height in feet of dominant and codominant trees in the timber stand at age 50. Ozark sites are more commonly labeled to correspond roughly with the average number of merchantable 16-foot logs produced by mature dominant trees in the stand. Site Class 2 is probably the most common Ozark site.

FIGURE 4. — *The oak-hickory type covers the greatest forest area. (Missouri Conservation Commission photo.)*

Oak-hickory stands in the Ozark forests are essentially even-aged.[4] This is particularly true of the second-growth stands following clear cutting as on the old Sligo and Midco charcoal "choppings" of the north-central Ozarks. Other areas exhibit the same even-aged characteristic although the area of any single even-aged stand on a particular forest is usually smaller. On 845,000 acres of commercial forest land in the Clark and Mark Twain National Forests, 50 percent of the area supports stands from 30 to 60 years old and 27 percent 90 years and older.

Regeneration is readily attained in the oak-hickory type, but seedling reproduction of desirable trees is hard to regulate. Oaks in this Region are prolific sprouters as well as heavy producers of seed at irregular intervals. Some reproduction after cutting is certain. Not always the best composition is achieved, however. Observations of experienced timber managers indicate adequate regeneration of desirable species can be obtained with some care in the regulation of preharvest cuttings (49, 90).

The major problem of hardwood management in the Region today is rehabilitation of stands heavily depleted by past fires, overcutting, and intensive grazing. Species composition is generally poor. Suitable crop trees are unevenly distributed. Defective trees are proportionately high in number.

Attempts to perpetuate the overstory trees to maturity in such stands, while often warranted, do not usually result in the highest yields within the capability of the site. This is because cultural measures are attempted too late in the life of the stand to insure maximum volume production.

Development of oak-hickory timber stands under management requires 80 to 90 years

---

[4]Most stands are within ± 15 years of average age in the overstory.

(90), depending on site. Pure white oak stands, on the other hand, should probably be managed for at least 110 to 120 years because that species maintains good growth longer. Scarlet oak is ready for harvest at about 60 to 70 years (49).

Cuttings are needed during the rotation period at intervals of 10 to 15 years after trees reach pole size (fig. 5). The first cutting in the early life of oak stands will likely be noncommercial; i.e., the dollar return from the small amount of wood removed would not pay for the cutting operation. Such cuttings are necessary however to improve the structure of the stand. Most foresters seem to agree subsequent thinnings will pay for themselves providing local markets are available for the material removed.

Oak-hickory sawtimber stands of good composition are managed for an average basal area of 50 to 60 square feet per acre of crop trees. A cleaning and weeding operation when trees are large-sapling size, followed by a noncommercial thinning at pole size should maintain stand structure and composition until repeated commercial thinnings can be undertaken (49).

FIGURE 5. — *Probable production pattern of a managed oak-hickory timber stand, Missouri Ozarks.*
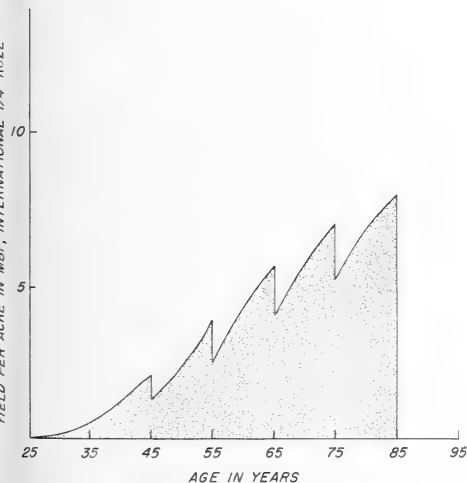
Poorly stocked stands may require different management. Frequently called for are immediate timber stand improvement[5] and perhaps a commercial thinning as well to bring spacing and composition into better balance. In some cases further stand improvement is also required later. Such stands do not always attain the best volume of quality production at rotation age because of the handicap under which management began.

PINE MANAGEMENT

The pine and pine-oak types occupy approximately 1 million acres in the Ozarks (fig. 6). Pine is an important timber species and with management might be increased to 3 million acres (31, 33).

An 80- to 90-year rotation is commonly accepted today for the development of a commercial pine stand, although shorter periods are possible and used by some managers.

Recommended management for seedling-and-sapling pine stands is to remove inferior and unwanted trees at an early age. At the same time the main stand is cut back to a well-distributed 80 square feet of basal area[6] per acre (91). In the Ozarks this may require spraying with herbicides to kill competing hardwoods and cleaning and weeding the sapling stand to adjust tree distribution and favor future crop trees.

Subsequent thinnings throughout the life of the stand attempt to maintain basal area at about 70 square feet per acre (fig. 7). Each thinning may cut this back to approximately 60 square feet per acre and subsequent growth boost it up to the favored range again before next thinning. Other management patterns are being evaluated to learn the most productive system over the full life of a stand.

---

[5]Timber stand improvement is the elimination of undesirable species and defective and unwanted trees to reduce competition in the timber stand and to improve spacing of residual trees.

[6]Basal area is total area in square feet of cross sections of all tree stems on an acre, measured at 4½ feet above ground.

FIGURE 6. — *Shortleaf pine and pine-oak stands occupy approximately 1 million acres in the Ozarks.*

FIGURE 7. — *Thinning is the process by which growth is regulated.*

FIGURE 8. — *Spraying by mist blower provides effective pine release.*

8

Pine stands should be thinned at intervals of 8 to 10 years. The first commercial thinning is possible at an early age. Post and pole markets that utilize small-size trees are available throughout the pine area.

In pine management, the so-called "hardwood problem" is often acute. A dense growth of hardwood sprouts and seedlings begins to crowd out pine reproduction at an early age, often suppressing it severely. Stands of mixed pine and oak are common in the Ozarks. Such stands are generally found on upper slopes of north and east hillsides and middle slopes of south and west exposures where deep and moist soils occur.

These mixed pine-oak stands of intermediate age can be converted quickly to hardwood if the pine is simply removed by logging. Conversion to pine is not nearly so simple. Whereas hardwoods are prolific sprouters, shortleaf pine is not.

The mixed pine-oak stands often require intermediate treatment to eliminate hardwoods from the stand if pine production is the major objective.

In mixed stands, hardwoods are frequently inferior to pine and are commonly removed by aerial spraying with herbicides (fig. 8). Done properly, this treatment does not damage the pines. Contract flyers do this type of spraying throughout the Region. If the hardwoods are merchantable, cutting is the usual method of removal.

Young pine trees are moderately tolerant to shade, which helps the species to persist throughout the Region. Seedling and sapling pines in the understory respond well to overhead release up to about 20 years of age, making possible the conversion of mixed stands to pure pine stands under some conditions. Aerial and ground spraying with herbicides is becoming accepted practice in providing such release.

Regeneration is no problem in the pine type if an adequate seed source and exposed mineral soil are present. Best results are obtained by a preharvest regeneration cut to encourage advance reproduction. This is followed by leaving about three to four well-distributed seed trees per acre at final harvest (91).

TIMBER-PRODUCTION COSTS

Timber-production costs vary from owner to owner and tract to tract depending on many factors. To most owners, cost means an actual cash outlay. Even here, some owners do not consider every cash outlay a business cost. For example, a man who buys rural land for a retirement home and later becomes interested in managing the timber may charge the land cost to the home, not to timber growing. The example is sharper still for inherited forest tracts where no actual cash outlay occurs. Many such holdings are to be found in the Ozarks where timber production is possible. Actual cost in such cases may be hidden and thus ignored by the owner in timber-production accounting.

For economic analysis, however, the costs of timber production to small owners must include cost of the land, taxes, interest, and all operating costs — protection, management, logging, and supervision.

Common Costs — 1959

Common costs of land, taxes, protection, timber operations, and supervision are known to owners and foresters working in the Region (tables 2 and 3). An owner may estimate what it may cost to manage a particular tract of oak or pine by modifying these data to suit his own locality and conditions (table 4).

The accumulated cost for various periods is the original cash outlay plus compound interest for the period specified. The range in cost and in time shown permits selection of specified values to meet a variety of conditions.

For example, an owner pays $6 per acre for his land, his taxes average $0.03 per acre per year, and his timber is judged by a forester to be harvestable in 40 years. His investment in land will be $18.83 per acre and his tax payments $2.21 when harvesttime arrives. His total investment then is $21.04 per acre if he spends no other money on management.

Interest

Interest on cost is often considered an additional cost. An owner has the alternative of banking his money or investing it elsewhere,

thus securing "rent" for its use. He foregoes this income if he buys land. So he expects his timberland to pay a like amount to compensate for income he foregoes.

Interest may also be considered income under some circumstances. For example, net returns from intermediate cuttings have earning power from the time of receipt to rotation age. This interest is a return to be balanced against cost in measuring profit. Interest is treated both as a cost and as income when appropriate to do so in this study.

Compound interest can be obtained in every Ozark county by depositing money in savings banks or purchasing Government bonds. These are practical alternatives open to small-forest owners. Government bonds particularly are in keeping with the conservative instincts common to the Region.

Average interest on long-term Government bonds during the decade 1949-1959 in the Eighth Federal Reserve District was 2.9 percent (fig. 9). This district includes the Missouri Ozarks. Since forest production can cover periods of eight or nine decades, this value provides a realistic standard. It is based on the past decade as are other fixed costs used in the study. Owners wishing to analyze their own land for timber production may turn to the Practical Application section and consider other investment alternatives at different rates of interest.

Variables Due to Management

The owner who chooses to do nothing except sell his timber as stumpage has no costs except land and taxes. Variables affecting his profit include time, market price, amount and quality of wood, and cost. In deciding not to manage his tract, control of wood quality and quantity is surrendered, however. Opportunity for profit is thus diminished. Profit will largely depend upon what he can expect from natural growth.

The owner choosing to develop his timber stand has greater costs, but he also has control of quality and quantity of production. This control can greatly affect profit.

The intensively managed forest requires two conditions for success: adequate original stocking and continuous growing-stock regulation. Foresters believe these conditions exist or are attainable on many Ozark forests.

Assuming these conditions and applying an interest rate of 2.9 percent, we can analyze production potential under intensive management. Thus for the management conditions previously described for oak and pine stands, total rotation costs range from about $93 to $462 per acre in oak stands and $134 to $532 in pine.

Only operations that do not pay their way during intermediate harvest are included. Timber marking is repeated at each thinning
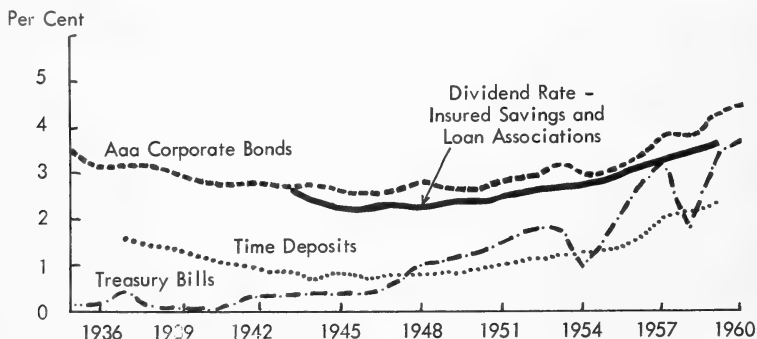
FIGURE 9. — Some interest rates in the Eighth Federal Reserve District 1935-1960. (Source: Monthly Review, Federal Reserve Bank of St. Louis, 1960.)

as the only cost incurred after the first non-commercial cut. Thinnings in Ozark oak and pine stands on medium sites provide enough volume to justify sale at prevailing stumpage prices. As a matter of common practice, most foresters do not mark stands for intermediate thinning unless a merchantable cut is possible.

With the services and payments available today from Government sources, small land-owners can frequently manage their forests for little more than the investment in land and taxes. In the Ozarks, services to owners who qualify under various programs include timber management planning, timber estimating, timber marking, fire protection, and forest-products marketing. Payments are available through current Government programs for timber stand improvement, thinning, weeding, pruning, and tree planting. Tree planting stock can be bought at less than nursery cost. Long-term FHA loans at low interest with deferred payment are now available for forestry pur-poses. And reduced taxes are possible under the Missouri Forest Crop Law.

If an owner wishes to utilize these services and perhaps do some work himself, such as planting or timber stand improvement, he can keep cash outlays low even under intensive management (fig. 10). However, from the eco-nomic viewpoint, production potential is ana-lyzed here as if all normal costs for a given level of management were actually incurred.

ANNUAL TIMBER GROWTH

Managed forest production places maximum per-acre growth on a few of the best trees, increasing their size faster and raising each tree greatly in quality. Maturity is thus achieved sooner and yield is of greater com-mercial value. Also, natural mortality and cull are reduced. The result is greater net yield. Unmanaged forests may produce large total wood volumes but growth on individual trees is lower (table 5).

Stands that have been indiscriminantly cut do not usually have enough growing stock left to permit full development under either natural or managed conditions. They may grow to maturity under either treatment and not reach maximum volume production. Major differences in growth are also common between forest sites, forest types, timber volume stock-ing levels, and stand ages.

Net growth in natural (i.e., unmanaged) Ozark oak-hickory sawtimber stands on all sites ranges between 2 and 3 percent per year (31, 52). In pine stands it is between 4 and 5 percent (135 to 170 board feet[7]) (46). Oak stands generally do not produce as much volume as pine. However, they maintain very nearly maximum annual growth for many

[7]Board-foot volumes measured by International $\frac{1}{4}$-Inch Rule unless otherwise specified.

FIGURE 10.—Owners can get tech-nical help that will reduce management costs. (Missouri Conservation Commission photo).

years. This peak is reached at about 50 years and continues approximately the same to about 100 years *(67)*.

Annual growth potential of pine is indicated in recently described research studies in the Ozarks. One shortleaf pine stand, Site Index 65, resulted from natural seeding of an old field about 1910. It was first thinned in 1935, yielding about 340 fence posts per acre and leaving about 3,600 board feet. In 1950 it was thinned again to leave about 8,300 board feet per acre, yielding 2,600 board feet in the process. Two subsequent thinnings removed a total of 1,500 board feet more. At 50 years of age the volume[8]

---

[8]In trees 7 inches in diameter at breast height, and larger, to 5 inches top diameter inside bark.

is about 10,600 board feet per acre. Average growth has been about 380 board feet per acre per year over the past 6 years.

Ten sample areas studied in another pine stand revealed an average growth rate of 10.7 percent or 426 board feet per acre per year. This stand was 30 years old on Site Index 70 land, contained 6,000 board feet and 570 trees per acre averaging 6.6 inches in diameter, and was growing at about 200 board feet per acre per year before thinning.

Thinning is the process by which growth is regulated. In this analysis frequent periodic thinning in managed stands to achieve rapid growth is assumed. The experience from National Forest stands under management provides the standard.

Timber Yields

Knowing how to manage and what it costs is not enough! We must know what our management can produce. The measure of timber stand production is timber yield. The amount of wood a given area of land can produce over time must be determined before the economist can relate units of production to the market place. For the Ozarks production forecasts are possible with data available today, although much remains to be done to increase precision. The yields described here are likely to be conservative. Nevertheless they provide a reasonable basis for judging production potential in the Region. More precise and comprehensive estimates await only time and more experience with both managed and unmanaged stands.

METHODS OF FORECASTING

Timber yield is the cumulative total at harvest of annual tree growth. It usually reaches maximum levels at the end of the production period. Rough productivity classes called sites are used by foresters to sum up the effects on production of combined influences from rainfall, species, soil, slope, altitude, exposure, temperature, and drainage. Timber volume yields differ noticeably between sites because of changes in these basic factors.

Timber yields have not been compiled specifically for Ozark forest sites, but oak-hickory and shortleaf pine yields have been studied over the range of these two timber types. These averages can be used as a measure of Ozark site productivity under some conditions.

Technical forest management, begun in the 1930's on some land, has only covered about one-third of a rotation period for most Ozark stands. The special characteristics of Ozark site productivity have yet to be thoroughly defined. However, estimates of yield potential for the Region can be made using data from similar forests in nearby regions, with adjustments for local conditions.

Timber yield from *unmanaged stands* as applied in the evaluation of economic potential in this study takes as its standard the production expected from fully stocked stands described by Schnur and others on even-aged upland oak forests and second-growth southern pines *(67, 83)*. Adjustments for local utilization standards were made.

In addition to yields from these sources, some recent estimates[9] have been made specifically for Ozark stands based on scattered small surveys and studies on the National Forests.[10] These provide the production standard for the *managed* conditions described in the study.

An owner may gauge production potential for his own land with either of these estimates always keeping in mind that yields from such sources assume full stocking. By making allowances for differences in stocking on any particular tract, a conservative estimate of individual tract yield potential is possible.

UNMANAGED STANDS

It has long been recognized by foresters that average timber sites in the Missouri Ozarks are somewhat less productive than average sites in nearby states. Ozark pine and oak forests are usually shorter in average total height than stands in Arkansas and Ohio, for example. However, this is because there are more good sites in those states. For any given site in Missouri, Site 2 for example, timber stands should approximate average yield conditions described by any regional studies. Early yield studies on pine and oak include Missouri within the range of described conditions, but in most cases work was concentrated on site conditions and utilization standards more common to other states.

---

[9]Estimates based on growth projections in average stands.

[10]Timber Management Staff, Clark National Forest.

One factor that must be recognized in using data from such studies is differences in merchantability standards between different areas. Ozark timber-utilization standards are noticeably lower in tree-size requirements. Missouri sawmills characteristically accept smaller and shorter logs than cut in other regions. And Missouri logging operators, working under generally lower economic conditions, are able to cut timber in stands with lower volume than can operators elsewhere. Foresters consider that operators can be found throughout much of the Ozark Region who will log stands averaging as little as 300 board feet per acre to be cut.

In adjusting published yield tables to Ozark conditions, minimum acceptable utilization standards were set as follows: for hardwoods — live commercial trees 10 inches d.b.h. with a top diameter of 8 inches inside bark adjustable for limbiness and other defect in the top; for pine — 8 inches d.b.h. and a top diameter of 5 inches. Timber yields from published studies adjusted to Missouri merchantability standards in this manner indicate the following production potential (figs. 11 and 12) (table 6):

Fully stocked unmanaged Site 2 Ozark stands are estimated capable of producing

FIGURE 11.—Estimated timber yield per acre for unmanaged Missouri upland oak, Site Index 50 (67, page 7, corrected to ¼-inch kerf, a 10-inch d.b.h. lower limit, and 8-inch top d.i.b.).
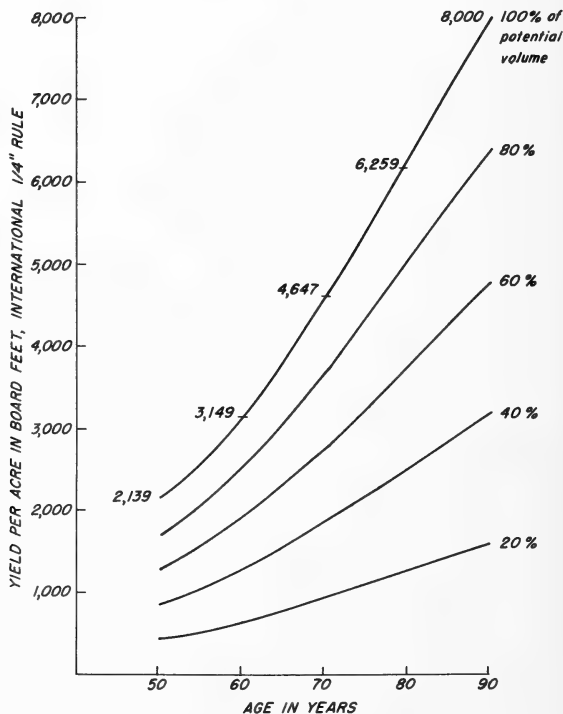
about 20,000 board feet of pine per acre at 85 years or 7,000 board feet of oak (figs. 13 and 14). On Site 4 land, some of the very best sites to be found in the Region, commercial yields of about 39,000 board feet per acre in pine and 16,000 in oak are indicated.

Most Ozark stands today are not fully stocked with commercial trees. Typical stands in this study are approximately 50 percent stocked with commercial trees at rotation. Much privately owned land is as low as about 40 percent stocked; some public forest land may run as high as 70 percent.

MANAGED STANDS

Managed forests will yield more merchantable timber than natural stands of the same type and on the same site fully stocked at maturity. Losses from cull and mortality are less under management. There is no volume

left in small unmerchantable trees at maturity in managed stands as there is in natural stands. The volume removed in thinnings under management is replaced by volume added to the growing stock and is merchantable, therefore computed in total harvest yield. And perhaps most important, tree quality is greatly improved by management as well.

Managed oak-hickory and shortleaf pine stands on the National Forests offer a yardstick for gauging timber-production potential. Selected sample plots[11] of typical young Ozark stands from the central and eastern Ozark counties (table 7) were projected through a rotation period of 85 years using standard techniques (13). Yields thus estimated (table 8) noticeably exceed yields from unmanaged stands described in published studies adjusted to Ozark conditions.

---

[11]Seventy-five oak-hickory plots, thirty-six shortleaf pine plots.

FIGURE 12. — Estimated timber yield per acre for unmanaged Missouri shortleaf pine, Site Index 50 (83, page 137, corrected to ¼-inch kerf, an 8-inch d.b.h. lower limit, and 5-inch top d.i.b.).
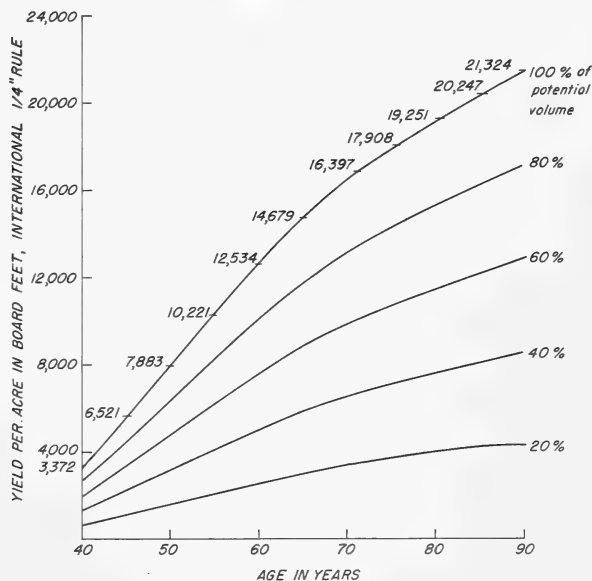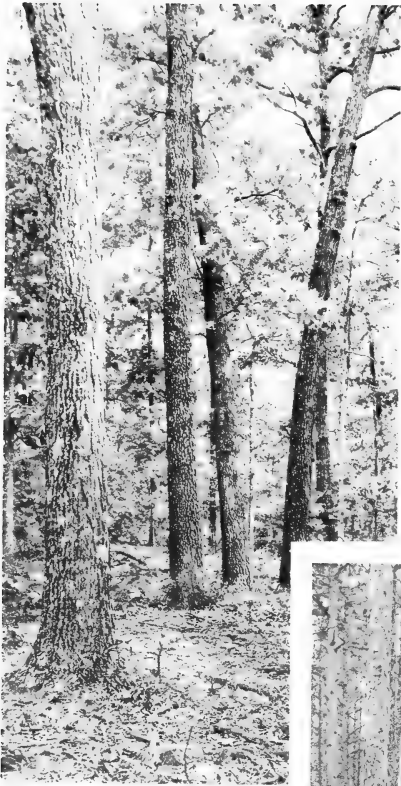
FIGURE 13.—(Left) Oak-hickory stands on Site 2 land develop large volume by rotation age.

FIGURE 14.—(Right) In the Ozarks pine stands yield more volume per acre than hardwoods.
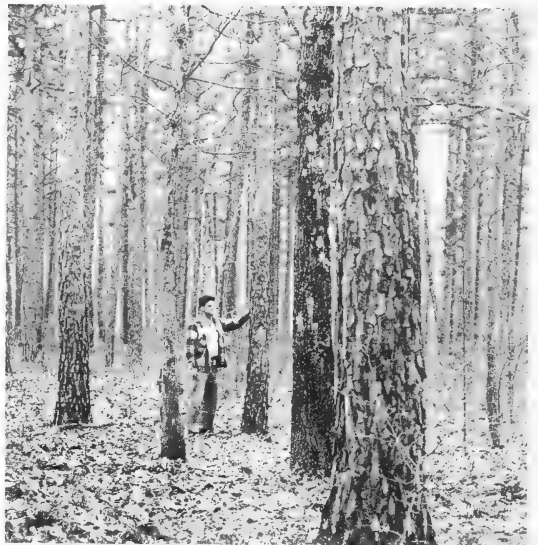
Intensively managed stands of oak-hickory on Site 2 land (table 8) appear capable of producing about 7,900 board feet per acre in 85 years plus 5,700 board feet and about 10 cords from intermediate thinnings (fig. 15). And, it is estimated this yield could be increased by about 25 percent if the faster growing oaks were consistently favored during management to produce a black oak-scarlet oak composition.

Pure pine stands in the Missouri Ozarks on Site 2 land can probably produce about 15,100 board feet per acre in 85 years plus about 8,300 board feet and nearly 8½ cords from intermediate cuttings with intensive management (fig. 16).[12]

[12]These data are the only yield projections available based on measurements and careful analysis. They appear consistent with field observations of remnant, fully stocked stands. Future research may, of course, refine or revise them.

FIGURE 15. — Estimated timber yield per acre for Missouri upland oak under intensive management (Site Class 2). (Basis — 75 plots, Missouri National Forest, 1959, Site Index 45-54, age 30-40 years.)
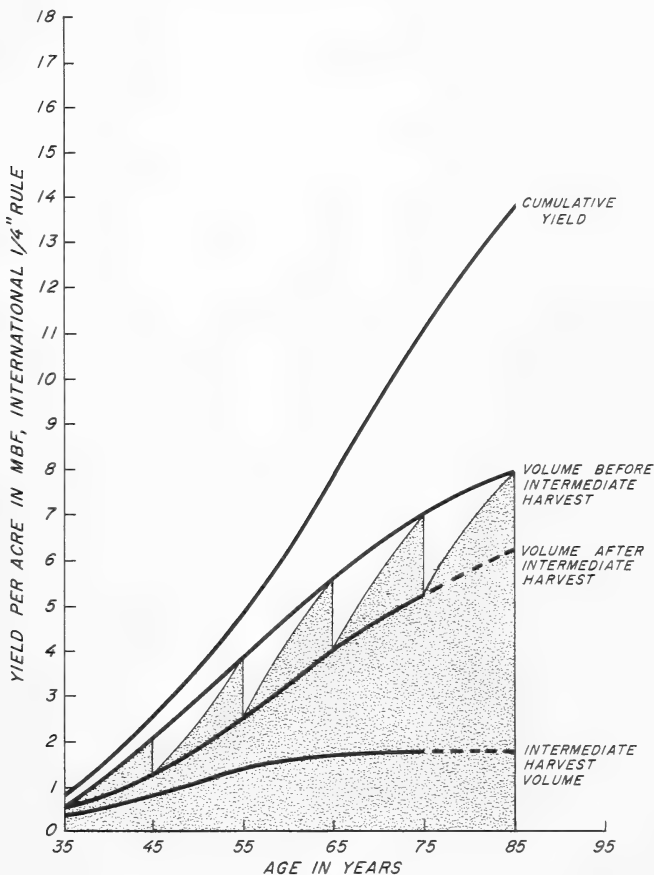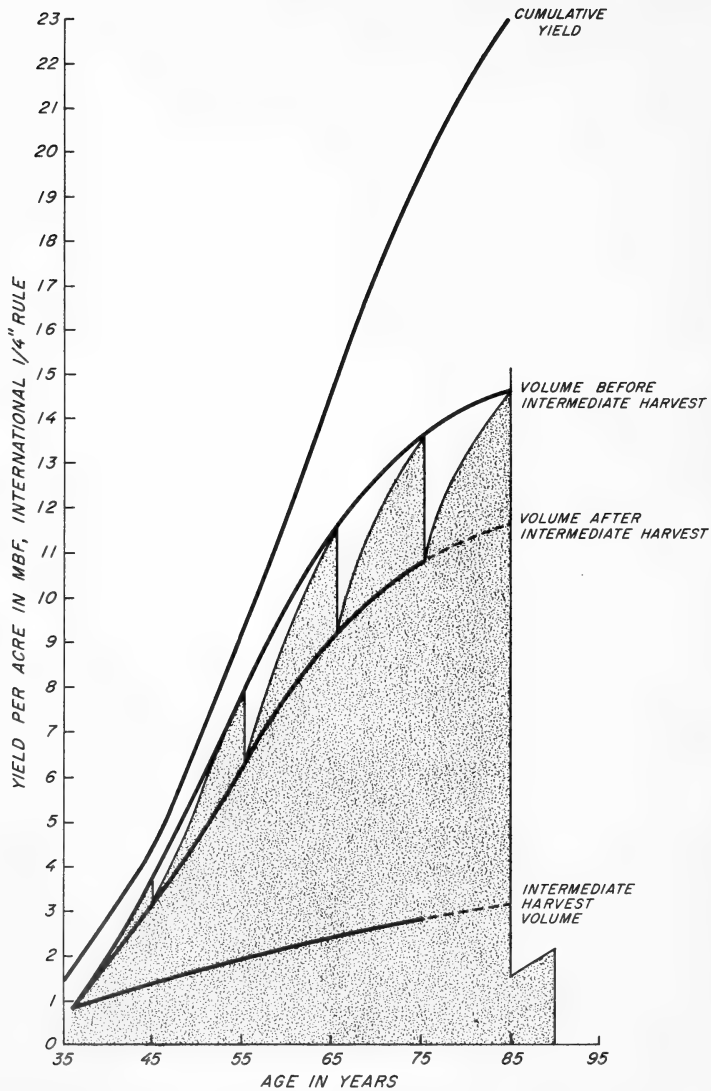
Yields from mixed stands of oak and pine, and yields from the more highly productive sites such as Sites 3 and 4, are yet to be developed for the Region. It may be assumed, however, that Sites 3 and 4 are more productive than Site 2 and therefore capable of producing greater dollar value. Stands of mixed oak and pine can produce volumes somewhere between those for pure oak and pure pine stands.

Differences in rotation age are to be expected between stands. Pine stands on good sites might be carried economically to maturity through shorter periods than oak-hickory on poor sites, for example. Approximately 80 to 90 years are indicated by present managers. Age 85 is used as a standard throughout this analysis. In pine stands where some seed trees were carried beyond rotation age, an additional 5 years were allowed for the small volume involved. The value of this wood at the time of removal was discounted back to rotation age.

Because yield estimates are reported in gross volume, some method of reduction to net volume was necessary. Experience factors compiled from log-scale books and tree-sale measurements by the Missouri National Forest in 1958 provided a guide.

Average cull in residual hardwood trees in unregulated stands ranges from 10 to 32 percent in trees 12 inches d.b.h. and larger. Based on this range, assumed correction factors selected for the study varied from 20 percent at age 35 to 5 percent at age 85 in managed hardwood stands, and 10 to 5 percent at these ages in pine. Factors used for cordwood were less than for board feet. Included is allowance for cull and mortality in stand after thinning.

Such adjustments are somewhat arbitrary but are necessary to reduce gross yield estimates to realistic levels before applying value. For specific tracts, foresters may apply experience values of their own choice.

Thus with yield estimates from both unmanaged and managed timber stands, in both pine and oak on Site 2, income-producing potential may be estimated. We must first, however, examine the markets in which this production is to be valued.

FIGURE 16. — (Left) Estimated timber yield per acre for Missouri shortleaf pine under intensive management (Site Class 2). (Basis — 36 plots Missouri National Forest, 1959, Site Index 45-54, age 30-40 years.)

Markets for Ozark Timber Products

Product prices and market extent and durability influence timber production and thus our analysis. We need to describe the market place in which Ozark producers must sell their timber.

A recent survey of the Region's timber resources shows timber cut from Missouri forests totaling approximately 78 million cubic feet including 364 million board feet from sawtimber-size trees in 1958. Lumber production accounts for 48 percent of the cut, fuelwood 25 percent, posts and industrial wood each about 9 percent, cooperage 4 percent, and all other products 5 percent. An estimated 60 percent of all Missouri timber cut is from the Ozarks. This material is marketed in many forms and in a variety of ways. Major products are lumber, cooperage, pulpwood and industrial wood, posts, and poles. Prices we will use in the analysis are noted by product with each market description.

LUMBER

The lumber industry is the backbone of the regional forest economy. Nearly 85 million dollars of value were added annually by manufacture to products removed from Missouri forests at last estimate (fig. 17).

Ozark sawmill operators purchase logs or stumpage throughout the Region or saw logs on a share basis for small-tract owners. Lumber is marketed to larger secondary manufacturers, particularly the eight flooring mills located in the Region.

Missouri lumber production climbed from a low of 140 million board feet in 1932 to 519 million board feet in 1946. Eighty-nine percent of this was hardwoods. Production since would more nearly average 300 to 400 million board feet annually. Favorable markets and a diminishing supply of quality timber in the Ozarks

FIGURE 17. — *Rough lumber in large quantities is produced from Ozark timber.*

have been reflected in increasing stumpage prices during recent years.

About 75 percent of Missouri stumpage buyers make lump-sum purchases (56), but log-scale and lumber-scale purchases are becoming more common, especially where foresters have handled recurrent business with buyers on behalf of owners.

Oak stumpage sold in the Ozarks for lumber frequently moves at a common price regardless of species. Higher values are placed on some oaks for specialty products such as veneer, piling, and stave bolts; but for lumber, species differences do not command widespread price differences. Pine stumpage, of course, is sold separately.

Stumpage prices common to private sales in the Ozarks from November 1958 to November 1959 are similar to National Forest timber-sale prices (table 10). Pine in the eastern Ozarks sold for $15 to $40 per thousand board feet. One central Ozark timber sale brought the equivalent of $22 per thousand board feet for mixed-oak species, believed to be an all-time high price in the county. Prices around $10 per thousand board feet were commonplace throughout most of the Region.

Prices in nearby areas were similar and evidence the general nature of the market. National Forest timber-sale prices in 1959 in the Lake and Central Regions (which include Missouri) ranged from about $8 to $11 per thousand board feet for the red oaks, $14 to $17 for white oak, and $15 to $19 for shortleaf pine. White oak stumpage cut for saw logs in riverborder counties near St. Louis commonly sold for $10 to $40 per thousand board feet in 1959, with much higher prices in special sales.

Ozark lumber production is affected by national lumber consumption which gradually increased after 1945 and has maintained a high but fluctuating level during the past decade. Estimated lumber production in 1959 was 12 percent above 1958 and 3 percent above average production of the last 5 years, reflecting recent rises in economic activity. Oak lumber production in the United States has been increasing until recently about the same as all lumber consumption (table 11). This produc-

tion is generally related to activity in industries like housing and fabricated products. Such industries fluctuate over short periods, but have been generally expanding since World War II. Lumber production in Missouri is down from the high level of the early post World War II years but has been rising since the mid-1950's. Recent Missouri production has regained much of the drop occurring since the Korean Conflict and appears to be moving upward again.

Lumber-demand projections for the United States indicate further increases in hardwood timber use by 1975 (92). Hardwood lumber demand is expected to be 33 to 62 percent higher than in 1952. Flooring, manufactured products, and railroad ties now make up 82 percent of oak lumber used in the United States. These are also the end products of most Ozark hardwood timber. Markets for Ozark lumber would thus appear reasonably stable, assuring the future of many of the 700 sawmill operators that form the core of the Ozark lumber producers.

PULPWOOD

Pulpwood production in the Nation has increased 22-fold since about 1900 (fig. 18) (table 12). It is now second only to lumber among forest products cut (73, 92). A new peak production of 36 million cords was reached in 1959, hardwood making up 18 percent of the total (68). Major increases in domestic production and consumption of pulp, paper, and paperboard products are expected by 1975 (73, 92). Consumption of hardwood pulpwood has been increasing for some years, and increasing national use of hardwood for pulp is forecast for the future (68).

The outlook for development of a pulp and paper industry that draws upon Ozark wood appears good (17, 48). Recent location of one 50-ton-per-day hardboard plant in central Missouri and the mixing of soft hardwood fiber and rag fiber at another plant producing roofing felt are the first cases of Missouri industry offering markets for locally grown pulpwood.

Pulpwood production in Missouri today is not great, but both softwood and hardwood pulpwood have been moving out of the State

FIGURE 18. — *Pulpwood production in the Nation has increased 22-fold since 1900. (Missouri Conservation Commission photo.)*

into nearby markets for some years. Hardwood-pulpwood production, of most interest to Missouri, is growing in nearby states *(44)*.

The strong interest in Missouri as a pulpwood-producing area stems in part from an ample wood and water supply, nearness to large markets, and low labor and land costs *(66)*. Both hard hardwoods and soft hardwoods are now harvested in small quantities in counties along the major rivers in northeast and southeast Missouri and near Kansas City.

Nearby regions provide a guide for pulpwood prices that might prevail in future Ozark markets. The 1959 pulpwood stumpage price in north-central Mississippi, for example, was $2.50 per cord[13] for hardwood pulpwood and $4 for pine. Hardwood logs were selling at that time for $12 to $20 per thousand board feet (Doyle Rule) *(17)*.

Pulpwood prices in the Southeast also give one indication of price growth that can occur when established markets for pulpwood exist (table 13). Southern pine and hardwood pulp-

wood available in Missouri is similar in pulping characteristics to that produced in the Southeast, and in face of rising national demand is becoming a resource that is attractive to industry.

In 1958 hardwood-pulpwood prices in Ohio ranged from $0.50 to $2 per cord with $1 the most frequent price paid *(40)*. Pulpwood, including oak, has been selling in the northeastern states for several years at prices ranging from $1 to $4 per cord stumpage and presently averages about $2 in eastern New York. Hardwood pulpwood of all types ranged from $0.75 to $3 per cord in New England as early as 1957 *(68)*.

Hard-hardwood pulpwood from northeast Missouri has been moving recently into Iowa at prices of $4 to $6.50 per ton at local delivery points. This is about equivalent to $2 to $3.50 per cord stumpage.[14] A price of $1.50 per cord is therefore considered possible for the Ozark Region in future cordwood markets.

---

[13]Standard cord, 4 x 4 x 8 feet.

[14]Converted at one-fifth delivery price for stumpage and 2.8 tons per standard cord, rough wood.

COOPERAGE

Missouri is the Central States' largest producer of cooperage logs and bolts and the principal producer in the United States. In 1960, 40.1 million board feet (approximately 401,000 cord feet) were taken from Missouri forests. All of this production was consumed by Missouri cooperage mills. Sixty-six mills, two-thirds of which are in the Ozarks, form the market today. White oak is the principal species used, but bur oak and post oak account for approximately 10 percent of the harvest *(43, 56)* (fig. 19).

Cooperage prices did not enter directly into the analysis. Owners with cooperage-quality oak usually find sawtimber must also be removed from their stands. A price range of $10 to $40 per thousand board feet adequately covers average stumpage returns likely even with part of the stand selling for cooperage bolts.

POSTS AND POLES

Pine post and pole markets have been increasing since 1950 as demand for treated wood posts in the cornbelt area of the midwestern United States has grown *(56, 57, 58)*. Twenty thousand posts were produced in Missouri that year. By 1954 the market grew to 6 producers operating 16 concentration yards and producing 2½ million pine posts and a quarter of a million poles. This was more than a tenfold increase in production. It is estimated that in the 3-million-acre Ozark pine area 5½ million posts can be safely harvested annually in thinning operations needed by existing stands *(58)*.

Prices of posts and poles vary by size of product. Stumpage prices are commonly observed in sales of pine sawtimber on private land by quoting an average sawtimber price understood to cover both saw logs and posts and poles. In 1959 prices commonly used by foresters in the Ozarks for stumpage values ranged from $0.04 to $0.06 for posts and $0.14 to $1.50 for poles of various sizes. Posts and poles provide a ready market for pine removed in thinning young stands (fig. 20).

OTHER PRODUCTS

Wood for handles, veneer, mine timbers, and charcoal is also cut in the Ozarks. Although relatively less important to the economy, these products contribute strongly to markets in many areas. Production in 1958 for all such products was estimated at about 14 million board feet. Veneer markets are particularly important to the owner of high-quality timber. High prices are offered to owners of veneer-quality oak and walnut. Production of veneer logs in 1960 in Missouri exceeded 6.8 million board feet.

Handle manufacture and mine-timber production are not expanding today, but charcoal production has been growing remarkably in recent years, reaching an estimated total of 43,000 tons in 1958 (fig. 21). Between 1956 and 1961 the Central States, within which Missouri dominates production, expanded output by 190 percent.

FUTURE OPPORTUNITIES

Long-term market conditions for products grown in the Missouri Ozarks thus appear favorable for increasing expansion of timber production from small forests. Increase in market size and diversity is clearly possible for the future despite fluctuations in the economy. Over the long run, prices can be expected to rise if the national economy develops about as predicted and the sawtimber supply tightens accordingly *(92)*. New pulpwood markets for the Ozarks seem likely within the rotation periods of most timber stands existing today.

FIGURE 19. — Stave bolts offer high returns to owners with quality oak timber.

FIGURE 20. — Pine posts and poles removed in thinnings find a ready market.

FIGURE 21. — Cordwood for charcoal offers markets for low-grade timber. (Missouri Conservation Commission photo.)

Costs and Returns Compared

What is the production potential of Ozark timberland in economic terms? Let's examine our question now on the small forest which dominates the Region! We will use as a framework the quality and condition of the resource earlier described, the management systems now in use, the yields to be expected, and the values represented by today's market.

In estimating returns three levels of cost and four levels of stumpage value are used. Since costs and values on some individual tracts may differ from these standards, a Practical Application section is provided to enable an owner or forester to analyze any particular case he may wish to study. For our purpose the more common conditions apply.

The levels of cost used in this analysis place all low-cost items together at one level, all medium costs at another, and all high costs likewise for convenience in analysis and reporting. No separate categories are provided for conditions where several low- and medium-cost items and one high cost may be encountered together, for example. Any such combination would, of course, lie somewhere within the range of costs presented here. Exceptionally high costs or exceptionally low costs an owner might experience under unusual circumstances are outside of the standard range altogether. These more special cases are not treated in the study.

The range in stumpage values used is set at levels including the common prices in the Region today with an upper limit of $40 per thousand board feet. This value appears reasonable only for the long-term future. Owners selling the high-quality trees possible to produce under management could expect premium prices in the market. It may prove too conservative for the high portion of our range in view of market-growth trends in recent years. The value of young stands is increasing steadily in nearby areas as quality timber becomes harder to find. However, no attempt at estimating future conditions is made.

The prospect of a future pulpwood market is recognized here in the analysis of intensively managed stands only. Allowance is made for minimium stumpage values common to other regions. Even these values are not assumed until log stumpage values are $20 per thousand board feet or greater. The assumption made is that when the Ozark Region experiences high stumpage values for logs, markets for some cordwood probably will be available also.

RETURNS WITHOUT MANAGEMENT

Many Ozark forest owners let their timberland develop naturally, doing nothing except paying taxes. Does this pay? An analysis of normal yields indicates not in many cases. Let's see why!

In Hardwood Stands

Our standard for potential production is yields from fully stocked stands. These yields vary by site, from about 3,800 board feet per acre at 85 years on the poorer hardwood sites in the Ozarks (Site 1) to about 16,750 on the best sites (Site 4) (table 6).

At lower levels of stocking, without management, correspondingly lower yields are assumed. Stands yielding 100 percent of potential may be broken down into several groups to permit comparison within the range of conditions likely to affect most Ozark owners.

Costs ranging from $3 to $15 per acre for land and $0.03 to $0.25 per acre per year for taxes are found throughout the Region today. Stumpage prices from $10 to $40 per thousand board feet cover present and possible future conditions. With these values, and assuming sawtimber markets, Ozark sites may be evaluated and compared. Analysis of this full range of conditions reveals the following pattern (tables 14, 15, and 16).

On the most common site

Site 2 is the most widespread site in the Region. Without management Site 2 stands can pay only *if costs are low,* maximum yields are achieved, and stumpage prices high (fig. 22). Yet even with low costs and stumpage prices double those of today, yields must approach 7,000 board feet per acre before $1 per acre per year can be realized.

Without management the understocked stands typical of the Region today won't yield a profit even with low costs and today's stumpage prices, unless the investment-carrying period is short. If the investment period lasts a full rotation, stumpage prices of $40 per thousand board feet are required to provide this same return. Such a price is four times the present market. Even in future markets, only the best quality timber will likely command prices this high. Not many unmanaged forests contain such timber.

At medium costs and present stumpage prices, unmanaged stands, even on this site, producing maximum yields do not pay an owner well for his investment. Prices must be two to three times higher than at present to provide $1 per acre per year. Lower yields, of course, reduce the potential even further. Stands yielding as much as 3,500 board feet per acre in a $30 stumpage market lose $8 per acre for the owner.

FIGURE 22. — *Potential net returns at harvest from typically stocked stands on Site 2 hardwood land.*
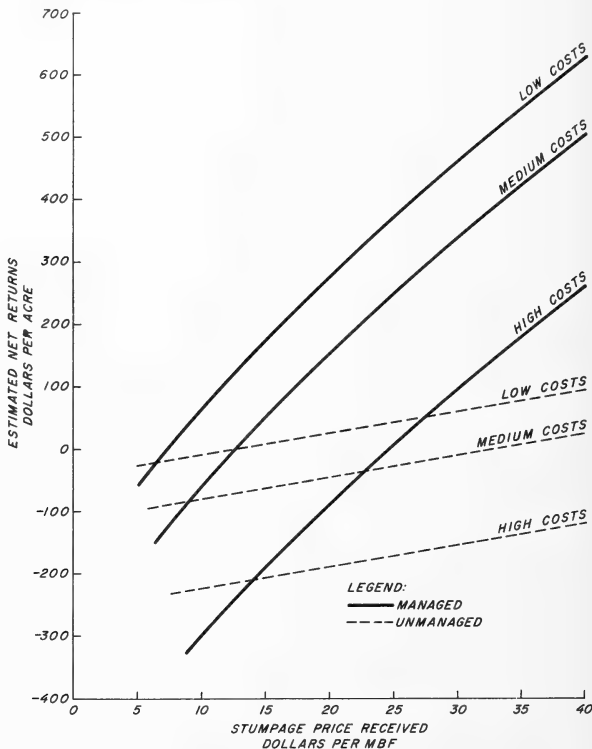
When costs are high, Site 2 land yielding maximum potential volumes without management pays only when stumpage approaches $40 per thousand board feet. Even then, the return is low! Losses exceeding $100 per acre occur when understocked stands yield only 50 percent of potential.

Without management it is extremely difficult to obtain maximum timber yields or high timber quality. We have noted that many unmanaged Ozark Site 2 forests are badly understocked. Under these circumstances, the expectation for profit on Site 2 forest land without management can only be described as marginal, at best.

On different sites

Greater returns may be expected from the more productive sites. Even on these sites, however, if volume production is too low to offset high costs, low stumpage, or long waiting periods, the owner may lose money. If we set as a standard maximum potential yields; today's stumpage prices, medium costs, and a full rotation, some differences in economic potential among various sites can be described.

Under this standard the 1-log sites produce only a loss. Stumpage must reach nearly $26 per thousand board feet before 1-log stands will produce returns equal to interest charges. They appear clearly submarginal without management under common conditions today.

On the 2-log sites losses are still indicated. Here, however, doubling the stumpage price, lowering the cost somewhat, or shortening the investment period offers a marginal range for some slight profit under choice conditions.

The 3-log sites provide a small return, but one so small it is still negligible — $0.50 per acre per rotation.

The 4-log sites can produce a small profit without management even at today's stumpage level. Sites 3 and 4 together, however, occupy less than 7 percent of the commercial forest land in the Region.

It appears then that without timber stand management enabling owners to increase timber production and timber quality and realize higher market prices, many Ozark owners carry a losing investment in hardwood land. The conditions where land may be treated in this fashion, and still give some economic return *assuming maximum yields,* appear to be the following: At lowest levels of cost, on all sites (the best returns, of course, coming from the best sites); at medium levels of cost, only on the best sites; and at high levels of cost, only on the best sites and also only with stumpage prices much higher than at present. Stands yielding less than the maximum potential volume require the most favorable cost and market conditions before this practice can even break even. *The conditions under which nonmanagement does not pay now prevail throughout most of the Ozark Region.*

Short investment periods

Some owners may have timber stands that will produce maximum yields without an 85-year waiting period. For example, a recently acquired well-stocked, immature stand only 40 years from rotation age would shorten the investment-carrying period 45 years. A glance at table 15 shows that the owner could expect a profit of $17.09 per acre even on Site 1 land under these conditions. Better sites under similar circumstances could pay higher returns.

Investment periods shorter than a rotation are possible for some owners then if they enter the production process at a point well along in the development of their timber stand. An owner who has bought wisely, kept his costs low, and secured a well-stocked, immature stand places himself in an excellent investment position. Throughout the Region a large number of immature stands, many of which are in good condition, offer opportunities for short investments and close to optimum or better returns. Added returns are possible under management, however. Discussion of this subject occurs further on in this analysis.

In Pine Stands

In pure shortleaf pine stands, the situation is different (tables 17, 18, and 19). Stumpage prices and yields are higher. Costs remain about the same. Maximum yield and sawtimber markets are again assumed in all cases. Where post markets exist even higher returns than indicated here should be possible. Trees smaller than sawtimber size would be merchantable as well.

On all Site 2 or better pine land, maximum timber yields will return profits without management even at high levels of cost. At medium-cost levels, Site 2 land can return about $65; Site- 3, $212; and Site 4, $366 per acre over an 85-year investment period. Lower costs or shorter investment periods with the same maximum yields can, of course, produce even higher net returns.

Stands producing less than maximum yield will make a profit on most sites if costs are moderate. On Site 2 land in the Region this is possible even at yields as low as 40 percent of potential. Pure pine stands, however, are relatively restricted in area throughout the Region and most of those with maximum yield potential are managed.

The owner who relies on natural stand development to produce profit from his timberland must count on some combination of the best sites, high yields, low costs, high stumpage prices, and short investment periods to assure maximum returns. Such economic opportunity in the Ozarks is better in pine stands, but suitable areas are scarce. In oak-hickory stands the opportunity is even more restricted. *No management may mean an economic loss to many Ozark owners who think they only have to pay taxes and wait.*

RETURNS WITH MANAGEMENT

Forests managed for high production of quality timber are becoming more numerous in Missouri. Service programs of the Missouri Conservation Commission have reached more than 8,000 landowners since first begun and have brought the beginnings of management to about 1,700,000 acres of forest land. Many tracts have been in sustained production a decade or more. Cost-and-return information from some properties offers further evidence of favorable Ozark timber-production potential.

Case Studies

Several small private forests were selected for study with the help of Farm Foresters in the Region. Management had been carried on long enough on most tracts to be reflected in improved timber stands. Sufficient records were

available when combined with field measurements and interviews with owners and Farm Foresters to permit analysis of potential returns.

The analysis used today's costs, prices, and markets and assumed no change in these at final harvest. A somewhat conservative estimate thus results since prices have been rising and could rise further in the future despite periodic slumps. This would be offset to the degree that future costs rise also. Timber volume was projected to harvest age using growth rates determined from field measurements. Where judgment was necessary, every effort was made to keep projections realistic and on the conservative side. Supervision costs were included in most cases whether the owner considered them or not in his accounting. It was found most owners ignored such charges.

In addition to returns from wood products the owner actually sold, some returns for items he used himself were included. Although this amount was usually not great, inclusion as returns is justified because all items were part of actual production and would have cost the owner an equivalent value or greater if purchased. Interest was included as cost or income as appropriate for each item valued. All values were converted to constant dollars using the wholesale price index of all commodities.

The tracts studied exhibit a wide range of conditions in site, timber stocking, management practice, land area, and average costs and returns. All are operating profitably today. Tracts with greater standing timber volumes revealed generally higher net returns.

Expected net value returns at final harvest ranged from about $110 to $240 per acre for all properties, or $0.18 to $4.07 per acre per year over the period involved. The average ratio of total costs to total returns for all tracts is about 1:3.

Local Yield Studies

Estimated potential returns using yield studies developed for the Region provide additional evidence that Ozark timberland can pay well (tables 20-25). A wide range in economic possibilities is indicated where cultural operations are practiced in the timber stands.

Site 2 hardwood yields projected from typically stocked sample stands 30 to 40 years old indicate a *net merchantable harvest volume* of approximately 7,600 board feet per acre at maturity when managed intensively, plus merchantable volume removed in thinnings of about 4,800 board feet and 9 cords of pulpwood per acre. Valued in differing potential markets at three levels of costs, the net expected returns from such yield range from $3.42 to $7.46 per acre per year depending on price received at harvest (tables 20-22).

In today's $10 saw log stumpage market, these yields return about $77 per acre over a rotation period at lower levels of cost. This return is greater than $0.90-per-acre-per-year net earnings. Higher stumpage values are required, however, before such yield produces profit at medium and high levels of cost.

Costs assumed at the medium level total about $216 per acre capitalized value at rotation age (table 2). High level costs may reach $462 per acre. Included are land values, taxes, costs of administration, fire protection, and several cultural operations in the timber stand at differing amounts previously discussed under management costs.

With costs in this range and stumpage values of $20 to $40 per thousand board feet for sawtimber and $1.50 per cord for pulpwood, net returns range from $0.90 to $6.02 per acre per year. At only $25 for stumpage, the return equals $3.00 per acre per year even at medium levels of cost. The break-even point in price at which returns equaled costs lies between $10 and $15 at medium-cost levels and between $20 and $25 at high-cost levels. Since products managed this intensively would justify highest stumpage prices, even yields from typically stocked hardwood stands on Site 2 land appear clearly profitable in the Ozarks with present-day costs.

Pure pine stands on Site 2 land are estimated capable of producing about 14,500 board feet per acre *net volume* in saw logs at maturity with intermediate yields from thinning totaling about 6,700 board feet, 43 poles, and 574 posts per acre over 85 years. Local experience with thinnings in some young pine stands indicates these averages to be conservative.

For example, one 30-year-old shortleaf pine area thinned in the central Ozarks yielded 500 posts and 100 poles per acre at first cutting and left 275 trees per acre to grow to maturity. Potential for at least several more profitable thinnings still exists.

However, at the lower yields and today's prices, pine production potential ranges in value from about $40 to about $1,170 per acre over three levels of cost. This is the equivalent of $0.45 to $13.75 per acre per year. Prices of $16 to $40 per thousand board feet for saw log stumpage, $0.04 to $0.06 per post, and $0.14 to $1.50 per pole are used in establishing these values.

Post and pole markets, together with saw logs, seem to offer the most profitable combination at today's prices. Yet other combinations are possible also. Saw log and cordwood markets exist in some parts of the Ozarks. Evaluation for such markets produces comparable returns.

With saw log and cordwood markets, medium-cost levels, and stumpage prices of $10 to $40 for saw logs and $1.50 per cord for pulpwood, the potential yield of Site 2 pure pine stands ranges from about $30 to $930 per acre over a rotation period.

Intensive management of medium sites in the Ozarks clearly promises high-value returns. Returns cannot be estimated for the best oak-hickory and pine sites without yield data. The evidence is strong, however, that such returns would be substantially greater.

The poor Ozark sites may be questionable for intensive investment. Reduced yields and longer rotation periods certain to be experienced may be generally assumed to mean narrower margin for profit. Without management they are clearly submarginal at today's costs. But full evaluation of the 1-log sites requires more adequate yield studies.

The Economic Outlook for Owners

A variety of pressures, imperfectly understood at best, sway the decisions of small-forest owners in the Missouri Ozarks. Among them is the economic motive. Many owners are only slightly affected even by the economic motive. This is evidenced by widespread lack of land-use objectives, frequently ignored standing timber values, and rapidly shifting land-tenure patterns. For those with personal interest and the resources, economic productivity of timberland can be gauged and opportunities seized to increase income. The long-term economic outlook for Ozark timber production is encouraging.

National trends of lumber and pulpwood market development have been upward in recent years despite occasional setbacks. The trend in lumber prices relates to rising per capita real income in the American economy. Per capita real income in the Nation has shown a steady rise over the past century. An expanding national economy is developing new markets. A marked increase in pulpwood demand during recent years adds new strength to the role of timber in the economy. Further shifts are anticipated in the future.

There is no current downward trend in the importance of timber products within the whole economy. Forestry is being practiced at an accelerated rate on both public and private land. Demand for wood is increasing even with periods of distress in some markets. Future demand for lumber and pulpwood is expected to be greater by the year 2000.

In the Ozarks, stumpage prices have been slowly rising and new markets slowly developing. Offsetting this are occasional slumps in the market, and the trend toward increased costs for taxes, land, and labor. At cost-return ratios indicated for the Region, timber production can be profitable even in today's markets. For owners who write off land costs to some other use and provide their own labor for some operations, the cost-return ratio can be more favorable than that disclosed by this study. For owners who do not treat interest as a cost, further returns are offered. For owners who can grow high-value products, such as veneer and cooperage, the profit can be large. Markets, time, and continuity of management are major considerations.

Timber yields are modest by some standards but they are adequate. Economic opportunities for individual owners vary widely depending upon time, markets, timber stocking, quality of management, and costs.

The influence of cost on productivity and economic return is minimized by many assistance programs available. Time involved is often shortened by the fact that existing stands may already be partially grown, well stocked, and require only thinning or a small amount of timber stand improvement to make them produce adequately. Owners who by fortunate circumstances or wise choice have acquired well-stocked forest land at low cost are in an advantageous position.

Many small forests will require more than minimum attention in building the stands. Owners of such forests will find economic opportunities variable and worthy of careful evaluation. The advice and assistance of a competent forester should be sought in any individual case (fig. 23).

FIGURE 23. — (Right) Missouri farm forestry districts and services.

Map of Missouri counties with labeled cities: Kirksville, Hannibal, California, Warrenton, Owensville, Farmington, Steelville, Ironton, Jackson, Mt. Grove, Monett, Van Buren, Poplar Bluff

Information can be secured
from
MISSOURI CONSERVATION
COMMISSION
Jefferson City, Missouri
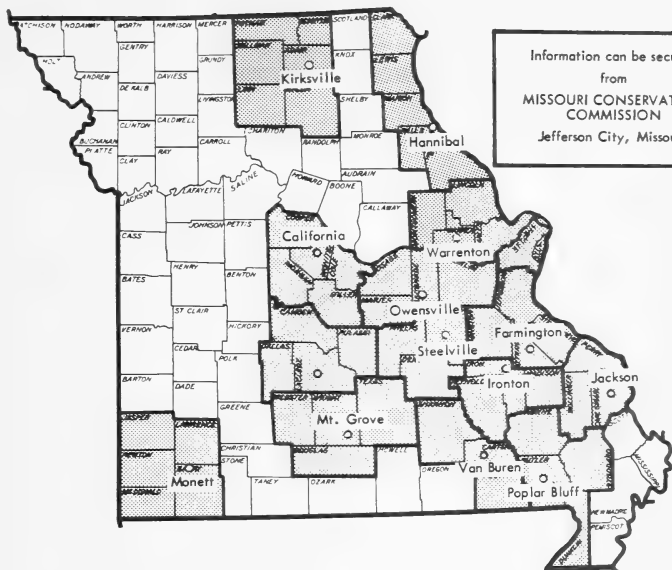
Farm Foresters provide the following free services to woodland owners interested in good forestry.

A. Planting
    1. Recommend types of trees to plant, methods, numbers required, sources of tree seedlings, and
        plantation plans.
    2. Advise on care and harvesting of plantations.
    3. Provide mechanical tree planters at nominal charges.
    4. Inspect and approve plantings for County ASC Committees.

B. Management
    1. Inventory standing timber.
    2. Develop proper management plans on cutting, protection, and improvement of the woods.
    3. Advise on woodland wildlife management.
    4. Provide information on insect and disease infestations.
    5. Advise on various assistance programs available to timber owners.

C. Harvesting
    1. Help mark or select ripe trees for cutting.
    2. Estimate volumes in marked trees.
    3. Give instruction in log scaling.
    4. Instruct and encourage owners in doing own cutting.

D. Marketing
    1. Grade trees for most profitable products.
    2. Maintain lists of timber buyers, and assist in conducting timber sales.
    3. Seek and develop new markets and industries for timber products.
    4. Give instruction in lumber grading.

E. Utilization
    1. Advise on the use of native lumber for farm construction.
    2. Show methods of wood preservation.
    3. Work with timber operators to increase efficiency, locate stumpage, locate markets, and assist in
        other ways.

Conclusion

The economic potential of small forests in the Missouri Ozarks is good. Managed forests can provide adequate returns over much of the Region under conditions common today. Some forests offer outstanding production opportunities. Improved market conditions would raise potential returns even higher. On sites where timber production is a reasonable alternative to other uses, large, long-range investments are clearly justified. But, one of the best ways to get maximum returns is to manage for high-quality, high-volume production, beginning early in the life of the timber stand.

Practical Application

A land manager may calculate potential costs and returns on a specific property by following the instructions below. Certain technical information about the stand is needed, plus the owner's own records. Tables 26 through 31 permit calculation of net expected value of any individual tract at interest rates of 3, 4, or 5 percent.

Net expected value is the estimated value a tract may be expected to produce by the time it reaches maturity. As computed here, it is based on present-day costs, prices, and markets; the interest rate selected; and the esti-mated yield the timber stand may provide by harvest. All costs and intermediate returns are accumulated at interest to rotation age and total accumulated cost is balanced against total accumulated returns to give an average net value return per acre. A negative net expected value, of course, indicates economic loss.

Enter all the information below in the appropriate places on the Calculation Sheet (fig. 24). All entries in the Summary Column of the Calculation Sheet are read from the tables indicated except for item 1 (Harvest), which is obtained by multiplying yield by stumpage price.

Information needed	Source	Entry number on calculation sheet
Estimated timber yield per acre at rotation age (present volume per acre plus accumulated net growth until end of rotation)	forester	1a
Stumpage price per thousand board feet	forester	1b, 2b
Estimated intermediate timber yield per acre	forester	2a
Years from intermediate cut to rotation	forester	2c
Average land cost per acre (forest land only)	owner records	3a
Years to rotation	forester	3b, 4b, 5b, 6b
Cost per acre for timber operations	forester	4a
Average annual tax per acre (forest land only)	owner records	5a
Other fixed annual costs per acre	owner records	6a

CALCULATION SHEET

Summary Column

Value per acre
at harvest
(dollars)

RETURNS

1. HARVEST - harvest yield X stumpage price

     $\underline{4}$ MBF X $ $\underline{12.00}$ $\underline{48.00}$
     a   b

2. INTERMEDIATE - intermediate yield X stumpage price
   capitalized for number of years to harvest

   $\underline{500}$ BF X $ $\underline{12.00}$ = $ $\underline{6.00}$ for $\underline{15}$ years $\underline{9.35}$ (table 26, 28, or 30)
     a   b   c

   _____ BF X $_____ = $_____ for ___ years   _____ (table 26, 28, or 30)

   _____ BF X $_____ = $_____ for ___ years   _____ (table 26, 28, or 30)

                    TOTAL RETURNS: 1 + 2 $\underline{57.35}$

COSTS

3. LAND - average cost/acre capitalized for number of
   years to harvest

   $ $\underline{5.00}$ for $\underline{20}$ years $\underline{9.03}$ (table 26, 28, or 30)
       a   b

4. TIMBER OPERATIONS - average cost/acre capitalized
   for number of years to harvest

   $ $\underline{4.00}$ for $\underline{20}$ years $\underline{7.22}$ (table 26, 28, or 30)
       a   b

   $_____ for _____ years   _____ (table 26, 28, or 30)

5. TAXES - average tax/acre/year capitalized for
   number of years to harvest

   $ $\underline{.12}$ per acre per year for $\underline{20}$ years $\underline{3.22}$ (table 27, 29, or 31)
       a   b

6. OTHER FIXED COSTS - average cost/acre/year capi-
   talized for number of years to harvest

   $ $\underline{.02}$ per acre per year for $\underline{20}$ years $\underline{.54}$ (table 27, 29, or 31)
       a   b

                    TOTAL COSTS: 3 + 4 + 5 + 6 $\underline{20.01}$

NET EXPECTED VALUE OF TIMBER PRODUCED:

   (1 + 2) - (3 + 4 + 5 + 6) $\underline{37.34}$

FIGURE 24.—Sample form for calculating potential costs and returns and hypothetical example. (Example is based on an interest rate of 3 percent, hence tables 26 and 27 are used. Tables based on 4 and 5 percent interest rates are also provided.)

Scientific Names of Tree Species Mentioned

Ash ....*Fraxinus* L. spp.
Cedar (eastern redcedar) ....*Juniperus virginiana* L.
Cottonwood ....*Populus deltoides* Bartr.
Cypress (baldcypress) ....*Taxodium distichum* (L.) Rich.
Elm ....*Ulmus* L. spp.
Hickory ....*Carya* Nutt. spp.
Maple
    Hard ....*Acer saccharum* Marsh.
    Soft ....*A. rubrum* L. and *A. saccharinum* L.
Oak
    Black ....*Quercus velutina* Lam.
    Bur ....*Q. macrocarpa* Michx.
    Northern red ....*Q. rubra* L.
    Post ....*Q. stellata* Wangenh.
    Scarlet ....*Q. coccinea* Muenchh.
    White ....*Q. alba* L.
Shortleaf pine ....*Pinus echinata* Mill.
Sycamore ....*Platanus occidentalis* L.
Walnut ....*Juglans nigra* L.

References

1. Anderson, Walter C.
   1957. SAWTIMBER PRICES ARE HIGHEST IN THE FALL. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 105, 1 p.
2. Barraclough, Solon L., and Pleasonton, Alfred.
   1957. DATA FOR PLANNING WOODLAND OPPORTUNITIES ON WEST TENNESSEE FARMS. Tenn. Agr. Expt. Sta. Bul. 276, 64 pp., illus.
3. Beck, William B., Redman, John C., Hornbeck, Benn L., and McComas, Paul S.
   1956. ECONOMICS OF THE FARM WOODLAND IN THE EASTERN PENNYROYAL AREA OF KENTUCKY. Ky. Agr. Expt. Sta. Bul. 650, 32 pp., illus.
4. Bird, Ronald, Miller, Frank, and Turner, Samuel C.
   1958. RESOURCES AND LEVELS OF INCOME OF FARM AND RURAL NONFARM HOUSEHOLDS. Mo. Agr. Expt. Sta. Res. Bul. 661, 71 pp., illus.
5. Braathe, Peder.
   1957.THINNINGS IN EVEN-AGED STANDS, A SUMMARY OF EUROPEAN LITERATURE. 92 pp., illus. Fredericton: Univ. New Brunswick.
6. Brinkman, Kenneth A.
   1959. KILLING OAK BRUSH A TRICKY BUSINESS. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 165, 9 pp., illus.
7. Bruce, Donald, and Schumacher, Francis X.
   1942. FOREST MENSURATION. 425 pp., illus. New York: McGraw-Hill.
8. Burns, Paul Y.
   1950. VALUE OF FARM WOODLOT MANAGEMENT IN MISSOURI. Mo. Agr. Expt. Sta. Cir. 349, 8 pp.
9. Christopher, Joe F.
   1960. PULPWOOD PRICE TRENDS IN THE MID-SOUTH. Pulpwood Prod. 8(8): 28, illus.
10. Clark, F. Bryan, and Liming, Franklin G.
    1957. LOW-GRADE HARDWOOD STANDS IN THE MISSOURI OZARKS RESPOND TO STAND IMPROVEMENT. Jour. Forestry 55: 354-358, illus.
11. Cole, Alex B.
    1960. THE FOREST RESOURCES OF RURAL HOUSEHOLDERS IN DENT COUNTY, MISSOURI. 71 pp., illus. M.S. Thesis, Univ. of Missouri.
12. Cruikshank, James W., and Anderson, Walter C.
    1955. PINE SAWTIMBER STUMPAGE PRICES IN SOUTH CAROLINA, 1948-1954. U.S. Forest Serv. Southeast. Forest Expt. Sta. Paper 57, 14 pp., illus.
13. Davis, Kenneth P.
    1954. AMERICAN FOREST MANAGEMENT. 482 pp., illus. New York: McGraw-Hill.
14. _____
    1956. DETERMINATION OF DESIRABLE GROWING STOCK — A CENTRAL PROBLEM OF FOREST MANAGEMENT. Jour. Forestry 54: 811-815, illus.
15. Duerr, William A., Fedkiw, John, and Guttenberg, Sam.
    1956. FINANCIAL MATURITY: A GUIDE TO PROFITABLE TIMBER GROWING. U.S. Dept. Agr. Tech. Bul. 1146, 74 pp., illus.
16. Ely, Richard T., and Wehrwein, George S.
    1940. LAND ECONOMICS. 512 pp. New York: The MacMillan Co.
17. Farrell, John H.
    1959. WHAT A PULP MILL COULD MEAN TO MISSOURI. Mo. Business 10(2): 5-7, illus.
18. _____
    1964. THE SMALL-WOODLAND OWNER IN THE MISSOURI OZARKS — A CLOSE-UP. U.S. Forest Serv. Res. Paper CS-10, 15 pp., illus.
19. Federal Reserve Bank of St. Louis.
    1957. CURRENT AND PROSPECTIVE PULPWOOD PRODUCTION IN EIGHTH DISTRICT STATES. Monthly Rev. 39: 111-113, illus.
20. _____
    1958. THE BUSINESS AND FINANCIAL SITUATION. Monthly Rev. 40: 106-110, illus.
21. _____
    1959. INTEREST RATES AND CREDIT. Monthly Rev. 41: 100.
22. _____
    1960. INTEREST RATES IN PERSPECTIVE. Monthly Rev. 42: 2-5, illus.

23. Gertel, Karl, Frey, John C., and Marty, Robert J.
    1959. USE OF IDLE LAND IN POTTER COUNTY, PENNSYLVANIA FOR CROPS, PASTURE, AND FOREST. Pa. Agr. Expt. Sta. Bul. 642, 46 pp., illus.

24. Gregory, Cecil L.
    1958. RURAL SOCIAL AREAS IN MISSOURI. Mo. Agr. Expt. Sta. Res. Bul. 665, 71 pp., illus.

25. Guttenberg, Sam.
    1956. INFLUENCE OF TIMBER CHARACTERISTICS UPON STUMPAGE PRICES. U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 146, 14 pp., illus.

26. _____
    1960. GUIDELINES FOR THE FOREST INVESTOR. Forest Farmer 19(8): 6-7, illus.

27. Hart, Arthur C., and Bissell, Lewis P.
    1959. FARM WOODLOTS, COSTS AND INCOME. Maine Agr. Ext. Serv. Cir. 338, 11 pp., illus.

28. Holland, I. Irving.
    1960. AN EXPLANATION OF CHANGING LUMBER CONSUMPTION AND PRICE. Forest Sci. 6: 171-191, illus.

29. Hughes, Charles E.
    1953. NOW YOU CAN WIN AGAINST BRUSH. Country Gentleman, 123(2): 40-41, 112-113, 115, 117, illus.

30. Hutchison, O. Keith, and Thornton, Philip. L.
    1957. CENTRAL STATES TIMBER RESOURCES. U.S. Forest Serv. Cent. States Forest Expt. Sta. Misc. Release 13, 30 pp., illus.

31. King, D. B., Roberts, E. V., and Winters, R. K.
    1949. FOREST RESOURCES AND INDUSTRIES OF MISSOURI. Mo. Agr. Expt. Sta. Res. Bul. 452, 89 pp., illus.

32. Krajicek, John E.
    1954. SPECIAL MARKET MAKES HARVESTING LOW-GRADE TREES PROFITABLE. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 87, 2 pp.

33. Liming, Franklin G.
    1951. FOREST PROBLEM ANALYSIS AND RESEARCH PROGRAM FOR THE MISSOURI OZARKS. U.S. Forest Serv. Cent. States Forest Expt. Sta. Misc. Release 7, 57 pp., illus.

34. Martin, S. Clark.
    1955. RANGE PROBLEMS IN THE MISSOURI OZARKS. U.S. Forest Serv. Cent. States Forest Expt. Sta. Misc. Release 9, 33 pp., illus.

35. Martin, S. Clark, and Clark, F. Bryan.
    1954. CONTROLLING HARDWOOD SPROUTS WITH FOLIAGE SPRAYS. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 145, 10 pp., illus.

36. _____ Nichols, J. M., and Klingman, Dayton L.
    1954. CONTROLLING WOODY PLANTS WITH 2,4,5-T; 2,4-D AND AMMATE. Mo. Agr. Expt. Sta. Bul. 615, 7 pp., illus.

37. McCauley, Orris D.
    1958. 1957 PULPWOOD HARVEST — CENTRAL STATES. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 120, 2 pp.

38. _____
    1958. PULPWOOD PRICES AND MEASURES IN THE CENTRAL STATES. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 124, 2 pp.

39. _____
    1959. FOREST PRODUCTS PRICES IN OHIO — 1958. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 161, 10 pp., illus.

40. _____
    1960. FOREST PRODUCTS PRICES IN OHIO — 1959. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 170, 14 pp., illus.

41. McCormick, L. E.
    1957. FARM WOODLAND MANAGEMENT. Mo. Agr. Ext. Serv. Cir. 671, 24 pp., illus.

42. _____ and Wylie, John.
    1958. INCREASE YOUR TIMBER PROFITS THROUGH STAND IMPROVEMENT. Mo. Agr. Ext. Serv. Folder 62, 2 pp.

43. Mendel, Joseph J.
    1959. COOPERAGE LOGS AND BOLTS — PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES — 1958. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 140, 2 pp.

44. _____
    1959. PULPWOOD PRODUCTION IN THE CENTRAL STATES — 1958. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 130, 2 pp.

45. _____
    1960. PULPWOOD PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES,

1959. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 174, 5 pp., illus.

46. Mendel, Joseph J.
1961. TIMBER RESOURCES OF THE EASTERN OZARKS. Mo. Agr. Expt. Sta. Bul. B779, 74 pp., illus.

47. Missouri Division of Resources and Development.
1958. MISSOURI FACT FINDER. 39 pp., illus. Mo. Div. Resources and Devlpmt.

48. Missouri Forest Industries Committee.
1958. SUMMARIES OF SPEECHES GIVEN AT MISSOURI FOREST RESOURCE CONFERENCE, OCTOBER 18, 1958. Mo. Forest Indus. Com., St. Louis.

49. Missouri National Forests.
1959. NFA TIMBER MANAGEMENT GUIDES. 39 pp., illus.

50. Missouri Resources and Development Commission.
1960. MISSOURI'S MANUFACTURING PROFILE. Industrial News, Sept. 1960. 3 pp., illus.

51. Möller, Carl Mar:, Abell, Jorgen, Jagd, Thöger, and Juncker, Flemming.
1954. THINNING PROBLEMS AND PRACTICES IN DENMARK. N.Y. State Col. Forestry, Syracuse Univ. Tech. Pub. 76, 92 pp., illus.

52. Nash, Andrew J.
1959. GROWTH IN WELL-STOCKED NATURAL OAK STANDS IN MISSOURI. Mo. Agr. Expt. Sta. Res. Bul. 700, 20 pp., illus.

53. National Lumber Manufacturers Association.
1957. LUMBER INDUSTRY FACTS. 47 pp., illus. Washington.

54. Nelson, Ted R.
1960. THE INFLUENCE OF VOLUME AND COMPETITION ON AERIAL APPLICATION PRICES. Agr. Chem. 15(7): 58-59, 91, illus.

55. Poli, Adon, and Roberts, E. V.
1958. ECONOMICS OF THE UTILIZATION OF COMMERCIAL TIMBERLAND ON LIVESTOCK RANCHES IN NORTHWESTERN CALIFORNIA. U.S. Forest Serv. Calif. Forest and Range Expt. Sta. Misc. Paper 25, 51 pp., illus.

56. Quigley, Kenneth L.
1950. MARKETING FARM WOODLAND PRODUCTS IN THE MISSOURI OZARKS. U.S.

Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 116, 39 pp., illus.

57. Quigley, Kenneth L.
1952. PINE RESOURCES AND MARKETS IN THE MISSOURI OZARKS. 20 pp., illus. Mo. Div. Resources and Devlpmt.

58. _____and Clark, F. Bryan.
1951. FENCE POSTS, A POTENTIAL MARKET FOR MISSOURI PINE TIMBER. 9 pp., illus. Mo. Div. Resources and Devlpmt.

59. _____and Rogers, Nelson F.
1955. TEAMWORK BUILDS POST AND POLE INDUSTRY IN MISSOURI OZARKS PINE FORESTS. Wood Preserv. News 33(11): 10-11, 30, illus.

60. _____and Rogers, Nelson F.
1955. NEW MARKETS FOR PINE IN MISSOURI OZARKS. Mo. Div. Resources and Devlpmt. Newsletter 7(12): 9, illus.

61. Reynolds, R. R.
1959. EIGHTEEN YEARS OF SELECTION TIMBER MANAGEMENT ON THE CROSSETT EXPERIMENTAL FOREST. U.S. Forest Serv. South. Forest Expt. Sta. Tech. Bul. 1206, 68 pp., illus.

62. Reynolds, R. V., and Pierson, A. H.
1941. FOREST PRODUCTS STATISTICS OF CENTRAL AND PRAIRIE STATES. U.S. Dept. Agr. Statis. Bul. 73, 94 pp., illus.

63. Roach, Benjamin A.
1956. LOGGING COSTS FOR CENTRAL HARDWOODS. South. Lumberman, August 15, 1956: 53-54, illus.

64. Robinson, Vernon L.
1959. PULPWOOD PRICE TRENDS IN THE SOUTHEAST. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 136, 2 pp.

65. Rogers, Nelson F.
1958. AIRPLANE-SPRAYED HERBICIDES RELEASE SHORTLEAF PINE FROM HARDWOODS. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 117, 2 pp.

66. St. Louis-San Francisco Railway Company, Industrial Development Dept.
1957. TIMBER FOR INDUSTRY IN SHANNON, REYNOLDS AND CARTER COUNTIES IN SOUTHEASTERN MISSOURI. St. Louis-San Francisco Railway Company, St. Louis 1, Missouri.

67. Schnur, G. Luther.
1937. YIELD, STAND, AND VOLUME TABLES

for even-aged upland oak forests. U.S. Dept. Agr. Tech. Bul. 560, 87 pp., illus.

68. Shepard, H. B.
    1956. Hardwood pulp, its manufacture and use. 67 pp., illus. Boston: The New England Council.

69. Smith, Richard C.
    1957. Taxation of forest land in South Missouri. Mo. Agr. Expt. Sta. Res. Bul. 624, 44 pp., illus.

70. _____ Paulsell, Lee K., and Leney, Lawrence.
    1959. Oak paneling — its processing and marketing. Mo. Agr. Expt. Sta. Bul. 737, 31 pp., illus.

71. Society of American Forester, Ozark Section.
    1959. Field tour notes and summary sheets. S.A.F. Sect. Mtg. June 19-20, 1959, Holiday Inn, Pine Bluff, Ark.

72. _____
    1960. Field trip notes and summary sheets — Salem District, Missouri National Forests. S.A.F. Summer Mtg., June 2, 3, 4, 1960. Salem, Mo.

73. Stanford Research Institute.
    1954. America's demand for wood 1929-1975. 94 pp., illus. Stanford, Calif.: Stanford Res. Inst.

74. State of Missouri.
    1946. The state forestry act. House Bill No. 1006, 63rd General Assembly in 1946. Amendments through 1957.

75. Statewide Forestry Committee of Conservation Federation of Missouri.
    [n.d.] A forestry program for Missouri. 18 pp. illus. Conserv. Fed. of Mo.

76. Steer, Henry B.
    1935-45. Stumpage and log prices for the calendar years 1935-1945. U.S. Dept. Agr. Statis. Bul. 57, 56 pp.; Bul. 62, 59 pp.; Bul. 66, 61 pp.; Bul. 71, 63 pp.; Bul. 75, 67 pp.; Bul. 76, 67 pp.; Bul. 78, 72 pp.; Bul. 79, 128 pp.; Bul. 80, 138 pp.; Bul. 82, 52 pp.

77. _____
    1938. Stumpage prices of privately owned timber in the United States. U.S. Dept. Agr. Tech. Bul. 626, 162 pp., illus.

78. _____
    1948. Lumber production in the United States 1799-1946. U.S. Dept. Agr. Misc. Pub. 669, 233 pp.

79. Sternitzke, Herbert S.
    1959. Forest development opportunities in North Central Mississippi. U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 173, 40 pp., illus.

80. Thornton, Philip L.
    1957. 1955 Pulpwood production in the Central States. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 100, 2 pp., illus.

81. _____
    1957. Pulpwood production continues to increase in the Central States. U.S. Forest Serv. Cent. States Forest Expt. Sta. Note 104, 2 pp.

82. Todd, A. S., Jr.
    1956. Trends in the price of southeastern pulpwood. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 99, 1 p.

83. U.S. Department of Agriculture.
    1929. Volume, yield, and stand tables for second-growth southern pines. Misc. Pub. 50, 202 pp., illus.

84. _____
    1955. Development of agriculture's human resources. 44 pp., illus.

85. U.S. Forest Service.
    1947. Forest survey section, TM handbook. 46 pp., illus. North Central Region.

86. _____
    1949. Timber stand improvement in the Southern Appalachian Region. U.S. Dept. Agr. Misc. Pub. 693, 80 pp., illus.

87. _____
    1957. Price trends and relationships for forest products. 53 pp., illus.

88. _____
    1958. Historical forestry statistics of the United States. U.S. Dept. Agr. Statis. Bul. 228, 36 pp., illus.

89. _____
    1958. Sawtimber stumpage prices for sawtimber sold from National Forest, by selected species and regions, 1st, 3rd, and 4th quarters, 1958. Quarterly reports, 1 p. each.

90. U.S. Forest Service.
    1958. Timber management guide for the National Forests of the North Central States, oak-hickory type. 12 pp.

91. U.S. Forest Service.
    1958. TIMBER MANAGEMENT GUIDE FOR THE NATIONAL FORESTS OF THE NORTH CENTRAL STATES, SHORTLEAF PINE AND SHORTLEAF PINE-OAK TYPE. 10 pp.

92. _____
    1958. TIMBER RESOURCES FOR AMERICA'S FUTURE. Forest Resource Rpt. 14, 713 pp., illus.

93. _____
    1959. SAWTIMBER STUMPAGE PRICES FOR SAWTIMBER SOLD FROM NATIONAL FOREST, BY SELECTED SPECIES AND REGIONS. March, June, and November 1959. Quarterly reports, 1 p. each.

94. _____
    1960. SAWTIMBER STUMPAGE PRICES FOR SAWTIMBER SOLD FROM NATIONAL FOREST, BY SELECTED SPECIES AND REGIONS. January and March 1960. Quarterly reports, 1 p. each.

95. _____ and Commodity Stabilization Service.
    1955. THE DEMAND AND PRICE SITUATION FOR FOREST PRODUCTS, 1956. 38 pp., illus.

96. _____ and Commodity Stabilization Service.
    1957. THE DEMAND AND PRICE SITUATION FOR FOREST PRODUCTS. 37 pp., illus.

97. _____ and Commodity Stabilization Service.
    1958. THE DEMAND AND PRICE SITUATION FOR FOREST PRODUCTS. 32 pp., illus.

98. U.S. Forest Service and Commodity Stabilization Service.
    1959. THE DEMAND AND PRICE SITUATION FOR FOREST PRODUCTS. 33 pp., illus.

99. University of Missouri, School of Forestry.
    1958-59. MISSOURI FORESTRY AND FOREST INDUSTRIES, NOVEMBER 1958, MAY 1959, AND NOVEMBER 1959. Missouri Forestry and Forest Industries: November 1958, 6 pages; May 1959, 7 pages; November 1959, 5 pages. Mo. Agr. Ext. Serv. and School of Forestry.

100. White, George O.
    [n.d.] THE STATE FORESTRY LAW. 4 pp., illus. Jefferson City, Mo.: Conserv. Comm.

101. Williams, Robert D.
    1959. GROWTH AND YIELD OF A THINNED SHORTLEAF PINE PLANTATION. U.S. Forest Serv. Cent. States Forest Expt. Sta. Tech. Paper 169, 12 pp., illus.

102. Worrell, Albert C.
    1959. ECONOMICS OF AMERICAN FORESTRY. 441 pp., illus. New York: John Wiley & Sons, Inc.

103. Zaremba, Joseph.
    1958. THE TREND OF LUMBER PRICES. Jour. Forestry 56: 179-181, illus.

104. Zehngraff, Paul J.
    1947. HOW MANY SMALL FENCE POSTS TO A CORD? U.S. Forest Serv. Lake States Forest Expt. Sta. Tech. Note 269, 1 p.

LIST OF TABLES

Tables

Table 1.--<u>Missouri Ozark timber site classes and</u>

<u>estimated site distribution</u> (49)

Site class	Site index range	Average number of 16-foot logs produced at maturity Oak-hickory	Pine	Estimated[1] percent of Ozark forest covered
0	-34	-1	-1	0.2
1	35-44	1 - 1-1/2	1 - 2	27.2
2	45-54	2 - 2-1/2	2-1/2 - 3	66.0
3	55-64	3 - 3-1/2	3-1/2 - 4	6.5
4	65-74	4+	4-1/2+	.1

[1] Based on unpublished 1959 Missouri Forest Survey data.

Table 2.--<u>Estimated costs per acre of oak management at 2.9 percent interest over</u>

<u>an 85-year rotation</u>

Item	Original cost per acre			Time to rotation: age	Interest: factor	Accumulated cost per acre at rotation age[1]		
	Low	Medium	High			Low	Medium	High
	Dollars	Dollars	Dollars	Years		Dollars	Dollars	Dollars
Original cost								
Land	3.00	6.00	15.00	85	11.350	34.05	68.10	170.25
Annual costs								
Taxes	.03	.13	.25	85	356.896	10.71	46.40	89.22
Fire protection	.02	.04	.09	85	356.896	7.14	14.28	32.12
Administration[2]	.03	.10	.24	85	356.896	10.71	35.69	85.66
Cultural costs								
Cleaning-weeding	2.00	3.00	5.00	65	6.412	12.82	19.24	32.06
Noncomm. thinning	3.00	3.50	6.00	50	4.176	12.53	14.62	25.06
Timber marking	.40	1.30	2.00	50	4.176	1.67	5.43	8.35
	.40	1.30	2.00	40	3.138	1.26	4.08	6.28
	.40	1.30	2.00	30	2.358	.94	3.07	4.72
	.40	1.30	2.00	20	1.771	.71	2.30	3.54
	.40	1.30	2.00	10	1.331	.53	1.73	2.66
	.40	1.30	2.00	0	1.000	.40	1.30	2.00
Total						93.47	216.24	461.92

[1] Future value of $1 @ 2.9 percent compound interest for given number of years.

Formulae: $Vn = Vo(1+p)^n$ for single investment

$$Vn = \frac{a(1+p)^n - 1}{p} \quad \text{for annual series (taxes, etc.)}$$

Vn = future value
Vo = beginning value
p = interest rate (decimal)
n = number years
a = annual payment

[2] Includes allowance for risk @ $.02 per acre per year.

Table 3.--<u>Estimated costs per acre of pine management at 2.9 percent interest</u>

over an 85-year rotation

Item	Original cost per acre			:Time to : rotation age	:Interest: factor :	Accumulated cost per acre at rotation age		
	Low	:Medium :	High	age		Low	:Medium :	High
	Dollars	Dollars	Dollars	Years		Dollars	Dollars	Dollars
Original cost								
Land	3.00	6.00	15.00	85	11.350	34.05	68.10	170.25
Annual costs								
Taxes	.03	.13	.25	85	356.896	10.71	46.40	89.22
Fire protection	.02	.04	.09	85	356.896	7.14	14.28	32.12
Administration	.03	.10	.24	85	356.896	10.71	35.69	85.65
Cultural costs								
Aerial spraying	4.90	6.50	8.50	80	9.845	48.24	63.99	83.68
Cleaning-weeding	2.00	3.00	5.00	75	8.534	17.07	25.60	42.67
Timber marking	.40	1.30	2.00	55	4.818	1.93	6.26	9.64
	.40	1.30	2.00	40	3.138	1.25	4.08	6.28
	.40	1.30	2.00	30	2.358	.94	3.07	4.72
	.40	1.30	2.00	20	1.771	.71	2.30	3.54
	.40	1.30	2.00	10	1.331	.53	1.73	2.66
	.40	1.30	2.00	0	1.000	.40	1.30	2.00
TOTAL						133.68	272.80	532.43

Table 4.--Accumulated value of common operating costs per acre at harvest by years to harvest age and three cost levels

	0 Years			10 Years			20 Years			30 Years			40 Years			50 Years		
	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High
Original cost[1]/																		
Land	3.00	6.00	15.00	3.99	7.99	19.96	5.31	10.63	26.56	7.07	14.15	35.37	9.41	18.83	47.07	12.53	25.06	62.64
Annual fixed costs[2]/																		
Taxes	.03	.13	.25	.34	1.48	2.85	.80	3.46	6.65	1.40	6.09	11.71	2.21	9.58	18.43	3.29	14.24	27.38
Supervision	.01	.08	.22	.11	.91	2.51	.27	2.13	5.85	.47	3.75	10.30	.74	5.90	16.22	1.10	8.76	24.09
Fire protection	.02	.04	.09	.23	.46	1.03	.53	1.06	2.39	.94	1.87	4.21	1.47	2.95	6.64	2.19	4.38	9.86
Variable costs[1]/																		
Timber stand improve.	2.00	4.00	8.00	2.66	5.32	10.65	3.54	7.08	14.17	4.72	9.43	18.86	6.28	12.55	25.10	8.35	16.70	33.41
Noncommercial thinning	3.00	3.50	6.00	3.99	4.66	7.99	5.31	6.20	10.63	7.07	8.25	14.15	9.41	10.98	18.83	12.53	14.62	25.06
Cleaning - weeding	2.00	3.00	5.00	2.66	3.99	6.65	3.54	5.31	8.86	4.72	7.07	11.79	6.28	9.41	15.69	8.35	12.53	20.88
Marking	.40	1.30	2.00	.53	1.73	2.66	.71	2.30	3.54	.94	3.07	4.72	1.26	4.08	6.28	1.67	5.43	8.35
Aerial spraying	4.90	6.50	8.50	6.52	8.65	11.31	8.68	11.51	15.05	11.55	15.33	20.04	15.38	20.40	26.67	20.46	27.14	35.50

	60 Years			70 Years			80 Years			85 Years			90 Years			95 Years		
	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High
Original cost[1]/																		
Land	16.67	33.35	83.37	22.19	44.38	110.96	29.54	59.07	147.68	34.05	68.10	170.25	39.30	78.60	196.50	45.36	90.72	226.80
Annual fixed costs[2]/																		
Taxes	4.72	20.43	39.29	6.62	28.68	55.15	9.15	39.65	76.25	10.71	46.40	89.22	12.52	54.24	104.31	14.61	63.30	121.72
Supervision	1.57	12.57	34.58	2.21	17.65	48.53	3.05	24.40	67.10	3.57	28.55	78.52	4.17	33.38	91.79	4.87	38.95	107.12
Fire protection	3.14	6.29	14.15	4.41	8.82	19.85	6.10	12.20	27.45	7.14	14.28	32.12	8.34	16.69	37.55	9.74	19.48	43.82
Variable costs[1]/																		
Timber stand improve.	11.12	22.23	44.46	14.79	29.59	59.18	19.69	39.38	78.76	22.70	45.40	90.80	26.20	52.40	104.80	30.24	60.48	120.96
Noncommercial thinning	16.67	19.45	33.35	22.19	25.89	44.38	29.54	34.46	59.07	34.05	39.72	68.10	39.30	45.85	78.60	45.36	52.92	90.72
Cleaning - weeding	11.12	16.67	27.79	14.79	22.19	36.98	19.69	29.54	49.22	22.70	34.05	56.75	26.20	39.30	65.50	30.24	45.36	75.60
Marking	2.22	7.23	11.12	2.96	9.62	14.79	3.94	12.80	19.69	4.54	14.76	22.70	5.24	17.03	26.20	6.05	19.66	30.24
Aerial spraying	27.23	36.13	47.24	36.25	48.08	62.87	48.24	63.99	83.68	55.62	73.78	96.48	64.19	85.15	111.35	74.09	98.28	128.52

[1]/ Formula: $V_n = V_o (1+p)^n$ $p = 2.9$ percent

[2]/ Formula: $V_n = a \dfrac{(1+p)^n - 1}{p}$ $p = 2.9$ percent

45

Table 5.--<u>Annual growth rates in percent for Missouri trees,</u>

<u>diameter classes 10-36 inches</u>[1]

| Diameter class | Board feet growth rate percent | | |
	Group I[2]	Group II[3]	Group III[4]
10	4.0	---	7.2
12	2.7	4.6	6.1
14	2.3	3.2	5.4
16	2.2	2.6	4.8
18	2.0	2.3	4.3
20	1.9	2.1	3.9
22	1.8	2.0	3.5
24	1.7	2.0	3.2
26	1.6	1.9	3.0
28	1.6	1.9	2.8
30	1.5	1.8	2.6
32	1.4	1.8	2.4
34	1.4	1.7	2.2
36	1.3	1.7	2.1

[1] Based on unpublished 1947 Missouri Forest Survey data (2,954 sample trees).
[2] Group I - Black oak, white oak, hickory, northern red oak, cedar.
[3] Group II - Post oak, elm, scarlet oak, hard maple, walnut, other white oaks.
[4] Group III - Pine, sycamore, cottonwood, ash, soft maple, cypress, other red oaks and hardwoods.

Table 6.--<u>Estimated timber yields of unmanaged stands on Ozark sites and their value per acre</u>

<u>at various stumpage prices</u>[1]

Site Class	Estimated yield[2] @ 85 years:		Value of yield per acre @ various stumpage prices				
	Oak	Pine	Oak		Pine		
			$10/MBF	$20/MBF	$10/MBF	$20/MBF	$30/MBF
	Board feet[3]	Board feet[3]	Dollars	Dollars	Dollars	Dollars	Dollars
Site Class 1							
Site Index 35	3,800	6,300	38.00	76.00	63.00	126.00	189.00
Site Index 40	4,550	10,900	45.50	91.00	109.00	218.00	327.00
Site Index 45	5,600	15,600	56.00	112.00	156.00	312.00	468.00
Site Class 2							
Site Index 45	5,600	15,600	56.00	112.00	156.00	312.00	468.00
Site Index 50	7,100	20,300	71.00	142.00	203.00	406.00	609.00
Site Index 55	9,100	25,000	91.00	182.00	250.00	500.00	750.00
Site Class 3							
Site Index 55	9,100	25,000	91.00	182.00	250.00	500.00	750.00
Site Index 60	11,500	29,500	115.00	230.00	295.00	590.00	885.00
Site Index 65	14,000	34,400	140.00	280.00	344.00	688.00	1,032.00
Site Class 4							
Site Index 65	14,000	34,400	140.00	280.00	344.00	688.00	1,032.00
Site Index 70+	16,750	39,150	167.50	335.00	391.50	783.00	1,174.50

[1] Based on published yield studies adjusted to Ozark merchantability standards (<u>67</u>, <u>83</u>).
[2] In fully stocked upland oak-hickory stands and pure shortleaf pine stands.
[3] International 1/4-Inch Rule. Differences due to curving and rounding of figures.

Table 7.--Criteria for selecting plots used in empirical yield estimates

for managed stands on Missouri National Forest

Item	Stand conditions	
	Oak-hickory	Pine
Average age	30-40 years	30-40 years
Average basal area	40-100 sq. ft./acre[1]	60-110 sq. ft./acre[1]
D.b.h. range	2-12 inches[2]	4-10 inches
Species composition [3]	Black oak, scarlet oak, white oak, post oak hickory (pine less than 10%)	Shortleaf pine

[1] Cull no greater than 20 square feet for oak and 10 square feet for pine.

[2] No tree greater than 12 inches d.b.h.

[3] Seventy percent of gross volume in major species of each type.

Table 8.--Estimates of merchantable volume yield per acre from managed and unmanaged timber stands,

Site 2, Missouri Ozarks

(In board feet[1]/)

Age (years)	Oak-hickory					Shortleaf pine				
	Unmanaged (67): Yield	Managed[2]:				Unmanaged (83): Yield	Managed[2]:			
		Residual[3] volume (stocking)	Intermediate harvest volume	Cumulative intermediate harvest volume	Cumulative yield		Residual[3] volume (stocking)	Intermediate harvest volume[4]	Cumulative intermediate harvest volume	Cumulative yield
35	--	520	330	330	850	--	730	730	730	1,460
45	1,800	1,250	670	1,000	2,250	5,500	3,280	400	1,130	4,410
55	2,600	2,380	1,440	2,440	4,820	10,200	5,740	2,710	3,840	9,580
65	3,800	4,060	1,820	4,260	8,320	14,700	9,450	1,580	5,420	14,870
75	5,400	5,270	1,440	5,700	10,970	17,900	10,900	2,870	8,290	19,190
85	7,100	7,900	--	5,700	13,600	20,300	15,080	--	8,290	23,370

[1]/ International 1/4-inch Rule to an 8-inch top d.i.b. for hardwoods; 6-inch top d.i.b. for pine. Slight differences between reported data and curves are due to curving and rounding.

[2]/ Unpublished empirical yield estimates by L. L. Sluzailis, U.S. Forest Service, Missouri National Forest, 1959; basis 75 plots, oak-hickory; 36 plots, shortleaf pine, thinnings at 10-year intervals to 55 square feet of basal area.

[3]/ At rotation age, volume standing before harvest; otherwise volume standing after thinning.

[4]/ Varies due to unevenness in stands sampled.

Table 9.--Average high-bid stumpage prices from National

Forest sales in Missouri, 1950-1959[1]/

(In dollars per thousand board feet, Scribner Rule)

Year	Mixed oak	Shortleaf pine
1950	7.74	15.18
1951	10.03	20.36
1952	10.47	20.08
1953	9.99	18.42
1954	10.22	18.64
1955	12.32	17.62
1956	15.71	20.14
1957	12.32	18.95
1958	12.85	19.37
1959	14.74	20.53

[1]/ Based on Advertised Sales Missouri and Shawnee
National Forests, U.S. Forest Service, Region 9.

Table 10.--Sawtimber stumpage prices, Missouri Ozarks, 1958-1959 (99)

(In dollars per thousand board feet[1]/)

Species	Doyle Log Rule			Int. 1/4-Inch Log Rule		
	Low	Medium	High	Low	Medium	High
Red and black oak	5.00	16.00	25.00	3.00	10.00	16.00
White oak	6.50	16.00	32.00	4.00	10.00	20.00
Shortleaf pine	12.00	25.00	55.00	7.50	16.00	35.00

[1]/ Converted to one log rule in some cases because several
rules are in common use throughout the Region.

Table 11.—Oak lumber production in the United States, 1939-1957[1]/

(In million board feet)

Year	Production	Year	Production
1939	1,432	1949	2,518
1940	1,467	1950	3,347
1941	2,208	1951	3,590
1942	2,763	1952	3,353
1943	3,038	1953	3,339
1944	3,292	1954	3,451
1945	2,859	1955	3,716
1946	3,378	1956	3,928
1947	3,193	1957	3,639
1948	--[2]/		

[1]/ Based on (78) and U.S. Bureau of Census statistics.
[2]/ No estimates available.

Table 12.--Estimated pulpwood production in the United States, selected years, 1899-1959[1] (98)

(In million cords)

Year	Hardwoods	Softwoods	Total
1899	0.5	1.2	1.6
1905	.4	2.1	2.5
1910	.8	2.3	3.1
1916	.7	3.7	4.4
1920	.8	4.3	5.0
1925	.7	4.3	5.0
1930	.8	5.3	6.1
1935	.9	5.7	6.6
1941	1.8	12.3	14.2
1945	2.2	13.1	15.3
1950	2.9	17.8	20.7
1955	5.3	25.6	30.9
1960	8.5	31.5	40.0

[1]/ Data may not add due to rounding.

Table 13.--Pulpwood prices in southeastern United States,

1938-1958 (64)

(In dollars per cord[1]/)

Year	Pine		Hardwood	
	Actual[2]/	Adjusted[3]/	Actual	Adjusted
1938	3.60	7.05		
1939	3.90	7.80		
1940	4.15	8.10		
1941	4.60	8.10		
1942	6.00	9.35		
1943	7.25	10.80		
1944	8.20	12.10		
1945	8.45	12.30	8.10	11.80
1946	10.10	12.80	9.70	12.30
1947	10.95	11.40	9.80	10.20
1948	11.70	11.20	11.05	10.60
1949	11.00	11.10	10.80	10.90
1950	11.90	11.70	11.00	10.80
1951	13.85	12.10	12.75	11.10
1952	13.90	12.50	12.80	11.50
1953	13.90	12.60	12.75	11.60
1954	13.95	12.60	12.75	11.60
1955	14.35	13.00	13.05	11.80
1956	15.45	13.50	13.50	11.80
1957	15.50	13.20	13.35	11.40
1958	15.50	13.00	13.45	11.30

[1]/ 128 cubic foot cord of 5-foot bolts with bark.
Includes dealer allowance.
[2]/ Weighted average of all wood at various local delivery points.
[3]/ Converted to constant dollars by wholesale price index of all commodities and rounded, 1947-49 = 100.

Table 14.--Estimated net returns per acre from unmanaged hardwood stands at low cost levels[1]/ by site, stocking level, stumpage price, and years to harvest

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $10/MBF									Stumpage price $20/MBF								
			85 years	80	70	60	50 years	40	30	20	10 years	85 years	80	70	60	50 years	40	30	20	10 years
100	1	4550	.74	6.81	16.69	24.11	29.68	33.88	37.03	39.39	41.17	46.24	52.31	62.19	69.61	75.18	79.38	82.53	84.89	86.67
	2	7100	26.24	32.31	42.19	49.61	55.18	59.38	62.53	64.89	66.67	97.24	103.31	113.19	120.61	126.18	130.38	133.53	135.89	137.67
	3	11500	70.24	76.31	86.19	93.61	99.18	103.38	106.53	108.89	110.67	185.24	191.31	201.19	208.61	214.18	218.38	221.53	223.89	225.67
	4	16750	122.74	128.81	138.69	146.11	151.68	155.88	159.03	161.39	163.17	290.24	296.31	306.19	313.61	319.18	323.38	326.53	328.89	330.67
80	1	3650	-8.26	-2.19	7.69	15.11	20.68	24.88	28.03	30.39	32.17	28.24	34.31	44.19	51.61	57.18	61.38	64.53	66.89	68.67
	2	5700	12.24	18.32	28.19	35.61	41.18	45.38	48.53	50.89	52.67	69.24	75.31	85.19	92.61	98.18	102.38	105.53	107.89	109.67
	3	9200	47.24	53.32	63.19	70.61	76.18	80.38	83.53	85.89	87.67	139.24	145.31	155.19	162.61	168.18	172.38	175.53	177.89	179.67
	4	13400	89.24	95.32	105.19	112.61	118.18	122.38	125.53	127.89	129.67	223.24	229.31	239.19	246.61	252.18	256.38	259.53	261.89	263.67
60	1	2750	-17.26	-11.19	-1.31	6.11	11.68	15.88	19.03	21.39	23.17	10.24	16.31	26.19	33.61	39.18	43.38	46.53	48.89	50.67
	2	4250	-2.26	3.81	13.69	21.11	26.68	30.88	34.03	36.39	38.17	40.24	46.31	56.19	63.61	69.18	73.38	76.53	78.89	80.67
	3	6900	24.24	30.31	40.19	47.61	53.18	57.38	60.53	62.89	64.67	93.24	99.31	109.19	116.61	122.18	126.38	129.53	131.89	133.67
	4	10050	55.74	61.81	71.69	79.11	84.68	88.88	92.03	94.39	96.17	156.24	162.31	172.19	179.61	185.18	189.38	192.53	194.89	196.67
50	1	2250	-22.26	-16.19	-6.31	1.11	6.68	10.88	14.03	16.39	18.17	.24	6.31	16.19	23.61	29.18	33.38	36.53	38.89	40.67
	2	3550	-9.26	-3.19	6.69	14.11	19.68	23.88	27.03	29.39	31.17	26.24	32.31	42.19	49.61	55.18	59.38	62.53	64.89	66.67
	3	5750	12.74	18.81	28.69	36.11	41.68	45.88	49.03	51.39	53.17	70.24	76.31	86.19	93.61	99.18	103.38	106.53	108.89	110.67
	4	8350	38.74	44.81	54.69	62.11	67.68	71.88	75.03	77.39	79.17	122.24	128.31	138.19	145.61	151.18	155.38	158.53	160.89	162.67
40	1	1800	-26.76	-20.69	-10.81	-3.39	2.18	6.38	9.53	11.89	13.67	-8.76	-2.69	7.19	14.61	20.18	24.38	27.53	29.89	31.67
	2	2850	-16.26	-10.19	-.31	7.11	12.68	16.88	20.03	22.39	24.17	12.24	18.31	28.19	35.61	41.18	45.38	48.53	50.89	52.67
	3	4600	1.24	7.31	17.19	24.61	30.18	34.38	37.53	39.89	41.67	47.24	53.31	63.19	70.61	76.18	80.38	83.53	85.89	87.67
	4	6700	22.24	28.31	38.19	45.61	51.18	55.38	58.53	60.89	62.67	89.24	95.31	105.19	112.61	118.18	122.38	125.53	127.89	129.67
20	1	900	-35.76	-29.69	-19.81	-12.39	-6.82	-2.62	.53	2.89	4.67	-26.76	-20.69	-10.81	-3.39	2.18	6.38	9.53	11.89	13.67
	2	1400	-30.76	-24.69	-14.81	-7.39	-1.82	2.38	5.53	7.89	9.67	-16.76	-10.69	-.81	6.61	12.18	16.38	19.53	21.89	23.67
	3	2300	-21.76	-15.69	-5.81	1.61	7.18	11.38	14.53	16.89	18.67	1.24	7.31	17.19	24.61	30.18	34.38	37.53	39.89	41.67
	4	3400	-10.76	-4.69	5.19	12.61	18.18	22.38	25.53	27.89	29.67	23.24	29.31	39.19	46.61	52.18	56.38	59.53	61.89	63.67

1/ Land @ $3.00 per acre. Taxes @ $.03 per acre per year. Interest @ 2.9 percent.

2/ Negative returns within solid line.

Percent of full stocking class	Site class	Merch. volume per acre (years)	Stumpage price $30/MBF									Stumpage price $40/MBF								
			85 years	80	70	60	50 years	40	30	20	10 years	10 years	20	30	40	50 years	60	70	80	85 years
100	1	4550	91.74	97.81	107.69	115.11	120.68	124.88	128.03	130.39	132.17	177.67	175.89	173.53	170.38	166.18	160.61	153.19	143.31	137.24
	2	7100	168.24	174.81	184.19	191.61	197.18	201.38	204.53	206.89	208.67	279.67	277.89	275.53	272.38	268.18	262.61	255.19	245.31	239.24
	3	11500	300.24	306.31	316.19	323.61	329.18	333.38	336.53	338.89	340.67	455.67	453.89	451.53	448.38	444.18	438.61	431.19	421.31	415.24
	4	16750	457.74	463.81	473.69	481.11	486.68	490.88	494.03	496.39	498.17	665.67	663.89	661.53	658.38	654.18	648.61	641.19	631.31	625.24
80	1	3650	64.74	70.81	80.69	88.11	93.68	97.88	101.03	103.39	105.17	141.67	139.89	137.53	134.38	130.18	124.61	117.19	107.31	101.24
	2	5700	126.24	132.31	142.19	149.61	155.18	159.38	162.53	164.89	166.67	223.67	221.89	219.53	216.38	212.18	206.61	199.19	189.31	183.24
	3	9200	231.24	237.31	247.19	254.61	260.18	264.38	267.53	269.89	271.67	363.67	361.89	359.53	356.38	352.18	346.61	339.19	329.31	323.24
	4	13400	357.24	363.31	373.19	380.61	386.18	390.38	393.53	395.89	397.67	531.67	529.89	527.53	524.38	520.18	514.61	507.19	497.31	491.24
60	1	2750	37.74	43.81	53.69	61.11	66.68	70.88	74.03	76.39	78.17	105.67	103.89	101.53	98.38	94.18	88.61	81.19	71.31	65.24
	2	4250	82.74	88.81	98.69	106.11	111.68	115.88	119.03	121.39	123.17	165.67	163.89	161.53	158.38	154.18	148.61	141.19	131.31	125.24
	3	6900	162.24	168.31	178.19	185.61	191.18	195.38	198.53	200.89	202.67	271.67	269.89	267.53	264.38	260.18	254.61	247.19	237.31	231.24
	4	10050	256.74	262.81	272.69	280.11	285.68	289.88	293.03	295.39	297.17	397.67	395.89	393.53	390.38	386.18	380.61	373.19	363.31	357.24
50	1	2250	22.74	28.81	38.69	46.11	51.68	55.88	59.03	61.39	63.17	85.67	83.89	81.53	78.38	74.18	68.61	61.19	51.31	45.24
	2	3550	61.74	67.81	77.69	85.11	90.68	94.88	98.03	100.39	102.17	137.67	135.89	133.53	130.38	126.18	120.61	113.19	103.31	97.24
	3	5750	127.74	133.81	143.69	151.11	156.68	160.88	164.03	166.39	168.17	225.67	223.89	221.53	218.38	214.18	208.61	201.19	191.31	185.24
	4	8350	205.74	211.81	221.69	229.11	234.68	238.88	242.03	244.39	246.17	329.67	327.89	325.53	322.38	318.18	312.61	305.19	295.31	289.24
40	1	1800	9.24	15.31	25.19	32.61	38.18	42.38	45.53	47.89	49.67	67.67	65.89	63.53	60.38	56.18	50.61	43.19	33.31	27.24
	2	2850	40.74	46.81	56.69	64.11	69.68	73.88	77.03	79.39	81.17	109.67	107.89	105.53	102.38	98.18	92.61	85.19	75.31	69.24
	3	4600	93.24	99.31	109.19	116.61	122.18	126.38	129.53	131.89	133.67	179.67	177.89	175.53	172.38	168.18	162.61	155.19	145.31	139.24
	4	6700	156.24	162.31	172.19	179.61	185.18	189.38	192.53	194.89	196.67	263.67	261.89	259.53	256.38	252.18	246.61	239.19	229.31	223.24
20	1	900	-17.76	-11.69	-1.81	5.61	11.18	15.38	18.53	20.89	22.67	31.67	29.89	27.53	24.38	20.18	14.61	7.19	-2.69	-8.76
	2	1400	-2.76	3.31	13.19	20.61	26.18	30.38	33.53	35.89	37.67	51.67	49.89	47.53	44.38	40.18	34.61	27.19	17.31	11.24
	3	2300	24.24	30.31	40.19	47.61	53.18	57.38	60.53	62.89	64.67	87.67	85.89	83.53	80.38	76.18	70.61	63.19	53.31	47.24
	4	3400	57.24	63.31	73.19	80.61	86.18	90.38	93.53	95.89	97.67	131.67	129.89	127.53	124.38	120.18	114.61	107.19	97.31	91.24

[1]/ Land @ $3.00 per acre. Taxes @ $.03 per acre per year. Interest @ 2.9 percent.

[2]/ Negative returns within solid line.

Table 15.--Estimated net returns per acre from unmanaged hardwood stands at medium cost levels[1]/ by site, stocking level, stumpage price, and years to harvest

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $10/MBF 85 years	80 years	70 years	60 years	50 years	40 years	30 years	20 years	10 years	Stumpage price $20/MBF 85 years	80 years	70 years	60 years	50 years	40 years	30 years	20 years	10 years
100	1	4,550	-69.00	-53.22	-27.56	-8.28	6.20	17.09	25.26	31.41	36.03	-23.50	-7.72	17.94	37.22	51.20	62.59	70.76	76.91	81.53
	2	7,100	-63.50	-27.72	-2.06	17.22	31.70	42.59	50.76	56.91	61.53	27.50	43.28	68.94	88.22	102.70	113.59	121.76	127.91	132.53
	3	11,500	.50	16.28	41.94	61.22	75.70	86.59	94.76	100.91	105.53	115.50	131.28	156.94	176.22	190.70	201.59	209.76	215.91	220.53
	4	16,750	53.00	68.78	94.44	113.72	128.20	139.09	147.26	153.41	158.03	220.50	236.28	261.94	281.22	295.70	306.59	314.76	320.91	325.53
80	1	3,650	-78.00	-62.22	-36.56	-17.28	-2.80	8.09	16.26	22.41	27.03	-41.50	-25.72	-.06	19.22	33.70	44.59	52.76	58.91	63.53
	2	5,700	-57.50	-41.72	-16.06	3.22	17.70	28.59	36.76	42.91	47.53	-.50	15.28	40.94	60.22	74.70	85.59	93.76	99.91	104.53
	3	9,200	-22.50	-6.72	18.94	38.22	52.70	63.59	71.76	77.91	82.53	69.50	85.28	110.94	130.22	144.70	155.59	163.76	169.91	174.53
	4	13,400	19.50	35.28	60.94	80.22	94.70	105.59	113.76	119.91	124.53	153.50	169.28	194.94	214.22	228.70	239.59	247.76	253.91	258.53
60	1	2,750	-87.00	-71.22	-45.56	-26.28	-11.80	-.91	7.26	13.41	18.03	-59.50	-43.72	-18.06	1.22	15.70	26.59	34.76	40.91	45.53
	2	4,250	-72.00	-56.22	-30.56	-11.28	3.20	14.09	22.26	28.41	33.03	-29.50	-13.72	11.94	31.22	45.70	56.59	64.76	70.91	75.53
	3	6,900	-45.50	-29.72	-4.06	15.22	29.70	40.59	48.76	54.91	59.53	23.50	39.28	64.94	84.22	98.70	109.59	117.76	123.91	128.53
	4	10,050	-14.00	1.78	27.44	46.72	61.20	72.09	80.26	86.41	91.03	86.50	102.28	127.94	147.22	161.70	172.59	180.76	186.91	191.53
50	1	2,250	-92.00	-76.22	-50.56	-31.28	-16.80	-5.91	2.26	8.41	13.03	-69.50	-53.72	-28.06	-8.78	5.70	16.59	24.76	30.91	35.53
	2	3,550	-79.00	-63.22	-37.56	-18.28	-3.80	7.09	15.26	21.41	26.03	-43.50	-27.72	-2.06	17.22	31.70	42.59	50.76	56.91	61.53
	3	5,750	-57.00	-41.22	-15.56	3.72	18.20	29.09	37.26	43.41	48.03	.50	16.28	41.94	61.22	75.70	86.59	94.76	100.91	105.53
	4	8,350	-31.00	-15.22	10.44	29.72	44.20	55.09	63.26	69.41	74.03	52.50	68.28	93.94	113.22	127.70	138.59	146.76	152.91	157.53
40	1	1,800	-96.50	-80.72	-55.06	-35.78	-21.30	-10.41	-2.24	3.91	8.53	-78.50	-62.72	-37.06	-17.78	-3.30	7.59	15.76	21.91	26.53
	2	2,850	-86.00	-70.22	-44.56	-25.28	-10.80	.46	8.26	14.41	19.03	-57.50	-41.72	-16.06	3.22	17.70	28.59	36.76	42.91	47.53
	3	4,600	-68.50	-52.72	-27.06	-7.78	6.70	17.59	25.76	31.91	36.53	-22.50	-6.72	18.94	38.22	52.70	63.59	71.76	77.91	82.53
	4	6,700	-47.50	-31.72	-6.06	13.22	27.70	38.59	46.76	52.91	57.53	19.50	35.28	60.94	80.22	94.70	105.59	113.76	119.91	124.53
20	1	900	-105.50	-89.72	-64.06	-44.78	-30.30	-19.41	-11.24	-5.09	-.47	-96.50	-80.72	-55.06	-35.78	-21.30	-10.41	-2.24	3.91	8.53
	2	1,400	-100.50	-84.72	-59.06	-39.78	-25.30	-14.41	-6.24	-.09	4.53	-86.50	-70.72	-45.06	-25.78	-11.30	-.41	7.76	13.91	18.53
	3	2,300	-91.50	-75.72	-50.06	-30.78	-16.30	-5.41	2.76	8.91	13.53	-68.50	-52.72	-27.28	-7.78	6.70	17.59	25.76	31.91	36.53
	4	3,400	-80.50	-64.72	-39.06	-19.78	-5.30	5.59	13.76	19.91	24.53	-46.50	-30.72	-5.06	14.22	28.70	39.59	47.76	53.91	58.53

1/ Land @ $6.00 per acre. Taxes @ $0.13 per acre per year. Interest @ 2.9 percent.

2/ Negative returns within solid line.

Table 15.--Estimated net returns per acre from unmanaged hardwood stands at medium cost levels[1/] by site, stocking level, stumpage price, and years to harvest (cont.)

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $30/MBF years									Stumpage price $40/MBF years								
			85	80	70	60	50	40	30	20	10	85	80	70	60	50	40	30	20	10
100	1	4,550	22.00	37.78	63.44	82.72	97.20	108.09	116.26	122.41	127.03	67.50	83.28	108.94	128.22	142.70	153.59	161.76	167.91	172.53
	2	7,100	98.50	114.28	139.94	159.22	173.70	184.59	192.76	198.91	203.53	169.50	185.28	210.94	230.22	244.70	255.59	263.76	269.91	274.53
	3	11,500	230.50	246.28	271.94	291.22	305.70	316.59	324.76	330.91	335.53	345.50	361.28	386.94	406.22	420.70	431.59	439.76	445.91	450.53
	4	16,750	388.00	403.78	429.44	448.72	463.20	474.09	482.26	488.41	493.03	555.50	571.28	596.94	616.22	630.70	641.59	649.76	655.91	660.53
80	1	3,650	-5.00	10.78	36.44	55.72	70.20	81.09	89.26	95.41	100.03	31.50	47.28	72.94	92.22	106.70	117.59	125.76	131.91	136.53
	2	5,700	56.50	72.28	97.94	117.22	131.70	142.59	150.76	156.91	161.53	113.50	129.28	154.94	174.22	188.70	199.59	207.76	213.91	218.53
	3	9,200	161.50	177.28	202.94	222.22	236.70	247.59	255.76	261.91	266.53	253.50	269.28	294.94	314.22	328.70	339.59	347.76	353.91	358.53
	4	13,400	287.50	303.28	328.94	348.22	362.70	373.59	381.76	387.91	392.53	421.50	437.28	462.94	482.22	496.70	507.59	515.76	521.91	526.53
60	1	2,750	-32.00	-16.22	9.44	28.72	43.20	54.09	62.26	68.41	73.03	-4.50	11.28	36.94	56.22	70.70	81.59	89.76	95.91	100.53
	2	4,250	13.00	28.78	54.44	73.72	88.20	99.09	107.26	113.41	118.03	55.50	71.28	96.94	116.22	130.70	141.59	149.76	155.91	160.53
	3	6,900	92.50	108.28	133.94	153.22	167.70	178.59	186.76	192.91	197.53	161.50	177.28	202.94	222.22	236.70	247.59	255.76	261.91	266.53
	4	10,050	187.00	202.78	228.44	247.72	262.20	273.09	281.26	287.41	292.03	287.50	303.28	328.94	348.22	362.70	373.59	381.76	387.91	392.53
50	1	2,250	-47.00	-31.22	-5.56	13.72	28.20	39.09	47.26	53.41	58.03	-24.50	-8.72	16.94	36.22	50.70	61.59	69.76	75.91	80.53
	2	3,550	-8.00	7.78	33.44	52.72	67.20	78.09	86.26	92.41	97.03	27.50	43.28	68.94	88.22	102.70	113.59	121.76	127.91	132.53
	3	5,750	58.00	73.78	99.44	118.72	133.20	144.09	152.26	158.41	163.03	115.50	131.28	156.94	176.22	190.70	201.59	209.76	215.91	220.53
	4	8,350	136.00	151.78	177.44	196.72	211.20	222.09	230.26	236.41	241.03	219.50	235.28	260.94	280.22	294.70	305.59	313.76	319.91	324.53
40	1	1,800	-60.50	-44.72	-19.06	.22	14.70	25.59	33.76	39.91	44.53	-42.50	-26.72	-1.06	18.22	32.70	43.59	51.76	57.91	62.53
	2	2,850	-29.00	-13.22	12.44	31.72	46.20	57.09	65.26	71.41	76.03	-5.50	15.28	40.94	60.22	74.70	85.59	93.76	99.91	104.53
	3	4,600	23.50	39.28	64.94	84.22	98.70	109.59	117.76	123.91	128.53	69.50	85.28	110.94	130.22	144.70	155.59	163.76	169.91	174.53
	4	6,700	86.50	102.28	127.94	147.22	161.70	172.59	180.76	186.91	191.53	153.50	169.28	194.94	214.22	228.70	239.59	247.76	253.91	258.53
20	1	900	-87.50	-71.72	-46.06	-26.78	-12.30	-1.41	6.76	12.91	17.53	-78.50	-62.72	-37.06	-17.78	-3.30	7.59	15.76	21.91	26.53
	2	1,400	-72.50	-56.72	-31.06	-11.78	2.70	13.59	21.76	27.91	32.53	-58.50	-42.72	-17.06	2.22	16.70	27.59	35.76	41.91	46.53
	3	2,300	-45.50	-29.72	-4.06	15.22	29.70	40.59	48.76	54.91	59.53	-22.50	-6.72	18.94	38.22	52.70	63.59	71.76	77.91	82.53
	4	3,400	-12.50	3.28	28.94	48.22	62.70	73.59	81.76	87.91	92.53	21.50	37.28	62.94	82.22	96.70	107.59	115.76	121.91	126.53

1/ Land @ $6.00 per acre. Taxes @ $0.13 per acre per year. Interest @ 2.9 percent.

2/ Negative returns within solid line.

Table 16.--Estimated net returns per acre from unmanaged hardwood stands at high cost levels[1]/ by site, stocking level, stumpage price, and years to harvest

Percent of full stocking	Site class	Merch. volume per acre [2]/	Stumpage price $10/MBF (years)									Stumpage price $20/MBF (years)								
			85	80	70	60	50	40	30	20	10	85	80	70	60	50	40	30	20	10
100	1	4550	-213.97	-178.43	-120.61	-77.16	-44.52	-20.00	-1.58	12.29	22.69	-168.47	-132.93	-75.11	-31.66	.98	25.50	43.92	57.79	68.19
	2	7100	-188.47	-152.93	-95.11	-51.66	-19.02	5.50	23.92	37.79	48.19	-117.47	-81.93	-24.11	19.34	51.98	76.50	94.92	108.79	119.19
	3	11500	-144.47	-108.93	-51.11	-7.66	24.98	49.50	67.92	81.79	92.19	-29.47	6.07	63.89	107.34	139.98	164.50	182.92	196.79	207.19
	4	16750	-91.97	-56.43	1.39	44.84	77.48	102.00	120.42	134.29	144.69	75.53	111.07	168.89	212.34	244.98	269.50	287.92	301.79	312.19
80	1	3650	-222.97	-187.43	-129.61	-86.16	-53.52	-29.00	-10.58	3.29	13.69	-186.47	-150.93	-93.11	-49.66	-17.02	7.50	25.92	39.79	50.19
	2	5700	-202.47	-166.93	-109.11	-65.66	-33.02	-8.50	9.92	23.79	34.19	-145.47	-109.93	-52.11	-8.66	23.98	48.50	66.92	80.79	91.19
	3	9200	-167.47	-131.93	-74.11	-30.66	1.98	26.50	44.92	58.79	69.19	-75.47	-39.93	17.89	61.34	93.98	118.50	136.92	150.79	161.19
	4	13400	-125.47	-89.93	-32.11	11.34	43.98	68.50	86.92	100.79	111.19	8.53	44.07	101.89	145.34	177.98	202.50	220.92	234.79	245.19
60	1	2750	-231.97	-196.43	-138.61	-95.16	-62.52	-38.00	-19.58	-5.71	4.69	-204.47	-168.93	-111.11	-67.66	-35.02	-10.50	7.92	21.79	32.19
	2	4250	-216.97	-181.43	-123.61	-80.16	-47.52	-23.00	-4.58	9.29	19.69	-174.47	-138.93	-81.11	-37.66	-5.02	19.50	37.92	51.79	62.19
	3	6900	-190.47	-154.93	-97.11	-53.66	-21.02	3.50	21.92	35.79	46.19	-121.47	-85.93	-28.11	15.34	47.98	72.50	90.92	104.79	115.19
	4	10050	-158.97	-123.43	-65.61	-22.16	10.48	35.00	53.42	67.29	77.69	-58.47	-22.93	34.89	78.34	110.98	135.50	153.92	167.79	178.19
50	1	2250	-236.97	-201.43	-143.61	-100.16	-67.52	-43.00	-24.58	-10.71	-.31	-214.47	-178.93	-121.11	-77.66	-45.02	-20.50	-2.08	11.79	22.19
	2	3550	-223.97	-188.43	-130.61	-87.16	-54.52	-30.00	-11.58	2.29	12.69	-188.47	-152.93	-95.11	-51.66	-19.02	5.50	23.92	37.79	48.19
	3	5750	-201.97	-166.43	-108.61	-65.16	-32.52	-8.00	10.42	24.29	34.69	-144.47	-108.93	-51.11	-7.66	24.98	49.50	67.92	81.79	92.19
	4	8350	-175.97	-140.43	-82.61	-39.16	-6.52	18.00	36.42	50.29	60.69	-92.47	-56.93	.89	44.34	76.98	101.50	119.92	133.79	144.19
40	1	1800	-241.47	-205.93	-148.11	-104.66	-72.02	-47.50	-29.08	-15.21	-4.81	-223.47	-187.93	-130.11	-86.66	-54.02	-29.50	-11.08	2.79	13.19
	2	2850	-230.97	-195.43	-137.61	-94.16	-61.52	-37.00	-18.58	-4.71	5.69	-202.47	-166.93	-109.11	-65.66	-33.02	-8.50	9.92	23.79	34.19
	3	4600	-213.47	-177.93	-120.11	-76.66	-44.02	-19.50	-1.08	12.79	23.19	-167.47	-131.93	-74.11	-30.66	1.98	26.50	44.92	58.79	69.19
	4	6700	-192.47	-156.93	-99.11	-55.66	-23.02	1.50	19.92	33.79	44.19	-125.47	-89.93	-32.11	11.34	43.98	68.50	86.92	100.79	111.19
20	1	900	-250.47	-214.93	-157.11	-113.66	-81.02	-56.50	-38.08	-24.21	-13.81	-241.47	-205.93	-148.11	-104.66	-72.02	-47.50	-29.08	-15.21	-4.81
	2	1400	-245.47	-209.93	-152.11	-108.66	-76.02	-51.50	-33.08	-19.21	-8.81	-231.47	-195.93	-138.11	-94.66	-62.02	-37.50	-19.08	-5.21	5.19
	3	2300	-236.47	-200.93	-143.11	-99.66	-67.02	-42.50	-24.08	-10.21	.19	-213.47	-177.93	-120.11	-76.66	-44.02	-19.50	-1.08	12.79	23.19
	4	3400	-225.47	-189.93	-132.11	-88.66	-56.02	-31.50	-13.08	.79	11.19	-191.47	-155.93	-98.11	-54.66	-22.02	2.50	20.92	34.79	45.19

1/ Land @ $15.00 per acre. Taxes @ $.25 per acre per year. Interest @ 2.9 percent.
2/ Negative returns within solid line.

Table 16.--Estimated net returns per acre from unmanaged hardwood stands at high cost levels [1]/ by site, stocking level, stumpage price, and years to harvest (cont.)

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $30/MBF									Stumpage price $35/MBF									Stumpage price $40/MBF								
			85	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**	**85**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**	**85**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**
			years									years									years								
100	1	4550	-122.97 [2]	-87.43	-29.61	13.84	46.48	71.00	89.42	103.29	113.69	-100.22	-64.68	-6.86	36.59	69.23	93.75	112.17	126.04	136.44	-77.47	-41.93	15.89	59.34	91.98	116.50	134.92	148.79	159.19
	2	7100	-46.47	-10.93	46.89	90.34	122.98	147.50	165.92	179.79	190.19	-10.97	24.57	82.39	125.84	158.48	183.00	201.42	215.29	225.69	24.53	60.07	117.89	161.34	193.98	218.50	236.92	250.79	261.19
	3	11500	85.53	121.07	178.89	222.34	254.98	279.50	297.92	311.79	322.19	143.03	178.57	236.39	279.84	312.48	337.00	355.42	369.29	379.69	200.53	236.07	293.89	337.34	369.98	394.50	412.92	426.79	437.19
	4	16750	243.03	278.57	336.39	379.84	412.48	437.00	455.42	469.29	479.69	326.78	362.32	420.14	463.59	496.23	520.75	539.17	553.04	563.44	410.53	446.07	503.89	547.34	579.98	604.50	622.92	636.79	647.19
80	1	3650	-149.97	-114.43	-56.61	-13.16	19.48	44.00	62.42	76.29	86.69	-131.72	-96.18	-38.36	5.09	37.73	62.25	80.67	94.54	104.94	-113.47	-77.93	-20.11	23.34	55.98	80.50	98.92	112.79	123.19
	2	5700	-88.47	-52.93	4.89	48.34	80.98	105.50	123.92	137.79	148.19	-59.97	-24.43	33.39	76.84	109.48	134.00	152.42	166.29	176.69	-31.47	4.07	61.89	105.34	137.98	162.50	180.92	194.79	205.19
	3	9200	16.53	52.07	109.89	153.34	185.98	210.50	228.92	242.79	253.19	62.53	98.07	155.89	199.34	231.98	256.50	274.92	288.79	299.19	108.53	144.07	201.89	245.34	277.98	302.50	320.92	334.79	345.19
	4	13400	142.53	178.07	235.89	279.34	311.98	336.50	354.92	368.79	379.19	209.53	245.07	302.89	346.34	378.98	403.50	421.92	435.79	446.19	276.53	312.07	369.89	413.34	445.98	470.50	488.92	502.79	513.19
60	1	2750	-176.97	-141.43	-83.61	-40.16	-7.52	17.00	35.42	49.29	59.69	-163.22	-127.68	-69.86	-26.41	6.23	30.75	49.17	63.04	73.44	-149.47	-113.93	-56.11	-12.66	19.98	44.50	62.92	76.79	87.19
	2	4250	-131.97	-96.43	-38.61	4.84	37.48	62.00	80.42	94.29	104.69	-110.72	-75.18	-17.36	26.09	58.73	83.25	101.67	115.54	125.94	-89.47	-53.93	3.89	47.34	79.98	104.50	122.92	136.79	147.19
	3	6900	-52.47	-16.93	40.89	84.34	116.98	141.50	159.92	173.79	184.19	-17.97	17.57	75.39	118.84	151.48	176.00	194.42	208.29	218.69	16.53	52.07	109.89	153.34	185.98	210.50	228.92	242.79	253.19
	4	10050	42.03	77.57	135.39	178.84	211.48	236.00	254.42	268.29	278.69	92.28	127.82	185.64	229.09	261.73	286.25	304.67	318.54	328.94	142.53	178.07	235.89	279.34	311.98	336.50	354.92	368.79	379.19
50	1	2250	-191.97	-156.43	-98.61	-55.16	-22.52	2.00	20.42	34.29	44.69	-180.72	-145.18	-87.36	-43.91	-11.27	13.25	31.67	45.54	55.94	-169.47	-133.93	-76.11	-32.66	-.02	24.50	42.92	56.79	67.19
	2	3550	-152.97	-117.43	-59.61	-16.16	16.48	41.00	59.42	73.29	83.69	-135.22	-99.68	-41.86	1.59	34.23	58.75	77.17	91.04	101.44	-117.47	-81.93	-24.11	19.34	51.98	76.50	94.92	108.79	119.19
	3	5750	-86.97	-51.43	6.39	49.84	82.48	107.00	125.42	139.29	149.69	-58.22	-22.68	35.14	78.59	111.23	135.75	154.17	168.04	178.44	-29.47	6.07	63.89	107.34	139.98	164.50	182.92	196.79	207.19
	4	8350	-92.47	-56.93	0.89	44.34	76.98	101.50	119.92	133.79	144.19	-50.72	-15.18	42.64	86.09	118.73	143.25	161.67	175.54	185.94	-8.97	26.57	84.39	127.84	160.48	185.00	203.42	217.29	227.69
40	1	1800	-205.47	-169.93	-112.11	-68.66	-36.02	-11.50	6.92	20.79	31.19	-196.47	-160.93	-103.11	-59.66	-27.02	-2.50	15.92	29.79	40.19	-187.47	-151.93	-94.11	-50.66	-18.02	6.50	24.92	38.79	49.19
	2	2850	-173.97	-138.43	-80.61	-37.16	-4.52	20.00	38.42	52.29	62.69	-159.72	-124.18	-66.36	-22.91	9.73	34.25	52.67	66.54	76.94	-145.47	-109.93	-52.11	-8.66	23.98	48.50	66.92	80.79	91.19
	3	4600	-121.47	-85.93	-28.11	15.34	47.98	72.50	90.92	104.79	115.19	-98.47	-62.93	-5.11	38.34	70.98	95.50	113.92	127.79	138.19	-75.47	-39.93	17.89	61.34	93.98	118.50	136.92	150.79	161.19
	4	6700	-114.47	-78.93	-21.11	22.34	54.98	79.50	97.92	111.79	122.19	-80.97	-45.43	12.39	55.84	88.48	113.00	131.42	145.29	155.69	-47.47	-11.93	45.89	89.34	121.98	146.50	164.92	178.79	189.19
20	1	900	-232.47	-196.93	-139.11	-95.06	-63.02	-38.50	-20.08	-6.21	4.19	-227.97	-192.43	-134.61	-90.56	-58.52	-34.00	-15.58	-1.71	8.69	-223.47	-187.93	-130.11	-86.66	-54.02	-29.50	-11.08	2.79	13.19
	2	1400	-217.47	-181.93	-124.11	-80.66	-48.02	-23.50	-5.08	8.79	19.19	-210.47	-174.93	-117.11	-73.66	-41.02	-16.50	1.92	15.79	26.19	-203.47	-167.93	-110.11	-66.66	-34.02	-9.50	8.92	22.79	33.19
	3	2300	-190.47	-154.93	-97.11	-53.66	-21.02	3.50	21.92	35.79	46.19	-178.97	-143.43	-85.61	-42.16	-9.52	15.00	33.42	47.29	57.69	-167.47	-131.93	-74.11	-30.66	1.98	26.50	44.92	58.79	69.19
	4	3400	-157.47	-121.93	-64.11	-20.66	11.98	36.50	54.92	68.79	79.19	-140.47	-104.93	-47.11	-3.66	28.98	53.50	71.92	85.79	96.19	-123.47	-87.93	-30.11	13.34	45.98	70.50	88.92	102.79	113.19

[1]/ Land @ $15.00 per acre. Taxes @ $.25 per acre per year. Interest @ 2.9 percent.

[2]/ Negative returns within solid line.

Table 17.--Estimated net returns per acre from unmanaged pine stands at low cost levels[1]/ by site, stocking level, stumpage price, and years to harvest

The following is a single wide table split here into two halves (Stumpage price $16/MBF and $20/MBF) for readability; the left-hand columns (Percent of full stocking, Site class, Merch. volume per acre) apply to both halves. Year columns are "years to harvest."

Stumpage price $16/MBF

Percent of full stocking	Site class	Merch. volume per acre (85 years)	85 years	60	70	80	10 years	20	30	40	50 years
100	1	10900	129.64	153.01	145.59	135.71	170.07	168.29	165.93	162.78	158.58
	2	20300	280.04	303.41	295.99	286.11	320.47	318.69	316.33	313.18	308.98
	3	29500	427.24	450.61	443.19	433.31	467.67	465.89	463.53	460.38	456.18
	4	39150	581.64	605.01	597.59	587.71	622.07	620.29	617.93	614.78	610.58
80	1	8750	95.24	118.61	111.19	101.31	135.67	133.89	131.53	128.38	124.18
	2	16250	215.24	238.61	231.19	221.31	255.67	253.89	251.53	248.38	244.18
	3	23600	332.84	356.21	348.79	338.91	373.27	371.49	369.13	365.98	361.78
	4	31300	456.04	479.41	471.99	462.11	496.47	494.69	492.33	489.18	484.98
60	1	6500	59.24	82.61	75.19	65.31	99.67	97.89	95.53	92.38	88.18
	2	12200	150.44	173.81	166.39	156.51	190.87	189.09	186.73	183.58	179.38
	3	17700	238.44	261.81	254.39	244.51	278.87	277.09	274.73	271.58	267.38
	4	23500	331.24	354.61	347.19	337.31	371.67	369.89	367.53	364.38	360.18
50	1	5400	41.64	65.01	57.59	47.71	82.07	80.29	77.93	74.78	70.58
	2	10150	117.64	141.01	133.59	123.71	158.07	156.29	153.93	150.78	146.58
	3	14600	188.84	212.21	204.79	194.91	229.27	227.49	225.13	221.98	217.78
	4	19500	267.24	290.61	283.19	273.31	307.67	305.89	303.53	300.38	296.18
40	1	4350	24.84	48.21	40.79	30.91	65.27	63.49	61.13	57.98	53.78
	2	8100	84.84	108.21	100.79	90.91	125.27	123.49	121.13	117.98	113.78
	3	11800	144.04	167.41	159.99	150.11	184.47	182.69	180.33	177.18	172.98
	4	15600	204.84	228.21	220.79	210.91	245.27	243.49	241.13	237.98	233.78
20	1	2150	-10.36	13.01	5.59	-4.29	30.07	28.29	25.93	22.78	18.58
	2	4100	20.84	44.21	36.79	26.91	61.27	59.49	57.13	53.98	49.78
	3	5900	49.64	73.01	65.59	55.11	90.07	88.29	85.93	82.78	78.58
	4	7800	80.04	103.41	95.99	86.11	120.47	118.69	116.33	113.18	108.98

Stumpage price $20/MBF

Percent of full stocking	Site class	Merch. volume per acre (85 years)	85 years	60	70	80	10 years	20	30	40	50 years
100	1	10900	173.24	196.61	189.19	179.31	213.67	211.89	209.53	206.38	202.18
	2	20300	361.24	384.61	377.19	367.31	401.67	399.89	397.53	394.38	390.18
	3	29500	545.24	568.61	561.19	551.31	585.67	583.89	581.53	578.38	574.18
	4	39150	738.24	761.61	754.19	744.31	778.67	776.89	774.53	771.38	767.18
80	1	8750	130.24	153.61	146.19	136.31	170.67	168.89	166.53	163.38	159.18
	2	16250	280.24	303.61	296.19	286.31	320.67	318.89	316.53	313.38	309.18
	3	23600	427.24	450.61	443.19	433.31	467.67	465.89	463.53	460.38	456.18
	4	31300	581.24	604.61	597.19	587.31	621.67	619.89	617.53	614.38	610.18
60	1	6500	85.24	108.61	101.19	91.31	125.67	123.89	121.53	118.38	114.18
	2	12200	199.24	222.61	215.19	205.31	239.67	237.89	235.53	232.38	228.18
	3	17700	309.24	332.61	325.19	315.31	349.67	347.89	345.53	342.38	338.18
	4	23500	425.24	448.61	441.19	431.31	465.67	463.89	461.53	458.38	454.18
50	1	5400	63.24	86.61	79.19	69.31	103.67	101.89	99.53	96.38	92.18
	2	10150	158.24	181.61	174.19	164.31	198.67	196.89	194.53	191.38	187.18
	3	14600	247.24	270.61	263.19	253.31	287.67	285.89	283.53	280.38	276.18
	4	19500	345.24	368.61	361.19	351.31	385.67	383.89	381.53	378.38	374.18
40	1	4350	42.24	65.61	58.19	48.31	82.67	80.89	78.53	75.38	71.18
	2	8100	117.24	140.61	133.19	123.31	157.67	155.89	153.53	150.38	146.18
	3	11800	191.24	214.61	207.19	197.31	231.67	229.89	227.53	224.38	220.18
	4	15600	267.24	290.61	283.19	273.31	307.67	305.89	303.53	300.38	296.18
20	1	2150	-1.76	21.61	14.19	4.31	38.67	36.89	34.53	31.38	27.18
	2	4100	37.24	60.61	53.19	43.31	77.67	75.89	73.53	70.38	66.18
	3	5900	73.24	96.61	89.31	79.31	113.67	111.89	109.53	106.18	102.18
	4	7800	111.24	134.61	127.19	117.31	151.67	149.89	147.53	144.38	140.18

[1]/ Land @ $3.00 per acre. Taxes @ $.03 per acre per year. Interest @ 2.9 percent.

[2]/ Negative returns within solid line. (The boxed negative values: stocking 20, site 1 — $16/MBF 85 years = -10.36 and 80 years = -4.29; $20/MBF 85 years = -1.76.)

Table 17.—Estimated net returns per acre from unmanaged pine stands at low cost levels[1] by site, stocking level, stumpage price, and years to harvest (cont.)

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $30/MBF									Stumpage price $40/MBF								
			85 years	80	70	60	50 years	40	30	20	10 years	85 years	80	70	60	50 years	40	30	20	10 years
100	1	10900	282.24	288.31	298.19	305.61	311.18	315.38	318.53	320.89	322.67	391.24	397.31	407.19	414.61	420.18	424.38	427.53	429.89	431.67
	2	20300	564.24	570.31	580.19	587.61	593.18	597.38	600.53	602.89	604.67	767.24	773.31	783.19	790.61	796.18	800.38	803.53	805.89	807.67
	3	29500	840.24	846.31	856.19	863.61	869.18	873.38	876.53	878.89	880.67	1135.24	1141.31	1151.19	1158.61	1164.18	1168.38	1171.53	1173.89	1175.67
	4	39150	1129.74	1135.81	1145.69	1153.11	1158.68	1162.88	1166.03	1168.39	1170.17	1521.24	1527.31	1537.19	1544.61	1550.18	1554.18	1557.53	1559.89	1561.67
80	1	8750	217.74	223.81	233.69	241.11	246.68	250.88	254.03	256.39	258.17	305.24	311.31	321.19	328.61	334.18	338.38	341.53	343.89	345.67
	2	16250	442.74	448.81	458.69	466.11	471.68	475.88	479.03	481.39	483.17	605.24	611.31	621.19	628.61	634.18	638.38	641.53	643.89	645.67
	3	23600	663.24	669.31	679.19	686.61	692.18	696.38	699.53	701.89	703.67	899.24	905.31	915.19	922.61	928.18	932.38	935.53	937.89	939.67
	4	31300	894.24	900.31	910.19	917.61	923.18	927.38	930.53	932.89	934.67	1207.24	1213.31	1223.19	1230.61	1236.18	1240.38	1243.53	1245.89	1247.67
60	1	6500	150.24	156.31	166.19	173.61	179.18	183.38	186.53	188.89	190.67	215.24	221.31	231.19	238.61	244.18	248.38	251.53	253.89	255.67
	2	12200	321.24	327.31	337.19	344.61	350.18	354.38	357.53	359.89	361.67	443.24	449.31	459.19	466.61	472.18	476.38	479.53	481.89	483.67
	3	17700	486.24	492.31	502.19	509.61	515.18	519.38	522.53	524.89	526.67	663.24	669.31	679.19	686.61	692.18	696.38	699.53	701.89	703.67
	4	23500	660.24	666.31	676.19	683.61	689.18	693.38	696.53	698.89	700.67	895.24	901.31	911.19	918.61	924.18	928.38	931.53	933.89	935.67
50	1	5400	117.24	123.31	133.19	140.61	146.18	150.38	153.53	155.89	157.67	171.24	177.31	187.19	194.61	200.18	204.38	207.53	209.89	211.67
	2	10150	259.74	265.81	275.69	283.11	288.68	292.88	296.03	298.39	300.17	361.24	367.31	377.19	384.61	390.18	394.38	397.53	399.89	401.67
	3	14600	393.24	399.31	409.19	416.61	422.18	426.38	429.53	431.89	433.67	539.24	545.31	555.19	562.61	568.18	572.38	575.53	577.89	579.67
	4	19500	540.24	546.31	556.19	563.61	569.18	573.38	576.53	578.89	580.67	735.24	741.31	751.19	758.61	764.18	768.38	771.53	773.89	775.67
40	1	4350	85.74	91.81	101.69	109.11	114.68	118.88	122.03	124.39	126.17	129.24	135.31	145.19	152.61	158.18	162.38	165.53	167.89	169.67
	2	8100	198.24	204.31	214.19	221.61	227.18	231.38	234.53	236.89	238.67	279.24	285.31	295.19	302.61	308.18	312.38	315.53	317.89	319.67
	3	11800	309.24	315.31	325.19	332.61	338.18	342.38	345.53	347.89	349.67	427.24	433.31	443.19	450.61	456.18	460.38	463.53	465.89	467.67
	4	15600	423.24	429.31	439.19	446.61	452.18	456.38	459.53	461.89	463.67	579.24	585.31	595.19	602.61	608.18	612.38	615.53	617.89	619.67
20	1	2150	19.74	25.81	35.69	43.11	48.68	52.88	56.03	58.39	60.17	41.24	47.31	57.19	64.61	70.18	74.38	77.53	79.89	81.67
	2	4100	78.24	84.31	94.19	101.61	107.18	111.38	114.53	116.89	118.67	119.24	125.31	135.19	142.61	148.18	152.38	155.53	157.89	159.67
	3	5900	132.24	138.31	148.19	155.61	161.18	165.38	168.53	170.89	172.67	191.24	197.31	207.19	214.61	220.18	224.38	227.53	229.89	231.67
	4	7800	189.24	195.31	205.19	212.61	218.18	222.38	225.53	227.89	229.67	267.24	273.31	283.19	290.61	296.18	300.38	303.53	305.89	307.67

1/ Land @ $3.00 per acre. Taxes @ $.03 per acre per year. Interest @ 2.9 percent.

Table 18.--Estimated net returns per acre from unmanaged pine stands at medium cost levels[1] by site, stocking level, stumpage price, and years to harvest

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $16/MBF									Stumpage price $20/MBF								
			85 years	80 years	70	60	50 years	40	30	20	10 years	85 years	80	70	60	50 years	40	30	20	10 years
100	1	10,900	59.90	75.68	101.34	120.62	135.10	145.99	154.16	160.31	164.93	103.50	119.28	144.94	164.22	178.70	189.59	197.76	203.91	208.53
	2	20,300	210.30	226.08	251.74	271.02	285.50	296.39	304.56	310.71	315.33	291.50	307.28	332.94	352.22	366.70	377.59	385.76	391.91	396.53
	3	29,500	357.50	373.28	398.94	418.22	432.70	443.59	451.76	457.91	462.53	475.50	491.28	516.94	536.22	550.70	561.59	569.76	575.91	580.53
	4	39,150	511.90	527.68	553.34	572.62	587.10	597.99	606.16	612.31	616.93	668.50	684.28	709.94	729.22	743.70	754.59	762.76	768.91	773.53
80	1	8,750	25.50	41.28	66.94	86.22	100.70	111.59	119.76	125.91	130.53	60.50	76.28	101.94	121.22	135.70	146.59	154.76	160.91	165.53
	2	16,250	145.50	161.28	186.94	206.22	220.70	231.59	239.76	245.91	250.53	210.50	226.28	251.94	271.22	285.70	296.59	304.76	310.91	315.53
	3	23,600	263.10	278.88	304.54	323.82	338.30	349.19	357.36	363.51	368.13	357.50	373.28	398.94	418.22	432.70	443.59	451.76	457.91	462.53
	4	31,300	386.30	402.08	427.74	447.02	461.50	472.39	480.56	486.71	491.33	511.50	527.28	552.94	572.22	586.70	597.59	605.76	611.91	616.53
60	1	6,500	-10.50	5.28	30.94	50.22	64.70	75.59	83.76	89.91	94.53	15.50	31.28	56.94	76.22	90.70	101.59	109.76	115.91	120.53
	2	12,200	80.70	96.48	122.14	141.42	155.90	166.79	174.96	181.11	185.73	129.50	145.28	170.94	190.22	204.70	215.59	223.76	229.91	234.53
	3	17,700	168.70	184.48	210.14	229.42	243.90	254.79	262.96	269.11	273.73	239.50	255.28	280.94	300.22	314.70	325.59	333.76	339.91	344.53
	4	23,500	261.50	277.28	302.94	322.22	336.70	347.59	355.76	361.91	366.53	355.50	371.28	396.94	416.22	430.70	441.59	449.76	455.91	460.53
50	1	5,400	-28.10	-12.32	13.34	32.62	47.10	57.99	66.16	72.31	76.93	-6.50	9.28	34.94	54.22	68.70	79.59	87.76	93.91	98.53
	2	10,150	47.90	63.68	89.34	108.62	123.10	133.99	142.16	148.31	152.93	88.50	104.28	129.94	149.22	163.70	174.59	182.76	188.91	193.53
	3	14,600	119.10	134.88	160.54	179.82	194.30	205.19	213.36	219.51	224.13	177.50	193.28	218.94	238.22	252.70	263.59	271.76	277.91	282.53
	4	19,500	197.50	213.28	238.94	258.22	272.70	283.59	291.76	297.91	302.53	275.50	291.28	316.94	336.22	350.70	361.59	369.76	375.91	380.53
40	1	4,350	-44.90	-29.12	-3.46	15.82	30.30	41.19	49.36	55.51	60.13	-27.50	-11.72	13.94	33.22	47.70	58.59	66.76	72.91	77.53
	2	8,100	15.10	30.88	56.54	75.82	90.30	101.19	109.36	115.51	120.13	47.50	63.28	88.94	108.22	122.70	133.59	141.76	147.91	152.53
	3	11,800	74.30	90.08	115.74	135.02	149.50	160.39	168.56	174.71	179.33	121.50	137.28	162.94	182.22	196.70	207.59	215.76	221.91	226.53
	4	15,600	135.10	150.88	176.54	195.82	210.30	221.19	229.36	235.51	240.13	197.50	213.28	238.94	258.22	272.70	283.59	291.76	297.91	302.53
20	1	2,150	-80.10	-64.32	-38.66	-19.38	-4.90	5.99	14.16	20.31	24.93	-71.50	-55.72	-30.06	-10.78	3.70	14.59	22.76	28.91	33.53
	2	4,100	-48.90	-33.12	-7.46	11.82	26.30	37.19	45.36	51.51	56.13	-32.50	-16.72	8.94	28.22	42.70	53.59	61.76	67.91	72.53
	3	5,900	-20.10	-4.32	21.34	40.62	55.10	65.99	74.16	80.31	84.93	3.50	19.28	44.94	64.22	78.70	89.59	97.76	103.91	108.53
	4	7,800	10.30	26.08	51.74	71.02	85.50	96.39	104.56	110.71	115.33	41.50	57.28	82.94	102.22	116.70	127.59	135.76	141.91	146.53

[1] Land @ $6.00 per acre. Taxes @ $0.13 per acre per year. Interest @ 2.9 percent.

[2] Negative returns within solid line.

Table 18.--Estimated net returns per acre from unmanaged pine stands at medium cost levels[1] by site, stocking level, stumpage price, and years to harvest (cont.)

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $30/MBF									Stumpage price $40/MBF								
			85 years	80	70	60	50 years	40	30	20	10 years	85 years	80	70	60	50 years	40	30	20	10 years
100	1	10,900	212.50	228.28	253.94	273.22	287.70	298.59	306.76	312.91	317.53	321.50	337.28	362.94	382.22	396.70	407.59	415.76	421.91	426.53
	2	20,300	494.50	510.28	535.94	555.22	569.70	580.59	588.76	594.91	599.53	697.50	713.28	738.94	758.22	772.70	783.59	791.76	797.91	802.53
	3	29,500	770.50	786.28	811.94	831.22	845.70	856.59	864.76	870.91	875.53	1065.50	1081.28	1106.94	1126.22	1140.70	1151.59	1159.76	1165.91	1170.53
	4	39,150	1060.00	1075.78	1101.44	1120.72	1135.20	1146.09	1154.26	1160.41	1165.03	1451.50	1467.28	1492.94	1512.22	1526.70	1537.59	1545.76	1551.91	1556.53
80	1	8,750	148.00	163.78	189.44	208.72	223.20	234.09	242.26	248.41	253.03	235.50	251.28	276.94	296.22	310.70	321.59	329.76	335.91	340.53
	2	16,250	373.00	388.78	414.44	433.72	448.20	459.09	467.26	473.41	478.03	535.50	551.28	576.94	596.22	610.70	621.59	629.76	635.91	640.53
	3	23,600	593.50	609.28	634.94	654.22	668.70	679.59	687.76	693.91	698.53	829.50	845.28	870.94	890.22	904.70	915.59	923.76	929.91	934.53
	4	31,300	824.50	840.28	865.94	885.22	899.70	910.59	918.76	924.91	929.53	1137.50	1153.28	1178.94	1198.22	1212.70	1223.59	1231.76	1237.91	1242.53
60	1	6,500	80.50	96.28	121.94	141.22	155.70	166.59	174.76	180.91	185.53	145.50	161.28	186.94	206.22	220.70	231.59	239.76	245.91	250.53
	2	12,200	251.50	267.28	292.94	312.22	326.70	337.59	345.76	351.91	356.53	373.50	389.28	414.94	434.22	448.70	459.59	467.76	473.91	478.53
	3	17,700	416.50	432.28	457.94	477.22	491.70	502.59	510.76	516.91	521.53	593.50	609.28	634.94	654.22	668.70	679.59	687.76	693.91	698.53
	4	23,500	590.50	606.28	631.94	651.22	665.70	676.59	684.76	690.91	695.53	825.50	841.28	866.94	886.22	900.70	911.59	919.76	925.91	930.53
50	1	5,400	47.50	63.28	88.94	108.22	122.70	133.59	141.76	147.91	152.53	101.50	117.28	142.94	162.22	176.70	187.59	195.76	201.91	206.53
	2	10,150	190.00	205.78	231.44	250.72	265.20	276.09	284.26	290.41	295.03	291.50	307.28	332.94	352.22	366.70	377.59	385.76	391.91	396.53
	3	14,600	323.50	339.28	364.94	384.22	398.70	409.59	417.76	423.91	428.53	469.50	485.28	510.94	530.22	544.70	555.59	563.76	569.91	574.53
	4	19,500	470.50	486.28	511.94	531.22	545.70	556.59	564.76	570.91	575.53	665.50	681.28	706.94	726.22	740.70	751.59	759.76	765.91	770.53
40	1	4,350	16.00	31.78	57.44	76.72	91.20	102.09	110.26	116.41	121.03	59.50	75.28	100.94	120.22	134.70	145.59	153.76	159.91	164.53
	2	8,100	128.50	144.28	169.94	189.22	203.70	214.59	222.76	228.91	233.53	209.50	225.28	250.94	270.22	284.70	295.59	303.76	309.91	314.53
	3	11,800	239.50	255.28	280.94	300.22	314.70	325.59	333.76	339.91	344.53	357.50	373.28	398.94	418.22	432.70	443.59	451.76	457.91	462.53
	4	15,600	353.50	369.28	394.94	414.22	428.70	439.59	447.76	453.91	458.53	509.50	525.28	550.94	570.22	584.70	595.59	603.76	609.91	614.53
20	1	2,150	[2]-50.00	-34.22	-8.56	10.72	25.20	36.09	44.26	50.41	55.03	-28.50	-12.72	12.94	32.22	46.70	57.59	65.76	71.91	76.53
	2	4,100	8.50	24.28	49.94	69.22	83.70	94.59	102.76	108.91	113.53	49.50	65.28	90.94	110.22	124.70	135.59	143.76	149.91	154.53
	3	5,900	62.50	78.28	103.94	123.22	137.70	148.59	156.76	162.91	167.53	121.50	137.28	162.94	182.22	196.70	207.59	215.76	221.91	226.53
	4	7,800	119.50	135.28	160.94	180.22	194.70	205.59	213.76	219.91	224.53	197.50	213.28	238.94	258.22	272.70	283.59	291.76	297.91	302.53

[1] Land @ $6.00 per acre. Taxes @ $0.13 per acre per year. Interest @ 2.9 percent.

[2] Negative returns within solid line.

Table 19.--Estimated net returns per acre from unmanaged pine stands at high cost levels[1]/ by site, stocking level, stumpage price, and years to harvest.

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $16/MBF years 85	80	70	60	50	40	30	20	10	Stumpage price $20/MBF years 85	80	70	60	50	40	30	20	10
100	1	10900	-85.07	-49.53	8.29	51.74	84.38	108.90	127.32	141.19	151.59	-41.47	-5.93	51.89	95.34	127.98	152.50	170.92	184.79	195.19
	2	20300	65.33	100.87	158.69	202.14	236.78	259.30	277.72	291.59	301.99	146.53	182.07	239.89	283.34	315.98	340.50	358.92	372.79	383.19
	3	29500	212.53	248.00	305.89	349.34	381.98	406.50	424.92	438.79	449.19	330.53	366.07	423.89	467.34	499.98	524.50	542.92	556.79	567.19
	4	39150	366.93	402.47	460.29	503.74	536.38	560.90	579.32	593.19	603.59	523.53	559.07	616.89	660.34	692.98	717.50	735.92	749.79	760.19
80	1	8750	-119.47	-83.93	-26.11	17.34	49.98	74.50	92.92	106.79	117.19	-86.47	-48.93	8.89	52.34	84.98	109.50	127.92	141.79	152.19
	2	16250	.53	36.07	93.89	137.34	169.98	194.50	212.92	226.79	237.19	65.53	101.07	158.89	202.34	234.98	259.50	277.92	291.79	302.19
	3	23600	118.13	153.67	211.49	254.94	287.58	312.10	330.52	344.39	354.79	212.53	248.07	305.89	349.34	381.98	406.50	424.92	438.79	449.19
	4	31300	241.33	276.87	334.69	378.14	410.78	435.30	453.72	467.59	477.99	366.53	402.07	459.89	503.34	535.98	560.50	578.92	592.79	603.19
60	1	6500	-155.47	-119.93	-62.11	-18.66	13.98	38.50	56.92	70.79	81.19	-129.47	-93.93	-36.11	7.34	39.98	64.50	82.92	96.79	107.19
	2	12200	-64.27	-28.73	29.09	72.54	105.18	129.70	148.12	161.99	172.39	-15.47	20.07	77.89	121.34	153.98	178.50	196.92	210.79	221.19
	3	17700	23.73	59.27	117.09	160.54	193.18	217.70	236.12	249.99	260.39	94.53	130.07	187.89	231.34	263.98	288.50	306.92	320.79	331.19
	4	23500	116.53	152.07	209.89	253.34	285.98	310.50	328.92	342.79	353.19	210.53	246.07	303.89	347.34	379.98	404.50	422.92	436.79	447.19
50	1	5400	-173.07	-137.53	-79.71	-36.26	-3.62	20.90	39.32	53.19	63.59	-151.47	-115.93	-58.11	-14.66	17.98	42.50	60.92	74.79	85.19
	2	10150	-97.07	-61.53	-3.71	39.74	72.38	96.90	115.32	129.19	139.59	-56.47	-20.93	36.89	80.34	112.98	137.50	155.92	169.79	180.19
	3	14600	-25.87	9.67	67.49	110.94	143.58	168.10	186.52	200.39	210.79	32.53	68.07	125.89	169.34	201.98	226.50	244.92	258.79	269.19
	4	19500	52.53	88.07	145.89	189.34	221.98	246.50	264.92	278.79	289.19	130.53	166.07	223.89	267.34	299.98	324.50	342.92	356.79	367.19
40	1	4350	-189.87	-154.33	-96.51	-53.06	-20.42	4.10	22.52	36.39	46.79	-172.47	-136.93	-79.11	-35.66	-3.02	21.50	39.92	53.79	64.19
	2	8100	-129.87	-94.33	-36.51	6.94	39.58	64.10	82.52	96.39	106.79	-97.47	-61.93	-4.11	39.34	71.98	96.50	114.92	128.79	139.19
	3	11800	-70.67	-35.13	22.69	66.14	98.78	123.30	141.72	155.59	165.99	-23.47	12.07	69.89	113.34	145.98	170.50	188.92	202.79	213.19
	4	15600	-9.87	25.67	83.49	126.94	159.58	184.10	202.52	216.39	226.79	52.53	88.07	145.89	189.34	221.98	246.50	264.92	278.79	289.19
20	1	2150	-225.07	-189.53	-131.71	-88.26	-55.62	-31.10	-12.68	1.19	11.59	-216.47	-180.93	-123.11	-79.66	-47.02	-22.50	-4.08	9.79	20.19
	2	4100	-193.87	-158.33	-100.51	-57.06	-24.42	.10	18.52	32.39	42.79	-177.47	-141.93	-84.11	-40.66	-8.02	16.50	34.92	48.79	59.19
	3	5900	-165.07	-129.53	-71.71	-28.26	4.38	28.90	47.32	61.19	71.59	-141.47	-105.93	-48.11	-4.66	27.98	52.50	70.92	84.79	95.19
	4	7800	-134.67	-99.13	-41.31	2.14	34.78	59.30	77.72	91.59	101.99	-103.47	-67.93	-10.11	33.34	65.98	90.50	108.92	122.79	133.19

1/ Land @ $15.00 per acre. Taxes @ $.25 per acre per year. Interest @ 2.9 percent.

2/ Negative returns within solid line.

61

Table 19.--Estimated net returns per acre from unmanaged pine stands at high cost levels[1] by site, stocking level, stumpage price, and years to harvest (cont.)

Percent of full stocking	Site class	Merch. volume per acre	Stumpage price $30/MBF (years)									Stumpage price $40/MBF (years)								
			85	80	70	60	50	40	30	20	10	85	80	70	60	50	40	30	20	10
100	1	10900	67.53	103.07	160.89	204.34	236.98	261.50	279.92	293.79	304.19	176.53	212.07	269.89	313.34	345.98	370.50	388.92	402.79	413.19
	2	20300	349.53	385.07	442.89	486.34	518.98	543.50	561.92	575.79	586.19	552.53	588.07	645.89	689.34	721.98	746.50	764.92	778.79	789.19
	3	29500	625.53	661.07	718.89	762.34	794.98	819.50	837.92	851.79	862.19	920.53	956.07	1013.89	1057.34	1089.98	1114.50	1132.92	1146.79	1157.19
	4	39150	915.03	950.57	1008.39	1051.84	1084.48	1109.00	1127.42	1141.29	1151.69	1306.53	1342.07	1399.89	1443.34	1475.98	1500.50	1518.92	1532.79	1543.19
80	1	8750	3.03	38.57	96.39	139.84	172.48	197.00	215.42	229.29	239.69	90.53	126.07	183.89	227.34	259.98	284.50	302.92	316.79	327.19
	2	16250	228.03	263.57	321.39	364.84	397.48	422.00	440.42	454.29	464.69	390.53	426.07	483.89	527.34	559.98	584.50	602.92	616.79	627.19
	3	23600	448.53	484.07	541.89	585.34	617.98	642.50	660.92	674.79	685.19	684.53	720.07	777.89	821.34	853.98	878.50	896.92	910.79	921.19
	4	31300	679.53	715.07	772.89	816.34	848.98	873.50	891.92	905.79	916.19	992.53	1028.07	1085.89	1129.34	1161.98	1186.50	1204.92	1218.79	1229.19
60	1	6500[2]	-64.47	-28.93	28.89	72.34	104.98	129.50	147.92	161.79	172.19	.53	36.07	93.89	137.34	169.98	194.50	212.92	226.79	237.19
	2	12200	106.53	142.07	199.89	243.34	275.98	300.50	318.92	332.79	343.19	228.53	264.07	321.89	365.34	397.98	422.50	440.92	454.79	465.19
	3	17700	271.53	307.07	364.89	408.34	440.98	465.50	483.92	497.79	508.19	448.53	484.07	541.89	585.34	617.98	642.50	660.92	674.79	685.19
	4	23500	445.53	481.07	538.89	582.34	614.98	639.50	657.92	671.79	682.19	680.53	716.07	773.89	817.34	849.98	874.50	892.92	906.79	917.19
50	1	5400	-97.47	-61.93	-4.11	39.34	71.98	96.50	114.92	128.79	139.19	-43.47	-7.93	49.89	93.34	125.98	150.50	168.92	182.79	193.19
	2	10150	45.03	80.57	138.39	181.84	214.48	239.00	257.42	271.29	281.69	146.53	182.07	239.89	283.34	315.98	340.50	358.92	372.79	383.19
	3	14600	178.53	214.07	271.89	315.34	347.98	372.50	390.92	404.79	415.19	324.53	360.07	417.89	461.34	493.98	518.50	536.92	550.79	561.19
	4	19500	325.53	361.07	418.89	462.34	494.98	519.50	537.92	551.79	562.19	520.53	556.07	613.89	657.34	689.98	714.50	732.92	746.79	757.19
40	1	4350	-128.97	-93.43	-35.61	7.84	40.48	65.00	83.42	97.29	107.69	-85.47	-49.93	7.89	51.34	83.98	108.50	126.92	140.79	151.19
	2	8100	-16.47	19.07	76.89	120.34	152.98	177.50	195.92	209.79	220.19	64.53	100.07	157.89	201.34	233.98	258.50	276.92	290.79	301.19
	3	11800	94.53	130.07	187.89	231.34	263.98	288.50	306.92	320.79	331.19	212.53	248.07	305.89	349.34	381.98	406.50	424.92	438.79	449.19
	4	15600	208.53	244.07	301.89	345.34	377.98	402.50	420.92	434.79	445.19	364.53	400.07	457.89	501.34	533.98	558.50	576.92	590.79	601.19
20	1	2150	-194.97	-159.43	-101.61	-58.16	-25.52	-1.00	17.42	31.29	41.69	-173.47	-137.93	-80.11	-36.66	-4.02	20.50	38.92	52.79	63.19
	2	4100	-136.47	-100.93	-43.11	.34	32.98	57.50	75.92	89.79	100.19	-95.47	-59.93	-2.11	41.34	73.98	98.50	116.92	130.79	141.19
	3	5900	-82.47	-46.93	10.89	54.34	86.98	111.50	129.92	143.79	154.19	-23.47	12.07	69.89	113.34	145.98	170.50	188.92	202.79	213.19
	4	7800	-25.47	10.07	67.89	111.34	143.98	168.50	186.92	200.79	211.19	52.53	88.07	145.89	189.34	221.98	246.50	264.92	278.79	289.19

1/ Land @ $15.00 per acre. Taxes @ $.25 per acre per year. Interest @ 2.9 percent.

2/ Negative returns within solid line.

Table 20.--Net expected returns[1]/ per acre from site 2 hardwood stands with intensive management at low levels of cost and varying stumpage prices.

Intermediate Yield — Volume Per Acre by Stand Age

Item	35 Years B.F.	Cords	45 Years B.F.	Cords	55 Years B.F.	Cords	65 Years B.F.	Cords	75 Years B.F.	Cords	85 Years B.F.	Cords
Gross Volume[2]/	330	3449	670	3.38	1820	1.77	1640	.83	1440	.43	7900	
Net Volume[3]/		3.32	570	3.21	1600	1.68	1040	.79	1300		7600	

Value of Yield Per Acre

Item	35 Years B.F.	Cords	45 Years B.F.	Cords	55 Years B.F.	Cords	65 Years B.F.	Cords	75 Years Fr.	Cords	85 Years B.F.	Cords
A. Stumpage $10 per MBF[4]/			5.70		13.00		16.40		13.40		76.00	
B. Stumpage $15 per MBF[5]/			8.55		19.50		21.50		19.50		114.00	
C. Stumpage $20 per MBF[6]/	4.98	4.82	11.40	4.82	26.00	2.52	32.80	1.18	26.00	152.00	
D. Stumpage $25 per MBF[7]/	4.98	4.82	14.25	4.82	32.50	2.52	41.00	1.18	32.50	190.00	
E. Stumpage $30 per MBF[8]/	4.98	4.82	17.10	4.82	39.00	2.52	49.20	1.18	39.00	228.00	
F. Stumpage $35 per MBF[9]/	4.98	4.82	19.95	4.82	45.50	2.52	57.40	1.18	45.50	266.00	
G. Stumpage $40 per MBF[10]/	4.98	4.82	22.80	4.82	52.00	2.52	65.60	1.18	52.00	304.40	

Years to Harvest	50	40	30	20	10	0
Interest Factor	4.176	3.138	2.358	1.771	1.331	1.000

Accumulated Value of Yield Per Acre[11]/

Item			
A. $10	17.89	29.04	30.65
B. $15	26.83	43.57	45.98
C. $20	35.77	58.09	61.31
D. $25	44.72	72.61	76.64
E. $30	53.66	87.13	91.90
F. $35	62.60	101.66	107.29
G. $40	71.55	116.18	122.62

Harvest Yield — Gross Returns @ Harvest

Item	75 Years B.F.	Cords	85 Years B.F.	Cords	Gross Returns @ Harvest
	1440	.43	7900	0	
	1300		7600	1.000	

Item	Fr.	Cords	B.F.	Cords
A.	13.40	.43	76.00	70.00
B.	19.50		114.00	114.00
C.	26.00	1.331	152.00	152.00
D.	32.50		190.00	190.00
E.	39.00		228.00	228.00
F.	45.50		266.00	266.00
G.	52.00		304.40	304.40

Item	Gross Returns @ Harvest
A.	170.08
B.	256.33
C.	385.74
D.	471.19
E.	559.62
F.	642.07
G.	727.52

Costs Accumulated to Harvest Age

Item	Cost Years @ Harvest / Per Acre Harvest	Interest Factor	Accumulated Value
Original Cost			$
Land	3.00		11.350	34.05
Annual Costs			
Taxes	.03	85	356.890	10.71
Administration[12]/	.03	85	356.896	10.71
Fire Protection	.02	85	356.896	7.44
Cultural Costs			
Cleaning-Weeding	2.00	65	6.412	12.02
Thinning	3.00	90	4.176	12.53
Marking	.40	50	4.176	1.67
	.40	30	3.138	1.26
	.40	20	2.358	.94
	.40	10	1.771	.71
	.40	0	1.331	.53
	.40		1.000	.40

Total	93.17

Net Expected Value Per Acre

Item	Total	Per Year
A. $10	77.41	.91
B. $15	162.96	1.92
C. $20	292.27	3.44
D. $25	317.72	4.44
E. $30	403.15	5.45
F. $35	548.60	6.45
G. $40	631.05	7.46

[1]/ With sawlog and cordwood markets
[2]/ With optimum stand structure
[3]/ Gross volume minus mortality and cull corrections; figures rounded
[4]/ Sawtimber $10/MBF, pulptimber 0
[5]/ Sawtimber $15/MBF, pulptimber 0
[6]/ Sawtimber $20/MBF, pulptimber $4.50/cord
[7]/ Sawtimber $25/MBF, pulptimber $4.50/cord
[8]/ Sawtimber $30/MBF, pulptimber $4.50/cord
[9]/ Sawtimber $35/MBF, pulptimber $4.50/cord
[10]/ Sawtimber $40/MBF, pulptimber $4.50 cord
[11]/ Interest @ 2.9 percent, rotation age 85
[12]/ Includes a risk factor of $.01/acre/year

Table 21.--Net expected returns[1]/ per acre from Site 2 hardwood stands with intensive management at medium levels of cost and varying stumpage prices

Item	Intermediate Yield Volume Per Acre by Stand Age										Harvest Yield 85 Years		Gross Return @ Harvest	Costs Accumulated to Harvest Age					Net Expected Value Per Acre	
	35 Years		45 Years		55 Years		65 Years		75 Years					Item	Cost Per Acre	Years to Harvest	Interest Factor	Value Accumulated	Total	Per Year
	B.F.	Cords	B.F.	Cords	B.F.	Cords	B.F.	Cords	B.F.	Cords	B.F.	Cords	$		$				$	$
Gross Volume[2]/	330	3.49	670	3.38	1140	1.77	1820	.83			7500			Original Cost	6.00	85	11.350	68.10		
Net Volume[3]/		3.32	570	3.21	1300	1.68	1610	.79	1440	.43	7500			Land						
									1300		7600									
					Value of Yield Per Acre									Annual Costs						
A. Stumpage $10 per MBF[4]/			5.70	4.82	13.00	2.52	16.40		13.00		76.00			Taxes Administration[12]/	.13	85	354.896	40.40	-45.36	-.53
B. Stumpage $15 per MBF[5]/		4.98	8.55	4.82	19.50	2.52	24.60	1.18	19.50		114.00			Fire Protection	.10	85	350.896	35.69	40.09	.47
C. Stumpage $20 per MBF[6]/		4.98	11.40	4.82	26.00	2.52	32.80	1.18	26.00		152.00				.04	85	350.896	14.28	169.50	1.99
D. Stumpage $25 per MBF[7]/		4.98	14.25	4.82	32.50	2.52	41.00	1.18	32.50		190.00			Cultural Costs					254.95	3.00
E. Stumpage $30 per MBF[8]/		4.98	17.10	4.82	39.00	2.52	49.20	1.18	39.00		228.00			Cleaning-Weeding	3.00	65	6.412	19.24	340.38	4.00
F. Stumpage $35 per MBF[9]/		4.98	19.95	4.82	45.50	2.52	57.40	1.18	45.50		266.00			Thinning	3.50	50	4.176	14.62	425.83	5.01
G. Stumpage $40 per MBF[10]/		4.98	22.80	4.82	52.00	2.52	65.60	1.18	52.00		304.00			Marking	1.30	50	4.176	5.43	511.28	6.02
															1.30	40	3.138	4.08		
															1.30	30	2.358	3.07		
Years to Harvest	50		40		30		20		10		0				1.30	20	1.771	2.30		
Interest Factor	4.17		3.138		2.358		1.771		1.331		1.000				1.30	10	1.331	1.73		
															1.30	0	1.000	1.30		
			Accumulated Value of Yield Per Acre[11]/																	
A. $10	17.89	20.08	30.65	15.13	29.04	2.09			17.30	5.94	76.00		170.88							
B. $15	26.83	20.08	45.28	15.13	43.57	2.09			25.95	5.94	114.00		256.33	Total				214.24		
C. $20	35.77	20.08	61.31	15.13	58.69	2.09			34.61	5.94	152.00		385.74							
D. $25	44.72	20.08	76.64	15.13	73.12	2.09			43.26	5.94	190.00		471.19							
E. $30	53.66	20.08	91.96	15.13	87.43	2.09			51.91	5.94	228.00		556.62							
F. $35	62.60	20.08	107.29	15.13	101.66	2.09			60.56	5.94	266.00		642.07							
G. $40	71.55	20.08	122.62	15.13	116.18	2.09			69.21	5.94	304.00		727.52							

1/ With sawlog and cordwood markets
2/ With optimum stand structure
3/ Gross volume minus mortality and cull corrections; figures rounded
4/ Sawtimber $10/MBF, pulptimber 0
5/ Sawtimber $15/MBF, pulptimber 0
6/ Sawtimber $20/MBF, pulptimber $1.50/cord
7/ Sawtimber $25/MBF, pulptimber $1.50/cord
8/ Sawtimber $30/MBF, pulptimber $1.50/cord
9/ Sawtimber $35/MBF, pulptimber $1.50/cord
10/ Sawtimber $40/MBF, pulptimber $1.50/cord
11/ Interest @ 2.9 percent, rotation age 85
12/ Includes a risk factor of $.02/acre/year

Table 22.--Net expected returns[1]/ per acre from Site 2 hardwood stands with intensive management at high levels of cost and varying stumpage prices

Item	Intermediate Yield — Volume Per Acre by Stand Age								Harvest Yield				Gross Returns @ Harvest	Costs Accumulated to Harvest Age					Net Expected Value Per Acre	
	25 Years		35 Years		55 Years		65 Years	75 Years	15 Years		85 Years			Item	Cost Per Acre	Years to Harvest	Interest Factor	Accumulated Value	Total	Per Acre
	Cu.ft.	Cords	Cu.ft.	Cords	Cu.ft.	Cords	Cu.ft. Cords	Cu.ft. Cords	Cu.ft. Cords		Cu.ft.	Cords	$		$			$	$	$
Gross Volume[2]/	330	3.49	670	3.38	1440	4.77	1820 .83	.79	.43		7900			Original Cost — Land	15.00	85	11.350	170.25		
Net Volume[3]/		3.32	570	3.21	1300	4.68	1690		1300		7600									

Value of Yield Per Acre

														Annual Costs						
A. Stumpage $10 per MBF[4]/	5.70		6.55		13.00		16.40		13.00		76.00			Taxes	.25	85	356.896	89.22		
B. Stumpage $15 per MBF[5]/		4.82	11.40	4.82	20.40		17.50	1.18	17.50		114.00			Administration[12]/	.24	85	356.896	85.46		
C. Stumpage $20 per MBF[6]/	4.98		11.25		26.00		26.00	1.18	26.00		152.00			Fire Protection	.49	85	356.896	34.12		
D. Stumpage $25 per MBF[7]/	4.98	4.82	14.25	4.82	32.50	2.52	41.00	1.18	32.50		190.00			Cultural Costs						
E. Stumpage $30 per MBF[8]/	4.98	4.82	17.20	4.82	39.00	2.52	49.20	1.18	39.00		228.00			Cleaning-weeding[13]/	5.00	65	6.112	33.06		
F. Stumpage $35 per MBF[9]/	4.98	4.82	19.75	4.82	45.50	2.52	57.40	1.18	45.50		266.00			Thinning	6.00	90	4.176	25.06		
G. Stumpage $40 per MBF[10]/	4.98	4.82	22.80	4.82	52.00	2.52	65.60	1.18	52.00		304.00				6.00		4.176	6.35		
														Marking	2.00	30	3.138	6.28		
Years to Harvest	50		40		30		20	10	0						2.00	40	2.358	4.72		
Interest Factor	4,176		3.138		2,330		1,771	1,231	1,000						2.00	30	1.771	3.94		
															2.00	10	1.334	2.00		
															2.00	0	1.000	2.00		

Accumulated Value of Yield Per Acre[11]/

														Total				161.92		
A. $10	17.89		20.83		30.05		29.04	17.30	76.00		170.88								-201.04	-3.42
B. $15	26.83		33.77		45.98		43.57	25.95	114.00		256.33								-80.59	-2.42
C. $20			40.72		63.31		56.69	34.61	152.00		485.14					Varied		161.92	-74.18	.90
D. $25	20.03		49.72		78.64		72.61	43.26	190.00		471.49								9.27	.11
E. $30	20.03		53.66		91.96		87.13	51.91	228.00		556.62								94.70	1.11
F. $35	20.03		62.60		107.29		101.66	60.56	266.00		642.07								180.15	2.12
G. $40	20.08		71.55		122.62		116.18	69.21	304.00		727.52								265.40	3.12

1/ With maple and cordwood markets
2/ With optimum stand structure
3/ Gross volume minus mortality and cull corrections; figures rounded
4/ Sawtimber $10/MBF, pulptimber 0
5/ Sawtimber $15/MBF, pulptimber $1.10/cord
6/ Sawtimber $20/MBF, pulptimber $1.10/cord

7/ Sawtimber $25/MBF, pulptimber $1.10/cord
8/ Sawtimber $30/MBF, pulptimber $1.10/cord
9/ Sawtimber $35/MBF, pulptimber $1.10/cord
10/ Sawtimber $40/MBF, pulptimber $1.10/cord
11/ Interest @ 2.5 percent, rotation age 85
12/ Includes a risk factor of 3¢/acre/year

Table 23.--Net expected returns[1]/ per acre from Site 2 pine stands with intensive management at low levels of cost and varying stumpage prices

Intermediate Yield and Harvest Yield

Item	30 Years Posts	30 Years Poles	45 Years Posts	45 Years Poles	55 Years Posts	55 Years Poles	55 Years B.F.	65 Years B.P.	65 Years Poles	75 Years B.F.	75 Years Poles	85 Years B.F.	90 Years B.F.	Gross Returns @ Harvest $
Gross Volume[2]/	330	13	118	18	126	18	2710	1578	6	2866	10	12713	2580[10]	
Net Volume[3]/	330	10	118	14	126	14	2450	1500	5	2700	5	12050	2450	
Value of Yield Per Acre														
A. Stumpage $10 per MBF[4]/	13.20	7.20	4.72	3.68	5.04	5.32	24.50	15.00	.70	27.00		120.50	24.50	
B. Stumpage $16 per MBF[5]/	13.20	7.20	4.72	3.68	5.04	5.32	39.20	24.00	.70	43.20		192.80	39.20	
C. Stumpage $20 per MBF[6]/	13.20	7.20	4.72	3.68	5.04	5.32	49.00	30.00	.70	54.00		241.00	49.00	
D. Stumpage $30 per MBF[7]/	19.80	12.60	7.08	7.80	7.56	12.60	73.50	45.00	1.50	81.00		361.50	73.50	
E. Stumpage $40 per MBF[8]/	19.80	12.60	7.08	7.80	7.56	12.60	98.00	60.00	1.50	108.00		482.00	98.00	
Years to Harvest	55		40		30			20		10		0	-5	
Interest Factor	4.818		3.138		2.358			1.771		1.331		1.000	.863	
Accumulated Value of Yield Per Acre[9]/														
A. $10	63.60	34.69	14.81	11.55	11.88	12.54	57.77	26.56	1.24	35.94		120.50	21.14	412.22
B. $16	63.60	34.69	14.81	11.55	11.88	12.54	92.43	42.50	1.24	57.50		192.80	33.83	569.37
C. $20	63.60	34.69	14.81	11.55	11.88	12.54	115.54	53.13	1.24	71.87		241.00	42.29	674.14
D. $30	95.40	60.71	22.22	24.48	17.83	29.71	173.31	79.70	2.66	107.81		361.50	63.43	1038.76
E. $40	95.40	60.71	22.22	24.48	17.83	29.71	231.08	106.26	2.66	143.75		482.00	84.57	1300.67

Costs Accumulated to Harvest Age

Item	Cost Per Acre	Years to Harvest	Interest Factor	Accumulated Value
Original Cost	$			$
Land	3.00	85	11.350	34.05
Annual Costs				
Taxes	.03	85	356.896	10.71
Administration[11]/	.03	85	356.896	10.71
Fire Protection	.02	85	356.896	7.14
Cultural Costs				
Aerial Spraying	4.90	80	9.845	48.24
Cleaning-weeding	2.00	75	8.534	17.07
Marking	.40	55	4.818	1.93
	.40	40	3.138	1.26
	.40	30	2.358	.94
	.40	20	1.771	.71
	.40	10	1.331	.53
	.40	0	1.000	.40
Total	Varied			133.69

Net Expected Value Per Acre

	Total $	Per Year $
A. $10	278.53	3.28
B. $16	435.68	5.16
C. $20	540.45	6.36
D. $30	905.07	10.65
E. $40	1166.98	13.73

1/ With sawlog, post and pole markets
2/ With optimum stand structure
3/ Gross volume minus mortality and cull corrections; figures rounded
4/ Sawlogs, $10/MBF; posts, $.04/post; poles, $.14-.90/pole
5/ Sawlogs, $16/MBF; posts, $.04/post; poles, $.14-.90/pole
6/ Sawlogs, $20/MBF; posts, $.04/post; poles, $.14-.90/pole
7/ Sawlogs, $30/MBF; posts, $.06/post; poles, $.30-1.50/pole
8/ Sawlogs, $40/MBF; posts, $.06/post; poles, $.30-1.50/pole
9/ Increase (2.9 percent, rotation age 85 years
10/ All seed trees are left at age 85
11/ Includes a risk factor of $.02/acre/year

Table 24.--Net expected returns[1] per acre from Site 2 pine stands with intensive management at medium levels of cost and varying stumpage prices

Item	Intermediate Yield — Volume Per Acre by Stand Age												Gross Return @ Harvest	Harvest Yield				
	30 Years		45 Years		55 Years			65 Years			75 Years			85 Years		90 Years		
	Posts	Poles	Posts	Poles	B.F.	Posts	Poles	B.F.	Posts	Poles	B.F.	Poles	$	B.F.	Poles	B.F.	Poles	
Gross Volume[3]	330	13	118	18	2710	126	18	1578	126	14	2866	6		12713	0	2580[10]	-5	
Net Volume[3]	330	10	118	14	2650	126	14	1500		5	2700	5		12090	1,000	2450	.863	

Value of Yield Per Acre

Item	30 Years		45 Years		55 Years			65 Years			75 Years			85 Years	90 Years
A. Stumpage $10 per MBF[4]	13.20	7.20	4.72	3.68	26.50	5.04	5.32	15.00	5.04	5.32	27.00	.70		120.50	24.50
B. Stumpage $16 per MBF[5]	13.20	7.20	4.72	3.68	39.20	5.04	5.32	24.00	5.04	5.32	43.20	.70		192.80	39.20
C. Stumpage $20 per MBF[6]	13.20	7.20	4.72	3.68	49.00	5.04	5.32	30.00	5.04	5.32	54.00	.70		241.00	49.00
D. Stumpage $30 per MBF[7]	19.80	12.60	7.08	7.80	73.50	7.56	12.60	45.00	7.56	12.60	81.00	1.50		361.50	73.50
E. Stumpage $40 per MBF[8]	19.80	12.60	7.08	7.80	98.00	7.06	12.60	60.00	7.06	12.60	108.00	1.50		482.00	98.00
Years to Harvest	55		40		30			20			10			0	-5
Interest Factor	4.818		3.138		2.258			1.771			1.331			1.000	.863

Accumulated Value of Yield Per Acre[9]

Item	30 Years		45 Years		55 Years			65 Years		75 Years	85 Years	90 Years	Total
A. $10	63.60	34.69	14.81	11.55	57.77	11.88	12.54	26.56	12.54	35.94	120.50	21.14	412.22
B. $16	63.60	34.69	14.81	11.55	92.43	11.88	12.54	42.50	12.54	57.50	192.80	33.83	569.37
C. $20	63.60	34.69	14.81	11.55	115.54	11.88	12.54	53.13	12.54	71.87	241.00	42.29	674.14
D. $30	95.40	60.71	22.22	24.48	173.31	17.83	29.71	79.70	29.71	107.81	361.50	63.43	1038.76
E. $40	95.40	60.71	22.22	24.48	231.08	17.83	29.71	106.26	29.71	143.75	482.00	86.57	1300.67

Costs Accumulated to Harvest Age

Item	Cost Per Acre	Years to Harvest	Interest Factor	Accumulated Value
	$			$
Original Cost				
Land	6.00	85	11.350	68.10
Annual Costs				
Taxes	.13	85	356.896	46.40
Administration[11]	.10	85	356.896	35.69
Fire Protection	.04	85	356.896	14.28
Cultural Costs				
Aerial Spraying	6.50	80	9.845	63.99
Cleaning-weeding	3.00	75	8.534	25.60
Marking	1.30	60	4.818	6.26
	1.30	40	3.138	4.08
	1.30	30	2.358	3.07
	1.30	20	1.771	2.30
	1.30	10	1.331	1.73
	1.30	0	1.000	1.30
Total		Varied		272.80

Net Expected Value Per Acre

Total	Per Year
$	$
139.42	1.64
296.57	3.49
449.36	4.72
746.96	9.01
1027.87	12.10

1/ With sawlog, post and pole markets
2/ With optimum stand structure
3/ Gross volume minus mortality and cull corrections; figures rounded
4/ Sawlogs, $10/MBF; posts, $.04/post; poles, $.14-.90/pole
5/ Sawlogs, $16/MBF; posts, $.04/post; poles, $.14-.90/pole
6/ Sawlogs, $20/MBF; posts, $.04/post; poles, $.14-.90/pole
7/ Sawlogs, $30/MBF; posts, $.06/post; poles, $.30-1.50/pole
8/ Sawlogs, $40/MBF; posts, $.06/post; poles, $.30-1.50/pole
9/ Interest @ 2.9 percent, rotation age 85 years
10/ 10 seed trees per acre left at age 85
11/ Includes a risk factor of $.02/acre/year

67

Table 25.--Net expected returns[1]/ per acre from Site 2 pine stands with intensive management at high levels of cost and varying stumpage prices

Intermediate Yield — Volume Per Acre by Stand Age / Harvest Yield / Gross Returns @ Harvest

Item	30 Years Posts	30 Years Poles	45 Years Posts	45 Years Poles	55 Years Posts	55 Years Poles	55 Years B.F.	65 Years B.F.	65 Years Poles	75 Years B.F.	75 Years Poles	85 Years B.F.	85 Years Poles	90 Years B.F.	90 Years Poles	Gross Returns @ Harvest
Gross Volume[2]/	330	13	118	18	126	18	2710	1578	6	2866	10	12713		2580[10]/		
Net Volume[3]/	330	10	118	14	126	14	2450	1300	5	2700		12050		2450		

Value of Yield Per Acre

Item	30 Years Posts	30 Years Poles	45 Years Posts	45 Years Poles	55 Years Posts	55 Years Poles	55 Years B.F.	65 Years B.F.	65 Years Poles	75 Years B.F.	85 Years B.F.	90 Years B.F.
A. Stumpage $10 per MBF[4]/	13.20	7.20	4.72	3.68	24.50	5.04	5.32	15.00	.70	27.00	120.50	24.50
B. Stumpage $16 per MBF[5]/	13.20	7.20	4.72	3.68	39.20	5.04	5.32	24.00	.70	43.20	192.80	39.20
C. Stumpage $20 per MBF[6]/	13.20	7.20	4.72	3.68	49.00	5.04	5.32	30.00	.70	54.00	241.00	49.00
D. Stumpage $30 per MBF[7]/	19.80	12.60	7.08	7.80	73.50	7.56	12.60	45.00	1.50	81.00	361.50	73.50
E. Stumpage $40 per MBF[8]/	19.80	12.60	7.08	7.80	98.00	7.56	12.60	60.00	1.50	108.00	482.00	98.00
Years to Harvest	55		40		30			20		10	0	-5
Interest Factor	4.818		3.138		2.358			1.771		1.331	1.000	.863

Accumulated Value of Yield Per Acre[9]/

Item	30 Years	45 Years	55 Years	65 Years	75 Years	85 Years	90 Years	Gross Returns @ Harvest
A. $10	63.60	14.81	57.77 11.88 12.54	26.56	35.94	120.50	21.14	412.22
B. $16	63.60	14.81	92.43 11.88 12.54	42.50	57.30	192.80	33.83	569.37
C. $20	63.60	14.81	115.54 11.88 12.54	53.13	71.87	241.00	42.29	674.14
D. $30	95.40	22.22	173.31 17.83 29.71	79.70	107.81	361.50	63.43	1038.76
E. $40	95.40	22.22	231.08 17.83 29.71	106.26	143.75	482.00	84.57	1300.67

Costs Accumulated to Harvest Age

Item	Cost Per Acre	Years to Harvest	Interest Factor	Accumulated Value
Original Cost	$			$
Land	15.00	85	11.350	170.25
Annual Costs				
Taxes	.25	85	356.896	89.22
Administration[11]/	.24	85	356.896	85.66
Fire Protection	.09	85	356.896	32.12
Cultural Costs				
Aerial Spraying	8.50	80	9.845	83.68
Cleaning-weeding	5.00	75	8.534	42.67
Marking	2.00	40	4.818	9.64
	2.00	30	3.138	6.28
	2.00	20	2.358	4.72
	2.00	10	1.771	3.54
	2.00	10	1.331	2.66
	2.00	0	1.000	2.00
Total		Varied		532.44

Net Expected Value Per Acre

	Total	Per Year
	$	$
A.	-120.22	-1.41
B.	36.93	.44
C.	141.70	1.67
D.	506.32	5.96
E.	768.23	9.04

1/ With sawlogs, post and pole markets
2/ With optimum stand structure
3/ Gross volume minus mortality and cull corrections; figures rounded
4/ Sawlogs, $10/MBF; posts, $.04/post; poles, $.14-.90/pole
5/ Sawlogs, $16/MBF; posts, $.04/post; poles, $.14-.90/pole
6/ Sawlogs, $20/MBF; posts, $.04/post; poles, $.14-.90/pole
7/ Sawlogs, $30/MBF; posts, $.06/post; poles, $.30-1.50/pole
8/ Sawlogs, $40/MBF; posts, $.06/post; poles, $.30-1.50/pole
9/ Interest @ 2.9 percent, rotation age 85 years
10/ 10 seed trees per acre left at age 85
11/ Includes a risk factor of $.02/acre/year

Table 26.--Investment value[1] per acre of costs or returns incurred in a particular year with interest by years to harvest age (interest @ 3 percent)

Years to harvest	Cost or intermediate returns per acre																			
	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$11	$12	$13	$14	$15	$16	$17	$18	$19	$20
									. . . dollars . . .											
10	1.34	2.69	4.03	5.38	6.72	8.06	9.41	10.75	12.10	13.44	14.78	16.13	17.47	18.82	20.16	21.50	22.85	24.19	25.54	26.88
15	1.56	3.12	4.67	6.23	7.79	9.35	10.91	12.46	14.02	15.58	17.14	18.70	20.25	21.81	23.37	24.93	26.49	28.04	29.60	31.16
20	1.81	3.61	5.42	7.22	9.03	10.84	12.64	14.45	16.25	18.06	19.87	21.67	23.48	25.28	27.09	28.90	30.70	32.51	34.31	36.12
25	2.09	4.19	6.28	8.38	10.47	12.56	14.66	16.75	18.85	20.94	23.03	25.13	27.22	29.32	31.41	33.50	35.60	37.69	39.79	41.88
30	2.43	4.85	7.28	9.71	12.14	14.56	16.99	19.42	21.84	24.27	26.70	29.12	31.55	33.98	36.40	38.83	41.26	43.69	46.11	48.54
35	2.81	5.63	8.44	11.26	14.07	16.88	19.70	22.51	25.33	28.14	30.95	33.77	36.58	39.40	42.21	45.02	47.84	50.65	53.47	56.28
40	3.26	6.52	9.79	13.05	16.31	19.57	22.83	26.10	29.36	32.62	35.88	39.14	42.41	45.67	48.93	52.19	55.45	58.72	61.98	65.24
45	3.78	7.56	11.35	15.13	18.91	22.69	26.47	30.26	34.04	37.82	41.60	45.38	49.17	52.95	56.73	60.51	64.29	68.08	71.86	75.64
50	4.38	8.77	13.15	17.54	21.92	26.30	30.69	35.07	39.46	43.84	48.22	52.61	56.99	61.38	65.76	70.14	74.53	78.91	83.30	87.68
55	5.08	10.16	15.25	20.33	25.41	30.49	35.57	40.66	45.74	50.82	55.90	60.98	66.07	71.15	76.23	81.31	86.39	91.48	96.56	101.64
60	5.89	11.78	17.68	23.57	29.46	35.35	41.24	47.14	53.03	58.92	64.81	70.70	76.60	82.49	88.38	94.27	100.16	106.06	111.95	117.84
65	6.83	13.66	20.49	27.32	34.15	40.98	47.81	54.64	61.47	68.30	75.13	81.96	88.79	95.62	102.45	109.28	116.11	122.94	129.77	136.60
70	7.92	15.84	23.75	31.67	39.59	47.51	55.43	63.34	71.26	79.18	87.10	95.02	102.93	110.85	118.77	126.69	134.61	142.52	150.44	158.36
75	9.18	18.36	27.54	36.72	45.90	55.07	64.25	73.43	82.61	91.79	100.97	110.15	119.33	128.51	137.68	146.86	156.04	165.22	174.40	183.58
80	10.64	21.28	31.92	42.56	53.20	63.84	74.48	85.12	95.76	106.40	117.04	127.68	138.32	148.96	159.60	170.24	180.88	191.52	202.16	212.80
85	12.34	24.68	37.02	49.36	61.70	74.04	86.38	98.72	111.06	123.40	135.74	148.08	160.42	172.76	185.10	197.44	209.78	222.12	234.46	246.80
90	14.30	28.60	42.90	57.20	71.50	85.80	100.10	114.40	128.70	143.00	157.30	171.60	185.90	200.20	214.50	228.80	243.10	257.40	271.70	286.00

[1] Either costs or returns/acre may be capitalized with this table.

69

Table 27.--Per acre value of fixed costs occurring annually with interest by years to harvest age (interest @ 3 percent)

Annual fixed cost per acre	Years to harvest																	
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
.01	.11	.19	.27	.36	.48	.60	.75	.93	1.13	1.36	1.63	1.94	2.31	2.73	3.21	3.78	4.43
.02	.23	.37	.54	.73	.95	1.21	1.51	1.85	2.26	2.72	3.26	3.89	4.61	5.45	6.43	7.56	8.87
.03	.34	.56	.81	1.09	1.43	1.81	2.26	2.78	3.38	4.08	4.89	5.83	6.92	8.18	9.64	11.34	13.30
.04	.46	.74	1.07	1.46	1.90	2.42	3.02	3.71	4.51	5.44	6.52	7.77	9.22	10.91	12.85	15.12	17.73
.05	.57	.93	1.34	1.82	2.38	3.02	3.77	4.64	5.64	6.80	8.15	9.72	11.53	13.63	16.07	18.90	22.17
.06	.69	1.12	1.61	2.19	2.85	3.63	4.52	5.56	6.77	8.16	9.78	11.66	13.84	16.36	19.28	22.68	26.60
.07	.80	1.30	1.88	2.55	3.33	4.23	5.28	6.49	7.90	9.52	11.41	13.60	16.14	19.08	22.49	26.46	31.03
.08	.92	1.49	2.15	2.92	3.81	4.84	6.03	7.42	9.02	10.89	13.05	15.55	18.45	21.81	25.71	30.24	35.47
.09	1.03	1.67	2.42	3.28	4.28	5.44	6.79	8.35	10.15	12.25	14.68	17.49	20.75	24.54	28.92	34.02	39.90
.10	1.15	1.86	2.69	3.65	4.76	6.05	7.54	9.27	11.28	13.61	16.31	19.43	23.06	27.26	32.13	37.80	44.33
.11	1.26	2.05	2.96	4.01	5.23	6.65	8.29	10.20	12.41	14.97	17.94	21.38	25.37	29.99	35.35	41.58	48.77
.12	1.38	2.23	3.22	4.38	5.71	7.26	9.05	11.13	13.54	16.33	19.57	23.32	27.67	32.72	38.56	45.36	53.20
.13	1.49	2.42	3.49	4.74	6.18	7.86	9.80	12.06	14.66	17.69	21.20	25.26	29.98	35.44	41.77	49.14	57.63
.14	1.61	2.60	3.76	5.11	6.66	8.47	10.56	12.98	15.79	19.05	22.83	27.21	32.28	38.17	44.99	52.92	62.07
.15	1.72	2.79	4.03	5.47	7.14	9.07	11.31	13.91	16.92	20.41	24.46	29.15	34.59	40.89	48.20	56.70	66.50
.16	1.83	2.98	4.30	5.83	7.61	9.67	12.06	14.84	18.05	21.77	26.09	31.09	36.90	43.62	51.41	60.48	70.93
.17	1.95	3.16	4.57	6.20	8.09	10.28	12.82	15.76	19.18	23.13	27.72	33.04	39.20	46.35	54.63	64.26	75.37
.18	2.06	3.35	4.84	6.56	8.56	10.88	13.57	16.69	20.30	24.49	29.35	34.98	41.51	49.07	57.84	68.04	79.80
.19	2.18	3.53	5.10	6.93	9.04	11.49	14.33	17.62	21.43	25.85	30.98	36.92	43.81	51.80	61.05	71.82	84.23
.20	2.29	3.72	5.37	7.29	9.51	12.09	15.08	18.55	22.56	27.21	32.61	38.87	46.12	54.53	64.27	75.60	88.67
.30	3.44	5.58	8.06	10.94	14.27	18.14	22.62	27.82	33.84	40.82	48.92	58.30	69.18	81.79	96.40	113.40	133.00
.40	4.59	7.44	10.75	14.59	19.03	24.19	30.16	37.09	45.12	54.43	65.23	77.73	92.24	109.05	128.53	151.20	177.33
.50	5.73	9.30	13.43	18.23	23.78	30.23	37.70	46.37	56.40	68.03	81.53	97.17	115.30	136.32	160.67	189.00	221.67

Table 28.--Investment value per acre of costs or returns incurred in a particular year with interest by years to harvest age (interest @ 4 percent)

Years to harvest	Cost or intermediate returns per acre

Years to harvest	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$11	$12	$13	$14	$15	$16	$17	$18	$19	$20
	. . . dollars . . .																			
10	1.48	2.96	4.44	5.92	7.40	8.88	10.36	11.84	13.32	14.80	16.28	17.76	19.24	20.72	22.20	23.68	25.16	26.64	28.12	29.60
15	1.80	3.60	5.40	7.20	9.00	10.81	12.61	14.41	16.21	18.01	19.81	21.61	23.41	25.21	27.02	28.82	30.62	32.42	34.22	36.02
20	2.19	4.38	6.57	8.76	10.96	13.15	15.34	17.53	19.72	21.91	24.10	26.29	28.48	30.67	32.86	35.06	37.25	39.44	41.63	43.82
25	2.67	5.33	8.00	10.66	13.33	16.00	18.66	21.33	23.99	26.66	29.33	31.99	34.66	37.32	39.99	42.66	45.32	47.99	50.65	53.32
30	3.24	6.49	9.73	12.97	16.22	19.46	22.70	25.94	29.19	32.43	35.67	38.92	42.16	45.40	48.64	51.89	55.13	58.37	61.62	64.86
35	3.95	7.89	11.84	15.78	19.73	23.68	27.62	31.57	35.51	39.46	43.41	47.35	51.30	55.24	59.19	63.14	67.08	71.03	74.97	78.92
40	4.80	9.60	14.40	19.20	24.00	28.81	33.61	38.41	43.21	48.01	52.81	57.61	62.41	67.21	72.02	76.82	81.62	86.42	91.22	96.02
45	5.84	11.68	17.52	23.36	29.20	35.05	40.89	46.73	52.57	58.41	64.25	70.09	75.93	81.77	87.62	93.46	99.30	105.14	110.98	116.82
50	7.11	14.21	21.32	28.43	35.54	42.64	49.75	56.86	63.96	71.07	78.18	85.28	92.39	99.50	106.60	113.71	120.82	127.93	135.03	142.14
55	8.65	17.29	25.94	34.58	43.23	51.88	60.52	69.17	77.81	86.46	95.11	103.75	112.40	121.04	129.69	138.34	146.98	155.63	164.27	172.92
60	10.52	21.04	31.56	42.08	52.60	63.12	73.64	84.16	94.68	105.20	115.72	126.24	136.76	147.28	157.80	168.32	178.84	189.36	199.88	210.40
65	12.80	25.60	38.40	51.20	64.00	76.80	89.60	102.40	115.20	128.00	140.80	153.60	166.40	179.20	192.00	204.80	217.60	230.40	243.20	256.00
70	15.57	31.14	46.71	62.28	77.85	93.42	108.99	124.56	140.13	155.70	171.27	186.84	202.41	217.98	233.55	249.12	264.69	280.26	295.83	311.40
75	18.95	37.90	56.85	75.80	94.75	113.70	132.65	151.60	170.55	189.50	208.45	227.40	246.35	265.30	284.25	303.20	322.15	341.10	360.05	379.00
80	23.05	46.10	69.15	92.20	115.25	138.30	161.35	184.40	207.45	230.50	253.55	276.60	299.65	322.70	345.75	368.80	391.85	414.90	437.95	461.00
85	28.04	56.08	84.12	112.16	140.20	168.24	196.28	224.32	252.36	280.40	308.44	336.48	364.52	392.56	420.60	448.64	476.68	504.72	532.76	560.80
90	34.12	68.24	102.36	136.48	170.60	204.72	238.84	272.96	307.08	341.20	375.32	409.44	443.56	477.68	511.80	545.92	580.04	614.16	648.28	682.40

71

Table 29.--Per acre value of fixed costs occurring annually with interest by years to harvest age (interest @ 4 percent)

Annual fixed cost per acre	Years to harvest																	
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
.01	.12	.20	.30	.42	.56	.74	.95	1.21	1.53	1.91	2.38	2.95	3.64	4.49	5.51	6.76	8.28
.02	.24	.40	.60	.83	1.12	1.47	1.90	2.42	3.05	3.82	4.76	5.90	7.28	8.98	11.02	13.52	16.56
.03	.36	.60	.89	1.25	1.68	2.21	2.85	3.63	4.58	5.73	7.14	8.85	10.93	13.46	16.54	20.28	24.84
.04	.48	.80	1.19	1.67	2.24	2.95	3.80	4.84	6.11	7.65	9.52	11.80	14.57	17.95	22.05	27.04	33.12
.05	.60	1.00	1.49	2.08	2.80	3.68	4.75	6.05	7.63	9.56	11.90	14.75	18.21	22.44	27.56	33.80	41.40
.06	.72	1.20	1.79	2.50	3.36	4.42	5.70	7.26	9.16	11.47	14.28	17.70	21.86	26.92	33.08	40.56	49.68
.07	.84	1.40	2.08	2.92	3.93	5.16	6.65	8.47	10.69	13.38	16.66	20.65	25.50	31.41	38.59	47.32	57.96
.08	.96	1.60	2.38	3.33	4.49	5.89	7.60	9.68	12.21	15.29	19.04	23.60	29.14	35.90	44.10	54.08	66.24
.09	1.08	1.80	2.68	3.75	5.05	6.63	8.55	10.89	13.74	17.20	21.42	26.55	32.78	40.39	49.61	60.84	74.52
.10	1.20	2.00	2.98	4.16	5.61	7.36	9.50	12.10	15.27	19.12	23.80	29.50	36.42	44.88	55.12	67.60	82.80
.11	1.32	2.20	3.28	4.58	6.17	8.10	10.45	13.31	16.79	21.03	26.18	32.45	40.07	49.36	60.64	74.36	91.08
.12	1.44	2.40	3.57	5.00	6.73	8.84	11.40	14.52	18.32	22.94	28.56	35.40	43.71	53.85	66.15	81.12	99.36
.13	1.56	2.60	3.87	5.41	7.29	9.57	12.35	15.73	19.85	24.85	30.94	38.35	47.35	58.34	71.66	87.88	107.64
.14	1.68	2.80	4.17	5.83	7.85	10.31	13.30	16.94	21.37	26.76	33.32	41.30	51.00	62.82	77.18	94.64	115.92
.15	1.80	3.00	4.47	6.25	8.41	11.05	14.25	18.15	22.90	28.67	35.70	44.25	54.64	67.31	82.69	101.40	124.20
.16	1.92	3.20	4.76	6.66	8.97	11.78	15.20	19.36	24.43	30.58	38.08	47.20	58.28	71.80	88.20	108.16	132.48
.17	2.04	3.40	5.06	7.08	9.53	12.52	16.15	20.57	25.95	32.50	40.46	50.15	61.92	76.29	93.71	114.92	140.76
.18	2.16	3.60	5.36	7.50	10.09	13.26	17.10	21.78	27.48	34.41	42.84	53.10	65.56	80.77	99.22	121.68	149.04
.19	2.28	3.80	5.66	7.91	10.65	13.99	18.05	22.99	29.01	36.32	45.22	56.05	69.21	85.26	104.74	128.44	157.32
.20	2.40	4.00	5.96	8.33	11.22	14.73	19.00	24.20	30.54	38.23	47.60	59.00	72.85	89.75	110.25	135.20	165.60
.30	3.60	6.01	8.93	12.50	16.82	22.10	28.51	36.31	45.80	57.34	71.40	88.50	109.28	134.62	165.38	202.80	248.40
.40	4.80	8.01	11.91	16.66	22.43	29.46	38.01	48.41	61.07	76.46	95.20	118.00	145.70	179.50	220.50	270.40	331.20
.50	6.00	10.01	14.89	20.82	28.04	36.82	47.51	60.51	76.34	95.58	119.00	147.50	182.12	224.38	275.62	338.00	414.00

Table 30.--Investment value per acre of costs or returns incurred in a particular year with interest by years to harvest age (interest @ 5 percent)

Years to harvest	Cost or intermediate returns per acre																			
	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$11	$12	$13	$14	$15	$16	$17	$18	$19	$20
	. . . . dollars																			
10	1.63	3.26	4.89	6.52	8.14	9.77	11.40	13.03	14.66	16.29	17.92	19.55	21.18	22.81	24.44	26.06	27.69	29.32	30.95	32.58
15	2.08	4.16	6.24	8.32	10.40	12.47	14.55	16.63	18.71	20.79	22.87	24.95	27.03	29.11	31.18	33.26	35.34	37.42	39.50	41.58
20	2.65	5.31	7.96	10.61	13.26	15.92	18.57	21.22	23.88	26.53	29.18	31.84	34.49	37.14	39.80	42.45	45.10	47.75	50.41	53.06
25	3.39	6.77	10.16	13.54	16.93	20.32	23.70	27.09	30.47	33.86	37.25	40.63	44.02	47.40	50.79	54.18	57.56	60.95	64.33	67.72
30	4.32	8.64	12.97	17.29	21.61	25.93	30.25	34.58	38.90	43.22	47.54	51.86	56.19	60.51	64.83	69.15	73.47	77.80	82.12	86.44
35	5.52	11.03	16.55	22.06	27.58	33.10	38.61	44.13	49.64	55.16	60.68	66.19	71.71	77.22	82.74	88.26	93.77	99.29	104.80	110.32
40	7.04	14.08	21.12	28.16	35.20	42.24	49.28	56.32	63.36	70.40	77.44	84.48	91.52	98.56	105.60	112.64	119.68	126.72	133.76	140.80
45	8.98	17.97	26.96	35.94	44.92	53.91	62.90	71.88	80.86	89.85	98.84	107.82	116.80	125.79	134.78	143.76	152.74	161.73	170.72	179.70
50	11.47	22.94	34.41	45.88	57.35	68.82	80.29	91.76	103.23	114.70	126.17	137.64	149.11	160.58	172.05	183.52	194.99	206.46	217.93	229.40
55	14.64	29.28	43.92	58.56	73.20	87.84	102.48	117.12	131.76	146.40	161.04	175.68	190.32	204.96	219.60	234.24	248.88	263.52	278.16	292.80
60	18.68	37.36	56.04	74.72	93.40	112.08	130.76	149.44	168.12	186.80	205.48	224.16	242.84	261.52	280.20	298.88	317.56	336.24	354.92	373.60
65	23.84	47.68	71.52	95.36	119.20	143.04	166.88	190.72	214.56	238.40	262.24	286.08	309.92	333.76	357.60	381.44	405.28	429.12	452.96	476.80
70	30.43	60.86	91.29	121.72	152.15	182.58	213.01	243.44	273.87	304.30	334.73	365.16	395.59	426.02	456.45	486.88	517.31	547.74	578.17	608.60
75	38.83	77.66	116.49	155.32	194.15	232.98	271.81	310.64	349.47	388.30	427.13	465.96	504.79	543.62	582.45	621.28	660.11	698.94	737.77	776.60
80	49.56	99.12	148.68	198.24	247.80	297.36	346.92	396.48	446.04	495.60	545.16	594.72	644.28	693.84	743.40	792.96	842.52	892.08	941.64	991.20
85	63.25	126.50	189.75	253.00	316.25	379.50	442.75	506.00	569.25	632.50	695.75	759.00	822.25	885.50	948.75	1012.00	1075.25	1138.50	1201.75	1265.00
90	80.73	161.46	242.19	322.92	403.65	484.38	565.11	645.84	726.57	807.30	888.03	968.76	1049.49	1130.22	1210.95	1291.68	1372.41	1453.14	1533.87	1614.60

73

Table 31.--Per acre value of fixed costs occurring annually with interest by years to harvest age (interest @ 5 percent)

Annual fixed cost per acre	Years to harvest																
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
.01	.13	.22	.33	.48	.66	.90	1.21	1.60	2.09	2.73	3.54	4.57	5.89	7.57	9.71	12.45	15.95
.02	.25	.43	.66	.95	1.33	1.81	2.42	3.19	4.19	5.46	7.07	9.14	11.77	15.13	19.42	24.90	31.89
.03	.38	.65	.99	1.43	1.99	2.71	3.62	4.79	6.28	8.18	10.61	13.70	17.66	22.70	29.14	37.35	47.84
.04	.50	.86	1.32	1.91	2.66	3.61	4.83	6.39	8.38	10.91	14.14	18.27	23.54	30.26	38.85	49.80	63.78
.05	.63	1.08	1.65	2.39	3.32	4.52	6.04	7.98	10.47	13.64	17.68	22.84	29.43	37.83	48.56	62.25	79.73
.06	.75	1.29	1.98	2.86	3.99	5.42	7.25	9.58	12.56	16.37	21.22	27.41	35.32	45.40	58.27	74.70	95.68
.07	.88	1.51	2.31	3.34	4.65	6.32	8.46	11.18	14.66	19.10	24.75	31.98	41.20	52.96	67.98	87.15	111.62
.08	1.01	1.73	2.64	3.82	5.32	7.23	9.66	12.78	16.75	21.82	28.29	36.54	47.09	60.53	77.70	99.60	127.57
.09	1.13	1.94	2.98	4.29	5.98	8.13	10.87	14.37	18.85	24.55	31.82	41.11	52.97	68.09	87.41	112.05	143.51
.10	1.26	2.16	3.31	4.77	6.64	9.03	12.08	15.97	20.94	27.28	35.36	45.68	58.86	75.66	97.12	124.50	159.46
.11	1.38	2.37	3.64	5.25	7.31	9.94	13.29	17.57	23.03	30.01	38.90	50.25	64.75	83.23	106.83	136.95	175.41
.12	1.51	2.59	3.97	5.73	7.97	10.84	14.50	19.16	25.13	32.74	42.43	54.82	70.63	90.79	116.54	149.40	191.35
.13	1.64	2.81	4.30	6.20	8.64	11.74	15.70	20.76	27.22	35.46	45.97	59.38	76.52	98.36	126.26	161.85	207.30
.14	1.76	3.02	4.63	6.68	9.30	12.64	16.91	22.36	29.32	38.19	49.50	63.95	82.40	105.92	135.97	174.30	223.24
.15	1.89	3.24	4.96	7.16	9.97	13.55	18.12	23.96	31.41	40.92	53.04	68.52	88.29	113.49	145.68	186.75	239.19
.16	2.01	3.45	5.29	7.64	10.63	14.45	19.33	25.55	33.50	43.65	56.58	73.09	94.18	121.06	155.39	199.20	255.14
.17	2.14	3.67	5.62	8.11	11.29	15.35	20.54	27.15	35.60	46.38	60.11	77.66	100.06	128.62	165.10	211.65	271.08
.18	2.26	3.88	5.95	8.59	11.96	16.26	21.74	28.75	37.69	49.10	63.65	82.22	105.95	136.19	174.82	224.10	287.03
.19	2.39	4.10	6.28	9.07	12.62	17.16	22.95	30.34	39.79	51.83	67.18	86.79	111.83	143.75	184.53	236.55	302.97
.20	2.52	4.32	6.61	9.54	13.29	18.06	24.16	31.94	41.88	54.56	70.72	91.36	117.72	151.32	194.24	249.00	318.92
.30	3.77	6.47	9.92	14.32	19.93	27.10	36.24	47.91	62.82	81.84	106.08	137.04	176.58	226.98	291.36	373.50	478.38
.40	5.03	8.63	13.22	19.09	26.58	36.13	48.32	63.88	83.76	109.12	141.44	182.72	235.44	302.64	388.48	498.00	637.84
.50	6.29	10.79	16.53	23.86	33.22	45.16	60.40	79.85	104.70	136.40	176.80	228.40	294.30	378.30	485.60	622.50	797.30

The Central States Forest Experiment Station is headquartered at Columbus, Ohio and maintains major field offices at:

Ames, Iowa (in cooperation with Iowa State University)
Athens, Ohio (in cooperation with Ohio University)
Bedford, Indiana
Berea, Kentucky (in cooperation with Berea College)
Carbondale, Illinois (in cooperation with Southern Illinois University)
Columbia, Missouri (in cooperation with the University of Missouri)