



Forest Biomass Resources of Oklahoma

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Forest Biomass Resources of Oklahoma

Summary

- Oklahoma has over 7 million acres of forest land representing 16 percent of the land area of the state.
- The forest land supports over 350 million tons of woody biomass. Seventy percent of the biomass is on productive forest land.
- Over 65 percent of Oklahoma's forest land is capable of being productively managed for forest products using current technology.
- The majority of Oklahoma's productive forest land is concentrated in the eastern part of the state particularly in the southeastern counties of McCurtain, Pushmataha, LeFlore and Latimer.
- Over 88 percent of the state's forest land is privately owned. Industrial forestry firms own approximately one million acres of forest land.
- Annual growth of woody biomass exceeds 14 million tons on timberland in Oklahoma.
- Annual woody biomass growth on Oklahoma's timberland exceeds total annual removals by over 5.7 million tons.

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Forest Biomass Resources of Oklahoma

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Introduction

This report is the first in a series devoted to describing the potential biological productivity of the Oklahoma forest resource and the impact of that potential production on the economy of the state. These reports are intended for use by policy makers in state and federal agencies concerned with the forest resource and regional economic development. This information also is useful to potential investors in the Oklahoma forest resource.

The primary objective of this report is to summarize and describe the forest land biomass resources of Oklahoma. This information will be the basis for estimation of the productive potential of the state's forest resource, and will serve as a basis for comparisons between the current forest and the potential of the forest land base to produce an increased supply of forest fiber.

Oklahoma's forest resource has been described by a number of authors, including Duck and Fletcher's important work in 1947. The United States Department of Agriculture, Forest Service conducted inventories of the forest land in Eastern Oklahoma in 1936, 1956, 1966, and 1976 (U.S.D.A.-Forest Service, 1938; U.S.D.A.-Forest Service, 1957; Sternitzke and Van Sickle, 1968; and Murphy, 1977) as part of the national forest survey. The United States Department of Agriculture, Soil Conservation Service also inventories non-federal forest land as part of their National Resource Inventory (U.S.D.A.-Soil Conservation Service, 1962, 1970, 1977, 1984). This report will describe the forest resource in terms of total biomass and area occupied for the entire state.

This report is based principally on the forest survey of Oklahoma which was conducted in 1976 (Murphy, 1977), the 1982 Oklahoma Resources Inventory (U.S.D.A.-Soil Conservation Service, 1984) and field samples collected by the Oklahoma State University, Department of Forestry.

Significant assistance has been given in the use of this information by the Forest Inventory and Analysis Work Unit of the Southern Forest Experiment Station, particularly Dr. Charles Thomas; the State Office of the Soil Conservation Service, including Norman Smola and Billy Wagner; the Forest Science Laboratory of the Southeastern Forest Experiment Station, particularly Alexander Clark; and Dick Dorsch and Dr. Roy Hickman of the Iowa State Statistical Laboratory.

Forest Land of Oklahoma

Land Area

The total land area of Oklahoma is approximately 44 million acres. Of this, 16 percent is classified as forest land. Forest land is defined as land that is at least 10 percent stocked by forest trees of any size, or formerly had such tree cover and is not currently developed for nonforest use (Figure 1). <1> The amount of Oklahoma land in forest is about the same as the land area classified as pasture, and is almost two thirds of the total cropland in the state (U.S.D.A.-Soil Conservation Service, 1984). The remaining land area is used primarily as range or for urban and rural development.

The land cover of the state ranges from the heavily forested areas in the eastern part of the state to short grass prairies in the west. Scrub forests and tall grass prairies provide a transition zone within the center of the state. Bottomland forests cross the state along stream courses.

Forest Land Area

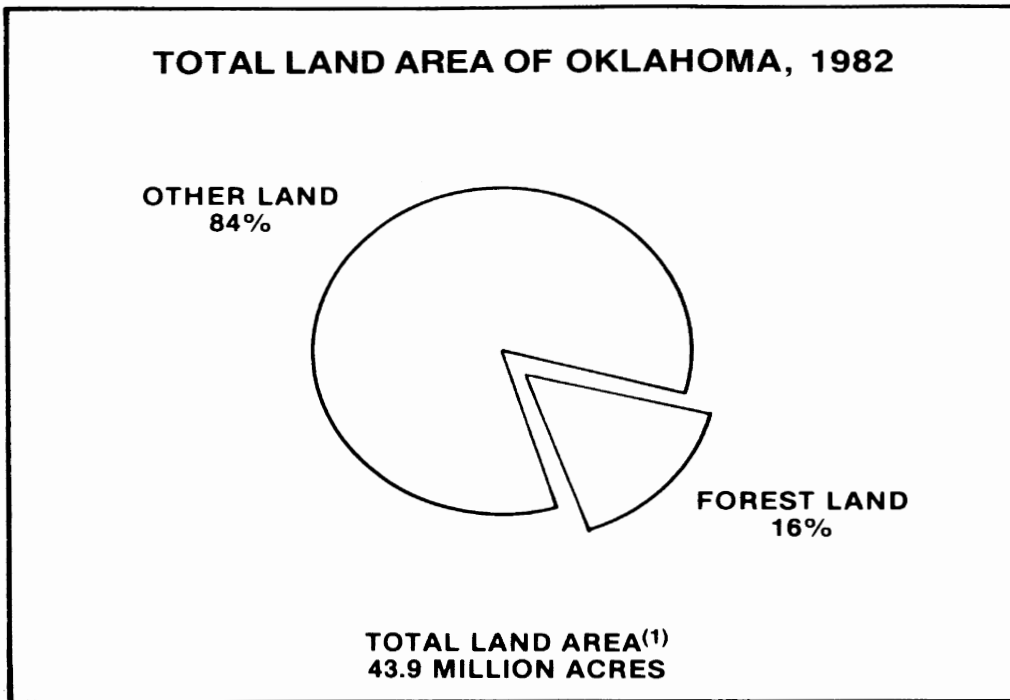
In 1982, it is estimated that Oklahoma had 7 million acres of forest land (U.S.D.A.-Soil Conservation Service, 1984; Thomas, 1984). <2> Of this total, 67 percent (4.7 million acres) is classified as timberland; that is forest land which is producing or is capable of producing crops of industrial wood and is not withdrawn from timber utilization (20 cubic feet per acre per year mean annual increment) (Figure 2). <3> The remaining 33 percent of the

<1> See Appendix C, Table 1.

<2> See Appendix C, Table 1.

<3> See glossary.

FIGURE 1.



(1) Total surface area excluding area covered by major water bodies.

forest land is classed as unproductive or has been reserved from the production of timber crops. The productive forest land reserved from management activities accounts for less than two percent of the state's total forest land area.

Forest Land Area Trends

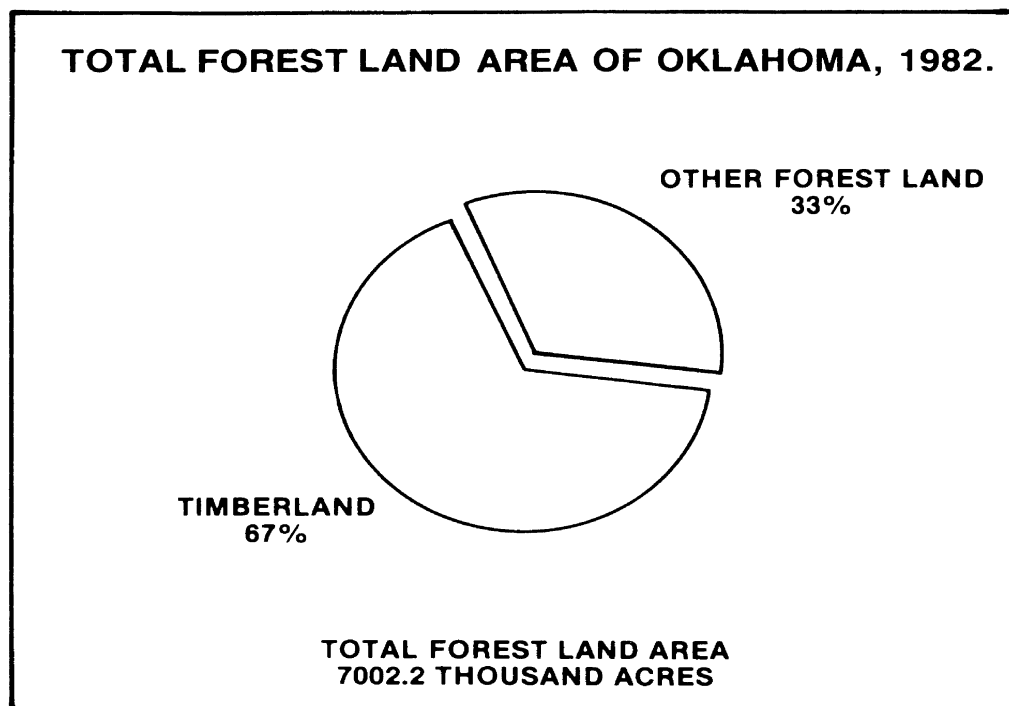
The state has experienced a steady decline in forest land area since the beginning of the century. Forest land probably exceeded 19 million acres before 1900, covering over 40 percent of the state (Duck and Fletcher, 1947). <4> Since that time dramatic changes in land use have reduced forest land to 7 million acres (Figure 3). <5> Over half of the state's counties are estimated at one time to have had more than 25 percent of their area occupied by forest. At the beginning of this century, 33 counties had forests covering 50 percent or more of their land area (Duck and Fletcher) (Figure 4). Currently, there are 16 counties that have at least 25 percent of their land in forest; only six of these have 50 percent or more forest cover (Figure 5).

Since 1956, total forest land has declined at an average rate of 121 thousand acres per year. The rate has accelerated to almost 272 thousand acres per year since 1976 (Figure 6). Timberland, in eastern Oklahoma, as part of

<4> Estimate based on the potential of soil types to support a particular habitat.

<5> See Appendix C, Table 2.

FIGURE 2.



the total, has also experienced a steep decline, although this trend has slowed considerably in recent years. <6> The timberland base, in the eastern counties, has declined at an average rate of 52 thousand acres per year since 1956 but the rate of loss has slowed to less than five thousand acres per year since 1976.

The amount of forest land set aside with timber production activities precluded through legislative mandate has been relatively small. There is a recent trend toward increasing the amount of land excluded from production of timber crops. This movement has resulted in approximately 26 thousand acres of National Forest being recategorized from the timberland class to the productive-deferred classification. <7> This increased the total of excluded forest land in Oklahoma by one third. The effect on the timberland base has been relatively insignificant. The combined total reserved lands is only two percent of the timberland area. <8>

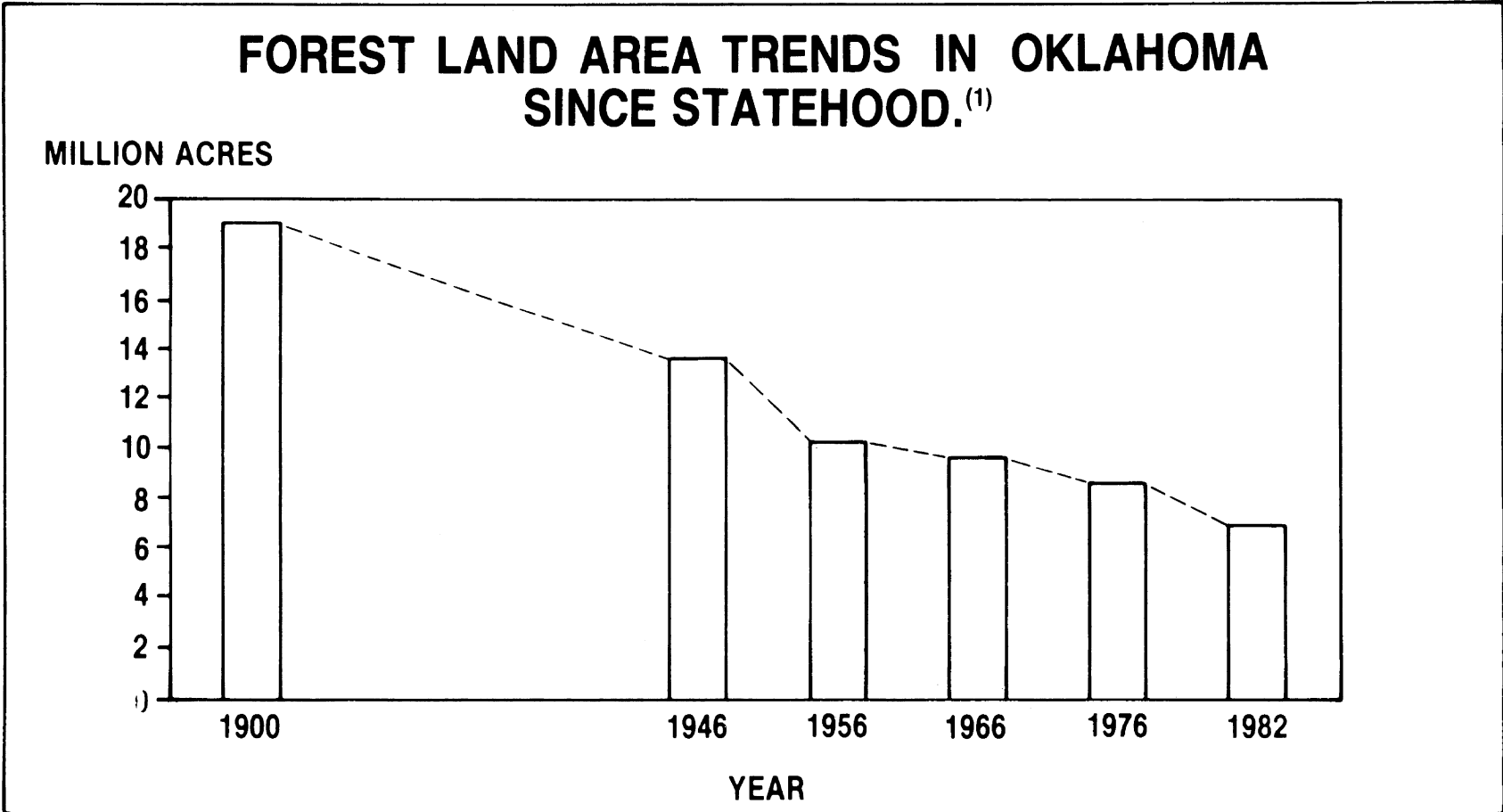
The major causes for the reduction of forest land have been conversion to cropland and pasture, water development projects, and commercial and residential development. Conversion to pasture has been the most important cause for the decline over the past decade, particularly of unproductive forest land areas.

<6> Data from previous surveys of forestland outside Eastern Oklahoma did not distinguish between timberland and other forest land.

<7> See glossary.

<8> Ibid.

FIGURE 3.



(1) Methodologies for estimating forest land area have been modified through time; therefore, some of the change in forest land area may be due to changes in the estimating procedures. See Appendix B for sources of information.

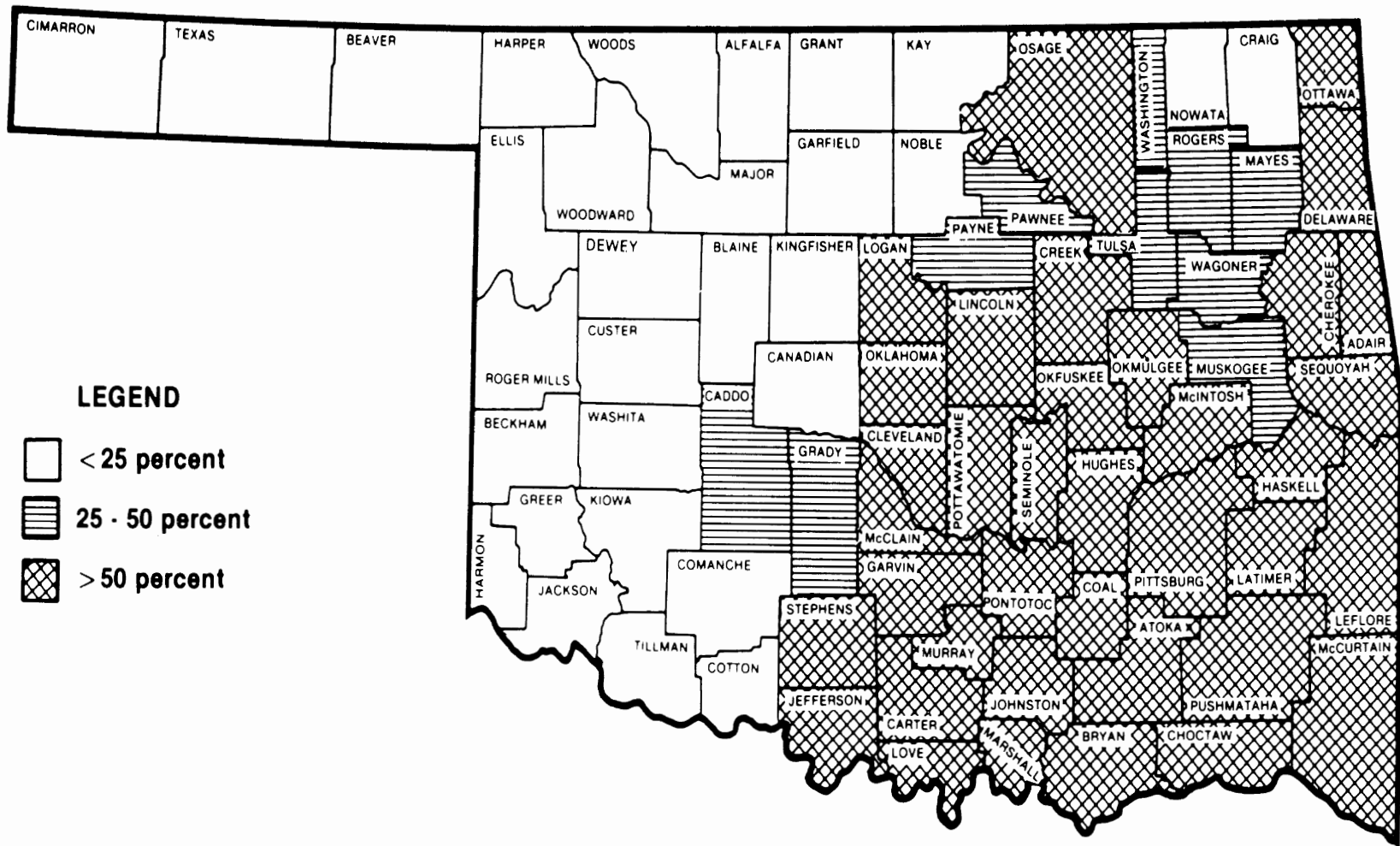


FIGURE 4: PERCENT OF TOTAL LAND AREA IN FOREST BY COUNTY IN OKLAHOMA BEFORE 1900 (DUCK AND FLETCHER, 1947).

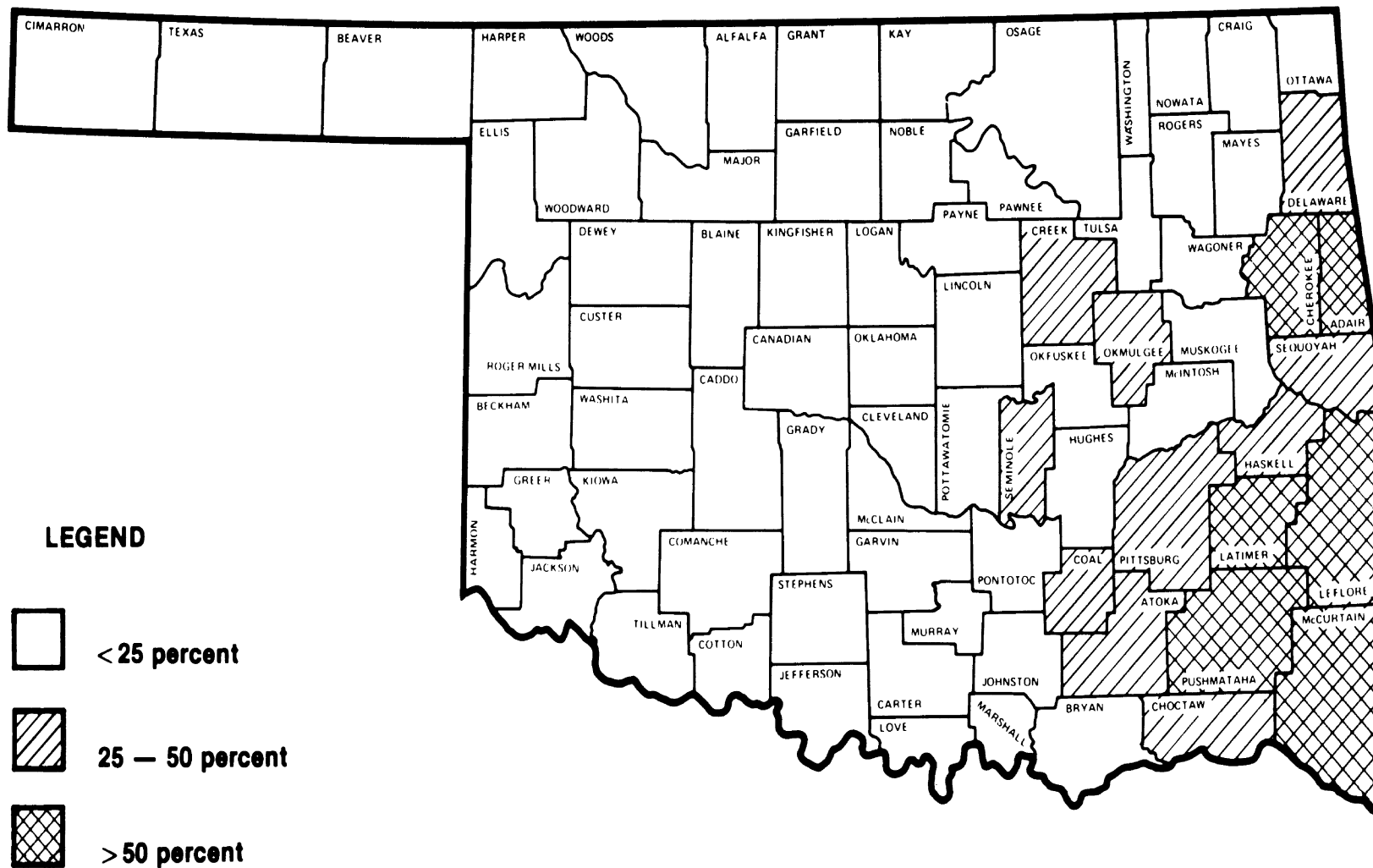
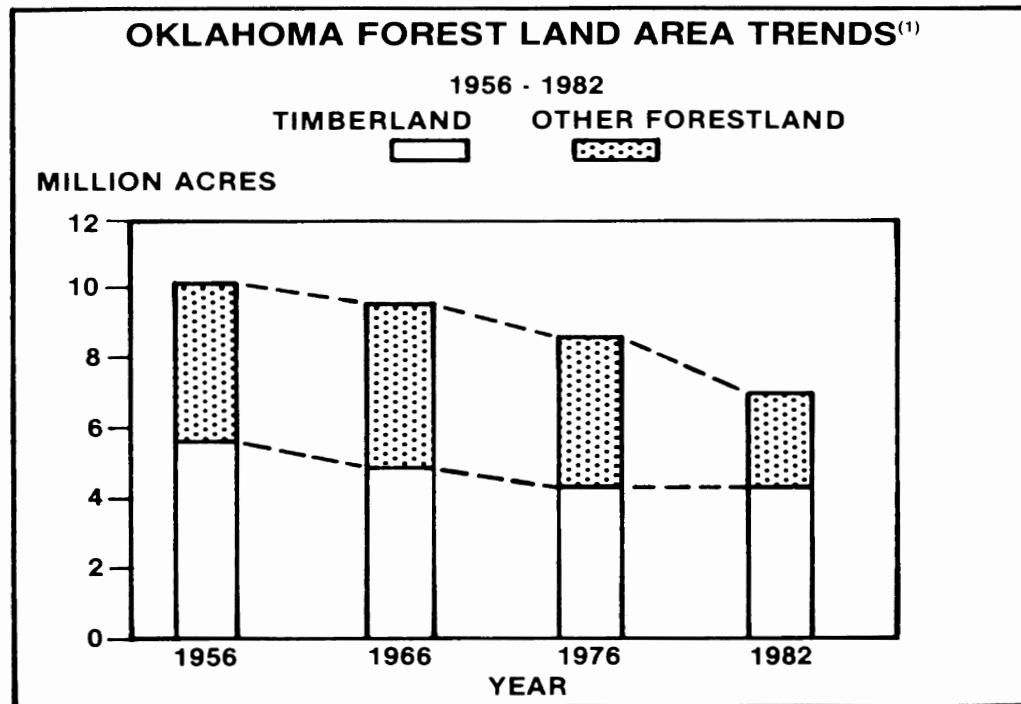


FIGURE 5: PERCENT OF TOTAL LAND AREA IN FOREST BY COUNTY IN OKLAHOMA, 1982.

FIGURE 6.



(1) See Appendix B for Sources of data. Timberland estimates do not include data from outside eastern Oklahoma.

Geographic Distribution of Forest Land

Oklahoma's forest land is concentrated in the eastern part of the state, which includes all sixteen counties with over 25 percent forest cover. The counties that are 50 percent or more forested included Pushmataha, Latimer, LeFlore, and McCurtain in the southeast, and Cherokee and Adair in the northeast (Figure 5). The state's remaining counties are less than 25 percent forested. Most of the western counties have less than five percent of their land area covered by timber.

Forest Land Ownership

Over 88 percent (6.2 million acres) of Oklahoma's forest land is owned by private land owners. <9> The majority of the private forest land (5.2 million acres) is owned by a group made up of farmers, private individuals, and nonforestry related businesses usually referred to as nonindustrial private forest land owners or miscellaneous private forest landowners (Figure 7). By definition the land owners in this class do not operate timber conversion facilities. The forest land owned by this class of owners represents over three quarters of the state's timberland (3.1 million acres) (Figure 8). Industrial forestry firms own the remaining 1 million acres of private forest land.

<9> See Appendix C, Table 1.

FIGURE 7.

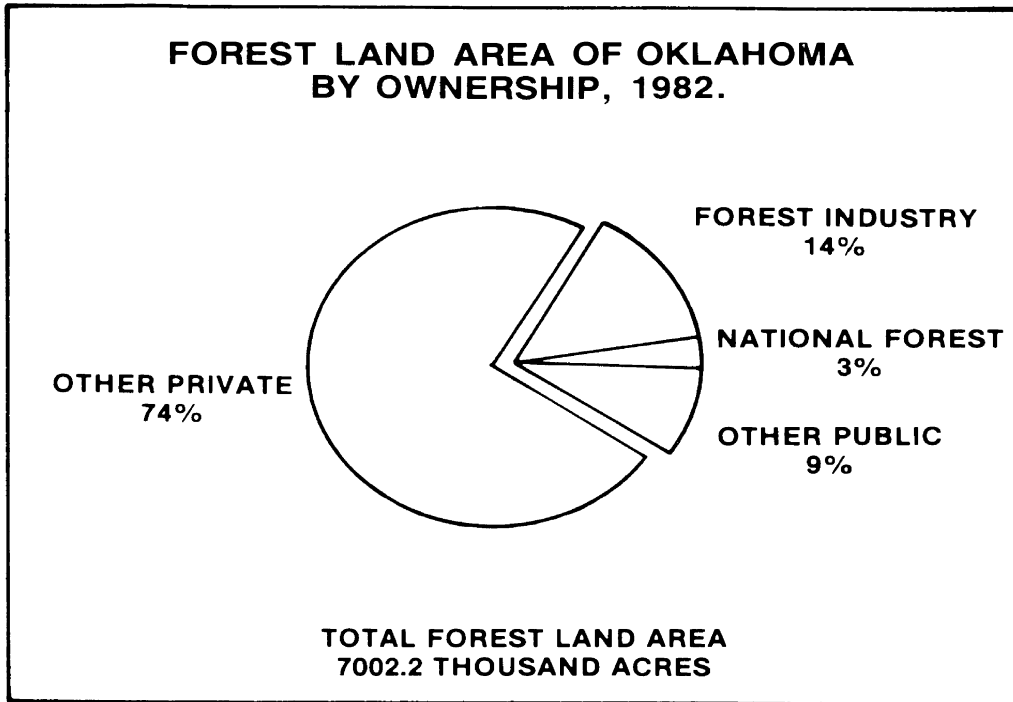
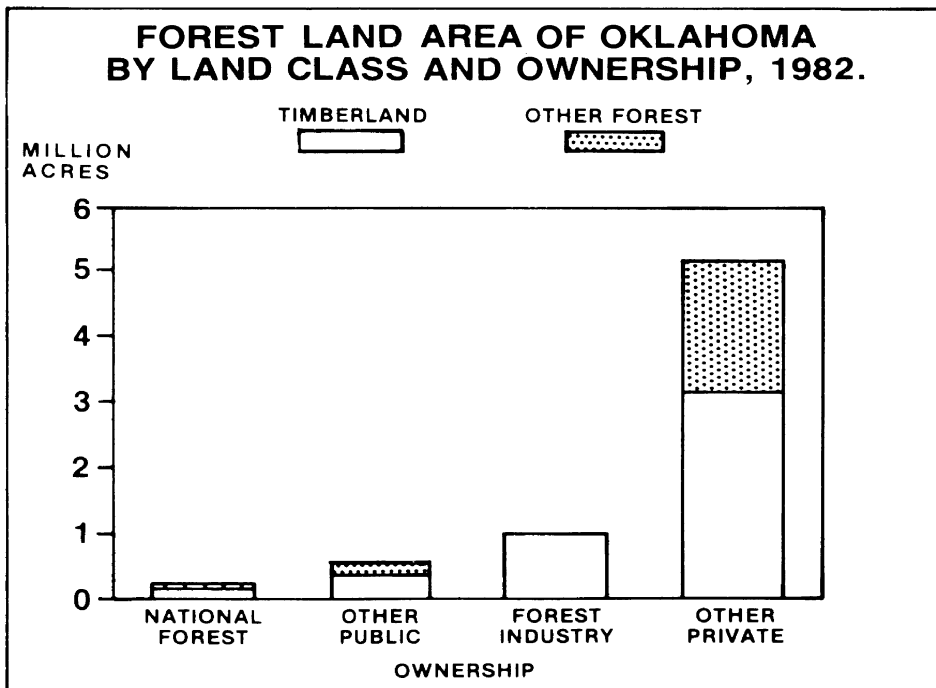


FIGURE 8.



Public ownership accounts for 836 thousand acres of forest land in the state. This land is managed by a variety of government agencies. The federal government owns half of the public forest land of the state representing three percent of the state total. Over half of the federal forest land is under the administration of the U.S.D.A.-Forest Service in the Ouachita National Forest. This land is managed under multiple use objectives to satisfy a large number of competing users with timber management a primary focus. Little of the other public forest land is managed intensively for timber. Much of the forest land managed by other public agencies is used primarily for purposes other than timber production; such as parkland, wildlife refuge, or reservoir buffer. <10>

Site Index Class of Oklahoma Forest Land

Site index is an expression of the potential of a specific combination of tree species, soil and climate to produce timber crops. It is based on the height of one or more free-growing dominant or codominant trees of a specific species in the forest type at a designated age. Site index information is used to enter a yield table of the selected species to predict the future output from the site. Product sizes and values at various ages are largely controlled by site quality and stand density (Clutter et al., 1983). From a higher site index class a higher production of wood fiber can be expected. Therefore, the choice of lands on which profitable forestry investments may be made is highly dependent on site quality.

The majority of Oklahoma's forest land is classified in the site index class of 50 (on a 50 year base) or lower. Only 14 percent, 993 thousand acres, of the state's forest land has a site index of 65 or greater (Figure 9). <11> The majority of other forest land is in site index class 20. There are 79 thousand acres in site classes 50 and 65 withheld from the production of timber crops by legislative mandate for wilderness use or other purposes.

The site quality of total forest landholdings varies with ownership. Both forest industry and National Forest lands have an average site index over 50 for their forest land (Figure 10). <12> The average site quality of the miscellaneous private forest land is lower than that of the other landowner groups. However, nonindustrial private owners have over 3.1 million acres of forest land in site index class of 50 or higher (Figure 11). This is a greater acreage of site 50 or higher forest land than the combined total of all the forest land in site index class 50 or higher owned by the other ownership groups in the state.

<10> Reservoir buffer is defined as the land area surrounding reservoirs that is left as protection to prevent erosion into the lakes and allows lake level to rise with minimal damage. The Corp of Engineers uses the land up to the 100 hundred year flood plain plus an additional five feet as a buffer.

<11> See Appendix C, Table 3.

<12> See Appendix C, Table 9.

FIGURE 9.

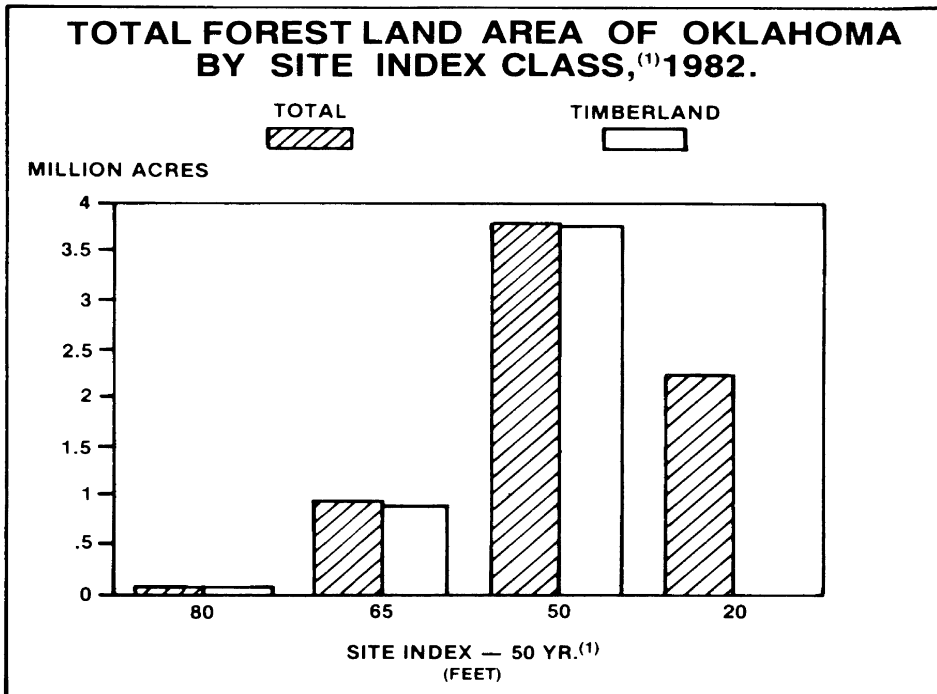


FIGURE 10.

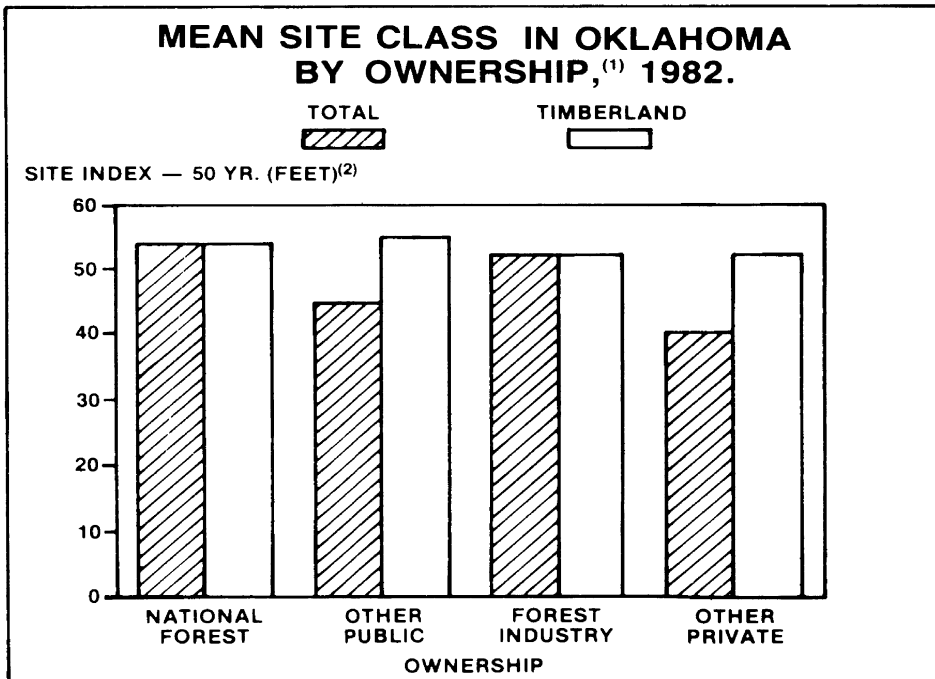
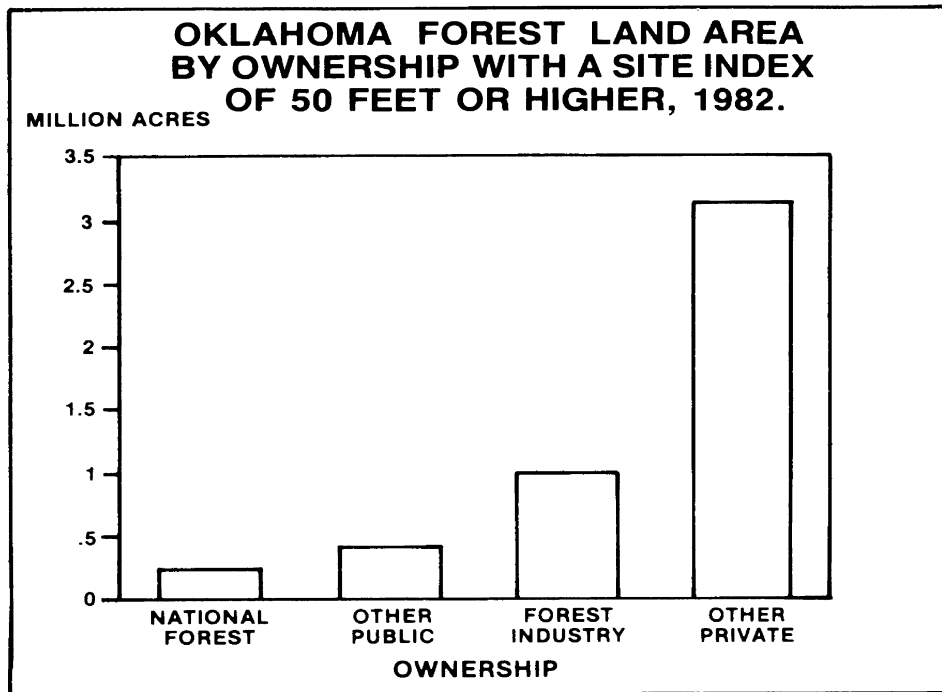


FIGURE 11.



Forty-seven thousand acres of National Forest land in site classes 50 and 65 have been reserved from production, representing almost 20 percent of the total National Forest land. <13> Public agencies, other than the Forest Service, have an additional 29 thousand acres of productive forest land reserved from production. These removals of forest land in site classes 35 and higher reduced the total productive forest land of the state by less than two percent.

Forest Biomass of Oklahoma

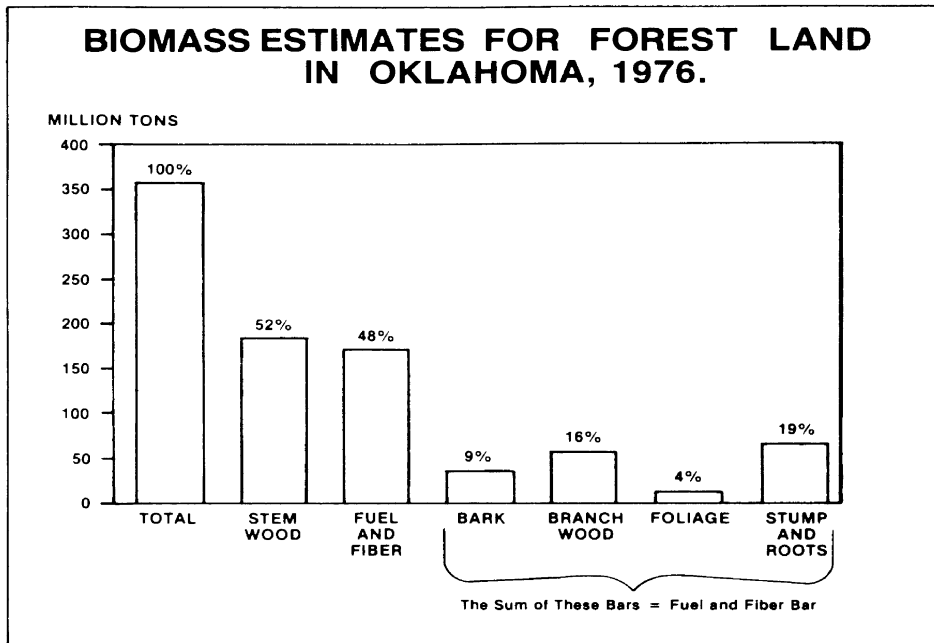
The forest land of Oklahoma supports over 358 million tons of biomass (green weight). <14> The estimates of biomass discussed in this paper refer to woody vegetation only. The woody biomass is present in several forms. Fifty-two percent of this material is stem wood (Figure 12). <15> The remaining woody biomass is available as potentially recoverable wood fiber in the form of: branches, bark, stumps, roots, and foliage. Presently, much of the available woody fiber is not recovered due to technological or economic limitations.

<13> See Appendix C, Tables 6 and 7.

<14> See definition of biomass in glossary.

<15> See Appendix C, Table 10.

FIGURE 12.



Note: Bark, Branchwood, Foliage, and Stump and Roots are all part of fuel and fiber group as part of whole.

Development of improved harvesting and utilization equipment is occurring rapidly. Technological advances and the increasing value of total utilization of wood fiber have changed the economics of utilization, leading to increased utilization of the entire tree in a timber harvest.

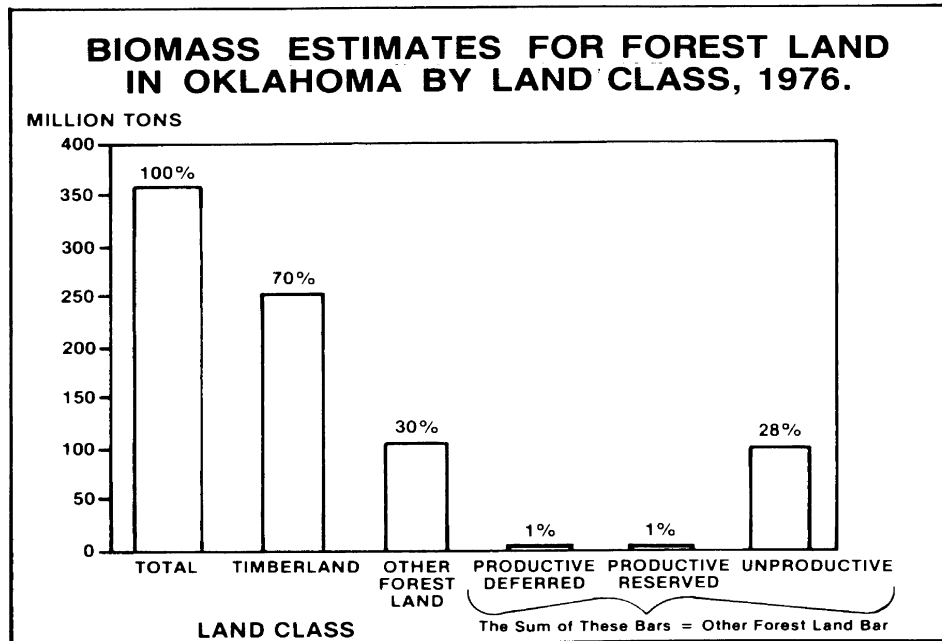
Seventy percent of the forest biomass in Oklahoma is located on land currently classed as timberland (Figure 13). <16> Only a small percentage of the potentially available forest biomass is unavailable due to withdrawal from timber production (Figure 13). The remaining fiber is found on unproductive forest land, characterized by low site class, low per acre concentrations of wood fiber, small size of trees, and unmarketable species. <17> These conditions offer little potential for economical production except possibly as fuelwood, precluding technological developments.

Oklahoma's timberland has a greater portion of its total woody biomass available as highly valued stem wood than is available on other forest land. The stem wood component accounts for 56 percent of the total biomass on timberland. Other forest land has only 42 percent of the total biomass in stem wood.

<16> See Appendix C, Table 11.

<17> See Appendix C, Table 12.

FIGURE 13.



The average total biomass on timberland owned by the forest industry and the National Forest are about equal to the averages of the Southern states (Figure 14). The remaining timberland owned by other public agencies and miscellaneous private landowners has a much lower average of biomass per acre. The average of woody biomass on the unproductive forest land is even lower.

The timberland of Oklahoma averages 46 tons of above ground biomass per acre. This average is exceeded by every state in the South (Figure 15). The differences are even more distinct when only the Western Gulf states of Louisiana, Arkansas, and Texas are compared to Oklahoma. Each of these states averages almost twice the woody biomass per acre.

Over 85 percent (219 million tons) of the economically available biomass is found on private lands. Forest industry lands have a greater portion of the state's forest biomass than forest land area because the industry forest land holdings have a higher level of growing stock per acre (Figure 16). The miscellaneous private landowners have forest land that is less fully stocked than the average. < 18 > Therefore, these forest landowners have a higher portion of forest land than total biomass. Also, the level of growing stock on miscellaneous private lands is lower than the West Gulf average (Murphy, 1975, 1976, 1978; Van Hees, 1980).

< 18 > Fully stocked is a subjective indication of the number of trees on a site that will yield the best results.

FIGURE 14.

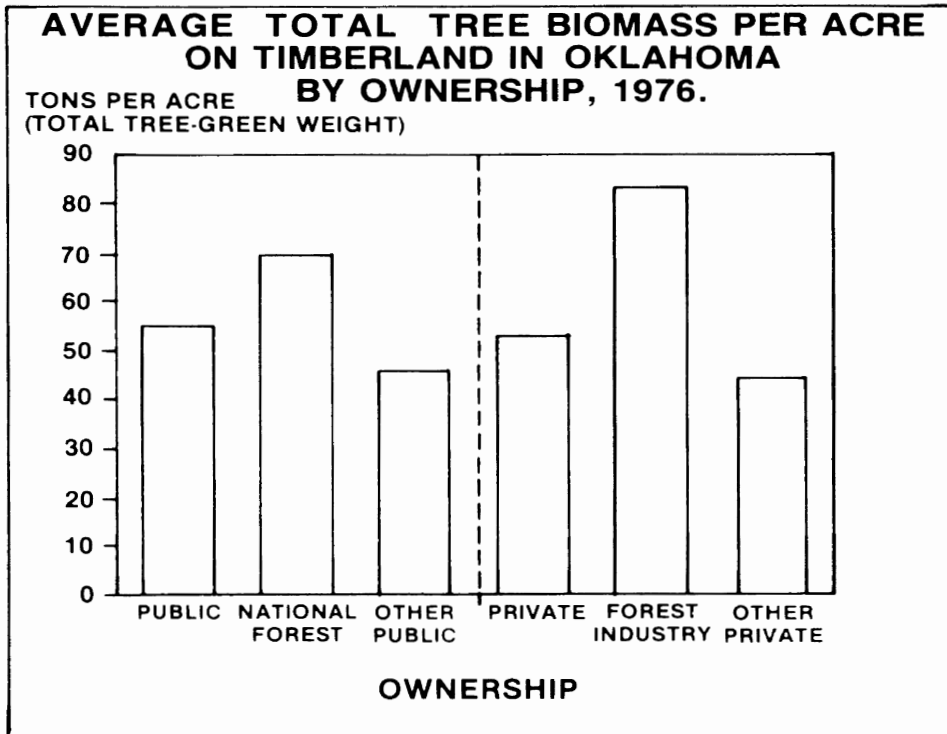


FIGURE 15.

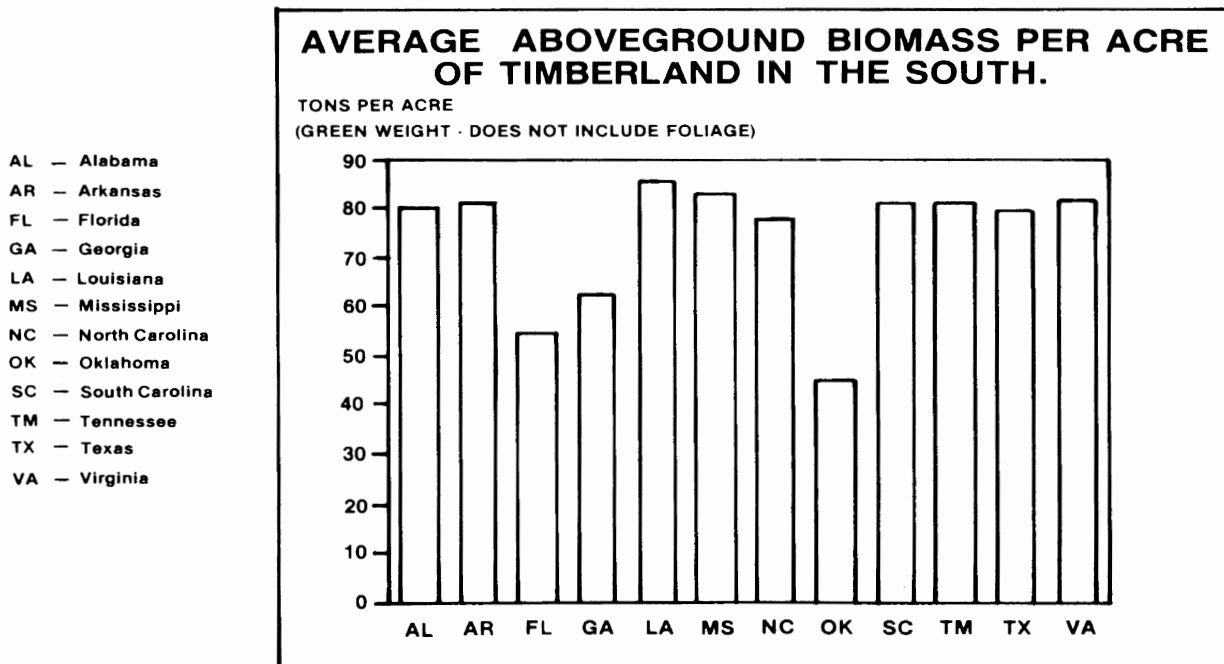
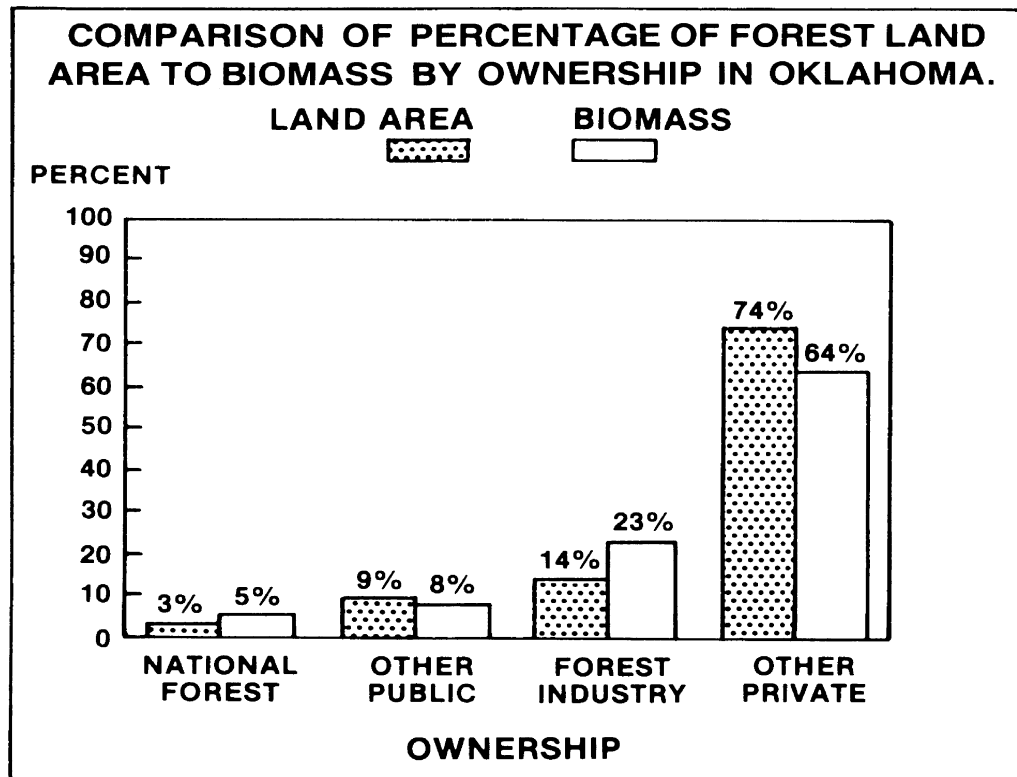


FIGURE 16.



Annual Growth and Removals of Forest Biomass

Estimation of biomass growth is not yet fully developed. The following estimates of biomass growth and removals are based on estimates of growth and removal volumes on timberland in the state. The following estimates should be viewed as only a best guess of the general changes that are occurring in the accumulation of biomass on the state's timberland.

Annual woody biomass growth on Oklahoma's timberland exceeds total annual removals by over 5.7 million tons. Annual growth in 1976 exceeded 14 million tons of total biomass (Figure 17). <19> Approximately 8.2 million tons of the annual growth is estimated to be stem wood. The remaining 6.3 million tons is in the form of bark, branchwood, foliage, stumps, and roots and is available as fuel and fiber. Removals of stem wood biomass are estimated to be greater than 5 million tons, however, over 3.2 million tons of stem wood biomass is not utilized each year. <20> There is an additional 2.5 million tons of other biomass that is not removed and is potentially a useful source of wood fiber. Most of the excess growth is present on forest land owned by miscellaneous private landowners, where annual growth exceeds removals by 4.5 million tons (Figure 18).

<19> See Appendix C, Table 16.

<20> See Appendix C, Table 17.

FIGURE 17.

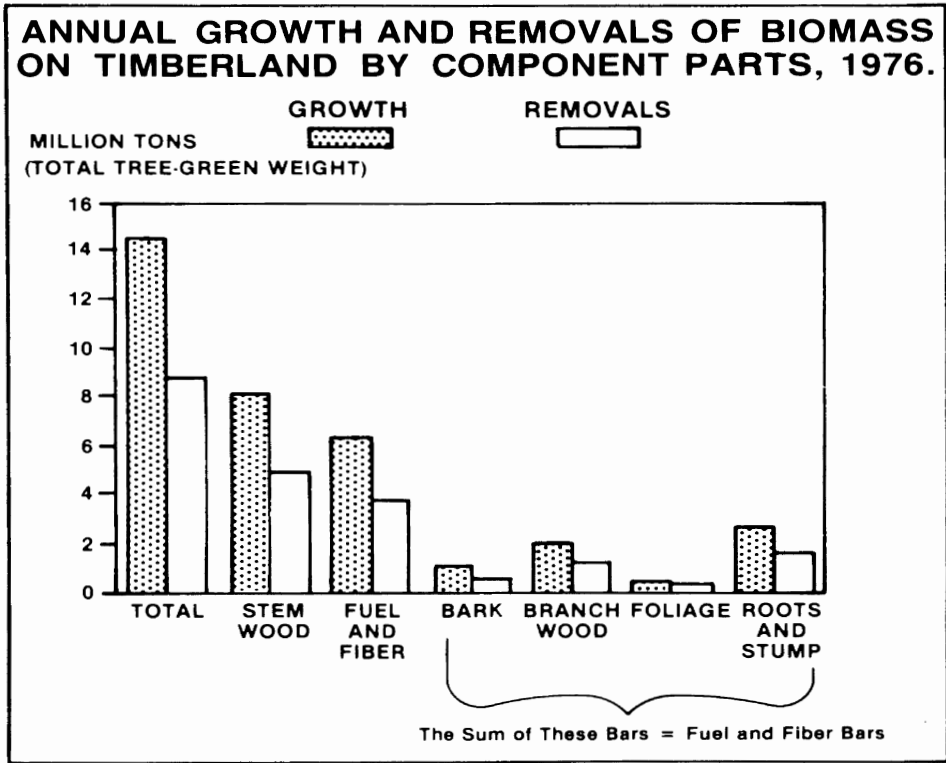


FIGURE 18.

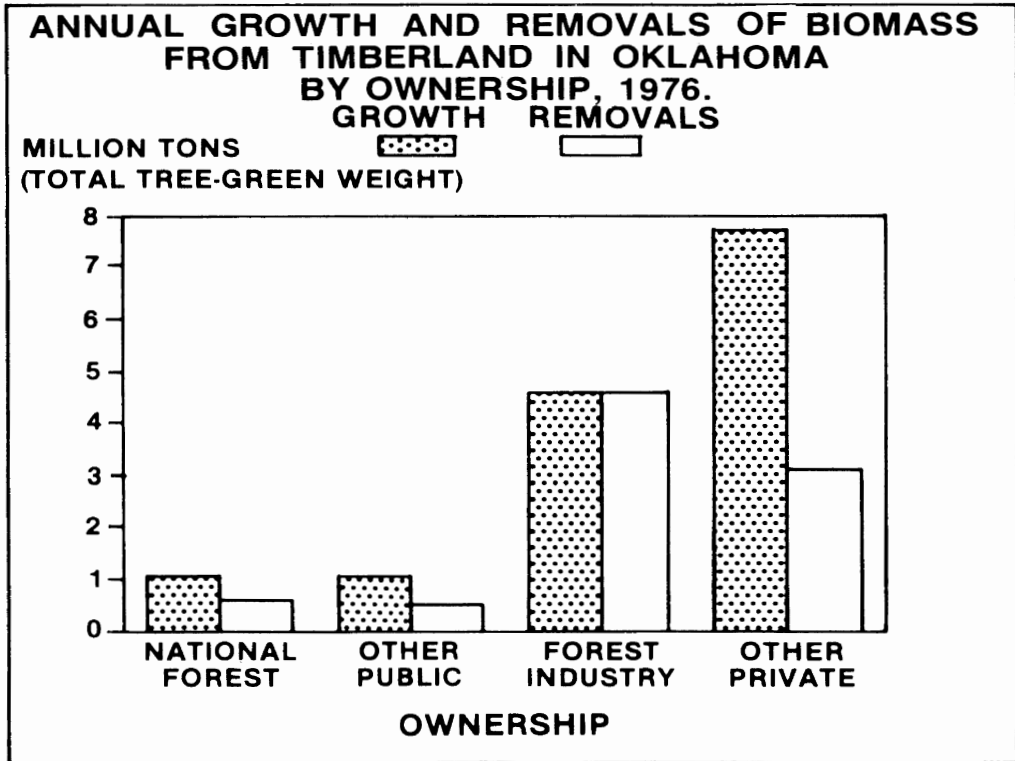
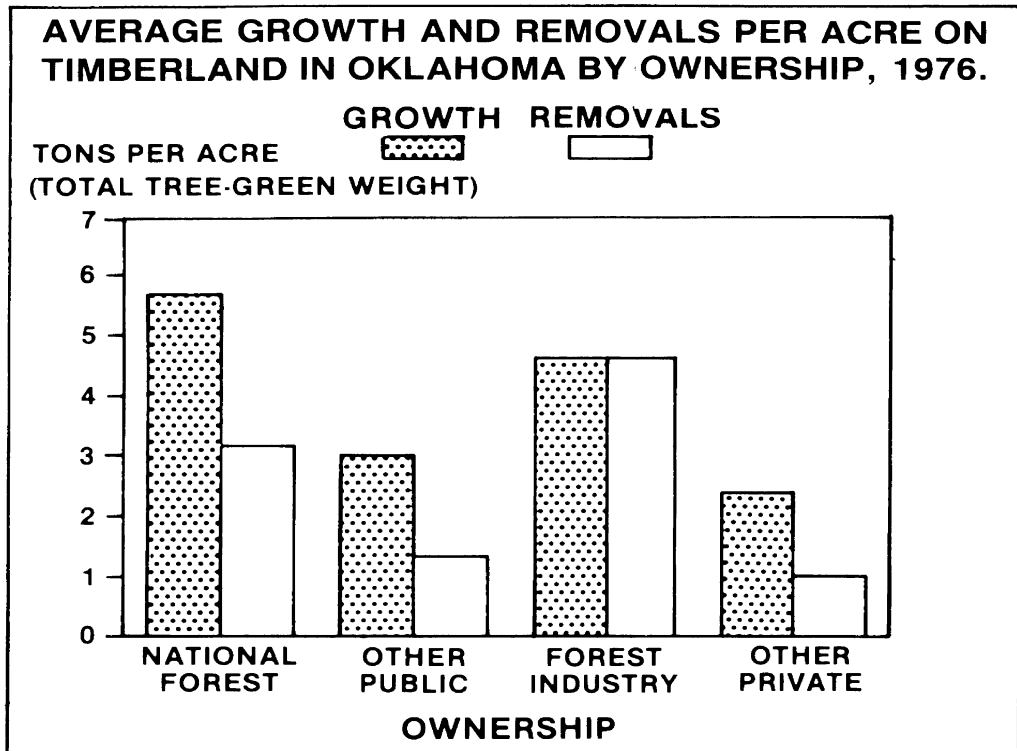


FIGURE 19.



Average annual growth rates per acre are highest on National Forest and forest industry lands (Figure 19). Miscellaneous private forest landowners have the lowest per acre growth rates. The average annual rate of removals is highest on forest industry lands where it equals the rate of growth. On miscellaneous private forest land and other public forest land, the average annual rate of removals is significantly below the state average.

Summary and Conclusions

Oklahoma has 7 million acres of forest land supporting over 350 million tons of forest biomass. Sixty-seven percent (4.7 million acres) of the forest land is currently classified as timberland, which supports 70 percent (251 million tons) of the forest biomass in the state. The growth of the state's forest fiber per cubic foot of growing stock is similar to other West Gulf states. (Murphy, 1975, 1976, 1978; Van Hees, 1980). This point supports the contention that the forests of the state produce forest fiber as efficiently as the other states within the West Gulf region. But since its forests have a much lower level of stocking it has significantly lower yields of biomass per acre than the other states in the region. The problem then is to raise the average level of stocking on the

state's timberland. If the present efficiency of production is maintained, a 50 percent increase in growing stock per acre would produce an additional 55 million cubic feet of forest fiber per year (6.3 million tons of biomass). Even with a 50 percent increase in growing stock, the average stocking level in Oklahoma would remain much lower than the other West Gulf states.

The forest resource of Oklahoma is concentrated in the eastern part of the state, particularly the southeastern corner. This concentration provides opportunities for increasing forest resource utilization and for increasing the growth of the wood products industry in the region. The forest resource is currently estimated to be accumulating biomass at a rate of over 5 million tons annually. Improved stocking of the forest land would allow biomass to accumulate at a more rapid pace. The availability of surplus timber at competitive prices could possibly serve as a stimulus to continued growth in the forest industry.

The utilization of the forest resource of the state would be enhanced by improving the structure of the forest resource. This could be accomplished by conversion of hardwoods to pine on sites that are capable of producing adequate growth of pine but are currently growing hardwoods. This change, in addition to an improvement in the level of growing stock per acre, would provide a significant increase in the quantity and quality of the state's forest resource. To accomplish these goals the transfer of information to landowners and potential investors must be improved. Presently, the opportunities for profitable investments in forest management and utilization are not clearly identifiable. Increased emphasis on extension programs for forest landowners and state government investment incentive programs for forest industry may provide some stimulus that will result in improvements in the utilization of the state's forest resource.

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GLOSSARY¹

- Above ground biomass - the green weight of wood and bark above a one foot stump of all live trees.
- Biomass - the total green weight of all component parts (including stumps, roots and foliage) of all live trees.
- Forest land - land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover and not currently developed for nonforest use.
- Timberland - forest land that is capable of producing crops of industrial wood and is not withdrawn from timber utilization.
- Other forest land - forest land that is not currently capable of producing crops of industrial wood or is withdrawn from production.
- Productive reserved - productive public forest land withdrawn from timber utilization through statute or administrative regulation.
- Productive deferred - productive public forest land withheld from timber utilization while under administrative review.
- Unproductive - forest land incapable of producing crops of industrial wood because of adverse site conditions.
- Green weight - weight of live or freshly cut trees.
- Hardwood - dicotyledonous trees, usually broad-leaved and deciduous.
- Mean annual increment - the total increment up to a given age divided by that age.
- Net annual growth - the increase in volume of growing stock trees on timberland.
- Net annual removals - the volume of growing stock trees removed from the inventory by harvesting and cultural operations.
- Private land ownership
- Forest industry - lands owned by companies or individuals operating wood using plants.
 - Farm and other private or miscellaneous private - all private ownerships except forest industry.
- Public land ownership
- County and municipal - lands owned by county and local government agencies.
 - Indian Trust - tribal lands held in fee by the Federal Government but administered for Indian tribal groups.

¹Definitions taken from Terminology of Forest Science, Technology Practice and Products, F.C. Robison, Ed., Society of American Foresters, and standard Forest Service definitions used in resource analysis reports.

- National Forest - Federal lands designated by Executive Order or statute as National Forest or purchase units, and other lands under the administration of the Forest Service.
- Other federal - Federal land other than lands administered by the Forest Service.
- Other public - publicly owned land other than National Forest land.
- State - land owned by state government agencies.
- Site class, site potential - a classification of forest land in terms of inherent capacity to grow crops of industrial wood.
- Site index - an expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at a designated age.
- Softwood - Coniferous trees, usually evergreen, having needle or scale like leaves.
- Stand - a contiguous groups of trees sufficiently uniform in species composition, arrangement of age classes, and condition to be a homogeneous and distinguishable unit, the essential unit of silviculture.
- Stem wood - wood of the stem of the tree to the terminal bud, i.e. of its main axis as distinct from the branches, stump or roots.

Appendix A

Forest Types of Oklahoma

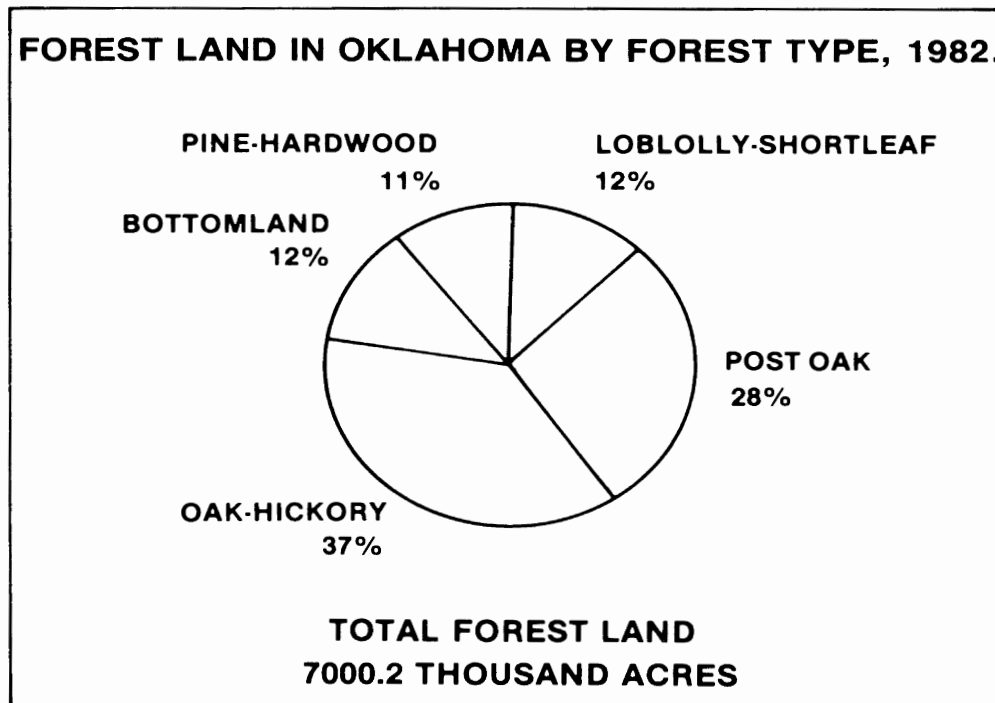
The forests of Oklahoma can be divided into four major associations: (1) the pine - mixed hardwoods of southeast Oklahoma, (2) the oak - hickory association concentrated in the northeast corner of the state, (3) the post oak - black-jack oak association, which is frequently referred to as the "Cross Timbers", stretching across the east - central part of the state from Texas to Kansas, and (4) the bottomland forest association found throughout the state, generally along the floodplains of water bodies. The basic characteristics of each of the forest types is described in the following sections. Each type contains a great deal of diversity due to site characteristics such as elevation, soil and aspect; therefore, these descriptions should be considered of a general nature.

Pine - Mixed Hardwood Association

The pine - mixed hardwood association covers 1.6 million acres of southeastern Oklahoma. It accounts for 23 percent of the total forest cover of the state (Figure A1). Although this association accounts for less than one fourth of the total forest cover, it is the most commercially significant within Oklahoma.

The pine - mixed hardwood forest association occurs in the Ouachita Mountains region of southeastern Oklahoma. The region is dominated by mixed stands of shortleaf pine (*Pinus echinata*) growing in conjunction with various

FIGURE A1.



oaks (*Quercus sp.*) and hickories (*Carya sp.*). Pure stands of shortleaf pine occur throughout the region and in the extreme southeast corner of the region naturally occurring stands of loblolly pine (*Pinus taeda*) exist. The distribution of loblolly pine in pure stands is being expanded within this region through the introduction of intensive forest management by the industrial forestry firms located there.

The climate of this region is characterized by high humidity and adequate precipitation. Annual precipitation ranges from an average of 56 inches in the southeast corner of the region to 42 inches in the northwest edge of the association range. This area is bisected by several small mountain chains and encompasses some of the most rugged topography within the state. The soils associated with this forest type are for the most part thin, low in productivity, and poorly drained (Duck and Fletcher, 1947). The ridges are frequently extremely rocky, and the lower parts of the slopes generally have a more finely textured soil.

The land in this association is typically used as woodland although a significant amount of cattle grazing is done. Due to the fertility level of the soil very little agricultural activity is undertaken. Forests of this timber type support the majority of the wood processing firms in the state, providing the raw material for production.

Most of the quality timber within this association was cut early in the century, leaving only the very poorest stems to repopulate the stands. During the past several decades the management of the timber in this area has improved dramatically. The forests of this association should increase their contribution of raw material to the wood processing firms of the state.

Oak - Hickory Association

The oak - hickory forest association is the most prevalent found in Oklahoma, where it accounts for 37 percent of the total forest cover and occupies over 2.6 million acres. This association can be found largely on the Ozark Plateau, located in the northeastern corner of the state. This forest type is also frequently found in the southeastern part of the state intermixed with the pine - mixed hardwood association.

The oak - hickory forest association is made up of various species of oaks and hickories including red oak (*Q. rubra*), white oak (*Q. alba*), black oak (*Q. velutina*), post oak (*Q. stellata*), pin oak (*Q. palustris*), blackjack oak (*Q. marilandica*), pignut hickory (*C. glabra*), black hickory (*C. texana*), bitternut hickory (*C. cordiformis*) and others.

The topography of this association is characterized by mountainous relief, as the Ozark Plateau is deeply dissected. The climate is characterized by high humidity and well dispersed precipitation. The annual rainfall varies across the association from 44 to 38 inches.

This area is heavily timbered. Although there are a significant number of small farms, the rugged topography of this type limits its agricultural uses.

Post Oak - Blackjack Oak Association

The post oak - blackjack oak forest association, which is estimated to once have covered 11.3 million acres in Oklahoma, now occupies only 2.0 million

acres and accounts for 29 percent of the state's forestland. This association stretches south to north, in a belt that lies to the west of the heavily timbered portion of the state, from Texas to Kansas. The so called "Cross Timbers", known by the early settlers as an area which was very difficult to pass through, occupies long, narrow, irregular belts where sandy or alluvial deposits overlies the limestone of the prairie region (Foreman, 1947).

The forests of this association are frequently open and scrublike with post oak, blackjack oak and black hickory dominating the overstory. The percent of blackjack oak in the stands increases as one moves toward the western extent of the association (Duck and Fletcher, 1945). The forests of this type are frequently interspersed with prairies (Foreman, 1947).

The climate of this association is drier than the previous types discussed. It is subhumid, with the average annual rainfall varying from 42 inches in the east to 26 inches in the west. The majority of the association receives 32 to 40 inches of rainfall yearly. The region is composed of rolling hills which have been made considerably rough by weathering processes (Blair and Hubbell, 1938). The soils of this association are generally coarse textured and relatively poor.

The land in this association is frequently converted to agricultural uses such as row crops or pasture. The conversion to pasture has increased dramatically with the development of herbicides, significantly reducing the cost of conversion. This helps account for the steep decline in the amount of land that is covered by this forest association.

Bottomland Association

Bottomland or floodplain forest comprises 12 percent (835 thousand acres) of the total forest cover of the state. The forests, similar to the post oak - blackjack oak association discussed previously, have been impacted significantly by developmental pressures. The increased demand for water has led to a greater use of impoundments, resulting in the flooding of a large portion of the forests of this type. Also, as a result of the fertility of many bottomlands, this land is often the first to be cleared for agriculture.

The bottomland forests extend from the low, humid coastal plain region of eastern Oklahoma to the high, semi-arid region found in the panhandle. In some western portions of the state the only forest type vegetation occurs along the rivers that have nearly continuous flow (Bruner, 1931). As a result of the widespread distribution of this association there is not a single species association. In the west there are scattered growths of willow species (*Salix sp.*) and cottonwood (*Populus deltoides*). Mixtures of elms (*Ulmus sp.*) and oaks occur as one proceeds eastward. Black oak, pecan (*Carya illinoensis*), sycamore (*Platanus occidentalis*) and black walnut (*Juglans nigra*) become more common to the south and east. In the southeast corner of the state forests of baldcypress (*Taxodium distichum*), blackgum (*Nyssa sylvatica*) and sweetgum (*Liquidambar styraciflua*) occur.

The bottomland association usually exists in narrow strips that follow stream courses. The number of species and growth rate of the vegetation within this type increase from west to east due to the increasingly mesic environment.

Appendix B

Computational Procedures

Forest Land

Land area of the state and its breakdown by land class and ownership is based on information obtained from U.S. Forest Service, Forest Inventory and Analysis Unit, Starkville, MS; the National Resource Inventory for Oklahoma, 1984 prepared by the Soil Conservation Service and East Oklahoma Forests, Trends and Outlooks (Murphy, 1977). Supplemental information was obtained from the following: Real Property Owned by the United States Government (General Services Administration); Public Land Statistics (Bureau of Land Management, 1984); The Sunday Oklahoman (Feb. 18, 1979); and by personal communication with the staff of the Ouachita National Forest.

Forest land area trends information was obtained by interpolation of data from the national forest resource summaries published in 1982, 1974, 1965, 1953 (U.S. Forest Service, 1953, 1965, 1974 and 1982) and from forest resource bulletins published in 1984, 1977, 1968, and 1957 (Thomas, 1984; Murphy, 1977; Sternitzke and Van Sickle, 1968; and U.S. Forest Service, 1957).

The distribution of area by site index class on timberland is based on site class productivity by forest type class tables produced for this project by the U.S. Forest Service, Forest Inventory and Analysis Unit, Starkville, MS. The productivity classes were equated to site index class using tables for shortleaf pine average yearly growth per acre in cubic feet (U.S. Forest Service, 1929) for softwoods and oak mean annual growth per acre in cubic feet (Schnur, 1937) for hardwoods. The totals for hardwoods and softwoods were combined for use in this report. The site class for other forest land was estimated as the mid-point between 0 and 40 feet (the lowest productive forest site class). Field sampling of site trees on 14 sample sites within the unproductive forest region was used to verify this estimate.

Inventory

The timberland biomass totals are based on county level biomass information compiled by Dr. Charles Thomas of the Forest Inventory and Analysis Unit of the Southern Forest Experiment Station, U.S. Forest Service, Starkville, MS. The county level data was divided into softwood and hardwood forest types. The separate totals were increased at this point by 22 percent for softwoods and 25 percent for hardwoods to account for the weight of foliage, stumps and roots (Koch 1972, 1984). The biomass totals were then divided into component parts by using information from the following chart.

Percentage of total tree by component parts by forest type.

Components	Hardwood (percent)	Softwood (percent)
Stump and roots	21	15
Foliage	4	3
Bark	8	7
Branches	14	14
Stem wood	53	61

The softwood and hardwood totals by county were then allocated to ownership groups based on the percentage of total growing stock represented by each ownership group by the individual county. Total biomass on forest industry lands was adjusted to account for the biomass on pine plantations. Timberland growing stock totals were obtained from a report on the Oklahoma forest resource (Murphy, 1977).

Other forest land biomass information was obtained by using estimates of total biomass from several sample sites then expanding these estimates by the total amount of unproductive forest land to reach a total estimate. Sample sites were selected on a nonrandom basis to cover the range of site conditions found in the unproductive forest region. Fourteen sample sites were chosen with the assistance of Norman Smola, Soil Conservation Service State Staff Forester, Stillwater, OK. Each site was sampled using a variable radius plot method. Each sample tree was measured for total tree height and diameter. The number of plots per site was based on the size of the individual site. The field data was summarized and the summaries processed by the Forest Science Laboratory, Athens, GA, using the Total-Tree Multiproduct Cruise Program (Clark et al., 1985).

Using the results of the cruise program a regression equation was developed to relate total biomass to basal area per acre. The following equation was developed:

$$\text{Log (Tons/Acre)} = .76761 + .01172 (\text{Basal Area per acre})$$
$$\text{R-Squared} = .93458$$

The range of the data for the model was 26 square feet of basal area to 81 square feet. The predicted total biomass per basal area per acre estimates were then multiplied by the number of acres in each basal area per acre class. The number of acres in each basal area per acre class were supplied by the Iowa State Statistical Laboratory, Ames, IA, using data collected for the National Resource Inventory of Oklahoma conducted by the U.S.D.A.-Soil Conservation Service, Stillwater, OK. The biomass totals were then increased by 25 percent to account for stumps, roots and foliage. The adjusted total biomass were then broken down using information from the following chart based on studies of scrub oak and hickory species (Tennessee Valley Authority, 1972, 1978).

Percentage of total tree by component parts on noncommercial forest land.

Component	Percent
Stump and Roots	21
Foliage	4
Bark	11
Branches	22
Stem wood	42

The component totals were then allocated to landownership groups based on the percentage of the total unproductive forest land owned in each group. The total biomass of unproductive forest land was adjusted upward to account for biomass in productive deferred and productive classifications.

Net annual growth and removals of biomass were estimated by developing a relationship between total volume on timberland and total biomass. This relationship of tons per cubic foot was multiplied by total cubic feet of growth and removals (Murphy, 1977). The totals were allocated to component parts in the same ratios as used for timberland biomass.

Appendix C

Oklahoma Forest Resource Tables

TABLE C 1: Land area of Oklahoma by ownership and land class, 1982.

Ownership Class	Total Land Area	Percent of Total Land Area	Forest Land					
			Total	Timber-land	Other			
					Prod Res*	Prod Def*	Unpro-ductive	
(THOUSAND ACRES)								
<i>Public</i>								
<i>Federal</i>								
National Forest	294.3	1	241.1	192.0	49.1	20.5	26.4	2.2
Other Federal	<u>1454.6</u>	<u>3</u>	<u>222.4</u>	<u>140.2</u>	<u>82.2</u>	<u>3.2</u>	<u>0.0</u>	<u>79.0</u>
<i>Total Federal</i>	1748.9	4	463.5	332.2	131.3	23.7	26.4	81.2
<i>Indian Trust Lands</i>								
State	1214.7	3	117.1	114.6	2.5	0.0	0.0	2.5
County & Municipal	1325.2	3	213.7	111.4	102.3	28.7	0.0	73.6
	<u>136.6</u>	<u>a</u>	<u>41.8</u>	<u>18.7</u>	<u>23.1</u>	<u>.5</u>	<u>0.0</u>	<u>22.6</u>
<i>Total Public</i>	4425.4	10	836.1	576.9	259.2	52.9	26.4	179.9
<i>Private</i>								
Forest Industry	991.4	2	991.4	991.4	0.0	0.0	0.0	0.0
Farm & Other	<u>38506.3</u>	<u>88</u>	<u>5174.7</u>	<u>3137.9</u>	<u>2036.8</u>	<u>0.0</u>	<u>0.0</u>	<u>2036.8</u>
<i>Total Private</i>	39497.7	90	6166.1	4129.3	2036.8	0.0	0.0	2036.8
<i>Total All Ownerships</i>	43923.1	100	7002.2	4706.2	2296.0	52.9	26.4	2216.7
<i>Percent of Total Land Area</i>								
	100		16	11	5	a	a	5

*Productive Reserved
 Productive Deferred
 a - less than 1 percent

TABLE C 2: Land area of Oklahoma by year and land class

Year	Forest Land								
	Total Land Area	Total	Total Forest Land as a Percent of 1982 Total Forest Land	Timberland ⁽¹⁾	Total Timberland as a Percent of 1982 Total Timberland	Other Forest Land			
						Total	Pro-ductive Reserved	Pro-ductive Deferred	Unpro-ductive ⁽²⁾
1956 (Thousand Acres) (percent total land area)	44161.4 100	10154.7 23	145	5632.1 13	131	4522.6 10	35.8 a	0.0	4486.8 10
1966 (Thousand Acres) (percent total land area)	44071.9 100	9574.0 22	137	4817.4 11	112	4756.6 11	34.3 a	0.0	4722.3 11
1976 (Thousand Acres) (percent total land area)	43972.1 100	8631.1 20	123	4323.2 10	101	4307.9 10	32.4 a	0.0	4275.5 10
1982 (Thousand Acres) (percent total land area)	43923.1 100	7002.2 16	100	4296.7 10	100	2705.5 6	52.9 a	26.4 a	2626.2 6

a/ less than 1 percent

(1) Timberland estimates include data only from eastern Oklahoma.

(2) Includes some productive timberland from outside eastern Oklahoma.

TABLE C 3: Total forest land in Oklahoma by ownership and site class, 1982.^(a)

Ownership Class	Site Index Class 50 Yr.				Total	Percent of Total, All Owners
	Height (Feet)					
	80	65	50	20		
(THOUSAND ACRES)						
<i>Public</i>						
National Forest	6.2	52.9	179.9	2.2	241.2	3
Other Public	<u>5.8</u>	<u>144.5</u>	<u>266.9</u>	<u>177.8</u>	<u>595.0</u>	<u>9</u>
<i>Total Public</i>	12.0	197.4	446.8	180.0	836.2	12
<i>Private</i>						
Forest Industry	10.9	118.4	862.1	0.0	991.4	14
Farm & Other Private	<u>19.8</u>	<u>634.6</u>	<u>2483.7</u>	<u>2036.5</u>	<u>5174.6</u>	<u>74</u>
<i>Total Private</i>	30.7	753.0	3345.8	2036.5	6166.0	88
<i>Total All Ownerships</i>	42.7	950.4	3792.6	2216.5	7002.2	100
<i>Percent of Total, All Ownerships</i>	1	13	54	32	100	

(a) Acres of less than 25 thousand acres are based on a very small number of sample locations.

TABLE C 4: Timberland in Oklahoma by ownership and site class, 1982.^(a)

Ownership Class	Site Index Class 50 Yr.				Total	Percent of Total, All Owners
	Height (Feet)					
	80	65	50	20		
(THOUSAND ACRES)						
<i>Public</i>						
National Forest	6.2	34.1	151.7	0.0	192.0	4
Other Public	<u>5.8</u>	<u>126.7</u>	<u>252.3</u>	<u>0.0</u>	<u>384.8</u>	<u>8</u>
<i>Total Public</i>	12.0	160.8	404.0	0.0	576.8	12
<i>Private</i>						
Forest Industry	10.9	118.4	862.1	0.0	991.4	21
Farm & Other Private	<u>19.8</u>	<u>634.6</u>	<u>2483.7</u>	<u>0.0</u>	<u>3138.1</u>	<u>67</u>
<i>Total Private</i>	30.7	753.0	3345.8	0.0	4129.5	88
<i>Total All Ownerships</i>	42.7	913.8	3749.8	0.0	4706.3	100
<i>Percent of Total, All Ownerships</i>	1	19	80	0	100.0	

(a) Acres of less than 25 thousand acres are based on a very small number of sample locations.

TABLE C 5: Other forest land in Oklahoma by ownership and site class, 1982.^(b)

Ownership Class	Site Index Class 50 Yr.				Total	Percent of Total, All Owners
	Height (Feet)					
	80	65	50	20		
(THOUSAND ACRES)						
<i>Public</i>						
National Forest	0.0	18.8	28.2	2.2	49.2	2
Other Public	0.0	17.8	14.6	177.8	21.2	9
<i>Total Public</i>	0.0	36.6	42.8	180.0	259.4	11
<i>Private</i>						
Forest Industry	0.0	0.0	0.0	0.0	0.0	0
Farm & Other Private	0.0	0.0	0.0	2036.5	2036.5	89
<i>Total Private</i>	0.0	0.0	0.0	2036.5	2036.5	89
<i>Total All Ownerships</i>	0.0	36.6	42.8	2216.5	2295.9	100
<i>Percent of Total, All Ownerships</i>	0	1	2	97	100	

(a) Less than 1 percent

(b) Acres of less than 25 thousand acres are based on a very small number of sample locations.

TABLE C 6: Productive reserved forest land in Oklahoma by ownership and site class, 1982.^(a)

Ownership Class	Site Index Class 50 Yr.				Total	Percent of Total, All Owners
	Height (Feet)					
	80	65	50	20		
(THOUSAND ACRES)						
<i>Public</i>						
National Forest	0.0	11.4	9.1	0.0	20.5	39
Other Public	0.0	17.8	14.6	0.0	32.4	61
<i>Total Public</i>	0.0	29.2	23.7	0.0	52.9	100
<i>Private</i>						
Forest Industry	0.0	0.0	0.0	0.0	0.0	0.0
Farm & Other Private	0.0	0.0	0.0	0.0	0.0	0.0
<i>Total Private</i>	0.0	0.0	0.0	0.0	0.0	0.0
<i>Total All Ownerships</i>	0.0	29.2	23.7	0.0	52.9	100
<i>Percent of Total, All Ownerships</i>	0	55	45	0	100	

(a) Acres of less than 25 thousand acres are based on a very small number of sample locations.

TABLE C 7: Productive deferred forest land in Oklahoma by ownership and site class, 1982. (a)

Ownership Class	Site Index Class 50 Yr.				Total	Percent of Total, All Owners
	Height (feet)					
	80	65	50	20		
(THOUSAND ACRES)						
<i>Public</i>						
National Forest	0.0	7.4	19.0	0.0	26.4	100
Other Public	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0</u>
<i>Total Public</i>	0.0	7.4	19.0	0.0	26.4	100
<i>Private</i>						
Forest Industry	0.0	0.0	0.0	0.0	0.0	0
Farm & Other Private	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0</u>
<i>Total Private</i>	0.0	0.0	0.0	0.0	0.0	0
Total All Ownerships	0.0	7.4	19.0	0.0	26.4	100
<i>Percent of Total, All Ownerships</i>	0	28	72	0	100	

(a) Areas of less than 25 thousand acres are based on a very small number of sample locations

TABLE C 8: Unproductive forest land in Oklahoma by ownership and site class, 1982. (a)

Ownership Class	Site Index Class 50 Yr.				Total	Percent of Total, All Owners
	80	65	50	20		
Height (feet)						
(THOUSAND ACRES)						
<i>Public</i>						
National Forest	0.0	0.0	0.0	2.2	2.2	b
Other Public	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>177.8</u>	<u>177.8</u>	<u>8</u>
<i>Total Public</i>	0.0	0.0	0.0	180.0	180.0	8
<i>Private</i>						
Forest Industry	0.0	0.0	0.0	0.0	0.0	0
Farm & Other Private	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>2036.5</u>	<u>2036.5</u>	<u>92</u>
<i>Total Private</i>	0.0	0.0	0.0	2036.5	2036.5	92
<i>Total All Ownerships</i>	0.0	0.0	0.0	2216.5	2216.5	100
<i>Percent of Total, All Ownerships</i>	0	0	0	100	100	

(a) Areas of less than 25 thousand acres are based on a very small number of sample locations
 (b) less than 1 percent

TABLE C 9: Mean site class in Oklahoma by ownership, 1982.

Ownership Class	Total Forest Land	Timberland
	(HEIGHT IN FEET AT AGE 50)	
<i>Public</i>		
Federal		
National Forest	54	54
Other Public	<u>45</u>	<u>55</u>
<i>Total Public</i>	48	55
<i>Private</i>		
Forest Industry	52	52
Farm & Other Private	<u>40</u>	<u>52</u>
<i>Total Private</i>	42	52
<i>Total All Ownerships</i>	43	53

TABLE C 10: Growing stock volume and biomass estimates for forest land in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							Roots and Stump	Percent Total Biomass
		Total	Stem Wood	Fuel and Fiber						
				Total	Bark	Branchwood	Foliage			
	(MILLION CUBIC FEET)	(THOUSAND TONS)								
<i>Public</i>										
National Forest	222.6	17941	10249	7692	1367	2439	656	3230	5	
Other Public	280.7	27496	14031	13465	2493	4630	1100	5242	8	
<i>Total Public</i>	503.3	45437	24280	21157	3860	7069	1756	8472	13	
<i>Private</i>										
Forest Industry	727.9	81934	46118	35816	6116	12216	2956	14528	23	
Farm & Other Private	2171.1	230897	116420	114477	21232	39687	9236	44322	64	
<i>Total Private</i>	2899.0	312831	162538	150293	27348	51903	12192	58850	87	
<i>Total All Ownerships</i>	3402.3	358268	186818	171450	31208	58972	13948	67322	100	
<i>Percent Total Biomass</i>		100	52	48	9	16	4	19		

TABLE C 11: Growing stock volume and biomass estimates for timberland in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							Roots and Stump	Percent Total Biomass
		Fuel and Fiber					Foliage			
		Total	Stem Wood	Total	Bark	Branchwood				
	(MILLION CUBIC FEET)	(THOUSAND TONS)								
<i>Public</i>										
National Forest	169.6	13775	7887	5888	1045	1863	503	2477	6	
Other Public	166.1	17732	9930	7802	1419	2482	709	3192	7	
<i>Total Public</i>	335.7	31507	17817	13690	2464	4345	1212	5669	13	
<i>Private</i>										
Forest Industry	727.9	81934	46118	35816	6116	12216	2956	14528	32	
Farm & Other Private	1117.1	138878	77772	61106	11110	19443	5555	24998	55	
<i>Total Private</i>	1845.0	220812	123890	96922	17226	31659	8511	39526	87	
<i>Total All Ownerships</i>	2180.7	252319	141707	110612	19690	36004	9723	45195	100	
<i>Percent Total Biomass</i>		100	56	44	8	14	4	18		

TABLE C 12: Growing stock volume and biomass estimates for other forest land in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							Percent Total Biomass
		Fuel and Fiber						Roots and Stump	
		Total	Stem Wood	Total	Bark	Branchwood	Foliage		
(MILLION CUBIC FEET)	(THOUSAND TONS)								
<i>Public</i>									
National Forest	53.0	4165	2362	1803	322	576	153	752	4
Other Public	114.6	9764	4101	5663	1074	2148	391	2050	9
<i>Total Public</i>	167.6	13929	6463	7466	1396	2724	544	2802	13
<i>Private</i>									
Forest Industry	0.0	0	0	0	0	0	0	0	0
Farm & Other Private	1054.0	92019	38648	53371	10122	20244	3681	19324	87
<i>Total Private</i>	1054.0	92019	38648	53371	10122	20244	3681	19324	87
<i>Total All Ownerships</i>	1221.6	105948	45111	60837	11518	22968	4225	22126	100
<i>Percent Total Biomass</i>		100	42	58	11	22	4	21	

TABLE C 13: Growing stock volume and biomass estimates productive reserved forest land in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							
		Fuel and Fiber						Roots and Stump	Percent Total Biomass
		Total	Stem Wood	Total	Bark	Branchwood	Foliage		
(MILLION CUBIC FEET)	(THOUSAND TONS)								
<i>Public</i>									
National Forest	17.7	1435	821	614	109	194	53	258	49
Other Public	<u>14.1</u>	<u>1509</u>	<u>842</u>	<u>667</u>	<u>117</u>	<u>208</u>	<u>56</u>	<u>286</u>	<u>51</u>
<i>Total Public</i>	31.8	2944	1663	1281	226	402	109	544	100
<i>Private</i>									
Forest Industry	0.0	0	0	0	0	0	0	0	0
Farm & Other Private	<u>0.0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
<i>Total Private</i>	0.0	0	0	0	0	0	0	0	0
<i>Total All Ownerships</i>	31.8	2944	1663	1281	226	402	109	544	100
<i>Percent Total Biomass</i>		100	56	44	8	14	4	18	

TABLE C 14: Growing stock volume and biomass estimates for productive deferred forest land in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							Percent Total Biomass
		Total	Stem Wood	Fuel and Fiber				Roots and Stump	
				Total	Bark	Branchwood	Foliage		
	(MILLION CUBIC FEET)	(THOUSAND TONS)							
<i>Public</i>									
National Forest	31.8	2582	1479	1103	196	349	95	463	100
Other Public	0.0	0	0	0	0	0	0	0	0
<i>Total Public</i>	31.8	2582	1479	1103	196	349	95	463	100
<i>Private</i>									
Forest Industry	0.0	0	0	0	0	0	0	0	0
Farm & Other Private	0.0	0	0	0	0	0	0	0	0
<i>Total Private</i>	0.0	0	0	0	0	0	0	0	0
<i>Total All Ownerships</i>	31.8	2582	1479	1103	196	349	95	463	100
<i>Percent Total Biomass</i>		100	57	43	8	13	4	18	

TABLE C 15: Growing stock volume and biomass estimates for unproductive forest land in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							Percent Total Biomass
		Total	Stem Wood	Fuel and Fiber				Roots and Stump	
				Total	Bark	Branchwood	Foliage		
	(MILLION CUBIC FEET)	(THOUSAND TONS)							
<i>Public</i>									
National Forest	3.5	148	62	86	17	33	5	31	a
Other Public	100.5	8255	3259	4996	957	1940	335	1764	8
<i>Total Public</i>	103.5	8403	3321	5082	974	1973	340	1795	8
<i>Private</i>									
Forest Industry	0.0	0	0	0	0	0	0	0	0
Farm & Other Private	1054.0	92019	38648	53371	10122	20244	3681	19324	92
<i>Total Private</i>	1054.0	92019	38648	53371	10122	20244	3681	19324	92
<i>Total All Ownerships</i>	1157.5	100422	41969	58453	11096	22217	4021	21119	100
<i>Percent Total Biomass</i>		100	42	58	11	22	4	21	

(a) less than 1 percent

TABLE C 16: Annual growth of growing stock equivalent and biomass estimates for timberland in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							
		Fuel and Fiber						Roots and Stump	Percent Total Biomass
		Total	Stem Wood	Total	Bark	Branchwood	Foliage		
(MILLION CUBIC FEET)	(THOUSAND TONS)								
<i>Public</i>									
National Forest	9.9	1101	655	446	80	146	36	184	8
Other Public	9.8	1143	640	503	87	156	43	217	8
<i>Total Public</i>	19.7	2244	1295	949	167	302	79	401	16
<i>Private</i>									
Forest Industry	39.6	4568	2578	1990	334	670	183	803	31
Farm & Other Private	66.5	7654	4311	3343	582	1028	284	1449	53
<i>Total Private</i>	106.1	12222	6889	5333	916	1698	467	2252	84
<i>Total All Ownerships</i>	125.8	14466	8184	6282	1083	2000	546	2653	100
<i>Percent Total Biomass</i>		100	57	43	7	14	4	18	

TABLE C 17: Annual removals of growing stock equivalent and biomass estimates for timberland in Oklahoma, 1976.

Ownership Class	Growing Stock Volume	Biomass - Green Weight							Roots and Stump	Percent Total Biomass
		Fuel and Fiber					Foliage			
		Total	Stem Wood	Total	Bark	Branchwood				
	(MILLION CUBIC FEET)	(THOUSAND TONS)								
<i>Public</i>										
National Forest	5.3	612	372	240	44	80	19	97	7	
Other Public	4.4	501	271	230	39	70	20	101	6	
<i>Total Public</i>	9.7	1113	643	470	83	150	39	198	13	
<i>Private</i>										
Forest Industry	39.6	4568	2627	1941	325	681	182	753	52	
Farm & Other Private	26.9	3101	1748	1353	236	416	115	586	35	
<i>Total Private</i>	66.5	7669	4375	3294	561	1097	297	1339	87	
<i>Total All Ownerships</i>	76.2	8782	5018	3764	644	1247	336	1537	100	
<i>Percent Total Biomass</i>		100	57	43	7	14	4	18		

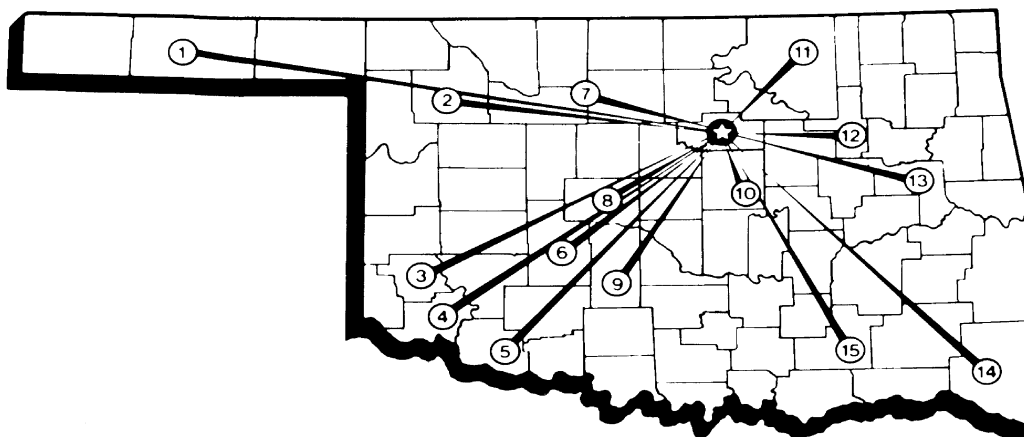
Appendix D⁽¹⁾

English - Metric Conversions

1 Acre	= 0.4047 Hectare
1 Cubic Foot	= 0.0283 Cubic Meter
1 Ton	= 0.9072 Metric Ton

(1) A complete set of the tables with data converted to metric are available upon request.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION System Covers the State



- * Main Station—*Stillwater, Perkins and Lake Carl Blackwell*
- 1. Panhandle Research Station — *Goodwell*
- 2. Southern Great Plains Field Station — *Woodward*
- 3. Sandyland Research Station — *Mangum*
- 4. Irrigation Research Station — *Altus*
- 5. Southwest Agronomy Research Station — *Tipton*
- 6. Caddo Research Station — *Ft. Cobb*
- 7. North Central Research Station — *Lahoma*
- 8. Southwestern Livestock and Forage Research Station — *El Reno*
- 9. South Central Research Station — *Chickasha*
- 10. Pecan Research Station — *Sparks*
- 11. Pawhuska Research Station — *Pawhuska*
- 12. Vegetable Research Station — *Bixby*
- 13. Eastern Research Station — *Haskell*
- 14. Kiamichi Field Station — *Idabel*
- 15. Southeastern Oklahoma Agricultural Research and Extension Center — *Lane*