FORESTRY RESOURCE PLANNING OF THE MISSOURI OZARKS

by

CLARK WILLIAM ODOR

B.S., Central Missouri State University, 1974
B.S., Central Missouri State University, 1975

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

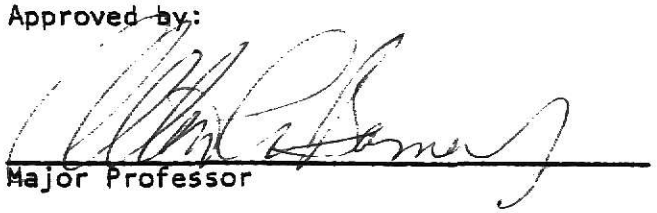
MASTER OF REGIONAL AND COMMUNITY PLANNING

Department of Regional and Community Planning

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1982

Approved by:



Major Professor

CONTENTS

LIST OF MAPS AND GRAPHS

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to acknowledge some of the many individuals whose assistance was greatly appreciated in the completion of this masters report. My committee, consisting of Mr. Alton Barnes (chairman), Dr. Wayne Geyer, and Dr. John Keller were instrumental in their guidance and limitless in their patience while working through the problems which arose during the study.

Technical information was obtained from reports and interviews with Dr. William Kurtz, Mr. Jeff Marsh, and Ms. Trude Foutch. Additional USDA Forest Service and State of Missouri Conservation Commission data were obtained from foresters Mr. Eldon Heflin and Mr. Gene Grey.

The editor of this report, Mr. Alan Gray, also helped reorganize the sequence of chapters which greatly helped the flow of the problem solving program. Mr. Richard Robinson was the draftsman and Ms. Janis MacGregor and Mrs. Donna Boles were the typists.

1

INTRODUCTION

Chapter 1

INTRODUCTION

The annual removal of trees in Missouri amounted to 168 million cubic feet in 1971 and the annual growth was 177 million cubic feet. But by the year 2002, removals are projected to be as high as 197 million cubic feet with a slight reduction in growing stock (7). With removals outnumbering the growing stock, the available forest resource will be rapidly depleted. According to the United States Department of Agriculture (USDA), the two major reasons for the predicted decline in growing stock are the conversion of forest land to pasture or other uses and the lack of improvement measures to existing forest land after commercially valuable trees have been removed.

Most of the forest land being converted to pasture or other uses is owned by farmers. Although farmers typically own small woodlots, these individuals cumulatively own over sixty percent of all forest land in Missouri. The woodlot owner is under economic pressure to convert to grassland to receive a quicker return on land investment. There is a great time lag, as much as 80 years depending on the species, between the established investment of planting young trees, the optimum harvest date, and the subsequent return on investment.

Statement of Direction

This research examined a twenty-seven county region in the Missouri Ozarks previously investigated in a 1976 study by Marsh and Kurtz of the University of Missouri (20). The economy of the study area is directly influenced by national demand for forest products extracted locally by wood-using industries. With this understanding, current and future rates of sawtimber growth and removals in the study area were estimated utilizing available USDA data and information from the University of Missouri study to determine whether the region may experience a forestry resource deficit problem in coming years.

Once the nature of the potential resource deficit problem was established, goals and objectives were developed for future forestry resource management planning in the study area. After a statistical analysis of independent variables which may affect lumber production levels was accomplished, different resource management scenarios were derived. These resource management scenarios each emphasized certain management objectives, and quantitative projections of how each alternative management scenario would influence the level of future lumber production in the study area were developed.

After development of alternative management scenarios, existing government forest management incentive programs were reviewed. Information from a 1976 study of the Federal Forestry Incentive Program (FIP) and the Agricultural Conservation Program (ACP) by Foutch (19) was used as a point of departure for analyzing alternative government incentive programs for forest land management.

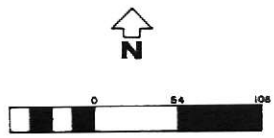
Information gained from review of the Foutch study was subsequently used in developing cost estimates for the implementation of the alternative management scenarios. After an analysis of the degree to which overall goals and strategic objectives would be attained or compromised under each scenario, one scenario was advanced as a recommended future level of forestry management for the study area. Finally, certain recommendations were developed to serve as guidance for the implementation of the preferred management program.

Definition of Study Area

This research examined the same twenty-seven county area used in a 1976 study of wood-using industries in the Missouri Ozarks, prepared by Mr. Jeff Marsh and Dr. William Kurtz of the University of Missouri Forestry Department. The study area contains approximately two-thirds of the eroded Missouri Ozarks Plateau. The study area also contains much of the commercial forest acreage in the state and forest cover as shown on the LANDSAT composite photograph (Map 1).

MAP 1

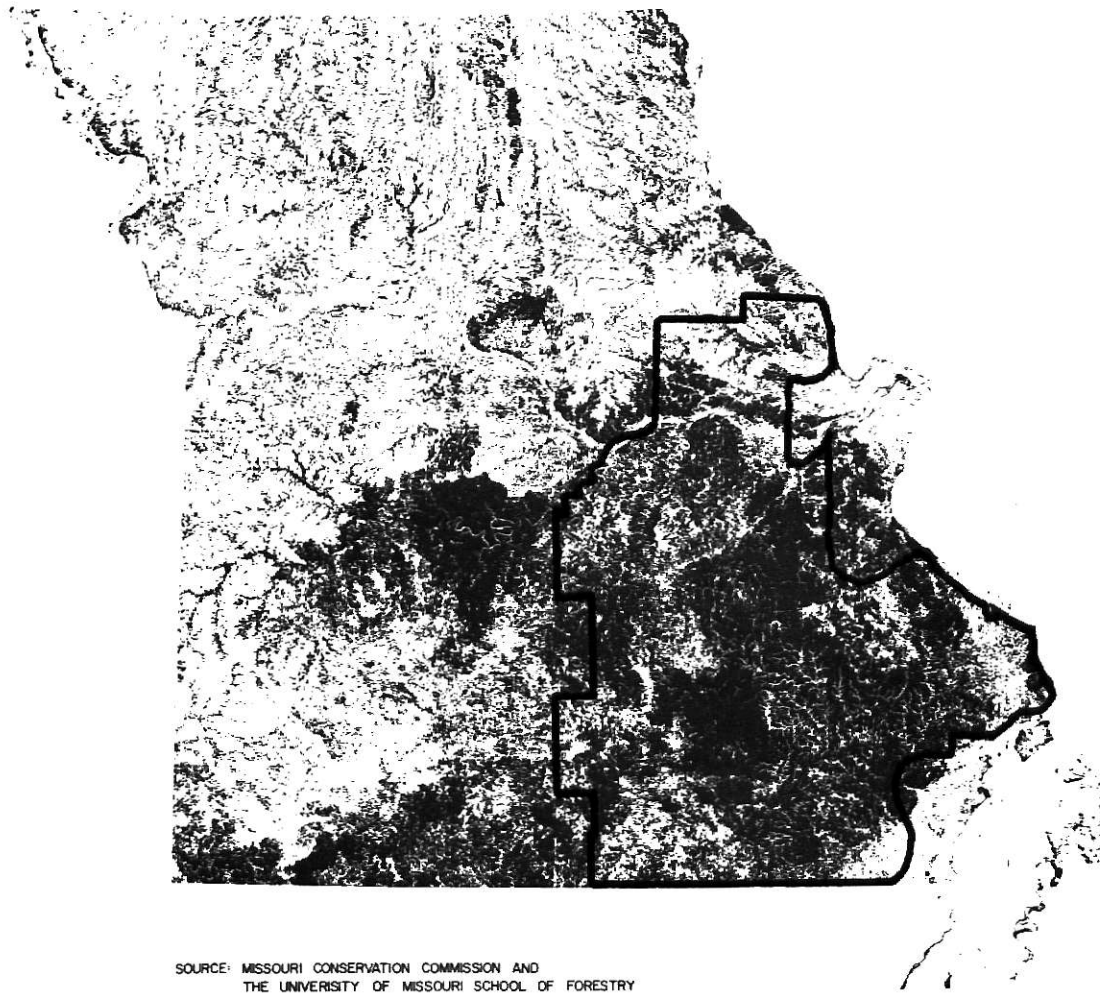
FOREST COVER OF MISSOURI



FOREST COVER

NON-FOREST COVER

TWENTY - SEVEN COUNTY
STUDY AREA BOUNDARY



SOURCE: MISSOURI CONSERVATION COMMISSION AND
THE UNIVERISITY OF MISSOURI SCHOOL OF FORESTRY

The twenty-seven county area includes fourteen counties in the Eastern Ozarks Forest Inventory Area (USDA Forest Service designation) and thirteen adjacent counties which border these fourteen on three sides. Large tracts of Federal and State owned forests comprise about one-third of the commercial forest land in the twenty-seven county area (Map 2).

Importance of Forest Resource in the State

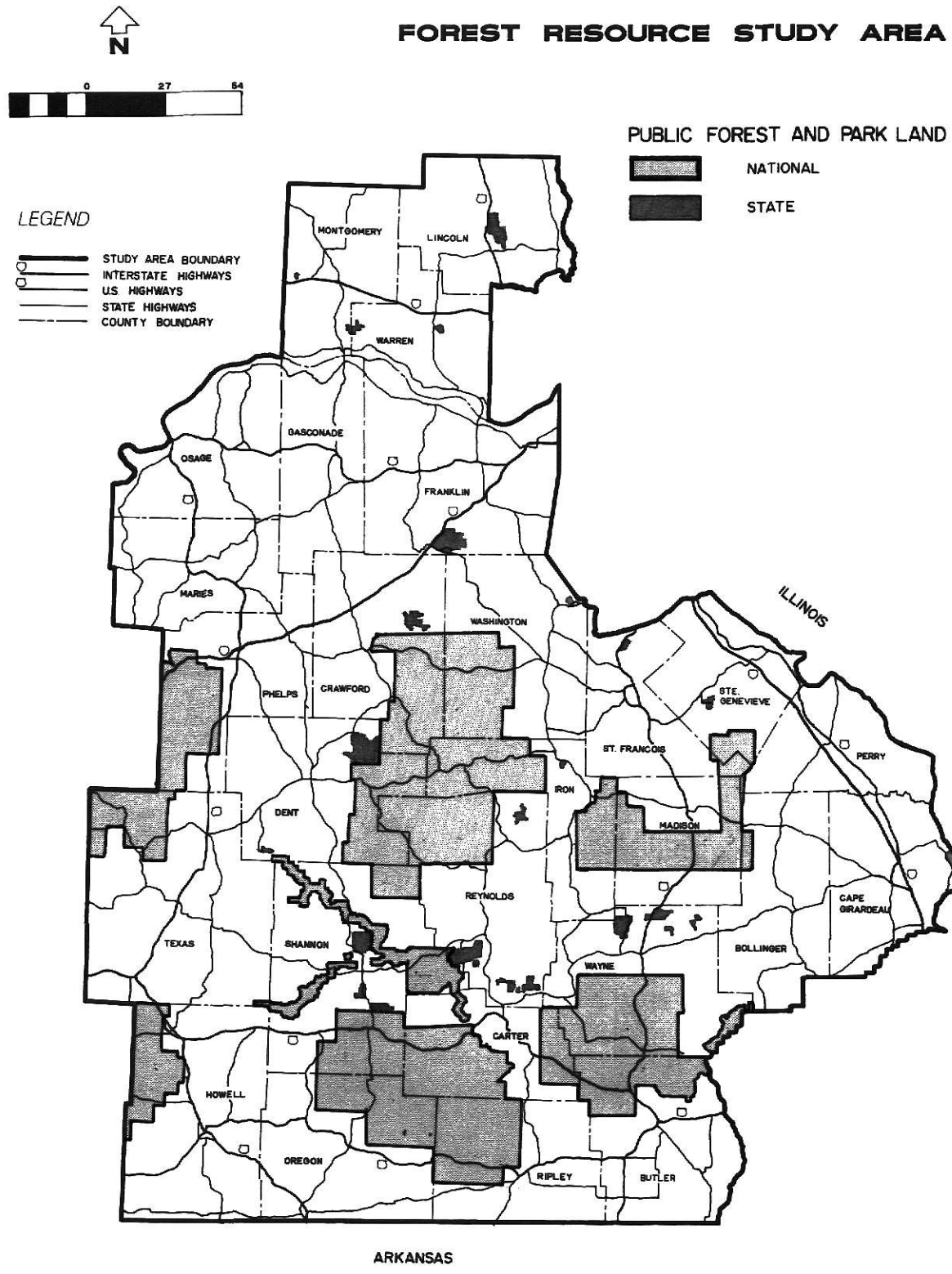
In the past, utilization of the Missouri forest resource and land development in general were governed by the desire for short-term profits. Two-thirds of the state, or thirty million acres, was once virgin forest, and there were so many trees that the early settlers thought the supply would last forever. Forests were perceived as an obstruction to agriculture. Therefore, farmers cleared fifteen million acres to grow corn and wheat and to raise cattle. The steep hills and rocky soils of the Ozark Plateau stopped the settlers from clearing the remaining fifteen million acres.

Following the farmers were the lumber and other wood-using industries. These industries came during the 1880's from Michigan and Minnesota after the northern pines were depleted. At that time, a lumber mill located at Grandin in Carter County became the largest mill in the nation, operating twenty-four hours a day. With intensive logging, the virgin forests of the Ozarks were depleted before World War I. However, trees are a renewable resource and the fifteen million acres of forest land that were not cleared for farming continued to grow new trees. This allowed smaller wood-using industries to remain in the area.

Today, Missouri has three major wood-using industry groups: lumber, cooperage (barrel making), and charcoal. Missouri leads the nation in the production of black walnut, white oak barrel staves, and charcoal (4). Other industries include veneer, pulp, wood preservatives, tool handles, and fence posts. Of the 681 large plants in 1969, 549 or 81 percent were sawmills. Much

MAP 2

FOREST RESOURCE STUDY AREA



of the lumber is used for making hardwood pallets and shipping boxes. Other lumber products include railroad ties, furniture stock, and cedar novelties (7). Map 3 shows the industry distribution in the study area. In 1969, wood-using plants employed 28,400 people, which was 6.8 percent of the total manufacturing employment in the state. These wood-using firms paid $174 million in wages and produced products worth $780 million (7).

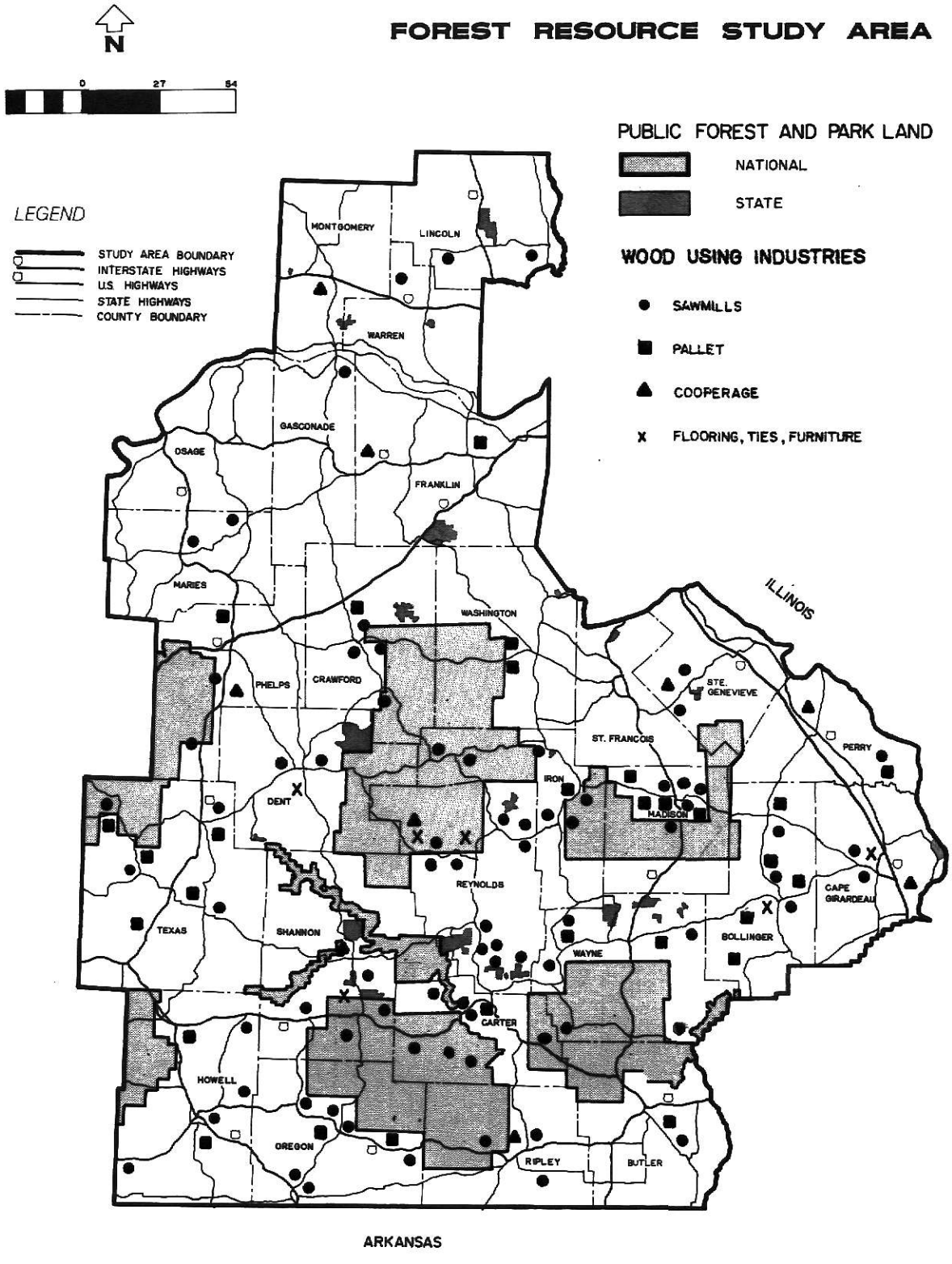
Government Agencies and Private Groups Involved in Forestry in the State

For many years government agencies concerned with forestry have been active in programs that have provided direct or indirect benefits to taxpayers. The first forest inventory of Missouri was conducted in 1947 by the USDA Forest Service. Subsequent inventories were conducted in 1959 and 1972 (7). The Missouri Conservation Commission's Forestry Department was established in 1938. At the same time the Federal government was utilizing the Civilian Conservation Corps (CCC) to accomplish tree planting and other timber improvement projects in the state. The first forestry college degree was offered in 1875 from the University of Missouri and, in 1911, the first funds for forestry research were offered at the same school (1).

Currently, the largest land owner in Missouri is the USDA Forest Service. It administers approximately 1.4 million acres in the Mark Twain National Forest, and twelve Forest Service ranger districts, established in the 1930's, are located in the Ozarks. The Forest Service has developed the Columbia Forest Research Center in Columbia, Missouri as part of the Federally funded North Central Forest Experiment Station. This station has a staff of six professionals assigned to oak-hickory forest research. The USDA also administers economic incentive programs to improve forestry. A major program is the Forestry Incentive Program (FIP), which will be discussed in the cost/benefit chapter of this report. Other Federally funded loan and cost-sharing programs are administered by the Soil Conservation Service and the Farmers Home Administration.

MAP 3

FOREST RESOURCE STUDY AREA



SOURCE: U.S.D.A. FOREST SERVICE

The National Park Service (United States Department of Interior) administers 50,000 acres of National Scenic Riverways located in the study area. These 50,000 acres are maintained in a pristine state for the enjoyment of canoeists, hikers and campers. Park Service rangers provide information and protect wildlife from poaching and fire.

Another Federal agency which controls forest land in the state is the United States Army Corps of Engineers. The Corps administers forest recreation sites around most of the large reservoirs in the state.

The Forestry Division of the Missouri Department of Conservation employs about seventy-five foresters and other professionals to administer 200,000 acres of state forest and thirteen fire protection districts. This state agency also assists private forest land owners and wood-using industries in twenty-two farm forestry districts and two urban forestry centers. Farm foresters from the Forest Division provide in-the-field forest management advice and help land owners obtain State and Federal funds for timber stand improvements. The Forestry Division also provides tree seedlings at nominal cost from the Lickling, Missouri State Nursery.

The two major private forestry concerns in the state are the wood-using industries and the private forest land owners. The industries have formed the Missouri Forest Industries Committee, which is based in Jefferson City, Missouri, to encourage better forest practices and to conduct legislative lobbying. Major lobbying issues are tax reduction, increased economic incentives for private forestry concerns, and the expansion of timber harvesting on public land. The largest private group interested in forestry is the forest land owners. There are some commercial Christmas tree and walnut plantations, but most private forest land owners are farmers with woodlots on their property.

Sources of Information

The main sources of information that have been used in this study are:

the third Forest Survey of Missouri in 1972 (USDA); "An Economic Analysis of Alternative Federal Incentive Schemes for Small Woodlot Management: Dent and Reynolds Counties, Missouri" by Mrs. T.K. Foutch of Washington University; the "Missouri Primary Wood Using Industry Study" by Mr. Jeff Marsh and Dr. William Kurtz of the University of Missouri; and direct discussions with Dr. Kurtz.

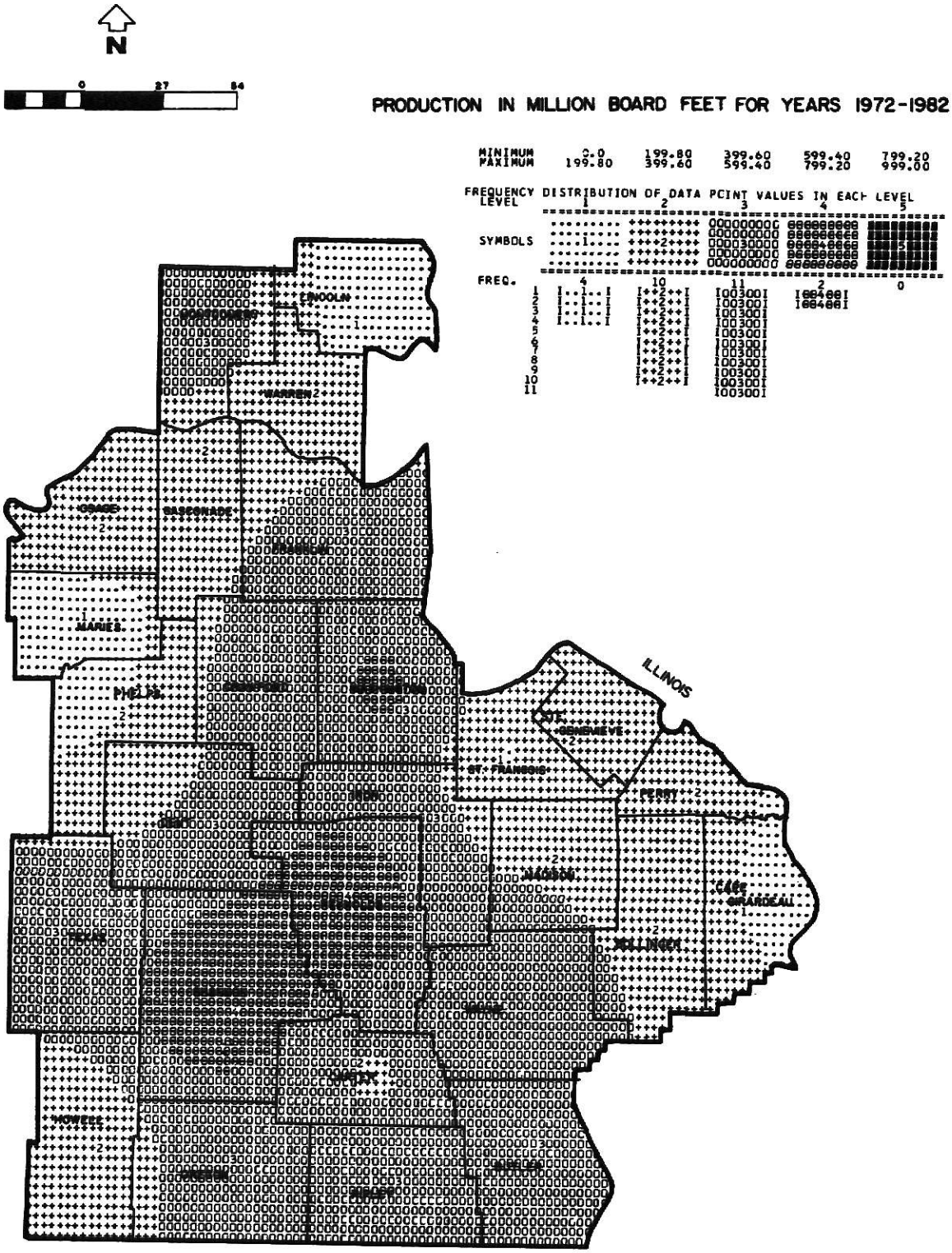
The Forest Survey of Missouri (1972) is the third forest survey accomplished by the USDA in accordance with the McSweeney-McNary Forest Research Act of 1928. Through such surveys, the USDA periodically inventories the country's forest lands to determine their extent, conditions, volumes of timber, growth, and removals. Information from the 1972 survey was used in this study to predict future supply and demand for sawtimber for each county in the study area. Map 4 is a computer graphic representation of this sawtimber data (see Appendix A).

The Foutch study is a thesis submitted to Washington University in August 1976. Ms. Foutch's objectives were to study costs and rates of return in forest management, to determine financial break-even points with Federal funding involvements, and to make recommendations to change the current USDA Forest Incentive Program and Agricultural Conservation Program allocation guidelines to meet the predicted break-even points. There were two counties surveyed in the Foutch study. One county survey (Reynolds) dealt with hardwood deciduous management and the other county survey (Dent) dealt with softwood pine trees. Information from the Foutch study is utilized in the section of this report which discusses the costs and benefits of existing Federal incentives for woodlot management.

The Missouri Primary Wood Using Industry Study was initiated in 1976 by Marsh and Kurtz of the University of Missouri. The survey requested information from individual wood-using industries concerning location, type of business, number of employees, cost of equipment, hauling distance, taxes, and capital investment. Because the information is confidential, site specific

MAP 4

BASE YEAR - SAME GROWTH RATE



SOURCE: U.S.D.A. FOREST SERVICE

data were not available for the present research. The only information available for this resource study was the number and type of industry by county, value of products by type, size of sawmills, average hauling distance to the mills, and production in million board feet for the entire study area.

Resource Planning and Comprehensive Regional Planning

The supply/demand of a resource such as wood can affect the future economic welfare of a region. If the demand for wood products increases and the local industry increases production, more jobs are created and additional demands for housing and community facilities in the region are generated. New roads may need to be built to reach previously inaccessible stands of timber. Conversely, if the demand for wood declines, or if the forest resource is depleted, new industries must be recruited and developed or people may have to leave the region to seek employment opportunities.

Forestry is an important industry in the sparsely populated twenty-seven county area identified in this study, and planning for the future management of the forest resource would be a key component of any comprehensive regional planning effort. Comprehensive planning studies the relationship of man and his environment. In a comprehensive planning process, population, land use, transportation and economic factors are inventoried and related to weather, soils, topography, natural resources, and other environmental characteristics. Predictions of future growth/decline and supply/demand are calculated. Though the present study was limited to the forestry resource, it could serve as one of the more important parts of a comprehensive regional planning study of the area.

2

SUPPLY AND DEMAND OF THE FORESTRY RESOURCE

Chapter 2

SUPPLY AND DEMAND OF THE FORESTRY RESOURCE

To understand the supply and demand for hardwood lumber produced in the Missouri Ozarks study area, one needs to be briefed on the supply and demand situation for the entire United States. Most of the study area's output is used outside of the Ozarks, and national demand largely controls the local lumber market. The supply and demand of hardwood products will be emphasized in the discussion below because most of the study area's products are made from hardwood. However, softwood will be discussed where appropriate. The national information comes from the 1973 USDA study, The Outlook for Timber in the United States (13).

According to the USDA, the nation's use of industrial wood products such as lumber, pulp, plywood, etc. increased 65 percent between the years 1942 and 1972. In this period, lumber consumption rose 25 percent, and veneer and plywood consumption rose over 438 percent. The use of fuelwood, poles and posts declined. The USDA study (13) projected that demand for hardwood sawtimber will rise from 15.0 billion board feet in 1970 to 21.3 billion board feet in the year 2000, a rise of 42 percent. These figures are repeated in Table 1, which presents a summary of timber removals, net growth, mortality, roundwood supplies, timber inventories in the 1952-70 period, and projections for 1980-2020 as developed in the USDA study (13). As shown in Table 1, the national production of hardwood sawtimber is predicted to rise from 11.2 billion board feet in 1970 to 19.5 billion board feet in the year 2000.

As Table 1 indicates, removals of all sizes and species of hardwood timber in 1970 was 23.9 percent less than net growth, and projected supplies of hardwood sawtimber should exceed predicted demand in the year 2000. Hardwood inventories in both cubic feet and board feet will continue to rise between 1970 and 2020, although at a considerably slower rate than previously (13).

TABLE 1

PROJECTED TIMBER SUPPLIES
IN THE NATION - 1970 LEVEL OF MANAGEMENT
(In Billion Board Feet)

Item	1952	1962	1970	1980	1990	2000	2020
SOFTWOODS							
Removals from sawtimber:							
Roundwood products	35.3	34.1	43.5	45.6	47.6	50.8	50.1
Logging residues	2.6	2.3	2.5	2.3	2.0	1.8	1.5
Other removals	1.3	1.3	1.7	1.5	1.6	1.6	1.6
Total:	39.2	37.7	47.7	49.4	51.2	54.2	53.2
Net growth	29.5	34.7	40.3	43.3	45.7	47.2	48.4
Mortality	11.9	11.6	11.3	10.8	10.6	10.4	10.0
Roundwood supplies:							
From sawtimber	35.3	34.1	43.5	45.6	47.6	50.8	50.1
From other stands	3.5	3.4	3.4	3.2	3.3	3.4	3.8
Total:	38.8	37.5	46.9	48.8	50.9	54.2	53.9
Inventory of sawtimber:	1978.9	1955.5	1905.3	1823.0	1777.1	1724.6	1621.9
HARDWOODS							
Removals from sawtimber:							
Roundwood products	11.3	10.0	11.2	14.4	17.1	19.5	19.4
Logging residues	.9	1.0	1.2	1.1	1.0	1.0	.8
Other removals	1.1	1.6	2.6	.7	.8	.8	.7
Total:	13.3	12.6	15.0	16.2	18.9	21.3	20.9
Net growth	15.6	17.6	19.7	20.8	21.0	20.9	20.3
Mortality	3.1	3.6	4.0	4.3	4.6	4.7	4.7
Roundwood supplies:							
From sawtimber	11.3	10.0	11.2	14.4	17.1	19.5	19.4
From other stands	.8	.8	1.1	1.1	1.1	1.1	1.1
Total:	12.1	10.8	12.3	15.5	18.2	20.6	20.5
Inventory of sawtimber:	433.1	474.8	515.5	572.8	608.3	618.8	611.6

SOURCE: U.S. Department of Agriculture Forestry Service, The Outlook for Timber in the United States, (Washington, D.C.: Government Printing Office, 1973), p. 47.

However, the majority of the growing stock is in small trees or species with a limited industrial market. The quality of the growing stock will need to be improved to meet the predicted national demand (9).

Besides a lack of quality in growing stock, another problem lies in the continuing conversion of forest land to other uses. The total amount of land in the United States classed as commercial timberland in 1970 was 500 million acres, 8.4 million acres less than in 1962 (13). Declines in commercial timberland may be attributed to shifts of public lands in National Forests in western states to reserved or deferred status for public recreation purposes. Considerable declines have also resulted from clearing of commercial timberland in southern states for crop production and pasture. In all regions, large areas of commercial timber have been converted for urban transportation, reservoirs, and other uses. Available data suggest that the long rise in commercial timberland acreage resulting from agricultural land abandonment in eastern states has been reversed. Consequently, it has been projected that commercial forest acreage in the United States will drop 5 million acres each decade during the 1970-2000 period to 485 million acres in the year 2000 (13).

Of the 500 million total acres of commercial timberland in 1970, there were 161.5 million acres of sawtimber (13). Based on available data, a reduction of one million acres every ten years is predicted for sawtimber. These data indicate that a high proportion of the commercial forest lands that will be converted for other uses in the United States are currently sawtimber acreage. With an increasing demand for sawtimber and a decreasing supply of sawtimber acreage, there will be a shortage of inventory sometime in the future. The USDA has predicted that the future increase in hardwood logging to meet rising national demand for sawtimber products will occur in eastern and north central forests, which include Missouri, with hardwood extraction in southern and western forests remaining at current levels. The increased logging anticipated for eastern and north central forests will require higher removal rates in the

Missouri Ozark study area.

Supply and Demand Outlook for the Study Area

The supply and demand situation for the forestry resource in the twenty-seven county study area was developed from the Forest Survey of Missouri 1972 (USDA) and the 1976 Marsh-Kurtz study.

According to the 1972 USDA survey, 258.9 million board feet of sawtimber is extracted in the study area each year, which is 1.7 percent of the national output. There are 6.3 million acres of commercial forest land and 1.9 million acres of sawtimber in the study area, which are 1.2 percent and 1.1 percent of the respective national totals of 500 million acres and 161.5 million acres given in the USDA study (13). These percentages indicate that the study area is currently producing in excess of its expected share of national output.

The 1976 Marsh-Kurtz study surveyed the wood-using industries in the study area and identified the type and level of production of these industries. Unfortunately, according to Dr. Kurtz, a significant number of the logs came from outside of the study area. To predict the supply and demand outlook for each county in the twenty-seven county study area, this author was required to use information from the 1972 USDA study because data by county were available from this source.

Projections of Inventory and Removals for the Study Area

The 1972 USDA survey of Missouri forests predicted low and high timber removal options for the entire state in million cubic feet for the year 1970-2002. These low and high predictions were not given by county. However, based on the fact that 53.9 percent of Missouri's total commercial forest acreage is located in the study area, it was possible to convert the USDA predictions to million board feet and derive estimates of low and high removal options for counties in the study area. The time frame utilized in the USDA survey (12) was extended to the year 2052 to incorporate the typical growth span of a

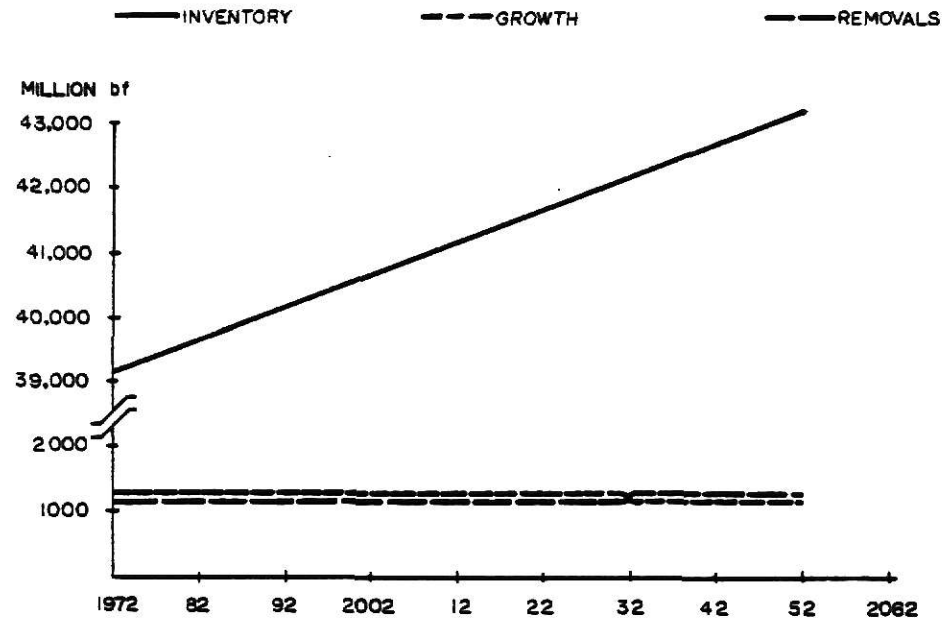
hardwood tree using, the USDA's percentage increase when available or an absolute-number extrapolation where required (see Appendix A).

Graphs 1 and 2, which show inventory and removals projections for the twenty-seven county study area, were developed from the USDA's projections (12) for the low and high removals options adjusted as noted above. Graph 1 indicates that under the low removals option, demand (removals) will increase only slightly during the period 1972-2052 while inventories increase. However, Graph 2 shows that under the high removals option, demand will increase and inventories will fall significantly.

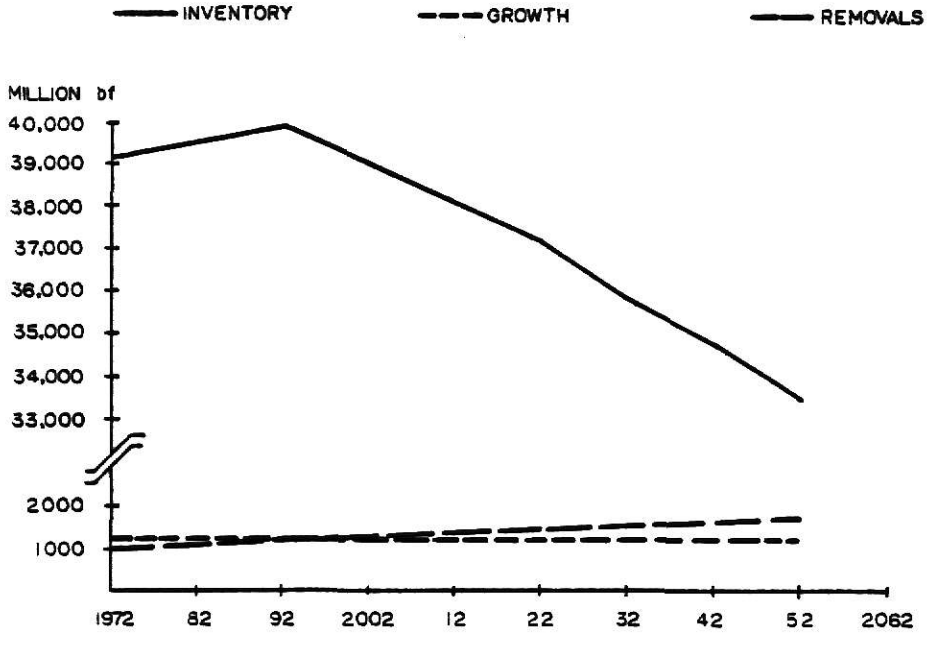
According to the national projections given by the USDA (13), the northern sector of the United States will be required to increase hardwood production by 4,800 million board feet and softwood production by 1,400 million board feet by the year 2000. Assuming that the twenty-seven county study area will attempt to maintain its current 3.81 percent share of regional output (northern sector), removals will need to be increased in the study area from 2658.0 million board feet in 1972 to 5750.0 million board feet in the year 2000 as shown in Graph 3. Graph 3 indicates that this level of increased removals would eliminate the total sawtimber inventory in the study area by the year 2002. Should this occur, removals after the year 2002 would be limited to growing stock that reaches acceptable sawtimber diameter. Under those circumstances, it is estimated that removals would be limited to 187.5 million board feet per year. Graph 3 demonstrates that if the study area were to attempt to meet these predicted levels of output, the study area would fall short and the entire inventory would be consumed.

A more moderate removal level is depicted in Graph 4. This Status Quo approach holds the 1972 base year removals and growth rates constant throughout the study period. Graph 4 shows that even at a constant rate of removals, the inventory in the study area is projected to be eliminated by the year 2084 (see Appendix A).

GRAPH 1 STATE LOW REMOVALS



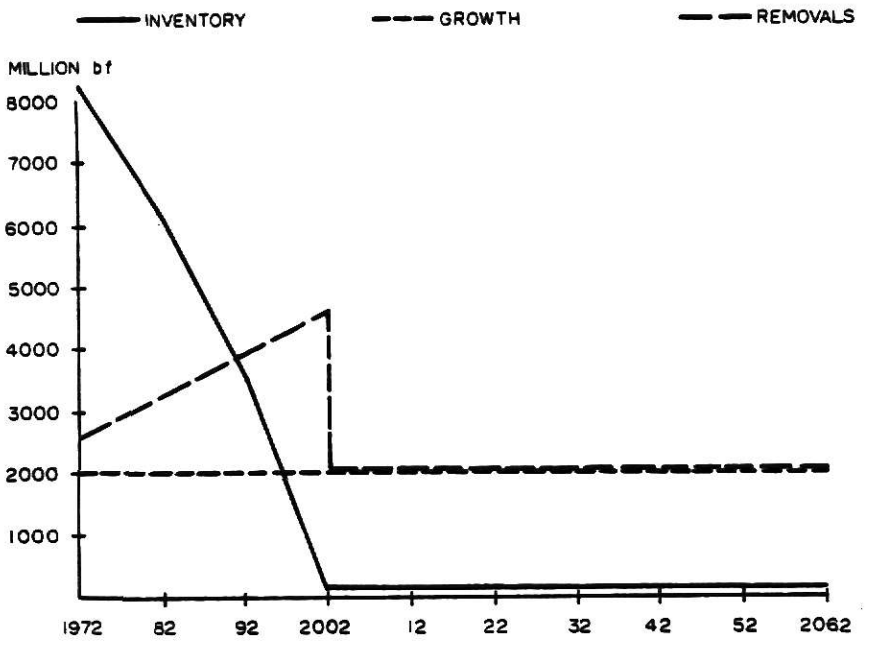
GRAPH 2 STATE HIGH REMOVALS



SOURCE: USDA FOREST SERVICE REVISED DATA (7)

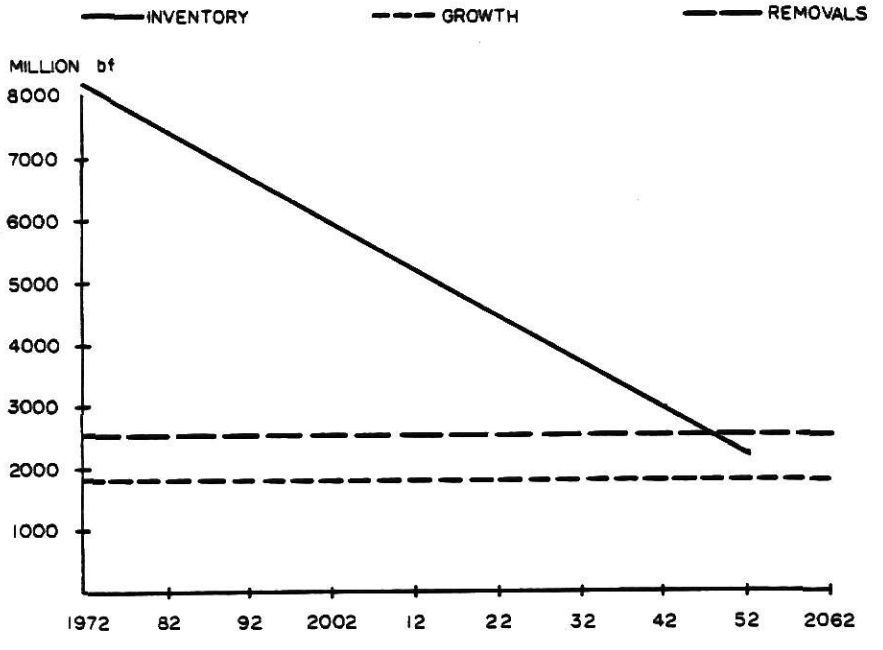
GRAPH 3 PROJECTED USDA DEMAND

(Growth and Removals on Ten Year Totals)



GRAPH 4 STATUS QUO

(Growth and Removals on Ten Year Totals)



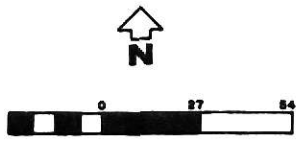
SOURCE: APPENDIX A

Tables in Appendix A illustrates that the removal and growth rates will not be the same for the various counties in the study area. The computer graphics of Map 5 compared to Map 4 show the changes in the distribution of sawtimber inventory in each county under the Status Quo approach from 1972 to the year 2002-2012 time period. Map 6 illustrates the impact of the continuation of the Status Quo rates would have on the year 2052-2062 level of sawtimber inventory distribution. For example, Howell County would lose its sawtimber very quickly while a few counties, such as Washington, would maintain their inventories longer because of higher initial inventory levels and lower initial removals. As sawtimber inventory in counties such as Howell are exhausted, removals must come from the remaining inventories in other counties in the study area (assuming no additional timber is imported from outside the study area). The USDA-predicted removal rates and the Status Quo tables in Appendix A indicate in what years the individual counties included in the study area would exhaust their sawtimber inventories.

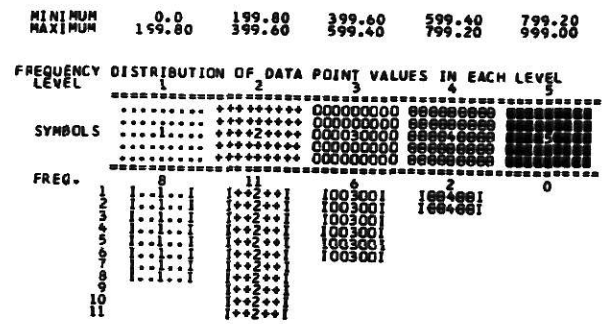
As sawtimber inventories are exhausted in portions of the study area, it is probable that sawmills would relocate to maintain accessibility to raw materials and to minimize transportation costs. When these operations relocate, they remove workers, dependents, payrolls, service industries, and tax base from the counties where they were previously located. In the next chapter various resource planning scenarios which have goals of increasing sawtimber inventories, increasing growth rates, and thus reducing the need for industries to relocate, will be discussed. The cost and benefits of increasing sawtimber growth and inventories will be discussed in Chapters 4 and 5.

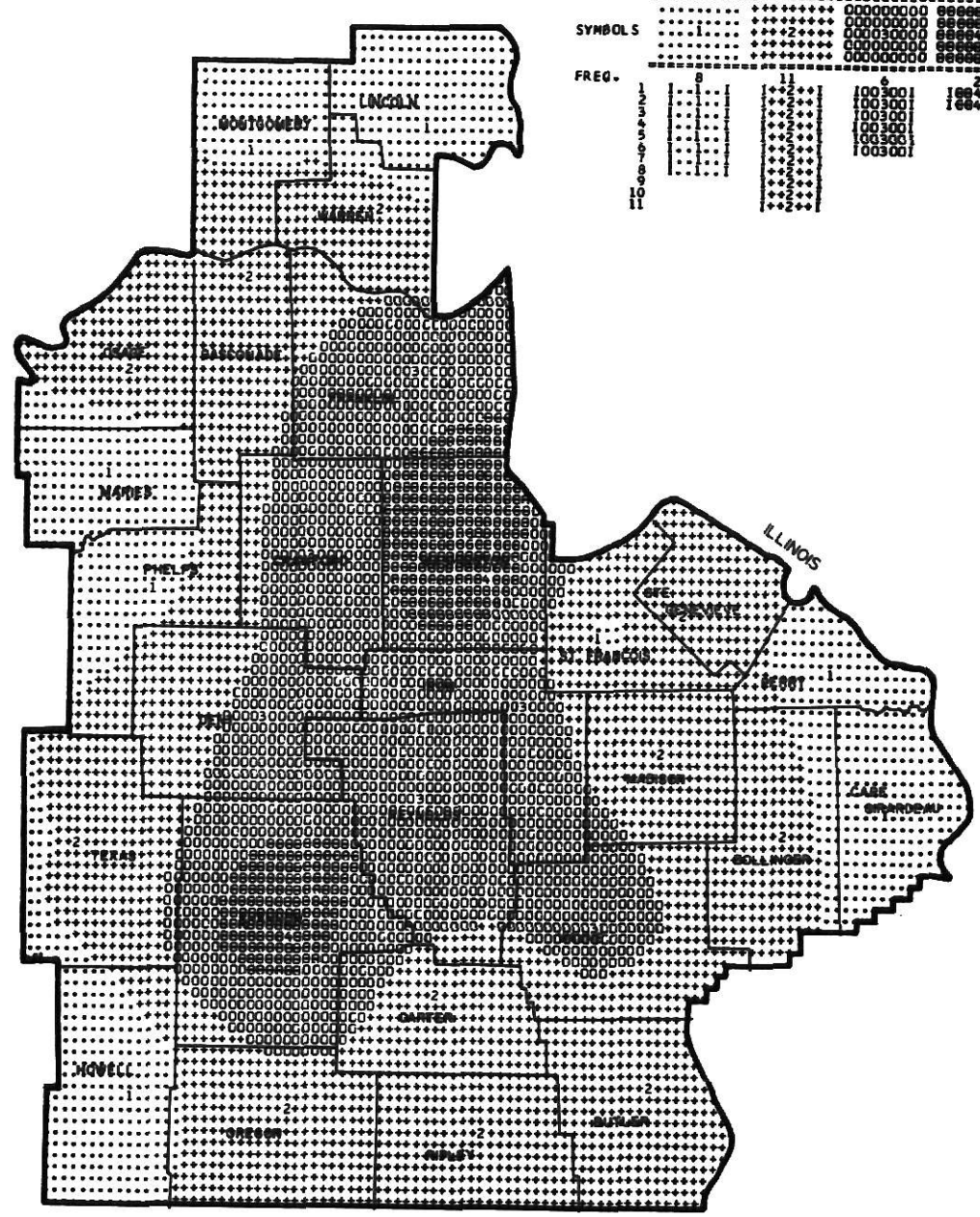
MAP 5

STATUS QUO



PRODUCTION IN MILLION BOARD FEET FOR YEARS 2002-2012



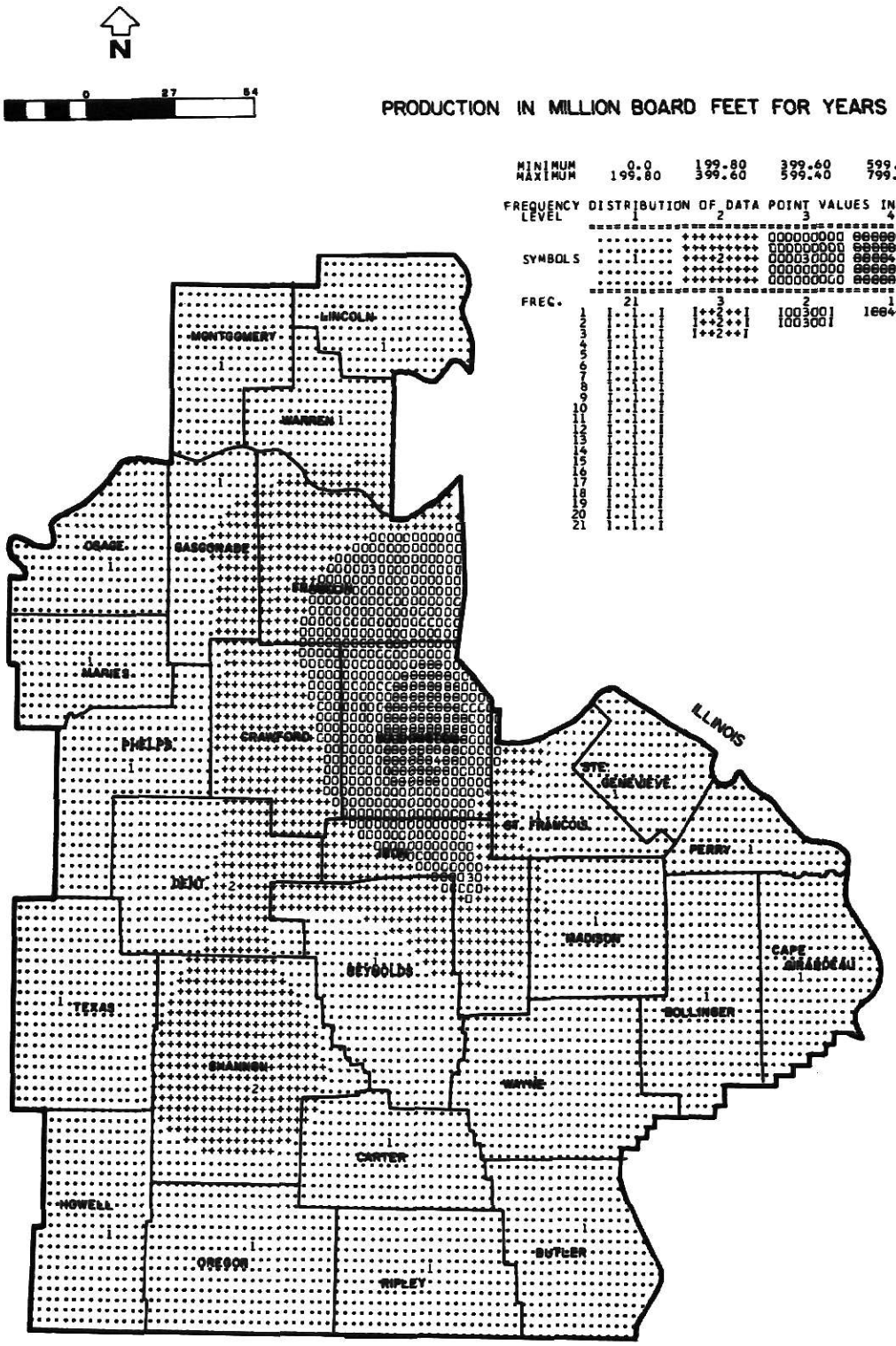


ARKANSAS

SOURCE: APPENDIX A

MAP 6

STATUS QUO



SOURCE: APPENDIX A

3

GOALS AND SCENARIOS FOR FORESTRY RESOURCE PLANNING

Chapter 3

GOALS AND SCENARIOS FOR FORESTRY RESOURCE PLANNING

Given projected supply and demand relationships, as well as trends in the conversion of forest land to other uses, it was demonstrated in the preceding chapter that a forest resource deficit problem may be experienced in the Missouri Ozarks study area at some point in the future. In this chapter, goals and objectives for future forestry resource management planning in the study area are developed. After a statistical analysis of independent variables which may affect lumber production is presented, several different resource management scenarios which, in turn, stress one management objective at the expense of others, are developed, along with quantitative descriptions of how these different management scenarios may influence the level of future lumber production in the study area.

Possible Future Consequences of a Resource Deficit Problem

Although the annual growth rate of timber currently exceeds the annual rate of removals, it has been projected that if the study area attempts to maintain its current percentage share of regional timber output, then the area's total sawtimber inventory may be consumed as soon as the year 2002. Should this occur, removals after the year 2002 would be limited to growing stock that reaches sawtimber diameter, and the study area's sawtimber output would decline. This would be unacceptable from the standpoint of the area's economy.

Despite any tendency toward a more diversified local economy less sensitive to the fortunes of single industries, depletion of the forest resource base would have a decidedly negative economic and social impact on the study area. Unemployment in forestry related industries would probably be the first condition to draw attention to such a situation. However, unemployment is only one of the many well know economic and social problems of depressed regions within

advanced industrial nations. Within such regions there is a characteristic sequence of events, beginning with rapid and indiscriminate exploitation of resources (usually accomplished without due regard for environmental concerns), progressing through changes in supply and/or demand conditions, and ending with the decline of leading industry, bringing unemployment, age-selective outward population migration, environmental problems such as dereliction of land, and general economic stagnation. Once established, such a situation perpetuates itself, discourages new industrial development, and thus exacerbates economic and social problems. Market forces could be allowed to take their course. But in areas where the potential for these kinds of problems has been identified, public intervention through resource management planning and injection of new investment is usually preferred to a "do-nothing", laissez-faire approach.

Resource Management Goals and Objectives

The starting point for the development of strategies to address the potential forest resource deficit problem of the Missouri Ozarks study area should be the setting up of planning goals. Naturally, the process of identifying the resource problem itself implies certain economic and social purposes, and these may automatically become policy goals. However, establishing goals often requires the resolution of a number of conflicting objectives. For example, should the increase of marketable timber be the highest priority for the study area, or should timber removals be held at a certain level in order to preserve wildlife habitat and scenic beauty? Such conflicting objectives lead to the observation that purely economic criteria are not always suitable as the sole determinants of resource management policies. For example, it is impossible to assign the true dollar value of a large area of forest land of outstanding scenic beauty. While economic ends tend to mold political compromise, many other factors, particularly those usually designated as

ecological, environmental, or ethological, are also of considerable significance in resource management policy formulation.

Bearing in mind the above concerns, this study makes the realistic assumption that planning for decreased timber production in the study area would not be a politically acceptable policy. Instead, the study focuses on the development of management strategies that will increase production on privately held forest land in the study area to meet rising demand for wood products, while at the same time discouraging further conversion of forest land to pasture or other uses. Given this overall direction for possible management strategies, three objectives have been derived to serve as the basis for the development of alternative resource management scenarios. These three objectives are: (1) to increase sawtimber production to meet the USDA's projected national demand for the year 2002; (2) to sustain the study area's sawtimber inventories at current levels; and (3) to avoid increasing the cut on recreational, scenic, or other public forest lands.

Regression Analysis of Variables Which May Influence Production

Achieving increased sawtimber production in the study area would require the use of certain tools or strategies that relate to independent variables that may affect lumber production. For the purposes of this research, four independent variables were examined to determine what, if any, relationship they might have to the dependent target variable, level of lumber production. The four variables examined were: (1) amount of commercial forest acreage; (2) number of sawmills; (3) number of miles of county and state maintained roads (a surrogate for investment in infrastructure); and (4) the amount of sawtimber acreage (see Appendix B). The single and combined effects of these four independent variables on the dependent variable, level of lumber production, were determined by simple and multiple linear regression analysis. The use of the standard statistical procedure of regression analysis provided a

reasonable method of examining expectations for the forestry resource situation in the study area.

The simple linear regression model describing the relationship between two variables take the form $Y = a + bX + e$, where Y is the dependent variable (that which is to be explained), X is the independent variable (or postulated causal factor), a and b are constants, and e is a random error variate. The correlation coefficient (r) is used to measure the strength of the relationship between the sets of values for X and Y. The general multiple regression model takes the form $Y = a + bX + b_2 X_2 \ldots + b_n X_n + e$, where Y is the dependent variable, X (1, 2, ..., n) the independent variables, a the intercept constant, b (1, 2, ..., n) the regression coefficients, and e the error term. The coefficient of multiple correlation (R) is used to measure the strength of the relationship between Y and the set of independent variables. The coefficient of determination (R^2), which can range in value from 0 to 1.0, is used to calculate the percentage of the variance in the dependent variable that is explained by the variance in the independent variables, and the F-test and the t-test are used to check the statistical significance of the relationships between the dependent and independent variables as indicated by linear regression analysis.

Regression analysis was used to examine the relationship between the level of lumber production (Y) and the four independent variables previously noted. The detailed findings, which are summarized below, are given in Appendix B. The simple regression analysis indicated that lumber production in the twenty-seven county study area is positively related to commercial forest acreage ($R^2 = .56$), number of sawmills ($R^2 = .56$) and sawtimber acreage ($R^2 = .52$). No relationship was observed between the level of lumber production and the number of miles of county and state maintained roads.

Out of the eleven possible independent variable combinations, the multiple regression analysis determined that only two combinations were statistically

significant. Under the first of these two, the level of lumber production was seen to increase as the independent variables of the number of sawmills and sawtimber acreage were increased (R^2 = .69). Under the second statistically significant variable combination, the level of lumber production was seen to increase with increasing commercial forest acreage and the number of sawmills (R^2 = .68). For the purposes of formulating resource management planning strategies, the scenarios presented in this paper will leave the location and number of sawmills up to market forces. Therefore, based on the regression analysis findings, effecting an increase in the amount of sawtimber acreage appears to be the best focus for any strategies to increase lumber production in the study area.

The Development of Management Scenarios

Earlier in the discussion, goals and objectives were established as a starting point for the development of future resource management strategies in the Missouri Ozarks study area. It was determined that the overall goals should be to increase sawtimber growth and inventory on privately held forest land and to discourage further conversion of forest land to other uses. Given these overall goals, three objectives were derived to serve as a basis for developing future forestry management scenarios. The three objectives were to increase sawtimber production in the study area to meet the USDA predicted demand for the year 2002, to sustain sawtimber inventories at current levels, and to avoid increasing timber removals on recreational, scenic or public forest lands. These three objectives, particularly the first, were suggested by economic concerns. However, the third objective and, to a lesser degree, the second objective, also take into consideration those social and aesthetic concerns which are difficult to value in dollar terms.

After establishing the overall goals and three management objectives, a regression analysis was conducted to discover instrument variables which

positively affect lumber production. This analysis suggested that the most promising approach towards increasing future lumber production would be to increase the amount of sawtimber acreage in the study area. Management strategies which could be used to increase the amount of sawtimber acreage include planting new timber stands and implementing timber stand improvement (TSI) measures to move existing commercial acreage up to sawtimber standards.

Having established overall goals and several strategic objectives, and having gained some insight into what the focus of a planning strategy to increase future lumber production in the study area should be, several future resource management scenarios can be developed. These scenarios include: (1) the high production management scenario, which emphasizes the objective of increasing sawtimber production to meet rising national demand; (2) the inventory retention scenario, which emphasizes the objective of sustaining the study area's sawtimber resource; and (3) the conservation scenario, which emphasizes the objective of protecting recreational, scenic, and other public forest land.

The High Production Scenario

The high lumber production scenario was developed to stress the objective of increasing sawtimber production to meet the study area's share of the USDA's projected regional output. According to the USDA projections presented in Chapter 2, if the study area is to maintain its current 3.81 percent share of regional production (northern sector), annual timber removals in the study area would need to increase from 2658 million board feet (bf) in 1972 to 5750 million bf in the year 2002. However, the supply-demand analysis in Chapter 2 further indicated that an attempt to attain this level of production would result in elimination of the study area's sawtimber inventory by the year 2002. Even if an intensive management program were implemented starting in 1982 and continuing through 1992, the increased rate of removals which would be required to

meet the USDA's projected demand could not be sustained past the year 2002. Therefore, a goal was set under which sawtimber growth would be increased so that 8000 million bf of hardwood timber and 500 million bf of pine would be available to be cut in the year 2062. This goal was derived through an arithmetic extrapolation of the year 2002 USDA projected demand of 5750 million bf discussed previously.

A number of growth and removal assumptions were necessary in order to develop a high production management scenario with the desired impact on future timber supply throughout the study period (1972 to 2062). Concerning growth, it was assumed that sawtimber placed under TSI would produce an additional 1.2 thousand bf per acre every 15 years for hardwoods and an additional 2 thousand bf per acre every 15 years for pine. This assumption was based on findings from the Foutch study (19) which is reviewed in Chapter 4. In terms of removals, it was assumed that at the end of a 70-year management program, pine could be clear-cut with a harvest of 20 thousand bf per acre. This assumption was based on information from the Foutch study and the USDA Forest Survey (7).

To set up the high production scenario, existing timber growth rates in the twenty-seven county study area as well as the improvement in growth rates that could be made through TSI management had to be estimated. This was complicated by the fact that the actual increase in forest growth that may be attributed to TSI has long been under debate among forestry professionals. The question is unresolved because of the various effects that side conditions such as tree species, soil types, rainfall, topography, temperature, and level of fire protection have on timber growth improvements. One study (15) has noted that sawtimber stands under TSI would increase 121.0 bf per acre per year for oak, 36.3 bf per acre per year for oak-pine stands, and 63.0 bf per acre per year for shortleaf pine stands compared to stands not under a forest management program.

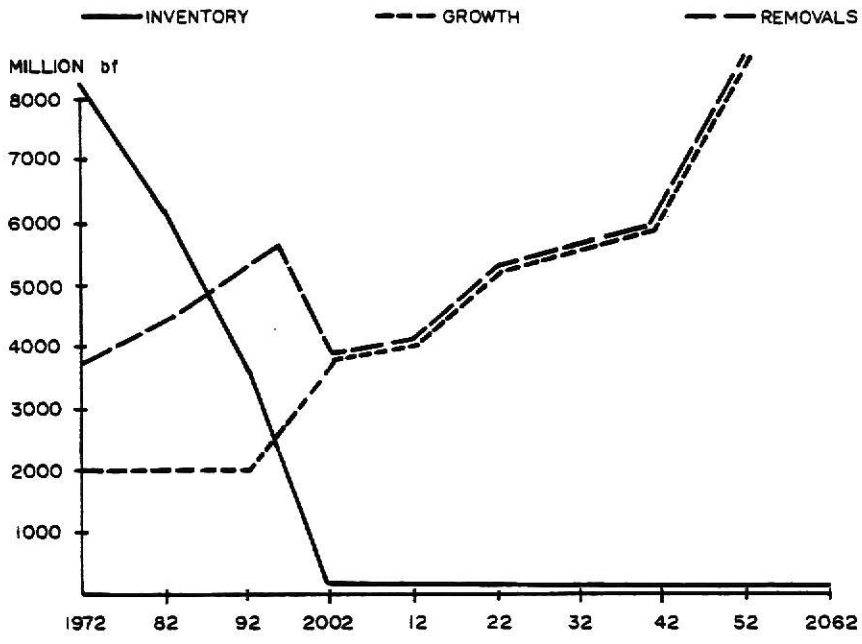
Undertaking in-depth calculations of improved growth rates due to TSI for

each tree species in each county in the Missouri Ozarks study area was determined to be outside the scope of this study. Thus, at the suggestion of a Kansas State Forester (11) the existing growth rates for each county in the study area were calculated by dividing the total sawtimber acreage for each county by the 1982 growth rate for each county, and these growth rates were assumed to double for all areas to be placed under forest management in the high production scenario (see Appendix C for these calculations). The existing growth rate per acre for each county was multiplied by the existing sawtimber acreage not under management. The new growth rates attributable to TSI were multiplied by the number of acres in each county assumed to be placed under management in the high production scenario. The number of acres to be placed under management in the high production scenario totaled to 615.7 thousand acres of hardwood and 545.6 thousand acres of pine during the time period of 1982 - 1992, and this acreage was allocated among the twenty-seven counties in the study area based on each county's past history of participation in forest management programs (see Appendix C). After the year 1992, the number of new acres placed under management in each county in the study area was reduced to the average 1975-80 levels (see Appendix F).

Graph 5 presents sawtimber inventory, removals, and net growth predicted to occur between the years 1972 - 2062 under the high production scenario. Although the number of acres of forest land placed under TSI is very high during 1982-92 under this scenario, the resulting increased timber growth does not show up in increased removals until a 15-year growth period has elapsed for hardwoods and a 30-year growth period has elapsed for shortleaf pine. The graph shows that the study area inventory is projected to fall to zero in the year 2002, so the removal rate cannot exceed the growth rate during the period 2002 to 2042. Because of this, the study area cannot meet its share of the USDA's predicted demand. However, a steep rise in net growth and removals is indicated for the period of 2052 - 2062 because of the clear-cutting of one-third

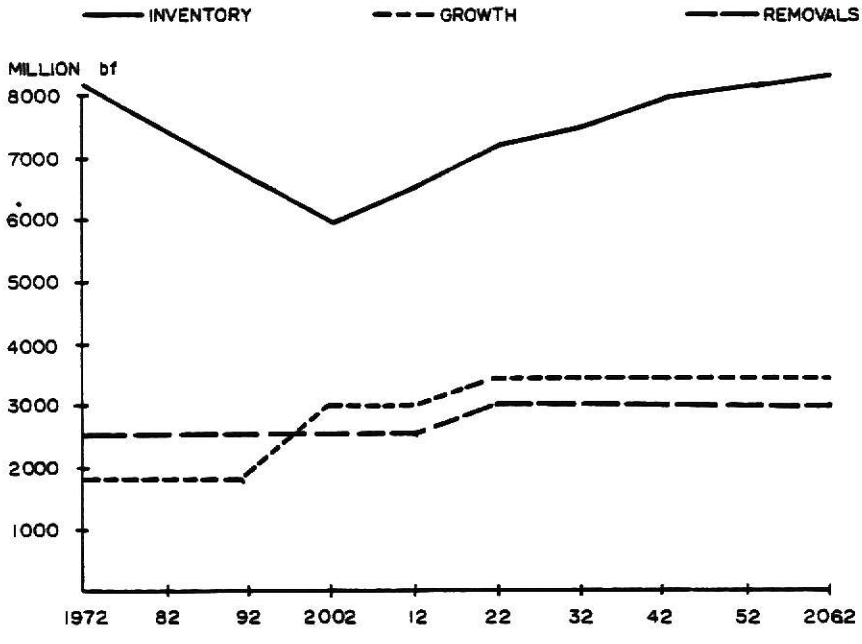
GRAPH 5 HIGH PRODUCTION

(Growth and Removals on Ten Year Totals)



GRAPH 6 INVENTORY RETENTION

(Growth and Removals on Ten Year Totals)



SOURCE: APPENDIX C

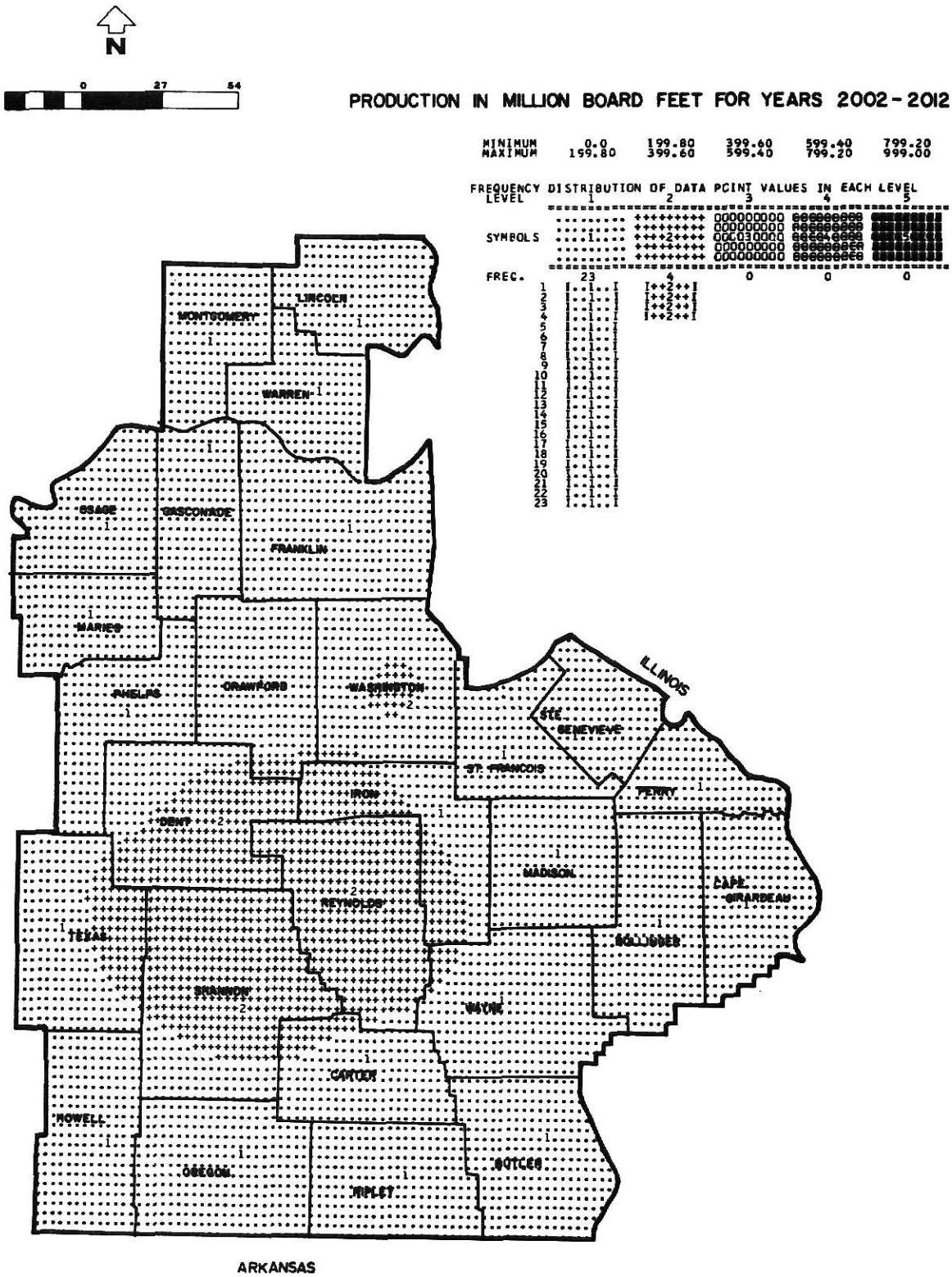
of the shortleaf pine planted during 1982 - 1992 (see predicted sawtimber, Appendix C). Thus, through an extensive forest management program and no additional forest land being converted to non-forest uses, the removal goal of 8500 million bf (hardwoods and pine combined) for the year 2062 is attained under the high production scenario.

Based on the growth rates and removal rates used in the high production scenario, Maps 7 and 8 indicate the impact that would occur on timber inventories in the twenty-seven county study area. Map 7 shows that existing inventories would be exhausted under the high production scenario, with only the growth of new sawtimber remaining. Map 8 illustrates where the majority of TSI activity would take place in the high production scenario. The increased management levels for each county were estimated based on the level of management practices reported for each county during 1975 - 1980 (see Appendix F). In addition, small increases in management activity were allocated across the entire study area because of an assumed increased interest among forest land owners due to rising timber demand. The majority of new shortleaf pine acreage under management shown on Map 8 is located in counties that have a history of shortleaf pine planting activity (see Appendix C).

It is hypothesized that under the high production scenario the wood-using industries currently located in northern and southeastern portions of the study area would experience rising transportation costs for assembling raw materials over increasing distances. These industries would come under pressure to discontinue operations or else relocate. However, industries in the central and western portions of the study area, especially those located in Reynolds, Shannon, Texas and Dent Counties, could likely expand production and new wood-using industries could be located in these areas. These possible relocations and expansions of industries in the study area would produce a number of economic and social impacts in the affected localities. For example, plants that expand or relocate in the central and western portions of the study area

MAP 7

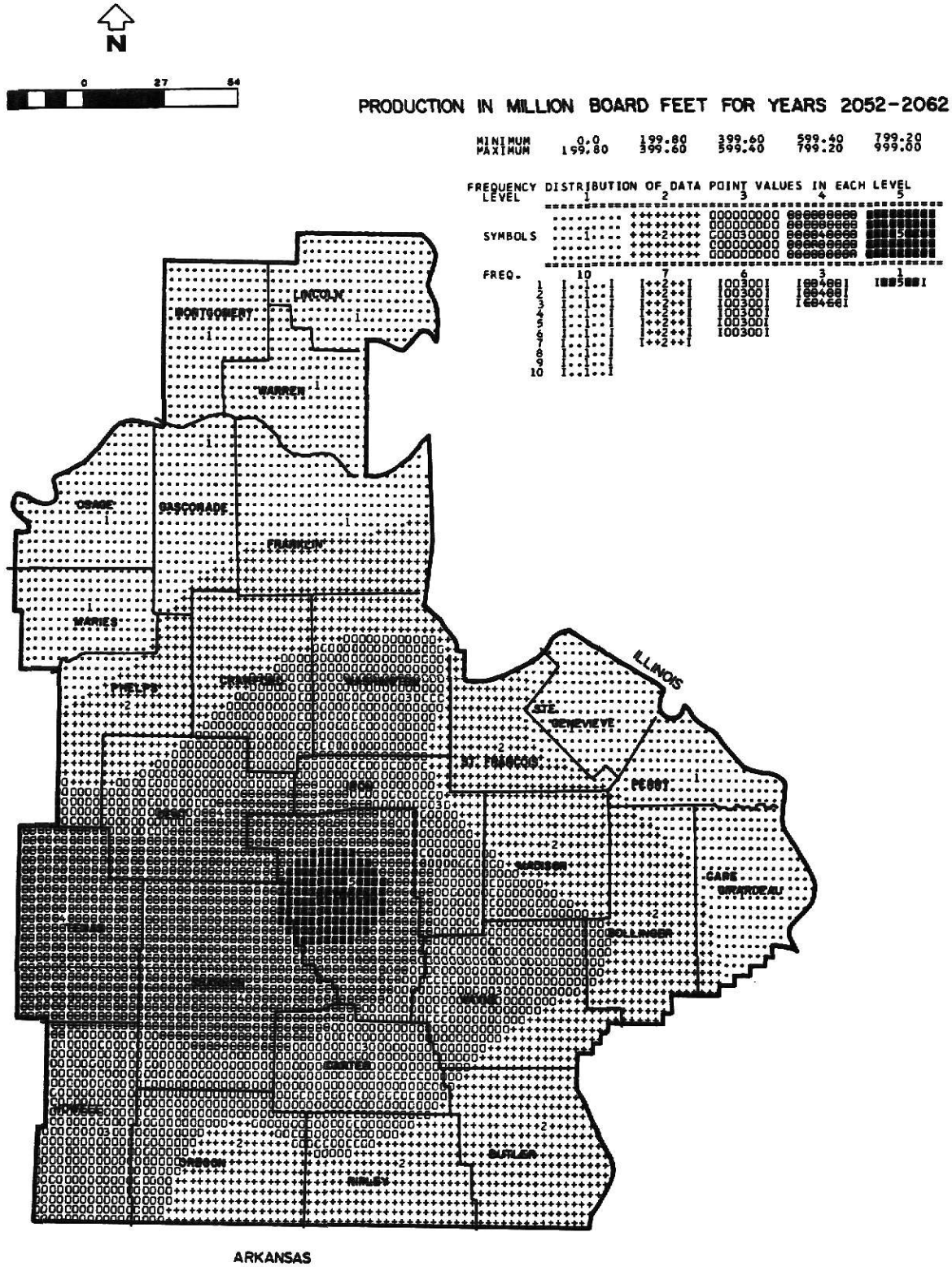
HIGH PRODUCTION - HIGH GROWTH RATE



SOURCE: APPENDIX C

MAP 8

HIGH PRODUCTION - HIGH GROWTH RATE



SOURCE : APPENDIX C

would create new employemnt and attract new service industries. Improved community facilities might eventually be required, such as schools, sewers, roads and hospitals to provide for the increasing population. These types of secondary economic and social effects are discussed in more detail in Chapter 5.

Inventory Retention Scenario

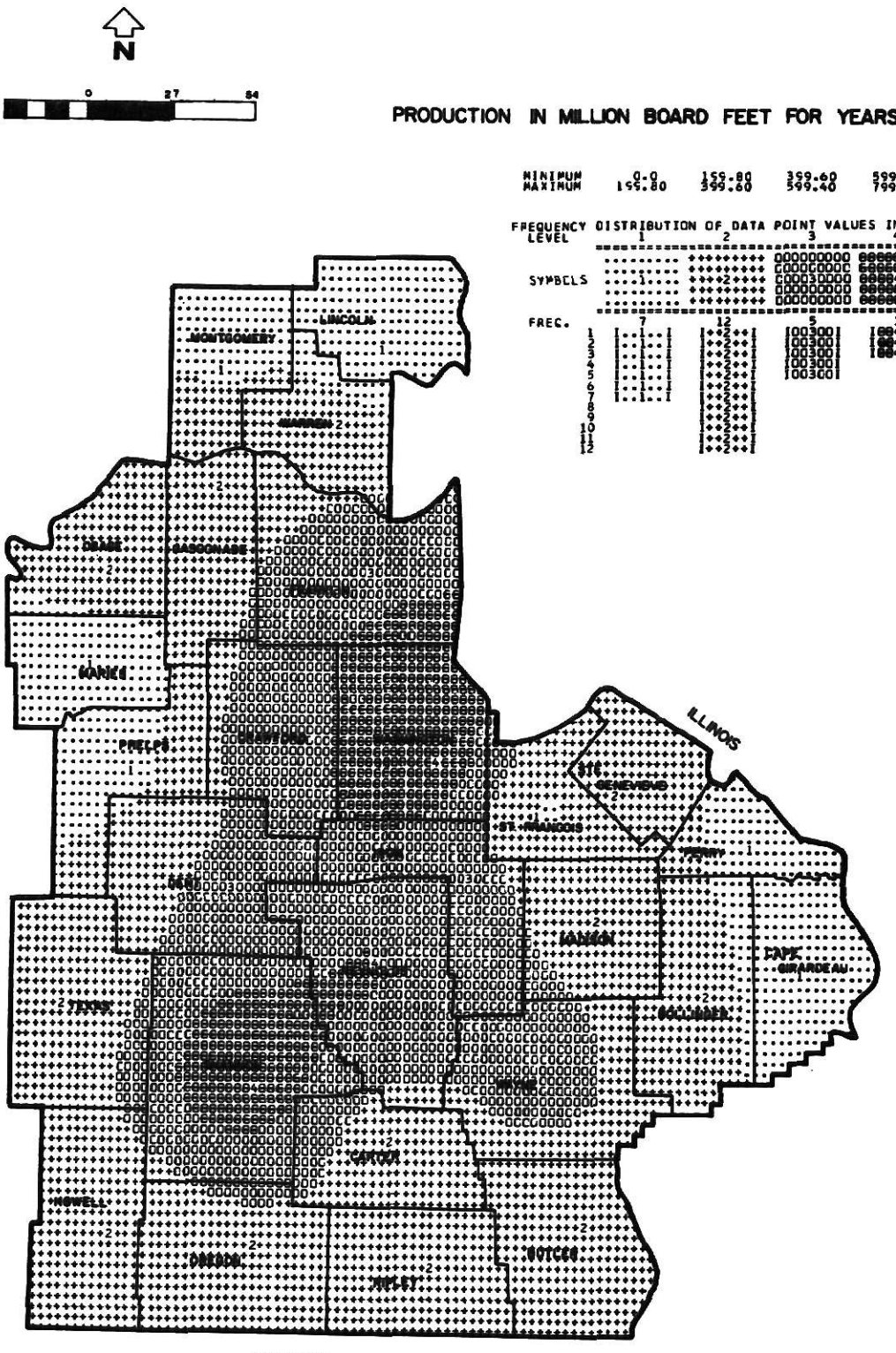
The inventory retention scenario was developed to emphasize the objective of sustaining the study area's sawtimber resource. More specifically, a scenario was set up under which the number of forest acres under management in the study area would be expanded by an amount sufficient to create timber growth adequate to bring each county's decreasing inventories back up to 1972 levels by the year 2062. Under this scenario, existing removal rates were held almost constant to allow current wood-using industries to remain at their present locations in the study area and to insure the future availability of a constant resource level. New shortleaf pine acreage (see Appendix C) was limited to the replacement of pine acreage previously lost in each county to raise pine acreage back to 1972 levels. Under this scenario, it was assumed that no additional sawtimber acres would be converted to other land uses.

In predicting future growth under the inventory retention scenario, the same growth rates that were used in developing the high production scenario were employed. However, due to the low amount of pine acreage involved in the inventory retention scenario, the old and new growth rates for hardwood were also used for pine.

In this scenario, growth rates in each county were increased by assuming a larger number of acres to be placed under TSI (see Appendix C). This was done to balance growth with existing removal rates. Graph 6 illustrates that growth, removals and inventory projections under the inventory retention scenario would mirror those predicted in Chapter 2 under the status quo scenario until the 2002 - 2012 time period. During the years 2002 - 2012, new growth

MAP 9

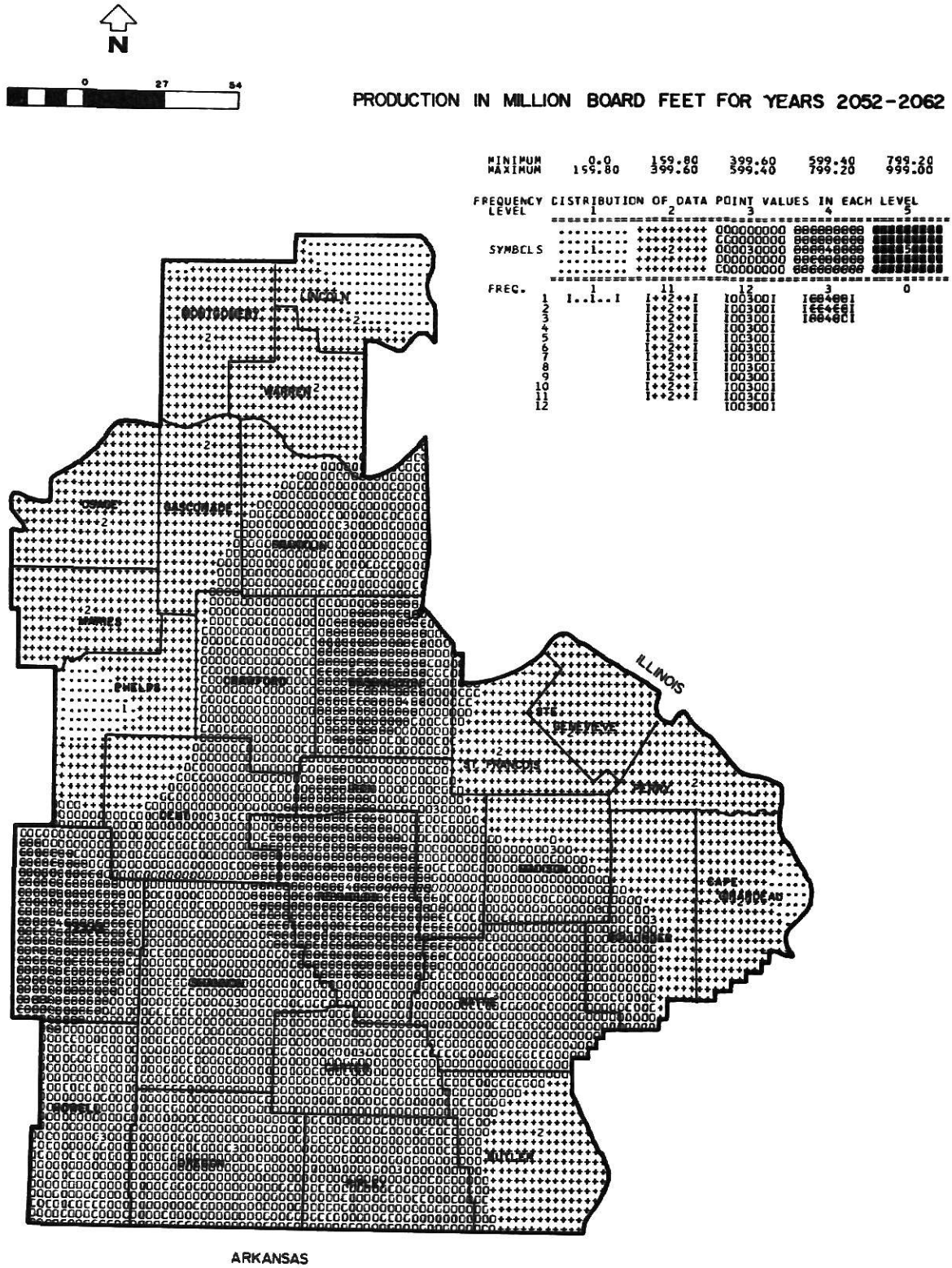
INVENTORY RETENTION SCENARIO



SOURCE : APPENDIX C

MAP 10

INVENTORY RETENTION SCENARIO



SOURCE : APPENDIX C

would be available because of forest management practices implemented earlier. With growth and removal adjustments in the 2022 - 2032 and the 2052 - 2062 time periods, the study area inventory is seen to surpass the 1972 inventory level. Unlike the high production scenario, the graph does not show any marked increase in growth late in the study period. This is because the inventory retention scenario involves a much lower level of shortleaf pine acreage.

Maps 9 and 10 show the sawtimber that would be available to be harvested during the years 2002 - 2012 and 2052 - 2062 by county under the inventory retention scenario. Map 9 indicates that counties located in the periphery of the study area would experience the most significant losses in resource supply. By the years 2052 - 2062, the illustrated inventory closely resembles that depicted in Map 4, the 1972 base year supply. Because of adjustments in the growth and removal rates, Texas and Howell Counties end up with higher inventories and Montgomery, Butler and Shannon Counties end up with inventories slightly lower than the base year supply.

The hypothesized effect that the timber supply distribution under the inventory retention scenario would have on industrial location patterns would be less destabilizing than that of the high production scenario. The timber supply distribution would permit the same type and size of wood-using industries to remain in their current locations. However, during the period of 1982 - 2062, fluctuations in timber inventories could require some industries to relocate, change their level of output, or transport raw materials from outside the study area.

Conservation Scenario

The conservation scenario was developed to emphasize the management goals of discouraging removals of timber in State Parks and scenic areas, and to keep timber removals on other public lands in the study area at the same level as in the base year 1972. The conservation scenario also seeks to discourage

the management practice of planting stands of shortleaf pine. This last management goal is desirable for promoting improved wildlife habitat and for the control of fire, insects and disease, which are more common in homogeneous timber stands.

The conservation scenario was based on several assumptions regarding acres under management and the rate of conversion of forest land to alternate uses. For this scenario, it was assumed that 615.7 thousand acres of hardwood timber would be placed under TSI management during the time period of 1982 - 1992. This is the same level of TSI assumed in the high production scenario for hardwoods. It was also assumed under the conservation scenario that acreage in shortleaf pine would remain at the 1982 level throughout the entire study projection period. The conservation scenario further assumed that 3.25 percent of the hardwood sawtimber acreage in each county in the twenty-seven county study area would be lost every ten years due to conversion to other uses. This is the same rate as the current rate of forest conversion for the entire state (7).

To develop growth, removal and inventory projections under the conservation scenario, it was assumed that each county in the study area would retain ten percent of its 1972 sawtimber inventory. This meant that ten percent of the sawtimber inventory in each county would not be available to be cut. This assumption was based on the need to restrict the cut on park lands as well as on the idea that a number of forest landowners may choose to preserve their land for scenic beauty and wildlife habitat. Additionally, some forest landowners may not be under pressure to sell timber for income or may be too independent to participate in government sponsored management practices. The assumption that the ten percent inventory retention would apply uniformly across all twenty-seven counties in the study area was employed for the sake of simplicity, with the determination of the actual amount of such lands by county being outside the scope of this study.

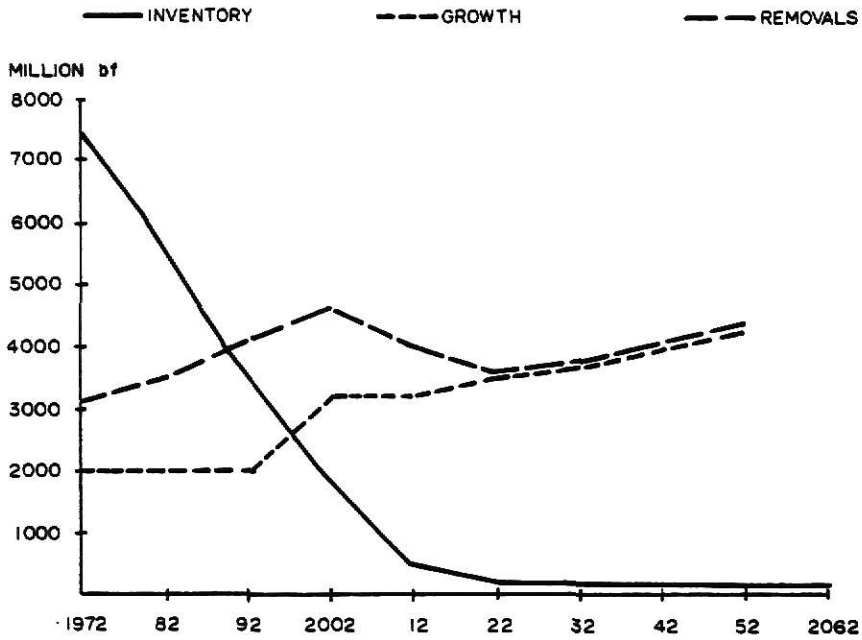
Because of the lower amount of sawtimber inventory available to be cut, the allowable cut under the conservation scenario was reduced to one-half the level provided under the high production scenario. This allowable cut was 502.7 million bf every ten years as long as it could be sustained by existing inventory and new growth.

The preceding inventory, growth and removal assumptions were used to develop the conservation scenario prediction series in Appendix C, and Graph 7 illustrates the projected growth and removal levels and the resulting impact on sawtimber inventory. As shown on the graph, removals were projected to increase 502.7 million bf every ten years until the period of 2012 - 2022 when inventory and growth are no longer able to sustain this level of removals. The growth rate for new hardwood sawtimber acreage placed under management was increased by 1.2 thousand bf per acre each 15 years as was done under the high production scenario, while the original growth rate for each county was set to decline slightly throughout the projection period due to the 3.25 percent of forest land being converted to other uses every ten years. Graph 7 does not indicate any spurt in growth late in the study period as was seen under the high production scenario. This was due to the lack of an extensive shortleaf pine management program.

Maps 11 and 12 show the sawtimber that would be available to be cut under the conservation scenario during the years 2002 - 2012 and 2052 - 2062 for each county in the study area. It can be seen that counties on the periphery of the study area would exhibit the most dramatic reductions in resource supply during the 2002 - 2012 time period under this scenario. By the period 2052 - 2062, Texas and Dent Counties would experience a rebound in timber inventories, but Washington, Franklin and Iron Counties would experience further declines. It is hypothesized that the changing geographic supply distribution which would occur under the conservation scenario would lead to an eventual concentration of wood-using industries in the center of the study area. Under this

GRAPH 7 CONSERVATION

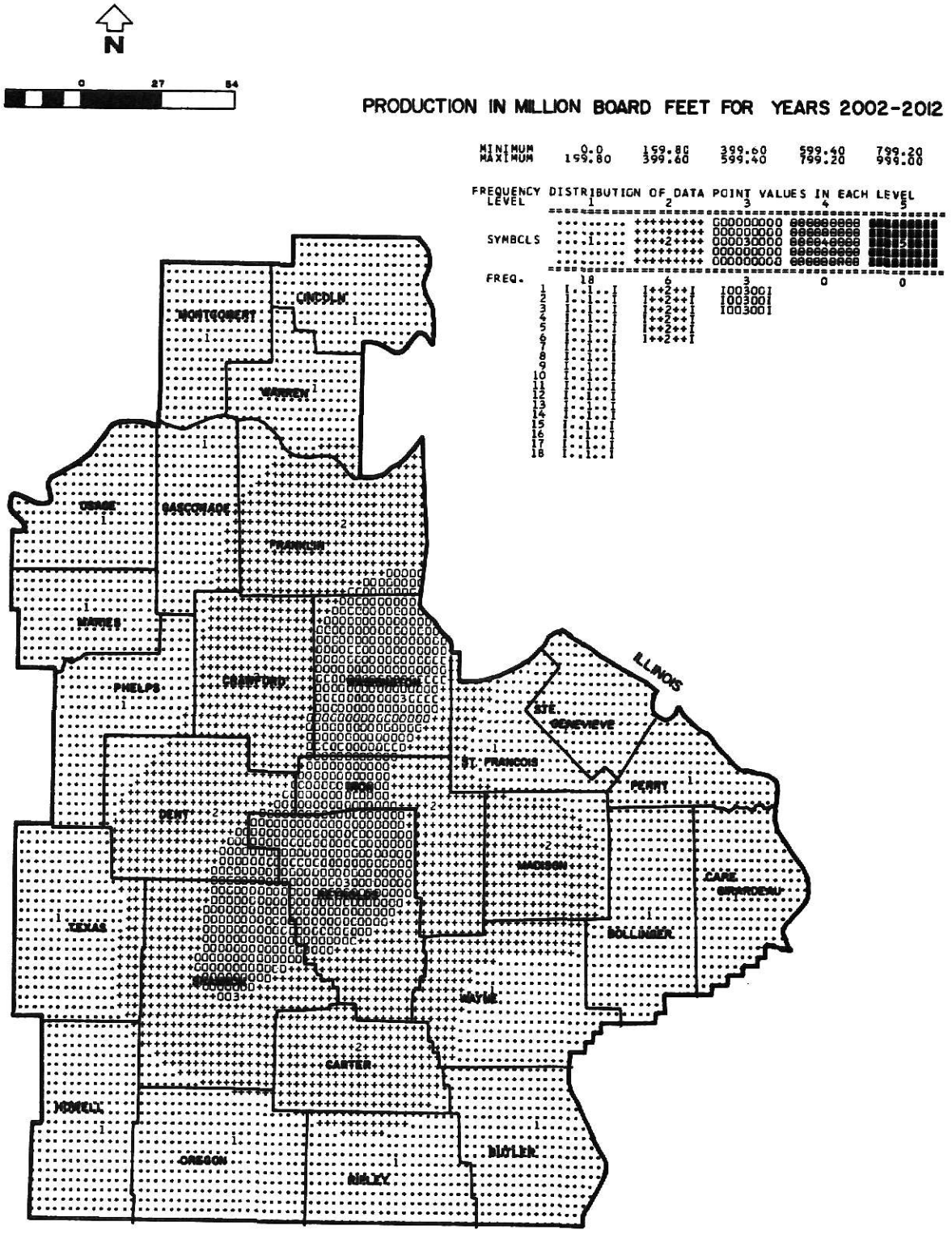
(Growth and Removals on Ten Year Totals)



SOURCE: APPENDIX C

MAP 11

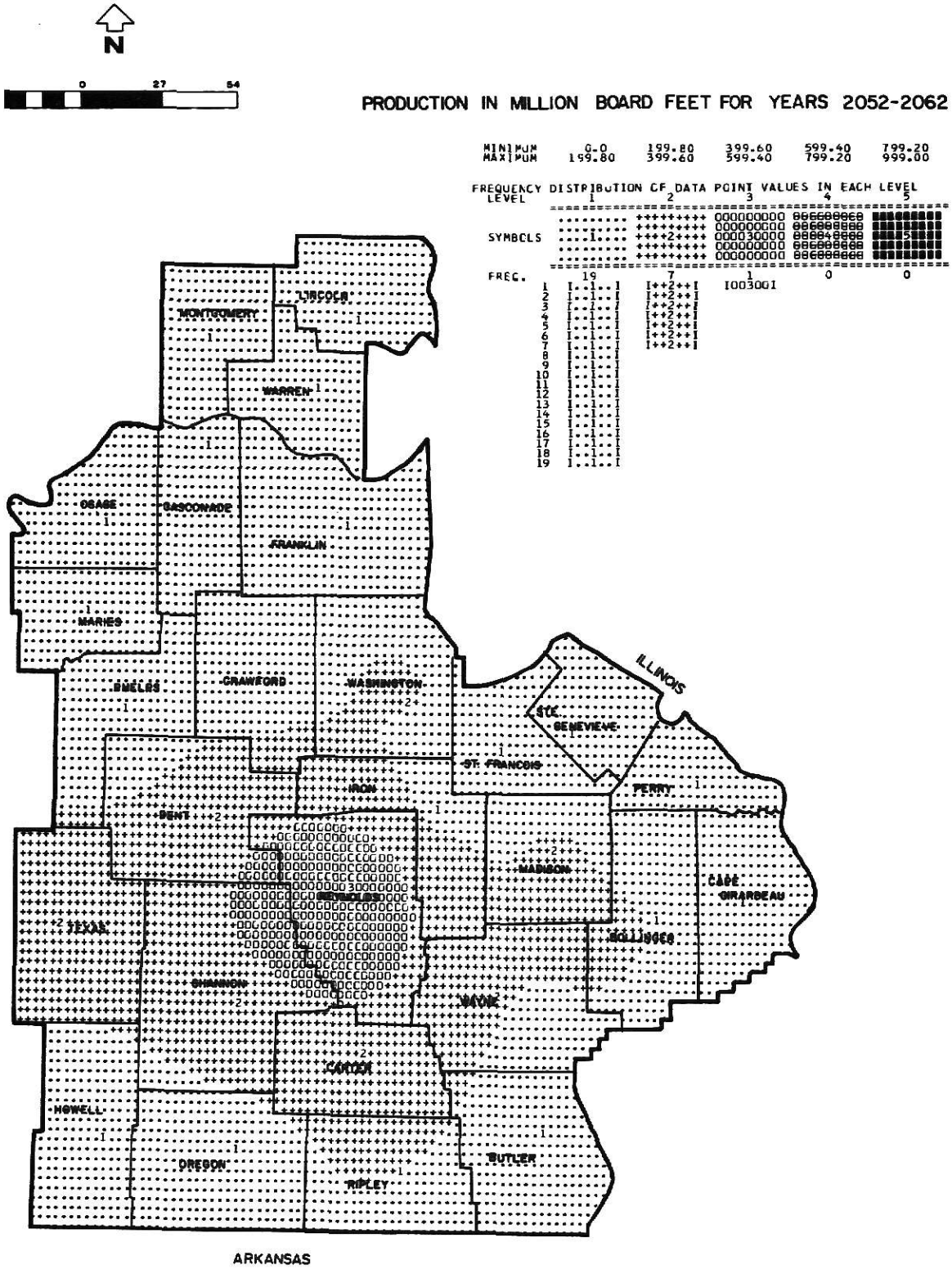
CONSERVATION SCENARIO



SOURCE : APPENDIX C

MAP 12

CONSERVATION SCENARIO



SOURCE: APPENDIX C

scenario, industries located in the periphery would be forced to respond to decreasing local availability of raw materials by either reducing production or relocating to reduce transporation costs for assembling raw materials.

The management scenarios presented in this chapter were developed to stress alternative management goals, and quantitative descriptions of growth, inventory and removals were projected for each scenario. The different impacts on future lumber supply in the study area, as well as the various environmental, social and economic effects associated with the alternate management scenarios, must be considered in the development of a course of action to address the predicted future resource deficit problem in a politically and financially acceptable manner. In Chapter 5, the economic costs of these alternate management scenarios will be estimated, and the various environmental, social and economic trade-offs associated with each will be investigated further.

The following chapter presents a discussion of existing Federal and State laws and forest management programs which may be available to help address the predicted resource shortage in the study area as well as to achieve other goals. The discussion particularly focuses on two existing government cost-share programs, the Agricultural Conservation Program (ACP) and the Forestry Incentive Program (FIP), and explores direct management costs to the government and to the forest land owner under these programs.

4

COST / BENEFIT ANALYSIS OF EXISTING STATE AND FEDERAL FOREST INCENTIVE PROGRAMS

Chapter 4

COST/BENEFIT ANALYSIS OF EXISTING STATE AND FEDERAL FOREST INCENTIVE PROGRAMS

It was established in Chapter 2 that, given expected supply and demand relationships and current levels of management, a forestry resource deficit problem may be experienced in the Missouri Ozarks study area in the future. In Chapter 3 three different levels of effort (scenarios) were proposed to increase production within different constraining economic, social and environmental goals. In the following discussion, existing government management incentive programs oriented toward alleviating the resource deficit and promoting conservation are examined. Most of the discussion is based on the economic study of the Agricultural Conservation Program (ACP) and the Forestry Incentive Program (FIP), "An Economic Analysis of Alternative Federal Incentive Schemes for Small Woodlot Management," prepared in 1976 by Ms. Trude K. Foutch.

The Foutch study dealth with the costs and income associated with the small woodlot owner's participation in the ACP and FIP management programs administered by the USDA. Under the ACP, the federal government will pay up to 65 percent of the costs involved with planting trees or improving forest stands for increased production, soil conservation and wildlife habitat. The FIP is designed to encourage the development, management and protection of non-industrial private forest land at a maximum 65 percent cost-share rate (see Appendix D for more detailed information). A number of small woodlot owners in the Missouri Ozarks study area have participated in these programs. Foutch's study, which closely examined how these programs have operated in Dent and Reynolds Counties in the study area, analyzed the effect of various cost-share rates and price ranges on the average small woodlot owner's internal rate of return and net present value. Direct costs to the government were

also examined. A review and analysis of the Foutch study will provide a framework for the cost/benefit analysis of alternative funding levels proposed for the management scenarios in the next chapter.

Characteristics of Small Woodlot Owners and Woodlot Economics

Several studies have sought to describe the characteristics of small woodlot owners (22,23,24). A large majority of small woodlot owners are over the age of fifty, and most of them are nonresident owners. Absentee ownership increases the likelihood of fires and timber theft. Although one of every two small woodlot owners have sold wood from their land, only 10 percent of owners have performed any management practices. In one survey it was determined that only 25 percent of small woodlot owners were familiar with ACP benefits (24). Most owners have been reluctant to spend money on forest management because they do not visualize higher rates of return achievable through management practices. At least for the short term, higher alternative rates of return attainable through present consumption of the forest resource or conversion of woodlot acreage to other uses create opportunity costs that discourage small woodlot owners from investing in forest management and conservation. Thus, most forest lands which receive management practices are owned by industry or the government.

In examining the small woodlot owner's costs and income, Foutch found that in most cases there is a negative rate of return. If an owner's initial and fixed costs are low (e.g., inherited land, low taxes, etc.), the owner's best long term option is to practice forest conservation and allow the woodlot to grow to optimum harvest condition. However, if an owner's costs are high (e.g., loan payments on the land, higher assessed value, etc.), it is likely that the owner will cut the timber for immediate income without regard to whether the forest crop has attained optimum harvest condition.

Although high costs and alternative rates of return may prevent many forest

land owners from implementing management practices, participation in Federal cost-sharing programs such as the FIP and ACP will lower the owner's management costs. In addition, the participant will receive guidance on timber marketing to aid in obtaining a higher return when timber is harvested and sold. Despite the land owner's common perception that the costs of management are excessive, studies have determined that participation in Federal incentive programs can markedly improve the quality and economic value of timber stands. In one study, it was found that, under FIP management, annual hardwood growth was increased by 121.0 bf per acre, annual mixed hardwood and pine growth was increased by 36.3 bf per acre, and annual net growth of shortleaf pine was 63.0 bf per acre (15).

Case Study Review

Foutch's objective in studying the economics of the small woodlot owner's participation in the FIP and ACP was to develop recommendations for improving the productivity, equity and effectiveness of alternative Federal incentive schemes. Two management scenarios for average woodlot owners were generated based on data gathered for FIP and ACP participants in Dent and Reynolds Counties in Missouri. The typical owner's rates of return and direct program costs to the government were then examined as a function of various subsidy levels and timber market values.

Foutch employed two methods to figure the participating woodlot owner's rate of return: (1) the internal rate of return (IRR), which is the percentage return on investment; and (2) net present value (NPV), which is the absolute difference between discounted revenue and costs. The IRR and NPV are frequently used in the field of forest economics to compare proposed forest management investment alternatives, where the criteria for selecting an investment is a positive NPV and/or an IRR equal to or greater than a predetermined rate. To determine the IRR or the NPV, costs and benefits are calculated. Costs include

items such as labor, equipment, land payments and taxes. Of these, labor costs may vary greatly depending on levels of management and whether the owner (who may be a farmer) personally accomplished needed work. Benefits include timber harvest income, as well as revenues that might be received from periodically thinning out marketable trees.

Foutch calculated costs as the average of costs experienced by land owners in Dent and Reynolds Counties who had implemented management practices under the FIP or ACP. Land taxes and purchase payments, which are generally fixed costs, were ignored in the analysis. Foutch assumed that woodlot owners maintained woodlots for secondary income only, and that any taxes and land payments incurred for woodlot acreage were paid for out of income from other sources.

Foutch gathered the following information for FIP and ACP participants in Dent and Reynolds Counties: year(s) of participation, acres of woodland owned, type of management practice(s) implemented on a cost-sharing basis, number of acres placed under management, amount paid out by the government, site quality, and site species type. Based on a review of this information, Foutch prepared "typical" management plans for the average size participating holdings for both counties. These typical management plans were also based on a number of assumptions Foutch made regarding timber stand and management characteristics (see Appendix E).

The typical management plan developed by Foutch for land owners in Dent County is shown in Table 2. Under this plan, shortleaf pine is directly seeded on 35 acres after existing timber has been cleared of undesirable trees such as blackjack or postoak. The woodlot is also treated with chemicals to prevent the growth of undesirable plants. The trees are then allowed to grow until they attain the age of 30 years, at which time they are thinned. The only TSI activity is thinning to alleviate crowding and to improve the quality and growth rate of the stand. At 80 years of age, when the shortleaf pine are most commercially desirable, the stand is clear-cut. The shortleaf pine's windblown

TABLE 2

FOREST MANAGEMENT PLAN FOR DENT COUNTY CASE*

(Reproduced From Foutch Study)

Stand Age	Practice	Expected Yield (thousand bf)
0	clear land of post oak; perform site preparation for seeding; direct seed shortleaf pine.	0
30	perform timber stand improvement (TSI) - thinning.	56
40	perform TSI - thinning	66.5
50	perform TSI - thinning	77
60	perform TSI - thinning	87.5
70	perform TSI - thinning	80.5
80	perform clearcut harvest	700

* Adapted from Managing Shortleaf Pine in Missouri by K.A. Brinkman and R. Smith (25).

TABLE 3

FOREST MANAGEMENT PLAN FOR REYNOLDS COUNTY CASE*

(Reproduced From Foutch Study)

(MBF = Thousand Board Feet)

Stand Age	Practice	Expected Yield (MBF)
40	perform timber stand improvement (TSI) - thinning	0
50	perform TSI - thinning	0
55	perform diameter limit cut	62.4
60	perform TSI - thinning	0
70	perform diameter limit cut and TSI - thinning	63.7
80	perform TSI - thinning	0
85	perform diameter limit cut	63.7
90	perform TSI - thinning	0
100	perform diameter limit cut	65

* Based on information obtained from the Farm Forester in Reynolds County.

seeds practically insure that a new crop of trees will begin to grow on the site after the clearcut harvest.

Expected benefits under the Dent County management plan for the typical participating land owner were calculated for five different situations in which market price per thousand (MBF=thou. board feet) bf was allowed to vary from $12.50 to $22.50. Under the management plan, benefits are available at 30, 40, 50, 60, 70 and 80 years.

Costs were then calculated for a wide range of government cost share rates. Initial costs to the land owner were set at $1,695.40 and additional costs, which arise at 30, 40, 50, 60, 70 and 80 years for thinning and harvest operations, were set at $730.80 per operation.

Foutch then calculated NPVs and IRRs for a variety of cost-share rates in combination with the five different benefit situations as shown in Table 4 and Table 5. Where the NPV was negative for a discount rate, it is not shown in Table 4. In regard to the cost-share rates given in Table 6, the first number given is the government share of the cost of planting and the second number is the government share for each thinning operation.

A government cost-share rate was considered acceptable to the owner if the IRR was 5 percent or greater, and/or the NPV was positive at discount rates of 5, 6 or 7 percent. As Table 7 indicates, the cost-share rates that meet these criteria ranged from a high of 100/100 (cost-share rate for planting/cost-share rate for thinning) which was acceptable for all the prices Foutch used, to a low of 50/50, which was acceptable only at a market price of $22.50/ MBF.

The typical management plan developed by Foutch for Reynolds County is shown in Table 3. It involves TSI for a 52 acre stand of hardwoods (various oak species - mostly black and scarlet) of uneven age. In the first year, the management plan calls for thinning out unmarketable trees to reduce crowding caused by previous lack of management. In ten years the thinning operation is repeated , and five years later a selective cut of marketable trees is performed

TABLE 4

NET PRESENT VALUES BY COST SHARE RATE FOR DENT COUNTY CASE (DOLLARS)

(Reproduced From Foutch Study)

(MBF = Thousand Board Feet)

(a)

Price/MBF: $12.50

cost share rate for planting	cost share rate for thinning 100	75	50	25	0	discount rate
100	632.32	532.39	432.43	322.52	292.59	5%
	338.19	270.08	202.43	133.57	65.76	6%
	247.39	205.00	153.04	105.88	58.70	7%
75	208.50	108.57	8.63			5%
						6%
						7%

(b)

Price/MBF: $15.00

cost share rate for planting	cost share rate for thinning 100	75	50	25	0	discount rate
100	758.80	658.81	558.93	459.00	359.07	5%
	465.85	397.74	330.09	261.03	193.42	6%
	296.74	254.35	202.39	115.23	108.05	7%
75	334.98	234.85	134.91	35.18		5%
	42.03					6%
						7%

(c)

Price/MBF: $17.50

cost share rate for planting	cost share rate for thinning 100	75	50	25	0	discount rate
100	885.24	785.31	685.37	585.44	485.51	5%
	543.48	475.37	407.72	338.66	271.05	6%
	346.19	303.80	251.84	204.68	157.50	7%
	461.42	361.49	261.55	161.62	61.69	5%
	119.66	51.55				6%
						7%

TABLE 4 - Continued

(d)

Price/MBF: $20.00

cost share rate for planting	cost share rate for thinning 100	75	50	25	0	discount rate
100	1011.72	911.73	811.85	711.92	611.99	5%
	621.23	553.12	485.47	416.41	348.80	6%
	395.66	353.27	301.31	254.15	206.99	7%
75	587.90	487.97	388.03	288.10	188.17	5%
	197.41	129.30	61.65			6%
						7%
50	164.08	64.15				5%
						6%
						7%

(e)

Price/MBF: $22.50

cost share rate for planting	cost share rate for thinning 100	75	50	25	0	discount rate
100	1141.17	1041.24	941.30	841.37	801.44	5%
	698.76	630.65	563.00	493.94	426.33	6%
	445.16	402.77	350.81	303.65	256.47	7%
75	717.35	617.42	517.48	417.55	317.62	5%
	274.94	206.83	139.18	70.62	2.51	6%
	21.34					7%
	293.53	193.60	93.66			5%
						6%
						7%

TABLE 5

INTERNAL RATE OF RETURN BY COST SHARE RATE FOR DENT COUNTY CASE

(Reproduced From Foutch Study)

cost share rate	price/MBF $12.50	$15.00	$17.50	$20.00	$22.50
100/100	20%	20%	20%	20%	20%
100/75	20%	20%	20%	20%	20%
100/50	20%	20%	20%	20%	20%
100/25	18%	18.5%	19%	19.5%	20%
100/0	17%	17.5%	18%	18.5%	19.5%
75/100	5.8%	6.2%	6.5%	6.8%	7.1%
75/75	5.4%	6.15%	6.2%	6.55%	6.85%
75/50	5%	5.5%	5.9%	6.25%	6.55%
75/25		5.15%	5.55%	5.95%	6.3%
75/0			5.2%	5.6%	6%
50/100			5.1%	5.4%	5.6%
50/75				5.3%	5.55%
50/50					
50/25					
50/0					
⋮					
0/0					

TABLE 6

COST TO THE GOVERNMENT TO PRODUCE 1067.5 MBF OF SHORTLEAF PINE IN DENT COUNTY BY COST SHARE RATE

(Reproduced From Foutch Study)

cost share rate	cost per 1067.5 MBF*	cost per MBF*
100/100	$ 1764	$ 1.65
100/75	1747	1.64
100/50	1730	1.62
100/25	1713	1.60
100/0	1696	1.59
75/100	1340	1.26
75/75	1318	1.23
75/50	1306	1.22
75/25	1289	1.21
75/0	1272	1.19
50/100	916	.86
50/75	886	.83
50/50	881	.82

* Discounted at 10% to present value.

TABLE 7

COST SHARE RATES ACCEPTABLE TO DENT COUNTY WOODLOT OWNER

(Reproduced From Foutch Study)

cost share rate	$12.50	$15.00	$17.50	$20.00	$22.50
100/100	A	A	A	A	A
100/75	A	A	A	A	A
100/50	A	A	A	A	A
100/25	A	A	A	A	A
100/0	A	A	A	A	A
75/100	B	C	C	C	C
75/75	B	B	C	C	C
75/50	B	B	B	C	C
75/25		B	B	B	C
75/0			B	B	C
50/100			D	B	B
50/75			D	B	B
50/50					B
50/25					
50/0					
25/100					
25/75					
25/50					
25/25					
25/0					
0/100					
0/75					
0/50					
0/25					
0/0					

LEGEND

A= cost share rate is acceptable under both NPV and IRR criteria

B= cost share rate is acceptable under IRR criteria and under NPV criteria at 5 percent

C= cost share rate is acceptable under IRR criteria and under NPV criteria at 5 and 6 percent

D= cost share rate is acceptable under IRR criteria

on a diameter limit basis. Assuming adherance to the management plan, the stand will continue to produce every 15 years with expected yields given in Table 3.

Following the methodology used in the Dent County case, and using the estimated yields given in Table 3, expected benefits under the Reynolds County plan were calculated for three different situations in which price was the variable. Benefits, which are available in 15, 30, 45 and 60 years, were determined for market prices of $15/MBF, $22/MBF, and $25/MBF.

Costs, which arise in the present and at 10, 20, 30, 40 and 50 years, were figured for government cost-share rates of n/100, n/75, n/50, n/25 and n/0 (planting costs are not involved). The cost of thinning was estimated at $22 per acre with no income expected from the cut trees.

Foutch calculated NPVs and IRRs for the alternative benefit scenarios as shown in Table 8 and Table 10. It can be seen that only those cost-share rates in which the government pays 75 or 100 percent of thinning costs are acceptable at any price/MBF, based on the criteria of an IRR of 5 percent or greater and/or a positive NPV at discount rates of 5, 6 or 7 percent. A cost-share rate of n/25 may be considered marginally acceptable at a price of $25/MBF (Table 11).

Benefits come sooner under the Reynolds County management plan than under the Dent County plan. This results in higher NPVs for the Reynolds County case when the market price was varied. However, the Reynolds County hardwoods would realize a smaller yield than the Dent County shortleaf pine, and they would require more frequent thinning operations.

Cost to the Government

Federal programs which provide for the cost-sharing of forestry improvements have been established with the realization that high alternative rates of return discourage land owners from effectively managing their woodlots. Programs such as the FIP and ACP attempt to lower the monetary investment of a

TABLE 8

INTERNAL RATE OF RETURN BY COST SHARE RATE
FOR REYNOLDS COUNTY CASE
(Reproduced From Foutch Study)

Cost Share Rate	price/MBF $15.00	$22.00	$25.00
n/100	>25%	>25%	>25%
n/75	6.3%	9.3%	10.5%
n/50			4.9%
n/25			
n/0			

TABLE 9

COST TO THE GOVERNMENT TO PRODUCE 254.8 MBF OF
OAK IN REYNOLDS COUNTY BY COST SHARE RATE
(Reproduced From Foutch Study)

Cost Share Rate	Cost per 254.8 MBF*	Cost per MBF*
n/100	$1855.54	$7.28
n/75	1391.67	5.46
n/50	928.53	3.64
n/25	475.59	1.87

* Discounted at 10% to present value.

TABLE 10

NET PRESENT VALUES BY COST SHARE RATE FOR
REYNOLDS COUNTY CASE (DOLLARS)
(Reproduced From Foutch Study)

(a)

Price received: $15/MBF

cost share rate	5%	6%	7%
n/0			
n/25			
n/50			
n/75	130.35	27.96	
n/100	831.45	655.95	529.10

(b)

Price received: $22/MBF

cost share rate	5%	6%	7%
n/0			
n/25			
n/50			
n/75	475.99	334.07	201.44
n/100	1177.09	962.06	773.09

(c)

Price received: $25/MBF

cost share rate	5%	6%	7%
n/0			
n/25			
n/50			
n/75	681.89	465.26	306.85
n/100	1382.99	1093.27	878.50

TABLE 11

COST SHARE RATES ACCEPTABLE TO REYNOLDS COUNTY WOODLOT OWNERS

(Reproduced From Foutch Study)

(MBF = Thousand Board Feet)

cost share rate	$15.00	$22.00	$25.00
n/100	A	A	A
n/75	C	A	A
n/50			D
n/25			
n/0			

LEGEND

A= cost share rate is acceptable under both NPV and IRR criteria.

C= cost share rate is acceptable under IRR criteria and under NPV criteria at 5 and 6 percent.

D= cost share rate is acceptable under IRR criteria.

land owner by decreasing the cost of management. These programs also seek to provide the land owner with market information so that the owner might obtain more equitable prices for timber. The small woodlot owner faces a horizontal demand curve for the timber product, so improved quality of the sale is a key to increased profits.

The test of any governmental subsidy program is that a substantial improvement should be realized at an acceptable cost to taxpayers. Foutch considered only direct monetary payments to land owners to estimate costs incurred by the government under the Dent and Reynolds Counties management plans. A 10 percent discount rate was used along with the various cost-share rates to determine the present value of the government's investment. The market value of the timber was discounted at the same rate for comparison. Foutch determined that in the Dent County case the government's cost was less than the market value of the timber produced, despite the given variations in price and different cost-share rates. It was determined that even if the government paid the total cost of the shortleaf pine management plan, the direct monetary benefits exceeded the government's cost. However, in the Reynolds County case, only a cost-share rate of n/25 and a price of $25/MBF resulted in timber output valued higher than the government's direct cost. Foutch concluded that it would be uneconomical from a net present value viewpoint for the government to invest in the hardwood management plan devised for Reynolds County except at cost-share rates above 25 percent. However, it should be noted that the hardwood management plan provides for sustained yields under a diameter limit cut while the shortleaf pine plan involves a clear-cutting every 80 years. This clear-cutting would require repeat initial expenditure and the amount of time the land owner would have to wait for benefits exceeds the average individual's lifetime. If the government were willing to use a discount rate of less than 10 percent as an investment acceptability criterion, the hardwood management subsidy could be economically feasible for the Reynolds County land owner.

Besides direct monetary cost and benefits, there are secondary economic and social effects that may be considered in evaluating a governmental subsidy program. In the case of the FIP and ACP, these secondary effects might include forest industry job creation, with resulting benefits to wage earners' dependents and local service industries. However, the direct monetary costs and benefits of these subsidy programs are the major emphasis of this resource report. Secondary economic and social benefits were briefly discussed within the framework of the management goals derived in Chapter 3, and these secondary benefits are discussed further along with the analysis of alternative management scenarios which are presented in Chapter 5.

5

MANAGEMENT SCENARIO AND GOAL ATTAINMENT

Chapter 5

MANAGEMENT SCENARIO ANALYSIS AND GOAL ATTAINMENT

Earlier in this report, USDA projections of future sawtimber supply and demand were used to derive predictions of a future sawtimber resource shortage in the twenty-seven county Missouri Ozarks study area. Given current and projected trends, a sawtimber shortage would result from higher rates of removals in response to increased national and regional demand, as well as losses of inventories attributable to continued conversion of forest lands to grassland and other nonforest uses.

Given predictions of a future resource deficit, goals and objectives for forestry resource management planning were developed in Chapter 3. It was determined that overall management goals should be to increase sawtimber growth and inventories while discouraging further conversion of forest land to other uses. Within the framework of these goals, three strategic objectives were derived to serve as a basis for the development of future management scenarios. These objectives and management scenarios included: (1) the high production scenario, which emphasized the objective of increasing sawtimber production to meet the study area's share of the USDA's projected regional output; (2) the inventory retention scenario, which emphasized the objective of sustaining sawtimber inventories at current levels in the study area; and (3) the conservation scenario, which emphasized the objective of protecting recreational, scenic and other public forest lands.

In this chapter, the alternate management scenarios derived in Chapter 3, along with the current level of management (which has been designated as the status quo scenario and which was described in Chapter 2), are further analyzed in terms of cost. The scenarios are further compared to ascertain the degree to which the overall goals and strategic objectives would be attained

under each scenario. One scenario will be advanced as the author's recommended future level of forestry management in the study area. The analysis will also briefly discuss the probable impacts that implementation of the recommended management scenario would create in regard to the local forest industry, local secondary economy, aesthetic considerations, and the general social and economic welfare of the study area's residents.

Status Quo Scenario

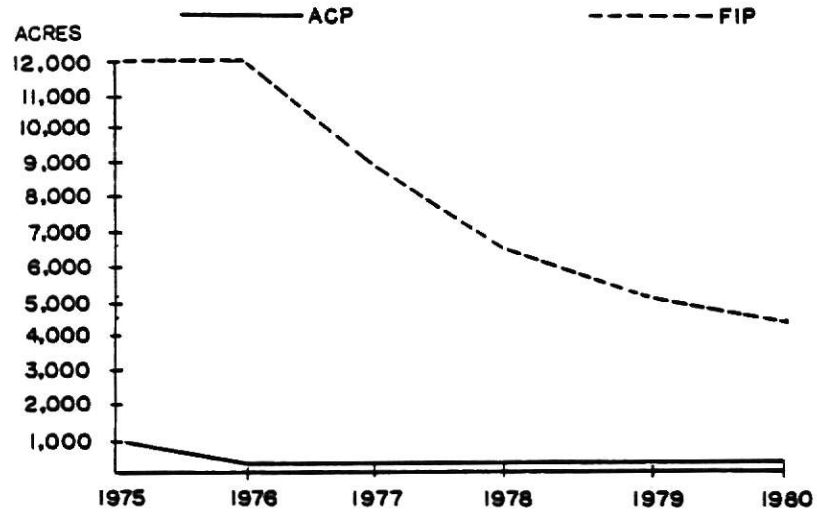
The status quo scenario would involve maintaining the 1972 base year growth and removals rates constant through the study period. Graph 4 and Maps 5 and 6 illustrate the predicted impact on the level and distribution of future sawtimber inventories in the study area if current management levels are continued under these growth and removal rates.

As described in Chapter 3, continuation of the status quo management approach would lead to the total depletion of the study area's sawtimber inventory by the year 2084. Under this scenario, many of the counties in the study area would lose their inventory much sooner than 2084, while some counties would actually increase their inventories during many years. During the study period, existing sawmills and other wood-using industries would come under pressure to relocate in response to the shifting geographic distribution of the forestry resource or incur higher transportation costs in assembling raw materials over increasing distances.

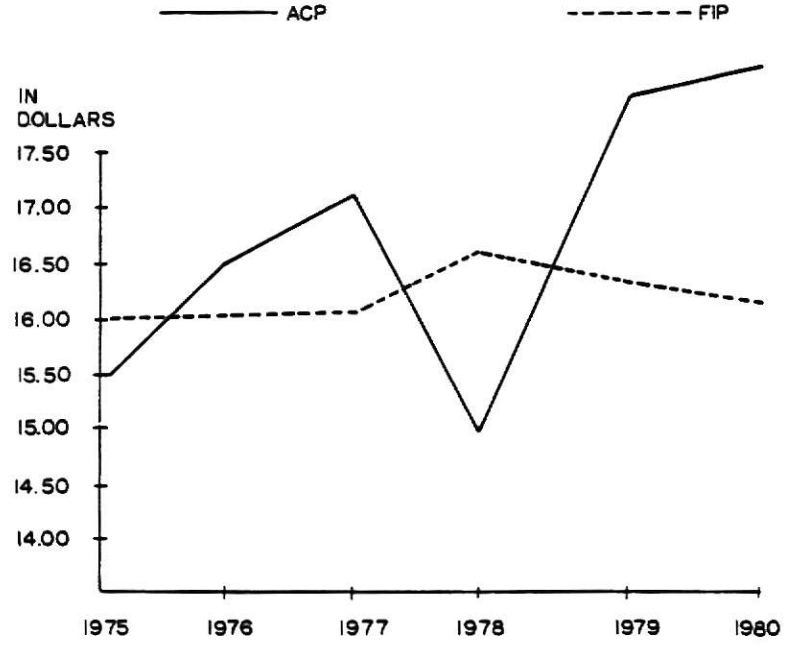
In order to estimate costs associated with continuing the existing level of forest management in the study area, this report assumed that 4.0 thousand acres would undergo TSI management each year and 1.2 thousand acres would be planted with trees each year. These assumed levels of TSI and tree plantings are based on the author's predicted level of status quo participation in the FIP and ACP programs, and were derived from recent trends expected to continue after the year 1980 as illustrated in Graphs 8 and 10.

ACP AND FIP PROGRAMS IN 27 COUNTY STUDY AREA FROM 1975 TO 1980 (RECORDS NOT KEPT ON 12 MONTH PERIODS, SEE APPENDIX F)

GRAPH 8 TSI IN TOTAL ACRES



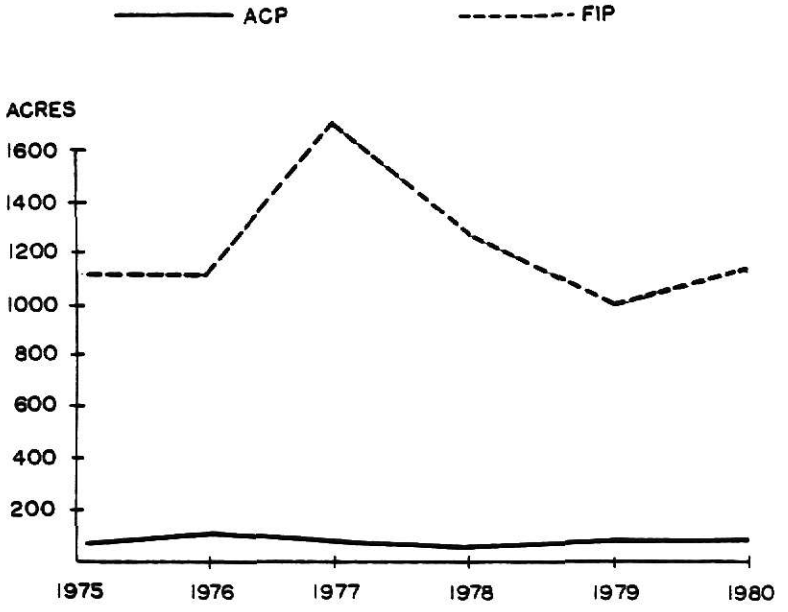
GRAPH 9 TSI IN COST *PER ACRE



* GOVERNMENT COST VARIES (UP TO 75% FEDERAL SHARE IN PAST) IN EACH COUNTY EACH YEAR, ASSUMED 65 % AVERAGE (19)

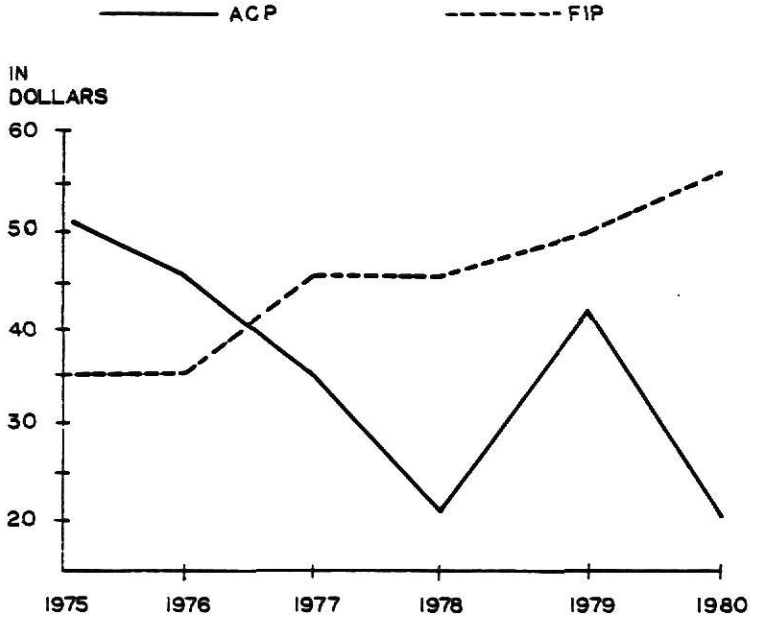
GRAPH 10 TREE PLANTING IN TOTAL ACRES

(APPENDIX F)



GRAPH 11 TREE PLANTING IN COST* PER ACRE

(APPENDIX F)



* GOVERNMENT COST VARIES (UP TO 75% FEDERAL SHARE IN PAST) IN EACH COUNTY EACH YEAR. ASSUMED 65% AVERAGE (19)

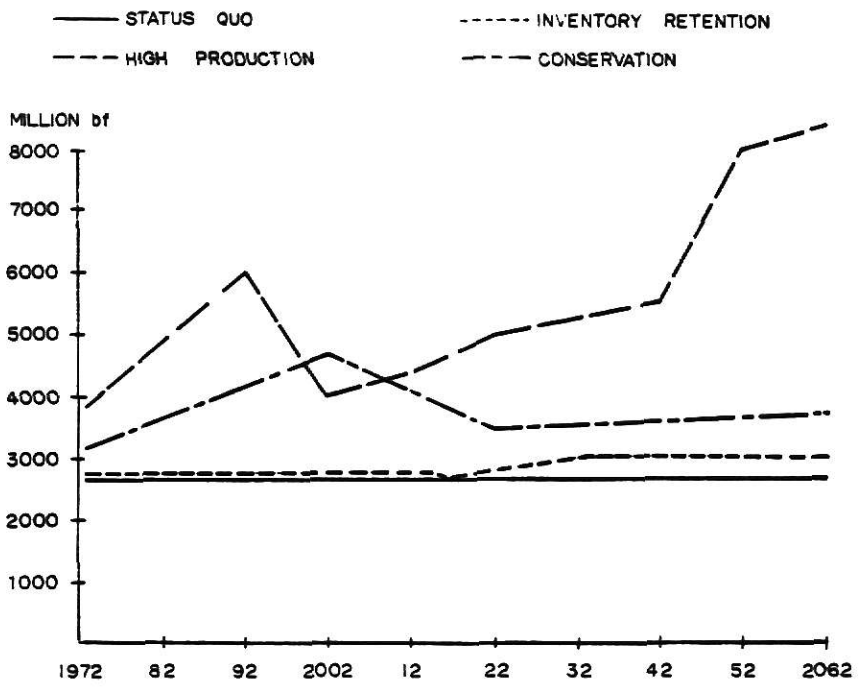
Past government cost averages (up to 75% cost-share rates) have been $16.50 per acre for TSI and $60.00 per acre for tree planting in the study area. Current total costs are $34.00 per acre for TSI and $90.00 per acre for tree planting (19). In Federal Fiscal Year 1982, the government's FIP and ACP cost-share rates were lowered to a maximum of 65 percent, which would translate to 21.10 per acre for TSI and $58.50 per acre for tree planting. Based on these costs per acre and the assumed future level of participation detailed in the preceding paragraph, continuation of status quo management levels would cost the government $84,400 per year for TSI and $70,200 per year for tree planting in 1981 dollars. If predicted removals under the status quo scenario are accurate (see Graph 12), the total cost to the government and landowners for forest management would be lower under the status quo scenario than under the other three management scenarios discussed in this report.

However, if the study area continues current management levels while endeavoring to respond to the USDA's predictions of future sawtimber demand, inventories in the study area would be drastically reduced and eventually exhausted. With the reduction and eventual loss of inventories, the lag time in new growth (and thus the amount of sawtimber available for harvest) would probably be too low to allow major wood-using industries to remain in the study area. The economic and social consequences which would be associated with out-migration of these industries and loss of economic base lead to the conclusion that the status quo management scenario would not be a prudent approach for future forestry resource planning.

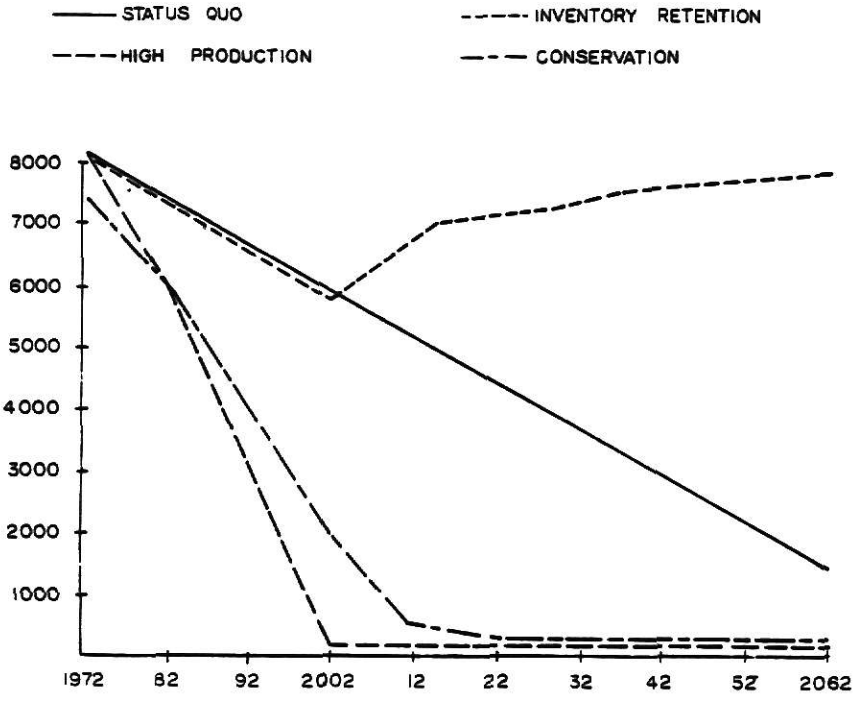
High Production Scenario

The high production scenario was developed to emphasize the objective of increasing sawtimber production to meet the USDA's predictions of rising future demand. This scenario was discussed in Chapter 3, with Graph 5 illustrating that the removal levels necessary to meet the USDA demand predictions could be

GRAPH 12 PREDICTED REMOVAL LEVELS (APPENDIXES A and C)



GRAPH 13 PREDICTED INVENTORY LEVELS (APPENDIXES A and C)



sustained through the 1992-2022 year period under the high production scenario. After that period, and even with the implementation of an intensive management program, the removal rates required to meet the USDA's predicted demand could not be reached again until the end of the study period. Between the years 2002 and 2062 the sawtimber output objective around which the high production scenario was developed would be unattainable. One Forest Service publication (18) expresses this type of situation as "...the capability exists but there is insufficient time for necessary growth to occur."

The intensive management program undertaken in the high production scenario would strive to increase sawtimber growth by the year 2062 to produce 800 million bf of hardwood and 500 million bf of pine. To accomplish these production levels, 615.7 thousand acres of hardwood and 537.8 thousand acres of planted shortleaf pine would be placed under management during the years 1982 to 1992. This level of management would cost the Federal government $1,360,697 per year for hardwood TSI at $21.10 per acre and $3,146,130 annually for pine planting, which represents 65 percent of the total TSI and planting cost in 1981 dollars. These cost estimates come from the FIP and ACP average costs for the study area counties during 1980 (19). Past records show that approximately 4.00 thousand new acres are involved in tree planting each year. (This report has assumed that all trees planted are shortleaf pine).

The high production scenario management program for the years 1982 to 1992 would involve 61.57 thousand acres per year for TSI and 53.78 thousand acres for pine planting. This would obviously be a dramatic increase over current management levels. Development of the high production scenario also assumes that 7.94 thousand acres per year would be added to the TSI program beginning in 1993 and continuing through 2062, at a cost of $202,470 per year in 1981 dollars. The 7.94 thousand acres per year is the average level over the past five years of new acres participating in TSI (see Graph 8). The timing of the TSI management program and removals under the high production scenario is the

same as outlined by Foutch on Tables 2 and 3.

If implemented, the high production scenario would compromise important management goals and objectives. The high removal rates under this scenario would exhaust the study area's sawtimber inventory by the year 2002 and limit removals to growing stock. Removal rates after the year 2002 would vary from county to county in the study area, and this instability in the geographic distribution of sawtimber resources would make it necessary for wood-using industries to discontinue operations, relocate, or assemble raw materials over increasing distances. Any large scale out-migration of wood-using industries would lead to tax base erosion and negative economic multiply effects in the local service sector.

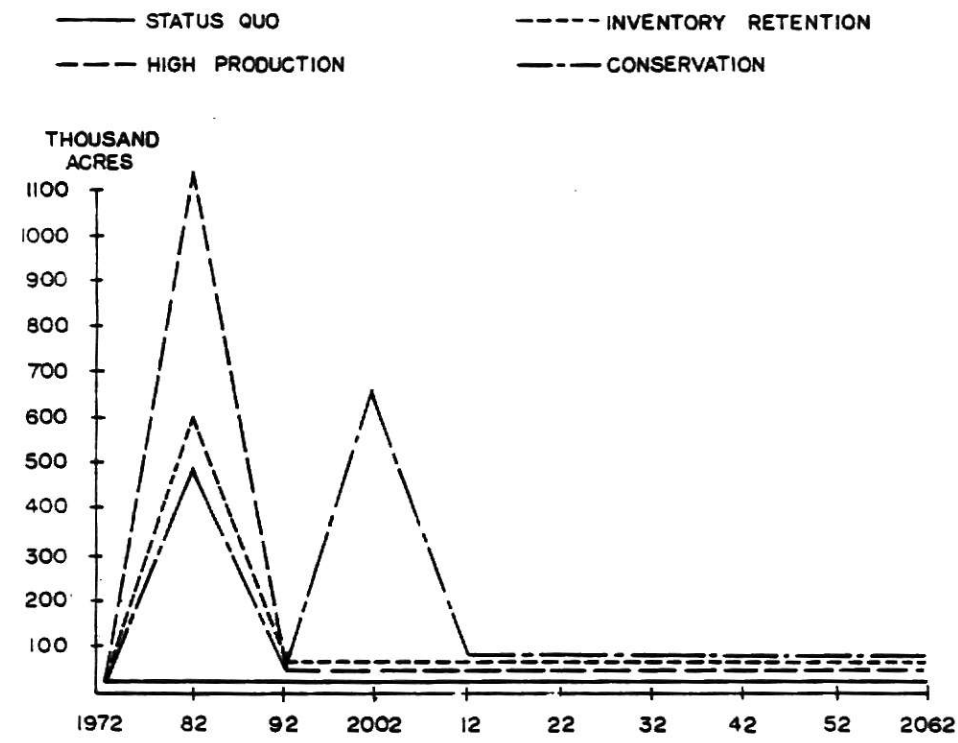
The high removal rates depicted under the high production scenario would also involve intensive utilization and eventual depletion of sawtimber inventories in parks and scenic areas. This would result in negative environmental and aesthetic effects. However, these negative aesthetic effects would be reduced by the many private forest land owners who would probably not sell their sawtimber under any circumstances unless forced to do so by a national emergency. Thus, it is unlikely that all public and privately owned timber would be available to be cut.

Because of the high costs (see Graph 15), as well as the other considerations cited above, the high production management scenario does not seem to be a probable or viable alternative for future forestry resource management planning in the study area.

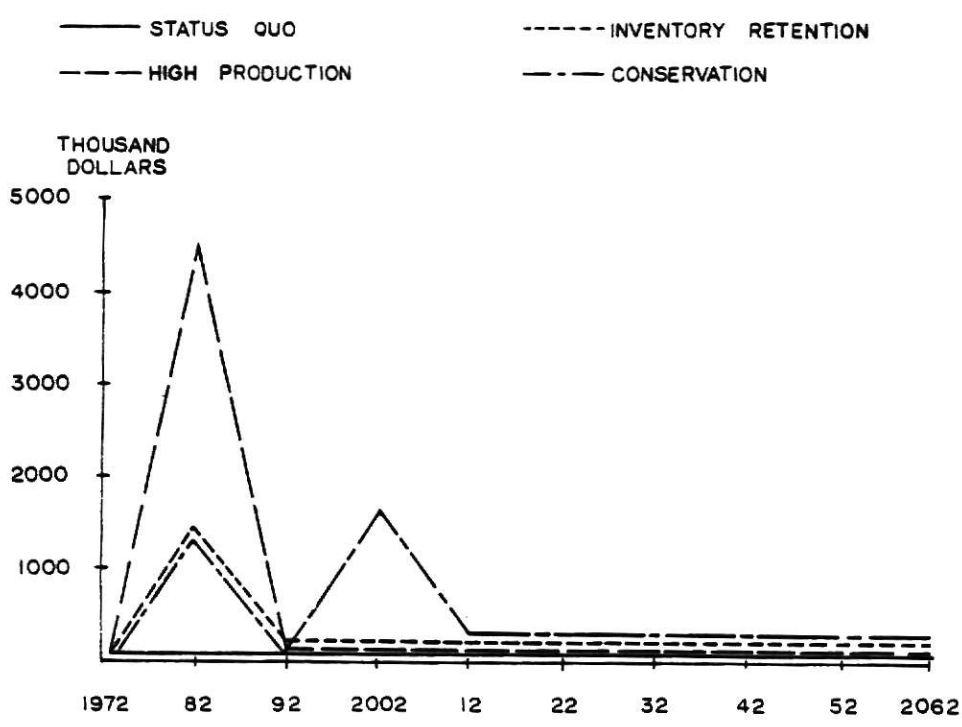
Inventory Retention Scenario

The inventory retention scenario was developed with a view toward arresting the decline of sawtimber inventory and increasing growth to return sawtimber inventory levels to 1972 base year levels in each county in the study area. This management scenario would seek to guarantee the future availability of

GRAPH 14 COMPARISON OF NUMBER OF ACRES PER YEAR IN THE MANAGEMENT SCENARIOS (APPENDIX F)



GRAPH 15 COMPARISON OF GOVERNMENT COST PER YEAR OF THE MANAGEMENT SCENARIOS (APPENDIX F)



sawtimber inventories in each county so that existing wood-using industries would not come under pressure to relocate. The inventory retention scenario also assumed a slight overall increase in removal rates during the study period due to above average inventory increases in a number of counties in the study area. Graph 6 and Maps 9 and 10 illustrate the impact of the inventory retention scenario and accompanying assumptions on the level and distribution of future sawtimber inventories in the study area.

The management approach under the inventory retention scenario would rely heavily on TSI to increase growth (see Graph 14). To accomplish the increased growth, 52.43 thousand acres per year would undergo TSI during the years 1982 to 1992, and 62.28 thousand acres per year would receive TSI practices during the years 2002 to 2012. Shortleaf pine plantings would be limited to 1.2 thousand acres per year, which is based on the recent five-year average for the study area. The TSI program under the inventory retention scenario would cost the government $1,106,273 per year from 1982 to 1992 and $1,314,108 per year from 2002 to 2013. These amounts are 65 percent of the total costs in 1981 dollars. Tree plantings under the inventory retention scenario would cost $70,200 per year in 1981 dollars.

Implementation of the inventory retention scenario would fulfill the objective of sustaining sawtimber inventory levels and this would allow most existing wood-using industries to remain at their current locations. Stability in the distribution of wood-using industries would minimize any disruption in the local secondary economy and make few new demands on existing public facilities which rely on a stable population and tax base.

However, the inventory retention scenario would not allow for the attainment of sawtimber production objectives. Growth and removal rates under the inventory retention scenario, which would resemble those which would occur under the status quo scenario, would fall short of levels needed to meet the USDA's predictions of rising future sawtimber demand. In any attempt to

preserve the current percentage share of regional output in response to future USDA demand predictions, sawtimber inventories in the study area could not be sustained.

The cost associated with implementation of the inventory retention scenario would be much higher than the cost associated with the status quo scenario. At the same time, the inventory retention approach would not provide much more than the status quo approach in terms of removals (see Graphs 12 and 13). The costs of the inventory retention scenario would also exceed that of the high production scenario, although the total cost would be split between two ten-year periods. These findings lead this author to reject the inventory retention scenario as a viable management alternative. Although the management approach would sustain sawtimber inventories in the study area, the low removal rates are unacceptable given the high cost of the inventory retention scenario (see Graph 15).

Conservation Scenario

The conservation scenario was developed in Chapter 3 to emphasize the management goals of discouraging removals of timber in State Parks and scenic areas, and to hold removals on other public lands in the study area at the same level as in the base year 1972. The conservation scenario also endeavored to discourage the planting of shortleaf pine in order to avoid the problems of fire, disease and insects frequently associated with homogeneous timber stands. Development of the conservation scenario also recognized the multi-use demands placed on the forestry resource. Besides the basic economic role of wood-using industries in the study area, tourism, second homes, farm conservation programs, wildlife, protection of scenic beauty and related concerns and considerations all place particular demands on forestry resources and must be considered in forestry management.

Major assumptions utilized in developing the conservation scenario were

discussed in Chapter 3. In the way of review, it was assumed that each county would lose 3.25 percent of its sawtimber inventory every ten years. This estimate was based on the statewide average (7). It was also assumed that 10 percent of each county's 1972 sawtimber inventory would not be available to be cut. This 10 percent was used to account for some forest areas being preserved for wildlife habitat, scenic purposes, wind rows, etc. The 10 percent exclusion was also used to account for a minority of landowners who might not sell their timber or cases in which access to timber would be cost prohibitive.

Because of the above constraining assumptions, the USDA's predicted demand for the study area as outlined in the high production scenario could not possibly be met under the conservation scenario. Thus the removal rate required to meet the USDA demand predictions was reduced by 50 percent under the conservation scenario, or 502.7 million bf every ten years.

The inventory and removal assumptions reviewed above were used to project sawtimber supply conditions under the conservation scenario using the growth rates discussed in Chapter 3. Graph 7 illustrates that removal rates desired under the conservation scenario could be sustained until the year 2002. After that time, removals would slowly decline by the year 2022 and then slowly increase during the remainder of the study period. The changes in inventory levels would differ for each county, but the study area as a whole would experience a less dramatic shifting of inventory than under the high production scenario.

To sustain removal levels desired under the conservation scenario, the growth rate was boosted by the amount discussed in Chapter 3 with the same number of new acres placed under TSI as in the high production scenario. The 61.57 thousand acres per year of hardwood TSI under the conservation scenario would cost the government $1,360,697 per year (65% of total cost) during the years 1982 to 1992. The management program would also add 7.94 thousand acres per year under TSI after 1992 at a cost of $202,472 annually in 1981 dollars

(same TSI program as under the high production scenario). The conservation scenario would not include any shortleaf pine program. Absence of intensive shortleaf pine planting and management would lower the total cost, but would also prohibit the availability of new timber late in the study period.

The conservation scenario would achieve the management objective of protecting wildlife and scenic areas, but it would not achieve desired removal rates. The removal rate given under the conservation scenario would lead to the depletion of sawtimber inventories in the study area by the year 2022 and subsequently limit removals to growing stock. Even when desired removal rates were reduced by 50 percent, the rates could not be sustained under the conservation scenario past the year 2002. At that time, wood-using industries located in some portions of the study area would come under pressure to relocate to avoid the necessity of transporting raw materials over greater distances. But overall, the disruption of the wood-using industry and negative secondary economic and social effects would be mild under the conservation scenario in comparison to those under the high production scenario.

After reviewing the alternative management scenarios outlined in this report, the overall attainment of management goals and objectives would appear to be highest with implementation of the conservation scenario. The conservation scenario is more realistic in recognizing the joint use of forest lands for a variety of economic, social and environmental purposes. The scenario would address wildlife habitat needs, protection of scenic areas, and would allow for the non-participation of some private forest landowners in government sponsored land use management efforts. The conservation management scenario also would allow for the continued conversion of some forested areas to grasslands or other non-forest uses because of the short-term economic requirements of the private property owner. Because of these considerations, the conservation scenario is selected by the author as the most effective and implementable management approach for addressing future forestry resource needs in the study

area.

In the next chapter, various recommendations are advanced to serve as guidance for the implementation of the conservation scenario in a cost-effective and equitable manner.

6

CONCLUSIONS AND RECOMMENDATIONS

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

In this final chapter, a number of summary observations relating to the research findings contained in this report are presented. Recommendations concerning improvements to existing government forestry management incentive programs and property tax incentives are also advanced. The recommendations are intended to be supportive of the goal of increasing sawtimber inventories in the study area to meet resource demands projected under the conservation scenario. Most of the recommendations are either (1) backed by analyses presented in this report, (2) modifications of recommendations originally advanced in the Foutch study, or (3) based on a broader review of relevant literature and/or opinions of forestry professionals that go beyond those portrayed in this report. Finally, areas for future study are listed at the end of this chapter.

Review of Study Findings

Utilizing projections based on USDA sawtimber supply and demand data, this study has demonstrated that a future forest resource deficit problem may be experienced in the twenty-seven county Missouri Ozarks study area. With removals projected to outpace growing stock, and a continuing trend of conversion of forest land to non-forest uses, the supply and demand projections presented in Chapter 2 indicated that sawtimber inventories could be depleted as soon as the year 2002.

In response to this potential resource deficit problem, management goals and objectives were developed in Chapter 3 after consideration of economic, social and environmental needs and trade-offs. Certain independent variables that relate to management strategies for increasing lumber production were analyzed via linear regression techniques. It was determined that increasing

sawtimber acreage would be the most effective way to increase lumber production in the study area. Based on the regression analysis findings, management goals and objectives were used to develop alternative management approaches or scenarios. These scenarios included a status quo scenario, a high production scenario, an inventory retention scenario, and a conservation scenario.

In Chapter 5, the conservation scenario was recommended as the management approach which would advance the most desirable and realistic mix of economic, social and environmental goals and objectives in the study area. Implementation of the conservation scenario would require that 61.57 thousand acres per year be placed under TSI management during the years 1982-1992, and 1.74 thousand acres per year be placed under TSI management after the year 1992.

TSI vs. Tree Planting Forest Management Recommendation

The conservation scenario advanced in this study would restrict TSI measures to hardwoods. The research findings indicate that the future thrust of the FIP or similar government incentive programs employed to facilitate implementation of the conservation scenario should be targeted to discourage the involvement of smaller forest landowners in shortleaf pine planting efforts. This approach is justified for several reasons: (1) homogeneous pine stands are more susceptible to disease, fire and insect damage; (2) there are higher initial costs in pine management due to expenses involved in site preparation; (3) the typical shortleaf pine management program involves a waiting period of thirty years before the first returns on investment are realized; (4) a market for pulp logs generated during thinning operations must be located nearby. For these reasons, industry is in a better position to plan for and provide future pine needs. Larger scale commercial lumbering and wood-using operations usually have the resources and expertise required to effectively manage and protect homogeneous pine stands. These entities have few problems in raising capital for initial site preparation, and they are better prepared to absorb management

costs. And since their investment plans need not be restricted by the average lifespan of an individual, these entities can tolerate the required waiting period for return on investment. Lastly, larger commercial operations can more effectively and efficiently plan for overall pulp resources and the accessibility of industrial markets in an area.

Recommendations for Improving the FIP

The number of acres that would *undergo TSI during* the implementation of the conservation scenario would represent a much higher level of small landowner participation in the FIP than has been the case in the past. While such an increase in FIP participation should be accomplished at the lowest possible cost to the government, financial incentives would necessarily have to be provided at levels high enough to draw the participation of many smaller landowners in the study area. The current 65 percent maximum Federal cost-share rate is generally too low to draw the desired number of FIP participants, and under current policies the number of acres will probably continue to decline as illustrated in Graph 8. As discussed in Chapter 4, the Foutch study analyzed the effects of various cost-share rates on the average small woodlot owner's internal rate of return and net present value and concluded that hardwood TSI was marginally acceptable at a government cost-share rate of 75 percent and a 5 percent return on the private landowner's investment dollar.

To implement the increased level of hardwood TSI required under the conservation scenario would require that cost-share rates be readjusted to make participation in the FIP more attractive. Foutch suggested that the US Forest Service should calculate different cost-share rates for each state. Foutch's approach would be to: "(1) empirically establish the characteristics of owners by county, size of holding, estimated retention and other factors; (2) develop a model for maximizing the effectiveness of the program using this information, subject to program goals and equity considerations (social goals), and to

program budget constraints; and (3) use this model to establish cost-share rates either nationally, by timber type, by county, or other criterion."

This author recommends a cost-share rate for hardwood TSI at 100 percent for initial TSI and a minimum of 75 percent for additional TSI. However, participating sites should be required to meet certain criteria. Sites should not be located in subareas with high rates of absentee ownership. Regional studies should be established to target management funds into subareas that have shown past success in forest management and low incidence of forest fires and timber theft. In addition, sites should be selected based on accessibility to markets. Site transportation analyses of primary transport costs (existing roads) and secondary transport costs (from stump to existing roads) should be conducted to establish a cost/benefit threshold level. This threshold should be jointly established by the USDA Forest Service and the Missouri Conservation Commission and be incorporated into the FIP and Missouri's enabling legislation. Criteria should be easy to understand and, where appropriate (e.g. distance cost thresholds) illustrated on detailed maps.

The above criteria could also be expanded to incorporate some additional recommendations previously advanced in the Foutch study. First, a minimum acreage requirement by tree species type should be established in order to maximize the cost-effectiveness of the FIP or similar government incentive programs. As demonstrated in the Foutch study, TSI costs vary depending on tree species, and larger consolidated tracts of timber can be harvested in a more cost-efficient manner than small dispersed timber lots. In addition, the US Forest Service and the Missouri Conservation Commission could jointly establish provisions under which a group of small landowners could pool their adjacent holdings to meet minimum acreage requirements. This type of minimum acreage approach is currently under study by the County Conservation Committee of the Missouri Conservation Commission.

Another additional Foutch recommendation involves extending the current

maximum TSI management period under the FIP from 25 years to 60 years. Related to this, the author suggests that the partial tax relief section (254.080) of the State enabling legislation be amended from 25 years to 80 years to take into consideration the life cycles of appropriate tree species. FIP participation agreements with property owners could require restrictive covenants which would run with property titles and which could be purchased back at a cost determined by the State to cover all public funds expended up to the time that a landowner would want to withdraw from FIP participation. Restrictive covenants would remain in force if property changed hands, unless a new owner was prepared to buy out of the FIP agreement.

The Foutch study also recommended that a current FIP provision which prohibits cost-sharing for recently harvested forest sites be eliminated. This ill-advised provision requires landowners to wait five years after a clear-cutting to be eligible for cost-sharing assistance for planting, and this wait makes site preparation at the time of planting more costly. The original intention of the provision was to stop landowners from exploiting their forest resource and then gaining immediate tax relief. But in most cases, the true effects of this provision have been to slow inventory replacement and create higher planting costs.

Two additional recommendations are not substantiated by this study, but they are worth mentioning. First, it is proposed that private landowners be permitted to take tax write-offs from the donation of land to private forest industries which agree to place the donated land under a long-term forest management program. Such land donations would help to lower the cost of producing wood products. In addition, such donations could provide a means for heirs of lands placed under FIP management by the previous owners to withdraw from the long-term FIP obligations. The second recommendation would involve increasing the maximum value of land eligible for FIP participation to approximately $1,200 per acre, or the current average value of forest land in the rural

portions of urban counties. To facilitate implementation of this recommendation, the Missouri Conservation Commission should determine an average absolute tax reduction per acre for forest lands currently under the FIP and apply it to all participating forest lands valued up to $1,200 per acre. For example, if this average tax reduction is $50, then a landowner whose forest land is worth $1,200 per acre and taxed $195 per acre per year should be allowed to participate in the FIP and receive a tax reduction of $50 per acre or pay $145 per acre per year.

A final recommendation previously advanced by Foutch would be to expand forestry management awareness and education programs to better inform small property owners concerning the FIP and related government forestry programs. Based on available survey data (26), most small forest landowners are not familiar with the forestry management programs available to them. This author agrees with Foutch's recommendation in the belief that expanded information efforts would increase the awareness of goals and benefits of forestry management programs and encourage increased participation in the FIP.

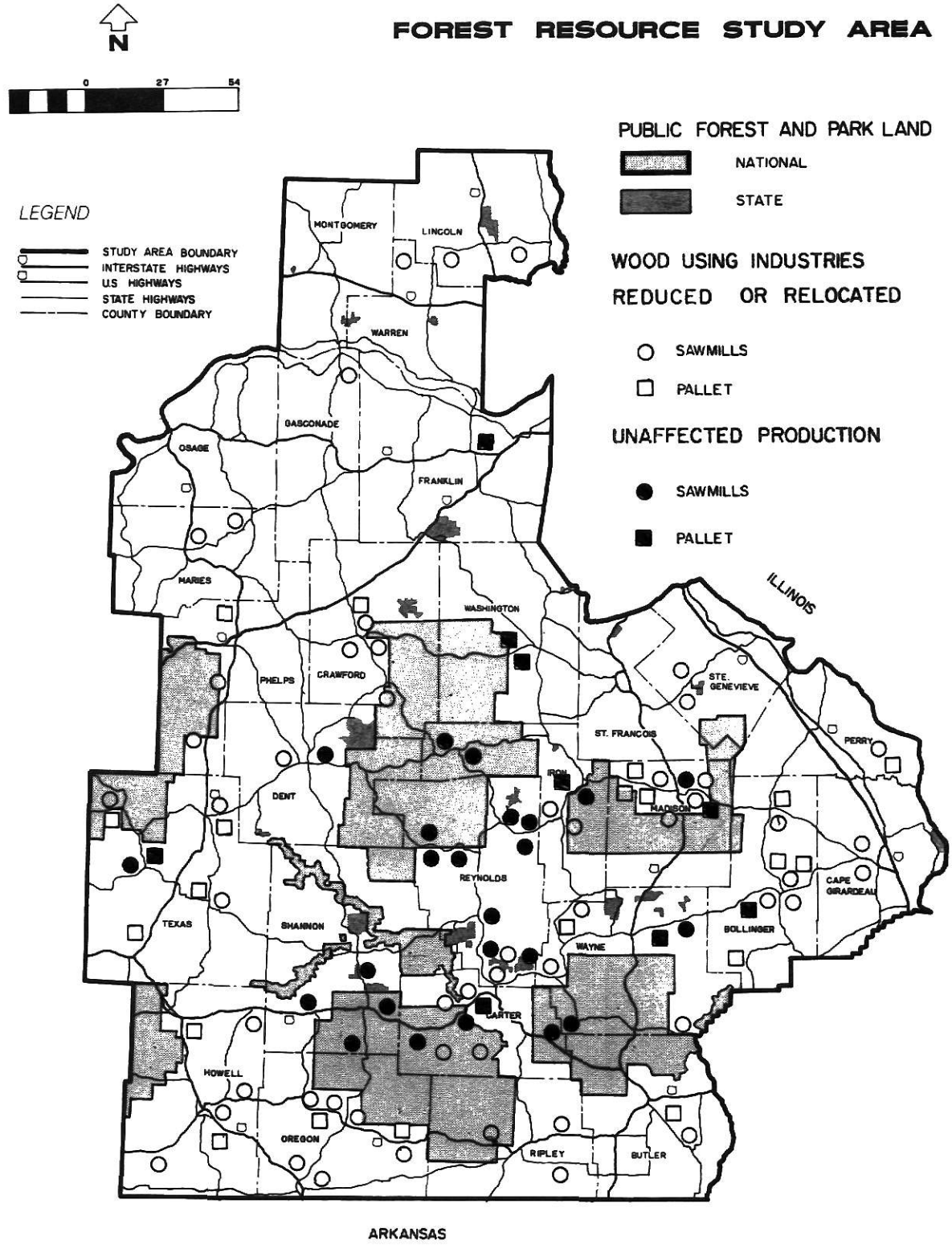
Summary

Adoption of the various recommendations presented in this chapter would support the successful implementation of the conservation scenario. As described in Chapter 5, implementation of the conservation scenario would cost a total of $2.0 million per year from 1982 to the year 1992, and $250,000 per year thereafter up to the year 2062. The assumptions, costs and benefits associated with the conservation scenario were discussed in Chapters 3 and 5. Maps 11 and 12 illustrate the predicted distribution of sawtimber inventories in the study area under the conservation scenario for the years 2002-2012 and 2052-2062, respectively. Map 13, which corresponds with Map 11, shows which industries would be most affected by reductions or shifts in the available forest resource by the year 2002 under the conservation scenario. The outlined

MAP 13

INDUSTRIAL RELOCATION BY YEAR 2002

FOREST RESOURCE STUDY AREA



SOURCE CONSERVATION SCENARIO DATA INTERPRETATION

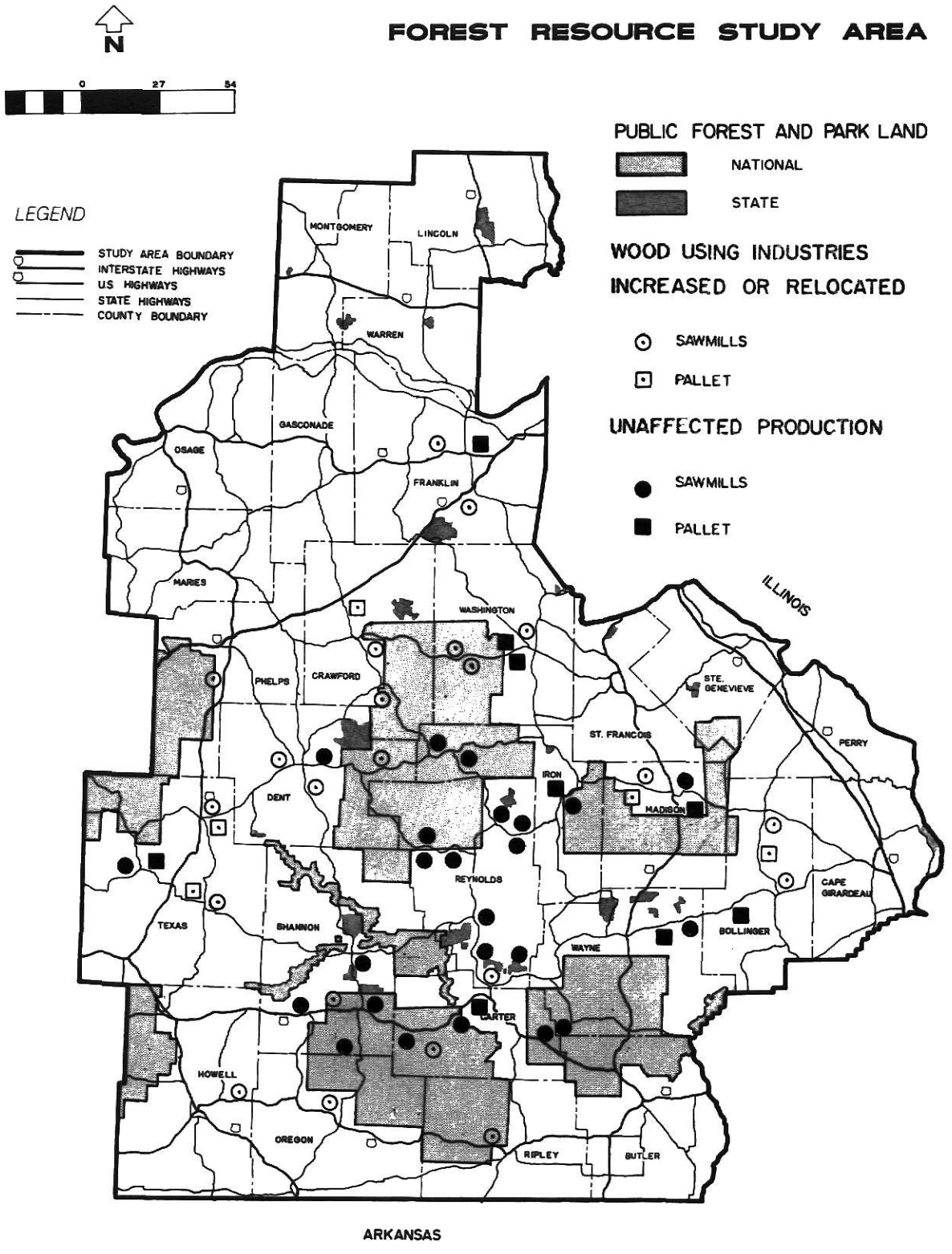
wood-using industries would be those most likely to come under pressure to relocate in order to maintain accessibility to raw material inputs. Map 14 depicts the predicted locations of wood-using industries in the year 2052 under the conservation scenario. By that time, those industry locations shown on Map 14 outlined and with a dot in the middle would become favorable locations to restart operations or expand production to utilize new sawtimber inventories produced under the conservation scenario.

Areas of Study for Others to Pursue

The following is a list of study areas touched upon in this study that the author felt could be improved or updated, or which were study topics which sparked an interest but were outside the scope of this study:

1. The 1972 Third Forest Survey for Missouri is due for an update. Inventories, growth and removal rates should be carefully surveyed and recorded in board feet wherever possible to help non-forestry professionals like the author to understand and use the data. It has been proposed (21) that forestry surveys have historically underestimated growth rates and thus are always predicting a future shortage. The new survey should dispel or confirm this accusation.
2. LANDSAT photography should be investigated to determine if it offers a viable inventorying process to supplement field surveys and industrial location studies.
3. Additional surveys of small forest property owners are needed to determine if an expanded educational program would be beneficial.
4. An extensive program to determine the improvement of timber growth rates of stands under FIP TSI management, compared to other unmanaged timber stands, needs to be undertaken for better cost/benefit data and analysis.
5. If the Federal government sells off its excess forest land, a study should be undertaken to comprehensively determine what areas would be best for industrial large tract forest management and what other areas should be recommended for smaller recreational uses.

MAP 14
INDUSTRIAL RELOCATION BY YEAR 2052
FOREST RESOURCE STUDY AREA



SOURCE: CONSERVATION SCENARIO DATA INTERPRETATION

REFERENCES

1. Comprehensive Program Review. Self-Evaluation Report. Columbia, Mo.: University of Missouri, 1976.

2. Cooperative Extension Service, Kansas State University. Woodland Tax Guide. Manhattan, Kansas, 1974.

3. Forest Division, Missouri Department of Conservation. Missouri Forest Products Industries 1975. Jefferson City, Mo.: Missouri State Press, 1976.

4. Missouri Conservation Commission. Forestry in Missouri. Jefferson City, Mo.: Missouri State Press, 1970.

5. Missouri Department of Conservation. 1975-76 Annual Report. Jefferson City, Mo.: Missouri State Press, 1976.

6. Missouri Department of Conservation. "The New Design for Conservation." Missouri Conservationist, (August, 1975).

7. J.S. Spencer, Timber in Missouri 1972. U.S. Department of Agriculture Forestry Service, Resource Bulletin NC-30, Washington, D.C.: U.S. Printing Office, 1976.

8. Statement by Harold Whitt, Farm Forester, in a personal interview, Columbia, Mo., April 25, 1977.

9. Statements by Eldon Heflin, State Forester, in a personal interview, Columbia, Mo., May 9, 1977.

10. Statements by William B. Kurtz, Associate Professor in Forestry, in a personal interview, University of Missouri, Columbia, Mo., August 16, 1977.

11. Statement by Gene W. Grey, Associate Professor in Forestry, in a personal interview, Kansas State University, June 29, 1978.

12. J.S. Spencer, Timber Resource of Missouri's Eastern Ozarks 1972. U.S. Department of Agriculture Forestry Service, Resource Bulletin NC-19, Washington, D.C.: U.S. Printing Office, 1974.

13. U.S. Department of Agriculture Forestry Service, The Outlook for Timber in the United States, FRR-20, Washington, D.C.: U.S. Printing Office, 1973.

14. U.S. Department of Agriculture Forestry Service, Public Assistance for Forest Landowners, U.S. Printing Office, 1976.

15. Statements by Rodney Jacobs, USDA Forestry Field Representative, in a telephone interview, Minneapolis, Minnesota, November 26, 1980.

16. U.S. Department of Agriculture Forestry Service, A Report to Congress on the Nation's Renewable Resources, Washington, D. C.: U.S. Printing Office, 1979.

17. U.S. Department of Agriculture Forestry Service, Plan for Managing the National Forests in Missouri, Rolla, Missouri: U.S. Printing Office, 1976.

18. U.S. Department of Agriculture Forestry Service, Guide for Managing the National Forests in the Ozark Highlands, Jefferson City, Missouri: U.S. Printing Office, 1974.

19. T.K. Foutch, "An Economic Analysis of Alternative Federal Incentive Schemes for Small Woodlot Management: Dent and Reynolds Counties, Missouri", (Master's Thesis, Washington University, St. Louis, Missouri, 1976).

20. J. Marsh, "Missouri Primary Wood Using Industry Study", (Master's Thesis, University of Missouri, Columbia, Missouri, 1976).

21. S.H. Olson, The Depletion Myth, Cambridge, Massachusetts: Harvard Press, 1971.

22. J.A. Zirnuska, "Forestry Investments for Multiple-Uses Among Multiple Ownership Types", Washington, D.C., 1974.

23. R.L. Morlerand, P.F. Graves, A New Management Rationale for Small Forest Landowners, American Forest Research Institute, 1974.

24. J.H. Farrell, The Small-Woodland Owner in the Missouri Ozarks - A Close-up, Central States Forest Experiment Station, Columbus, Ohio, 1964.

25. K. Brinkman and R. Smith, Managing Shortleaf Pine in Missouri, Agricultural Experiment Station, University of Missouri, Columbia, Missouri, 1968.

26. R. Beasley and I. Holland, Predicting the Success of Alternative Government Incentive Programs: A Case Analysis of Small Woodland Owner Behavior, Southern Illinois University, Carbondale, Illinois, 1973.

GLOSSARY

This glossary of terms was obtained from Timber in Missouri 1972 (7) and The Outlook for Timber in the United States (13).

Allowable Harvest. The volume of timber that would be cut on commercial timberland during a given period under specified management plans aimed at sustained production of timber products.

Commercial Timberland. Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. Commercial timberland must have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included, except when the areas involved are small and unlikely to become suitable for production of industrial wood in the foreseeable future.

Diameter Classes. A classification of trees based on diameter outside bark, measured at breast height (4.5 feet above the ground). D.b.h. is the common abbreviation for diameter at breast height. Two-inch diameter classes are commonly used in the Forest Surveys, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h., inclusive.

Forest Land. Land at least 10 percent occupied by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. The minimum are for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas are classed as forest if less than 120 feet in width.

Forest Site Productivity Class. A classification of forest land in terms of potential cubic-foot volume growth per acre at culmination of mean annual increment in fully stocked natural stands.

Forest Type. A classification of forest land based upon the species forming a plurality of live-tree stocking. Type is determined on the basis of species plurality of all live trees that contribute to stocking.

Growing-stock Trees. Live trees of commercial species qualifying as desirable or acceptable trees. Excludes rough, rotten, and dead trees.

Growing-stock Volume. Net volume in cubic feet of growing-stock 5.0 inches d.b.h. and over from a 1-foot stump to a minimum 4.0 inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Industrial Wood. All roundwood products, except fuelwood.

Ingrowth. The number or net volume of trees that grow large enough during a specified year to qualify as saplings, poletimber, or sawtimber.

Mortality. Number or sound-wood volume of live trees dying from natural causes during a specified period.

Multiple-use Management. The management of land resources aimed at achieving optimum yields of products and services from a given area without impairing the productive capacity of the site.

National Forest Lands. Federal lands which have been legally designated as National Forests or purchase units, and other lands under the administration of the Forest Service, including experimental areas.

Net Annual Growth. The increase in volume of trees during a specified year. Components of net annual growth include the increment in net volume of trees at the beginning of the specified year surviving to its end, plus the net volume of trees reaching the minimum size class during the year, minus the volume of trees that became rough or rotten trees during the year.

Net Volume in Board Feet. The gross board-foot volume of trees less deductions for rot or other defect affecting use of lumber.

Net Volume in Cubic Feet. Gross volume in cubic feet less deductions for rot.

Nonstocked Areas. Commercial timberland with less than 10 percent occupied with growing-stock trees.

Other Removals. The net volume of growing-stock trees removed from the inventory by cultural operations such as timber-stand improvement, by land clearing and by changes in land use, and not utilized for timber products.

Poletimber Stands. Stands at least 10 percent occupied with growing-stock trees of which half or more of this stocking is in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Primary Wood-processing Plants. Plants using road wood products such as sawlogs, pulpwood bolts, veneer logs, etc.

Productive-reserved Forest Land. Forest land sufficiently productive to qualify as commercial timberland, but withdrawn from timber utilization through statute or administrative designation.

Removals. Volumes of timber removed from the growing-stock inventory, including timber products, logging residues, and other removals such as land clearing.

Rotation. The period of years between establishment of a stand of timber and the time when it is considered ready for final harvest and regeneration.

Sawlogs. Logs meeting minimum regional standards of diameter, length, and defect. Logs must be at least 8 feet long, have a minimum diameter inside bard of 6 inches for softwoods and 8 inches for hardwoods and maximum defect as specified by regional standards.

Sawtimber Stands. Stands at least 10 percent occurpied with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Sawtimber Trees. Live trees of commercial species containing at least one 12-foot sawlog or two noncontiguous 8-foot logs, and meeting regional specifications for freedom from defect. Softwood trees must be at least 9.0 inches in diameter at breast height. Hardwood trees must be at least 11.0 inches in diameter.

Secondary Wood-processing Plants. Plants using primary manufactured products such as lumber, woodpulp, veneer, or plywood.

Shortleaf Pine. Forests in which shortleaf pine comprises a plurality of the stocking.

Shortleaf Pine-oak. Forests in which upland oaks comprise a plurality of the stocking, but in which shortleaf pine comprises 25 to 50 percent of the stocking.

Short-log. Sawtimber-sized trees of commercial species that contain at least one merchantable 8 to 11-foot sawlog but rot a 12-foot sawlog.

Site Preparation. Removal or deadening of unwanted vegetation prior to

planting trees, including prescribed burning, use of herbicides, and disking and other mechanical means of removing vegetative cover.

Softwoods. Coniferous trees, usually evergreen having needles or scalelike leaves.

Stand-age. Age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Stand Improvements. Measures such as thinning, release cutting, girdling, weeding, or poisoning of unwanted trees aimed at improving growing conditions.

Stand-size Class. A classification of forest land based on the size class of growing-stock trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

Timber Demand. The volume of timber that would be purchased at specified prices.

Timber Supply. (or timber harvest) Net volume of roundwood products available to forest industries from all sources at specified or implied price levels.

Tree Size Class. A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings and seedlings.

Trend Level. Estimate based on a curve or regression equation constructed from observed values over time.

Volume of Sawtimber. Net volume of the sawlog portion of live sawtimber trees in board feet, International 1/4-inch rule, from stump to a minimum 7 inches top diameter outside bark for softwoods and 9 inches for hardwoods.

A

PREDICTED SAWTIMBER GROWTH AND REMOVAL RATES

Appendix A

PREDICTED SAWTIMBER GROWTH AND REMOVAL RATES

The growth, removals and inventory of sawtimber are illustrated with the use of graphs, tables and maps. Map 1 in the report is a reproduction of a LANDSAT composite photograph taken from outer space. Map 4 is a SYMAP computer representation of the sawtimber distribution in the year 1972. This SYMAP technique uses the trend surface method of defining the boundary, plotting the data points and entering the data values for each point. The trend surface method distributes the values between the data points with the use of the gravity model.

State Removal Options

Tables 13 and 14 give the values which were used on Graphs 1 and 2 respectively. These values are a revision and projection of the original information in a USDA Forestry Report (7). Many rates of increased growth and removals were assumed from past trends and extrapolated into the future. These two graphs are a general representation of the trend of removals and growth at the state level which has been revised to represent the twenty-seven county study area.

TABLE 12

BASE YEAR 1972

(Million Board Feet)

County	Sawtimber Inventory in	Sawtimber Ground/yr.	Sawtimber Removals/yr.	Resulting Inventory	Net Change
Bollinger	275.7	6.4	-11.4	270.7	- 5.0
Butler	261.5	6.3	- 7.7	260.0	- 1.5
Carter	318.0	7.4	-11.9	313.5	- 4.5
Crawford	412.1	9.7	- 9.7	412.1	0
Dent	374.0	8.8	-10.3	372.5	- 1.5
Iron	364.8	8.6	- 6.3	3671.	+ 2.3
Madison	303.2	7.2	- 8.6	301.9	- 1.4
Oregon	378.5	8.8	-14.3	373.0	- 5.5
Reynolds	560.1	13.1	-18.2	555.0	- 5.1
Ripley	350.0	8.2	-13.5	344.7	- 5.3
St. Francis	158.6	3.7	- 4.3	157.0	- 1.6
Shannon	584.2	13.8	-16.3	581.7	- 2.5
Washington	484.7	11.2	- 6.3	489.6	+ 4.9
Wayne	461.1	10.8	-17.4	454.5	- 6.6
Howell	260.6	7.0	-18.1	249.5	-11.1
Texas	351.0	9.4	-20.9	339.5	-11.5
Maries	104.1	2.1	- 5.7	100.5	- 3.6
Phelps	168.1	3.4	- 5.3	166.2	- 1.9
Cape Car.	156.5	3.3	- 7.1	152.7	- 3.8
Franklin	408.7	8.4	- 6.2	410.9	+ 2.2
Gasconade	250.0	5.1	- 5.1	250.0	0
Montgomery	159.6	3.8	- 4.4	159.6	- 0.6
Osage	248.8	5.4	- 5.8	248.4	- 0.4
Perry	176.4	3.7	- 6.0	174.1	- 2.3
St. Gen.	227.6	4.6	- 6.5	225.7	- 1.9
Warren	212.1	4.7	- 5.0	211.8	- 0.3
Lincoln	106.9	2.8	- 6.5	103.2	- 3.7
	8116.9	187.7	-258.8	8045.8	-71.1

SOURCE: U.S. Department of Agriculture Forestry Service, Timber Resource of Missouri's Eastern Ozarks. (Washington, D.C.: Government Printing Office, 1972), pp. 3-16, pp. 64-86.

TABLE 13

STATE LOW REMOVALS OPTION

(Million Board Feet)

	Removals			Growth			Inventory		
Year	Hardwood	Softwood	Total	Hardwood	Softwood	Total	Hardwood	Softwood	Total
1972	1039.5	54.1	1093.7	1070.9	85.4	1156.3	36,735.9	2405.3	39,141.2
1982	1040.6	57.4	1098.0	1070.2	93.9	1164.1	37,005.3	2756.8	39,762.1
1992	1041.6	69.8	111.4	1068.3	100.4	1168.7	37,258.3	3095.3	40,353.6
2002	1042.6	85.4	1128.0	1065.0	104.4	1169.4	37,488.5	3344.4	40,832.9
2012	1043.6	91.9	1135.5	1061.5	108.4	1169.9	37,718.7	3594.4	41,313.1
2022	1044.6	109.6	1154.2	1061.0	112.4	1173.4	37,948.9	3844.4	41,793.3
2032	1045.6	130.8	1176.4	1060.5	116.4	1176.9	38,179.1	4094.4	42,273.5
2042	1046.6	156.0	1202.6	1060.0	120.4	1180.4	38,409.3	4344.4	42,753.7
2052	1047.6	186.1	1233.7	1059.5	124.4	1183.9	38,639.5	4594.4	43,233.9

TABLE 14

STATE HIGH REMOVALS OPTION

	Removals			Growth			Inventory		
Year	Hardwood	Softwood	Total	Hardwood	Softwood	Total	Hardwood	Softwood	Total
1972	1039.6	54.1	1093.7	1070.9	85.4	1156.3	36,735.9	2405.3	39,141.2
1982	1050.0	60.0	1110.0	1069.6	93.9	1163.5	36,992.2	2749.0	39,741.2
1992	1100.9	84.1	1185.0	1063.1	98.5	1161.6	36,906.8	2982.5	39,889.3
2002	1173.9	108.3	1282.2	1045.5	99.8	1145.3	36,051.8	3006.6	39,058.4
2012	1178.9	144.4	1323.3	1025.5	100.8	1126.3	35,051.8	3006.6	38,058.4
2022	1184.0	192.5	1376.5	1005.5	101.8	1107.3	34.051.8	2961.3	37,013.1
2032	1189.1	256.6	1445.7	985.5	102.8	1088.3	33,051.8	2884.4	35,936.2
2042	1194.2	342.0	1536.2	965.5	103.8	1069.3	32,051.8	2765.3	34,817.1
2052	1199.3	455.8	1655.1	945.5	104.8	1050.3	31,051.8	2589.8	33,641.6

TABLE 15

PREDICTED REMOVALS - SAME GROWTH RATE FOR THE YEARS 1972 TO 2002

(Million Board Feet of Sawtimber)

County Name	%	Inventory 1972	Growth	Removals	Inventory 1982	%	Growth	Removals	Inventory 1992	Growth	Removals	Inventory 2002
Bollinger	4.4	275.7	63.8	160.1	179.4	2.9	63.8	191.4	51.8	63.8	115.6	-0-
Butler	3.2	261.5	62.5	111.1	212.9	3.4	62.5	147.7	127.7	62.5	190.2	-0-
Carter	3.9	318.0	74.4	160.3	232.2	3.8	74.4	202.3	104.3	74.4	178.7	-0-
Crawford	5.0	412.1	96.6	150.0	358.7	5.8	96.6	213.5	241.8	96.6	338.4	-0-
Dent	4.5	374.0	88.0	150.2	311.8	5.0	88.0	205.2	194.6	88.0	282.6	-0-
Iron	4.4	364.8	86.0	109.4	341.4	5.5	86.0	169.7	257.7	86.0	343.7	-0-
Madison	3.7	303.2	71.6	124.9	249.9	4.0	71.6	168.0	153.5	71.6	225.1	-0-
Oregon	4.6	378.5	88.1	191.3	275.3	4.5	88.1	240.8	122.6	88.1	210.7	-0-
Reynolds	6.8	560.1	131.0	254.2	436.9	7.1	131.0	331.7	236.2	131.0	367.2	-0-
Ripley	4.2	350.0	82.5	179.1	253.4	4.1	82.5	223.3	112.6	82.5	195.1	-0-
St. Francois	2.0	158.6	37.5	63.9	132.3	2.1	37.5	86.5	83.3	37.5	120.8	-0-
Shannon	7.1	584.2	137.7	238.2	483.7	7.8	137.7	322.3	299.1	137.7	436.8	-0-
Washington	5.9	484.7	112.1	125.6	471.3	7.6	112.1	207.6	375.8	112.1	487.9	-0-
Wayne	5.6	461.1	107.7	233.6	335.3	5.4	107.7	291.8	151.2	107.7	258.9	-0-
Howell	3.2	260.6	69.5	214.5	115.6	-0-	69.5	185.2	-0-	69.5	69.5	-0-
Texas	4.3	351.0	93.9	253.9	191.0	3.1	93.9	284.9	-0-	93.9	93.9	-0-
Maries	1.3	104.1	21.3	70.6	54.8	-0-	21.3	76.2	-0-	21.3	21.3	-0-
Phelps	2.1	168.1	33.9	75.1	126.9	2.1	33.9	98.2	62.6	33.9	96.5	-0-
Cape	1.9	156.5	33.1	91.1	98.6	1.6	33.1	108.3	23.4	33.1	56.5	-0-
Franklin	4.9	408.7	84.2	113.2	379.8	6.1	84.2	179.9	284.0	84.2	368.2	-0-
Gasconade	3.1	250.0	50.9	83.5	217.4	3.5	50.9	122.2	146.0	50.9	196.9	-0-
Montgomery	2.0	159.6	37.6	64.7	132.6	2.1	37.6	87.3	82.9	37.6	120.5	-0-
Osage	3.1	248.8	54.4	90.5	212.8	3.4	54.4	127.2	140.0	54.4	194.4	-0-
Perry	2.2	176.4	37.0	83.4	130.0	2.1	37.0	106.0	61.0	37.0	98.0	-0-
St. Gen.	2.8	227.6	45.6	94.9	178.3	2.9	45.6	126.2	97.7	45.6	143.3	-0-
Warren	2.6	212.1	46.7	77.4	181.5	2.9	46.7	108.7	119.5	46.7	166.2	-0-
Lincoln	1.3	106.9	27.6	78.2	56.3	.9	27.6	83.9	-0-	27.6	27.6	-0-
		8116.9	1875.2	3642.0	6350.1		1875.2	4696.0	3529.3	1875.2	5404.5	-0-

NOTES: The growth and removal rates are in ten year totals. The removal rate i increased to meet the twenty-seven County study area's existing percentage of the USDA's future regional demand. These removal increases are evenly distributed by each county's percentage of total sawtimber. The 1972 redistribution is 1054 million bf and the 1982 redistribution is 1077.9 million bf.

TABLE 16

STATUS QUO - SAME GROWTH RATE FOR THE YEARS 1972 TO 2002

(Million Board Feet of Sawtimber)

County Name	Inventory 1972	Growth	Removals	Inventory 1982	Growth	Removals	Inventory 1992	%	Growth	Removals	Inventory 2002
Bollinger	275.7	63.8	113.7	225.8	63.8	113.7	175.9	2.7	63.8	115.9	123.8
Butler	261.5	62.5	77.4	246.6	62.5	77.4	231.7	3.5	62.5	80.2	214.0
Carter	318.0	74.4	119.2	273.2	74.4	119.2	228.4	3.4	74.4	121.9	180.9
Crawford	412.1	96.6	97.3	411.4	96.6	97.3	410.7	6.1	96.6	102.2	405.1
Dent	374.0	88.0	102.8	359.2	88.0	102.8	344.4	5.1	88.0	106.9	325.5
Iron	364.8	86.0	63.1	387.7	86.0	63.1	410.6	6.1	86.0	68.0	428.6
Madison	303.2	71.6	86.0	288.8	71.6	86.0	274.4	4.1	71.6	89.3	256.7
Oregon	378.5	88.1	142.9	323.7	88.1	142.9	268.9	4.0	88.1	146.1	210.9
Reynolds	560.1	131.0	182.4	508.7	131.0	182.4	457.3	6.8	131.0	187.9	400.4
Ripley	350.0	82.5	134.9	297.6	82.5	134.9	245.2	3.7	82.5	137.9	189.8
St. Francois	158.6	37.5	42.7	153.4	37.5	42.7	148.2	2.2	37.5	44.5	141.2
Shannon	584 2	137.7	163.5	558.4	137.7	163.5	532.6	8.0	137.7	169.9	500.4
Washington	484.7	112.1	63.5	533.3	112.1	63.5	581.9	8.7	112.1	70.5	623.5
Wayne	461.1	107.7	174.5	394.3	107.7	174.5	327.5	4.9	107.7	178.4	256.8
Howell	260.6	69.5	180.9	149.2	69.5	180.9	37.8	-0-	69.5	107.3	-0-
Texas	351.0	93.9	208.5	236.4	93.9	208.5	121.8	1.9	93.9	210.0	5.7
Marles	104.1	21.3	56.8	68.5	21.3	56.8	33.0	-0-	21.3	54.3	-0-
Phelps	168.1	33.9	53.1	148.9	33.9	53.1	129.7	2.0	33.9	54.7	108.9
Cape	156.5	33.1	71.2	118.4	33.1	71.2	80.3	1.2	33.1	72.2	41.2
Franklin	408.7	84.2	61.7	431.2	84.2	61.7	453.7	7.0	84.2	67.3	470.6
Gasconade	250.0	50.9	50.9	250.0	50.9	50.9	250.0	3.9	50.9	54.0	246.9
Montgomery	159.6	37.6	43.7	153.5	37.6	43.7	147.4	2.9	37.6	46.0	139.0
Osage	248.8	54.4	57.9	245.3	54.4	57.9	241.8	3.7	54.4	60.9	235.3
Perry	176.4	37.0	60.3	153.1	37.0	60.3	129.8	2.0	37.0	61.9	104.9
St. Gen.	227.6	45.6	65.5	207.7	45.6	65.5	187.8	2.9	45.6	67.8	165.6
Warren	212.1	46.7	50.1	208.7	46.7	50.1	205.3	3.2	46.7	52.7	199.3
Lincoln	106.9	27.6	64.6	69.9	27.6	64.6	32.9	-0-	27.6	60.5	-0-
	8116.9	1875.2	2589.1	7403.0	1875.2	2589.1	6689.0		1875.2	2589.1	5974.0

NOTES: The growth and removal rates are in ten year totals. The growth and removal rate totals are held constant throughout this scenario's study period. The individual county's removal reallocation increases are evenly distributed by each county's percentage of total sawtimber. The 1992 redistribution is 80.3 million bf.

TABLE 16 - CONTINUED

STATUS QUO - SAME GROWTH RATE FOR THE YEARS 2002 TO 2032

(Million Board Feet of Sawtimber)

County Name	%	Inventory 2002	Net Growth	Removals	Inventory 2012	%	Net Growth	Removals	Inventory 2022	%	Net Growth	Removals	Inventory 2032
Bollinger	2.1	123.8	63.8	120.4	67.2	2.1	63.8	121.4	9.6	-0-	63.8	73.4	-0-
Butler	3.6	214.0	62.5	87.9	188.6	3.6	62.5	89.6	161.5	3.6	62.5	91.9	132.1
Carter	3.0	180.9	74.4	128.3	127.0	3.0	74.4	129.7	71.7	1.6	74.4	130.7	15.4
Crawford	6.8	405.1	96.6	116.8	384.9	6.9	96.6	119.0	362.5	8.0	96.6	124.0	335.1
Dent	5.4	325.5	88.0	118.5	295.0	5.5	88.0	121.0	262.0	5.8	88.0	124.7	225.3
Iron	7.2	428.6	86.0	83.4	431.2	7.3	86.0	86.7	430.5	9.5	86.0	92.7	423.8
Madison	4.3	256.7	71.6	98.5	229.8	4.3	71.6	100.5	200.9	4.4	71.6	103.3	169.2
Oregon	3.5	210.9	88.1	153.6	145.4	3.5	88.1	155.2	78.3	1.7	88.1	156.3	10.1
Reynolds	6.7	400.4	131.0	202.2	329.2	6.8	131.0	205.3	254.9	5.6	131.1	208.8	177.2
Ripley	5.2	189.8	82.5	149.0	123.3	5.2	82.5	151.4	54.4	-0-	82.5	136.9	-0-
St. Francois	2.4	141.2	37.5	49.6	129.1	2.4	37.5	50.7	115.9	2.6	37.5	52.3	101.1
Shannon	8.4	500.4	137.7	187.8	450.3	8.5	137.7	191.7	396.3	8.7	137.7	197.2	336.8
Washington	10.4	623.5	112.1	92.7	642.9	10.5	112.1	97.5	657.5	14.5	112.1	106.6	663.0
Wayne	4.3	256.8	107.7	187.6	176.9	4.3	107.7	189.6	95.0	2.1	107.7	190.9	11.8
Howell	-0-	-0-	69.5	69.5	-0-	-0-	69.5	69.5	-0-	-0-	69.5	69.5	-0-
Texas	-0-	5.7	93.9	99.6	-0-	-0-	93.9	93.9	-0-	-0-	93.9	93.9	-0-
Marles	-0-	-0-	21.3	21.3	-0-	-0-	21.3	21.3	-0-	-0-	21.3	21.3	-0-
Phelps	1.8	108.9	33.9	58.5	84.3	1.8	33.9	59.3	58.9	1.3	33.9	60.1	32.7
Cape	.7	41.2	33.1	73.7	0.6	-0-	33.1	33.7	-0-	-0-	33.1	33.1	-0-
Franklin	7.9	470.6	84.2	84.2	470.6	8.0	84.2	87.9	466.9	10.3	84.2	94.4	456.7
Gasconade	4.1	246.9	50.9	62.8	235.0	4.1	50.9	64.7	221.9	4.9	50.9	67.8	205.0
Montgomery	2.3	139.0	37.6	50.9	125.7	2.3	37.6	52.0	111.3	2.5	37.6	53.6	95.3
Osage	3.9	235.3	54.4	69.2	220.5	3.9	54.4	71.0	203.9	4.5	54.4	73.8	184.5
Perry	1.8	104.9	37.0	65.8	76.1	1.8	37.0	66.6	46.5	1.0	37.0	67.2	16.3
St. Gen.	2.8	165.6	45.6	73.8	137.4	2.8	45.6	75.1	107.9	2.4	45.6	76.6	76.9
Warren	3.3	199.3	46.7	59.8	186.2	3.3	46.7	61.3	171.6	3.8	46.7	63.7	154.6
Lincoln	-0-	-0-	27.6	27.6	-0-	-0-	27.6	27.6	-0-	-0-	27.6	27.6	-0-
		5975.1	1875.0	2593.0	5257.2		1875.0	2593.2	4539.9		1875.0	2592.3	3822.9

NOTE: The years 2002, 2012 and 2022 redistribution are 214.1, 45.7 and 63.1 million bf respectively.

TABLE 16 - CONTINUED

STATUS QUO - SAME GROWTH RATE FOR THE YEARS 2032 TO 2052

County Name	%	Inventory 2032	Net Growth	Removals	Inventory 2042	%	Net Growth	Removals	Inventory 2052
Bollinger	-0-	-0-	63.8	63.8	-0-	-0-	63.8	63.8	-0-
Butler	3.5	132.1	62.5	102.6	92.0	3.0	62.5	104.0	50.5
Carter	-0-	15.4	74.4	89.8	-0-	-0-	74.4	74.4	-0-
Crawford	8.8	335.1	96.6	145.9	285.8	9.3	96.6	153.2	229.2
Dent	5.9	225.3	88.0	138.3	175.0	5.7	88.0	142.8	120.2
Iron	11.1	423.8	86.0	120.2	389.6	12.7	86.0	130.2	345.4
Madison	4.4	169.2	71.6	114.2	126.6	4.1	71.6	117.4	80.8
Oregon	-0-	10.1	88.1	298.2	-0-	-0-	88.1	88.1	-0-
Reynolds	4.6	177.2	131.1	220.2	88.1	-0-	131.1	219.2	-0-
Ripley	-0-	-0-	82.5	82.5	-0-	-0-	82.5	82.5	-0-
St. Francois	2.6	101.1	37.5	58.7	79.9	2.6	37.5	60.7	56.7
Shannon	8.8	336.8	137.7	219.1	255.4	8.3	137.7	225.6	167.5
Washington	17.3	663.0	112.1	149.5	625.6	20.3	112.1	165.5	572.2
Wayne	-0-	11.8	107.7	119.5	-0-	-0-	107.7	107.7	-0-
Howell	-0-	-0-	69.5	69.5	-0-	-0-	69.5	69.5	-0-
Texas	-0-	-0-	93.9	93.9	-0-	-0-	93.9	93.9	-0-
Maries	-0-	-0-	21.3	21.3	-0-	-0-	21.3	21.3	-0-
Phelps	0.9	32.7	33.9	62.3	4.3	-0-	33.9	38.2	-0-
Cape	-0-	-0-	33.1	33.1	-0-	-0-	33.1	33.1	-0-
Franklin	12.0	456.7	84.2	424.1	416.8	13.5	84.2	137.1	363.9
Gasconade	5.4	205.0	50.9	81.2	174.7	5.7	50.9	85.7	139.9
Montgomery	2.5	95.3	37.6	59.8	73.1	2.4	37.6	61.7	49.0
Osage	4.8	184.5	54.4	85.7	153.2	5.0	54.4	89.6	118.0
Perry	-0-	16.3	37.0	53.3	-0-	-0-	37.0	37.0	-0-
St. Gen.	2.0	76.9	45.6	81.6	40.9	1.3	45.6	82.6	3.9
Warren	4.0	154.6	46.7	73.7	127.6	4.1	46.7	76.9	97.4
Lincoln	-0-	-0-	27.6	27.6	-0-	-0-	27.6	27.6	-0-
		3822.9	1875.0	2589.6	3078.6		1875.0	2589.3	2394.6

NOTE: The years 2032 and 2042 redistribution are 248.3 and 78.6 million bf respectively.

B

REGRESSION ANALYSIS

Appendix B

REGRESSION ANALYSIS

For the purposes of this study, four independent variables were examined to determine what, if any, relationship they might have to the dependent target variable, level of lumber production. The four variables examined were: (1) amount of commercial forest acreage; (2) number of sawmills; (3) number of miles of county and state maintained roads; and (4) the amount of sawtimber acreage which is illustrated in Table 17. The single and combined effects of these four independent variables on the dependent variable, level of lumber production, were determined by simple and multiple linear regression analysis.

The simple linear regression model describing the relationship between two variables takes the form $Y = a + bX + e$, where Y is the dependent variable (that which is to be explained), X is the independent variable (or postulated causal factor), a and b are constants, and e is a random error variate. The correlation coefficient (r) is used to measure the strength of the relationship between X and Y. The general multiple regression model takes the form $Y = a + bX + b_2X_2 \ldots + bnXn + e$, where Y is the dependent variable, X (1,2,.., n) the independent variables, a the intercept (Y line on a graph), b (1,2,.., n) the regression coefficients, and e the error term. The coefficient of multiple correlation (R) is used to measure the strength of the relationship between Y and the set of independent variables. The coefficient of determination (R^2), which can range in value from 0 to 1.0, is used to calculate the percentage of the variance in the dependent variable that is explained by the variance in the independent variables, and the F-test and the t-test are used to check the statistical significance of the relationships between the dependent and independent variables as indicated by linear regression analysis.

Simple Regression Analysis

Regression analysis was used to examine the relationship between the level

TABLE 17

REGRESSION ANALYSIS

	Dependent Variable	Independent Variables			
	Y	X_1	X_2	X_3	X_4
County	Removals in Mill. board feet	Commercial Forest Acres in Thous.	Number of Sawmills	State and County Roads in Miles	Sawtimber Acres in Thous.
Bollinger	11,366	201.7	9	780.1	67.7
Butler	7,743	168.1	2	1037.9	51.9
Carter	11,916	251.8	8	427.7	67.8
Crawford	9,735	320.9	5	832.5	93.6
Dent	10,280	308.2	3	786.7	77.0
Iron	6,310	285.1	7	417.0	75.6
Madison	8,599	227.7	9	410.4	64.5
Oregon	14,296	316.4	7	753.9	85.9
Reynolds	18,240	423.0	14	756.9	123.3
Repley	13,491	269.7	4	587.2	73.4
St. Francis	4,274	141.1	0	546.2	34.6
Shannon	16,350	477.0	6	838.7	122.0
Washington	6,350	355.0	2	628.6	110.1
Wayne	17,450	338.3	7	691.1	98.3
Howell	18,087	270.6	6	509.1	91.0
Texas	20,851	373.6	9	1394.6	110.5
Maries	5,681	137.1	2	602.6	34.3
Phelps	5,310	212.7	4	809.2	56.3
Cape G.	7,121	87.4	4	826.0	38.1
Franklin	6,166	234.5	2	1279.4	102.3
Gasconade	5,087	154.3	1	694.1	60.5
Montgomery	4,374	102.1	1	761.9	37.4
Osage	5,791	170.2	0	701.7	60.2
Perry	6,027	103.4	3	695.3	43.7
St. Genevieve	6,549	151.8	3	494.5	54.2
Warren	5,010	123.5	1	473.9	50.5
Lincoln	6,461	79.4	2	867.5	30.5

of lumber production (Y) and the four independent variables previously noted. The simple regression analysis indicated that lumber production in the twenty-seven county study area is positively related to commercial forest acreage, number of sawmills and sawtimber acreage. No relationship was observed between the level of lumber production and the number of miles of county and state maintained roads. To achieve this positive relationship the calculations must show a R^2 value over .50 (author's assumed level) and have F and t values which are greater than or equal to the given standard deviation values for regression analysis.

There is an acceptable relationship between the number of commercial forest acres and the amount of lumber produced because the R^2 value is .56, F test is $32.39 \geq 4.24$ and the t test is $5.69 \geq 2.06$. In graphing this relationship the Y intercept is 1440.55 and the slope is positive 35.01. This relationship means that if the commercial forest land area is increased by one unit (1000 acres) then 56 percent of the 35 units (35 MBF) of increase in lumber production can be described. The remaining 44 percent of the increase has been caused by other factors.

The relationship between the number of sawmills and the amount of lumber produced is acceptable because the R^2 value equals .56, F test is $31.63 \geq 4.24$ and the t test is $5.62 \geq 2.06$. The graph has a Y intercept of 4690.72 and a slope of positive 1093.10. This relationship means that if the number of sawmills is increased by one then 56 percent of the 1093 units (1093 MBF) of increase in lumber production can be described by this relationship. This relationship shows that having more sawmills in the same county increases lumber production the most of all the variable combinations.

The relationship between the miles of county and state roads and lumber production is not acceptable because the R^2 value is .05, F test is $1.41 \geq 4.24$ and the t test is $1.19 \geq 2.06$. Failing any of these three calculations would render this relationship statistically unacceptable.

There is an acceptable relationship between the number of sawtimber acres and the amount of lumber produced because the R^2 value equals .52, F test is $27.04 \geq 4.24$ and the t test is $5.20 \geq 2.06$. The graph has a Y intercept of 431.28 and a positive slope of 129.11. This relationship means that if the number of sawtimber acres increase by one unit (1000 acres) then 52 percent of the 129 units (129 MBF) of lumber production increase can be described by this relationship.

Multiple Regression Analysis

Out of the eleven possible independent variable combinations, the multiple regression analysis determined that only two combinations were statistically significant. Under the first of these two, the level of lumber production was seen to increase as the independent variables of the number of sawmills and commercial forest acreage were increased. Under the second statistically significant variable combination, the level of lumber production was seen to increase with increasing sawtimber acreage and the number of sawmills.

The first relationship was statistically acceptable because of R^2 is .69, F test is $26.69 \geq 3.40$ and the two t test are $3.19 \geq 2.06$ and $3.12 \geq 2.06$. The graph of these two lines have a Y intercept of 1556.24 and positive slopes of 21.70 and 665.56. This multiple regression relationship has three meanings: (1) If the number of commercial forest acres was increased by one unit (1000 acres) and the number of sawmills was held constant, there will be a 21.7 MBF increase in the lumber production; (2) If the number of sawmills was increased by one and the number of commercial acres was held constant, there will be a 665.56 MBF increase of lumber production; and (3) If both of these independent variables were increased by one unit, there will be a 687.26 MBF increase in lumber production.

The second multiple regression relationship is between the number of sawmills, amount of sawtimber acreage and lumber production. It is statistically acceptable because the R^2 value is .68, F test is $25.78 \geq 3.40$ and the two

t tests are $3.51 \geq 2.06$ and $3.06 \geq 2.06$. The graph of these two lines has a Y intercept of 843.10 and positive slopes of 725.32 and 77.49. This relationship also has three meanings: (1) If the number of sawmills is increased by one and the amount of sawtimber acreage is held constant, there will be a 725.32 MBF increase in lumber production; (2) If the number of sawtimber acres is increased by one unit (1000 acres) and the number of sawmills held constant, there will be a 77.49 MBF increase in lumber producttion; and (3) If both independent variables are increased by one unit, there will be a 802.81 MBF increase in lumber production.

C

FORESTRY MANAGEMENT SCENARIO DATA

Appendix C

FORESTRY MANAGEMENT SCENARIO DATA

Goals and objectives were established as a starting point for the development of future resource management strategies or scenarios. These goals and objectives were quantified with the use of USDA Forestry Service trends or assumed rates derived from past levels of growth and removals. In some instances growth, removal and inventory rates were assumed by the author, based on an interpretation of the available data.

The new growth rate per acre was derived from the multiplying the old growth rates by two as suggested by a forester (11). The old growth rate was calculated by dividing the existing (1972) sawtimber growth level into the 1982 status quo number of sawtimber acres. These are the assumed 1982 old growth rates on million bf per acre are for the ten year cohorts: Bollinger 1.19, Butler 1.78, Carter 1.28, Crawford 1.27, Dent 1.36, Iron 1.40, Madison 1.38, Oregon 1.23, Reynolds 1.27, Ripley 1.39, St. Francois 1.35, Shannon 1.32, Washington 1.22, Wayne 1.31, Howell 1.04, Texas 1.17, Maries .90, Phelps .84, Capge G. 1.16, Franklin 1.08, Gasconade 1.07, Montgomery 1.51, Osage 1.22, Perry 1.11, St. Gen. 1.05, Warren 1.31 and Lincoln 1.37.

High Production Scenario

The overall goal of this scenerio is to increase lumber production to meet the increased rate of demand which was projected by the USDA Forestry Service for the northcentral region of the nation. Other assumptions include that hardwood sawtimber will increase after the year 2002 because of the historic trend of TSI activity between the years 1975 to 1980 in Table 28. It is assumed that no shortleaf pine sawtimber acres will be

lost or gained between the years 2002 and 2042. It was also assumed that one-third of the 1982 shortleaf pine management program will be clear-cut in the year 2052 and again in the year 2062 at a yield of 20 thousand bf per acre.

Inventory Retention Scenario

The major goal of the inventory retention scenario is to return the inventory supply in each county to the 1972 level. To achieve this goal many adjustments to the growth and removal rates per year had to be made in the projection. There are three assumptions which were made to the growth rate to achieve the main goal: (1) Growth will slightly exceed the removal level in the year 2002, (2) Growth will again be increased in the year 2052 and (3) The shortleaf pine management program was restricted to the replacement of the year 1972 shortleaf pine sawtimber level at the same growth rate as the old and new hardwood sawtimber. The three other assumptions dealt with changes in the removal rate: (1) In the year 2052 the counties which have exhausted their inventory in the year 2002 will increase growth, inventory and removal rates to the year 1972 levels, (2) In the year 2002 the counties with exhausted inventories will assume the year 1972 level of removal for their new growth rate, and (3) The removal rates were modified in the years 2002, 2022 and 2052 to obtain the main inventory goal.

Conservation Scenario

The overall goal of the conservation scenario is to restrict the cut of trees on parkland and scenic areas. To adjust the production of future supply to achieve this goal, it was assumed that ten percent of the year 1972 inventory in each county was not available to be cut and it was removed from the calculations. Growth rates for old and new sawtimber were assumed to be the same as the high production scenario.

TABLE 18

HIGH PRODUCTION SCENARIO

1982-1992 MANAGEMENT PROGRAM

(In Thousand Acres)

County	Hardwood TSI		Shortleaf Pine		
	Total	After 1992	Converted from oak	Nonstocked	Pine Total
Bollinger	45.0	2.8	13.9	5.0	18.9
Butler	10.0	0.6	12.2	4.0	16.2
Carter	60.0	11.3	14.8	5.0	19.8
Crawford	25.0	1.5	14.9	6.0	20.9
Dent	65.5	5.3	23.7	7.0	30.7
Iron	27.5	1.9	18.3	8.0	26.3
Madison	40.4	3.4	14.7	3.0	17.7
Oregon	14.0	0.4	23.0	7.0	30.0
Reynolds	90.0	16.4	26.2	10.0	36.2
Ripley	35.0	2.4	13.9	5.0	18.9
St. Francis	8.0	0.6	14.5	5.0	19.5
Shannon	36.0	11.3	31.5	7.0	38.5
Washington	37.0	2.4	23.7	5.0	28.7
Wayne	21.0	4.8	18.0	7.0	25.0
Howell	4.2	1.2	34.7	9.0	43.7
Texas	40.0	9.3	33.9	20.0	53.9
Marles	0.0	0.0	12.0	0.0	12.0
Phelps	13.5	2.6	14.9	4.0	18.9
Cape G.	3.0	0.0	3.0	0.0	3.0
Franklin	13.0	0.5	8.0	1.0	9.0
Gasconade	5.0	0.0	7.0	1.0	8.0
Montgomery	7.0	0.0	5.0	0.0	5.0
Osage	3.0	0.0	10.0	1.0	11.0
Perry	4.0	0.3	4.0	0.0	4.0
St. Gen.	3.0	0.2	10.0	0.0	10.0
Warren	5.0	0.1	10.0	0.0	10.0
Lincoln	1.0	0.1	2.0	0.0	2.0
	615.7	79.4	417.8	120.0	537.8

TABLE 19

HIGH PRODUCTION SCENARIO

PREDICTED SHORTLEAF PINE SAWTIMBER ACREAGE

(In Thousand Acres)

Counties	1972	1982	1992	2002	2012	2022	2032	2042	2052	2062
Bollinger	0.5	1.0	1.1	1.1	1.1	20.0	SAME		13.7	7.4
Butler	4.5	6.0	6.5	6.3	6.0	22.0			16.7	11.4
Carter	3.6	5.0	6.0	5.8	5.5	25.0			18.3	11.6
Crawford	0.4	0.6	0.8	0.9	1.0	31.0			20.9	10.8
Dent	2.0	3.0	3.2	3.5	4.0	35.0			24.3	13.6
Iron	0.6	1.6	1.8	1.8	1.7	28.0			19.2	10.4
Madison	2.8	3.5	4.0	3.8	3.5	21.0			15.2	9.4
Oregon	3.5	5.0	5.2	5.1	5.0	35.0			25.0	15.0
Reynolds	2.2	4.0	4.5	4.3	4.0	40.0			28.0	16.0
Ripley	5.5	6.5	6.8	6.5	6.3	25.0			18.8	12.6
St. Francis	0.1	0.4	0.6	0.6	0.5	20.0			13.5	7.0
Shannon	3.6	6.5	6.8	6.7	6.6	45.0			32.2	19.4
Washington	5.5	7.0	7.0	6.8	6.5	35.0			25.7	16.4
Wayne	4.7	7.5	8.5	8.0	7.5	32.0			23.8	15.6
Howell	1.3	2.0	1.8	2.0	2.2	46.0			31.3	16.6
Texas	4.4	5.7	5.4	5.7	5.9	60.0			41.9	23.8
Marles	0.0	0.0	0.0	0.0	0.0	12.0			8.0	4.0
Phelps	0.0	0.0	0.0	0.1	0.1	19.0			12.7	6.4
Cape G.	0.0	0.0	0.0	0.0	0.0	3.0			2.0	1.0
Franklin	0.0	0.0	0.0	0.0	0.0	9.0			6.0	3.0
Gasconade	0.0	0.0	0.0	0.0	0.0	8.0			5.3	2.6
Montgomery	0.0	0.0	0.0	0.0	0.0	5.0			3.3	1.6
Osage	0.0	0.0	0.0	0.0	0.0	11.0			7.3	3.6
Perry	0.0	0.0	0.0	0.0	0.0	4.0			2.7	1.4
St. Gen.	0.0	0.0	0.0	0.0	0.0	10.0			6.7	3.4
Warren	0.0	0.0	0.0	0.0	0.0	10.0			6.7	3.4
Lincoln	0.0	0.0	0.0	0.0	0.0	2.0			1.3	.6
	45.2	65.3	70.0	69.0	67.4	613.0	613.0	613.0	430.5	248.0

NOTES: The years 2022, 2032 and 2042 amount of acreage is predicted to be the same. In the years 2052 and 2062 one-third of the acreage that were under the new management program will be clearcut.

TABLE 20

HIGH PRODUCTION SCENARIO - PREDICTED HARDWOOD SAWTIMBER ACREAGE

(In Thousand Acres)

County Name	1972	1982	1992	2002	2012	2022	2032	2042	2052	2062
Bollinger	53.0	55.0	55.0	100.0	102.8	105.6	108.4	111.2	114.0	116.8
Butler	30.7	30.0	30.0	40.0	40.6	41.2	41.8	42.4	43.0	43.6
Carter	54.5	60.0	60.0	120.0	131.3	142.6	153.9	165.2	176.5	187.8
Crawford	75.4	75.0	75.0	100.0	101.5	103.0	104.5	106.0	107.5	109.0
Dent	62.8	65.5	65.5	131.0	136.3	141.6	146.9	152.2	157.5	162.8
Iron	63.0	62.5	62.5	90.0	91.9	93.8	95.7	97.6	99.5	101.4
Madison	49.1	50.0	50.0	90.0	93.4	96.8	100.2	10 .6	107.0	110.4
Oregon	67.8	66.0	66.0	80.0	80.4	80.8	81.2	81.6	82.0	82.4
Reynolds	100.6	110.0	110.0	200.0	216.4	232.8	249.2	265.6	282.0	298.4
Ripley	54.0	55.0	55.0	90.0	92.4	94.8	97.2	99.6	102.0	104.4
St. Francois	27.6	27.0	27.0	35.0	35.6	36.2	36.8	37.4	38.0	38.6
Shannon	100.7	108.0	108.0	146.0	157.3	168.6	179.9	191.2	202.5	213.8
Washington	86.5	87.0	87.0	124.0	126.4	128.8	131.2	133.6	136.0	138.4
Wayne	77.4	79.0	79.0	100.0	104.8	109.6	114.4	119.2	124.0	128.8
Howell	65.3	65.8	65.8	70.0	71.2	72.4	73.6	74.8	76.0	77.2
Texas	75.7	80.0	80.0	120.0	129.3	138.6	147.9	157.2	166.5	175.8
Maries	23.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Phelps	40.6	41.5	41.5	65.0	67.6	70.2	72.8	75.4	78.0	80.6
Cape	28 5	27.0	27.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Franklin	78.2	77.0	77.0	90.0	90.5	91.0	91.5	92.0	92.5	93.0
Gasconade	47.5	45.0	45.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Montgomery	24.9	23.0	23.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Osage	44.7	42.0	42.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Perry	33.2	31.0	31.0	35.0	35.3	35.6	35.9	35.9	36.5	36.8
St. Gen.	43.3	42.0	42.0	45.0	45.2	45.4	45.6	45.6	46.0	46.2
Warren	36.7	35.0	35.0	40.0	40.1	40.2	40.3	40.3	40.5	40.6
Lincoln	20.2	19.0	19.0	20.0	20.1	20.2	20.3	20.3	20.5	20.6
	1465.4	1478.3	1478.3	2106.0	2185.4	2264.8	2344.2	2344.2	2503.0	2582.4

NOTE: The forest species groups are shortleaf pine-oak, black-scarletoak and white oak.

TABLE 21

INVENTORY RETENTION SCENARIO

PREDICTED SAWTIMBER ACREAGE

(In Thousand Acres of Shortleaf Pine and Hardwood)

Counties	1972	2002		2012		2022	
		Old	New	Old	New	Old	New
Bollinger	53.5	SAME	23.8	SAME	SAME	SAME	37.8
Butler	35.2		7.1				7.1
Carter	58.1		21.1				35.2
Crawford	75.8		8.0				8.0
Dent	64.8		11.2				11.2
Iron	63.8		0				0
Madison	51.9		9.7				9.7
Oregon	71.3		26.6				40.6
Reynolds	102.8		28.0				39.4
Ripley	59.5		23.9				32.4
St. Francis	27.7		4.5				4.5
Shannon	104.3		19.0				19.0
Washington	92.0		0				0
Wayne	82.1		30.5				38.2
Howell	66.6		87.0				87.0
Texas	80.1		89.1				89.1
Marles	23.5		31.6				31.6
Phelps	40.6		14.6				14.6
Cape G.	28.5		17.5				28.0
Franklin	78.2		0				0
Gasconade	47.5		5.6				5.6
Montgomery	25.9		4.4				4.4
Osage	44.7		6.1				6.1
Perry	33.2		13.0				18.0
St. Gen.	43.3		13.4				16.7
Warren	36.7		5.0				5.0
Lincoln	20.2		23.6				23.6
	1510.6		524.3				622.8

NOTES: The sawtimber acreage in the years 1982 and 1992 are the same as in 1972. The old sawtimber acreage in 2002 and after is the same as in 1972. The year 2002 new acreage is from the 1982 to 1992 management program. The additional management program acreage shows-up in the year 2022 new acres. The years 2032 to 2062 new acres are the same as the year 2022 level.

TABLE 22

CONSERVATION SCENARIO

PREDICTED SHORTLEAF PINE ACREAGE

(In Thousand Acres)

Counties	1972	1982	1992	2002	2012	2022	2032	2042	2052	2062
Bollinger	0.5	1.0	1.1	1.1	1.1	SAME	SAME	SAME	SAME	SAME
Butler	4.5	6.0	6.5	6.3	6.0					
Carter	3.6	5.0	6.0	5.8	5.5					
Crawford	0.4	0.6	0.8	0.9	1.0					
Dent	2.0	3.0	3.2	3.5	4.0					
Iron	0.6	1.6	1.8	1.8	1.7					
Madison	2.8	3.5	4.0	3.8	3.5					
Oregon	3.5	5.0	5.2	5.1	5.0					
Reynolds	2.2	4.0	4.5	4.3	4.0					
Ripley	5.5	6.5	6.8	6.5	6.3					
St. Francis	0.1	0.4	0.6	0.6	0.5					
Shannon	3.6	6.5	6.8	6.7	6.6					
Washington	5.5	7.0	7.0	6.8	6.5					
Wayne	4.7	7.5	8.5	8.0	7.5					
Howell	1.3	2.0	1.8	2.0	2.2					
Texas	4.4	5.7	5.4	5.7	5.9					
Marles										
Phelps	0.0	0.0	0.0	0.1	0.1					
Cape G.										
Franklin										
Gasconade										
Montgomery										
Osage										
Perry										
St. Gen.										
Warren										
Lincoln										
	45.2	65.3	70.0	69.0	67.4					

NOTES: Many counties will not have pine management program. The year 2022 and after will have the same acreage as the year 2012.

TABLE 23

CONSERVATION SCENARIO - PREDICTED HARDWOOD SAWTIMBER ACREAGE

(in Thousand Acres)

Counties	1972	1982	1992	2002		2012		2022		2032		2042		2052		2062	
				Old	NewTSI	Old	NewTSI	Old	NewTSI	Old	NewTSI	Old	NewTSI	Old	NewTSI	Old	NewTSI
Bollinger	53.0	51.3	49.6	48.0	45.0	46.4	47.8	44.9	50.6	43.4	53.4	42.0	56.2	40.6	59.0	39.3	61.8
Butler	30.7	29.7	28.7	27.8	10.0	26.9	10.6	26.0	11.2	25.2	11.8	24.4	12.4	23.6	13.0	22.8	13.6
Carter	54.5	52.7	51.0	49.3	60.0	47.8	71.3	46.2	82.6	44.7	93.9	43.2	12.4	41.8	116.4	40.4	127.7
Crawford	75.4	72.9	70.6	68.3	25.0	66.1	26.5	63.9	28.0	61.8	29.6	59.8	31.0	57.9	32.5	56.0	34.0
Dent	62.8	60.8	58.8	56.9	65.5	55.0	70.8	53.2	76.1	51.5	81.5	49.8	86.8	48.2	92.0	46.6	97.3
Iron	63.0	61.0	59.0	57.1	27.5	55.2	29.4	53.4	31.3	51.7	33.3	50.1	35.1	48.5	37.0	46.9	38.9
Madison	49.1	47.5	46.0	44.5	40.0	43.0	43.4	41.6	46.8	40.2	50.2	38.9	53.6	37.6	57.0	36.4	60.4
Oregon	67.8	65.6	63.5	61.4	14.0	59.4	14.4	57.5	14.8	55.6	15.3	53.8	15.7	52.1	16.0	50.4	16.4
Reynolds	100.6	97.3	94.2	91.3	90.0	88.2	106.4	85.3	122.8	82.5	139.3	79.8	155.7	77.2	172.0	74.7	188.4
Ripley	54.0	52.2	50.5	48.9	35.0	47.3	37.4	45.8	39.8	44.3	42.2	42.9	44.6	41.5	47.0	40.2	49.4
St. Francis	27.6	26.7	25.8	25.0	8.0	24.2	8.6	23.4	9.2	22.6	9.8	21.9	10.4	21.2	11.0	20.5	11.6
Shannon	100.7	97.4	94.2	91.1	36.0	88.2	47.3	85.3	58.6	82.5	69.9	79.8	81.2	77.2	92.5	74.7	103.8
Washington	86.5	83.7	81.0	78.3	37.0	75.8	39.4	73.3	41.8	70.9	43.3	68.8	45.7	66.6	48.0	64.4	50.4
Wayne	77.4	74.9	72.4	70.0	21.0	67.8	25.8	65.6	30.6	63.5	35.4	61.4	40.7	59.4	45.5	57.5	50.3
Howell	65.3	63.2	61.1	59.2	4.2	57.2	5.4	55.3	6.6	53.6	7.8	51.9	40.7	50.2	10.2	48.6	11.4
Texas	75.7	73.2	70.9	68.6	40.0	66.3	49.3	64.1	58.6	62.0	67.9	60.1	77.2	58.1	86.5	56.2	95.8
Marles	23.5	22.7	22.0	21.3	0.0	20.6	0.0	19.9	0	19.3	0	18.8	0	18.2	0	17.6	0
Phelps	40.6	39.3	38.0	36.8	13.5	35.6	16.1	34.4	18.7	33.3	21.4	32.3	24.0	31.2	26.6	30.2	29.2
Cape G.	28.5	27.6	26.7	25.8	3.0	25.0	3.0	24.2	3.0	23.4	3.0	22.6	3.0	21.9	3.0	21.2	3.0
Franklin	78.2	75.7	73.2	70.9	13.0	68.6	13.5	66.4	18.7	64.2	14.6	62.2	15.1	60.2	15.6	58.2	16.1
Gasconade	47.5	46.0	44.5	43.0	5.0	41.6	5.0	40.2	5.0	38.9	5.0	37.8	5.0	36.6	5.0	35.4	5.0
Montgomery	24.9	24.1	23.3	22.6	7.0	21.8	7.0	21.2	7.0	20.5	7.0	18.8	7.0	18.2	7.0	17.6	7.0
Osage	44.7	43.2	41.8	40.5	3.0	39.2	3.0	37.9	3.0	36.7	3.0	35.6	3.0	34.4	3.0	33.3	3.0
Perry	33.2	32.1	31.1	30.0	4.0	29.1	4.3	28.2	4.6	27.3	4.9	26.4	5.2	25.5	5.5	24.7	5.8
St. Gen.	43.3	42.9	40.5	39.2	3.0	37.9	3.2	36.7	3.5	35.5	3.8	34.3	4.0	33.2	4.2	32.1	4.4
Warren	36.7	35.5	34.3	33.2	5.0	32.1	5.1	31.2	5.2	30.2	5.4	29.2	5.5	28.2	5.6	27.3	5.7
Lincoln	20.2	19.5	18.9	18.3	1.0	17.7	1.1	17.2	1.2	16.6	1.4	16.2	1.5	15.7	1.6	15.2	1.7
	1465.4	1417.8	1371.7	1327.1	615.7	1284.0	695.1	1242.3	774.5	1201.9	853.9	1162.8	933.3	1125.0	1012.7	1088.4	1092.1

NOTE: The forest species groups are shortleaf pine-oak, black-scarletoak and white oak.

TABLE 24

HIGH PRODUCTION - HIGH GROWTH RATE FOR THE YEARS 1972 TO 2002

(Million Board Feet of Sawtimber)

County Names	%	Inventory 1972	Growth	Removals	Inventory 1982	%	Growth	Removals	Inventory 1992	Growth	Removals	Inventory 2002
Bollinger	4.4	275.7	63.8	160.1	179.4	3.0	66.8	191.4	54.8	66.9	121.7	-0-
Butler	3.2	261.5	62.5	111.1	212.9	3.6	63.9	148.4	128.4	64.8	193.2	-0-
Carter	3.9	318.0	74.4	160.3	232.2	3.9	83.2	200.7	114.7	84.5	199.2	-0-
Crawford	5.0	412.1	96.6	15 .0	358.7	6.0	96.3	211.6	243.4	96.6	340.0	-0-
Dent	4.5	374.0	88.0	150.2	311.8	5.3	93.0	204.8	200.0	93.3	293.3	-0-
Iron	4.4	364.8	86.0	109.4	341.4	5.8	86.7	169.0	259.1	88.3	347.4	-0-
Madison	3.7	303.2	71.6	124.9	249.9	4.2	73.8	168.3	155.4	74.5	229.9	-0-
Oregon	4.6	378.5	88.1	191.3	275.3	4.6	87.7	238.8	124.2	87.9	212.1	-0-
Reynolds	6.8	560.1	131.0	254.2	436.9	7.4	145.3	329.9	252.3	145.9	398.2	-0-
Ripley	4.2	350.0	82.5	179.1	253.4	4.3	85.3	223.5	115.1	85.7	200.8	-0-
St. Francois	2.0	158.6	37.5	63.9	132.3	2.2	37.1	87.2	82.2	37.4	119.6	-0-
Shannon	7.1	584.2	137.7	238.2	483.7	8.2	151.2	322.0	312.9	151.6	464.5	-0-
Washington	5.9	484.7	112.1	125.6	471.3	7.9	114.5	206.4	379.4	114.5	493.9	-0-
Wayne	5.6	461.1	107.7	233.6	335.3	5.7	112.9	292.2	156.0	114.2	270.2	-0-
Howell	3.2	260.6	69.5	214.5	115.6	-0-	70.8	186.4	-0-	70.6	70.6	-0-
Texas	4.3	351.0	93.9	253.9	191.0	-0-	100.5	291.5	-0-	100.1	100.1	-0-
Marles	1.3	104.1	21.3	70.6	54.8	-0-	18.1	72.9	-0-	18.1	18.1	-0-
Phelps	2.1	168.1	33.9	75.1	126.9	2.1	34.7	98.3	63.3	34.7	98.0	-0-
Cape	1.9	156.5	33.1	91.1	98.6	1.7	31.4	109.3	20.7	31.4	52.1	-0-
Franklin	4.9	408.7	84.2	113.2	379.8	6.4	82.9	179.8	282.9	82.9	365.8	-0-
Gasconade	3.1	250.0	50.9	83.5	217.4	3.7	48.2	121.9	143.7	48.2	191.9	-0-
Montgomery	2.0	159.6	37.6	64.7	132.6	2.2	34.7	88.9	78.4	34.7	113.1	-0-
Osage	3.1	248.8	54.4	90.6	212.8	3.6	51.1	127.9	136.0	51.1	187.1	-0-
Perry	2.2	176.4	37.0	83.4	130.0	2.2	34.5	106.6	57.9	34.5	92.4	-0-
St. Gen.	2.8	227.6	45.6	94.9	178.3	3.0	44.2	126.2	96.3	44.2	140.5	-0-
Warren	2.6	212.1	46.7	77.4	181.5	3.0	44.5	109.7	116.3	44.5	160.8	-0-
Lincoln	1.3	106.9	27.6	78.2	56.3	-0-	26.0	82.3	-0-	26.0	26.0	-0-
		8116.9	1875.2	3642.0	6350.1		1919.3	4696.0	3573.4	1927.1	5500.5	-0-

NOTES: The growth and removal rates are in ten year totals. The removal rate is increased to meet the twenty-seven county study area's existing percentage of the USDA's future regional demand rate. These removal increases are evenly distributed by each county's percentage of total sawtimber. The 1972 and 1982 redistribution are 1054.0 and 1009.8 million bf respectively.

TABLE 24 - CONTINUED

HIGH PRODUCTION - HIGH GROWTH RATE FOR THE YEARS 2002 TO 2022

(Million Board Feet of Sawtimber)

County Names	Inventory 2002	Old Growth	New Growth	Net Growth	Removals	Inventory 2012	Old Growth	New Growth	Net Growth	Removals	Inventory 2022
Bollinger	-0-	66.9	107.1	174.0	174.0	-0-	66.9	113.8	180.7	180.7	-0-
Butler	-0-	64.8	34.9	99.7	99.7	-0-	64.8	36.0	100.8	100.8	-0-
Carter	-0-	84.5	93.3	177.8	177.8	-0-	84.5	181.3	265.7	265.7	-0-
Crawford	-0-	96.6	38.6	135.3	135.3	-0-	96.6	64.9	161.5	161.5	-0-
Dent	-0-	93.3	179.0	272.3	272.3	-0-	93.3	194.8	288.1	288.1	-0-
Iron	-0-	88.3	77.0	165.3	165.3	-0-	88.3	82.0	170.3	170.3	-0-
Madison	-0-	74.5	68.5	143.0	143.0	-0-	74.5	118.4	192.9	192.9	-0-
Oregon	-0-	87.9	34.2	122.1	122.1	-0-	87.9	34.9	122.8	122.8	-0-
Reynolds	-0-	145.9	228.1	374.0	374.0	-0-	145.9	269.0	414.9	414.9	-0-
Ripley	-0-	85.7	96.5	182.2	182.2	-0-	85.7	102.6	188.3	188.3	-0-
St. Francois	-0-	37.4	21.6	59.0	59.0	-0-	37.4	22.9	60.3	60.3	-0-
Shannon	-0-	151.6	100.1	251.7	251.7	-0-	151.6	129.6	281.2	281.2	-0-
Washington	-0-	114.5	89.8	204.3	204.3	-0-	114.5	94.9	209.4	209.4	-0-
Wayne	-0-	114.2	53.7	167.9	167.9	-0-	114.2	65.0	179.2	179.2	-0-
Howell	-0-	70.6	9.2	79.8	79.8	-0-	70.6	12.1	82.7	82.7	-0-
Texas	-0-	100.1	94.3	194.4	194.4	-0-	100.1	116.5	216.6	216.6	-0-
Marles	-0-	18.1	-0-	18.1	18.1	-0-	18.1	-0-	18.1	18.1	-0-
Phelps	-0-	34.7	19.8	54.5	54.5	-0-	34.7	44.0	78.7	78.7	-0-
Cape	-0-	31.4	7.0	38.4	38.4	-0-	31.4	6.7	38.1	38.1	-0-
Franklin	-0-	82.9	28.1	111.0	111.0	-0-	82.9	29.2	112.1	112.1	-0-
Gasconade	-0-	48.2	10.7	58.9	58.9	-0-	48.2	10.7	58.7	58.7	-0-
Montgomery	-0-	34.7	21.1	55.8	55.8	-0-	34.7	21.1	55.8	55.8	-0-
Osage	-0-	51.1	7.3	58.4	58.4	-0-	51.1	7.3	58.4	58.4	-0-
Perry	-0-	34.5	8.9	43.4	43.4	-0-	34.5	9.5	44.0	44.0	-0-
St. Gen.	-0-	44.2	6.3	50.5	50.5	-0-	44.2	6.7	50.9	50.9	-0-
Warren	-0-	44.5	13.1	57.6	57.6	-0-	44.5	13.4	57.9	57.9	-0-
Lincoln	-0-	26.0	2.7	28.7	28.7	-0-	26.0	3.0	29.0	29.0	-0-
	-0-	1927.1	1451.0	3378.1	3378.1	-0-	1927.1	1790.3	3717.4	3717.4	-0-

NOTES: The new growth numbers are from the 1982 to 1992 management program. The new acreage numbers per county are multiplied twice the old growth rate per acre.

TABLE 24 - CONTINUED

HIGH PRODUCTION - HIGH GROWTH RATE FOR THE YEARS 2022 TO 2042

(Million Board Feet of Sawtimber)

County Names	Inventory 2022	Old Growth	New Growth	Net Growth	Removals	Inventory 2032	Old Growth	New Growth	Net Growth	Removals	Inventory 2042
Bollinger	-0-	66.9	165.4	232.3	232.3	-0-	66.9	172.1	239.0	239.0	-0-
Butler	-0-	64.8	95.1	159.9	159.9	-0-	64.8	97.2	162.0	162.0	-0-
Carter	-0-	84.5	260.1	344.6	344.6	-0-	84.5	289.0	373.5	373.5	-0-
Crawford	-0-	96.6	147.8	244.4	244.4	-0-	96.6	151.6	248.2	248.2	-0-
Dent	-0-	93.3	293.5	386.8	386.8	-0-	93.3	307.9	401.2	401.2	-0-
Iron	-0-	88.3	161.0	249.3	249.3	-0-	88.3	166.3	254.6	254.6	-0-
Madison	-0-	74.5	176.1	250.6	250.6	-0-	74.5	185.5	250.0	260.0	-0-
Oregon	-0-	87.9	109.7	197.6	197.6	-0-	87.9	110.7	198.6	198.6	-0-
Reynolds	-0-	145.9	402.1	548.0	548.0	-0-	145.9	443.7	589.6	589.6	-0-
Ripley	-0-	85.7	161.2	246.9	246.9	-0-	85.7	167.9	253.6	253.6	-0-
St. Francois	-0-	37.4	76.1	113.5	113.5	-0-	37.4	78.8	116.2	116.2	-0-
Shannon	-0-	151.6	260.8	412.4	412.4	-0-	151.6	290.7	442.2	442.2	-0-
Washington	-0-	114.5	163.0	277.5	277.5	-0-	114.5	176.2	290.7	290.7	-0-
Wayne	-0-	114.2	141.7	255.9	255.9	-0-	114.2	154.3	268.5	268.5	-0-
Howell	-0-	70.6	105.7	176.3	176.3	-0-	70.6	108.2	178.8	178.8	-0-
Texas	-0-	100.1	114.2	214.3	214.3	-0-	100.1	286.6	386.7	386.7	-0-
Marles	-0-	18.1	21.6	39.7	39.7	-0-	18.1	21.6	39.7	39.7	-0-
Phelps	-0-	34.7	80.1	114.8	114.8	-0-	34.7	84.5	119.2	119.2	-0-
Cape	-0-	31.4	13.9	45.3	45.3	-0-	31.4	13.9	45.3	45.3	-0-
Franklin	-0-	82.9	49.7	132.6	132.6	-0-	82.9	50.8	133.7	133.7	-0-
Gasconade	-0-	48.2	27.8	76.0	76.0	-0-	48.2	27.8	76.0	76.0	-0-
Montgomery	-0-	34.7	36.2	70.9	70.9	-0-	34.7	36.2	70.9	70.9	-0-
Osage	-0-	51.1	34.2	85.3	85.3	-0-	51.1	34.2	85.3	85.3	-0-
Perry	-0-	34.5	19.1	53.6	53.6	-0-	34.5	19.8	54.3	54.3	-0-
St. Gen.	-0-	44.2	28.1	72.3	72.3	-0-	44.2	28.6	72.8	72.8	-0-
Warren	-0-	44.5	39.8	84.3	84.3	-0-	44.5	40.1	84.6	84.6	-0-
Lincoln	-0-	26.0	8.8	34.8	34.8	-0-	26.0	9.0	35.0	35.0	-0-
	-0-	1927.1	3192.8	5119.9	5119.9	-0-	1927.1	3553.2	5480.3	5480.3	-0-

TABLE 24 - CONTINUED

HIGH PRODUCTION - HIGH GROWTH RATE FOR THE YEARS 2042 TO 2062

(Million Board Feet of Sawtimber)

County Names	Inventory 2042	Old Growth	New Growth	Net Growth	Removals	Inventory 2052	Old Growth	New Growth	Clearcut Pine	Net Growth	Removals	Inventory 2062
Bollinger	-0-	66.9	178.7	245.6	245.6	-0-	66.9	170.4	126.0	363.3	363.3	-0-
Butler	-0-	64.8	99.3	164.1	164.1	-0-	64.8	82.6	106.0	253.4	253.4	-0-
Carter	-0-	84.5	318.0	402.5	402.5	-0-	84.5	329.7	134.0	548.2	548.2	-0-
Crawford	-0-	96.6	155.5	252.1	252.1	-0-	96.6	106.2	202.0	404.8	404.8	-0-
Dent	-0-	93.3	322.3	415.6	415.6	-0-	93.3	3 7.6	214.0	614.9	614.9	-0-
Iron	-0-	88.3	171.6	259.9	259.9	-0-	88.3	152.3	176.0	416.6	4 6.6	-0-
Madison	-0-	74.5	194.9	269.4	269.4	-0-	74.5	188.2	116.0	378.7	378.7	-0-
Oregon	-0-	87.9	111.7	199.6	199.6	-0-	87.9	88.1	200.0	376.0	376.0	-0-
Reynolds	-0-	145.9	485.4	631.3	631.3	-0-	145.9	496.6	240.0	882.5	882.5	-0-
Ripley	-0-	85.7	174.6	260.3	260.3	-0-	85.7	158.1	124.0	367.8	367.8	-0-
St. Francois	-0-	37.4	80.5	117.9	117.9	-0-	37.4	64.5	130.0	231.9	231.9	-0-
Shannon	-0-	151.6	320.5	472.1	472.1	-0-	151.6	316.5	256.0	724.1	724.1	-0-
Washington	-0-	114.5	182.0	296.5	296.5	-0-	114.5	165.2	186.0	465.7	465.7	-0-
Wayne	-0-	114.2	166.9	281.1	281.1	-0-	114.2	158.0	164.0	436.2	436.2	-0-
Howell	-0-	70.6	108.2	178.8	178.8	-0-	70.6	82.6	294.0	447.2	447.2	-0-
Texas	-0-	100.1	310.8	410.9	410.9	-0-	100.1	287.8	362.0	749.9	749.9	-0-
Marles	-0-	18.1	21.6	39.7	39.7	-0-	18.1	14.4	80.0	112.5	112.5	-0-
Phelps	-0-	34.7	88.9	123.6	123.6	-0-	34.7	82.7	126.0	243.4	243.4	-0-
Cape	-0-	31.4	13.9	45.3	45.3	-0-	31.4	11.6	20.0	63.0	63.0	-0-
Franklin	-0-	82.9	51.8	134.7	134.7	-0-	82.9	46.4	60.0	189.3	189.3	-0-
Gasconade	-0-	48.2	27.8	76.0	76.0	-0-	48.2	22.0	54.0	124.2	124.2	-0-
Montgomery	-0-	34.7	36.2	70.9	70.9	-0-	34.7	31.1	34.0	99.8	99.8	-0-
Osage	-0-	51.1	34.2	85.3	85.3	-0-	51.1	25.1	74.0	150.2	150.2	-0-
Perry	-0-	34.5	20.4	54.9	54.9	-0-	34.5	18.2	26.0	78.7	78.7	-0-
St. Gen.	-0-	44.2	29.0	73.2	73.2	-0-	44.2	22.5	66.0	132.7	132.7	-0-
Warren	-0-	44.5	40.3	84.8	84.8	-0-	44.5	32.0	66.0	142.5	142.5	-0-
Lincoln	-0-	26.0	9.3	35.3	35.3	-0-	26.0	7.7	14.0	47.7	47.7	-0-
	-0-	1927.1	3754.3	5681.4	5681.4	-0-	1927.1	3468.1	3650.0	9045.2	9045.2	-0-

NOTE: The clearcut pine numbers reflect a harvest of one-third of the 1982-1992 shortleaf pine management program's acreage.

TABLE 25

INVENTORY RETENTION SCENARIO FOR THE YEARS 2002 TO 2022

(Million Board Feet of Sawtimber)

County Names	%	Inventory 2002	Old Growth	New Growth	Removals	Inventory 2012	Old Growth	New Growth	Removals	Inventory 2022
Bollinger	2.1	123.8	63.8	56.6	120.4	123.8	63.8	56.6	113.7	130.5
Butler	3.6	214.0	62.5	25.4	87.9	214.0	62.5	25.4	77.4	224.5
Carter	3.0	180.9	74.4	53.9	128.3	180.9	74.4	53.9	119.2	190.0
Crawford	6.8	405.1	96.6	20.2	116.8	405.1	96.6	20.2	97.3	424.6
Dent	5.4	325.5	88.0	30.5	118.5	325.5	88.0	30.5	102.8	341.2
Iron	7.2	428.6	86.0	-0-	100.0	414.6	86.0	-0-	63.1	437.5
Madison	4.3	256.7	71.6	26.9	98.5	256.7	71.6	26.9	86.0	269.2
Oregon	3.5	210.9	88.1	65.5	153.6	210.9	88.1	65.5	142.9	221.6
Reynolds	6.7	400.4	131.0	71.2	202.2	400.4	131.0	71.2	182.4	420.2
Ripley	5.2	189.8	82.5	66.5	149.0	189.8	82.5	66.5	134.9	203.9
St. Francois	2.4	141.2	37.5	12.1	49.6	141.2	37.5	12.1	42.7	148.1
Shannon	8.4	500.4	137.7	50.1	187.8	500.4	137.7	50.1	163.5	524.7
Washington	10.4	623.5	112.1	-0-	140.0	595.6	112.1	-0-	63.5	644.2
Wayne	4.3	256.8	107.7	79.9	187.6	256.8	107.7	79.9	174.5	269.9
Howell	-0-	-0-	69.5	180.9	49.5	200.9	69.5	180.9	180.9	270.4
Texas	0.1	5.7	93.9	208.5	79.6	228.5	93.9	208.5	208.5	322.4
Maries	-0-	-0-	21.3	56.8	11.3	66.8	21.3	56.8	56.8	88.1
Phelps	1.8	108.9	33.9	24.6	58.5	108.9	33.9	24.6	53.1	114.3
Cape	0.7	41.2	33.1	40.6	73.7	41.2	33.1	40.6	71.2	43.7
Franklin	7.9	470.6	84.2	-0-	84.2	470.6	84.2	-0-	61.7	493.0
Gasconade	4.1	246.9	50.9	11.9	62.8	246.8	50.9	11.9	50.9	258.7
Montgomery	2.3	139.0	37.6	13.3	50.9	139.0	37.6	13.3	43.7	146.2
Osage	3.9	235.3	54.4	14.8	69.2	235.3	54.4	14.8	57.9	246.6
Perry	1.8	104.9	37.0	28.8	65.8	104.9	37.0	28.8	60.3	110.4
St. Gen.	2.8	165.6	45.6	28.2	73.8	165.6	45.6	28.2	65.5	173.9
Warren	3.3	199.3	46.7	13.1	59.8	199.3	46.7	13.1	50.1	209.0
Lincoln	-0-	-0-	27.6	64.6	13.7	78.5	27.6	64.6	64.6	106.0
		5975.1	1875.0	1244.9	2593.0	6502.0	1875.0	1244.9	2589.1	7032.8

NOTES: The growth and removal rates are in ten year totals. The 1972 to 2002 year predictions of inventory, growth and removals are the same as the status quo scenarion on Table 16. The other assumptions are explained in the Inventory Retention paragraph which was earlier in this appendix. The removal adjustment of 214.1 million bf in the year 2002 is evenly distributed by each county's percentage of total sawtimber. The new growth numbers are from the 1982 to 1992 management program. The new acreage numbers are multiplied by twice the old growth rate.

TABLE 25 - CONTINUED

INVENTORY RETENTION SCENARIO FOR THE YEARS 2022 TO 2042

(Million Board Feet of Sawtimber)

County Name	Inventory 2022	Old Growth	New Growth	Removals	Inventory 2032	Old Growth	New Growth	Removals	Inventory 2042
Bollinger	130.5	63.8	90.0	113.7	170.6	63.8	90.0	113.7	210.7
Butler	224.5	62.5	25.4	77.4	235.0	62.5	25.4	77.4	245.5
Carter	190.0	74.4	90.0	119.2	235.2	74.4	90.0	119.2	280.4
Crawford	424.6	96.6	20.2	117.3	424.1	96.6	20.2	117.3	423.6
Dent	341.2	88.0	30.5	102.8	356.9	88.0	30.5	102.8	372.6
Iron	437.5	86.0	-0-	100.0	423.5	86.0	-0-	100.0	409.5
Madison	269.2	71.6	26.9	86.0	281.7	71.6	26.9	86.0	294.2
Oregon	221.6	88.1	100.0	142.9	266.8	88.1	100.0	142.9	312.0
Reynolds	420.2	131.0	100.0	182.4	468.8	131.0	100.0	182.4	517.4
Ripley	203.9	82.5	90.0	134.9	241.5	82.5	90.0	134.9	279.0
St. Francois	148.1	37.5	12.1	42.7	155.0	37.5	12.1	42.7	161.9
Shannon	524.7	137.7	50.1	163.5	549.0	137.7	50.1	163.5	573.2
Washington	644.2	112.1	-0-	145.0	611.3	112.1	-0-	145.0	578.4
Wayne	269.9	107.7	100.0	174.5	303.0	107.7	100.0	174.5	336.2
Howell	270.4	69.5	180.9	250.0	270.8	69.5	180.9	250.0	271.2
Texas	322.4	93.9	208.5	288.5	336.3	93.9	208.5	288.5	350.2
Marles	88.1	21.3	56.8	56.8	109.4	21.3	56.8	56.8	130.7
Phelps	114.3	33.9	24.6	53.1	119.7	33.9	24.6	53.1	125.1
Cape	43.7	33.1	65.0	71.2	70.6	33.1	65.0	71.2	97.5
Franklin	493.0	84.2	-0-	110.0	467.2	84.2	-0-	110.0	441.4
Gasconade	258.7	50.9	11.9	60.0	261.5	50.9	11.9	60.0	264.3
Montgomery	146.2	37.6	13.3	43.7	153.4	37.6	13.3	43.7	160.6
Osage	246.6	54.4	14.8	57.9	257.9	54.4	14.8	57.9	269.2
Perry	110.4	37.0	40.0	60.3	127.0	37.0	40.0	60.3	143.7
St. Gen.	173.9	45.6	35.0	65.5	189.0	45.6	35.0	65.5	204.1
Warren	209.0	46.7	13.1	50.1	218.7	46.7	13.1	50.1	228.4
Lincoln	106.0	27.6	64.6	91.0	107.2	27.6	64.6	91.0	108.4
	7032.8	1875.0	1463.7	2960.4	7411.1	1875.0	1463.7	2960.4	7789.4

TABLE 25 - CONTINUED

INVENTORY RETENTION SCENARIO FOR THE YEARS 2042 TO 2062

County Name	Inventory 2042	Old Growth	New Growth	Removals	Inventory 2052	Old Growth	New Growth	Removals	Inventory 2062
Bollinger	210.7	63.8	90.0	113.7	250.8	63.8	90.0	113.7	290.9
Butler	245.5	62.5	25.4	77.4	256.0	62.5	25.4	77.4	266.5
Carter	280.4	74.4	90.0	119.2	325.8	74.4	90.0	119.2	371.0
Crawford	423.6	96.6	20.2	117.3	423.2	96.6	20.2	117.3	422.7
Dent	372.6	88.0	30.5	102.8	388.5	88.0	30.5	102.8	404.2
Iron	409.5	86.0	-0-	100.0	395.6	86.0	-0-	120.0	361.6
Madison	294.2	71.6	26.9	86.0	306.8	71.6	26.9	86.0	319.3
Oregon	312.0	88.1	100.0	142.9	357.4	88.1	100.0	142.9	402.6
Reynolds	517.4	131.0	100.0	182.4	566.0	131.0	100.0	182.4	614.6
Ripley	279.0	82.5	90.0	134.9	316.8	82.5	90.0	100.0	389.3
St. Francois	161.9	37.5	12.1	42.7	168.8	37.5	12.1	45.0	173.4
Shannon	573.2	137.7	50.1	163.5	597.6	137.7	50.1	170.0	615.4
Washington	578.4	112.1	-0-	145.0	545.6	112.1	-0-	160.0	497.7
Wayne	336.2	107.7	100.0	174.5	369.8	107.7	100.0	150.0	427.6
Howell	271.2	69.5	180.9	250.0	271.8	69.5	180.9	250.0	272.2
Texas	350.2	93.9	208.5	288.5	364.2	93.9	208.5	290.0	376.6
Marles	130.7	21.3	56.8	56.8	152.0	21.3	56.8	65.0	165.1
Phelps	125.1	33.9	24.6	53.1	130.6	33.9	24.6	45.0	144.0
Cape	97.5	33.1	65.0	74.2	121.4	33.1	65.0	65.0	154.5
Franklin	441.4	84.2	-0-	110.0	415.8	84.2	-0-	110.0	390.0
Gasconade	264.3	50.9	11.9	60.0	267.2	50.9	11.9	62.0	268.0
Montgomery	160.6	37.6	13.3	43.7	167.8	37.6	13.3	45.0	173.7
Osage	269.2	54.4	14.8	57.9	280.6	54.4	14.8	65.0	284.8
Perry	143.7	37.0	40.0	60.3	160.4	37.0	40.0	55.0	182.4
St. Gen.	204.1	45.6	35.0	65.5	219.2	45.6	35.0	60.0	239.8
Warren	228.4	46.7	13.1	50.1	238.2	46.7	13.1	55.0	243.0
Lincoln	108.4	27.6	64.6	91.0	109.8	27.6	64.6	91.0	111.0
	7789.4	1875.0	1463.7	2960.4	8167.7	1875.0	1463.7	2944.7	8561.7

TABLE 26

CONSERVATION SCENARIO FOR THE YEARS 1972 TO 2002

(Million Board Feet of Sawtimber)

County Names	%	Inventory 1972	Growth	Removals	Inventory 1982	%	Growth	Removals	Inventory 1992	%	Growth	Removals	Inventory 2002
Bollinger	3.4	248.1	63.8	131.1	180.8	3.0	62.2	146.9	96.1	-0-	60.3	156.4	-0-
Butler	3.2	235.4	62.5	93.1	204.8	3.4	63.6	110.9	157.5	3.8	62.7	143.1	77.1
Carter	3.9	286.2	74.4	138.6	222.0	3.7	73.9	158.0	137.9	3.3	71.7	186.0	23.6
Crawford	5.1	370.9	96.6	122.6	344.9	5.8	93.4	153.1	285.2	6.8	90.7	210.8	165.1
Dent	4.6	336.6	88.0	126.0	298.6	5.0	86.8	152.3	233.1	5.6	84.3	199.8	117.6
Iron	4.5	328.3	86.0	85.6	328.7	5.5	87.6	114.5	301.8	7.2	85.1	175.6	211.3
Madison	3.7	272.9	71.6	104.6	239.9	4.0	70.4	125.6	184.7	4.4	69.0	162.9	90.8
Oregon	4.7	340.6	88.1	166.6	262.1	4.4	86.8	189.8	159.1	3.8	84.5	222.0	21.6
Reynolds	6.9	504.1	131.0	216.7	418.4	7.0	128.7	253.4	293.7	7.0	125.3	312.8	106.2
Ripley	4.3	315.0	82.5	156.6	240.9	4.0	81.6	177.6	144.9	3.6	79.6	208.1	16.4
St. Francois	1.9	142.7	37.5	52.6	127.6	2.1	36.5	63.6	100.5	2.4	35.6	84.0	52.1
Shannon	7.2	525.8	137.7	199.2	464.3	7.8	137.2	240.2	361.3	8.6	133.3	313.1	181.5
Washington	6.0	436.2	112.1	93.2	455.1	7.6	110.6	133.1	432.6	10.3	107.4	220.5	319.5
Wayne	5.7	415.0	107.7	202.7	320.0	5.3	107.9	230.5	197.4	4.8	106.0	271.2	32.2
Howell	3.2	234.5	69.5	197.0	107.0	-0-	67.8	174.8	-0-	-0-	65.4	65.4	-0-
Texas	4.3	315.9	93.9	230.6	179.2	3.0	92.3	246.4	25.1	-0-	89.3	114.4	-0-
Marles	1.3	93.7	21.3	63.5	51.5	0.9	20.4	68.1	3.8	-0-	19.8	23.6	-0-
Phelps	2.1	151.3	33.9	63.6	121.6	2.0	33.0	74.1	80.5	1.9	31.9	90.2	22.2
Cape	1.9	140.8	33.1	80.6	93.3	1.6	32.0	89.0	36.3	-0-	31.0	67.3	-0-
Franklin	5.0	367.8	84.2	87.1	364.9	6.1	81.8	119.1	327.6	7.8	79.1	185.3	221.4
Gasconade	3.1	225.0	50.9	66.6	209.3	3.5	49.2	85.0	173.5	4.2	47.6	120.6	100.5
Montgomery	2.0	143.6	37.6	54.1	127.1	2.1	36.4	65.1	98.4	2.3	35.2	84.6	49.0
Osage	3.1	223.9	54.4	73.6	204.7	3.4	52.7	91.5	165.9	4.0	51.0	125.4	91.5
Perry	2.2	158.8	37.0	71.1	124.7	2.1	35.6	82.1	78.2	1.9	34.5	98.2	14.5
St. Gen.	2.8	204.8	45.6	79.1	171.3	2.9	44.0	94.3	121.0	2.9	42.5	118.9	44.6
Warren	2.6	190.9	46.7	63.1	174.5	2.9	46.5	78.3	142.7	3.4	44.9	107.1	80.5
Lincoln	1.3	96.2	27.6	71.5	52.3	0.9	26.7	76.1	2.9	-0-	25.9	28.8	-0-
		7305.0	1875.2	3090.5	6089.5		1845.6	3593.4	4341.7		1793.6	4096.1	2039.2

NOTES: The growth and removal rates are in ten year totals. The 1972 inventory level is reduced by ten percent per county as discussed before. The old growth will be reduced by 3.25 percent every ten years for sawtimber not under management. The removal rates are one-half of the high production scenario. These removal increases are evenly distributed by each county's percentage of total sawtimber. The 1972, 1982 and 1992 redistribution are 502.7, 524.9 and 848.1 million bf respectively.

TABLE 26 - CONTINUED

CONSERVATION SCENARIO FOR THE YEARS 2002 TO 2022

(Million Board Feet of Sawtimber)

County Names	%	Inventory 2002	Old Growth	New Growth	Removals	Inventory 2012	Old Growth	New Growth	Removals	Inventory 2022
Bollinger	-0-	-0-	58.4	107.1	156.4	9.1	56.5	113.8	179.4	-0-
Butler	-0-	77.1	60.2	35.6	172.9	-0-	58.6	37.7	96.3	-0-
Carter	1.6	23.6	70.5	153.6	196.3	51.4	68.2	182.5	302.1	-0-
Crawford	11.5	165.1	87.9	63.5	284.6	31.9	85.2	67.3	184.4	-0-
Dent	8.2	117.6	82.1	178.2	252.4	125.5	80.2	192.6	398.3	-0-
Iron	14.7	211.3	82.5	77.0	269.9	100.9	79.7	82.3	262.9	-0-
Madison	6.3	90.8	66.7	110.4	203.3	64.6	64.2	119.8	248.6	-0-
Oregon	-0-	21.6	81.8	34.4	137.8	-0-	79.2	70.8	150.0	-0-
Reynolds	7.4	106.2	121.4	228.6	360.2	96.0	117.1	95.0	308.1	-0-
Ripley	-0-	16.4	77.0	97.3	190.7	-0-	74.5	104.0	178.5	-0-
St. Francois	-0-	52.1	34.6	21.6	108.3	-0-	33.3	23.2	56.5	-0-
Shannon	12.6	181.5	129.1	95.0	393.8	11.8	125.3	124.9	262.0	-0-
Washington	22.3	319.5	103.8	90.3	363.6	150.0	100.4	96.1	346.5	-0-
Wayne	-0-	32.2	102.2	55.0	189.4	-0-	98.6	67.6	166.2	-0-
Howell	-0-	-0-	63.6	8.7	65.4	6.9	61.8	11.2	79.9	-0-
Texas	-0-	-0-	86.9	93.6	114.5	66.0	84.5	115.4	265.9	-0-
Harles	-0-	-0-	19.2	-0-	19.2	-0-	18.5	-0-	18.5	-0-
Phelps	-0-	22.2	31.0	22.7	75.9	-0-	30.0	27.0	57.0	-0-
Cape	-0-	-0-	29.9	7.0	36.9	-0-	29.0	7.0	36.0	-0-
Franklin	15.4	221.4	76.6	28.1	284.0	42.1	74.1	29.2	145.4	-0-
Gasconade	-0-	100.5	46.0	10.7	157.2	-0-	44.5	10.7	55.2	-0-
Montgomery	-0-	49.0	34.1	21.1	104.2	-0-	32.9	21.1	54.0	-0-
Osage	-0-	91.5	49.4	7.3	148.2	-0-	47.8	7.3	55.1	-0-
Perry	-0-	14.5	33.3	8.9	56.7	-0-	32.3	9.5	41.8	-0-
St. Gen.	-0-	44.6	41.2	6.3	92.1	-0-	39.8	6.7	46.5	-0-
Warren	-0-	80.5	43.5	13.1	137.1	-0-	42.1	13.4	55.5	-0-
Lincoln	-0-	-0-	25.1	2.7	27.8	-0-	24.2	3.0	27.2	-0-
		2039.2	1738.0	1577.8	4598.8	756.2	1682.5	1639.1	4077.8	-0-

NOTES: The new growth rates are from the 1982 to 1992 management program. The management acreage is multiplied by twice the old growth rate to get the new growth numbers per county. The year 2002 removal increase of 641.6 million bf is evenly distributed by each county's percentage of total sawtimber.

TABLE 26 - CONTINUED

CONSERVATION SCENARIO FOR THE YEARS 2022 TO 2042

(Million Board Feet of Sawtimber)

County Names	Inventory 2022	Old Growth	New Growth	Removals	Inventory 2032	Old Growth	New Growth	Removals	Inventory 2042
Bollinger	-0-	54.7	120.4	175.1	-0-	53.0	129.1	182.1	-0-
Butler	-0-	57.0	39.9	96.9	-0-	55.5	42.0	97.5	-0-
Carter	-0-	66.2	211.5	277.7	-0-	64.3	240.4	304.7	-0-
Crawford	-0-	82.4	71.1	153.5	-0-	79.8	75.2	155.0	-0-
Dent	-0-	77.8	207.0	284.8	-0-	75.5	221.7	297.2	-0-
Iron	-0-	77.1	87.6	164.7	-0-	74.8	93.2	168.0	-0-
Madison	-0-	62.2	129.2	191.4	-0-	60.3	138.6	198.9	-0-
Oregon	-0-	76.9	36.4	113.3	-0-	74.5	37.6	112.1	-0-
Reynolds	-0-	113.4	311.9	425.3	-0-	109.9	353.8	463.7	-0-
Ripley	-0-	72.4	110.6	183.0	-0-	70.3	117.3	187.6	-0-
St. Francois	-0-	32.3	24.8	57.1	-0-	31.2	26.5	57.7	-0-
Shannon	-0-	121.3	154.7	276.0	-0-	117.6	184.5	302.1	-0-
Washington	-0-	97.4	102.0	199.4	-0-	94.4	105.7	200.1	-0-
Wayne	-0-	95.8	80.2	176.0	-0-	93.0	92.7	185.7	-0-
Howell	-0-	59.8	13.7	73.5	-0-	58.0	16.2	74.2	-0-
Texas	-0-	81.9	137.0	219.0	-0-	79.4	158.9	238.3	-0-
Maries	-0-	17.9	-0-	17.9	-0-	17.3	-0-	17.3	-0-
Phelps	-0-	29.0	31.4	60.4	-0-	28.1	36.0	64.1	-0-
Cape	-0-	28.1	7.0	35.1	-0-	27.1	7.0	34.1	-0-
Franklin	-0-	71.7	30.2	101.9	-0-	69.3	31.5	100.8	-0-
Gasconade	-0-	43.0	10.7	53.7	-0-	41.6	10.7	52.3	-0-
Montgomery	-0-	32.0	21.1	53.1	-0-	31.0	21.1	52.1	-0-
Osage	-0-	46.2	7.3	53.5	-0-	44.8	7.3	52.1	-0-
Perry	-0-	31.3	10.2	41.5	-0-	30.3	10.9	41.2	-0-
St. Gen	-0-	38.5	7.3	45.8	-0-	37.3	8.0	45.3	-0-
Warren	-0-	40.9	13.6	54.5	-0-	39.6	14.1	53.7	-0-
Lincoln	-0-	23.6	3.3	26.9	-0-	22.7	3.8	26.5	-0-
	-0-	1630.8	1980.2	3611.0	-0-	1580.6	2183.8	3764.4	-0-

TABLE 26 - CONTINUED

CONSERVATION SCENARIO FOR THE YEARS 2042 TO 2062

(Million Board Feet of Sawtimber)

County Names	Inventory 2042	Old Growth	New Growth	Removals	Inventory 2052	Old Growth	New Growth	Removals	Inventory 2062
Bollinger	-0-	51.3	133.8	185.1	-0-	49.6	140.4	190.0	-0-
Butler	-0-	54.1	44.1	98.2	-0-	52.7	46.3	99.0	-0-
Carter	-0-	62.3	269.3	331.6	-0-	60.5	298.0	358.5	-0-
Crawford	-0-	77.2	78.7	155.9	-0-	74.8	82.5	157.3	-0-
Dent	-0-	73.2	236.1	309.3	-0-	71.0	250.2	321.2	-0-
Iron	-0-	72.5	98.3	170.8	-0-	70.3	103.6	173.9	-0-
Madison	-0-	58.5	147.9	206.4	-0-	56.7	157.3	214.0	-0-
Oregon	-0-	72.3	38.6	110.9	-0-	70.2	39.4	109.6	-0-
Reynolds	-0-	106.4	395.5	501.9	-0-	103.1	436.9	540.0	-0-
Ripley	-0-	68.5	124.0	192.5	-0-	66.4	130.7	197.1	-0-
St. Francois	-0-	30.2	28.1	58.3	-0-	29.3	29.7	59.0	-0-
Shannon	-0-	114.0	214.4	328.4	-0-	110.6	244.2	354.8	-0-
Washington	-0-	91.9	111.5	203.4	-0-	89.2	117.1	206.3	-0-
Wayne	-0-	90.3	106.6	196.9	-0-	87.6	119.2	206.8	-0-
Howell	-0-	56.3	18.7	75.0	-0-	54.5	21.2	75.7	-0-
Texas	-0-	77.2	180.6	257.8	-0-	74.9	202.4	277.3	-0-
Marles	-0-	16.9	-0-	16.9	-0-	16.4	-0-	16.4	-0-
Phelps	-0-	27.2	40.3	67.5	-0-	26.3	44.7	71.0	-0-
Cape	-0-	26.2	7.0	33.2	-0-	25.4	9.1	34.5	-0-
Franklin	-0-	67.2	32.6	99.8	-0-	65.0	33.7	98.7	-0-
Gasconade	-0-	40.4	10.7	51.1	-0-	39.2	10.7	49.9	-0-
Montgomery	-0-	28.4	21.1	49.5	-0-	27.5	21.1	48.6	-0-
Osage	-0-	43.4	7.3	50.7	-0-	42.0	7.3	49.3	-0-
Perry	-0-	29.3	11.5	40.8	-0-	28.3	12.2	40.5	-0-
St. Gen.	-0-	36.0	8.4	44.4	-0-	34.9	8.8	43.7	-0-
Warren	-0-	38.2	14.4	52.6	-0-	36.9	14.7	51.6	-0-
Lincoln	-0-	22.2	4.1	26.3	-0-	21.5	4.4	25.9	-0-
	-0-	1531.6	2383.6	3915.2	-0-	1484.8	2585.8	4070.6	-0-

NOTES: The new growth rate is the same as in the high production scenario except that the shortleaf pine clear-cut doesn't occur.

D

LAWS, REGULATIONS AND PROGRAMS

Appendix D

LAWS, REGULATIONS, AND SERVICES AFFECTING FORESTRY IN THE STUDY AREA

There are a multitude of state and federal programs which affect forestry in Missouri. The major Federal Acts which affect privately owned forest land are the Clarke-McNary Act, Soil Conservation and Domestic Allotment Act, Cooperative Forest Management Act, and the Cooperative Forestry Assistance Act. These Acts, along with the Missouri state enabling legislation (The State Forestry Law), provide the bulk of funding and technical assistance for timber stand improvements, seedling planting, and the deferment of taxes. The following information is obtained from a pamphlet titled, "Public Assistance for Forest Landowners" (14).

Technical Forest Management Information

The State Forester of the Conservation Commission provides information and technical advice to private landowners on the management of their forest stands through the Cooperative Forest Management Program. The State employed farm foresters advise the landowners on selective cutting, timber stand improvement, and timber stand regeneration. The foresters also assist landowners, loggers, and mill operators in the cutting and marketing of their wood products.

Tree Planting Stock

Through the Clarke-McNary Act, the state forestry program furnishes landowners with a large variety of tree species at a moderate cost. These seedlings can be utilized for forest stand improvement, wind barriers, or watershed protection. The state seedlings cannot be used for ornamental purposes or game baiting. Applications can be obtained from the State Forester, farm foresters, county extension service, and the Soil Conservation Service

(SCS). Financial assistance for tree planting can be obtained through the county Agricultural Stabilization and Conservation Service (ASCS) office.

Extension Forestry Assistance

The Smith-Lever Act of 1914 established the Federal Extension Service which is an educational agency of the USDA that cooperates with the University of Missouri Extension Service. The Extension Foresters are on the university staff and work with the state and farm foresters in education and research programs. The extension program utilizes university, private industry, and state and federal government personnel to provide expert information for adult education courses and youth programs.

Conservation Planning Assistance

The forestry services of the Soil Conservation Service (USDA) coordinate forestry activities which help control soil erosion in watershed districts in the study area. Landowners within these districts can receive technical assistance from the SCS conservationists, State Forester, and farm foresters in developing a soil conservation plan. The landowner will also receive information about other forestry programs that could be utilized in implementing conservation plans.

Loans For Forestry Activities

If farmers are unable to obtain affordable credit from private sources, they can apply to the Farmers Home Administration (FmHA). The landowners can obtain FmHA loans for developing, buying or refinancing forest land. Loans are available for the operation, harvesting and processing of forest products. Funds are also available to farm and ranch associations of the purchase of equipment. Woodland owners can obtain more information about loans for forestry purposes from the local FmHA offices.

Financial Assistance for Forestry Practices

The Soil Conservation and Domestic Allotment Act of 1936 established the Agricultural Conservation Program (ACP) of the USDA. The ACP offers financial assistance to plant trees, improve forest stands for higher production, soil conservation, and wildlife habitat. To participate in the ACP one must possess a farm which is defined as a tract of land more than 10 acres in size which sells at least $50 worth of agricultural products per year, or at least $250 per year if the land is less than 10 acres. Farm plans are approved by the local Soil Conservation District and can be annual or long term agreements. The government pays for 50 to 75 percent (65% maximum after 1980) of the site preparation, planting and timber stand improvement (TSI). Section FE-1 permits cost-sharing where at least one acre of walnut or 5 acres of pine seedlings are planted. Section FE-2 permits cost-sharing of TSI on a minimum 2 acres of walnut or 5 acres of other trees.

The ACP is administered by the USDA's Agricultural Stabilization and Conservation Service (ASCS) through the locally elected conservation committees. The ASCS issues implementation guidelines for what tree species to be planted and the cost share rate. The Forest Service, also a section of the USDA, provides information and forest management advice through the state farm foresters.

The Forestry Incentives Program (FIP) was enacted through Title X, Section 1009 of the Agricultural - Environmental Consumer Act of 1973. The FIP was designed to encourage the development, management and protection of non-industrial private forest land. The land must be capable of producing a marketable timber crop through forestation, reforestation, or TSI. The government cost share rates for planting and TSI range from 50 to 80 percent (65% maximum after 1980). The program is administered through the Forest Service (USDA), ASCS and the State Forester. Additional information is available

about the laws and programs later in this appendix.

State Forestry Law

The State Forestry Law was enacted in 1946 and is under the direction of the Missouri Conservation Commission. The State Forestry Law describes how the federal programs will affect non-federal forest land in Missouri. Its goal is to increase the production of forest crops by encouraging better management and protection of privately owned forest property. The three objectives in reaching the goal are to reduce forest fires, stop timber theft from unprotected land, and the deferment of a portion of the taxes until a cash yield can be obtained. The taxation question is the most important part of the objectives in the context of this report.

To participate in the property tax deferment, the landowner must have his forest land classified as "forest cropland" and must agree to follow a set of basic rules for forest management and taxation which are set by the Missouri Conservation Commission. Forest tracts of land must be at least 40 acres, but not over 500 acres, and not valued over $125 per acre to be eligible for the forest crop land designation. The tracts of land will then be assessed on a valuation of $3 per acre for a period of 25 years. County tax rates will be applied to this $3 per acre valuation. The State of Missouri will pay each county 35 cents per acre per year for all designated forest cropland.

Timber cut on the forest cropland will be assessed a yield tax of 6 percent of the stumpage value. Harvesting after the 25 year period expires will not be subject to the yield tax. The forest landowner will file a sworn statement with the Conservation Commission not later than one month after the timber harvest. The statement shall include species and quantity of timber cut, and the stumpage value received. The Conservation Commission will bill the owner of the amount of yield tax to be paid to the State Forester's Office.

No yield tax will be assessed on trees cut for the landowner's personal use.

The Conservation Commission may cancel the forest cropland designation at any time if there is evidence that the owner is not following the required management practices. The owner cannot erect permanent buildings or subdivide the land into less than 40 acre tracts. If an owner wants to withdraw from the program he must pay the back taxes plus a penalty of 5 percent. When the Conservation Commission cancels the contract, the landowner must pay the back taxes plus a 10 percent fine. These payments are in addition to any regular tax or yield tax that was paid previously. The ownership of the forest cropland may transfer if the new owner agrees to abide by the Conservation Commission rules.

Both the ACP and FIP are implemented through the State Forest Law but there are a number of differences in the two Federal acts. The main goal of the FIP is timber production while the ACP is more interesting in soil conservation. Trees that are planted and not managed will control soil erosion but will not produce a significant amount of marketable timber. Many farmers in the ACP have placed their forest land under the FIP management plan but the potential timber production justifies all ACP acres put under the FIP plan.

Both programs are implemented through the State Forester and their farm foresters. The state is reimbursed through the Cooperative Forest Management Program of the Forest Service for the desimination of information and management advice. The FIP is generally replacing the ACP in funding the forest management cost-sharing allocations.

Laws and Regulations Affecting Forestry

Forest productive capabilities form a base for renewable resource yield if properly managed. Laws form a legal base for incentives and penalties to help insure future generations a continuing forest yield. The following is

a list of the more important federal laws obtained from the USDA's Report to Congress on the Nations Renewable Resources (16):

Organic Administration Act of 1897 (30 Stat. 34 amended; 16 U.S.C. 473-478, 479, 482, 551)--Authorized the Secretary of Agriculture to manage the National Forests, to improve and protect the forests, and to furnish a continuous supply of timber.

Weeks Law of 1911 (36 Stat. 961, as amended; 16 U.S.C. 480, 500, 513-519, 521, 522)--Authorized purchasing and adding to the National Forest System forested, cut-over or denuded lands to produce timber.

Smith-Lever Act of 1914 (30 Stat. 372; 7 U.S.C. 341-349)--Established a federal/state cooperative extension program to provide education for the public in natural resources.

Clarke-McNary Act of 1924 (43 Stat. 653-654, as amended; 16 U.S.C. 563-567)--Authorized technical and financial assistance to the states for forest fire control and for production and distribution of forest tree seedlings. (Sections 1 through 4 were repealed by the Cooperative Forestry Assistance Act of 1978).

Soil Conservation and Domestic Allotment Act of 1936 (49 Stat. 1148, as amended; 16 U.S.C. 590 et. seq.)--Established the Agricultural Conservation Program, which provides cost-sharing funds to landowners which include tree planting and timber stand improvement practices.

Cooperative Forest Management Act of 1950 (64 Stat. 473, as amended; U.S.C.

586c, 586d)--Authorized technical and financial assistance to states so they can provide technical assistance to private forest landowners and processors.

Multiple Use-Sustained Yield Act of 1960 (74 Stat. 215; 16 U.S.C. 528-531)--Established a policy of multiple use, sustained yield management for the renewable resources of the National Forest System.

McIntyre-Stennis Act of 1962 (76 Stat. 806; 16 U.S.C. 582a--582a-7)--Established a cooperative research program in forestry for state land grant colleges and universities.

Forest and Rangeland Renewable Resources Planning Act of 1974 (88 Stat. 476 as amended; 16 U.S.C. 1600-1614)--Provided for continuing assessment and long range planning of the nation's forest and range renewable resources under the jurisdiction of the Secretary of Agriculture.

National Forest Management Act of 1976 (90 Stat. 2949; 16 U.S.C. 472a, 476 (note), 500, 513-516, 521b, 528 (note), 576b, 594-2 (note), 1600 (note), 1600-1602, 1604, 1606, 1608-1614)--Established additional standards and guidelines for managing the National Forests, including directives for National Forestland management planning, and public participation.

Federal Land Policy and Management Act of 1976 (90 Stat. 2743; 43 U.S.C. 1701 et. seq.)--Set policies primarily for the administration of Bureau of Land Management (BLM) lands. Includes common statutory authorities for the Secretaries of the Interior and Agriculture in managing land administered by the BLM and the Forest Service.

Cooperative Forestry Assistance Act of 1978 (92 Stat. 365; 16 U.S.C. 2101-2111)--Brought together authorities for nine cooperative assistance programs in forestry and expanded some of them; also authorized consolidated programs to participating states.

Forest and Rangeland Resources Extension Act of 1978 (92 Stat. 349; 16 U.S.C. 1600 (note), 1601, 1671-1676)--Authorization expanding the forest and rangeland renewable resource portion of the extension education program.

Forest and Rangeland Renewable Resources Act of 1978 (92 Stat. 353; 16 U.S.C. 1600-1601, 1641-1647, 581-581c)--Authorized expanding forest and rangeland renewable resources research.

The State Forestry Law

The original legislation was passed as House Bill No. 1006, 63rd General Assembly in 1946. The following section descriptions are the original bill and its amendments through 1974.

254.010. Citation of law. This law shall be known and may be cited as "The State Forestry Law".

254.020. Definitions. As used in this chapter, the following words shall have the following meanings:

(1) The word "commission" shall mean the conservation commission of Missouri upon which, by the terms hereof impressed, are vested the responsibilities for the administration hereof in conformity with sections 40 to 46 of article IV of the Constitution of Missouri; and the words "rules and regulations" shall mean those made by the commission pursuant thereto;

(2) "Forest croplands" shall mean those lands devoted exclusively to growing wood and timber except for such other uses as shall be approved by the commission by regulations and which are tendered to the commission by any person and accepted and classified by the commission as such; and the commission shall prescribe the terms and conditions of such tender, acceptance and classification.

(3) The word "person" shall mean any individual, male or female, singular or plural, of whatever age, and this term shall include and refer to any owner, grantee, lessee, licensee, permittee, firm, association, copartnership, corporation, municipality or county, as the context may require.

(4) The title "State Forester" shall mean the administrative head of the state forestry program.

254.040. Commission to classify forest croplands--applicant may appeal--limitations. 1. Any person desiring to have lands designated as forest croplands shall submit an application therefor to the state forester on form or forms to be provided by the commission. The state forester will make or cause to be made an examination of the lands covered by said application and shall forward a copy of same, together with his recommendations, to the commission. If the commission approve and classify lands as forest croplands they shall be subject to the provisions of this chapter and such rules and regulations.

2. If the commission refuse so to accept and classify said lands, the applicant may appeal from the decision of the commission to the circuit court in which such lands, or major part thereof, are located and the decision of the circuit court in all such matters shall be final.

3. No application shall be accepted for a tract of land containing less than forty acres; and no such land shall be classified for tax relief if the

value thereof shall exceed one hundred twenty-five dollars per acre.

254.050. Certification of forest croplands, where filed. For all such lands which have been accepted and classified by the commission as forest croplands, a certificate shall be issued in quadruplicate by the commission; and the original thereof shall be filed in the commission office, one copy in the office of the director of revenue, one copy with the county clerk of the county and one copy with the applicant. The lands described in such certificate shall be entitled to the partial tax relief provided for in this chapter.

254.060. Transfer of ownership. The transfer of the ownership of any such forest croplands shall not affect any classification thereof as such.

254.070. Grants to counties in lieu of taxes--state-owned forest croplands. 1. The commission may classify as forest croplands any part of lands conveyed to the state for use of the commission. The state shall pay to the county wherein the state-owned and classified lands are situated a certain sum appropriated by law from general revenue funds as a grant in lieu of taxes thereon, which sum shall be thirty-five cents per acre per year.

2. The grants in lieu of taxes so received by the respective counties shall be placed in the general revenue fund of each such county.

3. The commission shall annually certify to the comtroller and the state auditor the acreage of such lands and the amount payable to each county under the provisions hereof and the treasurer is authorized to pay, and, after appropriations are made as herein provided, such amounts shall be paid to such counties on or before the first day of January following the certification. This section shall not be retroactive.

254.080. Partial tax relief, period of duration. Any privately owned lands approved and classified by the commission as forest croplands as defined

in this chapter shall receive partial relief from taxation, as provided in said chapter, during a period of time not to exceed twenty-five years.

254.090. Taxation of forest croplands, how assessed. Privately owned lands classified as forest croplands under this chapter shall be assessed for general taxation purposes at three dollars per acre, and taxed at the local rates of the county wherein the lands are located. Lands so classified prior to the effective date of this chapter shall be assessed for general taxation purposes at one dollar per acre and taxed at the local rate of the county wherein the lands are located.

254.100. Private plan of forest management--partial tax relief--revisions. 1. Any person owning or controlling forest land may inaugurate and develop his own plan of management and employ such standards and methods of forest management as may suffice in the judgment of the commission to accomplish the purposes of this chapter and may obtain the partial relief from taxation provided for in this chapter for such forest property so long as the provisions of this chapter are being complied with, provided such plans and methods and application for tax relief be submitted on forms provided by the commission and the same are approved by the commission. Such plans, methods and application shall not be approved unless the commission finds they give reasonable assurance of accomplishing the purposes of this law.

2. After approval of such plans and methods and such application for tax relief such person may present revised working plans from time to time to the commission for the cutting and management of said forest lands, for their approval. Such period prescribed by the commission and the decision of the commission in all such matters shall be final. The procedure in effectuating said tax relief shall be as that outlined in this chapter for forest croplands.

254.110. Grants to counties in lieu of taxes--privately owned forest croplands. 1. The commission shall determine as of January first of each year the number of acres of privately owned forest cropland which has been accepted in each county under this chapter. The state shall pay to each county in which these lands are situated a certain sum appropriated by law from general revenue funds as a grant in lieu of taxes, this sum to be thirty-five cents per acre per year for each acre so accepted.

2. The grants in lieu of taxes so received by the respective counties shall be placed in the general revenue fund of each such county.

3. The commission shall annually certify to the comtroller and the state auditor the amount payable to each county and the treasurer is authorized to pay, and, after appropriations are made as provided in this section, such amounts shall be paid to such counties on or before the first day of January following This section shall not be retroactive.

254.120. Tax relief not to affect valuation of other property. The assessor shall not increase the valuation of property other than forest lands owned by any person so as to make up for loss of taxable property value because of the forest croplands tax relief provided for in this chapter.

254.130. Compliance with forest management rules and regulations required. All persons interested in any way in the forest croplands or the cutting of crops therefrom covered by this chapter shall comply with and follow such forest management rules and regulations as are required by the commission.

254.140. Right to cut timber, when. Nothing in this chapter shall be construed as limiting the right of any such person to cut from said forest croplands owned or controlled by him, firewood and timber for his own domestic use.

254.150. Yield tax on cutting--exceptions. All products of cuttings on classified lands shall pay a yield tax as provided by this chapter, except materials from cuttings permitted by section 254.140, when such materials shall be used by the owner of the land, or by a tenant with the permission of the owner upon property belonging to such owner, which is taxable in the same county as the timberland from which the timber was removed.

254.160. Collection of yield tax from cuttings-method. If such products of cuttings shall be sold or otherwise disposed of or transferred to the ownership of other persons it shall be subject to the yield tax provided in this chapter. Whenever a cutting shall be made other than as excepted in sections 254.140 and 254.150, of this chapter, the owner of the land shall file a sworn statement with the commission of the qunatity and species of timber cut; this statement shall be filed not later than one month following said cutting or at the end of each month where the cutting is continuous. The commission shall review this statement and determine the stumpage value and forward its report to the director of revenue. The director of revenue or his agent shall arrange collection of the yield tax from the owner.

254.170. Yield tax, rate. When ever a cutting shall be made on lands so classified, except as otherwise provided in this chapter and in addition to the local tax, the material so cut shall be subject to a yield tax on the value as determined under section 254.160 and at the rate of six percentum of such value.

254.200. Proper forest practices to be maintained--grounds for cancellation. 1. When any lands have been so classified the classifications shall be continued as long as proper forest conditions and practices are maintained and continued thereon, and for such periods of time as do not exceed the provisions of this chapter.

2. Use of such lands for pastures, destruction of tree-growth and failure of owner to restore forest conditions, removal of tree-growth and use of land for other purposes, or any changed condition which in the opinion of the commission shall show that the requirements of this chapter are not being fulfilled, or the use of such lands for pasture in violation of any regulations promulgated by the commission shall be sufficient ground for the cancellation of such classification. If the commission find the provisions of this chapter are not being complied with, it shall forthwith cancel the classification of such lands, sending notice of such cancellation to the assessor, the county clerk of the county in which the land is situated and to the owner of such lands. Such lands shall thereafter be taxed as other lands.

254.210. Cancellation for cause--penalty. When a classification shall have been cancelled for cause, the owner of such lands shall make reimbursement to the state in a manner as the director of revenue shall prescribe for the grant which was paid by the state to the county in lieu of taxes on this land while so classified as forest cropland, plus a penalty equivalent to ten percent interest thereon. Such reimbursement shall be in addition to any yield tax which may have been paid or may be collected.

254.220. Voluntary cancellation--penalty. In the event an owner of forest croplands may desire to remove his land from classification, he may do so by making reimbursement to the state in a manner as the director of revenue shall perscribe for the grant which was paid by the state to the county in lieu of taxes on this land while so classified, plus a penalty equivalent to five percent interest thereon.

FOUTCH STUDY

Appendix E

FOUTCH STUDY ANALYSIS SUMMARY

Ms. Foutch made many assumptions in her analysis of costs and acceptable levels of return on investment. The major assumption concerning calculating costs is that the landowner is not making payments on his land. If payments are being made the costs greatly increase and her analysis is not relevant. The most important assumption of analyzing an acceptable rate of return is the 1976 bank saving's account return of 5 percent. Over the past few years this bank account interest level has dramatically increased, but her analysis is a good point of departure for recalculating a more current rate of return. The best summary of her work is chapter 6 of her study (19) which is reproduced below:

Summary of Analytical Findings

"The economic analysis of the alternative Federal incentive schemes for small woodlot management presented here deals with three points of view. The first two are those of the 'average' woodlot owners in Dent and Reynolds Counties in Missouri. The third is the government's view.

In the Dent County case, the average owner seeds 35 acres with shortleaf pine. Thinnings will be made at 30 years, and every ten years thereafter until age 80, when the stand is clearcut. All the thinnings and the harvest can be sold for between $12.50 and $22.50 per thousand board feet (MBF). Assuming adherence to the management plan, the owner's internal rate of return (IRR), and net present value (NPV) are calculated for a variety of cost share rates and price/MBF. Two types of rates are considered, one for planting, the other for thinning. These rates may differ from each other. A cost share rate is considered acceptable to the owner if the IRR is 5 percent or greater, and/or the NPV is positive at a discount rate of 5, 6, or 7 percent. The rates that

fit this criteria range from a high of 100/100 (cost share rate for planting/ cost share rate for thinning) which is acceptable at all the prices/MBF used, to a low of 50/50, which is acceptable only if the market price is $22.50/MBF. The cost share rate represents the government's share of the cost.

In the Reynolds County case, the average woodlot owner thins his 52 acre stand of black and scarlet oak every ten years for sixty years, starting in the present. The products of thinning are not saleable. During the course of 60 years, four diameter limit cuts will be made, in which all trees over 14 inches in diameter at 4-1/2 feet from the ground are harvested. The timber obtained in these harvests will fetch between $15 and $25/MBF. The methodology used in Dent County is followed for the Reynolds County data, and acceptable cost share rates identified. The cost share rate for planting is not important here since no planting is included in the management plan. Only those rates in which the government pays 100 or 75 percent of the cost of thinning are acceptable at any price/MBF. A rate of n/25 is marginally acceptable if the price is $25/MBF.

The internal rate of return and net present value in both counties are very sensitive to changes in either of the cost share rates, or the price per thousand board feet. Reynolds County is more sensitive because there is no large initial planting cost to temper the effects of changes in the cost share rate, and the benefits are received sooner than in Dent County, which results in higher present values when the price/MBF is varied.

The third point of view is that of the government. The cost of producing timber by following the designed management plan in each county is calculated at a 10 percent discount rate for various cost share rates. This is compared to the market value of the timber, which is discounted at the same rate. In Dent County, the cost to the government is less than the market value of the timber, despite variations in price and in cost share rates. In Reynolds,

however, only a cost share rate of n/25 results in a value greater than the cost, and then only if the price is $25 per thousand board feet. In this part of the analysis, only direct monetary benefits and costs were considered. Social benefits, such as soil and water conservation which may result from the sustained yield harvest used in Reynolds County are not included.

As illustrated in Table , there are no cost share rates which are acceptable to both Dent and Reynolds 'average' woodlot owners and to the government. In the Dent County case, there is no such overlap."

TABLE 27

COST SHARE RATES WHICH ARE ACCEPTABLE TO THE

WOODLOT OWNERS AND THE GOVERNMENT UNDER VARIOUS CRITERIA

(Reproduced from Foutch Study)

RESULTS

	Woodlot Owner														Government			
	High Price								Low Price						High Price		Low Price	
	NPV						IRR		NPV						NPV		NPV	
	5%		6%		7%				5%		6%		7%		10%		10%	
100/100	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D		D	
100/75	D	R	D	R	D	R	D	R	D	R	D	R	D		D	R	D	
100/50	D		D		D		D		D		D		D		D		D	
100/25	D		D		D		D		D		D		D		D	R	D	
100/0	D		D		D		D		D		D		D		D	R	D	R
75/100	D	R	D	R		R	D	R	D	R		R		R	D		D	
75/75	D	R	D	R		R	D	R	D	R		R			D		D	
75/50	D		D				D		D						D		D	
75/25	D		D				D								D	R	D	R
75/0	D						D								D	R	D	R
50/100	D	R		R		R	D	R		R		R		R	D		D	
50/75	D	R		R		R	D	R		R		R			D		D	
50/50	D						D	R							D		D	
50/25															D	R	D	
50/0															D	R	D	R
25/100		R		R		R		R		R		R		R	D		D	
25/75		R		R		R		R		R		R		R	D		D	
25/50								R							D		D	
25/25															D	R	D	
25/0															D	R	D	R
0/100		R		R		R		R		R		R		R	D		D	
0/75		R		R		R		R		R		R			D		D	
0/50								R							D		D	
0/25															D	R	D	
0/0															D	R	D	R

Legend

D = acceptable in Dent County case
R = acceptable in Reynolds County case

F

SUMMARY DATA TABLES

Appendix F

SUMMARY DATA TABLES

The ACP and FIP data in Table 28 was obtained from a computer printout at the ASCS Office in Columbia, Missouri. This data were in some instances not organized in twelve month periods. The information in the first five year period is for the ACP and the second set of years is for the FIP. Table 28 illustrates the data which were used in Graphs 8, 9, 10 and 11.

TABLE 28

ACP AND FIP PROGRAMS IN THE STUDY AREA

County Name	1975 PLANTING # of acres	1975 PLANTING Average Cost/Acre	1975 T.S.I. # of acres	1975 T.S.I. Average Cost/Acre	1976 PLANTING # of acres	1976 PLANTING Average Cost/Acre	1976 T.S.I. # of acres	1976 T.S.I. Average Cost/Acre
Bollinger	-0-	-0-	187	$8.13	2	$29.50	2	$29.50
Butler	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Carter	-0-	-0-	47	15.74	-0-	-0-	-0-	-0-
Crawford	8	35.38	10	15.70	10	14.40	10	14.40
Dent	30	54.77	175	17.30	-0-	-0-	-0-	-0-
Iron	-0-	-0-	255	16.50	-0-	-0-	-0-	-0-
Madison	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Oregon	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Reynolds	-0-	-0-	240	16.50	-0-	-0-	-0-	-0-
Ripley	-0-	-0-	40	16.50	-0-	-0-	-0-	-0-
St. Francois	10	74.00	130	18.75	-0-	-0-	-0-	-0-
Shannon	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Washington	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Wayne	-0-	-0-	176	16.50	-0-	-0-	-0-	-0-
Howell	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Texas	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Maries	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Phelps	3	50.00	-0-	-0-	15	36.07	15	36.07
Cape	3	12.00	-0-	-0-	1	9.00	1	9.00
Franklin	2	37.50	5	16.60	39	66.23	39	66.23
Gasconade	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Montgomery	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Osage	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Perry	3	40.00	-0-	-0-	16	44.56	16	44.56
St. Gen.	-0-	-0-	-0-	-0-	10	27.80	10	27.80
Warren	2	56.50	30	16.50	-0-	-0-	-0-	-0-
Lincoln	-0-	-0-	13	11.00	-0-	-0-	-0-	-0-
Total	61		1308		93		93	
Average Cost/Acre		$50.41		$15.55		$46.53		$46.53

SOURCE: Computer printout at ASCS Office in Columbia, Missouri, July 1981.

TABLE 28 - CONTINUED

ACP AND FIP PROGRAMS IN THE STUDY AREA

County Name	1977 PLANTING # of acres	1977 PLANTING Average Cost/Acre	1977 T.S.I. # of acres	1977 T.S.I. Average Cost/Acre	1978 PLANTING # of acres	1978 PLANTING Average Cost/Acre	1978 T.S.I. # of acres	1978 T.S.I. Average Cost/Acre
Bollinger	21	$31.90	106	$16.42	8	$22.00	-0-	-0-
Butler	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Carter	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Crawford	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Dent	35	37.31	-0-	-0-	8	23.25	43	16.51
Iron	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Madison	-0-	-0-	-0-	-0-	4	14.25	-0-	-0-
Oregon	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Reynolds	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Ripley	-0-	-0-	5	16.60	-0-	-0-	4	16.50
St. Francois	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Shannon	-0-	-0-	15	15.13	-0-	-0-	-0-	-0-
Washington	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Wayne	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Howell	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Texas	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Maries	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Phelps	-0-	-0-	16	20.50	-0-	-0-	-0-	-0-
Cape	3	12.00	-0-	-0-	-0-	-0-	-0-	-0-
Franklin	-0-	-0-	-0-	-0-	-0-	-0-	50	12.42
Gasconade	2	95.00	-0-	-0-	4	32.75	7	16.57
Montgomery	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Osage	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Perry	17	31.59	13	21.15	2	25.00	40	15.40
St. Gen.	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Warren	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Lincoln	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total	78		155		26		144	
Average Cost/Acre		$35.11		$17.12		$23.08		$14.78

TABLE 28 - CONTINUED

ACP AND FIP PROGRAMS IN THE STUDY AREA

	1979				1980			
	PLANTING		T.S.I.		PLANTING		T.S.I.	
County Name	# of acres	Average Cost/Acre	# of acres	Average Cost/Acre	# of acres	Average Cost/Acre	# of acres	Average Cost/Acre
Bollinger	24	$34.29	4	$16.50	-0-	-0-	75	$16.51
Butler	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Carter	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Crawford	8	39.75	-0-	-0-	-0-	-0-	-0-	-0-
Dent	-0-	-0-	43	16.51	4	22.50	45	17.29
Iron	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Madison	4	14.25	-0-	-0-	-0-	-0-	-0-	-0-
Oregon	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Reynolds	1	88.00	-0-	-0-	-0-	-0-	-0-	-0-
Ripley	-0-	-0-	-0-	-0-	4	15.00	-0-	-0-
St. Francois	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Shannon	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Washington	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Wayne	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Howell	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Texas	8	36.38	-0-	-0-	13	18.85	-0-	-0-
Marles	-0-	-0-	-0-	-0-	3	41.33	-0-	-0-
Phelps	-0-	-0-	6	15.83	6	38.33	-0-	-0-
Cape	-0-	-0-	8	15.63	-0-	-0-	-0-	-0-
Franklin	7	83.00	-0-	-0-	-0-	-0-	6	17.33
Gasconade	-0-	-0-	-0-	-0-	-0-	-0-	5	13.60
Montgomery	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Osage	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Perry	-0-	-0-	40	15.40	7	15.71	4	18.75
St. Gen.	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Warren	-0-	-0-	13	33.00	-0-	-0-	10	27.00
Lincoln	-0-	-0-	-0-	-0-	-0-	-0-	15	22.80
Total	52		114		37		160	
Average Cost/Acre		$41.50		$17.90		$23.22		$17.97

TABLE 28 - CONTINUED

ACP AND FIP PROGRAMS IN THE STUDY AREA

	May 1975 to September 1976				October 1976 to December 1977			
	PLANTING		T.S.I.		PLANTING		T.S.I.	
County Name	# of acres	Average Cost/Acre	# of acres	Average Cost/Acre	# of acres	Average Cost/Acre	# of acres	Average Cost/Acre
Bollinger	55	$27.11	340	$16.50	-0-	-0-	334	$16.70
Butler	-0-	-0-	15	16.47	-0-	-0-	147	16.50
Carter	47	21.15	980	16.07	-0-	-0-	755	15.98
Crawford	86	24.20	304	17.45	39	30.03	282	19.54
Dent	470	41.74	1177	16.10	1052	47.48	744	16.15
Iron	33	19.55	315	16.50	-0-	-0-	122	16.51
Madison	4	24.75	361	16.50	-0-	-0-	665	16.50
Oregon	101	26.71	93	15.75	19	59.00	-0-	-0-
Reynolds	-0-	-0-	3002	16.50	-0-	-0-	1752	16.50
Ripley	3	54.67	305	16.50	12	84.75	138	16.50
St. Francois	-0-	-0-	20	18.75	-0-	-0-	60	17.75
Shannon	53	48.13	2326	13.42	154	39.27	1071	16.70
Washington	50	18.76	598	18.39	-0-	-0-	290	18.76
Wayne	-0-	-0-	914	16.50	42	46.45	660	16.50
Howell	88	54.69	107	15.89	98	42.65	296	0.60
Texas	169	43.22	895	18.03	270	41.55	1141	17.12
Marles	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Phelps	12	25.92	224	15.96	20	23.20	672	16.36
Cape	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Franklin	-0-	-0-	5	36.00	30	110.27	-0-	-0-
Gasconade	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Montgomery	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Osage	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Perry	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
St. Gen.	-0-	-0-	65	18.75	10	105.00	20	18.75
Warren	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Lincoln	-0-	-0-	20	11.00	-0-	-0-	-0-	-0-
Total	1171		12,066		1746		9149	
Average Cost/Acre		$35.20		$16.06		$46.66		$16.19

TABLE 28 - CONTINUED

ACP AND FIP PROGRAMS IN THE STUDY AREA

County Name	January 1 to September 30, 1978 PLANTING # of acres	PLANTING Average Cost/Acre	T.S.I. # of acres	T.S.I. Average Cost/Acre	October 1978 to September 1979 PLANTING # of acres	PLANTING Average Cost/Acre	T.S.I. # of acres	T.S.I. Average Cost/Acre
Bollinger	80	$39.14	40	$16.50	-0-	-0-	130	$16.51
Butler	-0-	-0-	55	9.69	-0-	-0-	-0-	-0-
Carter	-0-	-0-	2017	16.83	-0-	-0-	1559	16.50
Crawford	47	28.06	100	20.05	40	50.25	40	15.75
Dent	557	44.78	67	12.51	285	52.81	357	15.81
Iron	-0-	-0-	255	16.50	-0-	-0-	-0-	-0-
Madison	-0-	-0-	510	16.50	-0-	-0-	25	16.52
Oregon	30	108.67	-0-	-0-	55	63.13	58	32.98
Reynolds	-0-	-0-	1178	16.50	-0-	-0-	720	15.79
Ripley	19	44.21	384	16.50	-0-	-0-	147	16.51
St. Francois	-0-	-0-	20	18.75	-0-	-0-	-0-	-0-
Shannon	10	12.00	913	15.64	62	63.97	750	16.69
Washington	15	72.73	100	18.75	7	86.43	137	18.76
Wayne	-0-	-0-	31	16.48	-0-	-0-	467	16.50
Howell	77	47.70	34	35.91	71	46.49	125	11.14
Texas	466	48.57	850	16.59	350	38.21	530	16.12
Maries	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Phelps	47	42.87	236	15.96	142	63.43	126	15.90
Cape	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Franklin	-0-	-0-	40	16.50	-0-	-0-	100	10.00
Gasconade	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Montgomery	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Osage	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Perry	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
St. Gen.	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Warren	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Lincoln	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total	1348		6830		1012		5271	
Average Cost/Acre		$46.75		$16.57		$50.18		$16.32

TABLE 28 - CONTINUED

ACP AND FIP PROGRAMS IN THE STUDY AREA

October 1979 to December 1980

County Name	PLANTING # of acres	PLANTING Average Cost/Acre	T.S.I. # of acres	T.S.I. Average Cost/Acre
Bollinger	10	$31.30	216	$16.50
Butler	20	60.00	103	10.35
Carter	-0-	-0-	270	16.50
Crawford	10	45.80	23	19.52
Dent	374	61.02	-0-	-0-
Iron	-0-	-0-	-0-	-0-
Madison	-0-	-0-	120	16.50
Oregon	11	61.36	33	16.39
Reynolds	-0-	-0-	1292	15.95
Ripley	44	75.00	197	18.50
St. Francois	-0-	-0-	80	18.75
Shannon	100	27.01	548	16.76
Washington	31	74.55	82	18.76
Wayne	-0-	-0-	157	16.50
Howell	10	41.00	58	18.45
Texas	419	47.84	1237	17.28
Marles	-0-	-0-	-0-	-0-
Phelps	55	155.60	11	25.55
Cape	-0-	-0-	-0-	-0-
Franklin	-0-	-0-	40	12.40
Gasconade	-0-	-0-	-0-	-0-
Montgomery	-0-	-0-	-0-	-0-
Osage	-0-	-0-	-0-	-0-
Perry	40	63.75	29	14.66
St. Gen.	18	36.94	40	18.75
Warren	-0-	-0-	-0-	-0-
Lincoln	-0-	-0-	-0-	-0-
Total	1142		4536	
Average Cost/Acre		$57.80		$16.08

FORESTRY RESOURCE PLANNING OF THE MISSOURI OZARKS

by

CLARK WILLIAM ODOR

B.S., Central Missouri State University, 1974

B.S., Central Missouri State University, 1975

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF REGIONAL AND COMMUNITY PLANNING

Department of Regional and Community Planning

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1982

The removals of trees in the Missouri Ozark study area are projected to increase in the future, but the forestland has been decreasing at a rate of 100,000 acres per year. The major reason for this decline in acreage is the conversion of forest into pasture by small land owners. The small forest land owner is handicapped by the great time lag between the established investment of timber stand improvement, the optimum harvest date, and the subsequent return on the investment. The short term profit motive of converting the forest to pasture must be overcome to insure future availability of the forest resource.

Based on the United States Department of Agriculture's Forest Service data, the twenty-seven county study area's existing forest resource was analyzed. The existing sawtimber characteristics of growth, removals and inventory were projected into the future. The inventory was projected to be eliminated in the year 2084. The Forest Service's estimated increase of demand was incorporated into the projection and the sawtimber inventory was eliminated in the year 2002. These projections show that some type of management plan needs to be initiated to insure the future availability of the forestry resource.

The existing Federal and State of Missouri forestry cost-sharing management programs were analyzed. Information from the Foutch Study was used to determine the cost/benefit level of government participation and the improvement of the forestry resource. The programs that the Foutch Study analyzed were the Forestry Incentive Program and the Agricultural Conservation Program. Both of these programs are designed to assist the small forest land owner cut his forest management costs.

Scenarios were developed with a range of resource management goals. All the management programs were based on the goal of increasing sawtimber growth and inventory on private forest land and to stop the conversion of forest land to pasture because of economic necessity. The management goals were to increase

sawtimber to meet the Forest Service year 2000 demand, to sustain the sawtimber inventory at current levels, and to retain the same removals and inventory without increasing the cut on recreational, scenic or other public forest lands. All scenarios estimated the level of government subsidy and proposed implementation plans.