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Changes in Area of Timberland in the United States, 1952-2040, By Ownership, Forest Type, Region, and State

Ralph J. Alig, William G. Hohenstein,
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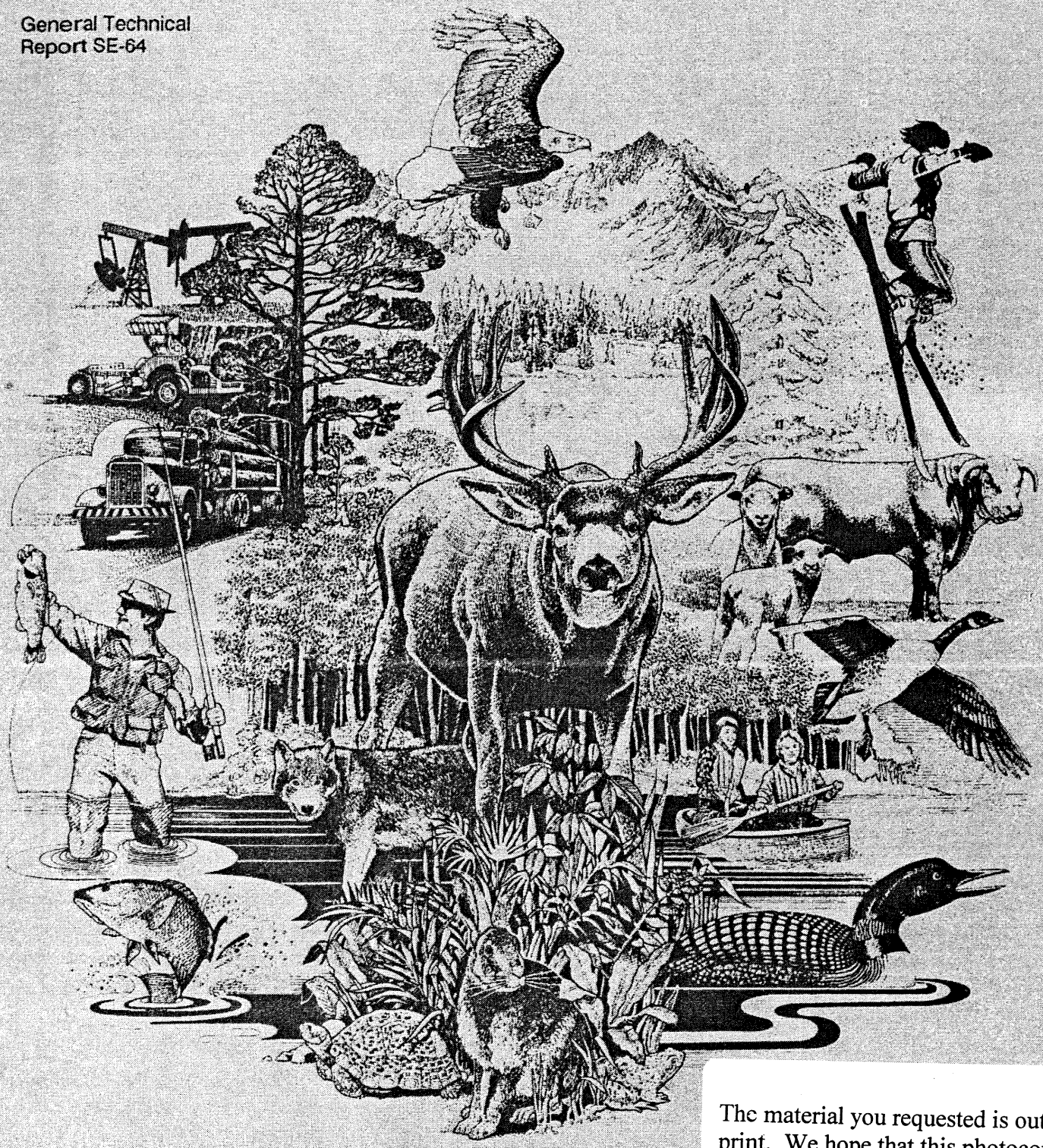

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ABSTRACT

Projection systems were significantly improved for estimating timberland area in the United States through 2040 by region, State, ownership, and forest type. The model for projecting forest area and ownership considers competing land uses. The model for projecting changes in covertypes considers successional influences and behavior of various types of owners. Timberland area in the United States is projected to decline by 21 million acres or 4 percent by the year 2040. The South is the region with the most dynamic changes, including a notable increase in planted pine area. Nonindustrial private owners will make the most changes in land use, causing a net loss of over 18 million acres of timberland by 2040.

Keywords: Land use change, RPA Assessment, land allocation.

Introduction

The area of timberland is a major determinant of the Nation's ability to produce forest-related goods and services. Forests provide timber, recreation, watershed protection, wildlife habitat, and other benefits, but forest land may also be used for producing crops, pasture, or urban development. The effects of demographic and economic forces on land allocation must therefore be considered when projecting changes in forest area.

This report presents estimates of historical and current timberland area, and projections of timberland area, by region (fig. I), State, ownership, and forest type in the United States. This information and that contained in related documents (USDA Forest Service 1989a, in press) will be useful for large-scale natural resource assessments.

Timberland is defined as forest land that can produce 20 cubic feet of timber per acre per year and is not reserved for other uses.1 This measure is compatible with historical records. In 1987, the United States contained 483 million acres (195 million hectares) of timberland.

Estimates of historical and current timberland area were obtained from the Resources Planning Act (RPA) data base maintained by the USDA Forest Service (Waddell and others 1989). The timberland area projections were developed for the 1989 RPA Assessment. The Assessment must include 'an analysis; of the present and anticipated uses, demand for, and supply of the renewable resources of forest, range, and other associated lands, with consideration of the international resource situation, and an emphasis of pertinent supply, demand, and price relationship trends" (USDA Forest Service 1989a). Projections were developed with statistical-based methods and expert opinion. Specific methodologies that were used are described in subsequent sections.

Historical Trends in Timberland Area

From 1952 to 1987, the area of timberland in the United States dropped from 509 million acres to 483 million acres, a 5-percent reduction (fig. 2). The reduction in timberland area in this century has not been steady. Several trend reversals have been caused by broad economic and institutional forces. Our look backward to define trends begins in 1952 because that is the first year for which accurate estimates of timberland area are available for all States. General trends in timberland area can be inferred,, however, from earlier records and patterns of development (USDA Forest Service 1982, 1989a; Waddell and others 1989).

[1] In determining what areas are suitable for timber production, National Forest planners use additional economic and social constraints. Timberland, as defined in this document, does not include these constraints.

Figure 1 — RPA Assessment Regions.

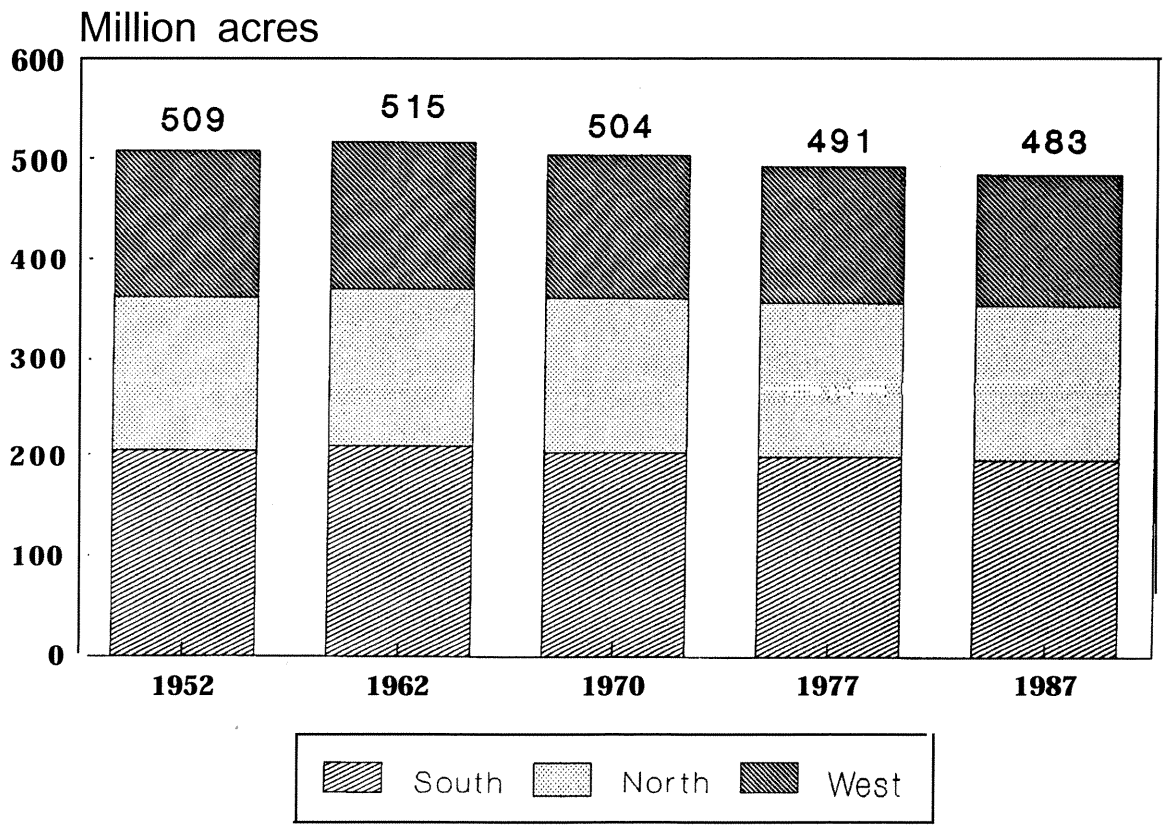

Figure P-Timberland area in the United States, by region, 1952-1987.

From the initial settlement until the early twentieth century, the amount of timberland in this country declined. Timberland was cleared primarily for crop production and pasture in the South, the Northeast, and the Appalachians. In colonial times, timberland was often seen as a hindrance to development rather than as an asset. In certain areas, bare land commanded a higher price than land with timber. As the US. population shifted westward, the primary area of agricultural production shifted from the East to the Midwest. Deep soils, gentle slopes, ease of conversion, and larger tract sizes made this area more suitable for crop production than much of the East.

Declines in the amount of timberland occurred until the early 1920's (USDA Forest Service 1988). Significant changes in agriculture took place after 1920 that caused abandonment of large areas of crop and pasture land. These include: (1) the internal combustion engine speeded transportation of perishable crops and severely curtailed use of horses, and (2) the boll weevil made cotton growing unprofitable in many parts of the South. Many eastern and southern farms were abandoned.

Some of this abandoned land was planted with trees, but the majority reverted naturally to forest. This reversion took substantially longer than it would have if trees had been planted. Nevertheless, timberland acreage increased.

By the late 1950's and early 1960's these factors diminished, and timberland area again began to decline. Shifts in timberland in the 1960's occurred primarily in the South and Rocky Mountains. Timberland area reductions in the West largely reflected public lands being reserved and placed in wilderness use. Reduced timberland area in the South was caused primarily by the clearing of forest for soybean and other crop production. Much of this timberland reduction occurred in the bottomland hardwood forest areas of the Mississippi Delta. Reductions in all regions were further fueled by growth in urban areas, highways and powerlines, and related development.

Throughout the 1970's, timberland was cleared for agricultural use for an expanding export market. While technological improvements were promoting substitution of other factors in place of land for crop production, the large increases in agricultural export markets were still resulting in net gains in crop area.

Data from recent surveys indicate that total timberland area in the United States has been declining in the past decade (Waddell and others 1989), but modest gains have been reported in a few States.

Several major factors affect change in timberland area. Losses are caused by continued increases in population and per capita income and the reservation of Federal and State timberland for wilderness or similar use. Gains are caused by excess agricultural capacity and conservation policies that encourage tree planting. Such factors will be examined in the next two sections of this report.

Relatively small net changes in timberland area often mask relatively large losses (diversions) and gains (reversions) that offset each other. Historical data on diversions and reversions are too limited to support projections of these processes of landscape changes.

Site quality, a measure of the inherent capacity of land to grow trees, can be one of the important determinants of changes in the composition of the forest resource. However, analysis of data first assembled around the mid-1960's for the South-the most dynamic of the Nation's major timber-growing regions-indicates no major net changes in the regional distribution of timberland by site class. For example, the last two surveys in the Southeast indicate there has been a very minor increase in overall site qualii (Alig and others 1986).

Methods for Projecting Timberland Area in the 1989 RPA Assessment

Until recently, projections of timberland area were based on extrapolations of past trends and expert opinion,, Parks and Alig (1988) survey land-based models for forest resource supply analysis and describe their evolution over time in aggregate natural resource assessments. Wall's (1981) expert opinion approach for the 1980 RPA Assessment was also used in earlier assessments. Wall estimated future timberland by subtracting acreage perceived to have higher nonforest value from the potential forest base. Area projections were developed based on the opinions of regional experts.

Alig (1985) developed a system of econometric equations to project future land uses, based on the theory of competitive land rents. Land rent represents a residual economic surplus, which is the net total economic returns from a land use after the factor costs of production are deducted. Alig (1986) hypothesizes that the percentage of the land base in a given land use is a function of the ratio of the land rent for that use relative to the average land rent for all land uses.

Alig's projection system drives the Southern Area Model (SAM), which was used to project changes in timberland area for the South's Fourth Forest study (Alig and others 1988; USDA Forest Service 1988). Constraints were imposed on the models to preclude double counting across land uses, which was possible with earlier expert opinion projection approaches. Land-area models with the SAM structure (fig. 3) were developed for the other major timber-growing regions of the United States. With these models, State-level projections of timberland area were made for the 1989 RPA Assessment (Alig 1989). Methods and assumptions used in the development of these projections are described below.

For the projections of timberland area, four major land uses were recognized: timberland, cropland, pasture-range, and urban and other developed land. Expected demands for all competing land uses were examined in the context of the economic hierarchy of land use (i.e., land is generally assumed to be employed in most profitable use). In projecting land use areas, the entire land base in each State was accounted for to ensure a complete estimate. Within the timberland class, three ownerships were considered: public, forest industry, and farmer and other private.*

Total land area in each State was projected through time. The land base of most States is projected to decline by approximately 0.05 percent per decade, due mainly to water impoundments, flooding, and erosion. The summed area of State-level projections of each land use were reconciled to the acreage of the total State land base, as estimated by the US. Geological Survey.

[2]In the Southern Study (USDA Forest Service 1988), data availability allowed this 'farmer and other private group' to be separated into three groups: farmer, corporate, and other individuals.

Because management intensity may vary by type of owner, changes in forest types were projected separately for each owner class. In the second phase of timberland area projections, area changes for major forest types on the forest ownerships are projected. Failure to account for forest type change over time can lead to miscalculation of resource production and errors in policy design. Timberland value and productivity depend in part on the species of trees that are on site. Because physiographic differences exist between regions, forest types often differ as well. The proportion of timberland in each forest type on a particular ownership in 1987 was used as a starting point for the timberland area projections (Waddell and others 1989). Information on how species composition changes over time in response to natural succession, management practices, and other disturbances was incorporated into the forest type projections (Alig 1985).

The intensity of forest management over time and the rate of natural succession largely determine the forest type. Alig (1985) and Alig and Wyant (1985) describe a transition probability model, based on Markovian transition assumptions, for forest type area change on private ownerships in the Southeast. The transition model projects the acres of forest types that will result from a mixture of custodial care, harvesting, and other miscellaneous forest management activities, and natural succession. The Markovian assumption means that the path over time to a current state is independent of future transitions among possible states of nature for a forest type aggregate. For example, if two plots of timberland were classified into the same forest type aggregate based on the Forest Inventory and Analysis (FIA) data characterization, they would be treated similarly for projection purposes, even if their past histories were different. Modifications of this technique were used in the study of the South's Fourth Forest (USDA Forest Service 1988) and in the 1989 RPA Assessment (USDA Forest Service, in press).

Forest type transition matrices were determined using a framework of forest type change probabilities. The form of each forest change probability is the product of two probabilities:

$$P(D_{k(i,j,t)}) \; P\{FT_{i,j',t+1} \mid D_{k(i,j,t)}, FT_{i,j,t}\}.$$

for all i,j; $t=1,\ldots,n$.

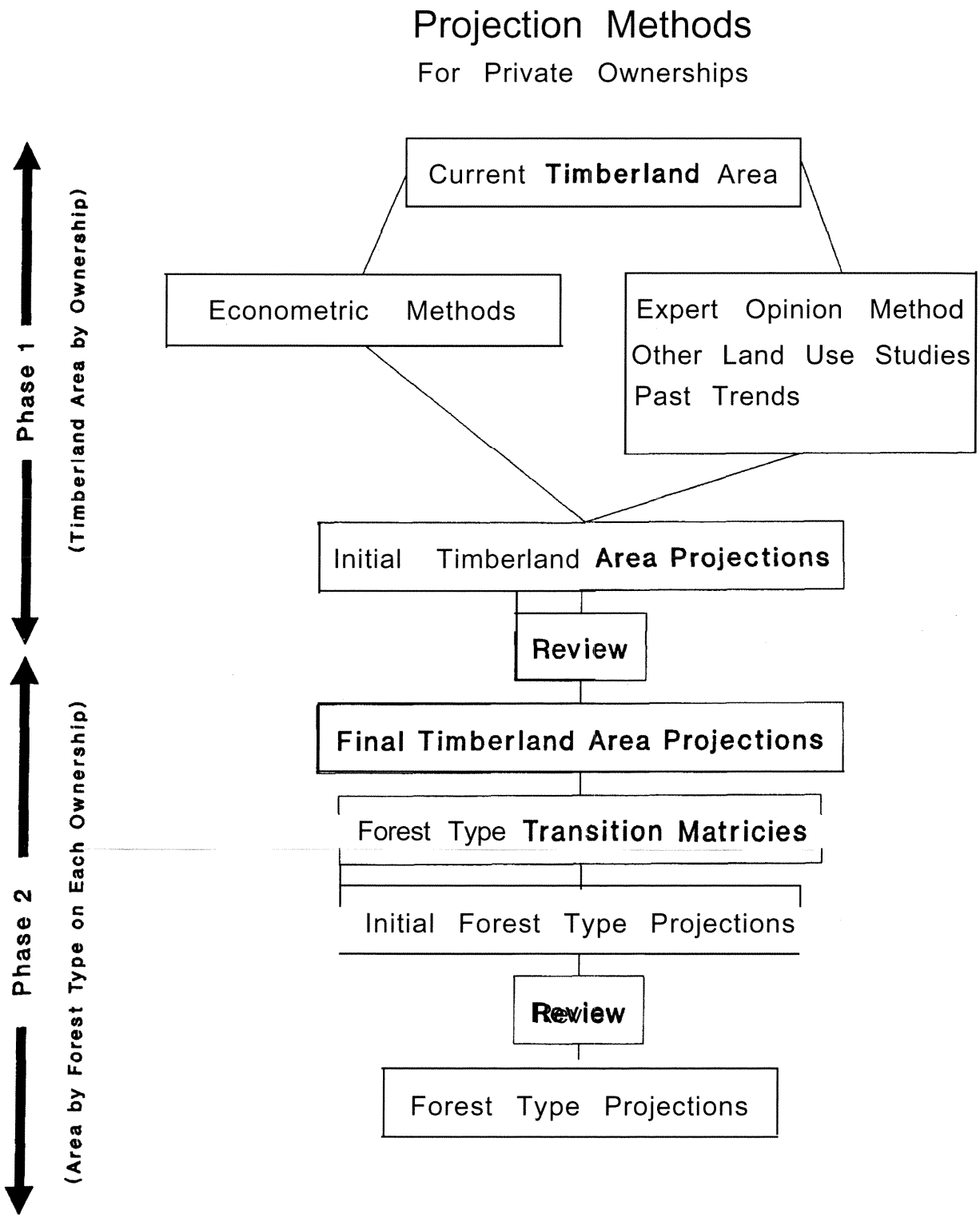

Figure 3-Methods used to project area changes for timberland in the 1989 RPA Assessment

The change probability is the probability of a disturbance of type k on ownership i and forest type j, in decade t, multiplied by the conditional probability that a unit area of timberland on ownership i at decade t+I will be in forest type j', given the disturbance. In this way, the probability of land in a forest type remaining in that forest type, or changing to any other given forest type, is expressed. The probabilities used in these calculations were typically determined from observed frequencies of type changes on remeasured Forest Service inventory plots. Probabilities of forest type change over time were summarized in matrix form. Projections of future forest type areas, by decade, were calculated by multiplying an initial vector of forest type areas by the transition probability matrix.

If sufficient data on disturbances did not exist and suitable plots had been remeasured at least once, the simpler probabilities were computed:

$$P(FT_{i,j',t+1} \mid FT_{i,j,t}).$$

These probabilities are an average over all disturbance regimes (including no disturbance) and ownership groups, and were estimated from sample relative frequencies. If no time series data existed, the projections were based on the opinions of regional experts, which in many cases involve extrapolations of recent forest area trends.

Public Timberland

Projections for this class were based on documented land allocation plans and on the opinions of regional experts. No attempt was made to model these lands by economic parameters because such modeling is not well suited for analyzing changes in land area that are influenced largely by institutional planning and legislative actions. Public timberland area projections were reviewed and modified by State, Bureau of Land Management, and Forest Service experts.

Private Timberland

Models to project area of private timberland were developed separately for each region based largely on the methods developed for the South (Alig 1985). Factors influencing land use conversion and the sources and quality of data vary greatly across regions. Econometric models have fairly extensive data requirements, and a full complement of time series of data did not exist for all States and ownerships. Therefore, certain projections were based on expert opinion and analysis of historical trends. A listing of the techniques used in each region can be found in table 1. Although individual models vary in the extent to which they utilize econometric analysis in the projection process, all models share similar basic design and assumptions (e.g., total area constraints for the land base are imposed).

Successive lo-year projections were made over the 50-year planning horizon for the RPA Assessment. Areas for land uses were projected independently and then summed. To reconcile the independent projections of area changes for land uses with the area for the entire land base, corrections were apportioned according to the proportions of all land area in the various land uses. Areas of urban and national forest land were excluded from this reconciliation process because their area trends in the future are less uncertain than for other land uses.

Documentation for other assumptions can be found in "Basic: Assumptions: A Technical Document Supporting the 1989 USDA Forest Service RPA Assessment* (USDA Forest Service 1989b).

Regional Models

This section describes the methods and models, including the specifications and assumptions, that were applied in each region. The models for the southern region will be discussed first because they are more detailed than any others and served as prototypes for other regional models. Common variables across regions include population, personal income, incomes from agricultural and forestry land enterprises, and government programs influencing land use change.

South. The Southern region includes 13 States: Virginia, North Carolina, South Carolina, Georgia, Florida, Nlabama, Mississippi, Tennessee, Arkansas, Louisiana, eastern Texas, eastern Oklahoma, and Kentucky. The land area projections for 12 of these States were developed for the study of the South's Fourth Forest (USDA Forest Service 1988). Kentucky was not included in the Southern Study, so expert opinion-based projections for it were developed separately for the 1989 RPA Assessment.

Table 1--Methods for projecting timberland area for private land, by region

Region	Technique	Reference
North		
Northeast	New York, Pennsylvania, and Maine--econometric models	Howard and Lutz (in press)
	All other States--expert opinion	
North Central	Lake States--econometric models	Plantinga and others (1989)
	Other States--expert opinion	
South		
Southeast	Econometric models	Alig (1985)
South Central	Econometric models	Alig and others (1988)
Rocky Mountains	Expert opinion	
Pacific Coast		
Northwest Douglas-fir Subregion	Econometric models	Parks (1988c)
Northwest Pine Subregion	Expert opinion	
Southwest	Expert opinion	

A series of econometric equations was developed to project areas in crops, pasture and range, urban and other developed land, farm forest, industrial forest, and miscellaneous private forest. Input data for these dependent variables were collected by the USDA Forest Service's FIA units of the Southeastern and Southern Forest Experiment Stations. Time series data were pooled across survey units to provide adequate sample sizes (Alig 1986).

Land area projections derive from projecting the diverse set of independent variables that influence land use changes. Because highly accurate predictions of these variables often were unavailable, assumptions were based on historical trends, developments that affect those trends, and the expectations regarding future changes. The assumptions used in making projections for population, personal income, and inflation rates are documented in the RPA technical supporting paper 'Basic Assumptions' (USDA Forest Service 1989b).

Specific assumptions about the independent variables were made as follows. Projections of income per acre for crop, pasture, and range uses were based on agricultural price and productivity projections to the year 2080 in the Soil Conservation Service's analysis, which supports the Resources Conservation Act (RCA) appraisal (USDA Soil Conservation Service 1989). The RCA price projections were based on the Center for Agricultural and Rural Development (CARD)/RCA modeling system (USDA Soil Conservation Service 1989). Constant real future crop prices were projected assuming annual productivity growth of 1.1 percent until the year 2000 and 0.9 percent thereafter. Livestock incomes were projected assuming constant real prices and the Soil Conservation Service projection of 0.9 percent annual increase in productivity.

For forest type projections, separate models of forest type transitions were constructed for farm and miscellaneous private and industry owner groups. The transition probability structure is as outlined in the previous section. Projections for the RPA assessment were developed for the study of the South's Fourth Forest (USDA Forest Service 1988). Because transitions in forest type are important in the South, and because there are data on these transitions, these southern models are more detailed and more extensively tested than any others (table 2).

North. The North region is comprised of two subregions: the Northeast and North Central. The Northeast subregion contains Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Delaware,, Maryland, New Jersey, New York, Pennsylvania, and West Virginia. The approach to projections there utilized econometric models (Howard and Lutz, in press) for some States and expert opinion projections for other States,

Econometric equations were developed to project timberland area for forest industry, farmer, and other private ownership for Maine, Pennsylvania, and New York. Timberland area for other States in this subregion was projected using expert opinion. The econometric models project the amount of total land in these forest ownership classes and acreage in cropland, pasture and rangeland, and urban and other land when using the following independent variables: real per capita income, rural population, urban population, farm income, the Standard and Poor's 500 stock index, and regional pulp capacity (Howard and Lutz, in press). Projections of real per capita income were taken from the RPA 'Basic Assumptions" (USDA Forest Service 1989b). Current rural and urban population levels were determined from "Census of the Population" (U.S. Department of Commerce 1982) data. Future rates of population change were determined from the Basic Assumptions (USDA Forest Service 1989b). Current farm income data were determined from State-level farm income tables in various issues from the U.S. Department of Commerce periodic Census of Agriculture. These values were held constant over time. An average annual rate of the Standard and Poor's stock index from 1945 to 1984 was extrapolated through the projection period. The regional pulp capacity from 1945 to 1984 was also extrapolated through the projection period. This last variable was used only in the Maine econometric model.

For States in which econometric models were not estimated, area projections for cropland, pasture and range land, and urban and other land were made from unpublished area projections by the USDA Economic Research Service and expert opinion. Initial timberland area projections were obtained from FIA forest resource analysts and other forestry experts. Any differences between projected total land area and the sum of all projected land areas by

Table 2--Forest type projection methods

Region	Method	Reference
North		
Northeast	Extrapolation/ Expert opinion	
North Central	Lake States-- Transition probability analysis	Parks **(1988b)**
	Other States-- Extrapolation/ Expert opinion	
South		
Southeast	Transition probability analysis	Alig (1985) Alig and Wyant (1985)
South Central	Transition probability analysis	Alig (1985) Alig and Wyant (1985)
Rocky Mountains	Extrapolation/ Expert opinion	
Pacific Coast		
Northwest Douglas-fir Subregion	Forest Industry-- Transition Probability analysis. All other ownerships-- Extrapolation/ Expert opinion	
Northwest Pine Subregion	Extrapolation/ Expert opinion	
Southwest	Extrapolation/ Expert Opinion	

ownership were apportioned among the private forest land, cropland, pasture and range land, and urban and other developed lands as described earlier for the general procedures. Rates of change from an earlier timberland area study (Wall 1981) were used to develop upper and lower limits for these projections. These results were also modified in response to Federal, State, industry, and academic review.

The North Central subregion consists of Michigan, Minnesota, Wisconsin, Indiana, Illinois, Kansas, Missouri, Nebraska, North Dakota, and South Dakota. An econometric model was developed (Plantinga and others 1989) to project land uses in the three Lake States: Michigan, Minnesota, and Wisconsin. Timberland in the remaining States was projected with an expert opinion approach.

Econometric equations were developed to project private timberland as a function of population and county-level income in the Lake States. Timberland acreage for the private land ownerships was determined from USDA Forest Service surveys (e.g., Spencer and others 1988). Population and county income statistics were obtained from various issues of the USDC Census. Differentiation of the projection equations determined the rates of change. These rates of change were then applied to the 1987 acreages from the RPA data base to project land areas over the projection period.

For forest type projections, a high degree of species heterogeneity exists within the Northeast and North Central subregions. To account for this, several transition matrices for forest types were developed for specific physiographic areas. Five areas were analyzed in the Northeast: Maine, New York, Pennsylvania, other mid-Atlantic States, and other New England States. Two areas in the North Central subregion were analyzed: the Lake States and the Central States.

The forest type transition matrices for the Northeast were based on expert opinion. Projections of forest type areas for the Lake States were based on analysis of Wisconsin data (Parks **1988b).** Spencer and others (1988) examined the available data and associated area changes in forest types in Wisconsin between 1968 and 1983. Including nonstocked land, there are 13 forest types recorded for 1968 and 15 forest types recorded for 1983 in Wisconsin. These types were combined into groups for the Lake States: white pine, red pine, jack pine, spruce-fir, swamp conifer, oak-hickory, elm-ash-cottonwood, maple-beech-birch, aspen-birch, and nonstocked.

Some modifications of empirical rates of forest type change were needed in order to apply the Wisconsin data matrix to Michigan and Minnesota. Unlike the other Lake States, Wisconsin experienced an increase in timberland area between 1968 and 1983, which is not projected to continue. By modifying the Wisconsin matrix, an average matrix for application to the Lake States region was computed. The Lake States regional matrix is a weighted average (based on State timberland area) of the individual States. The 1987 RPA data base **(Waddell** and others 1989) provided the starting allocations of acres among forest types. The **proportions** of acres were projected with the regional 1968-83 model for **15-year** intervals (1998, 2013, 2028, 2043). Proportional allocations of acres among forest types, by decade for 1990 to 2040, were linearly interpolated and applied to projected timberland area.

The forest type transition matrix for the Central States is based on analysis of FIA data from a recent resurvey of Indiana. For these States (Iowa, Illinois, Indiana, Kansas, Missouri, North Dakota, Nebraska, South Dakota, and Ohio), unpublished plot data for forest type changes in Indiana from 1967 to 1986 form the basis for projections. The 1987 RPA data base **provided** the starting allocations of acres among forest types. Proportions of acres among forest types were projected for **18-year** intervals (2004, 2032, 2050) by using the regional 1967-86 model. Projections of forest type areas for each decade in the **projection** period, 1990 to 2040, were obtained by linear interpolation.

Pacific Coast. The Pacific Coast region consists of: California, Washington, Oregon, Alaska, and Hawaii. Econometric models (Parks **1988c)** and expert opinions were utilized in the projection process. Separate models were estimated for western Washington, western Oregon, and northern California. Expert opinion **projections** were prepared for eastern Washington, eastern Oregon, southern California, and Hawaii; Alaska was considered separately because unique land use and ownership patterns exist in the State.

The econometric approach was used to project areas of private forest and agricultural land for western Washington, western Oregon, and northern California. Forestry income per acre, crop income per acre, livestock income per acre, population density, and urban population percentage are the independent variables (Parks **1988c).**

These determinants were projected based on the following assumptions. Forestry income projections were based on current harvest levels from USDA Forest Service data, future harvest levels as projected by the Timber Assessment Market Model **(TAMM)** (Adams and Haynes **1980),** and **stumpage** price projections from the TAMM model. Crop and livestock incomes per acre were developed from the **Department** of Commerce Census of Agriculture data for the market value of crops sold, divided by land acreage at the county level. Agricultural income projections were based on productivity improvements per acre projected in the Second RCA Appraisal (USDA Soil Conservation Service 1989). Projections of population density were developed from Bureau of Census population projections, adjusted for differences in regional growth. Urban population percentage was based on Bureau of Census statistics that were linearly extrapolated into the future. Current values for the dependent variables for agriculture were derived from various USDA Economic Research Service statistics.

Initially, the Pacific Northwest **Westside** model projected total private timberland. Separating private timberland into forest industry and other private was accomplished by using the initial breakdown from the RPA data base and by applying future breakdowns between the ownership types from Wall's (1981) earlier projections for each timberland ownership.

The expert opinion approach was used to obtain area change projections for private land in eastern Washington, eastern Oregon, southern California, Alaska, and Hawaii. The initial or base year 1987 acreages were obtained from the **RPA** data base.

Areas of nonforest land uses were also projected to obtain area projections for the entire land base. A combination of expert opinion and historical trend analysis was relied on to project area changes for agriculture and urban and other developed uses.[3] Current crop and pasture and range acreages were interpollated from Economic Research Service projections. The Department of Commerce's Census of Agriculture data at the county level were used for sub-State breakdowns. Current urban and other land acreage was determined from unpublished USDA Economic Research Service estimates.

Forest type change varies significantly by subregion in the Pacific Northwest. However, since data for projection purposes similar to that used in eastern regions were not available, a constant proportions approach was used for all but the industrial timberland in the western part of the Pacific Northwest.

The transition matrix used for industrial land in the western part of the Pacific Northwest is based on responses to a survey of industrial forest owners in **western** Oregon, conducted by the USDA Forest Service in cooperation with Oregon State University.[4] Preliminary results from the survey and expert opinion suggest two major trends, First, lands currently in Douglas-fir, hemlock-sitka spruce, fir-spruce, and pine will tend to remain in these types. Second, forest types that are relatively less economically important, including other softwoods, western hardwoods, and all other types, will tend to be converted to the more profitable types over time.

Rocky Mountains. The Rocky Mountains region includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. Projections for this region were based on expert opinions from the timberlland area study conducted for the 1980 RPA Assessment (Wall 1981). Rates of change in timberland **area** from this study were applied to the 1987 timberlland acreages from the RPA data-base figures

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[3]**Historical** statistics on land area came from the ERS series, 'Major Uses of Land in the United States' (e.g., Frey and Hexem 1984). Appendix tables in each contain estimates by State of cropland, pasture-range, forest land, special uses, and other uses. Rates of change were developed for major use areas and were used in developing associated projections, which were modified when necessary by checking with individuals knowledgeable about land use trends in subject States. Projections were obtained from: USDA Economic Research Service. 1987. Projections of Urban Area Prepared for USDA Analysis. Four tables with cover letter from Klaus **Alt** to Basic Assumptions Working Group. Washington, DC.

[4]**Personal** communication, Brian Greber, Oregon State University, Department of Forest Resources, February 1989.

to provide an initial guide for the projections. These projections were then modified in response to State and Forest Service review.

For forest type projections, analysis of historical data indicated relatively slow exchanges among major groupings of forest types at a regional scale. Disturbances in forest stands are relatively infrequent in this region, compared with other regions. Transition matrices were constructed to simply extrapolate these recent trends among the relative proportions of forest types, while allowing the areas of all forest types to be affected by changes in total timberland area.

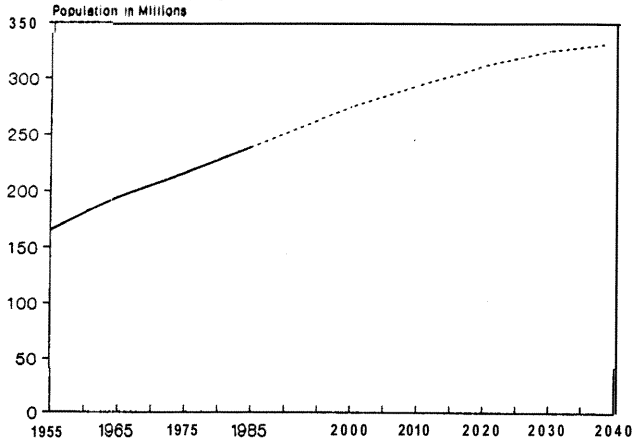
Forest land in the Rocky Mountains section was classified as 'hardwood' and 'softwood' types independent of the ownership class. Species-specific timber types were aggregated into hardwood and softwood types and used to compute the proportion of the forest-land area in hardwood and softwood types. These proportions were projected to be the same in each decade between years 2000 and 2040. In each decade, the timber type proportions were multiplied by the projected forest-land area to obtain estimates of area by hardwood and softwood types.

Area Projections for Timberland

Table 3 summarizes the timberland area projections by region and ownership. Each region's projections are discussed separately after an overview of land use projections for the United States.

Area of U.S. timberland is projected to decrease by 21 million acres by 2040, or a 4-percent reduction, Area in urban and developed uses will increase over the next five decades, but at a slowly declining rate. The population of the United States is expected to increase from 242 million people in 1986 to 333 million people in 2040, a 38-percent increase (fig. 4). In addition, disposable income per capita in constant 1982 dollars is expected to increase 2.6 times over the same period, from $10,947 per capita to $28,790 in constant 1982 dollars (fig. 4, USDA Forest Service 1989b). In short, more people will have more money to save and invest. They will generate increased demands for timberland as an asset and for recreational and other nontimber uses (Plantinga and others, in press).

Population in the United States 1955-1985, with projections to 2040



Per capita disposable income in the United States 1955-1985, with projections to 2040

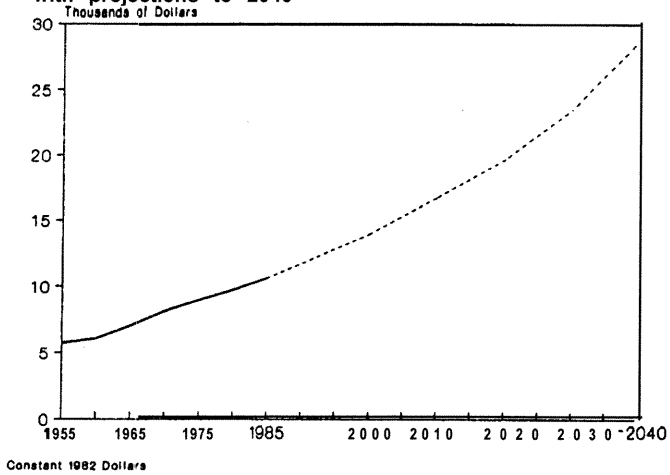


Figure 4-Population and personal income projections (USDA 1989b).

Competition for land between forestry and crop agriculture is difficult to predict. In the late **1970's** and early **1980's,** motivated by increasing export demand, farmers cleared land for crop production. According to Soil Conservation Service RCA projections, however, this trend will not continue (USDA Soil Conservation Service 1989).

Sharp declines in exports increased excess agricultural capacity to about 45 million acres in the mid-I 980's (Moulton and **Dicks** 1987). The RCA 'intermediate' estimate **projects** the area of **cropland** to decline until 2000, then rise slightly until 2030 (USDA Soil Conservation Service 1989).

Table 3--Area of timberland in the United States, by ownership class and region, for 1952, 1962, 1970, 1977, and 1987, with projections to 2040

Ownership class and region	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
					Million acres					
Ownership class										
Public	153	152	150	144	136	134	134	134	134	134
Forest industry	59	61	68	69	71	71	71	71	71	71
Farmer and other private	297	301	286	278	276	270	267	263	260	258
Total, all classes	509	515	504	491	483	476	473	469	465	463
Region										
North	154	157	154	153	155	154	154	152	151	150
South	205	209	203	198	195	191	190	189	187	187
Rocky Mountains[1]	67	67	65	60	61	60	60	60	59	59
Pacific Coast[2]	83	83	82	79	72	70	69	69	68	67
Total, all regions	509	515	504	491	483	476	473	469	465	463

Data for 1952 and 1962 are as of December 31; all other years are as of January 1.
Totals may not sum exactly because of rounding.

[1] Includes Great Plains.
[2] Includes Alaska and Hawaii.

Increases in urban land area reduce timberland area, not only through clearing for development but also by taking cropland that must be replaced by clearing forest. Cropland in the South is projected to decline by several million acres, while urban and other land uses increase by over 10 million acres.

Reductions in timberland area will result mainly from conversion of land to other uses such as urban and related uses, highways, airports, reservoirs, and surface mining. Inland water continues to increase, although at reduced rates, mainly due to reservoir construction. Additional constraints on the management of the remaining timberland can also be expected, as more people live in or near wooded areas (Alig and Healy 1987).

The amount of unused cropland that is converted to forest depends heavily on government policies, which are difficult to predict far into the future. The Food Security Act of 1985, which created the Conservation Reserve Program (CRP), also embodies the Conservation compliance provisions, the "sodbuster," the "swampbuster,' and other provisions that could increase the amount of timberland acreage (Moulton and Dicks 1987). Some States, such as Minnesota, are adopting their own forms of CRP programs, which could affect future acreage of timberland.

Other factors that will affect the aggregate composition of timberland include the transfer of farms to nonfarmer ownership, the subdivision of tracts, and increases in absentee ownership. These factors need not directly affect the area of timberland, although they have been shown to affect the intensity of management and the ability of these lands to produce certain outputs (Alig and Healy 1987).

Ownership and Total Timberland Area Projections

Timberland area projections by region are described in this section. State-level projections are shown in appendix tables Al -A4.

South. Net declines or constant levels of timberland area are projected for all Southern States (app. table Al). The declines are linked to increases in economic activity and land development. Projected declines in timberland area are largest in States where the largest increases in urban land are expected (e.g., Florida, Georgia, and Alabama). Total timberland area is projected to decrease from 195 million acres in 1987 to 187 million acres in 2040.

The Conservation Reserve Program continues to have a significant impact in the South. Between 2 to 4 million acres of highly erodible cropland are likely to be planted to trees under that program. Other marginal cropland acreage may be forced into pasture or trees if the conservation provisions of the Food Security Act are implemented strictly (Moulton and Dicks 1987). Currently, there are 18 million acres of crop or pasture land in the South that would yield higher returns to the landowners if they were converted to pine plantations (USDA Forest Service 1988). Also, there are 23 million acres of land in the South currently in trees that have high or medium potential for conversion to crops (USDA Forest Service 1988). Domestic and export markets for crops will strongly influence the disposition of this land on the margin between uses (Healy 1985).

To ensure wood supplies for paper mills, forest industry has purchased a great deal of land over the last 35 years. Land acquisition by forest industry is expected to continue but at a much slower rate (Alig and others 1986). Forest industry currently owns 38 million southern acres and is expected to own 39 million acres by 2040.

Farmers and miscellaneous private owners are expected to experience a net decline of 10 million acres, from 137 million in 1987 to 127 million in 2040. Some of this land will remain in timber after transfer to other owners, but some will be converted to urban or cropland uses.

In the South the public owns approximately 10 percent of the timberland. Public acreage is likely to increase slightly, by 0.8 million acres or 4 percent, by 2040. Most of the increase will be in State or local rather than Fedleral land. Not included in the other public timberland expansion is some bottomland hardwood acreage that is likely to be acquired by State agencies and withdrawn from the timberland base to protect wetlands;.

North. Timberland in the North is projected to drop by 5 milliion acres by 2040, a 3-percent decline (app. table A2). Most of this loss will be from farms and miscellaneous private tracts. Acreage in these categories is expected to decline from 107 million acres in 1987 to 101 million acres in 2040.

Earlier in this century, changes in timberland area in the North were more strongly influenced by demands for crop and pasture land. Recent declines in

timberland in the North, however, have been caused primarily by increases in urban and related uses. Development of rural land in the North for second homes, transportation networks, powerlines, and other uses is expected to cause further declines in timberland in the region. The future amount of timberland converted for highway construction will be less than in the past, because the bulk of the planned highway system in the North is now in place.

A reduction in the need for agricultural lands will offset the conversion of timberland somewhat. For example, the production of dairy products has become more efficient, reducing the amount of pastureland needed in States such as Wisconsin, Minnesota, and New York. Less pastureland is needed in the Midwest because of the tendency towards feeding cattle in feedlots rather than pasturing them.

The distribution of forests and rangeland between private and public ownership has not changed appreciably in the last quarter of a century, and it is projected to change relatively little through 2040. Considerable shifting has occurred, however, among the major classes of private forest owners-farmers, forest industry, and other private owners-who hold over 80 percent of the forest land in the North.

As in other parts of the United States, northern acreage in forest industry ownership is projected to remain fairly stable. The area held by farmers and other private parties is expected to drop about 5 percent by 2040. As in other regions, the projected decline in nonindustrial private forest area is due largely to the continued downward trend in land owned by individuals classified as 'farmers.' Although the Conservation Reserve Program should stimulate tree planting on some highly erodible cropland, the extent of expected tree planting is small relative to the existing area of farm forest.

Area of public timberland is projected to increase slightly. Growing concern over trends in land use may lead to further public purchase of forest land, but it is not clear to what degree, if any, such land will be managed for timber production (Webster 1989). For example, the northern forests of Maine, New Hampshire, New York, and Vermont are within a day's drive of 70 million people. Values for recreation and development in many cases may exceed value for timber production.

Pacific Coast. Many projected changes in land uses for the Pacific Coast States are continuations of recent trends. Timberland area is projected to decline from 72 million acres in 1987 to 67 million acres in 2040 (app. table A3), a 7-percent reduction. Most of this projected loss in area classified as "timberland will result from urban and other development of private nonindustrial forest and from reclassification of public timberland.

The amount of forest land held by nonindustrial private owners is expected to fall by 2 million acres, 11 percent,, by 2040. Over one-half of that decline is projected to occur in California. Timberland from this class will in many cases be used for urban and built-up uses, and to replace crop and pastureland that is developed.

Historical changes among the major groups of owners-forest industry and other private ownerships-have been substantial. Outside of Alaska, about 5 million acres-around 30 percent of the timberland area in farmer and other private ownership- has been converted to other uses or transferred to other owners since 1952. Most of this area reduction occurred on farm ownerships.

Nonindustrial private forest will in some cases be purchased by-forest industry and other corporations. Industry corporate ownership is projected to increase, especially in the areas dominated by Douglas-fir.

For forest industry, slight area increases are projected to the year 2000, followed by area declines for the remainder of the projection period. Overall increases in area in the Douglas-fir subregion and reductions in less productive subregions are projected. The result should be higher average productivity on remaining forest industry lands.

Only 16 million acres of Alaska's total land area of 362 million acres qualifies as timberland. The total timberland base of the State is projected to be essentially constant for the next 50 years. Substantial changes in land ownership are projected to occur in Alaska, however, primarily the transfer of roughly 500,000 acres from public ownership to Alaskan Native ownership.

Although some land in Alaskan Native ownership may be sold to forest industry, industry ownership of timberland is projected to remain negligible for the foreseeable future.

Rocky Mountains. A **3-percent** decline in timberland area is projected for the Rocky Mountains. Virtually all of the loss will be from public and farmer and miscellaneous private holdings (app. table A4). Timberland area in industry ownership is expected to be fairly constant.

Timberland comprises less than **10** percent of the land base in this region. Substantial areas of privately owned forest land have been subdivided for home-sites, particularly in Montana, Idaho, and Colorado. A modest, but steady, further area reduction in private timberland is projected because of increases in urban and developed land area.

Declines in crop acreage will be offset partially by increases in pasture and range. Pasture and range area is projected to increase by several million acres as a **result** of the conversion of erodible **cropland** through **the** Conservation Reserve Program.

Reduction in area of public timberland is primarily **attributable** to reclassification of current timberland. However, as in the Pacific Coast region, the projected amount of reclassification is substantially less than that since! 1952, and there is considerable uncertainty about the! total.

Projected Area Changes for Forest Types, by Region

Table 4 and figure 5 present projections of forest type area, by region. The following is a discussion of results for each region.

Table 4--Projections of forest type areas on timberland, by region, 1987 to 2040

Region and forest type group	Projections		
	1987	2000	2040
	Million acres		
North			
Hardwoods	118	117	116
Conifers	31	31	30
Hardwoods-Conifers/Other	5	5	4
Total	155	154	150
South			
Hardwoods	102	**96**	**90**
Pine	62	**69**	72
Hardwoods-Pine/Other	31	26	24
Total	195	191	187
Rocky Mountains and Great Plains			
Conifers	53	52	51
Hardwoods/Other	8	8	8
Total	61	60	59
Pacific Coast			
Hardwoods	12	11	10
Douglas-fir	19	20	21
Other Conifers	41	39	37
Total	72	70	67

Note: Totals may **not** sum exactly because of rounding.

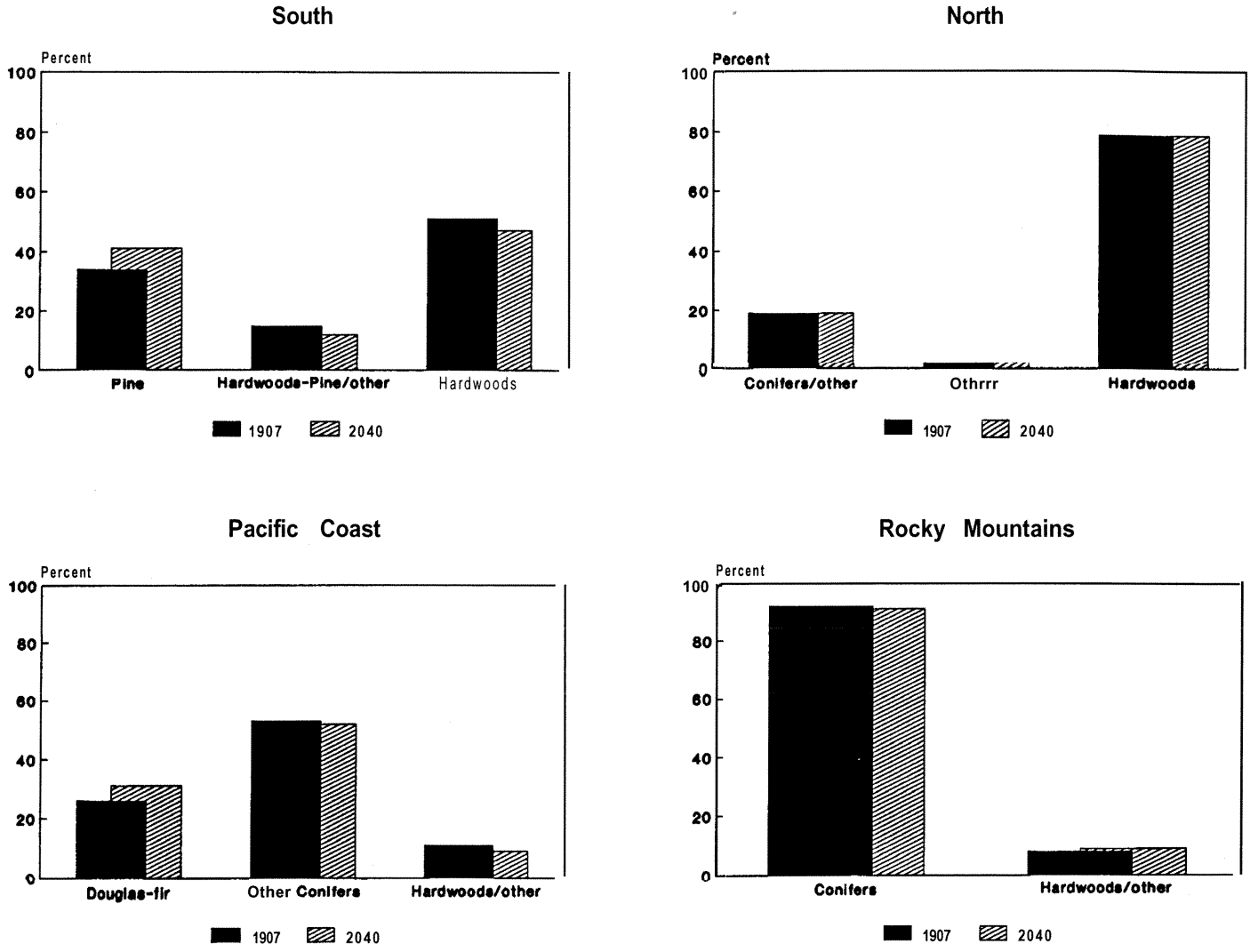


Figure 5-Area projections for forest type, by region.

South. In our analysis, we classify five southern forest types: planted pine, natural pine, oak-pine, upland hardwoods, and bottomland hardwoods. Area of planted pine in the South is projected to increase substantially in the next 50 years (fig. 6). The vast majority of these acres will be converted from natural pine stands after final harvest, causing a corresponding decline in area of natural pine. The amount of land in both oak-pine and hardwoods is expected to decline slightly, primarily because of development for urban and built-up uses, and conversion to planted pine.

There is an indication that changes in forest types will be more extensive in the South than in any other region. Large amounts of investment capital, particularly on industry lands, are transforming large

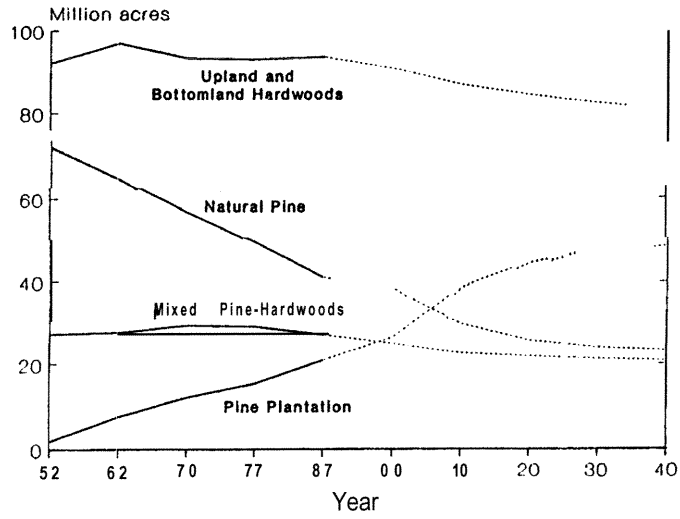


Figure S-Timberland area in the South, by forest management type, 1952-I 987, with projections to 2040.

acreages into intensively managed pine plantations. The area in pine plantations is projected to increase by over 20 million acres.

Hardwood area in the South is projected to drop by about 10 percent by 2040. Reasons for this projected decline include: (1) conversion of some upland hardwood area to pine, especially on industry land; (2) clearing for cropland; and (3) conversion to urban and developed uses.

Area in oak-pine or mixed pine-hardwood is projected to drop by over 6 million acres, or about one-fifth. Much of this reduction will occur on forest industry land, where many acres are converted to pine types. As an intermediate stage in natural succession, oak-pine is an unstable type. Many oak-pine acres result from human intervention (e.g., partial cutting of natural pine). Also, on some inland areas, oak-pine is the 'climax' forest type.

North. The relative distribution of forest types is projected to change little over the projection period for the region as a whole. The largest area change is projected for northern hardwoods, which will increase by several million acres by 2040. Much of this forest type group is comprised of the climax and shade-tolerant maple-beech-birch, which is expected to increase because of successional forces. Increases will come largely at the expense of the oak-hickory area, which is projected to drop slowly. The forests of the North are relatively diverse and are in transition. Control of wildfire and selective cutting are favoring climax maple and beech over subclimax oak forest. In addition, some oak-hickory area is being converted to softwoods. However, the associated projected change is small because so much land in the North is held by nonindustrial private landowners who generally do not manage their forests intensively.

Area in aspen-birch is also projected to drop. Aspen-birch, a pioneer type, requires disturbances. Because most stands were not managed in the past, the area of aspen-birch has been declining. The rate of area loss is projected to slow because more stands are likely to be harvested for panel and pulp production. Prior to the **1980's,** relatively little aspen was cut, but since then removals of aspen have increased markedly in Minnesota, and to a lesser degree in the other Lake States.

The area in softwood types is projected to drop slowly over the projection period. Spruce-fir may decline **slightly** due to harvesting pressures, the increased use of clearcutting, and environmental factors. The area in white-red-jack pine is also projected **to** drop slightly, and oak-pine is projected to gain in some cases at the expense of the white pine. The area in pitch-loblolly-shortleaf pine is expected to decline. Hemlock area is projected to increase dlue to natural succession on unmanaged nonindustrial private land.

In the **North's** three major subdivisions-the Northeast, the Lake States, and the Central States-trends will be somewhat different. Timberland in the Northeast is heavily (dominated by hardwoods. The two major types, oak-hickory and maple-beech, are projected to decline slightly, primarily due to an overall reduction in **timberland** area in the subregion. Some land is projected **to** be converted to **softwoods:** white pine in New **York** and Pennsylvania, and loblolly, shortleaf, and pitch pines in New Jersey, Delaware, and Maryland. This increase will be offset somewhat by the loss of white pine and spruce-fir to hardwoods in the New **England** States.

For the Lake States a slight increase of area in pine types is projected, with increases in whiie and red pines offsetting declines in jack pine. Area of two other softwood types, swamp conifer and spruce fir, are projected to decline. Area in the maple-birch type is projected to increase substantially, while area of the aspen-birch type is projected to decline. Forest type projections for the Central States showed area declines for oak-hickory and oak-pine types and increases **for** pine, maple-birch, and bottomland hardwoods types.

Pacific Coast. Projected net area changes for forest types in ttne Pacific Coast region are relatively small. The most substantial changes are projected for forest industry land, as more acres are planted to Douglas-fir.

Because **sufficient** data were not available to construct forest type transition matrices for nonindustrial owners in the Douglas-fir subregion or for any owner group in the Interior subregion, the relative distributions of forest **types** for these groups were held constant at 1987 levels. For similar reasons, we had to assume that regionwide trends in forest type changes would continue. Projected timberland losses are distributed across all **forest** types.

Hardwood area on the forest industry land is projected to decline. If aider stumpage prices continue to rise, however, the rate of conversion from alder to other species may decline. Frequently, alder comes in naturally after softwood harvests on other ownerships, and its acreage has recently increased in some areas of Oregon and Washington west of the Cascades.

A trend toward greater reliance on natural regeneration, which favors western hemlock in mixtures with Douglas-fir, is likely to continue. Other trends likely to continue include an increase in hardwoods in some coastal areas when conifers are harvested. In the Interior, tolerant species such as white fir and incense-cedar may increase as pines are removed from mixed conifer stands.

The projected drop in the area of 'other softwoods" for the region primarily involves ponderosa and lodgepole pine. Many of these acres are in eastern Oregon and Washington. The projections are based on a continuation of recent trends.

Conversion of other softwoods, western hardwoods, and all other types on industrial land is projected to favor Douglas-fir and western hemlock. Ninety percent of projected conversions are to Douglas-fir, and 10 percent to western hemlock. It is unlikely that complete conversion of other softwoods, western hardwoods, and all other types will ever occur on this ownership. Half of the acres in these types are projected to be converted over the next 30 years. The other half will remain in the initial types or be converted to nonforest uses.

Rocky Mountains. The relative distribution of forest type areas is expected to remain essentially constant over the projection period. Conifers dominate in this region and are projected to do so for the foreseeable future.

Douglas-fir, ponderosa pine, fir-spruce, lodgepole pine, and western hardwoods make up a large majority of the timberland in this region. The hardwood species have wide ranges throughout much of the Rocky Mountains portion of the region. Management of timberland in this region is moving, in some cases, toward a different balance of traditional timber management and management emphasizing the production of nontimber values (USDA Forest Service 1989a), and this may lead to changes in the frequency and size of man-caused disturbances that influence natural successional trends.

Alternative Projections

The projections reported thus far are predicated on assumptions about future economic growth, timber management practices, demands for other land for other uses, international markets for forestry and agricultural products, and other factors that affect land supply and demand. Changes in these assumptions alter the resulting projections. To assess other possiibilities, we examined two alternative sets of assumptions: (1) that all economically attractive opportunities for timber investment on private land would be pursued, and (2) that all marginal cropland and pastureland would revert to natural cover types if land were allocated to agriculture on a least-cost basis. Two other recent studies have also examined the possible effects of changes in economic conditions and changes in policy, and we briefly cover the implications of these other scenarios for future changes in timberland area. In the first, Parks (1988a) compared the relative value of marginal cropland for agricultural production and timber production. In the other, Moulton and Dicks (1987') evaluated the future effects of the 1985 Food Security Act in terms of the implications for forest-land area.

Alternative No. 1: Economic Opportunities on Private Timberland

Nationwide, many acres could be managed to grow increased wood volumes per acre, market-preferred species, and/or higher valued products. These opportunities to increase timber growth exist in stands that are poorly stocked, have competing vegetation, have offsite or inappropriate species, are financially ovennature, or are in some other less than fully productive condition. Only opportunities that return at least 4 percent above inflation were considered (USDA Forest Service, in press).

Not all the changes in area of timberland associated with this alternative are likely to occur. Instead, the alternative is provided as an upper bound for some measure of timberland area. If the investments were actually undertaken, two types of change could occur: (1) changes in forest types on existing timberland, through species conversions, and (2) conversion of nonforest to timberland. Forest types would change on 40 million acres of existing timberland (USDA Forest Service, in press). In addition, over 30 million

acres would be added to the timberland base. The change in timberland area associated with this economic 'upper bound' is depicted in figure 7, along with the baseline RPA projection for total timberland area and the ecological 'upper bound represented by Alternative No. 2.

The South's Fourth Forest report (USDA Forest Service 1988) contains an analysis of the treatment opportunities for private land in the South, where most of the economic opportunities are located. Analyses of other regions were based on similar procedures for that study. Some of the opportunities were implicitly included in the baseline projections.

To avoid double counting, these acres projected to be enrolled in the baseline case were subtracted from the Alternative No. 1 analysis. The primary data sources for economic opportunities to increase timber supplies are the USDA Forest Service's FIA compilations for individual States.

Although many options are possible for each stand condition, one preferred option or treatment was selected for analysis on each class of acres. In general, selected options favored more intensive treatments to assure regeneration, control stocking, shorten rotations, and increase the value or size of crop trees. Natural stand management was preferred where artificial regeneration was considered inappropriate or uneconomical. The same options were used for all ownerships because available data were insufficient to develop consistent sets of options for different ownership groups.

Management options were combined with treatment costs, yields, and **stumpage** prices to project **cash-**flows for each investment opportunity. Cash-flows were analyzed to determine present net worth, internal rate of return, net timber volume gains, and capital costs per acre for each treatment group. Income taxes, ad **valorem** taxes, and land costs were excluded from the analyses. **Stumpage** price projections from the **TAMM90/ATLAS** model for 1989 RPA Assessment were used as input (USDA Forest Service, in press).

A **4-percent** interest rate in real terms (i.e., net of inflation or deflation effects) was used for discounting all costs and revenues. Although 4 percent approximates the average long-run rate of return on investments in the private sector, it is an average. Because many management options yield higher rates of return, investments were also analyzed with a lo-percent rate of return to provide a measure of economic opportunities with high rates of return.

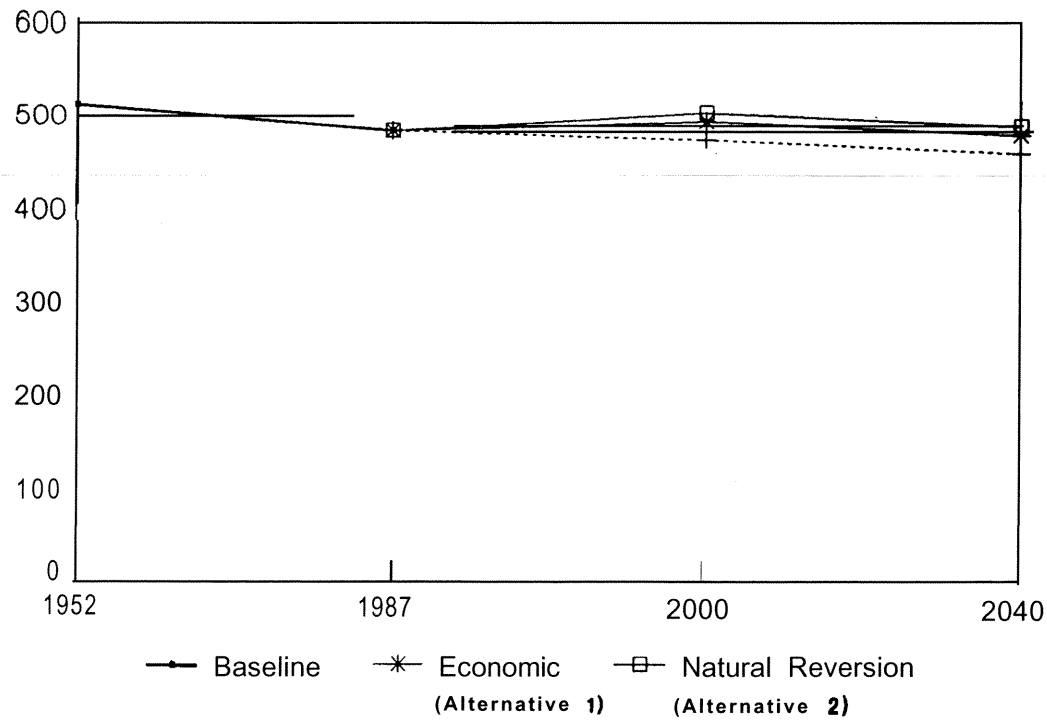


Figure 7-Projection of total timberland area under three sets of assumptions.

In addition to possible changes in the overall area of timberland on private lands, implementation of other economic opportunities for timberland investment would result in area changes for forest types on that timberland base. As with total timberland area changes, the impacts would be greatest in the South (fig. 8; USDA Forest Service 1988).

Alternative No. 2: Reversion of Cropland and Pastureland to Natural Cover Types

Important factors that influence the demand for cropland-such as changes in the domestic and international demand for agricultural products and changes in agricultural production technologies- are difficult to project. The result is considerable uncertainty about future land reallocation. Alternative No. 2 assumes that all surplus cropland, projected by the Second RCA Appraisal (USDA SCS **1989),** will revert to natural vegetation, either grass or forest cover. It therefore tests the sensitivity of future forest area trends to area changes in the agricultural land base.

Idle **cropland** area was determined from the 2030 intermediate scenario projections in the 1988 RCA Appraisal. The Second RCA Appraisal projects the **availability** of 387 million acres of **cropland** in 2030. Of this total, 218 million acres are assumed to be used for crop production, and 40 million are assumed to be enrolled in the Conservation Reserve Program. Thus, about 128 million acres are assumed to be idle. Idle land is that **cropland** that is not needed to meet Ithe RCA projected demand for agricultural products,

Suitability of the 128 million acres of idle **cropland** in the RCA 2030 intermediate scenario for reversion to forest cover was examined from an ecological perspective. Maps of potential natural vegetation

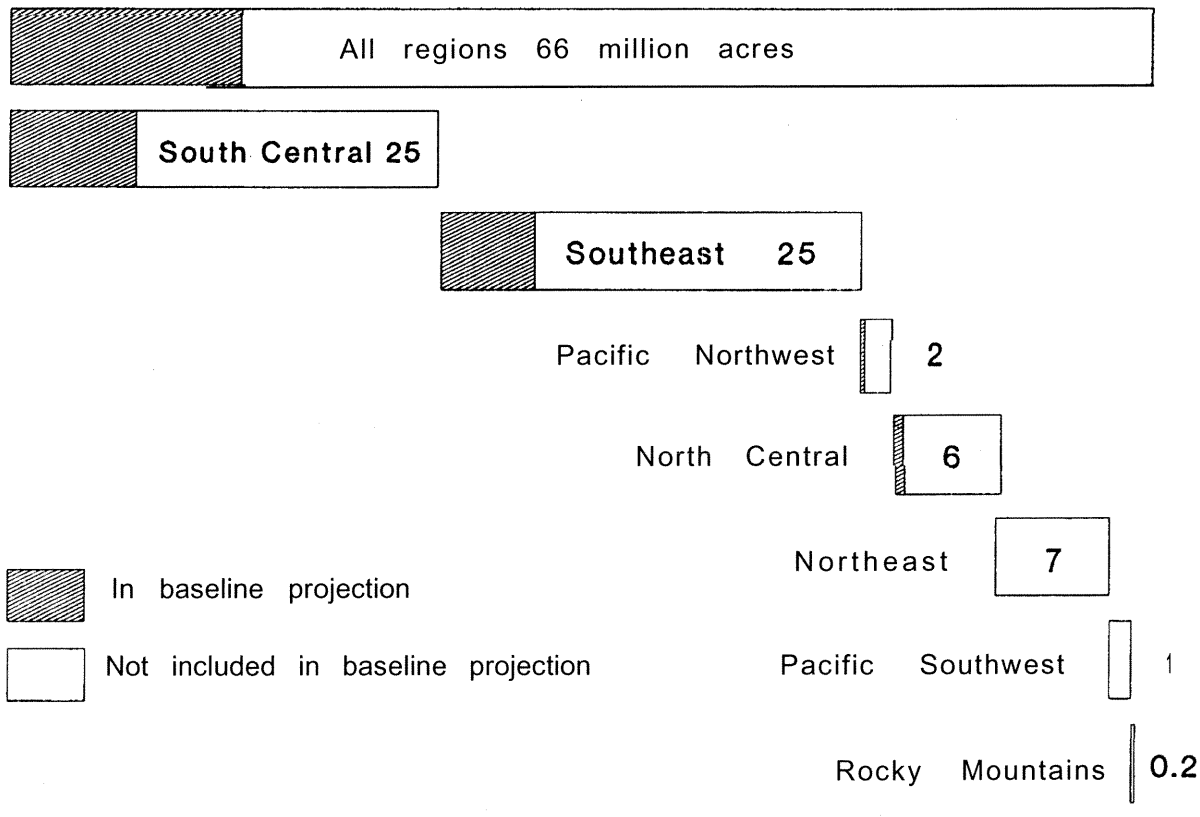


Figure 8-Acres of potential timber investment opportunities on nonindustrial private forests in the United States, by region.

types were overlayed on county maps to determine the Kuchler vegetation class for each county.[5] If a county had more than one dominant potential vegetation class associated with it, a percentage was assigned to each Kuchler class based on its proportional dominance on the county's land.

This information was applied to the county-level data on idle **cropland** area to determine how much **cropland** would revert to each natural vegetation type. These data were then aggregated by RPA region. Kuchler classes were combined into four natural vegetation types: range, hardwood, softwood, and **hardwood-softwood** types.

RPA baseline projections were assumed to already include a portion of the RCA idle **cropland** acres reverting to forest cover. To avoid double counting these acres in the surplus **cropland** and pastureland projections, the baseline amount was subtracted from the idle **cropland** area. One-twentieth of the remaining idle land was assumed to revert annually, starting in 1990; thus the entire idle **cropland** area was added by 2010. It was assumed for this alternative that this land would not change ownership class, so all of the idle acres were placed in the farmer and miscellaneous private class.

An analysis based on Kuchler's classifications indicates that most of this idle land, some 96 million acres, would revert naturally to range. An additional 16 million acres would revert to hardwoods, 15 million to a mixture of hardwoods and softwoods, and 1 million to softwoods. This analysis may understate the amount of acres reverting to softwood types. The Kuchler vegetation classification system identifies potentially stable vegetation types in the late stages of plant succession. Early successional species that occupy abandoned **cropland** differ significantly from the identified types. Many decades may pass before **cropland** that reverts to timberland has the characteristics of natural vegetation types. If other disturbances occur, characteristics may never be the same.

Roughly 40 percent of the RCA idle **cropland** available for reversion to forest was accounted for in the initial 1989 RPA baseline timberland projections. The remaining 60 percent would add 19 million acres to the timberland base over the next 20 years. Most of these acres would be dominated by hardwood and hardwood-softwood types, and most are in the North and South.

Other Scenarios

Alternative No. 2 explored possible ecological conversion of surplus **cropland** to forest. Parks (1988a) analyzed the acres of idle **cropland** projected by the CARD model, used in SCS Appraisals, that would pass an economic screen for conversion to trees.

Nationwide, less than 5 million acres outside the South are economically attractive for active conversion to trees. **Many** more agricultural acres in the South are economically attractive for conversion to trees (USDA Forest Service 1986).

The advent of new policy programs has the potential to influence the amount and quality of timberland well into Ithe next century. The 1985 Farm Security Act **(FSA)** contains many provisions that have such potential, as highlighted by a recent analysis by Moulton and Dicks (1987). This study indicates that various programs in FSA could, under certain **assumptions,** bring about a net increase of about 16 million **acres** to the Nation's forest-land base between 1986 **and** 1995.

The Moulton and Dicks study indicates that approximately **45** million acres of highly erodible **cropland** are eligible for conversion to pasture or trees under the Conservation Reserve Program. While it is projected1 that much of this land will be converted to pasture, it is estimated that between 3 and 4 million acres, primarily in the South, will be planted to trees, primarily pine.

Additional1 acres of marginal **cropland** could revert to trees, as farmers comply with the conservation provisions of the FSA. Farmers face the loss of government subsidies on all of their land if they do not comply **with** these provisions. If the provisions are strictly enforced, most farmers may have to convert marginal croplands to trees, or pasture may be the only option open to farmers. However, full implementation of the conservation compliance provisions is not expected for several years, and the magnitude of the changes resulting from its implementation are difficult to predict.

[5]Research conducted by Ronald Hackett of the USDA Forest Service's North Central Forest Experiment Station.

Two provisions of the FSA, the sodbuster and swampbuster, are designed to discourage the conversion of environmentally sensitive areas to farming. The sodbuster provision applies to 502 million acres of highly erodible pasture, range, and forest land, of which 221 million have the potential for conversion to agriculture (74 million acres are currently forested). Soil conservation practices must be employed on these lands if they are converted to agriculture, or farmers would lose eligibility for most Federal farm program benefits for all of their land.

The swampbuster provision works similarly but more strictly limits use. It applies to the 65 million acres of privately owned wetlands, of which 5 million acres have medium or high potential for conversion to agriculture and 2 million acres are wooded. Farmers who use land converted after December 23, 1985, can lose their eligibility for farm program benefits.

Another consideration in the long-term outlook for changes in forest area is the implications of any significant global climate change that may occur. The possible implications of climate change is less than certain, both in terms of **severity** and timing, but it could have a substantial impact on changes in total forest area and the relative distribution of forest types over the longer term. The large body of ongoing related research and monitoring of the possible effects should assist in assessing its importance along with other factors that influence forest area changes.

Summary and Conclusions

The methods and models developed to project long-term area changes in area of timberland, by ownership and forest type, for the 1989 RPA Assessment will be useful in future assessments. Some improvements depend primarily on gathering additional data, because existing data were insufficient with which to develop econometric models for the Rocky Mounl:ains region and portions of the Pacific Coast and North. In these areas, we rely on expert opinion. Further research designed to increase the understanding of land values and further study of the factors that **affect** land use change could reduce the reliance on **subjective** opinions as the basis for land use projections.

The **area** in forests and rangeland has been declining in **recent** decades. A significant excess of **crop**-growing capacity and government farm programs designed to reduce cropping on highly erodible lands are expected to partially offset losses of **timberland** for urban and related development. The total area of timberland is projected to decrease by about 4 percent between 1987 and 2040.

In fact, loss of timberland has moderated since the last RPA Assessment in 1979. Many acres of forests and rangelands were converted to crop agriculture in the late 1970's and early **1980's,** due mainly to rapid growth in agricultural exports. As with the rest of the economy, the reallocation of domestic land resources is increasingly influenced by international trade and economic conditions. In particular, **export**-driven demand for crops such as soybeans led to conversion of many acres of bottomland forest. However, the current outlook for U.S. agriculture is uncertain. Area of **cropland** harvested is rising in some cases after declining in the early 1980's and **recent** FIA surveys indicate accompanying modest gains in forest area in a few States. International markets for, and supplies of, wood products may also affect land reallocation decisions.

Several general points deriving from the timberland projections are:

- Although timberland is relatively abundant in the United States, projected reductions in **timberland** area imply further pressure on the forest resource base needed to supply a variety **of** goods and services.

- The most notable landscape changes are projected for the South, where substantial increases in planted pine area are expected.

- A majority of the **cropland** on which landowner returns could be increased by planting trees is in the South. Land use competition from agriculture is not expected to be as strong over prolonged periods as it was in the 1950's and **1970's.**

- Timberland holdings of farmers will decline, while holdings of other nonindustrial private owners may increase in some regions.

- Projected changes in total timberland area over the next five decades are relatively small, compared with area changes between 1952 and 1977. The trend is downward, but at a slower rate in recent years than in previous decades.

- Timberland conversions to urban and developed uses are projected to continue as the population of the United States increases by more than 90 million people by 2040.

- The intensity of management and the proportion of acres in plantation are likely to increase on forest industry holdings, particularly in the South.

- Conversion of idle **cropland** to forest is strongly influenced by public programs, such as the **ongoing** Conservation Reserve Program. **Disposition** of idle land will need to be monitored to gauge possible impacts on timberland area, particularly where large amounts of marginal **cropland** exist.

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Appendix

Table A1--Area of timberland in the South, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
	Thousand acres									
Southeast										
Florida										
Public	2,251	2,220	2,146	2,158	2,166	2,216	2,212	2,207	2,203	2,201
Forest industry	4,369	4,767	4,758	4,658	4,789	4,838	4,802	4,752	4,711	4,675
Farm and misc. priv.	11,515	9.843	9.557	9.027	8.283	8.061	7.871	7.502	7.218	7.016
Total	18,135	16,830	16,461	15,843	15,238	15,115	14,885	14,461	14,132	13,892
Georgia										
Public	1,685	1,813	1,600	1,589	1,609	1,586	1,590	1,594	1,602	1,595
Forest industry	4,246	4,068	4,447	4,629	5,207	5,154	5,112	5,173	5,222	5,226
Farm and misc. priv.	18,038	20,417	19,056	17,888	16,568	15.801	15.458	15.225	14.998	14.968
Total	23,969	26,298	25,103	24,106	23,384	22,541	22,160	21,992	21,822	21,789
North Carolina										
Public	1,592	1,721	1,751	1,770	1,830	1,828	1,829	1,830	1,831	1,831
Forest industry	2,584	2,495	2,644	2,140	2,337	2,441	2,453	2,459	2,471	2,480
Farm and misc. priv.	15,407	15,774	15,735	15,525	14.191	13.404	13.343	13.250	13,192	13.169
Total	19,583	19,990	20,130	19,435	18,358	17,673	17,625	17,539	17,494	17,480
South Carolina										
Public	955	1,034	1,073	1,085	1,174	1,176	1,178	1,180	1,181	1,182
Forest industry	1,650	2,010	2,101	2,215	2,626	2,693	2,727	2,735	2,718	2,715
Farm and misc. priv.	9,279	9.127	9.270	9.196	a.379	7.989	8.114	8,184	8.196	8,186
Total	11,884	12,171	12,444	12,496	12,179	11,858	12,019	12,099	12,095	12,083
Virginia										
Public	1,493	1,535	1,672	1,922	1,993	2,037	2,050	2,058	2,063	2,063
Forest industry	1,095	1,454	1,634	1,670	1,834	1,890	1,878	1,909	1,923	1,937
Farm and misc. priv.	12,909	12,763	12,553	12,347	11,608	11,116	11.113	11,084	11,048	11,029
Total	15,497	15,752	15,859	15,939	15,435	15,043	15,041	15,051	15,034	15,029
Total Southeast										
Public	7,976	8,323	8,242	8,524	8,772	8,843	8,859	8,869	8,880	8,872
Forest industry	13,944	14,794	15,584	15,312	16,793	17,016	16,972	17,028	17,045	17,033
Farm and misc. priv.	67,148	67,924	66,171	63,983	59,029	56.371	55,899	55.245	54.652	54,360
Total	89,068	91,041	89,997	87,819	84,594	82,230	81,730	81,142	80,577	80,273
South Central										
Alabama										
Public	968	1,003	1,021	1,091	1,161	1,195	1,190	1,194	1,198	1,201
Forest industry	3,138	3,818	4,302	4,330	4,464	4,677	4,768	4,833	4,873	4,935
Farm and misc. priv.	16,650	16.923	16,095	16.077	16.034	15.935	15,784	15.623	15.293	15.125
Total	20,756	21,744	21,418	21,498	21,659	21,807	21,742	21,650	21,364	21,261
Arkansas										
Public	2,916	2,856	2,939	2,918	3,011	3,193	3,315	3,383	3,450	3,466
Forest industry	4,157	4,007	3,975	4,156	4,240	4,254	4,265	4,280	4,297	4,326
Farm and misc. priv.	12,554	13,108	11,118	9.719	9,422	a.196	7,808	7.466	7,323	7.283
Total	19,627	19,971	18,032	16,793	16,673	15,643	15,388	15,129	15,070	15,075
Kentucky										
Public	725	652	820	895	890	913	917	927	937	947
Forest industry	308	308	228	255	205	192	182	172	161	150
Farm and misc. priv.	10,464	10,691	10,778	10,752	10.814	11,029	11,155	11.273	11,370	11.459
Total	11,497	11,651	11,826	11,902	11,909	12,134	12,254	12,372	12,468	12,556

Table A1--Area of timberland in the South, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040--Continued

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
					Thousand acres					
Louisiana										
Public	848	883	1,022	1,024	1,331	1,384	1,407	1,428	1,444	1,449
Forest industry	3,166	3,032	3,491	3,773	3,603	3,625	3,632	3,636	3,642	3,654
Farm and misc. priv.	12.025	12.121	10.617	9,495	8,938	8.663	8.557	8.468	8,405	8,324
Total	16,039	16,036	15,130	14,292	13,872	13,672	13,596	13,532	13,491	13,427
Mississippi										
Public	1,719	1,720	1,770	1,677	1,724	1,755	1,759	1,763	1,765	1,766
Forest industry	2,461	2,526	2,652	2,995	2,864	2,916	2,942	2,961	2,979	2,998
Farm and misc. priv.	12,673	12,798	12.353	11.832	12,085	11,680	11.472	11,226	10.972	10.786
Total	16,853	17,044	16,775	16,504	16,673	16,351	16,173	15,950	15,716	15,550
Oklahoma										
Public	634	567	562	563	632	631	628	625	623	621
Forest industry	889	865	931	1,009	1,046	1,055	1,059	1,064	1,068	1,072
Farm and misc. priv.	3,552	3,460	3,127	2,747	3,071	2.953	2,879	2,803	2,726	2,653
Total	5,075	4,892	4,620	4,319	4,749	4,639	4,566	4,492	4.417	4,346
Tennessee										
Public	1,114	1,199	1,287	1,161	1,360	1,363	1,365	1,374	1,373	1,373
Forest industry	713	923	1,121	1,212	1,220	1,253	1,276	1,300	1,310	1,318
Farm and misc. priv.	10.724	11.243	10,412	10.489	10,260	10.003	9.821	9.666	9,650	9,639
Total	12,551	13,365	12,820	12,862	12,840	12,619	12,462	12,340	12,333	12,330
Texas										
Public	786	833	779	776	801	809	812	817	820	822
Forest industry	3,019	3,362	3,615	3,818	3,796	3,772	3,761	3,756	3,754	3,751
Farm and misc. priv.	9,276	8,765	8,325	7,832	7.817	7,612	7,486	7,435	7,433	7,427
Total	13,081	12,960	12,719	12,426	12,414	12,193	12,059	12,008	12,007	12,000
Total South Central										
Public	9,710	9,713	10,200	10,105	10,910	11,243	11,393	11,511	11,610	11,645
Forest industry	17,851	18,841	20,315	21,548	21,438	21,744	21,885	22,002	22,084	22,204
Farm and misc. priv.	87.918	89.109	82,825	78,943	78.441	76.071	74.962	73.960	73.172	72,696
Total	115,479	117,663	113,340	110,596	110,789	109,058	108,240	107,473	106,866	106,545
Total South										
Public	17,686	18,036	18,442	18,629	19,682	20,086	20,252	20,380	20,490	20,517
Forest industry	31,795	33,635	35,899	36,860	38,231	38,760	38,857	39,030	39,129	39,237
Farm and misc. priv.	155.066	157,033	148,996	142,926	137.470	132.442	130,861	129.205	127.824	127,064
Total	204,547	208,704	203,337	198,415	195,383	191,288	189,970	188,615	187,443	186,818

Table A2--Area of timberland in the North, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
	Thousand acres									
Northeast										
Connecticut										
Public	155	155	155	147	246	264	272	280	289	297
Forest industry	3	3	3	0	0	0	0	0	0	0
Farm and misc. priv.	1,815	1,736	1,665	1,659	1,530	1,445	1,350	1,256	1,156	1,057
Total	1,973	1,894	1,823	1,806	1,776	1,709	1,622	1,536	1,445	1,354
Delaware										
Public	13	9	9	14	14	14	14	14	14	14
Forest industry	21	25	30	30	30	30	30	30	30	30
Farm and misc. priv.	358	357	351	341	344	326	317	311	304	298
Total	392	391	390	385	388	370	361	355	348	342
Maine										
Public	182	205	312	541	613	641	641	641	641	641
Forest industry	6,617	6,521	8,255	8,083	8,286	8,200	8,124	8,099	8,046	7,990
Farm and misc. priv.	9,810	10,053	8,328	8,240	8,275	8,346	8,324	8,195	8,120	8,040
Total	16,609	16,779	16,895	16,864	17,174	17,187	17,089	16,935	16,007	16,671
Maryland										
Public	214	214	189	243	280	278	277	276	275	273
Forest industry	57	57	101	139	133	129	127	123	121	118
Farm and misc. priv.	2,584	2,575	2,384	2,141	2,049	1,954	1,879	1,806	1,733	1,663
Total	2,855	2,846	2,674	2,523	2,462	2,361	2,283	2,205	2,129	2,054
Massachusetts										
Public	399	399	399	365	474	473	473	473	473	473
Forest industry	259	30	30	30	81	78	82	82	82	82
Farm and misc. priv.	2,601	2,612	2,417	2,402	2,455	2,438	2,358	2,247	2,132	2,017
Total	3,259	3,041	2,846	2,797	3,010	2,989	2,913	2,802	2,687	2,572
New Hampshire										
Public	682	697	696	580	788	783	781	778	776	774
Forest industry	771	793	793	947	662	692	705	716	727	735
Farm and misc. priv.	3,366	3,448	3,318	3,165	3,353	3,310	2,955	2,799	2,636	2,473
Total	4,819	4,938	4,807	4,692	4,803	4,785	4,441	4,293	4,139	3,982
New Jersey										
Public	181	254	254	319	533	532	531	530	529	528
Forest industry	4	4	4	16	0	0	0	0	0	0
Farm and misc. priv.	1,865	2,004	1,721	1,522	1,381	1,263	1,199	1,136	1,075	1,014
Total	2,050	2,262	1,979	1,857	1,914	1,795	1,730	1,666	1,604	1,542
New York										
Public	895	895	892	979	1,215	1,286	1,336	1,386	1,426	1,456
Forest industry	1,172	1,172	1,180	1,034	1,116	1,105	1,100	1,095	1,092	1,090
Farm and misc. priv.	9,885	11,350	12,209	13,392	13,467	13,582	13,892	13,479	13,124	13,076
Total	11,952	13,417	14,281	15,405	15,798	15,973	16,328	15,960	15,642	15,622
Pennsylvania										
Public	3,229	3,300	3,406	3,471	3,545	3,625	3,653	3,653	3,653	3,653
Forest industry	442	442	610	964	894	884	880	878	874	867
Farm and misc. priv.	10,903	12,537	12,099	11,489	11,747	11,774	11,750	11,532	11,441	11,332
Total	14,574	16,279	16,115	15,924	16,186	16,283	16,283	16,063	15,968	15,852
Rhode Island										
Public	26	26	26	32	82	82	82	82	82	82
Forest industry	0	0	0	0	0	0	0	0	0	0
Farm and misc. priv.	404	403	403	363	286	243	225	208	195	181
Total	430	429	429	395	368	325	307	290	277	263

Table A2--Area of timberland in the North, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040--Continued

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
	Thousand acres									
Vermont										
Public	297	329	406	422	660	677	693	707	707	708
Forest industry	528	528	678	666	352	347	343	339	336	332
Farm and misc. priv.	3,021	3,354	3,280	3,342	3.412	3.442	3,396	3,246	3,204	3.158
Total	3,846	4,211	4.364	4,430	4,424	4,466	4,432	4,292	4,247	4,198
Uest Virginia										
Public	982	1,036	1,046	1,121	1,320	1,323	1,328	1,333	1,338	1,344
Forest industry	270	530	530	880	1,036	1,035	1,031	1,026	1,020	1,013
Farm and misc. priv.	9,024	9,823	9.864	9.483	9.442	9.481	9,490	9,487	9,476	9,453
Total	10,276	11,389	11,440	11,484	11,798	11,839	11,849	11,846	11,834	11,810
Total Northeast										
Public	7,255	7,519	7,790	8,234	9,770	9,978	10,081	10,153	10,203	10,243
Forest industry	10,144	10,105	12,214	12,789	12,590	12,500	12,422	12,388	12,328	12,257
Farm and misc. priv.	55.636	60,252	58,039	57,539	57,741	57.604	57,135	55,702	54,596	53,762
Total	73,035	77,876	78,043	78,562	80,101	80,082	79,638	78,243	77,127	76,262
North Central										
Illinois										
Public	226	240	288	330	389	361	361	361	361	361
Forest industry	I0	17	16	15	13	13	13	13	13	13
Farm and misc. priv.	3,594	3,777	3,730	3,688	3.628	3.582	3,513	3,437	3.418	3.401
Total	3,830	4,034	4,034	4,033	4,030	3,956	3,887	3,811	3,792	3,775
Indiana										
Public	283	294	361	410	535	531	531	531	531	531
Forest industry	9	9	22	27	18	19	20	20	21	21
Farm and misc. priv.	3,723	3,627	3.457	3,378	3,743;	3,641	3,584	3.543	3,504	3,472
Total	4,015	3.930	3,840	3,815	4,296	4,191	4,135	4,094	4,056	4,024
Iowa										
Public	37	54	93	113	102	102	102	102	102	102
Forest industry	0	6	14	17	0	0	0	0	0	0
Farm and misc. priv.	2.558	1,939	1,593	1,331	1,358	1,331	1,270	1,227	1,231	1,236
Total	2,595	1,999	1,700	1,461	1,460	1,433	1,372	1,329	1,333	1,338
Michigan										
Public	6,310	6,310	6,441	6,378	6,310	6,282	6,305	6,328	6,352	6,376
Forest industry	1,548	1,548	2,257	2,137	1,966	2,009	2,035	2,051	2,054	2,061
Farm and misc. priv.	11,263	11,263	10,102	9,684	9,088	8,990	a.921	8,862	8.825	8,815
Total	19,121	19,121	18,800	18,199	17,364	17,281	17,261	17,241	17,231	17,252
Minnesota										
Public	9,124	8,158	7,995	7,329	7,279	7,277	7,277	7,277	7,277	7,277
Forest industry	578	716	al4	772	788	788	788	788	788	788
Farm and misc. priv.	6.878	6,538	5,686	5,595	5,505	5,359	5,297	5,262	5,241	5,240
Total	16,580	15,412	14,495	13,696	13,572	13,424	13,362	13,327	13,306	13,305
Missouri										
Public	1,617	1,571	1,600	1,532	1,657	1,665	1,672	1,680	1,684	1,687
Forest industry	460	280	343	362	231	236	240	244	248	252
Farm and misc. priv.	12.223	11,649	10,557	10.394	10,107	10.064	10,038	10.021	10,020	10.019
Total	14,300	13,500	12,500	12,288	11,995	11,965	11,950	11,945	11,952	11,958
Ohio										
Public	297	360	365	411	423	423	423	428	428	428
Forest industry	30	74	127	186	186	180	179	178	176	175
Farm and misc. priv.	5,123	5,607	5.930	6,319	6,532	6,727	6,672	6,481	6,422	6,358
Total	5,450	6,041	6,422	6,916	7,141	7,330	7,274	7,087	7,026	6,961

Table A2--Area of timberland in the North, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040--Continued

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
					Thousand acres					
Wisconsin										
Public	5,099	4,882	4,525	4,687	4,523	4,529	4,532	4,535	4,538	4,541
Forest industry	942	933	1,368	1,148	1,159	1,160	1,160	1,160	1,160	1,160
Farm and misc. priv.	9,308	8,878	8,643	8,643	9,045	9,020	8,998	8,969	8,932	8,897
Total	**15,349**	**14,693**	**14,536**	**14,478**	**14,727**	**14,709**	**14,690**	**14,664**	**14,630**	**14,599**
Total North Central										
Public	22,993	21,869	21,668	21,190	21,218	21,170	21,203	21,242	21,273	21,303
Forest industry	3,577	3,583	4,961	4,664	4,361	4,405	4,435	4,454	4,460	4,470
Farm and misc. priv.	54,670	53,278	49,698	49,032	49,006	48,714	48,293	47,802	47,593	47,438
Total	**81,240**	**78,730**	76,327	74,886	**74,585**	74,289	73,931	**73,498**	73,326	73,211
Total North										
Public	30,248	29,388	29,458	29,424	30,988	31,148	31,284	31,395	31,476	31,546
Forest industry	13,721	13,688	17,175	17,453	16,951	16,905	16,857	16,842	16,788	16,727
Farm and misc. priv.	110,306	113,530	107,737	106,571	106,747	106,318	105,428	103,504	102,189	101,200
Total	154,275	**156,606**	**154,370**	**153,448**	**154,606**	154,371	**153,569**	151,741	150,453	149,473

Note: Area estimates for ownerships in some States with zero or little acreage (less than 4,000 acres) are shown as zero.

Table A3--Area of timberland in the Pacific Coast, by geographic region and omership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
	Thousand acres									
Pacific Northwest										
Alaska, interior										
Public	12,866	12,538	12,428	12,316	4,595	4,484	4,389	4,310	4,296	4,282
Forest industry	0	0	0	0	0	0	0	0	0	0
Farm and misc. priv.	121	254	310	367	5,469	5,585	5,683	5,762	5,776	5,790
Total	12,987	12,792	12,738	12,683	10,064	0,069	10,072	10,072	10,072	10,072
Alaska, coastal										
Public	7,326	7,297	7,270	6,954	5,005	4,747	4,736	4,725	4,724	4,723
Forest industry	0	0	0	0	0	0	0	0	0	0
Farm and misc. priv.	30	30	30	85	694	950	951	952	953	954
Total	7,356	7,327	7,300	7,039	5,699	5,697	5,687	5,677	5,677	5,677
Oregon, western										
Public	7,730	7,817	7,749	7,445	7,119	6,962	6,954	6,950	6,910	6,873
Forest industry	3,128	3,548	3,624	3,895	3,547	3,853	3,978	4,017	4,059	4,063
Farm and misc. priv.	3,743	3,354	3,234	2,311	2,358	2,054	1,937	1,894	1,851	1,853
Total	14,601	14,719	14,607	13,651	13,024	12,869	12,869	12,861	12,820	12,789
Oregon, eastern										
Public	8,065	7,741	7,715	7,682	6,587	6,273	6,206	6,145	6,033	5,926
Forest industry	1,533	1,540	1,628	1,627	1,568	1,523	1,491	1,464	1,456	1,449
Farm and misc. priv.	1,489	1,623	1,379	1,251	907	903	898	894	893	893
Total	11,087	10,904	10,722	10,560	9,062	8,699	8,595	8,503	8,382	8,268
Washington, western										
Public	4,349	4,250	4,123	3,991	4,179	4,030	4,011	3,992	3,962	3,932
Forest industry	3,748	3,686	3,598	3,581	3,708	3,764	3,761	3,714	3,619	3,500
Farm and misc. priv.	2,531	2,416	2,270	2,216	2,229	2,093	1,980	1,873	1,797	1,739
Total	10,628	10,352	9,991	9,788	10,116	9,887	9,752	9,579	9,378	9,171
Washington, eastern										
Public	5,537	5,500	5,395	5,203	4,472	4,364	4,360	4,356	4,332	4,308
Forest industry	637	652	750	738	880	871	862	856	853	851
Farm and misc. priv.	2,386	2,356	2,265	2,193	1,380	1,358	1,331	1,306	1,295	1,286
Total	8,560	8,508	8,410	8,134	6,732	6,593	6,553	6,518	6,480	6,445
Total Pacific Northwest										
Public	45,873	45,143	44,680	43,591	31,957	30,860	30,656	30,478	30,257	30,044
Forest industry	9,046	9,426	9,600	9,841	9,703	10,011	10,092	10,051	9,987	9,863
Farm and misc. priv.	10,300	10,033	9,488	8,423	13,037	12,943	12,780	12,681	12,565	12,515
Total	65,219	64,602	63,768	61,855	54,697	53,814	53,528	53,210	52,809	52,422
Pacific Southwest										
California										
Public	9,075	9,430	9,448	8,675	9,257	8,771	8,713	8,641	8,617	8,593
Forest industry	2,167	2,445	2,671	2,687	2,757	2,830	2,711	2,566	2,404	2,242
Farm and misc. priv.	5,885	5,323	4,962	4,941	4,698	4,161	3,924	3,692	3,471	3,252
Total	17,127	17,198	17,081	16,303	16,712	15,762	15,348	14,899	14,492	14,087
Hawaii										
Public	496	496	454	454	338	336	335	334	333	332
Forest industry	0	0	0	0	0	0	0	0	0	0
Farm and misc. priv.	593	593	494	494	362	316	308	300	293	287
Total	1,089	1,089	948	948	700	652	643	634	626	619
Total Pacific Southwest										
Public	9,571	9,926	9,902	9,129	9,595	9,107	9,048	8,975	8,950	8,925
Forest industry	2,167	2,445	2,671	2,687	2,757	2,830	2,711	2,566	2,404	2,242
Farm and misc. priv.	6,478	5,916	5,456	5,435	5,060	4,477	4,232	3,992	3,764	3,539
Total	18,216	18,287	18,029	17,251	17,412	16,414	15,991	15,533	15,118	14,706

Table A3--Area of timberland in the Pacific Coast, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040--Continued

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987:	2000	2010	2020	2030	2040
	Thousand acres									
Total Pacific Coast										
Public	55,444	55,069	54,582	52,720	41,552	39,967	39,704	39,453	39,207	38,969
Forest industry	11,213	11,871	12,271	12,528	12,460	12,841	12,803	12,617	12,391	12,105
Farm and misc. priv.	16,778	15,949	14,944	13,858	18,097	17,420	17,012	16,673	16,329	16,054
Total	**83,435**	82,889	81,797	**79,106**	**72,109**	**70,228**	**69,519**	68,743	67,927	67,128

Note: Area estimates for ownerships in some States with zero or little acreage (less than 4,000 acres) are shown as zero.

Table A4--Area of timberland in the Great Plains and Rocky Mountains, by geographic region and ownership class for 1952, 1962, 1970, 1977, and 1987, with projections to 2040

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
	Thousand acres									
Greet Plains										
Kansas										
Public	27	37	37	37	51	51	51	51	51	51
Forest industry	0	0	0	0		0	0	0	0	0
Farm and misc. priv.	1,208	1,198	1,151	1,151	1,157	1,166	1,173	1,189	1,195	1,199
Total			1,188	1,188	1,208	1,217	1,224	1,240	1,246	1,250
Nebraska										
Public	62	60	63	63	64	63	63	63	63	63
Forest industry	0	0	0	0	0	0	0	0	0	0
Farm and misc. priv.	672	615	570	530	473	445	443	442	441	440
Total	734	675	633	593	537	508	506	505	504	503
North Dakota										
Public	139	128	125	124	67	66	66	66	66	66
Forest industry	0	0	0	0	0	D	0	0	0	0
Farm and misc. priv.	312	296	281	281	271	267	266	263	260	258
Total	451	424	406	405	338	333	332	329	326	324
South Dakota										
Public	1,130	1,107	1,107	1,106	1,044	1,028	1,028	1,028	1,028	1,028
Forest industry	17	17	17	16	21	21	21	21	21	21
Farm and misc. priv.	475	417	410	345	381	375	369	363	358	353
Total	1,622	1,541	1,534	1,467	1,446	1,424	1,418	1,412	1,407	1,402
Total Great Plains										
Public	1,358	1,332	1,332	1,330	1,226	1,208	1,208	1,208	1,208	1,208
Forest industry	17	17	17	16	21	21	21	21	21	21
Farm and misc. priv.	2,640	2,486	2,412	2,307	2,282	2,253	2,251	2,257	2,254	2,250
Total	4,015	3,835	3,761	3,653	3,529	3,482	3,480	3,486	3,483	3,479
Rocky Mountains										
Arizona										
Public	3,453	3,526	3,524	3,729	3,746	3,746	3,746	3,746	3,746	3,746
Forest industry	0	0	166	0	0	0	D	0	0	0
Farm and misc. priv.	168	167	3,690	166	43	42	41	40	39	38
Total	3,621	3,693		3,895	3,789	3,788	3,787	3,786	3,785	3,784
Colorado										
Public	9,142	9,235	8,465	8,196	8,514	7,971	7,971	7,971	7,971	7,971
Forest industry	15	15		15	0	0	0	0	0	D
Farm and misc. priv.	3,127	3,113	3,104	3,104	3,226	3,188	3,169	3,150	3,131	3,100
Total	12,284	12,359	11,584	11,315	11,740	11,159	11,140	11,121	11,102	11,071
Idaho										
Public	12,497	12,695	12,172	10,520	11,435	11,021	11,021	11,021	11,021	11,021
Forest industry	954	950	947	947	1,198	1,196	1,195	1,194	1,194	1,194
Farm and misc. priv.	2,090	1,984	2,074	2,074	1,901	1,831	1,776	1,722	1,672	1,622
Total	15,541	15,630	15,193	13,541	14,534	14,048	13,992	13,937	13,887	13,837
Montana										
Public	12,154	12,251	11,418	9,794	10,004	10,003	10,003	10,003	10,003	10,003
Forest industry	1,063	1,059	1,055	1,055	1,703	1,701	1,699	1,698	1,697	1,696
Farm and misc. priv.	3,536	3,521	3,510	3,510	3,0301	3,026	3,023	3,020	3,020	3,020
Total	16,753	16,831	15,983	14,359	14,737	14,730	14,725	14,721	14,720	14,719
Nevada										
Public	73	73	60	66	109	62	62	62	62	62
Forest industry	8	8	8	8	0	0	0	0	0	0
Farm and misc. priv.	19	61	60	60	112	108	106	103	102	100
Total		142	128	134	221	170	168	165	164	162

Table A4--Area of timberland in the Great Plains and Rocky Mountains, by geographic region and ownership class for 1952, 1962, 1970, 1977, ad 1987, with projections to 2040--Continued

Region and State, by ownership class	Year					Projections				
	1952	1962	1970	1977	1987	2000	2010	2020	2030	2040
	Thousand acres									
New Mexico										
Public	3,685	3,814	3,809	3,610	3,586	3,586	3,586	3,586	3,586	3,586
Forest industry	138	138	137	0	5	5	5	5	5	5
Farm and misc. priv.	1,803	1,795	1,790	1,927	1,589	1,541	1,503	1,467	1,433	1,399
Total	5,626	5,747	5,736	5,537	5,180	5,132	5,094	5,058	5,024	4,990
Utah										
Public	3,216	3,209	3,164	2,744	2,511	2,511	2,511	2,511	2,511	2,511
Forest industry	0	0	0	0	0	0	0	0	0	0
Farm and misc. priv.	666	663	661	661	567	550	536	523	511	499
Total	3,882	3,872	3,825	3,405	3,078	3,061	3,047	3,034	3,022	3,010
Uyoming										
Public	3,877	3,863	3,795	3,479	3,000	3,000	3,000	3,000	3,000	3,000
Forest industry	55	55	54	54	37	37	37	37	37	37
Farm and misc. priv.	807	803	801	801	1,295	1,256	1,226	1,196	1,168	1,140
Total	4,739	4,721	4,650	4,334	4,332	4,293	4,263	4,233	4,205	4,177
Total Rocky Mountain										
Public	48,097	48,662	46,407	42,138	42,905	41,900	41,900	41,900	41,900	41,900
Forest industry	2,233	2,225	2,216	2,079	2,943	2,939	2,936	2,934	2,933	2,932
Farm and misc. priv.	12,258	12,204	12,166	12,303	11,763	11,542	11,380	11,221	11,076	10,918
Total	62,588	63,091	60,789	56,520	57,611	56,381	56,216	56,055	55,909	55,750
Total Great Plains and Rocky Mountians										
Public	49,455	49,994	47,739	43,468	44,131	43,108	43,108	43,108	43,108	43,108
Forest industry	2,250	2,242	2,233	2,095	2,964	2,960	2,957	2,955	2,954	2,953
Farm and misc. priv.	14,898	14,690	14,578	14,610	14,045	13,795	13,631	13,478	13,330	13,168
Total	66,603	66,926	64,550	60,173	61,140	59,863	59,696	59,541	59,392	59,229
Total United States										
Public	152,833	152,487	150,221	144,241	136,353	134,309	134,348	134,336	134,281	134,140
Forest industry	58,979	61,436	67,578	68,936	70,606	71,466	71,474	71,444	71,262	71,022
Farm and misc. priv.	297,048	301,202	286,255	277,965	276,359	269,975	266,932	262,860	259,672	257,486
Total	508,860	515,125	504,054	491,142	483,318	475,750	472,754	468,640	465,215	462,648

Note: Area estimates for ownerships in some States with zero or little acreage (less than 4,000 acres) are shown as zero.

Alig, Ralph J.; Hohenstein, William G.; Murray, Brian C.; Haight, Robert G. 1990. Changes in area of timberland in the United States, 1952-2040, by ownership, forest type, region, and State. Gen. Tech. Rep. SE-64. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 34 pp.

Area change projections for timberland in the United States are provided by region, State, ownership, and forest type. Total timberland area is projected to drop by 21 million acres or 4 percent by the year 2040.

KEYWORDS: Land use change, RPA Assessment, land allocation.

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