United States
Department of
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**Forest
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America's Renewable Resources:

A Supplement to the 1979 Assessment of the Forest and Range Land Situation in the United States

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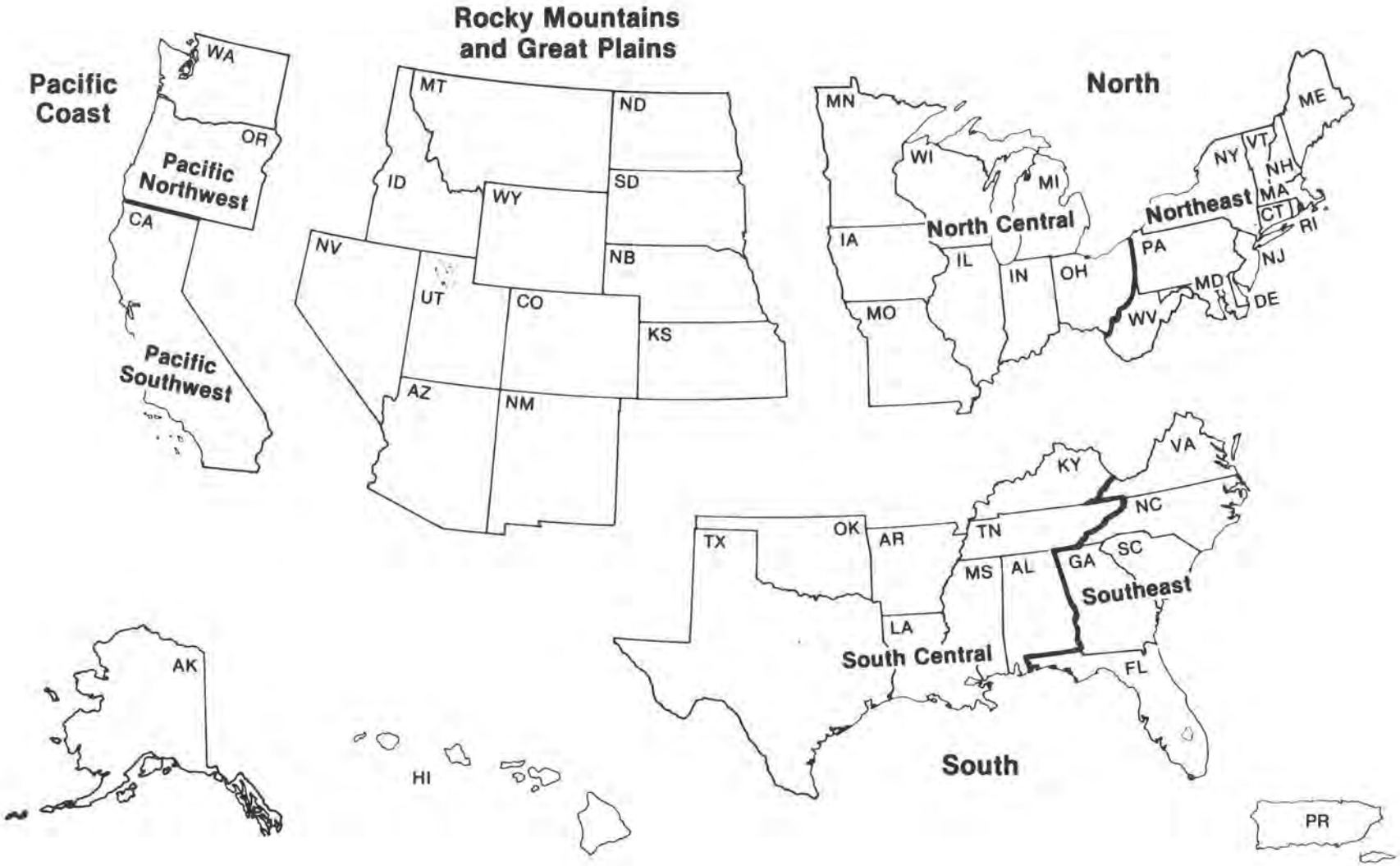
Sections and Regions of the United States



Just five decades from now, a little more than half a lifetime away, we will have a total of over 300 million people, each with purchasing power nearly three times that of today. Economic activity will have expanded by nearly four times.

We have analyzed the effects of these and other views of the future on the demands for and supplies of renewable resources. While the results varied over a wide range, these analyses showed that demands for timber; for water; and for forage, outdoor recreation, wilderness, wildlife and fish will be above the levels that can be supplied with present investments in renewable resource programs and the existing physical facilities. It seems clear that in the years and decades ahead there will be growing competition for the available supplies of renewable resource products unless we take action to increase the productivity of forest and range lands and waters.

And this can be done--we can meet nearly all of the foreseeable increases in demands. With adequate investments in management, research and assistance programs, timberlands can grow more than twice the volume of timber they are growing today; rangelands can produce three times the forage they are now producing. Water yields can be increased, water quality improved, and damages from floods contained. Forest and range lands and waters have the physical potential to meet increases in demands for most kinds of outdoor recreation, and they can support larger populations of most species of wildlife and fish.

Thus we have the opportunities, and if we take advantage of them, we can assure future generations an abundant supply of goods and services from renewable resources. Moving forward to achieve this goal will require increased public and private investments. But when the social, economic, and environmental benefits are considered, substantial investments will be profitable to our society.

R. MAX PETERSON
Chief

This report supplements "An Assessment of the Forest and Range Land Situation in the United States"[1/], which was completed in 1979 to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976. This Supplement and the 1979 Assessment provide the factual and analytical basis for a recommended Forest Service program to be submitted to Congress in 1985 as required by these two Acts.

The 1979 Assessment presents projections of demands and supplies for timber, water, range forage, outdoor recreation and wilderness, wildlife and fish, and selected minerals. It also includes information on the social, economic, and environmental implications of the demand and supply projections; the forest, range, and water resource base; and the opportunities to manage the resource base in ways which will increase and extend supplies of renewable resources.

This report summarizes the major findings of the 1979 Assessment as revised in accordance with new data, analytical methods, and expectations about the future. In addition, it describes the implications of these findings for the 1985 Forest Service recommended program and discusses some possible social and economic events which could change the Assessment outlook, and program development, and implementation.

The sources of data and the supporting analyses for nearly all of the material in this report are detailed in the 1979 Assessment. Supporting documentation on the new material, including the detail on the basic assumptions and the simulations of the effects of various futures on the timber situation (see following discussion), will be supplied upon request.

1/ U.S. Department of Agriculture, Forest Service, An Assessment of the Forest and Range Land Situation in the United States. U.S. Dep. Agric., Forest Serv. For. Res. Rep. 22, Washington, D.C., 352 p. 1981.

Contents

Appendix

In the past, as population and incomes grew and economic activity expanded, the consumption or use of nearly all products of forest and range lands and the associated inland waters increased and, in most areas, at rapid rates. This is one of the major findings of the 1979 Assessment, and it has not changed. The 1979 Assessment also found that the demand for most products is likely to continue to rise in the decades ahead and that supplies will increase but at much slower rates. These basic findings also have not changed.

Further, most of the resource demand and supply projections--those for water, forage, outdoor recreation and wilderness, and wildlife and fish--have not been changed. Some of the demand-supply projections, however, have been revised to reflect new data and expectations about the future. The significant revisions include:

1. Lower projections of demand for softwood lumber, plywood, and sawtimber--a response to a downward revision in the demand for housing and an upward revision in base prices for softwood lumber and plywood.
2. A somewhat smaller reduction in softwood roundwood demand--a response to an upward revision in the demand for fuelwood offsetting part of the downward revision for lumber and plywood.
3. Higher projections of demand for hardwood roundwood--a response to an upward revision in the demand for fuelwood.
4. New projections of demand for minerals--a response to improved analytical methods and changed expectations about the outlook for mineral fuels.

The demands for timber and most other renewable resource products are likely to increase rapidly in the decades ahead. Supplies are also likely to increase but at slower rates.

In the future, as in the past, demands and supplies of renewable resource products will be largely determined by such things as growth in population, income, and economic activity; technological and institutional changes; energy costs; capital availability; and investments in forest, range, and water management, utilization, assistance, and research programs.

The historical information on and present expectations about future changes in these basic determinants are not much different today from those at the time the 1979 Assessment was prepared.

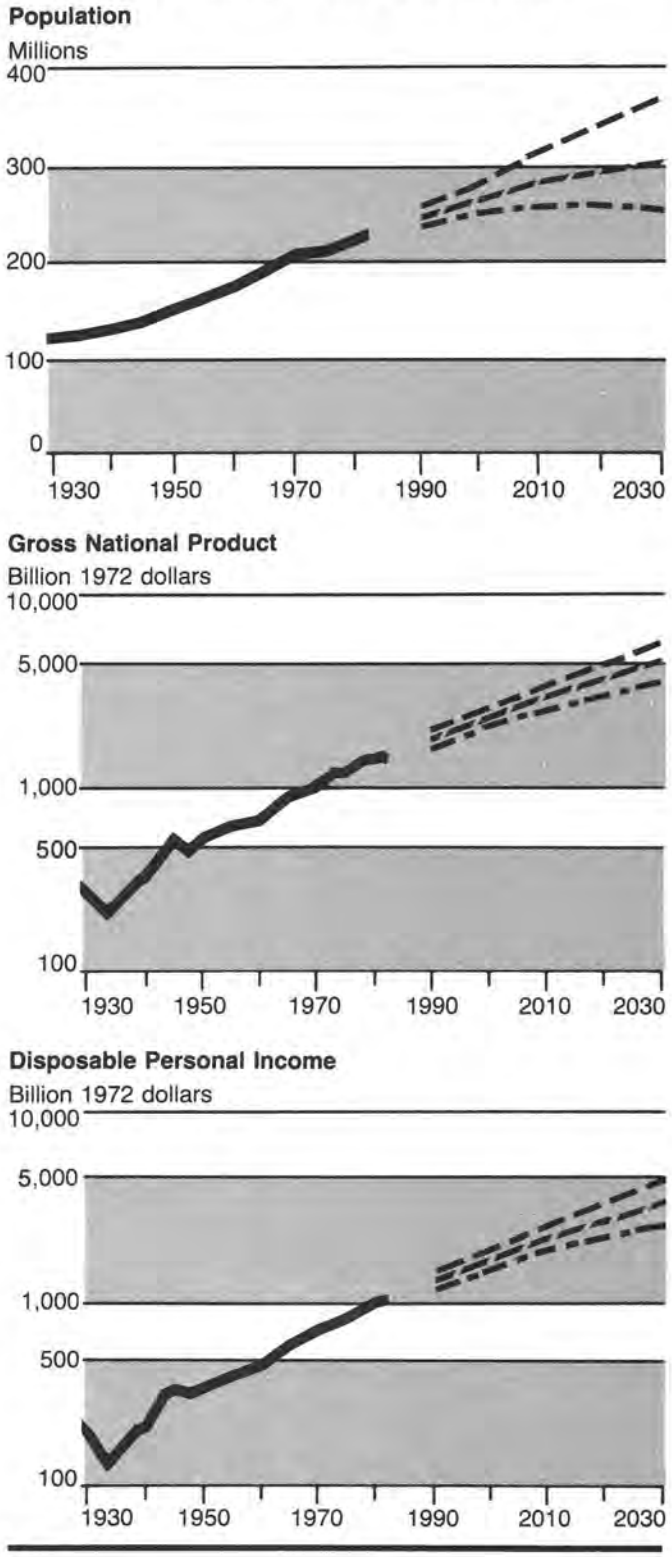
In the five decades between 1931 and 1981, the population of the United States increased from 123 million to 230 million people. The latest estimates of the Bureau of the Census show population continuing to grow, with the midlevel projection reaching 304 million by 2030 (fig. 1).

Economic activity, as measured by the gross national product in constant dollars (net of inflation and deflation), increased by over four times in the last five decades. In this period, there have been a major depression and number of recessions. In each case the economy has recovered, and it is expected to continue to do so in the future. The basic forces that bring about longrun growth are still there. Thus, the latest projections of the Bureau of Economic Analysis show that economic activity will nearly quadruple again by 2030 (fig. 1). Total income available for spending (disposable personal income) is also projected to be nearly four times larger by 2030: per capita income will increase almost three times (fig. 1).

In the past, institutional and technological changes have influenced demands and supplies of forest, range, and water resources. It is assumed that the stream of institutional and technological changes will continue, and that the effects of these changes on demands and supplies of renewable resources will be similar to those that have taken place and are included in the historical data base used in

Figure 1

Population, Economic Activity and Income



making the projections. It is also assumed that there would be adequate capital available to support intensified management and use of forest, range, and water resources and the production of renewable resource products. Energy costs over the projection decades are assumed to continue to rise with oil and gas prices increasing more rapidly than those for coal.

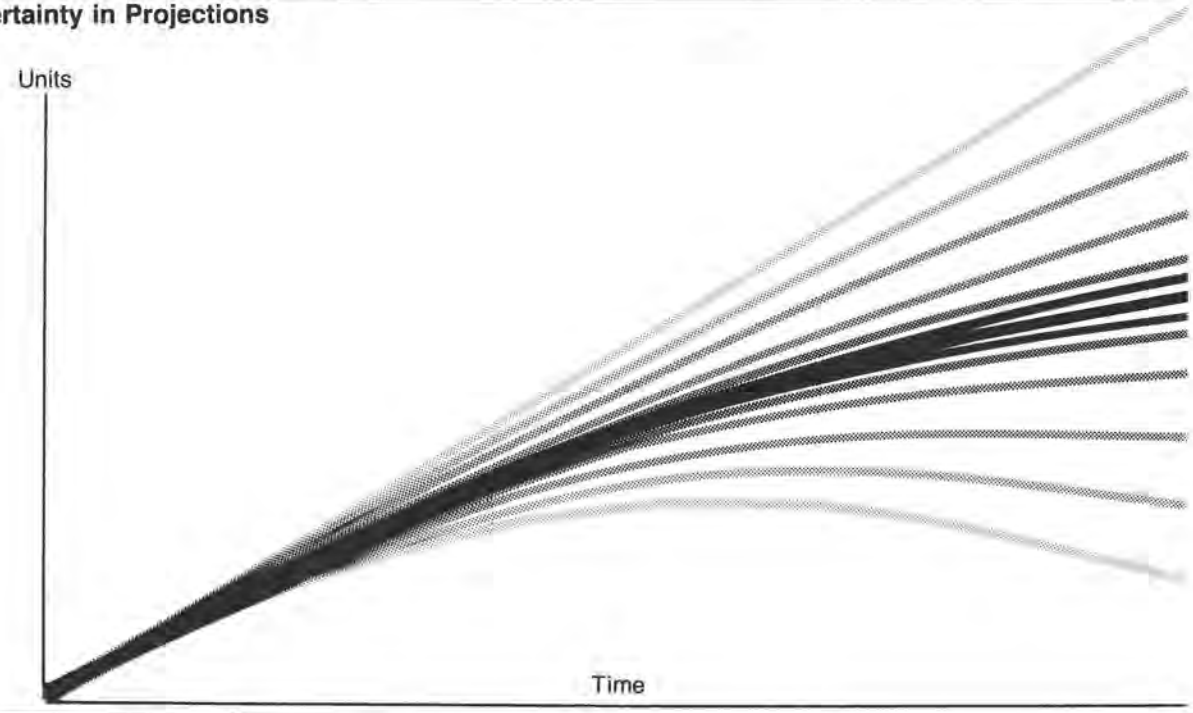
In one sense, the basic assumptions measure the job ahead; meeting the renewable resource demands of 75 million more people and, in total, the demands of 304 million with purchasing power nearly triple that of today. The rates of increase in demands will, of course, vary--those for some renewable resource products or uses are likely to grow more rapidly than they will for others. The supply outlook is also variable; much will depend on the kinds and sizes of management, research, and assistance programs in future years.

Of course, no one knows what the future holds, and what actually happens may be greatly different from what the above assumptions describe. However, these assumptions are consistent with general societal goals of full employment, continued economic growth, rising income, and current expectations about the future. Thus, they can be viewed as the most probable course of events or the center line in the schematic illustration in figure 2. The surrounding band in this figure illustrates uncertainty--the further away from the assessment center, the less likely is this kind of event to actually occur.

All of the projections in this report have such a band of uncertainty. As an illustration, the effects of nine selected futures--including low housing growth, import duties, high exports, intensive management on forest industry lands, high National Forest harvests, and reduced commercial timberland area--which differ in various ways from the future described by the basic assumptions have been simulated. The results are shown in the appendix to this report. The 1979 Assessment also showed the effects of a range of assumptions on population, economic activity, and income on all resource demand projections. Some of these, and the timber simulations, are discussed in the following text.

Figure 2

Uncertainty in Projections



Although much is uncertain about the future, one thing is clear, the United States now has a huge forest and range land and water base. Some 1.6 billion acres, about 66 percent of the Nation's total area, is classified as forest or rangeland or is covered by water (appendix table 1).

Forest, Rangeland, and Water Areas

As indicated in the tabulation on page 6, a little less than half of this 1.6 billion acres, or some 770 million acres, is currently classified as rangeland.

This is land on which the native vegetation (climax or natural potential plant communities) is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing use. It includes natural grasslands, savannas, most deserts, shrublands, tundra, alpine plant communities, coastal marshes, wet meadows, and introduced plant communities managed like rangelands.

Most of the rangeland is found in the Great Plains, the States westward of the Great Plains to the Pacific Coast, and in Alaska (appendix table 1). Most of the land east of the Great Plains is forested or cultivated, seeded, fertilized, or irrigated and is not classified as rangeland.

About 721 million acres are classified as forest and transition land--land that is at least 10 percent stocked with forest trees, or formerly had such cover, and not developed for other purposes. Two-thirds of the forest land, 482 million acres, is capable of growing more than 20 cubic feet of industrial wood per acre per year and is called commercial timberland. In 1976 about nine-tenths of the timber harvested each year came from this area.

About a third of the United States, some 770 million acres, is classified as rangeland.

Class of Land	Area (1,000 acres)
Non-Federal land:	
Crop and pasture land	529,851
Rangeland	441,466
Transition land	35,603
Forest land	409,284
Other land	159,776
Total, non-Federal	1,575,980
Federal land:	
Rangeland	328,887
Forest land	276,417
Other land	73,504
Total, Federal	678,808
Total land	2,254,788
All land:	
Crop and pastureland	529,851
Rangeland	770,353
Transition land	35,603
Forest land	685,701
Other land	233,280
Total land	2,254,788

Nearly three-quarters of the commercial timberland is in the eastern half of the country. Most of that in the West is located in the Pacific Coast States and in Montana, Idaho, and Colorado.

The Nation's forest and range lands are underlain by extensive mineral resources. The greatest concentrations occur in the Western Overthrust Belt, the Northern Great Plains, and the Appalachian region.

About 5 percent of the area of the United States, 109 million acres, is covered by water. A little over half of this area is in lakes (exclusive of the Great Lakes), ponds, and waterways. The rest is in the Great Lakes and coastal waters such as bays, sounds, and straits.

Ownership of Forest and Range Land

A little over two-fifths of the rangeland is in Federal ownership (fig. 3 on page 8, and appendix table 2). Most of this is the arid and semiarid lands of the Southwest and the tundra, shrub, and muskeg-bog lands of interior Alaska. The rangeland in private ownership is concentrated in the Rocky Mountain and Great Plains States. Because of a more favorable climate, these lands generally have a higher potential for production of forage and for grazing than those in Federal ownership.

There are 482 million acres of land, one-fifth of the total area of the country, classified as commercial timberland.

A little less than two-fifths of the Nation's forest land is in Federal ownership (fig. 3, appendix table 2). These lands are concentrated in the Rocky Mountains and Pacific Coast States. Most of the forests on these lands have never been harvested; they contain a large part of the Nation's softwood timber inventory. Some of the high elevation forests also have great scenic beauty and contribute in important ways to meeting outdoor recreation demands.

About three-fourths of the privately owned forest land is in the eastern part of the country. Much of this area has good soils and other conditions favorable for growing trees and is close to the largest markets for timber products. These lands are also closest to densely populated areas and provide opportunities for many kinds of outdoor recreation.

Productivity of Forest and Range Lands and Water

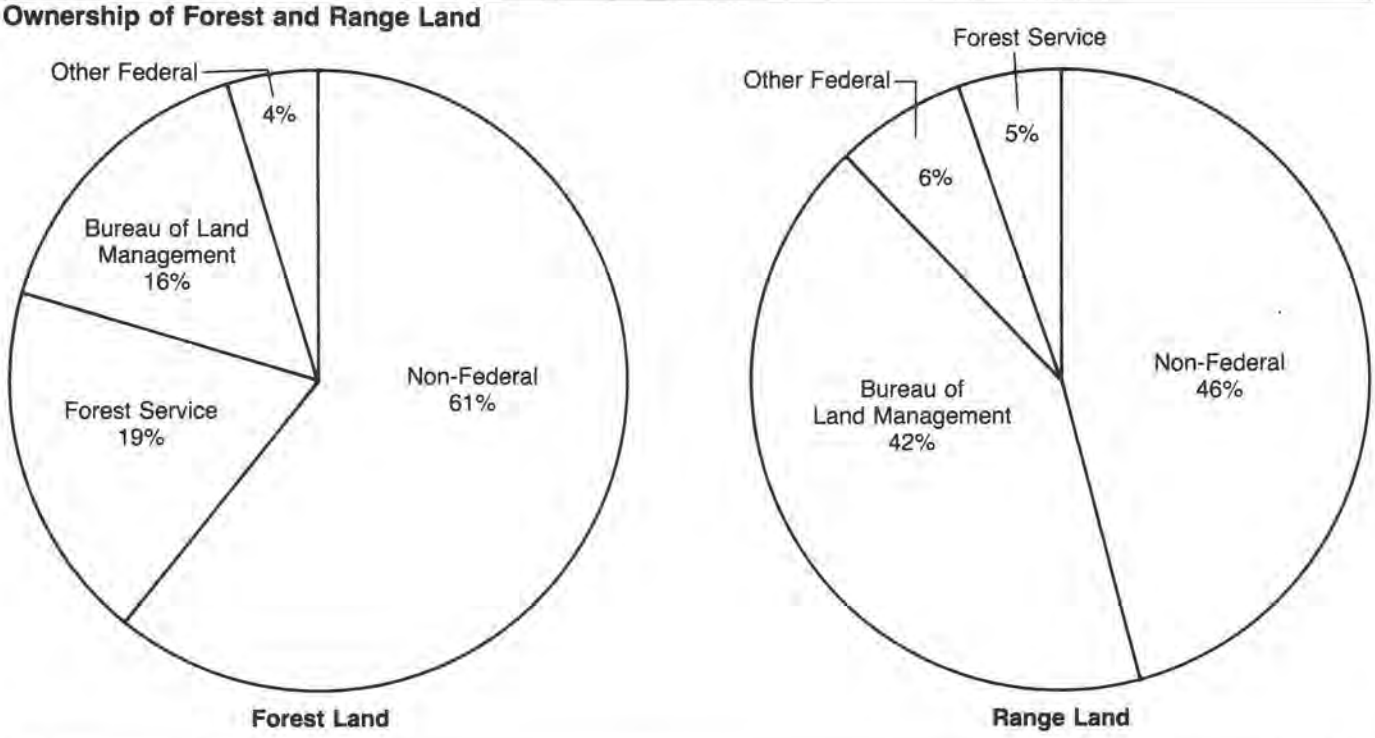
The productivity of forest and range lands varies widely as a result of differences in climate, soils, elevation, and latitude. In general, however, production is much below the levels that could be achieved with additional investments in management, research, and assistance programs.

For example, average net annual timber growth per acre on commercial timberland is about 45 cubic feet. This is three-fifths of what could be attained in fully stocked natural stands and far below what can be achieved with intensive management practices such as spacing control, the use of genetically improved planting stock, and fertilizers.

Some 107 million acres, 5 percent of the Nation's area, is occupied by lakes, ponds, waterways, and inland coastal waters.

Figure 3

Ownership of Forest and Range Land



Water yields from forest and range lands can be increased by various management practices. Water quality can be improved, and flooding and soil erosion and the associated sedimentation of streams restrained.

Livestock grazing in the contiguous States amounts to a little over 213 million animal unit months (the amount of forage required for a 1,000-pound cow, or the equivalent, for 1 month) a year, only a little over a third of the estimated biological potential.

The 1.6 billion acres of forest and range land and water has the potential capacity to supply sites for picnicking, camping, hiking, skiing, hunting and fishing, birdwatching, canoeing, swimming, and most other kinds of outdoor recreation far in excess of present use.

Forest and range lands and water also have the potential to foster diversity and increased numbers of most species of wildlife, including those of recreational and commercial importance and endangered or threatened species.

Finally, the mineral resources on these lands can contribute in important ways to meeting growing needs for minerals.

In summation, the Nation's forest and range lands and water have the physical capacity to produce much larger quantities of renewable resource products and support much higher levels of use.

Trends in Areas

The productivity capacity is likely to be affected in the future by changes in areas. In recent years, the area of forest and range land has been declining as these lands have been converted to other uses. The water area, on the other hand, has been increasing due to the construction of ponds and lakes (reservoirs).

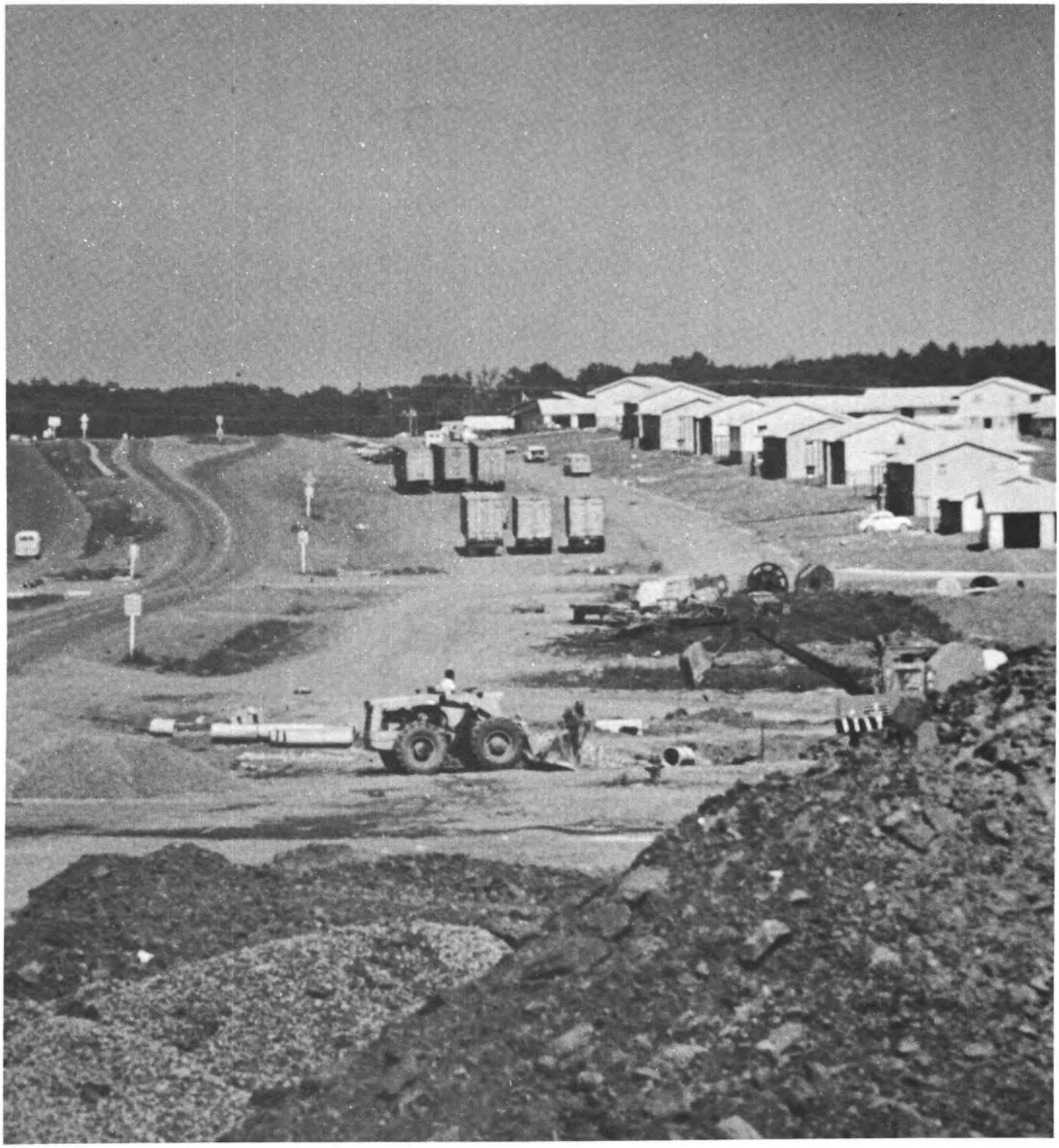
With more intensive management, forest lands, rangelands, and waters have the capacity to produce much larger quantities of renewable resource products and support much higher levels of use.

These trends in forest and range land areas are expected to continue as the Nation's needs for crop and pasture land, roads, and urban space grow in the decades ahead. As a result, the area of forest land is expected to drop by 19 million acres by 2030. Rangeland area in the same period declines by about 56 million acres. Water areas continue to increase, but wetland areas are declining.

Nearly all of the areas converted to crop and pasture use will come from those forest and range lands with the best soils and climatic conditions for growing timber and forage. As a consequence, these conversions are likely to have some significant impacts, especially on timber supplies in the South, where most of the conversion is expected to take place.

Despite the projected losses, the Nation will still have a very large forest and range land and water area in 2030 and even beyond. The major problem will not be one of the size of area in these uses. It will be the management of the available lands and waters in ways which achieve a larger part of their productive potential.

But, there will be some size problems. A continuation of recent losses, about 458,000 acres of wetland a year including 300,000 acres of bottomland hardwoods, is certain to constrain the potential to increase supplies of some waterfowl and hardwood timber species. The area suitable for many specialized uses is also limited.



As the Nation's population grows, the need for residential areas, roads, parks, and many other uses will expand. This will cause further declines in the area available for forest and range lands.

Although areas in forest and range lands and inland waters will be large during the next 50 years, the losses of certain specialized areas could have important effects. For example, a continuation of recent losses in the areas of wetlands could seriously restrain the potential to increase supplies of some waterfowl and bottomland timber species. It will also cause a reduction in streamflows and ground water levels in many parts of the country.

In one form or another--as housing, furniture, containers, writing paper, books, and newspapers--products made from timber affect the quality of life for everyone. The way that forest lands are managed for timber production is also important. Regeneration, intermediate stand treatment, and harvesting practices can and do have major impacts on forage production, water yields and quality, wildlife and fish populations, and the suitability of the forest for many kinds of outdoor recreation.

Trends in Timber Use and Projected Demands

Beginning with settlement and for a long time after, timber was the Nation's most important raw material. It had wide use in all types of construction and manufacturing, ranging from houses, bridges, and even road surfaces to the wagons and ships which provided the chief means of transportation. It was also the main source of fuel for domestic and industrial uses.

Although over the years domestic and industrial users turned more and more to iron, steel, plastics, and other raw materials and to fuel oil, gas, and other nonwood materials for power and heating, the demand for timber products continues. And in total in recent decades it has been rising.

Between 1950 and 1980, there was no well defined upward or downward trend in lumber consumption (fig. 4). Pulpwood use, however, increased nearly three times and plywood more than four times. Since 1980 the recession has caused a drop in consumption, and a substantial one for lumber and plywood. The use of roundwood for fuel followed a long downward trend through the mid-1970's. Since then, consumption has increased rapidly in response to rising costs of oil and natural gas; in 1980 it was five times that in 1976.

As illustrated in figure 4, the longrun demands for all major timber products are projected to go up over the next five decades; as in the past, the demands for some products rise more rapidly than for others. Roundwood fuel demand rises at first and then after 2010 begins to decline, a response to projected increases in stumpage prices and fuelwood costs.

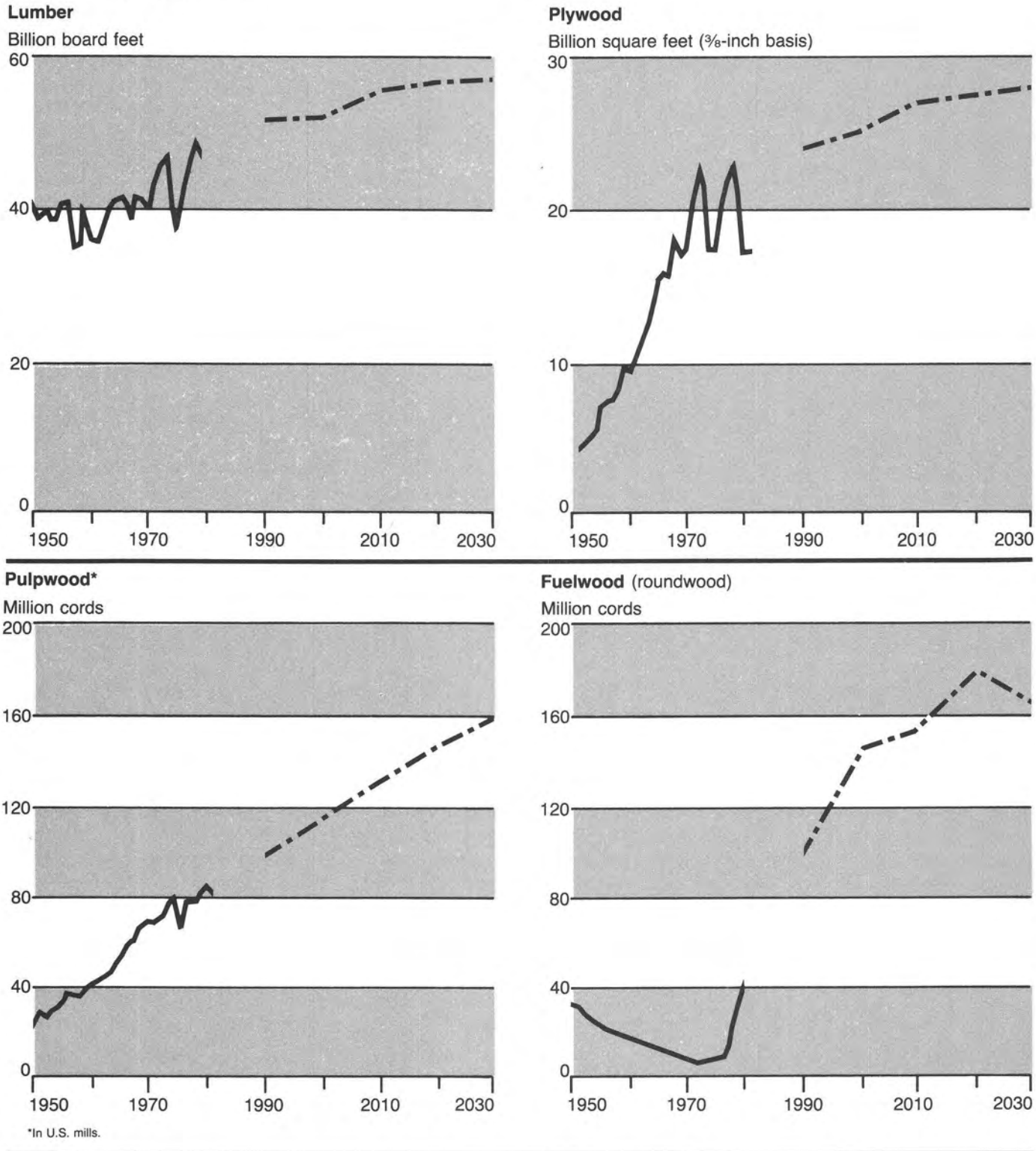
The demands shown in figure 4 are in the standard measurement units for the various products--board feet for lumber, square feet for plywood, and cords for pulpwood and fuelwood. In the tabulation on page 14, these are converted to cubic feet roundwood equivalent; that is, the volume of roundwood (round sections of trees) needed to produce the various products.

As these data show, a substantial part of the projected increase in softwood timber demand takes place by 1990. This is in response to an expected surge in homebuilding in the last half

A substantial part of the projected increase in softwood timber demand takes place by 1990. This reflects an expected surge in homebuilding in the last half of the 1980's as the large numbers of people born during the 1950's and 1960's seek their own place to live.

Figure 4

Timber Products Demands



*In U.S. mills.

Year	Softwoods	Hardwoods	Total
	(Billion cubic feet, roundwood equivalent)		
1950	8.4	3.7	12.2
1960	8.3	3.1	11.4
1970	9.5	3.0	12.5
1980	10.7	5.0	15.7
	Projections		
1990	12.0	6.0	18.0
2000	12.8	7.6	20.4
2010	14.0	9.1	23.1
2020	15.0	10.3	25.3
2030	15.1	10.7	25.8

Note: Some of the historical data and the projections in this tabulation differ from those published in the 1979 Assessment. For example, the projected demands for softwood timber are lower--this largely reflects a reduction in the projected housing demands shown in the 1979 Assessment. The projected demands for hardwood timber are higher as a result of a large increase in fuelwood use in the last half of the 1970's and projected further increases. All projections are base level projections as defined in the 1979 Assessment. The fuelwood projections exclude demands on nongrowing stock resources such as tree tops, limbs, and bark; trees under 5 inches in diameter at breast height; and trees on noncommercial forest lands, in fence rows, and in urban areas. Total fuelwood demand, including demand on these resources, is shown in figure 4.

of the 1980's as the large numbers of people born during the 1950's and 1960's seek their own place to live. Pent-up demands resulting from the recent low levels of housing construction will also contribute to the surge in housing in the late 1980's. However, even beyond the 1980's, softwood timber demands continue to rise and by 2030 will be some 1.4 times the consumption in 1980.

Projected demand for hardwood timber will increase 2.1 times by 2030. This is largely due to growth in demands for pulpwood, fuelwood, and products such as pallets, railroad ties, and furniture.

Consumption of softwood and hardwood sawtimber--the larger size timber that is measured in board feet and used mostly for producing lumber and plywood--has followed the general roundwood trends. This is expected to continue.

Timber product imports have been rising and have supplied part of the past domestic needs. Imports are expected to continue to go up until about 2010 when they level off at about 3.9 billion cubic feet, roundwood equivalent.

Exports of timber products have also been going up, but because of offsetting trends--such as a decline in softwood log exports and a rise in woodpulp and paper--the recent levels of 2 billion cubic feet will not change much over the projection years.

Given the above trends, net imports--total imports less total exports--will increase to 1.6

Year	Softwoods	Hardwoods	Total
	(Billion cubic feet, roundwood)		
1990	10.9	5.6	16.5
2000	11.7	7.2	18.9
2010	13.0	8.7	21.7
2020	13.8	9.9	23.7
2030	13.9	10.3	24.2

Note: Excludes projected fuelwood demands on nongrowing stock resources.

billion cubic feet in 2030. This will satisfy part, but only a small part, of the higher demands projected for the future. Domestic forest lands must supply most of the demands. The projected demands on domestic forests are shown in the tabulation above.

The Timber Resource

The Nation's commercial timberlands contain some 792 billion cubic feet of roundwood (appendix table 3). About two-thirds of this is in sawtimber trees (trees large enough to contain at least one log suitable for the manufacture of lumber). Another quarter is in poletimber trees (trees from 5 inches in diameter at breast height to sawtimber size, and now or prospectively suitable for industrial timber products). The remaining 10 percent of all roundwood volume is in rotten, cull, and salvable dead trees. Some of the latter may be suitable for lumber and veneer, but most of it is usable only for pulp, fuel, and other products where there are no significant log quality requirements.2/

2/ There are additional and large volumes of fiber in tree tops, limbs, and bark; trees under 5 inches in diameter at breast height; and in trees on noncommercial timberlands, in fence rows, and in urban areas that are also usable for fuel, pulp and other products where there are no significant log quality requirements. Much of the fuelwood now being used for domestic heating comes from these sources.

Timber inventories rise when net annual growth (total growth less mortality) is greater than the volumes removed by timber harvesting, clearing, or changing land use (timber removals). Net annual growth on all softwood growing stock exceeds removals by more than 50 percent in the East. Net annual growth of eastern hardwoods also substantially exceeds removals, especially in the North. For all of the East, net annual growth of hardwood growing stock is more than double removals. As a consequence, timber inventories, both softwoods and hardwoods, have been rising in the East and at rapid rates.

In contrast to the East, softwood inventories in the West have been declining largely as a result of timber removals exceeding growth on the National Forests and forest industry ownerships on the Pacific Coast. Such growth-removal balances and inventory declines are a natural consequence of harvesting the mature stands in the region. Net annual growth in such stands is low. Once harvested and regenerated, however, the lands in the Douglas-fir subregion of Oregon and Washington and those in coastal Alaska have the capacity to grow large volumes of timber.

The Rocky Mountain region has had a favorable growth-removal balance, but inventories have increased slowly because many of the stands are old and net annual growth is low.

Domestic forests must supply most of the Nation's demands for timber products.

Projected Trends in Timber Supplies

The current growth-removal balances show that the hardwood forests and eastern softwood forests can support additional timber harvests. However, these balances will change, and future harvests, particularly in the decades beyond 2000, could vary over a wide range. Nonetheless, assuming that commercial timberland owners continue to respond to price and inventory changes and manage their timber stands much as they have in the recent past, timber harvests can be increased substantially in most regions during the next few decades. Total projected softwood roundwood harvests rise from 9.6 billion cubic feet in 1980 to 11.9 billion cubic feet in 2030, an increase of 24 percent.

Although the outlook is for increased softwood harvests nationally, there are important differences among the major softwood timber producing regions. The projected annual softwood timber harvests in the Douglas-fir subregion remain close to the 1980 level of 2.3 billion cubic feet until 1990 then decline slightly to about 2 billion cubic feet, a level that is roughly maintained through the rest of the projection period.

In contrast to the trends in the Douglas-fir subregion, softwood timber harvests in the South are projected to rise from about 4.1 billion cubic feet in 1980 to 7.3 billion in 2030.

Projected hardwood harvests will almost triple, rising from 3.4 billion cubic feet in 1980 to 9.4 billion in 2030. The largest increases will be in the South.

Timber harvests can be increased in most forested regions; the largest opportunities are in the South.

Timber Demand-Supply Comparisons

The data on projected harvests (supplies of timber) make it clear that there is not likely to be a physical shortage of timber in the United States in the decades immediately ahead, a prospect that exists in many regions of the world. A comparison of projected supplies with projected demands shows, however, that the demands are rising faster than supplies. Thus, the outlook is one of increasing economic scarcity with rising timber and timber product prices.

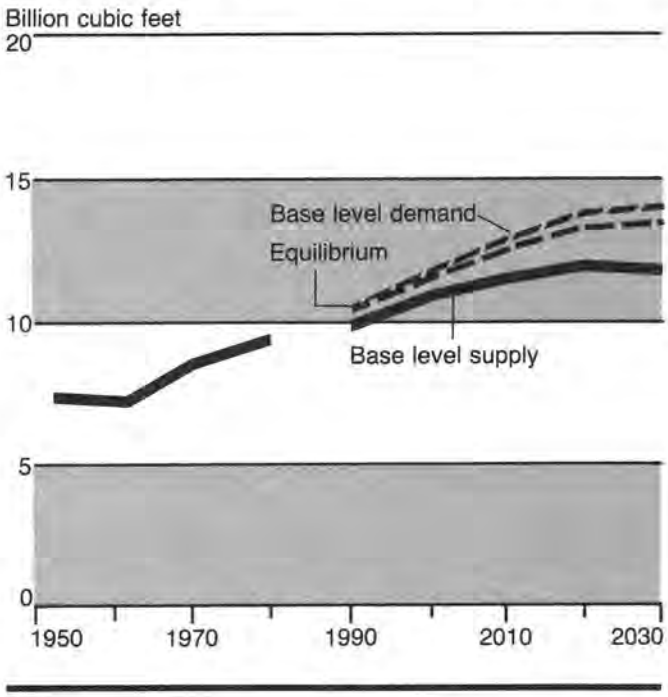
The outlook for softwoods is illustrated in figure 5. Projected demands on domestic forests for softwoods (upper line) rise to 11.7 billion cubic feet by 2000 and 13.9 billion by 2030. Projected supplies of softwood roundwood from domestic forests (lower line) show more moderate increases to 11.0 billion cubic feet in 2000 and 11.9 billion by 2030. The outlook for softwood sawtimber is similar--large increases in demand under the given assumptions and modest increases in supplies.

In a competitive economy such as that operating in the timber sector, this means that prices will rise to the extent necessary to bring about an equilibrium (middle line) between demands and supplies. For example, in the South, the real price for softwood sawtimber stumpage (trees standing in the forest) measured net of inflation or deflation will go up at an average rate of 2.1 percent a year during the five decades 1980-2030. In the Douglas-fir subregion of the Pacific Northwest, real prices rise more slowly, at an average rate of about 1.4 percent annually. Increases in stumpage prices are likely to be fastest in the late 1980's and early 1990's; a response to the effects of the projected surge in homebuilding on the demands for softwood timber.

The outlook for the bulk of the hardwood timber--the smaller sized timber of common species--is somewhat better than that for softwood (fig. 6). However, after 2000, as hardwood inventories begin to show substantial

Figure 5

Softwood Roundwood Demands and Supplies —Domestic Forests



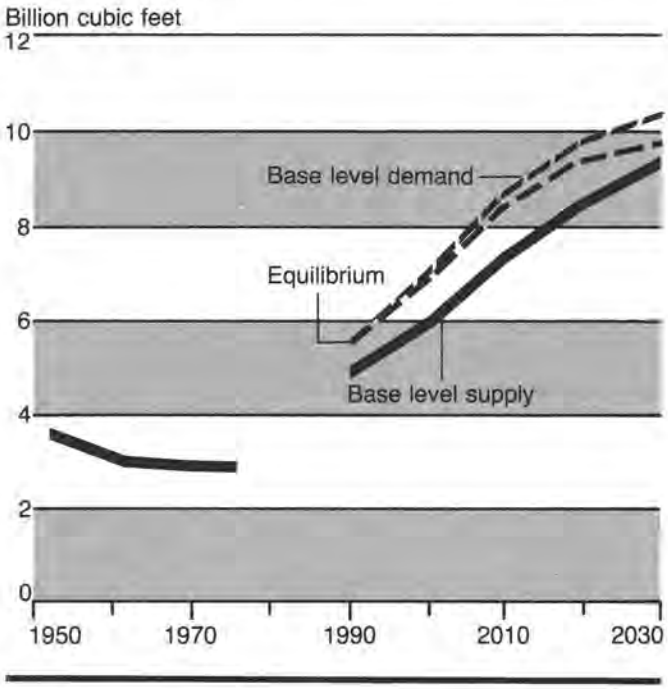
declines in response to increased removals, stumpage prices move up. The upward price pressures are likely to be strongest in the North Central region.

During recent decades, there have been inventory pressures on high-quality preferred hardwood species--such as select white and red oak, walnut, hard maple, and black cherry. The increases in stumpage prices that occurred in this period for the preferred species have reflected this situation. Such increases are likely to continue.

Rising stumpage prices will, of course, be reflected in prices of timber products. For example, softwood lumber and plywood prices measured in real terms both increase at annual rates of 1.3 percent over the projection period. Real price increases for hardwoods average about 0.8 percent per year for lumber and 0.2 percent for plywood.

Figure 6

Hardwood Roundwood Demands and Supplies —Domestic Forests



Effects of Other Futures

The preceding discussion describes a future that is based on assumptions and projections of a large number of demand and supply determinants such as economic activity, housing construction, import duties, export volumes, management intensity on private lands, National Forest harvests, and commercial timberland acreages. Future changes in these determinants can be quite different from what has been assumed. Expectations about these determinants also change with time--some of the current expectations vary considerably from those prevailing in the late 1970's when the analytical work for the 1979 Assessment was underway.

The changed expectations about housing and some of the other demand determinants that have become evident since the 1979 Assessment analysis was completed have been incorporated in the demand projections presented above. The basic timber resource projections, excepting those for the Douglas-fir subregion which were changed to reflect new data on the timber resource in western Washington, timber harvests for the National Forests which in most regions were held at the levels prevailing in the late 1970's, and some adjustments reflecting new assumptions on prices, have not been changed.

There are, however, some recent developments which suggest that it may be necessary to consider changed expectations about management on the private ownerships. Some of the newest data on the timber resource and some of the first preliminary results from new resource projections systems now being developed indicate that management on forest industry lands is likely to be more intensive than that assumed in making the Supplement resource projections. This would result in higher softwood timber inventories and supplies over the projection period. On the other hand, the same data and analyses indicate that part of the forest industry lands may not be suitable for intensive softwood management, and that softwood timber inventories and supplies on the farmer and other private ownerships are likely to be below the projected levels in the 1979 Assessment. Hardwood timber inventories and supplies on the farmer and other private ownerships would presumably be higher.

The new projection systems are not yet developed to the point where they can be used in making revised timber resource projections. When this development work is completed, and a new resource data base compiled, projections of changes in the timber resource may be different from those shown in this Supplement.

Although at this time there is not an adequate basis for changing the present resource projections, the effects of different assumptions on management intensity, harvest levels, and other supply determinants have been simulated for timber demands; stumpage prices; softwood lumber production, prices and im-

ports; and growing stock inventories. The results are shown in appendix table 4. The effects of different assumptions on demand determinants such as economic activity, housing construction, import duties, and export volumes have also been simulated.

As might be expected with more intensive management on forest industry lands or higher harvest levels on the National Forests, the projected increases in stumpage and product prices as shown in this Supplement are reduced. On the other hand, if higher exports and greater losses of commercial timberland are assumed, stumpage and product prices will rise beyond the projected Supplement levels.

Nearly all of the simulations that have been run--five additional ones have been made to supplement this analysis, and the results including more detail on the effects will be published in a supporting technical report--indicate that the Nation is faced with the prospect of continuing and substantial real increases in stumpage prices for most species and sizes of timber, and in the prices of most timber products. And the increases will very likely be largest for softwood sawtimber; high-quality hardwood sawtimber of preferred species; and the products, mainly lumber and plywood, made from this timber.

About 60 percent of the precipitation in the Eastern United States and 90 percent of that in the West falls on forest and range land. The water that flows from these lands is essential to the economy of the Nation and the well-being of everyone. The importance of this water has long been recognized in various Federal and State laws and regulations. For example, the Organic Act of 1897, which provided for the administration of the National Forests, stipulated that "No national forest shall be established, except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, . . ."

There are three types of water use which must be considered in any assessment of the water situation: withdrawal use is water removed from a source; consumptive use is that part of water withdrawals that is not returned to a source for re-use; and instream use for navigation, hydroelectric power generation, recreation, and as habitat for fish and various forms of wildlife. In addition, water quality, which determines the suitability of water for use, and flooding must also be considered.

Trends in Water Use and Projected Demands

Data developed by the Water Resources Council indicate that freshwater withdrawals amounted to about 340 billion gallons a day in 1975, nearly half of this for irrigation. Another quarter of the total was used for steam electric cooling. Most of the remaining withdrawals were for manufacturing and domestic uses. The latest projections by the Water Resources Council show withdrawals declining to a little over 300 billion gallons a day by 2000. Most of the decline is in manufacturing, steam electric cooling, and irrigation, and it reflects expected improvements in water conservation and recycling and increased substitution of brackish water in steam generation and manufacturing. The volumes withdrawn for domestic uses and mineral extraction show substantial increases, but these uses account for only 12 percent and 5 percent, respectively, of withdrawals in 2030.

About two-thirds of the water withdrawn is returned to a water source for reuse. As a result, water consumption is only a little above 100 billion gallons a day. In contrast to withdrawals, consumptive demands are projected to rise by about 70 percent to near 170 billion gallons a day by 2030.

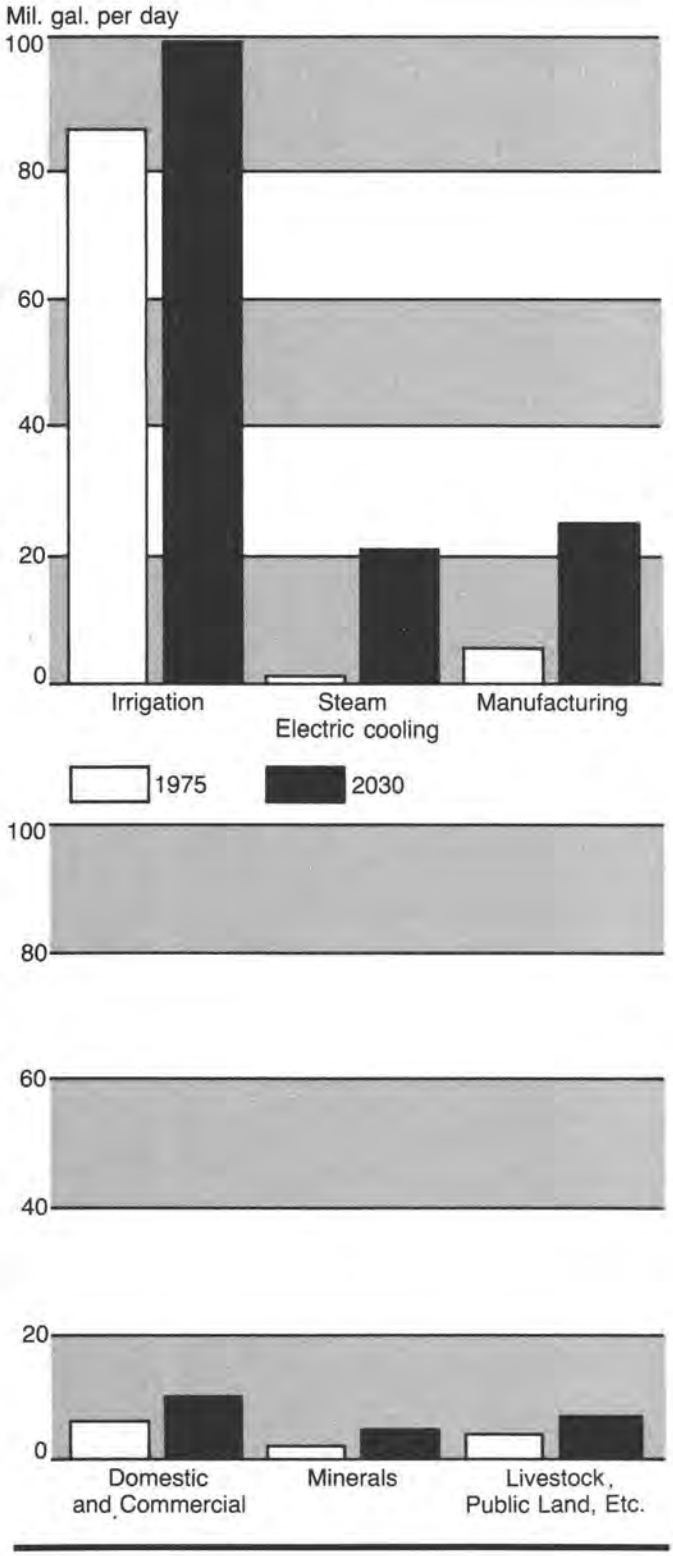
Irrigation is the largest consumptive use of water, about 80 percent of the total, and it accounts for a significant part of the projected rise in demand (fig. 7). However, all the major uses show some increase; over half of the total is in steam electric and manufacturing uses. Most of the water used for irrigation, now and over the projection period, is in the arid and semiarid regions of the West.

Some of the uses of water--navigation, hydroelectric power generation, water-based recreation, and habitat for wildlife and fish--do not

About half of the fresh water withdrawn from waterways, ponds, groundwater, and other sources is used for irrigation.

Figure 7

Water Consumptive Demands



involve moving water from its natural sources. They do require maintenance of certain volumes of water--and flows and levels are critical to most of these uses.

Such instream demands are growing. For example, the demand for water-based recreation is projected to more than double by 2030. Reductions in free flowing streams, coastal beaches, and public access to water will increase the difficulties associated with meeting these demands. Loss of aquatic habitat has been a major factor in reducing the populations of many species of waterfowl and fish. Recovery for these species, and many other species, seems to be dependent upon the restoration and enhancement of water and wetland breeding and wintering habitats.

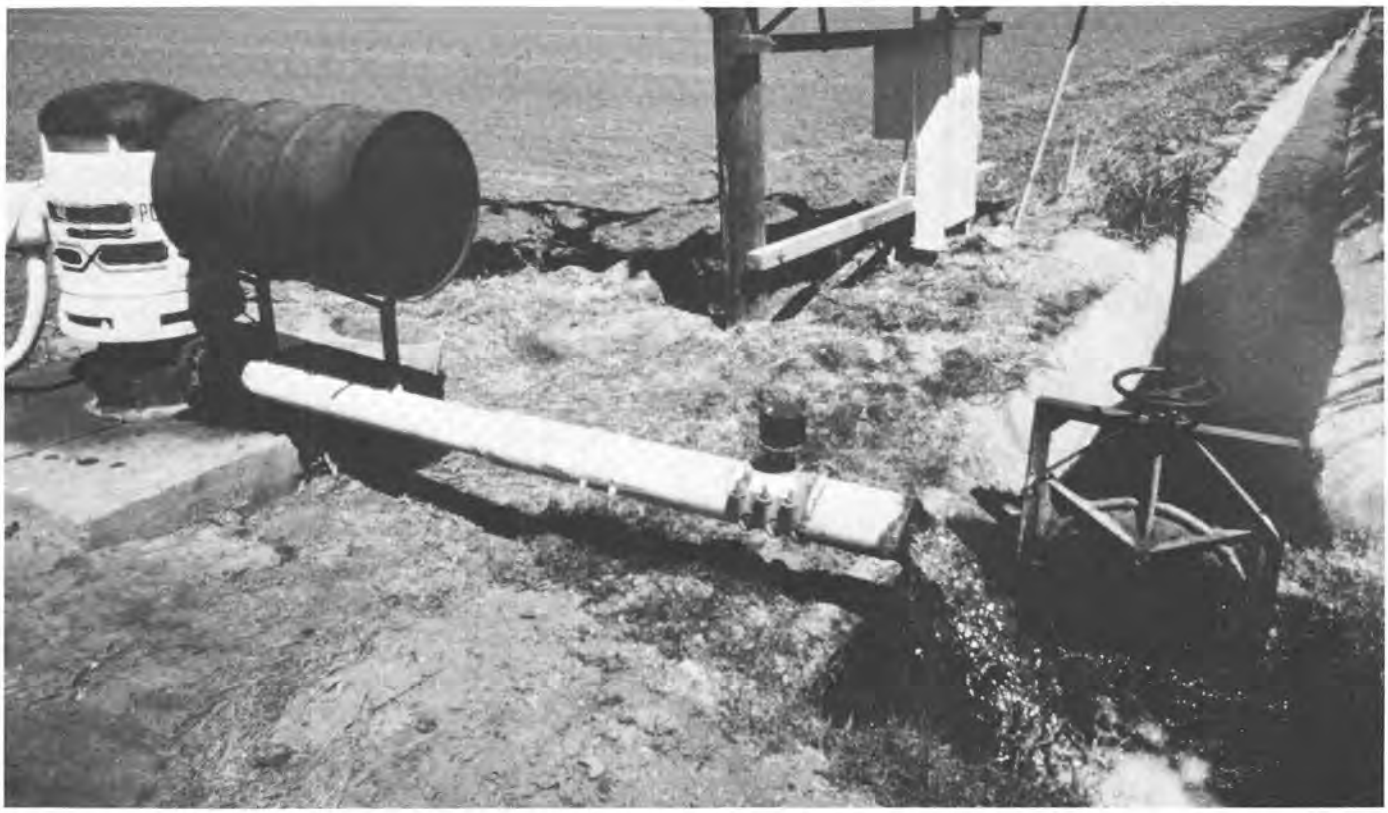
The Water Resource

Water, 107 million acres of it, covers about 5 percent of the area of the United States. Nearly half of the water area is in waterways one-eighth of a mile or more in width and lakes or ponds at least 40 acres in size. About three-fourths of these large water bodies are in the contiguous States and largely in the East.

Small waterways (less than one-eighth mile in width) and ponds and lakes (2 to 40 acres) cover about 8 million acres. The geographic distribution is similar to that for the large water bodies. Nearly all of the ponds are developed. The remaining water area, some 48 million acres, consists of the Great Lakes, bays such as the Chesapeake, sounds such as the Long Island and Puget, straits such as Juan de Fuca, and other similar coastal waters.

In addition to surface water, there is a very large ground water resource. It is estimated that about 50 billion acre feet of this is economically and environmentally available for use.

The Atlantic and Gulf Coastal Plains contain the largest reserve of ground water. Another



In addition to waterways, lakes, and other surface water, there is a very large groundwater resource in the United States.

significant reserve is in a series of alluvial basins in the West. The glacial deposits in an area extending from eastern Montana to eastern New York also contain very large volumes of ground water.

Water Supplies

Precipitation in the form of rain, snow, sleet, and hail is the source of both surface and ground water. Precipitation averages about 30 inches a year nationwide. About two-thirds of this returns to the atmosphere via evaporation and transpiration. The remainder, about 1.4 trillion gallons a day, enters surface and ground waters.

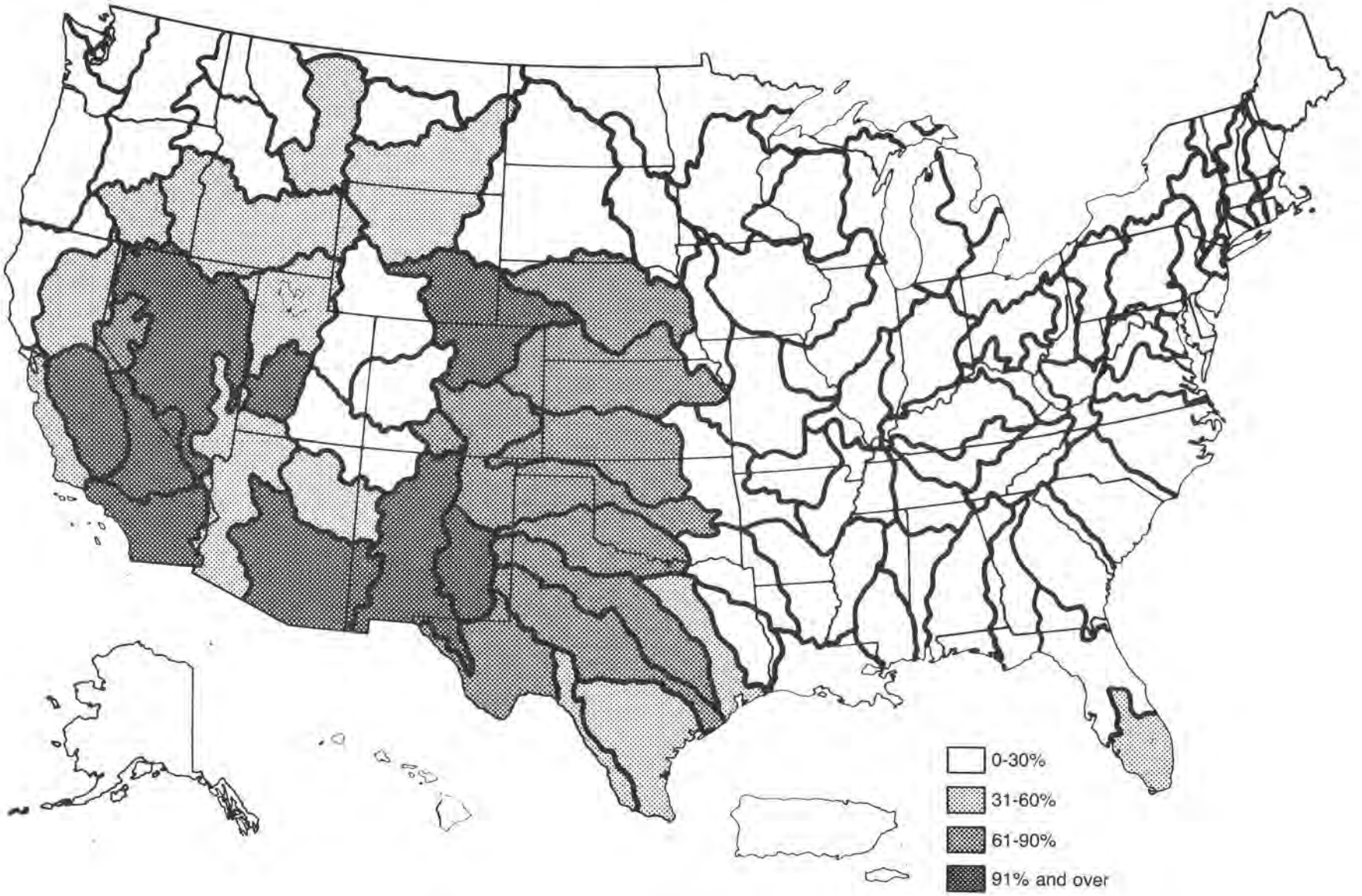
The amount of precipitation varies greatly from area to area within the country. It ranges from less than 4 inches per year in some arid regions of the West to over 200 inches per year in areas along the Pacific Coast. Precipitation also varies widely by season and from year to year. In some areas where snow accumulates during the winter months, the melt accounts for most of the annual runoff.

Water Demand-Supply Comparisons

It is apparent that precipitation provides enough surface and ground water (1.4 trillion gallons a day) to meet present and prospective withdrawals (300 million plus gallons a day) and consumptive demands (170 million gallons a day in 2030). There are, however, serious imbalances caused by the geographic, seasonal, and annual variation in supplies. The areas most affected by prospective water shortages are delineated in figure 8.

Figure 8

Highest Percentage Water Depletion (1975-2000) in a Mean Water Supply Year, by Water Resource Region



Flooding occurs in all parts of the United States--the damages are greatest in coastal and southern California, the Mississippi River drainage, and in a broad area extending up the Atlantic Coast from South Carolina to Maine.

In the East, significant and prolonged seasonal shortages now occur in southern Florida in most years and in the Chicago area in dry years. Problems in these areas are expected to become severe by 2000.

Water quantity problems exist in many parts of the Plains States, the Southwest, major drainages in the Rocky Mountains, and in arid areas in the Pacific Southwest. Depletion rates in these areas are 90 percent or more in average years, and projected to go higher.

The water supply situation in some areas--such as the High Plains which extends from central Texas and eastern New Mexico north into eastern Colorado, Kansas, and southern Nebraska--is being affected by ground water mining (ground water withdrawals exceed natural replenishment). Such mining is now severe in 8 and moderate in 30 of the Nation's water resource subregions. As a result of ground water mining and rising energy costs (the energy is used for pumping and distribution), the use of ground water for irrigation over substantial areas may become uneconomic during the next two or three decades.

Most of the Nation's water shortage problems are caused by annual and seasonal variations in precipitation and waterflows. Variations caused by unusual storms are the cause of another major problem--flooding. Flooding occurs in all parts of the United States, in arid as well as humid areas. Flood damages are greatest in coastal and southern California, in a broad area extending up the Mississippi River drainage, and in another broad area

Condition Class	Total	Area by Ownership		
		Forest Service	Other Federal	Non-Federal
		(Million acres)		
1	920	149	116	655
2	142	10	75	57
3	137	6	24	107
Total	1,199	165	215	819

extending up the Atlantic Coast from South Carolina to Maine.

In the 6 years between 1973 and 1979, 80 percent of the major disasters and emergencies in the country involved floods. Total flood-related Federal costs during this period exceeded 4 billion dollars. Although there is no evidence that variation in precipitation is increasing, flood damage has been rising. This trend is projected to continue as new development takes place in flood-prone or flood-susceptible areas.

The tabulation above shows the watershed condition of forest and range lands by ownership in the contiguous States.

About three-quarters of all watersheds are in good or excellent condition and need no treatment (condition class 1). The 13 percent in condition class 2 needs treatment chiefly for the control of excessive erosion which threatens, or has already diminished, long-term productivity. The remaining acreage, approximately 11 percent, has naturally poor watershed condition, and treatment is not justifiable.

Even in circumstances where watersheds are in good condition and water volumes are adequate for all purposes--neither too much nor too little--the characteristics of the water, or its quality, determine its suitability for many uses. And improving the quality of water affected by pollution, or the way people use water, is a matter of national concern.

There are two broad sources of pollution. Point source pollutants originate at a known location, are generally transported through pipes or ditches, and are discharged into water at a fixed point. Nonpoint source pollutants have diffuse origins and usually enter water from large areas of land. They are largely composed of sediments, organic material, nutrients, and pesticides. Nonpoint source pollution is strongly influenced by physical and biological factors such as land slope, soil characteristics, mobility of pollutants, and natural transport mechanisms such as wind and water runoff.

Most of the pollution abatement efforts to date have been directed at point sources. The abatement of some nonpoint source pollution may now be more cost effective than the remaining opportunities for point source abatement. But the improvements in water quality may not be as large as those achieved with point source abatement.

Part of the nonpoint source water pollutants originate on forest and range lands. On the other hand, some water pollutants, such as acids in rain, have the potential to seriously affect the productivity of these same lands.

In summation, the Nation is facing a future of growing water shortages in many agricultural

Nonpoint source pollutants are largely composed of sediments caused by erosion, organic material, nutrients, and pesticides.

and industrial regions, rising flood damages, and widespread water pollution. This outlook, if unchanged, will surely adversely affect agricultural and industrial activity and the general health and quality of life for many people.

All of the Nation's forest and range lands supply habitat for wildlife and, in recent centuries, most of them supply forage for domestic livestock. Livestock grazing began with Coronado in 1514 in the Southwest and in the East in 1614 with the settlement of Jamestown Colony. Gradually as settlement spread, livestock grazing followed, and by the beginning of the 20th century virtually all of the rangeland and a substantial part of the forest land in the contiguous States were grazed by cattle and to a lesser extent by sheep, horses, and burros.

Today, the forage produced on these lands benefits in some degree everyone who eats red meat--many also benefit in some way from grazing and browsing species of wildlife. The way rangelands are managed is important. As is the case with forest lands, rangeland management and use practices affect forage production, water yields and quality, wildlife and fish populations, and the suitability of the land for various kinds of outdoor recreation.

Where rangeland and forests occupy much of the land area, livestock grazing is almost always an important use.

Trends in Range Forage Use and Projected Demands

There are no reliable data which measure in a quantitative way historical trends in forage production on forest and range lands, or the amount of grazing. The only estimates available indicate that in 1970 and 1976, there were about 213 million animal unit months of grazing by domestic livestock. This grazing is the predominant source of demand for forage.

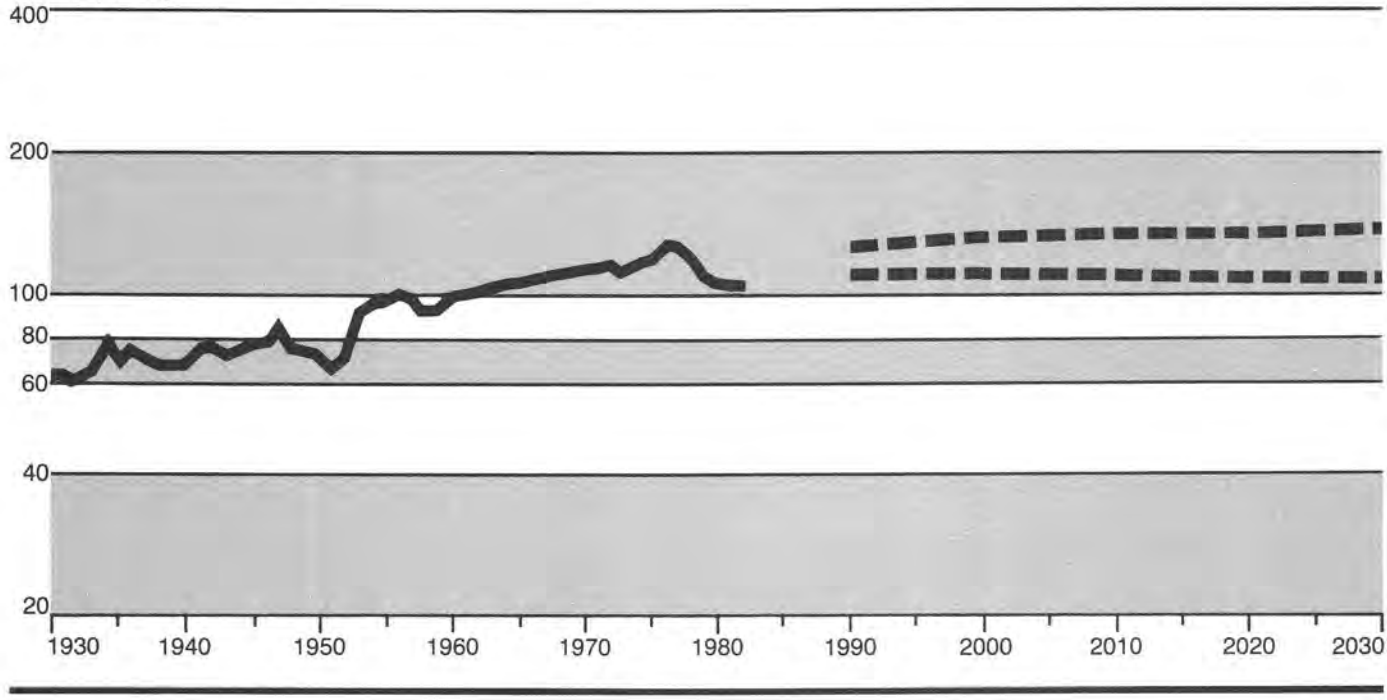
In the years between 1930 and 1976, per capita red meat consumption (beef, veal, lamb and mutton) rose from 72 to 135 pounds (fig. 9). Although this has been followed by a decline, at least partly caused by the economic recession, the projections in the 1979 Assessment show the per capita demand for red meat rising to 148 pounds in 2030, some 10 percent above the 1976 peak. In addition, there could be a significant export demand. Largely on the basis of such projected increases, but with consideration of the relative costs of alternative sources of feed, the demand for range forage by domestic livestock is projected to rise to 300 million animal unit months in 2030, a level about 40 percent above use in 1976.

Effects of Other Futures

As with all projections, there is a lot of uncertainty about the projections of red meat demand and the associated forage estimates. Historically, there has been a high correlation between per capita disposable personal income and per capita red meat consumption. Projections based on this relationship, or the extension of the historical trend shown in figure 9, would be substantially higher than those given above. On the other hand, such things as growing concerns over the perceived health effects of red meat consumption and shifts in the cost of red meat compared with poultry and pork may be causing a structural change in the historical income-consumption relationship. A simulation based on this kind of

Figure 9

Red Meat Demands



change shows per capita red meat demand remaining close to 114 pounds through the projection period.

In addition to grazing by domestic livestock, there is, and will likely continue to be, a substantial amount of grazing and browsing by wildlife, and wild horses and burros. For example, according to a recent estimate, about 11 million animal unit months of forage are required to sustain the big game population in the Western States.

The Forage Resource

Rangeland area is one indicator of the forage resource; another is rangeland condition, a measure of the degree to which the present vegetation represents the forage potential for the site. Over half of the 597 million acres of rangeland in the contiguous States is rated in less than satisfactory condition, that is, producing less than 40 percent of the forage vegetation potential.

The shrublands in the Southwest account for much of the rangeland in unsatisfactory condition. This probably reflects the arid climate, prolonged grazing seasons, and 400 years of livestock grazing. In general, the grasslands in the Plains States are in slightly better condition than the shrublands. The high elevation rangelands--mountain meadows and mountain grasslands--are in the best condition.

Past and Projected Trends in Forage Supplies and Comparisons with Demand

The data that are available suggest that from the 1940's until the present, the additional feed needed for the Nation's rapidly growing beef herds came from grain and grazing sources such as improved pasture, cropland pasture, and grazed cropland. The amount of

Although domestic livestock will account for most of the range grazing, there will continue to be a substantial amount of grazing by wildlife.

range forage used by domestic livestock remained essentially unchanged at around 200 million animal unit months a year. If this level of supply continues unchanged, a substantial imbalance would gradually develop between projected demands (300 million animal unit months in 2030) and the available supply of range forage grazing. Thus, the Nation is faced with the prospect of a growing economic scarcity of range forage and rising prices as cattle producers compete for the available supplies.

The use of the Nation's forest and range land and inland water for outdoor recreation varies widely--from an occasional hunter or fisherman on the barrens and grasslands of Alaska--to family picnicking--to extremely high intensity use common in areas of great scenic beauty such as Yosemite National Park, developed recreational sites such as a major ski area, or urban-oriented areas such as the Cook County Forest Reserve in northern Illinois.

Although not precise, the results of a recent survey show that nearly three-quarters of the people 12 years and older in the United States participate in some form of outdoor recreation each year. The economic activities associated with this recreation generate over $100 billion annually, much of it forest and range land areas where other opportunities are limited.

Past and Projected Trends in Participation in Outdoor Recreation

In the last decade or so, and over a much longer period, participation in most kinds of outdoor recreation has been growing. The most rapid growth has been in snow and ice activities. For example, data from the Neilsen survey indicate that the number of persons participating in cross country skiing increased 76 percent between 1976 and 1982. There have also been increases in almost all other recreation activities including picnicking, bicycling, fishing, camping, boating, and backpacking.

Increases in sales of boats and canoes, and memberships in various water oriented organizations, suggest that participation in water-based activities has also been rising. Records of campground and trail use on the National Forests and surveys conducted by Kampgrounds of America and Nielsen show that similar participation increases have been taking place in land-based activities.

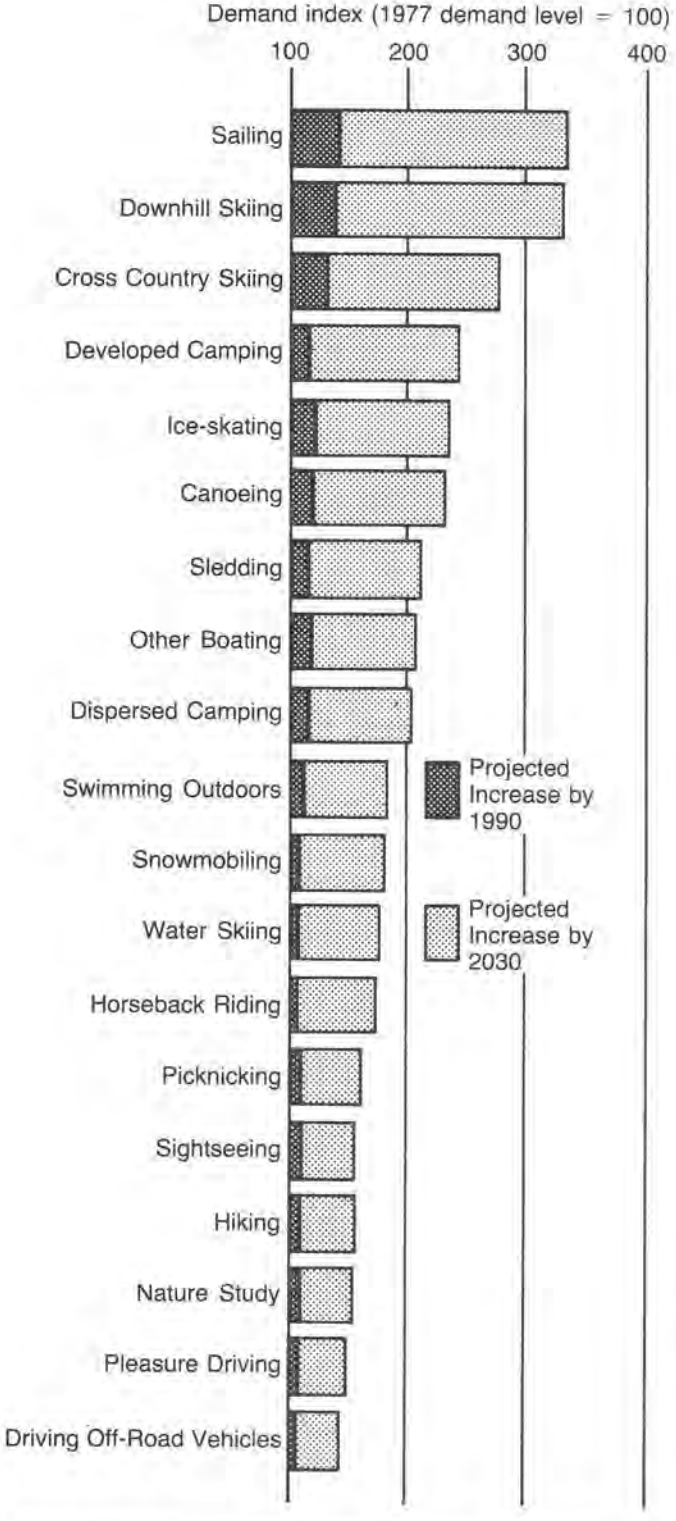
Much of the growth in participation in most outdoor recreational activities has been related to increases in population, per capita disposable personal income, and leisure time. There have been other important factors, however. The development of improved recreation equipment, increasing participation by women, and greater concern about physical fitness have been significant factors. Low cost has been another factor, especially on public forest and range lands. Most of the opportunities on these lands have been provided free or at low cost.

The past growth in participation in the various kinds of outdoor recreational activities is expected to continue (figure 10). Snow and ice activities show the largest percentage increases. While there are indications that growth rates in some kinds of activities like downhill skiing and snowmobiling have slowed,

Nearly all of the Nation's forest and range lands and inland waters are used to some extent for outdoor recreation, varying from an occasional hunter or fisherman on the barrens and grasslands of Alaska, to high intensity use common in areas of great scenic beauty such as Yosemite National Park.

Figure 10

Outdoor Recreation Demands



participation in snow and ice activities is projected to rise 140 percent by 2030.

Participation in water activities is projected to increase fairly rapidly, 106 percent by 2030, with sailing and canoeing showing the fastest growth. Increases in participation in land-based activities are slower, 61 percent by 2030. However, for activities such as camping, participation increases faster than for several kinds of water and snow activities. The numbers of people involved in land-based activities are larger than in the other activities, and especially so in comparison to snow and ice activities.

The use of wilderness is also expected to grow in future decades. Recreation use, for example, is expected to rise at about 2 percent per year on the present National Wilderness Preservation System. Larger increases are expected if more acreage is added to the System.

Effects of Other Futures

There was a wide range in the projections of demand for most outdoor recreation activities in the 1979 Assessment--for example, the projected increase in 2030 for snow and ice activities ranges from a low of 1.7 to a high of 3.8 times recent levels. Such things as the near tripling in per capita disposable personal income assumed in this study, increasing amounts of leisure time, and increasing mobility of the population are forces which will tend to move demands into the higher part of the range. In contrast, such things as the rising average age of the population and increasingly attractive sources of various forms of indoor recreation, including that available in homes, could cause demands to fall in the lower parts of the range.

The Outdoor Recreation Resource

Although forest and range lands and water are suitable for some forms of outdoor recreation, only a small portion is intensively managed for recreational purposes. Parks, reservoirs, and

Only a small part of the Nation's forest and range lands and waters are intensively managed for outdoor recreation.

picnic areas account for a large proportion of this intensively managed area. Most of these areas are administered by the National Park Service, Corps of Engineers, and park agencies of State and local governments.

Most of the outdoor recreation activities that involve capital-intensive, convenience-oriented facilities, and high-density use areas such as recreation vehicle parks, marinas, and swimming pools, are on private lands with privately owned facilities, although most of the major ski areas in the country are provided by private capital on public lands. In contrast, most of the dispersed recreational activities that require little if any convenience facilities are provided publicly on public lands, particularly those managed by the Forest Service and the Bureau of Land Management. Most of the public lands managed by these agencies are also used for multiple purposes--including the production of timber, water, forage, and wildlife.

Past and Projected Trends in Supplies of Outdoor Recreation Facilities

As participation in outdoor recreation activities has increased, so have many of the necessary facilities. For some activities, however, part of the growth in participation has come from more intensive use of existing facilities. In some places, and particularly in the public sector, this has resulted in overcrowding, constraints on use, and a lower quality experience for the participants. For example, private sector winter sports complexes have generally expanded to meet increases in demand. On the other hand, facilities needed for such activities as cross country skiing, snowmobiling, snowshoeing, mountaineering, and ice fishing have not

Strong public pressure to preserve rivers and streams with high scenic and recreation values is likely to continue.

increased as rapidly as demands. The bulk of these facilities is publicly provided; the profit potential has often been too limited to attract private capital.

Rustic natural-resource oriented camping and picnicking facilities in the public sector have not kept pace with growing demands; this has resulted in more intensive use of the existing facilities. There has been substantial growth in access to forest areas in recent years, but most of this has come through various arrangements for the use of roads, trails, and access points developed for other purposes.

Facilities for water-based outdoor recreation have also been increasing. This has come, in part, through the construction of reservoirs and ponds, which have added to the area of water, and through pollution control and cleanup programs that have expanded the range of activities for which existing streams and water bodies are suitable. There has also been a variety of public programs, and widespread development of private facilities, which have increased access to water.

Strong public pressure to preserve rivers and streams with high scenic and recreation values has resulted in the establishment of the National Wild and Scenic Rivers System, which includes about 2,400 miles of rivers or river segments. In addition, over half the States have authorized similar systems, and these now include about 7,000 miles on some rivers or river segments. Use of these resources is intense in many areas.

There has been rapid growth in landbased outdoor recreation associated with widespread use of outdoor recreation vehicles--truck campers, camping and travel trailers, motor

homes, and off-road vehicles. The roads where this kind of equipment could be used were already in existence on National Forests and other forest and range lands in Federal and State ownership. Overuse is now a problem in some areas.

Another significant factor in the growth in land-based outdoor recreation has been the increase in recreation trail mileage. There is now close to 300,000 miles of trails in the country, over a third of which is on private lands. Much of the trail mileage, however, is not now receiving adequate maintenance and is below desirable standards.

The development of recreational sites such as campgrounds and picnic areas proceeded rapidly in the 1960's and early 1970's but has essentially come to a standstill in recent years. The increased use of outdoor recreation vehicles has somewhat stimulated the development of the more urbanized private campgrounds, most of which have water, electricity, and other convenience facilities. In contrast, many campgrounds on public lands which provide more natural experiences have become increasingly crowded and suffer from the lack of maintenance.

Visitor centers--there are over 500 on intensive use sites on Federal lands--have upgraded the outdoor recreational experience of many people by providing information on recreational opportunities and interpreting the natural and cultural values of the areas where they are located. Again maintenance is a problem often because of poor initial design or location.

Although wilderness areas provide habitat for wildlife, protection for watersheds, forage for domestic livestock, and serve many scientific and educational purposes, recreation is the most common use. Thus, the rapid expansion of the National Wilderness Preservation System is enhancing the opportunities for certain kinds of outdoor recreational activities now and in the future.

While substantial areas of National Forests have been maintained in a wilderness state for a long time, most of the growth in areas formally set aside as wilderness has taken place since the passage of the Wilderness Act of 1964 and, more recently, the Roadless Area Review and Evaluation (RARE II) process of 1980. In 1982, the National Wilderness Preservation System contained about 80 million acres of Federal land. About 71 percent of this area is in Alaska and is administered by the National Park Service and the Fish and Wildlife Service in the Department of the Interior. The bulk of the 23 million acres in the National Wilderness Preservation System in the contiguous States is administered by the Forest Service.

Outdoor Recreation Demand-Supply Comparisons

The supplies of outdoor recreation facilities now available will have to be expanded if the projected growth in demand is to be met and quality maintained. The increased demands for some kinds of activities can be easily satisfied. For example, the Nation's forest and range lands and inland waters have the physical capacity--area, geographic, and cultural features--to meet any foreseeable growth in demands for rustic natural-resource-based outdoor recreation. This will, of course, require additional facilities of various kinds. For some activities, these requirements will be minimal. For others, they will involve such things as additional construction of trails, roads, access points, and campgrounds There will be related needs for user information and education programs and specialized personnel such as back-country rangers and interpreters.

Meeting the prospective growth in demand for some activities will require special efforts. For example, developing winter sports facilities, especially on public lands, is becoming an increasingly complex issue. These lands contain most of the remaining suitable sites. The development of these sites will depend in large part on the resolution of problems associated with the impacts on the environment;

Wilderness use must be kept at low density levels if unmodified natural conditions are to be protected and if "outstanding opportunities for solitude," as described in the Wilderness Act, are to be maintained.

utility, transportation and communication systems; and local communities.

It seems evident that future demands for the use of unique and popular areas, such as the Yosemite and Yellowstone National Parks, cannot be satisfied in ways they have been satisfied in the past. There is a similar situation on many wilderness areas. Wilderness use must be kept at low-density levels if unmodified natural conditions are to be protected and if "outstanding opportunities for solitude," as described in the Wilderness Act, are to be maintained.

There is a related kind of situation on much of the private land that is open for outdoor recreational activities. As population has grown and public use increased, adverse impacts from such things as littering, trampling, and damage to structures have also risen. As a result, more and more private owners have limited or prohibited public access.

In most densely populated regions, there are simply limits on the land and water areas that are available for many kinds of outdoor recreation. In such areas, the outlook, given recent levels of investment in facilities and management programs, is for more overcrowding and continuing declines in the quality of experiences. In a sense, this summarizes the outlook for most outdoor recreation activities. But as described in the following sections, much can be done to improve the opportunities available for outdoor recreation.

In a general way, the wildlife and fish resource is an indicator of the health of the forest and range land and inland water environment. A growing awareness of this has contributed to a dramatic rise in public concern about the wildlife and fish resource. This is reflected in the passage of laws intended to ensure protection and bring about management of this resource, increases in membership of wildlife and fish interest groups, and public interest in policies and programs affecting wildlife and fish.

Trends in Wildlife Use and Projected Demands

The interest in the wildlife and fish resource reflects not only its importance as an indicator of the health of the environment, but also its values to the economy and to society.

There has been a dramatic rise in public concern about wildlife and fish. This is reflected in the passage of laws to ensure protection and management, and by increases in membership in organizations concerned with these resources.

These values can be divided into three overlapping categories; market, social, and existence. Market values are those associated with the sale or barter of wildlife and fish for food and clothing. Social values are those associated with hunting, fishing, and wildlife observation. Existence values are those associated with the natural environment--the Endangered Species Act is perhaps the clearest evidence of public concern about these kinds of values.

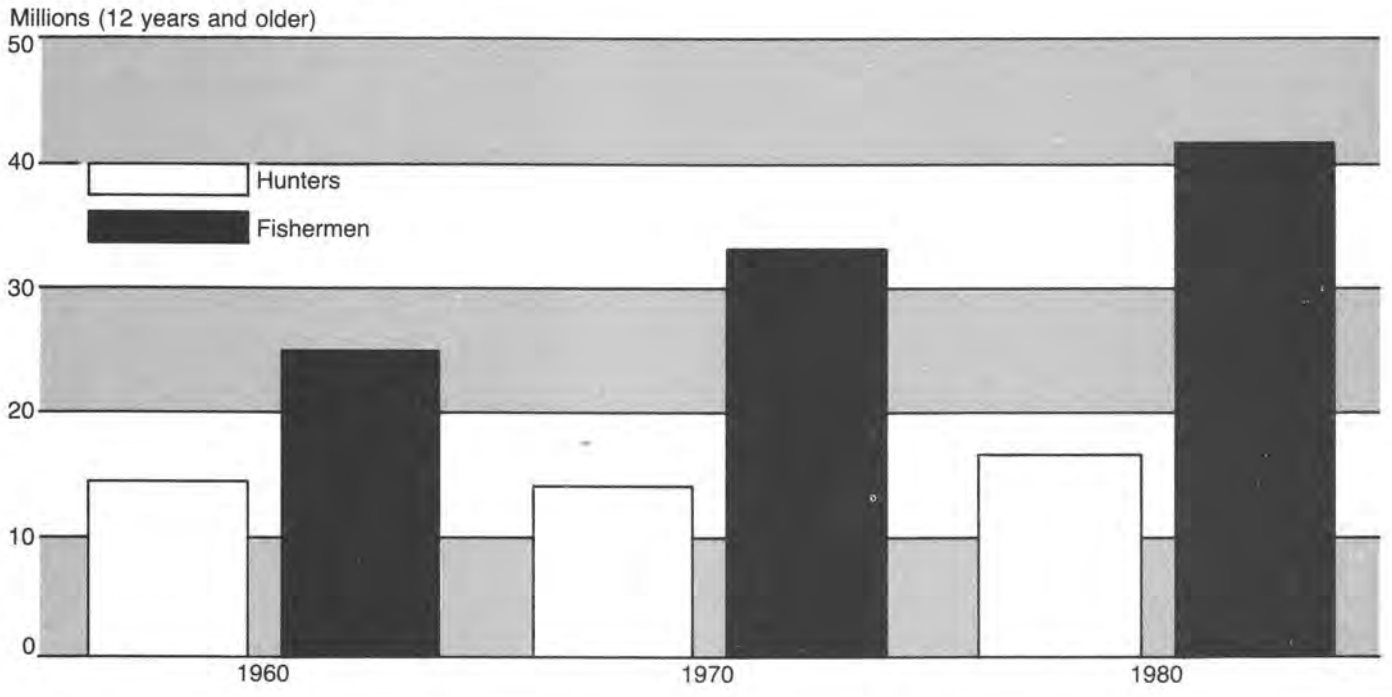
The fragmentary data that are available indicate that the production of furs and fish, the chief market products from the wildlife and fish resource, has been rising in recent years. There have also been rising trends in social uses such as hunting, fishing, wildlife observation, wildlife photography, clamming and crabbing. In the 1960-80 period, for example, the number of hunters increased 15 percent and the number of fisherman 66 percent (figure 11).

There are substantial indications of growth in public interest in existence values. This is illustrated by support for legislation such as the Endangered Species Act and by increasing membership in organizations such as the National Wildlife Federation and the National Audubon Society. The Fish and Wildlife Conservation Act of 1980 recognizes that land management actions should be undertaken to alleviate the need for crisis-threatened and endangered species management programs. It also recognizes the value of recreation use of the wildlife and fish resource.

Given the projected increases in population and income, it seems reasonable to assume that there will be continuing increases in the market demands for fish and furs over the projection period. The projected social demands show such continued increases--55 percent for nature study, 90 percent for freshwater fishing, and 69 percent for waterfowl hunting by 2030, for example. There is no practical way of projecting demands for existence values. But the whole tenor of recent times suggests that concern about these values

Figure 11

Numbers of Hunters and Fishermen



will continue to grow. As pressures on land and water and the wildlife and fish resources increase, as they surely will with larger numbers of people and rising incomes, these values may become dominant considerations in developing wildlife and fish policies and programs.

The Wildlife and Fish Resource

The Nation's forest and range lands and inland waters contain an enormous variety of wildlife and fish species. These range from tropical species of the Caribbean and Pacific islands, to caribou above the Arctic Circle, to songbirds distributed throughout the country. The resident and common migrant vertebrate species and major subspecies associated with forest and range land and inland water include 850 birds, 400 mammals, 1,100 fish, 200 amphibians, and 350 reptiles. There are perhaps six to eight times as many species of invertebrates.

Most of the mammals, fish, and reptiles spend their lives in relatively small areas. In contrast, most birds and some fish range widely over the continent and surrounding oceans during their life cycle.

A relatively small number of bird species, chiefly doves, quail, pheasant, grouse, woodcock, crows, geese, and nearly all ducks, is regularly hunted for food and/or recreation. Among the mammals, 40 or so are regularly trapped or hunted for food and/or fur. Some 330 species of fish are sold commercially and nearly 500 are regularly sought by recreation fishermen. Nearly all species of birds and mammals are important for various kinds of recreation and other social uses. And all species are important from the existence standpoint. Over 220 species (vertebrates and invertebrates) are now classified as endangered or threatened under the provisions of the Endangered Species Act. State agencies have identified an additional 820 species as

endangered or threatened. The Forest Service has identified another 860 species that are judged to be particularly sensitive to changes in the physical conditions caused by applying standard land management practices. Thus, in total, nearly 2,000 species may require some sort of special consideration in managing forest and range land and inland water.

Trends in Wildlife and Fish Supplies

Harvest data provide some indication of trends in populations of the wildlife and fish species that have substantial market values. And these show variable trends. But in recent years, some of the important ones have increased. For example, some 18 million fur pelts were harvested in the 1979-80 season, some 2.6 times the number harvested in 1971. Salmon harvests reached over 600 million pounds a year in the late 1970's and early 1980's, considerably above the annual range of 200-400 million pounds in the preceding 25 years. Salmon, by a large margin, is the most valuable species of wildlife and fish as measured by the market value of the harvest.

Populations for the species with high social values--hunting, fishing and wildlife observation--also seem to be showing variable trends.

Nongame breeding bird population surveys and counts of migrating birds in autumn, and of resident birds in winter, provide some indication of trends in bird populations. These show that most nongame bird species associated with forest habitats have had relatively stable populations during the past decade when considered on a continent-wide basis.

There have been significant changes in the populations of some bird species on a regional basis. Most notably, a number of eastern species associated with unstocked forest lands have declined in numbers. There may have been compensating increases in species typical of stocked forest stands, but the evidence is not adequate for firm conclusions.

Annual harvests and other data indicate that duck populations have been fluctuating widely, largely because of varying climatic conditions and changes in habitat. Geese and swan populations have apparently been rising in recent years.

Salmon harvests amounted to over 600 million pounds a year in the late 1970's and early 1980's, considerably above the annual harvest levels in the preceding 25 years. Salmon, by a large margin, is the most valuable species of wildlife and fish as measured by the market value of the harvest.

The available data show that the populations of some big game animals such as white-tailed deer, antelope, Rocky Mountain elk, and turkeys have been going up in recent decades. Data on the harvests of some other big game species such as mule deer, black-tailed deer, and black bear suggest a downward trend. For most species of both small and big game, there simply are no reliable indicators of current population trends. It is evident that in the past the trends for the endangered and threatened species have been down. In recent years,

however, the situation for some species, such as the alligator, bald eagle, and peregrine falcon, has improved.

Wildlife and Fish Demand-Supply Comparisons

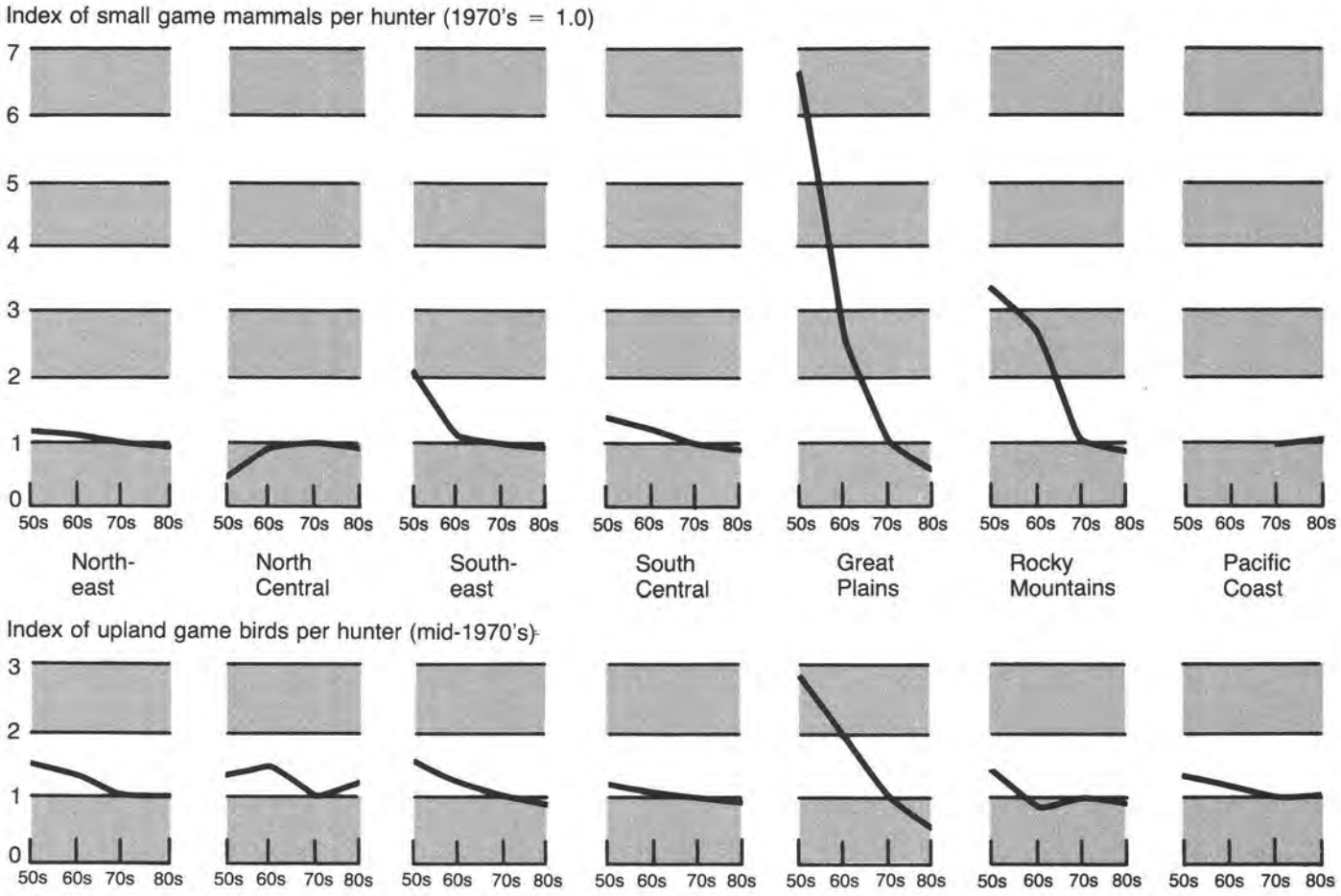
Although there are indications that the populations of some wildlife and fish species have been increasing, there are also indications that they have not been rising as rapidly as demands. This kind of situation is illustrated for small game mammals and upland game birds in figure 12. Almost without exception, among the regions of the contiguous States, the numbers of small game animals and upland game birds per hunter have been declining. There are similar trends for big game--the numbers of animals per hunter have been dropping--and in most regions very rapidly.

It seems clear that market, social, and existence demands on the wildlife and fish resource are likely to continue to grow in the decades ahead. While the capability to project future supplies of wildlife and fish is limited, continuing increases in the human population and losses and degradation of habitat suggest that even maintaining present population levels of many species will be difficult and costly.

As for the other major renewable resources of forest and range land and inland waters, the outlook for wildlife and fish is one in which demands will be growing more rapidly than the available supplies. Thus, the lines in figure 12 characterize not only the past, but the future. For the consumers of market products, this will mean rising prices. For the social users, it will mean increasing constraints on use and rationing of the available opportunities. For some endangered and threatened wildlife and fish species, life itself may end.

Figure 12

Number of Small Game Mammals[1] and Upland Game Birds Relative to Number of Hunters in the Contiguous States by Section



[1]No data for Pacific Coast before 1970's; indexes exceed scale for Rocky Mountains and Great Plains before 1970's.

Mineral resources, both energy and nonenergy, are the basic raw materials of modern life. Much of the mining in the United States takes place on forest and range lands. In part, this is because forest and range lands are the most extensive category of lands in the country, and in part it is because these lands happen to coincide with major areas of mineralization.

Trends in Minerals Use and Projected Demands

Consumption of energy minerals has been rising in the United States. For example, in the two decades 1960-80, the consumption of coal increased 77 percent, oil 74 percent, and natural gas 67 percent. Total energy consumption rose by about 80 percent. Consumption of nonenergy minerals has also been rising. The greatest increases occurred for lightweight metals (molybdenum) and for mineral fertilizers (phosphate).

Much of the mining in the United States takes place on forest and range lands.

The historical rising trends are likely to continue. The total demand for energy is expected to nearly triple by 2030. Demand for electrical energy will show the fastest growth and will be supplied primarily by coal and nuclear fuels. Demand for the minerals that are mined in large volumes, such as stone, sand and gravel, clays, iron ore, and phosphate rock, is expected to grow along with economic activity. As in the past, demands for the other minerals will grow at varying rates. Demands for lightweight metals and alloying components, however, will likely experience the fastest growth due to expanding uses in machinery, vehicles, and high-strength corrosion-resistant steel (used in processing synthetic fuels and specialty chemicals).

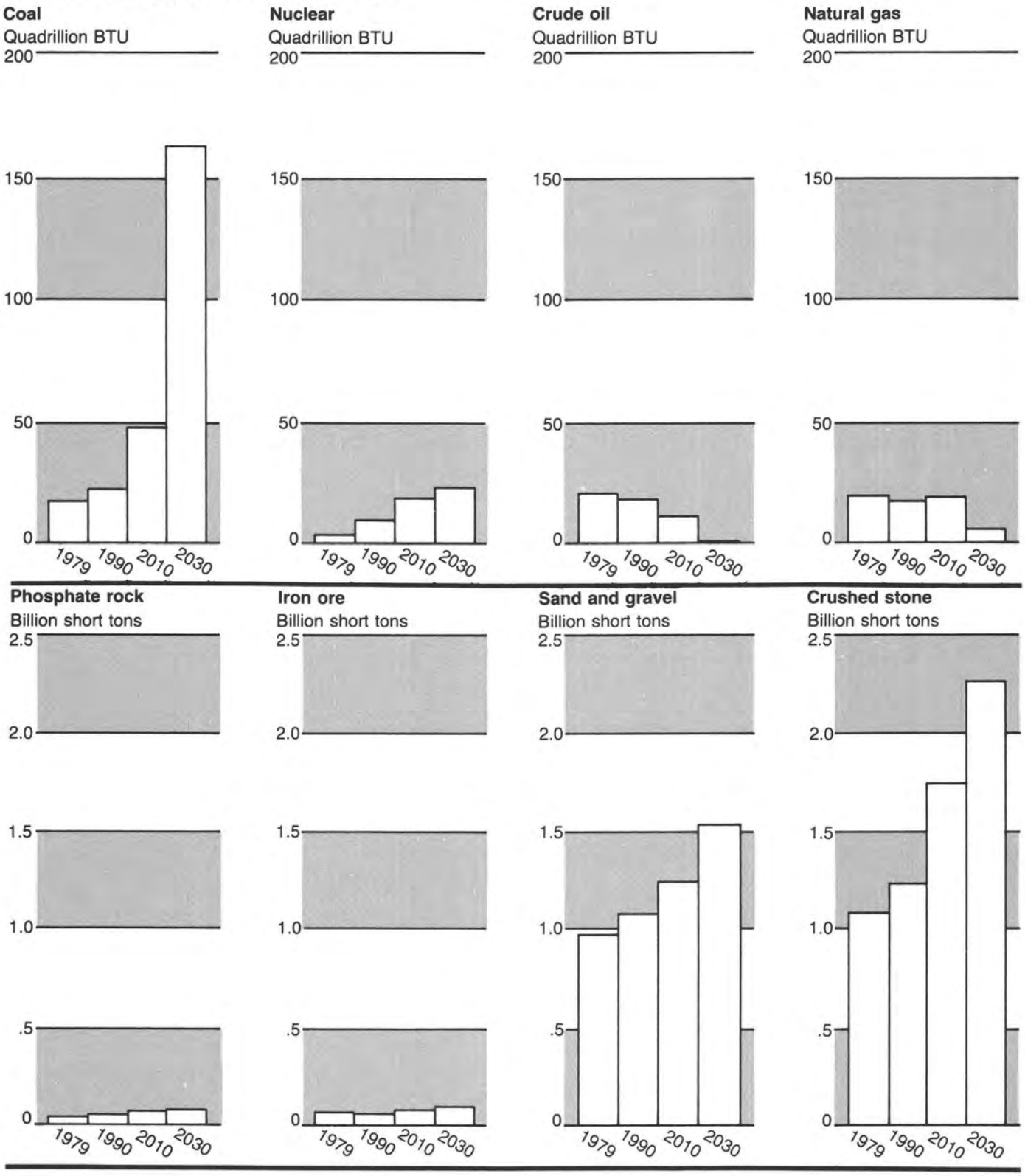
Although the United States has large reserves of most minerals, it is dependent on imports for a number of metals of economic and military importance. For example, the United States relies almost completely on imports for its supplies of columbium, cobalt, chromium, and platinum-group metals. These are essential components of turbine engines, machine tools, electrical parts, and other industrial products.

Although imports are important, and will continue to be so, domestic sources will supply the largest part of future mineral demands. Currently, more than 80 percent of United States nonenergy mineral supplies, on a value basis, come from domestic sources. However, imports supply about 65 percent of the volume of nonenergy materials consumed. For energy minerals, domestic sources contribute about 60 percent of the total supplies on a value basis and an estimated 80 percent on the basis of demand measured in British thermal units.

The projected growth in demands on selected domestic resources (projected domestic production) is shown in figure 13. The demand on the domestic coal resource is projected to rise nearly 10 times by 2030. The demand on the domestic nuclear resources (uranium) shows even more rapid growth although the volumes involved will be much smaller. Most of the

Figure 13

Demands on Domestic Mineral Resources



projected growth for both coal and uranium occurs after 2010. This reflects the shift associated with the expected decline in production of crude oil and natural gas in the United States and in other producing regions in the world. The projected increases in demands on domestic resources for nonenergy minerals are much smaller than for coal--the rates of growth are roughly of the order of the projected increases in economic activity.

The Minerals Supply Situation

The United States has huge reserves of coal; they underlie about 13 percent of the land area. The Nation also has very large reserves of oil shale, uranium, and other nonenergy minerals--including sand and gravel, clays, iron ore, and phosphate rock.

Most of the coal reserves are under forest lands in the Appalachian region and range lands in the northern Great Plains area. The exploitable reserves of oil shale are largely concentrated on the forest and range lands in Wyoming, Colorado, and Utah. Recent geologic data indicate that the area of greatest potential for oil and gas development is in Alaska and in the overthrust belts of the Appalachian and Rocky Mountains.

Most of the metallic minerals occur in a great mineralized belt 1,300 miles long and 300 miles wide stretching from western North Dakota to southern Arizona. Nearly all of this is forest and range land. Some metallic minerals, particularly gold, are also found in the streams in this area.

There are large phosphate deposits in the Rocky Mountain region and in the Southeast. Most of the other minerals mined in large quantities are widely distributed; a large part of them is found on forest and range lands.

A substantial proportion of the mineral resources on forest and range lands is on Federal lands, chiefly the lands administered by the Forest Service and the Bureau of Land Management. On National Forest System

Mining in streams for minerals such as gold, sand and gravel is common over much of the United States.

lands the greatest activity is likely to be in coal, oil and gas, phosphate, molybdenum, and certain precious metals. Approximately 6.5 million acres is known to be underlain by coal. Approximately 45 million acres has potential for oil and gas. Other sizable acreages have potential for oil shale, geothermal, and a variety of nonenergy minerals. Geologically, these lands also contain some of the most favorable host rocks for mineral deposits.

Nearly all of the areas in Federal ownership are subject to some restrictions on minerals exploration and development. Some of the forest and range land in this ownership has been withdrawn specifically to protect against impacts associated with mineral exploration and development. Other, much larger, areas have been reserved (dedicated) for particular public purposes or uses (parks, wilderness, etc.), and are not available for minerals pro-

duction. On much of the rest of the Federal lands, there are various kinds of constraints that affect mining. These constraints are intended to protect the natural environment and the use of the land for other purposes, such as wildlife habitat and outdoor recreation. At this time, it seems these kinds of constraints, and the reservation of forest and range lands for specific purposes, will continue and will affect mining in the future.

As indicated in various ways in preceding sections, the course of events may differ from those shown by the projections of demands and supplies of renewable resource products and uses. Nevertheless, it seems clear that the Nation is facing a future in which there is likely to be a growing imbalance between the quantities of renewable resources that people would like to consume and the available supplies. Thus, if investments in management, research, and assistance programs remain at recent levels, there will be intensifying competition for the available supplies. And this will affect the quality of life for everyone and in undesirable ways.

The Costs for Timber

For timber, such an outlook can only mean rising real prices (net of inflation or deflation) of stumpage and timber products. Consumers--and this includes everyone in the society--will be adversely affected by these price increases.

By 2030, they will pay several billion dollars more for the timber products and substitute materials needed to produce the goods they will consume. Prospective home buyers will be most affected. For example, the projected real increases in softwood lumber prices will cause a reduction in home building by 2030, below the levels that would have been attained without the price increases. The size and quality of the units that are built will also be adversely affected.

As stumpage and timber product prices rise relative to other materials, use of substitute products such as concrete, steel, aluminum, and plastic will increase above the levels that would have otherwise prevailed. And as production of these substitutes is stepped up, more and more nonrenewable resources, including the ore and fossil fuels used in their production, will be removed from the country's finite store of these materials.

In addition, the mining, industrial processing, and power generation associated with increased use of timber substitutes will result in more air and water pollution. Thus, as timber prices go up, environmental costs will also rise.

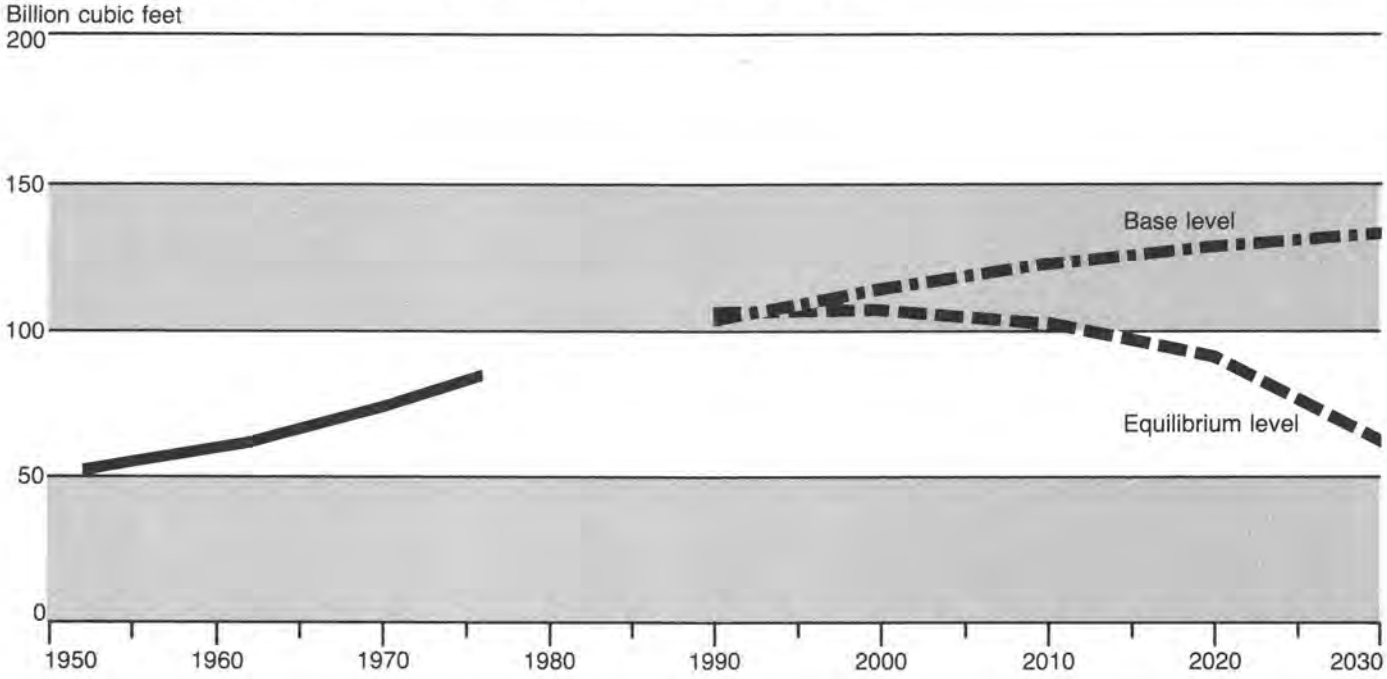
Since the timber sector operates in a free competitive economy, as prices move up, consumers simply use less. These reduced demands will be felt in the mills manufacturing lumber, plywood, and pulp products. For instance, by 2030, softwood lumber production will be several billion board feet below the volume that would have been demanded without real price increases.

Exports of most timber products are determined largely by the capability of U.S. producers to compete on a price basis with producers in other countries. Consequently,

Rising lumber and plywood prices will reduce the volume of home building below the levels that would be reached with stable prices. The size and quality of the homes built will also be adversely affected.

Figure 14

Softwood Roundwood Inventories on Private Ownerships in the South



rising real prices will also constrain the country's timber export potential.

Reductions in domestic and export markets will affect employment. Employment in the timber industries in 2030 will be nearly a hundred thousand person-years below the levels that would exist without the real price increases. Since losses in one industry affect many related jobs in other industries, eventually as many as a quarter of a million workers could be affected. Equally critical, these losses will be concentrated in the forested areas in rural communities which are chronically burdened with high unemployment.

Rising real prices will also affect the timber resource. Owners will increase harvests as prices go up, and as harvests rise, net annual growth and inventories will be changed.

The largest impacts will be on forests in the South. By 2030, growing stock inventories on private ownerships in this section will be 45 percent below that projected without rising real prices and assuming recent trends in management (equilibrium level in fig. 14). The rising prices will, of course, induce more intensive management with an associated increase in net annual growth. But the intensification in management is likely to be limited, and significant effects on net annual growth and inventories in the South may not be evident until late in the projection period.

The Costs for Water

Most of the adverse effects associated with the prospective water shortages will fall on agriculture. In some places, such as the areas on the High Plains of Texas and adjoining States where ground water mining is severe, as water production costs go up and the water for crop and pasture land irrigation becomes uneconomic, there will be a shift to dryland farming or range grazing. In most other

In some areas, such as the High Plains area of Texas and the adjoining States, pumping of ground water for irrigation may become uneconomic in a relatively short time. As this happens, there will be a shift to dryland farming or range grazing. The economic and social costs of this change will be high.

water-short regions, more and more of the available water is likely to go to the higher value uses--such as domestic, commercial, manufacturing, and mining. In the decades beyond 2010, as the demand for domestic coal surges, mining and processing may become the predominant uses of water in some coal producing areas in the West.

The costs of these kinds of changes will be high. In the water-short areas, such as those on the High Plains, it will mean reduced income and employment in agriculture and the loss of capital invested in agricultural equipment and facilities. Much of the agriculture base for dependent communities will disappear, and the economic and social costs associated with the loss of jobs, capital, and the migration of people to other areas will be large. In those areas where the shift is to higher value uses, such as mining and manufacturing, increased employment and income in these industries may more than offset the losses in agriculture.

The shift from irrigation to dryland farming and range grazing will cause a reduction in food and fiber production in the affected areas. As this occurs, production will be shifted to other regions where water supplies are adequate and the land is suitable for crop and/or pasture use.

Most of the prime farmland that is not now in cropland or pastureland is in forest (42 million acres) and rangeland (22 million acres). If

Conversion of wetlands, now taking place at a rate of about 460,000 acres a year, has had severe adverse impacts on many species of wildlife and fish. It has also contributed to reduced stream flows and ground water levels in many parts of the country.

production is shifted from irrigated areas in water-short regions, these are the lands that are most likely to be converted to crop and pasture use. The conversion of these highly productive lands will reduce timber and forage production. Most of the prime farmland now in forests is in the Southeastern States--Virginia, North Carolina, South Carolina, Florida, Georgia, and Alabama.

There is a related conversion problem with wetlands. Conversion of wetlands, currently going on at a rate of about 458,000 acres per year, has had adverse impacts on many species of wildlife and fish. Conversion in the Prairies Pothole region and the Mississippi River Delta forests and emergent marshes has been particularly serious because these are crucial areas for the production and wintering of some species of waterfowl. Wetland conversion also contributes to reduced streamflows and ground water levels in many parts of the country. And in some areas, such as the lower Mississippi Valley, it has seriously reduced the supplies of bottomland hardwood timber and adversely affected the industries dependent on the hardwood resource.

Damage from floods has been above $1 billion in several years since 1950, the highest being $4.5 billion in 1972. Almost half the damage is to agriculture, as crops and livestock are destroyed and topsoil is covered or washed away.

Floodwaters also cause a substantial loss of human life--more than 500 in 1972--injuries and disease. In addition, they cause losses of wildlife and severely damage the habitat of many wildlife and fish species.

The costs of water pollution are pervasive; they touch everyone and every aspect of the economy and the environment. Over $10 billion a year is now spent on water pollution abatement and control activities. But still the adverse impacts on health, wildlife and fish, outdoor recreation, and agricultural and industrial productivity go on, and the total cost of water pollution to the Nation must be a far greater sum.

The Costs for Range Forage

For range forage, the outlook is for rising real prices, and in a general way, the effects will be similar to those for timber. Consumers, to some degree, will pay higher prices for red meat, leather, and other products produced from cattle, sheep, and goats.

Forage production on rangelands is largely a natural process that does not routinely involve cultivation, seeding, fertilization, or irrigation. The shifts to grains and other substitute feed sources, which will come if the costs of forage are allowed to rise, will involve the use of more fossil fuels, fertilizers, and other nonrenewable resources. The processing of such materials will also result in more environmental pollution.

But perhaps most important of all are the potential adverse impacts on the range livestock industry. Where rangelands occupy much of the land area, grazing is often the predominant use. In those areas, range grazing and the activities associated with it have economic, social, and cultural impacts that are of local and even regional importance.

The Costs for Outdoor Recreation and Wilderness

It is difficult to appraise in any quantitative way the social, economic, and environmental costs of prospective imbalances between desires to participate in outdoor recreational activities and the supplies that will be available.

Where rangelands occupy much of the land area, grazing is an important and often the predominant base for the local economy.

Without increased investments in outdoor recreation programs, the intensifying competition for the use of the available resources, the crowding, the limitations, and constraints will clearly lead to less satisfying experiences for millions of people. The competition and crowding will also have adverse impacts on the environment and lead to increased protection and pollution abatement costs.

Similarly some people will no longer be able to participate as they would like. Of course, there is no way to measure the costs of this reduced participation, but it will be important to the people involved and, in a broad way, to society. There will be a gradual deterioration in the quality of life, and the Nation will be poorer for the loss.

Intensifying competition for the use of outdoor recreation resources will lead to less satisfying experiences for millions of people.

The Costs for Wildlife and Fish

The social, economic, and environmental costs of the rising pressures on the wildlife and fish resource is hard to quantify. There are economic costs associated with an increasing scarcity of fish and wildlife products such as salmon and furbearing animals that are market products. The employment and income involved in harvesting and processing these species will be constrained; consumers will pay more for the products. Employment and income impacts can have important consequences in fishing communities in areas such as coastal Alaska where other opportunities are limited.

Intensifying competition for the available wildlife and fish resources associated with the growth in social demands may well lead to shrinking populations and more restricted distribution for some species. There will be fewer social experiences. This is already the case for the hunters of some big game species that are available in such limited numbers that only the winners of special lotteries can expect to participate. Similarly, reduced or restricted populations diminish the satisfaction of others who are interested in bird-watching or nature study.

Constraints on social demands will adversely affect the economies of many rural communities that provide supporting services, and the manufacturers of equipment used in activities such as hunting and fishing. These constraints are also likely to adversely affect Federal and State funding of wildlife and fish support activities, since much of the funding comes from license fees and taxes on sporting equipment.

Some big-game species are so limited in numbers that only the winners of special lotteries can participate in hunts.

Reduction in the populations of many species can lead to serious imbalances, as when declines in bird populations lead to a buildup in insect populations. Such imbalances can have substantial economic effects in the form of reduced crop production and higher environmental costs resulting from the increased use of pesticides.

The growing pressures on the wildlife and fish resources are likely to be especially significant for the endangered and threatened species. The extinction of species diminishes the Nation's natural biological heritage and future options for study and perhaps even crossbreeding.

The Costs for Minerals

The minerals outlook has some cost implications for society, the economy, and the environment. For example, the tenfold increase in domestic coal production that will be necessary to supply the Nation's increased demands is certain to have important effects on the environment and renewable resources. In part, these effects will result from increased land disturbance. A tenfold increase in production will involve substantial areas of rangelands in Wyoming, North Dakota, and Montana. Forest lands in Illinois, Indiana, Kentucky, West Virginia, Pennsylvania, and Ohio are also likely to be disturbed. By 2010 the land disturbance associated with the surface mining of coal will average about 340,000 acres a year, some six times the area disturbed in 1980. On a smaller scale, there will also be land disturbance associated with the mining of other minerals such as uranium, oil shale, and the nonenergy minerals produced in large volumes such as stone, sand and gravel, clays, iron ore, and phosphate rock.

Nearly all of the land disturbed by mining will undoubtedly be reclaimed but the effects of the disturbance on such activities as production of timber and wildlife habitat can extend over several decades. Mining can also affect water quality--water that comes into contact with mined surfaces or disturbed soils can carry chemicals which will pollute surface and ground water sources. Burning or converting the large volumes of coal needed to meet demands may also have serious effects on the atmosphere, and--through increases in undesirable elements, such as acid chemicals in rain--on forest and range vegetation.

The tenfold increase in domestic coal production to supply the projected increases in demands by 2030 will involve the disturbance by surface mining of about 340,000 acres a year.

The bulk of the disturbance will be on rangeland in Wyoming, North Dakota, and Montana, and forest lands in Illinois, Indiana, Kentucky, West Virginia, Ohio, and Pennsylvania.

More Renewable Resources from Forest and Range Lands — The Opportunities

For a long time, the Nation's renewable resources--its forests, its rangelands and its waters--surely seemed limitless. Today, it is apparent the Nation is facing a future of more competition for the available resources and rising social, economic, and environmental costs unless action is taken to increase the productivity of forest and range lands and inland waters.

And this can be done. As described in a preceding section, these lands and waters have the capacity to provide greatly increased supplies of renewable resource products. With more intensive management, commercial timberlands can grow more than twice the volume of timber they are growing today; rangelands can produce three times the forage they are now producing. Water yields can be increased, water quality improved, and damages from floods contained.

Forest and range lands and waters have the physical potential to meet the projected increases in demands for most kinds of outdoor recreation; with better management, they can support larger populations of most species of wildlife and fish.

Thus, the costs of scarcity to the society, the economy, and the environment are not inevitable. The outlook can be changed.

With additional private and public investments in management, research, assistance and education programs, the Nation's forest and range lands and inland waters can meet most foreseeable domestic and export demands. Further, the resources they produce are renewable and the increased outputs can be maintained for future generations.

There are a number of management opportunities to increase and extend supplies of renewable resource products. The most important of these are summarized below for the major resources.

Timber — The Opportunities

There are three major ways to respond to rising demands for timber: (1) extending supplies through improved utilization, (2) increasing harvests from the existing timber resource, and (3) increasing net annual growth. More specifically:

Timber supplies can be extended by:

- -- Increasing the useful life of wood products by preservative treatments; improving designs of new structures, and renovating and maintaining existing structures rather than replacing them.
- -- Improving efficiency in harvesting, milling, construction, and manufacturing.
- -- Utilizing unused wood materials such as logging residues; treetops and limbs; rough, rotten, and salvable dead trees; trees in urban areas, fence rows, and the low productivity forest areas; and urban wood wastes.

Harvests from the existing timber resource can be increased by:

- -- Accelerating harvests on National Forests in Washington, Oregon, northern California, northern Idaho, and western Montana that have large inventories of old-growth softwood timber.
- -- Increasing softwood and hardwood timber harvests on forests in the East.

Sustaining increased harvests on the National Forests in the West and on the forest lands in the East beyond a few decades will require large investments in more intensive management programs to increase net annual timber growth.

Net annual timber growth can be increased by:

- -- Regenerating nonstocked and poorly stocked commercial timberlands, harvesting and regenerating mature stands, and converting existing stands to more desired species.

For a long time the Nation's renewable resources--its forests, its rangelands, and its waters--surely seemed limitless. Today it is evident that the Nation is facing a future of increasing scarcity.

Net annual timber growth can be increased by reforesting nonstocked and poorly stocked commercial timberlands--by applying intensive management practices such as spacing control--and by using management, control, and harvesting practices to reduce losses.

-- Applying intensive timber management practices such as species and spacing regulation, fertilization, and use of genetically improved trees.
-- Using management and harvesting practices to prevent or reduce losses caused by natural mortality (suppression), undesirable vegetation, wildfire, insects, diseases, and poor logging practices.

Water — The Opportunities

There are many opportunities on forest and range lands to increase and extend water supplies, ameliorate the effects of flooding, and improve water quality. All of these things can be achieved by:

-- Improving vegetation management to enhance the natural recharge of surface and ground water, to reduce evaporation and transpiration losses, and to change the timing of waterflows.
-- Improving protection of watersheds from wildfire.
-- Maintaining wetlands.

In addition:

Water supplies can be increased by:
-- Expanding and improving reservoirs to increase storage, regulate flows, and reduce evaporation.
-- Improving snow management.

Water supplies can be extended by:
-- Improving conservation including more re-use.

Flood damage can be ameliorated by:
-- Controlling floatable debris such as logging residues.

Water supplies can be increased, flooding effects ameliorated, and water quality improved by better vegetation management--protection of watersheds from wildfire--maintaining wetlands.

-- Increasing use of structures to control waterflows.
-- Improving management of flood plain use.
-- Expanding land treatment programs.

Water quality can be improved by:

-- Improving use of pesticides and fertilizers.
-- Increasing reclamation of mine sites to reduce erosion and acid flows from abandoned mines.
-- Improving deteriorated watershed conditions.

Range Forage — The Opportunities

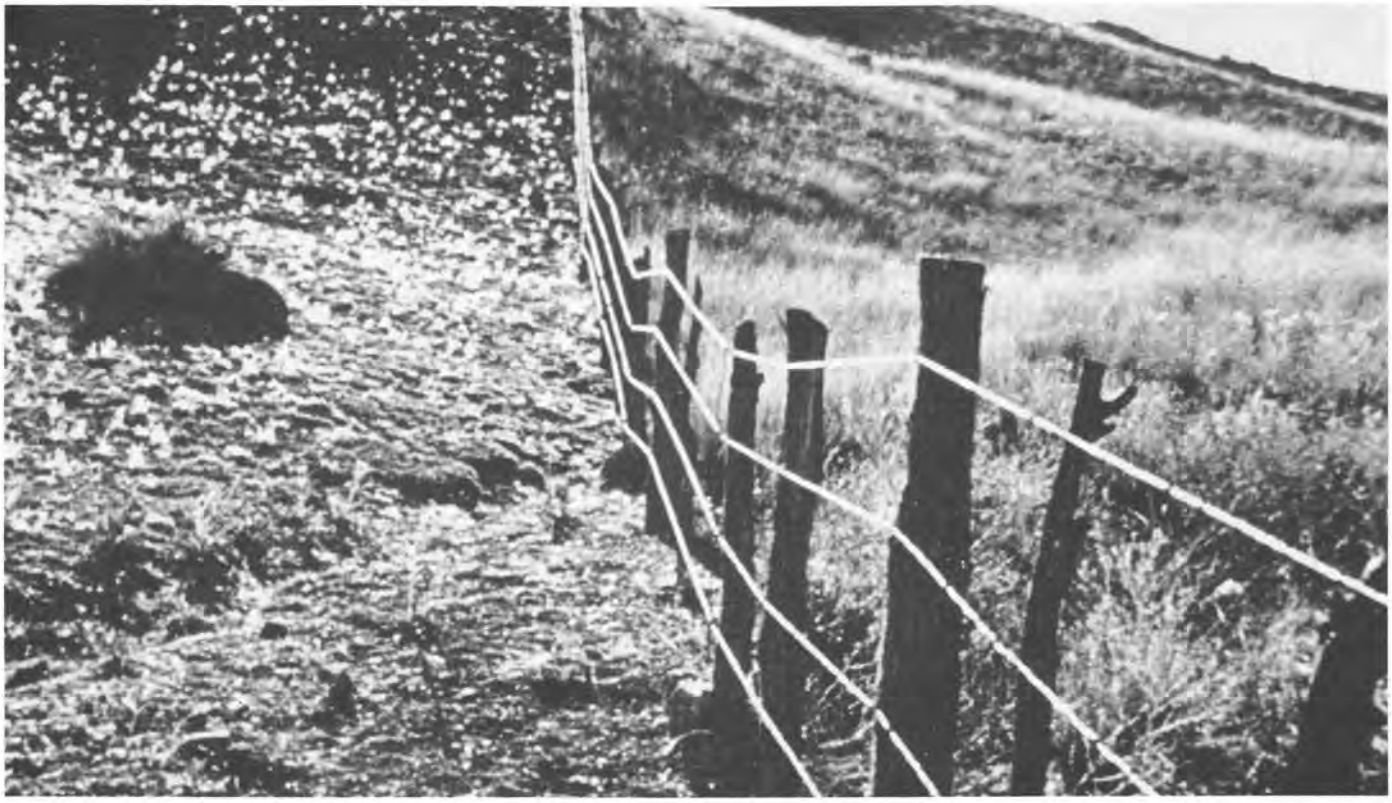
The opportunities to increase forage production and to improve the condition of forest and range lands for grazing include:

-- Rehabilitating rangelands by seeding palatable grasses and legumes and controlling poisonous plants, noxious weeds, and other undesirable plants and shrubs.
-- Increasing the utilization of forage on forest and range lands by the use of improved grazing systems and livestock management practices.
-- Constructing needed livestock control and handling facilities such as fences, and developing adequate water supplies.
-- Reducing forage losses by controlling wildfires, rànge insects and diseases, and pests.

Outdoor Recreation and Wilderness — The Opportunities

Most of the projected increases in demands for outdoor recreation on forest and range lands and inland waters can be met--the major opportunities include:

-- Rehabilitating deteriorating sites and adequately maintaining existing facilities.
-- Constructing additional facilities such as trails, campgrounds, picnic areas, and boat ramps.
-- Designating additional areas as wilderness, where appropriate potential exists.
-- Improving access to forest and range land and inland water suitable for outdoor recreation.
-- Expanding programs concerned with visitor information services including field interpretive and educational services and back-country safety patrols.
-- Improving management and information techniques for shifting more recreation demands to underutilized areas and facilities.
-- Improving the coordination and integration of outdoor recreation uses with other uses.
-- Improving management and protection practices to minimize the adverse impacts of visitors on wilderness resources.



Forage production can be increased by rehabilitating rangelands--and by constructing needed livestock control facilities such as fences.

Wildlife and Fish — The Opportunities

There are opportunities to respond to the diverse demands on the wildlife and fish resource. These include:

- -- Expanding programs to improve wildlife and fish habitats by increasing food supplies and suitable habitat cover, improving water quality, and increasing the size, diversity, and distribution of habitat areas.
- -- Integrating more fully wildlife and fish needs in the management of forest and range lands for other renewable resources, and especially timber and forage.
- -- Providing better access by constructing trails, boat landings, and rights-of-way where the wildlife and fish resources are underutilized.
- -- Controlling land and water pollution, and especially the use of pesticides that adversely affect wildlife and fish species.
- -- Expanding wetlands nesting habitats through fee purchase of key tracts and easements in the United States and Canada, and preserving and enhancing migration and wintering habitats.
- -- Increasing the reintroduction of species that have been displaced in areas where suitable habitats exist or are developed.

In addition, there are some opportunities that relate to specific demands on the wildlife and fish resource. These include:

- -- Increasing efforts to define, protect, improve, and augment critical habitats of endangered and threatened species and the important habitat of other spe-

Increasing demands for outdoor recreation can be met by constructing additional facilities such as trails--by rehabilitating deteriorating sites--and by improving access to forest and range land and inland waters.

cies being adversely affected by changes in management or use.

-- Removing barriers to fish migration.
-- Promoting the nonconsumptive use of fishery resources in some select areas through special management techniques such as catch and release fishing.

Minerals — The Opportunities

Meeting the projected growth in demands for coal and other minerals can be facilitated by:

-- Improving access for exploration and development on Federal lands.
-- Improving permit and leasing processes to reduce certain financial and market risks and enhance the efficiency of exploration and development.

The impacts of the projected growth in mining on the environment and renewable resources can be managed by:

-- Increasing research to develop more efficient and lower cost ways of reclaiming disturbed land.
-- Expanding programs to control mine related pollution and to reclaim disturbed areas.
-- Using appropriate lease and operating stipulations to control environmental impacts.

Research — The Opportunities

The management opportunities described above can be carried out with existing

There are opportunities to respond to the diverse demands on the wildlife and fish resource by: expanding programs to improve habitat, more fully integrating wildlife and fish needs in management plans, and controlling land and water pollution.

There are many research opportunities to increase and extend supplies of renewable resource products and to improve efficiency and reduce cost of management.

technology--the knowledge base that has been developed through past research work. Further research can, however, develop new ways to increase and extend supplies of renewable resources, improve the efficiency, and reduce the cost of implementing the opportunities described above for all resources--timber, water, forage, outdoor recreation and wilderness, wildlife and fish, and minerals.

For example, research to develop genetically improved plant and animal species, more economical ways of regenerating or propagating desired species, and methods for controlling unwanted species, insects, diseases, and wildfires can contribute to the effectiveness of management practices. Research on better ways of restoring and protecting watersheds and of reducing the adverse effects of activities such as timber harvesting and mining can increase waterflows, reduce flooding, and improve water quality and wildlife and fish habitat. Because of the environmental and biological effects of chemicals, there is a special urgency for research to develop management practices based on natural control measures for reducing the impacts of undesirable vegetation, insects, diseases, and pests.

These are, of course, the classic kinds of research opportunities and undoubtedly the ones that can contribute the most in a quantitative sense to meeting future demands on renewable resources. However, there are other research needs. For example, inventories of forest, range, and water resources are basic to almost any decision concerning the management or use of these resources. Presently, inventory information is fragmentary and limited for most resources--and especially so for

Up-to-date, accurate inventories of forest, range and inland water resources are basic to almost any decision concerning management and use.

range, wildlife and fish, outdoor recreation, and minerals.

In many respects, information on the production from, and the uses of, forest and range lands and waters is more fragmentary and limited than that for inventories. National and regional data on the amount of range grazing, many end uses of timber products, recreational activities by kinds, and wildlife harvests are largely nonexistent. Further, lack of comparability and timing severely constrain the usefulness of part of the data that are collected.

It seems clear that systematic continuing surveys with national standards and specifications on the data to be collected could greatly facilitate analyses of investment opportunities, the effectiveness of existing policies and programs, and new or additional management and program needs.

There is a lack of information on the physical responses of forest and range lands and waters to changes in management practices in terms of changes in timber and forage growth, water yields, and wildlife populations. There is an equal need for information on the costs of management practices and on the prices and values of renewable resource products and uses. Such information is essential for evaluating investment programs, analyzing supply situations, and determining harvest and use levels; it is also essential for the management of lands and waters for multiple purposes and for minimizing adverse impacts on the natural environment.

Finally, there is a need for research to further explore the social, economic, and environmental implications of a future in which the demands for renewable resource products are rising more rapidly than supplies. Such research is concerned with the societal basis for changing policies and programs; the results are likely to have profound impacts on management and use of forest, range, and water resources.

It is evident that there are many kinds of management and research opportunities to increase and extend the supplies of nearly all renewable resource products, and by more than enough to meet the projected increases in domestic and export demands. But there are also obstacles to achieving the available opportunities; they are important, and must be overcome if much progress is to be made.

In the United States, the economy largely relies on a system of markets and prices to bring about changes in the supplies of goods and services. For most renewable resource products and uses, however, the problem, and the basic obstacle to increasing and extending supplies, is that this system does not work or does not work very well.

There are four major reasons for this: (1) the public ownership of some resources, (2) the broad societal nature of the benefits from many programs, (3) the lack of market prices for some products and uses, and (4) the limited supply responses of some products and uses to changes in prices.

Here and in many other countries, wildlife and fish are considered public property. This reflects the mobile nature of most species of wildlife and fish--it is difficult or impossible to control movement across property and jurisdictional lines, including international boundaries.

There is some wildlife and fish production on a commercial basis--hunting preserves, fur and fish raising--where market forces induce changes in supplies. Most changes in supplies, however, depend upon publicly financed programs. Part of the funding for programs to increase wildlife, fish and water supplies, to improve water quality, and to reduce adverse impacts of floods on both private and public lands comes from license and other user fees. But the bulk is from public funds and dependent upon the political forces that determine funding levels.

Aside from the limited commercial operations, there is no price in the normal market sense on most wildlife and fish. Water at its source in a stream or lake or underground is a free good--costs and prices develop as it is transferred from its point of origin or stored for future use. Many forms of outdoor recreation are also free or available at prices below the providing cost.

The lack of market prices is due in part to the mobile nature and public ownership of the resource. It also results from the broad societal nature of the benefits. There seems to be no practical way of establishing a market price for scenic beauty, for water quality, for songbirds, or for the enjoyment associated with nature walks.

Some products of forest and range lands, and especially timber and forage, do have established markets and prices. But the problem with these goods, and particularly timber, is the limited response to price changes. For example, the best available data show that for a 10-percent increase in stumpage prices, there is only a 3-to-4-percent increase in supplies.

This limited response to price changes reflects in part the substantial public ownership of forest and range land--management decisions are only indirectly related to changes in market prices. Most of it is related to the characteristics of the private owners who control nearly three-quarters of the commercial timberlands and nearly half of the rangeland.

Various studies have shown that the millions of private timberland owners have widely diverse ownership objectives and attitudes, a limited knowledge of existing management opportunities, and a varying willingness and capacity to make investments which will increase timber growth. Ownership tenures are typically short, and most owners are in the older age groups. Thus, for timber, where the time between investments and harvest is long, there is the likelihood that direct benefits, such as income from timber sales, will not accrue to many current owners.

There are no market prices for scenic beauty, for water quality, for songbirds, and for many other renewable resource products and uses. Without prices, markets cannot operate to bring about changes in supplies. Meeting projected increases in demands will thus require public support for programs to increase and extend supplies.

The same kinds of obstacles--different characteristics, objectives, and attitudes; lack of knowledge of existing technology; lack of capital; and varying willingness to make changes--also constrain improvements in utilizing timber and timber products.

In a general sense, most of the factors that inhibit investments in management and utilization programs inhibit investments in research on renewable resources, and perhaps to an even greater extent. The broad societal nature of the benefits, the lack of conventional markets and market prices for research results, and the large numbers and characteristics of the owners of forest and range lands effectively limit research in the private sector to that of a few large industrial ownerships. Thus, the great bulk of the research on renewable resources is now, as in the past, carried on by Federal and State research agencies and publicly supported educational institutions.

Research in the private sector on renewable resources is limited because of the broad societal nature of the benefits, and the lack of conventional markets and market prices for research results. Thus, the great bulk of research on renewable resources must be carried on by Federal and State research agencies and publicly supported educational institutions.

In view of the kinds of obstacles described, meeting the projected growth in demands upon renewable resources will require public support--investments in management programs for those resources that are publicly owned; investments in research; and investments in technical, financial, and educational assistance for those in the private sector who own and manage such a large part of the country's forest and range lands. Without increased public investments, progress in increasing and extending supplies of renewable resources is likely to be limited.

The management and research opportunities to increase and extend renewable resource supplies have been described above. Technical and financial assistance and education simply provide a means to an end, that of encouraging private owners of forest and range lands to put the management opportunities and the existing technology into practice.

It is perhaps inevitable, given the millions of owners of forest and range lands, that there will be long time lags between the development of new knowledge and its general acceptance and practice. But by providing technical assistance, this lag can be greatly shortened.

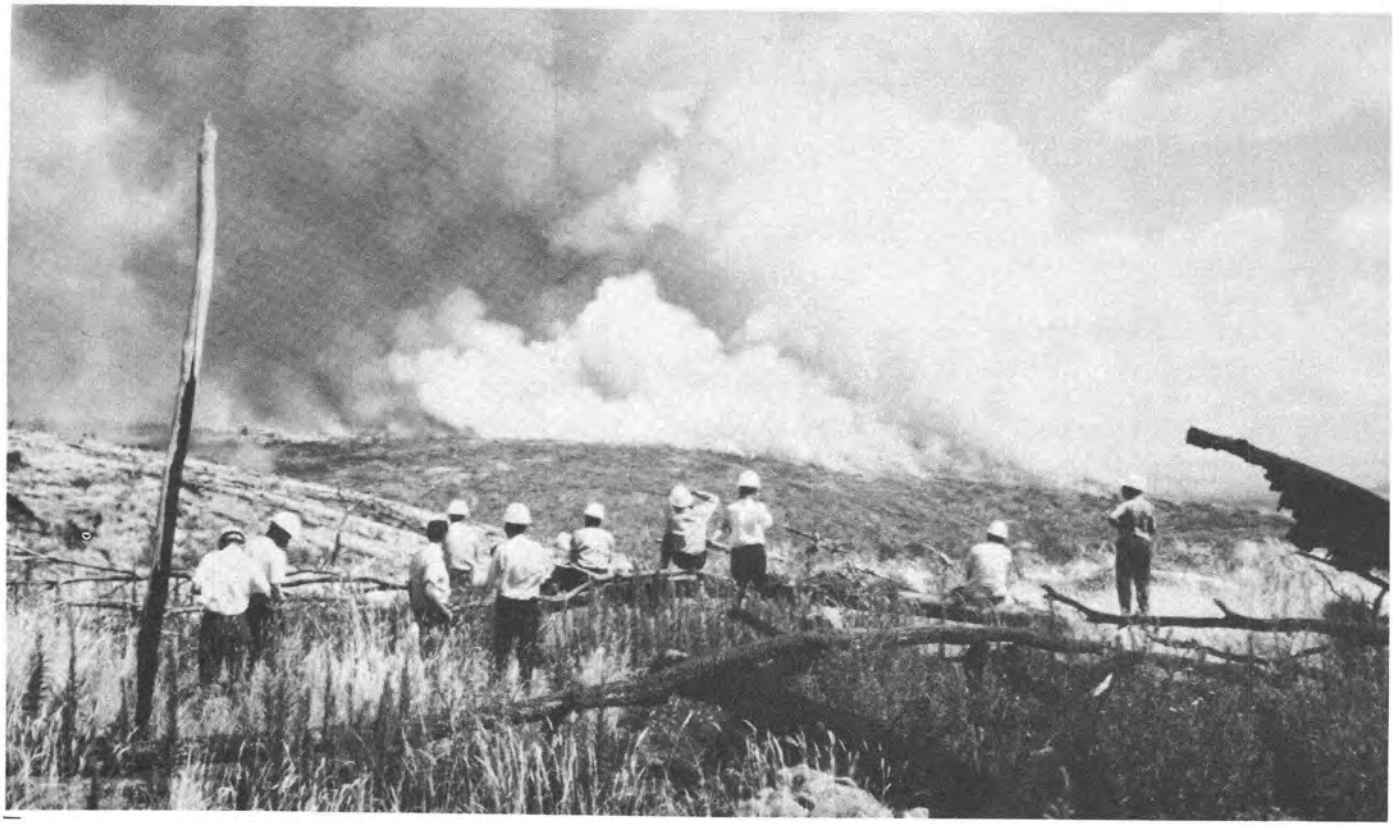
Demonstration of the benefits of new knowledge provide the most direct way of bringing about the adoption of research results. Education programs can also pass on and speed up the use of knowledge. However, such efforts are in general most effective when accompanied and supplemented by direct on-the-ground technical assistance in planning, organizing, and implementing desirable practices.

Financial assistance is necessary for those owners who lack capital and to provide inducement for the adoption of practices which benefit society generally. Financial assistance can be provided in a variety of ways--cooperative cost-sharing arrangements, direct whole or partial payments for the use of specified practices, or by indirect means such as preferential tax treatment.

The largest and most effective forest management effort in the United States has been the cooperative fire control program administered by State forestry agencies that began with the passage of the Weeks Act of 1911, and the fire control programs on the National Forests and other public lands. The results have been remarkable; the area burned has declined by 30 to 40 million acres. It has made possible the regeneration of forests over very large areas in the eastern part of the United States and in parts of the West. In turn, this has contributed in a major way to the buildup in the timber growth of recent decades and such important economic developments as the establishment and growth of the pulp and softwood plywood industries in the South.

Technical assistance, demonstrations, education—these are the ways of getting new knowledge accepted and used.

The potential of assistance and education programs is great, and such programs may, in fact, be the best hope for achieving the kinds of increases in supplies needed to meet the growing domestic and export demands for most renewable resource products.



The largest and most effective forest management effort in the United States has been the fire control program. It has made possible the regeneration of forests over very large areas.

In addition to an Assessment, the Forest and Rangeland Renewable Resources Planning Act directs the Secretary of Agriculture to prepare and transmit to the President every fifth year a recommended renewable resources Program ". . . for management and administration of the National Forest System, for research, for cooperative State and private programs, and for conduct of other Forest Service activities in relation to the findings of the Assessment . . . ." This, and other language in the Forest and Rangeland Renewable Resources Planning Act, shows that the Assessment is intended as the factual and analytical basis for the recommended Forest Service programs, including the program now being developed for submission to the President at the beginning of 1985.

As described in a preceding section, the Assessment shows that future demands for renewable resource products are likely to be above the levels that can be supplied with present management, research, and assistance programs. Thus, the Nation is faced with a future in which there will be increasing scarcity and intensifying competition for available supplies of renewable resource products. This will have serious and adverse impacts on the economy, the environment, and the general quality of life for all people.

The preceding discussion also shows that such a future is not inevitable. Supplies of renewable resource products can be increased and extended and there is a strong societal basis for continuing and expanding those programs which will increase and extend supplies.

General Program Implications

This is the major program implication of the Assessment: renewable resource management, research, and assistance programs are needed, can be justified, and with adequate expansion can greatly increase and extend supplies of renewable resources--enough to meet the Forest Service program goals that have been established for each resource. The justification for expanded programs exists in all regions of the country and for all products. It also exists on all ownerships--Forest Service, other Federal, State and private.

The Assessment shows that the Nation has a very large forest and range land and water base. This, in turn, suggests that the area is adequate in size for meeting prospective increases in demand. And, in a general sense and with more intensive management, it is adequate for most products and uses. However, there are exceptions. The loss of wetlands used as nesting and wintering sites for waterfowl and other wildlife species, and of areas of timberland in bottomland hardwoods has had serious impacts. Conversion of forest land to crop and pasture land, which may be necessary to replace the loss of irrigated acreage in the High Plains area of Texas and adjoining States, would add to the loss of commercial timberland and could significantly reduce future timber supplies. These area losses need to be considered from the standpoint of intensifying Forest Service programs, which will increase and extend supplies of the impacted renewable resources.

The National Forests and other public lands also offer the major opportunities for increasing or extending the supplies of some products or uses. For example, the bulk of the opportunities for expanding wilderness use is on the public lands. The only practical opportunities for protecting or increasing the population of some wildlife species such as the California condor and the grizzly bear are on the Federal ownerships. These lands also contain many cultural and natural sites that are unique or of outstanding historical, cultural, archeological, scenic, geological, or ecological value. Forest Service programs must adequately take into account these opportunities and values.

Timber Program Implications

The preceding discussion shows that there is a need for programs to respond to the increased demands for timber which lie immediately ahead in the 1980's and early 1990's. There is

Nearly all of the opportunities for expanding wilderness areas are on public lands.

also a longer term need to respond to continued growth in demands for softwood and hardwood timber and to move toward achieving a net surplus in international trade in timber products. Softwood timber supplies can be increased in the 1980's and 1990's by temporarily accelerating harvests on the National Forests in Washington, Oregon, northern California, northern Idaho, and western Montana which have large inventories of old-growth timber. Both softwood and hardwood timber supplies can be expanded in these decades by increasing harvests on the private timberlands in the South and North, and by improving the utilization of timber and wood resources.

Accelerating harvests on the National Forests will require programs to build roads into the old-growth stands (most of which are in unroaded areas); to protect the environment and provide opportunities for wildlife, outdoor recreation, and other uses of the impacted timberlands, and to establish and care for the replacement stands. Sustaining the higher harvests will require an intensification of the management programs necessary for increased net annual growth.

Sustaining the increased harvests on the private timberlands in the South and North will also require expanded Forest Service programs, chiefly those involving technical and financial assistance, to regenerate and maintain stands of desirable species.

Progress in improving utilization can be achieved by enlarging Forest Service utilization research programs and the programs to transfer this technology to timber and wood products processors and users.

Accelerating harvests on the National Forests with old-growth timber stands will require large roadbuilding programs.

For the long term, programs to increase net annual growth provide the only practical means of meeting the projected increases in timber demands for softwoods and hardwoods, and moving the Nation toward a net surplus of trade in timber products. Basically, the programs needed to achieve this are the same as those needed for the shorter run--an expansion in the management programs on the National Forests, the assistance and education programs for private owners, and research programs that benefit all owners.

These programs need to be directed in part to the emerging regional problems. For example, National Forest programs can be developed to increase softwood timber harvests on the Pacific Coast. Likewise, the assistance programs for private owners can increase net annual softwood timber growth in the South and hardwood growth in both the South and North. Such programs can offset the projected declines in inventories and net annual growth that will otherwise take place.

The projected falloff in the softwood timber resource in the South that is shown in figure 14, page 46, is partly the result of the natural successional change of pine stands to hardwoods after harvest. This successional change has been going on for some time, and the area in pine has decreased by several million acres in the last decade or so. As a result of this and earlier harvest and management practices, less than half of the 138 million acres of pine site lands is occupied by pine. This can only be changed by implementing management practices to convert such stands and ensure pine regeneration after harvest.

Assistance programs for private owners can increase net annual softwood timber growth, and offset declines in inventories and annual growth that are projected in the South.

This kind of problem is not confined to the South. The need for conversion and regeneration with desirable species is a general problem, common to all regions and for both softwood and hardwood species. There are also substantial delays in regeneration--up to 5 years in the South and 10 years in the West. This is a significant loss; a delay of 5 years in regenerating a stand grown on a 50-year rotation is the equivalent of a 10-percent reduction in growth.

Management, assistance, and research programs directed at regenerating stands to desirable softwood and hardwood species and to reducing the time lag between harvest and stand establishment have the largest longrun potential for increasing net annual timber growth. Most of this potential is on the private timberlands in the South.

Expanded research programs may be the best way of extending timber supplies through improvements in utilization; primarily by reducing the costs and increasing the efficiency of utilizing unused wood materials, of construction and manufacturing, and of the design and maintenance of products and structures.

Water Program Implications

Preceding discussion sections have described the need for and the opportunities to increase water yields, ameliorate flooding and erosion, and improve water quality.

Expanding the Forest Service programs concerned with the restoration and protection of watersheds on the National Forests, and the

Watershed protection and restoration programs can reduce flooding, increase water yields, and improve water quality.

cooperative assistance programs concerned with watershed planning and land treatment measures on private lands, can reduce flooding by as much as 35 percent and increase water yields by as much as 7 percent while maintaining water quality. Forest Service research programs that lead to (1) better methods of managing forest and range lands to stabilize soils and constrain erosion and sedimentation; (2) rehabilitation of mined and other disturbed areas; and (3) minimizing the pollution associated with the use of chemical fertilizers and pesticides can improve the yield, timing, and quality of waterflows.

These kinds of management measures also need to be integrated into the Forest Service programs primarily designed to increase timber growth and harvests, forage supplies, and minerals production; and in those to protect forests and range from insects and disease. The cooperative assistance programs for private owners also need to include such measures.

Range Program Implications

With respect to range, expanded Forest Service management programs to (1) rehabilitate range administered by the Forest Service by seeding desirable species and controlling undesirable plants and shrubs, (2) construct needed livestock control and handling facilities such as fences, (3) develop additional water supplies, (4) improve grazing systems and livestock management practices, and (5) decrease erosion and sustain long-term productivity can result in additional forage supplies and improved utilization. Supplies of forage and the utilization of existing forage on forest lands can also be increased by integrating grazing into timber management programs, both those in the National Forest System and, with technical assistance through State Foresters, on private lands.

In range areas, particularly in the West, the limiting factor for some private grazing operations is the amount of forage available on National Forest and other Federal and State lands when feed supplies on deeded lands are short. Thus, programs to increase forage supplies on the range administered by the Forest Service can lead to higher levels of livestock production and increased income for ranchers.

The integration of grazing into timber management programs can improve the utilization of existing forage and increase supplies.

Research to improve systems of range management and develop lower cost, more efficient, methods of improving ranges can also lead to increased forage production on Forest Service, other public, and private lands.

Outdoor Recreation and Wilderness Program Implications

The Assessment analyses of outdoor recreation showed that in the short run there is a special

Providing public access to existing underutilized resources can go a long way toward meeting future demands for many kinds of outdoor recreation.

need for increasing programs to rehabilitate deteriorating outdoor recreation sites and adequately maintain the existing facilities on National Forest System lands.

The 191 million acres of forest and range land and water in the National Forest System includes nearly all of the land forms, climatic zones, and vegetative systems found in the United States. This land has many areas of great scenic beauty and of great historical and cultural interest. By enlarging construction programs for additional facilities such as trails, campgrounds, picnic areas, and boat ramps to more fully utilize such resources, the Forest Service can meet a significant part of the longrun growth in demands for many kinds of outdoor recreation. There is a special need for expanding such programs on the National Forests closest to densely populated areas.

Expanding programs designed to spread use to underutilized wilderness and nonwilderness areas and facilities and to improve protection and management practices to minimize the adverse impacts of visitors can satisfy part of the projected growth in outdoor recreation demand. Programs providing visitor information service--one of the best means of spreading use and minimizing adverse impacts--can also contribute in important ways to meeting demands.

Increasing the research programs designed to develop practical lower cost ways of constructing, restoring, and maintaining facilities or minimizing the adverse impacts of use can further contribute to meeting outdoor recreation demands. Technical assistance programs to increase the supply and efficient use of

outdoor recreation facilities on private forest and range lands can achieve the same end.

Wildlife and Fish Program Implications

The Assessment analysis showed that an efficient way to improve the wildlife and fish situation, both on National Forest System and State and private lands and waters, is to more fully integrate wildlife and fish needs in the management and protection programs for other resources, and especially those for timber, forage and minerals. Such integration can go a long way in improving wildlife and fish habitats by increasing food supplies and suitable cover, enlarging the area of suitable habitat, and controlling land and water pollution resulting from the use of pesticides, harvesting and silvicultural practices, and mining. Populations can be increased by programs aimed directly at improving and enlarging habitats, removing barriers to fish migration, and the preservation or expansion of key habitats by fee purchase or easements.

As a result of the public ownership of wildlife and fish and the limited ways in which private landowners can benefit, it seems clear that progress in improving the wildlife and fish situation on private lands will in large part depend on cooperative Federal-State technical and financial assistance programs. Expanded research programs to develop more effective methods of integrating wildlife needs in management and protection programs, and lower cost ways of maintaining and improving natural habitats by such measures as prescribed burning, planting food and cover, and protection from destructive agents can contribute significantly to increased wildlife and fish supplies on both Forest Service and State and private holdings.

Minerals Program Implications

It seems clear that demands for most minerals, and particularly for coal, are likely to grow rapidly in the decades ahead. National Forest System lands are likely to be of increasing importance in supplying these demands. The implications of this are evident--there is a need for expanded Forest Service programs to facilitate exploration, development, and mining of these resources, and to protect the natural environment from the impacts associated with these activities.

There is a further need to restore the lands that have been disturbed by mining and related activities in the past and not reclaimed, and those likely to be disturbed on a much larger scale in the future. Thus, expansion of related research and technical assistance programs concerned with the control of land and water pollution from mining, and the reclamation of mined areas, can also contribute in significant ways.

Protection and Support Program Implications

As Forest Service management and research programs are increased, there will be a related need to expand many protection and support programs. For example, accelerating the harvest of old-growth timber in the 1980's and 1990's will require a large road construction program since the bulk of this timber is in unroaded areas. It will also involve additional road maintenance, sales administration, and various landownership management programs concerned with such things as boundary location and rights-of-way acquisition. As the basic Forest Service programs expand, there will be additional maintenance of existing facilities and the need for new supporting facilities such as warehouses, offices, and laboratories. Management and research programs to protect (1) the soil from erosion and loss of long-term productivity; (2) timber and forage resources from fire, insects, diseases, and other pests; (3) water from nonpoint pollution; and 4) National Forest System visitors and users will also need to be intensified.

International Program Implications

The United States is only one country with only part of the world's forest and range land and renewable resources. It is dependent upon other countries for a significant part of its

There is a need to restore the lands that have been disturbed by mining in the past and those likely to be disturbed in the future.

mineral and timber needs. At the same time, many countries depend upon the United States for supplies of timber products and minerals, including coal. Some species of wildlife and fish that are commercially or recreationally important spend part of their lives in other countries or international waters. The world's outdoor recreational opportunities and global environment are shared by everyone, and everyone loses or gains as these resources and the environment change.

As the world's wealthiest country, the United States surely has an obligation to support programs of assistance to others for improving the management and use of all forest and range lands and renewable resources and to protect the natural environment. It also has an obligation to support programs which will facilitate trade in timber and other renewable resource products.

The Implications of the Assessment for other Federal, State, and Private Programs

Increasing Forest Service programs as outlined above can contribute to meeting the Nation's growing demands for renewable resources and minerals. For some, such as timber, dispersed outdoor recreation, and some species of wildlife and fish, the potential contributions are quite large. For others, such as capital intensive outdoor recreational facilities, they are relatively small.

Thus, fully meeting the projected growth in demands for renewable resources will require a large expansion in the research, assistance and education programs of other Federal agencies, the States, educational institutions, and private organizations and management programs of private owners who administer or own forest and range land. Large investments will also be necessary for physical facilities such as plants, lodgings, and ski lifts.

Moving Forward to Meet Demands — The Costs and Benefits

The 1979 Assessment and this Supplement did not evaluate in aggregative ways the costs and benefits of moving forward to meet renewable resource demands. This is done, however, in considerable detail in the recommended renewable resources program now being developed for submission to the President at the beginning of 1985. Analyses of this kind, and other partial analyses that have been made including the earlier recommended programs, indicate that when the economic, social, and environmental benefits are considered, the investments necessary to meet the growing demands are likely to be profitable from the standpoint of the society.

Table 1.--Land and water areas in the United States, by class of land, water, and region 1/

(Thousand acres)

Class of land and water	All regions	Regions							
		Northeast	North Central	Southeast	South Central	Rocky Mountains	Great Plains	Pacific Coast 2/	Alaska
Non-Federal land:									
Crop 3/ and pasture land 4/	529,851	23,488	167,745	36,185	123,213	48,844	101,063	29,218	95
Rangeland 5/	441,466	16	238	4,192	111,365	168,407	74,080	33,212	49,956
Transition land 6/	35,603	3,601	1,021	989	934	17,876	86	1,167	9,929
Forest land 7/	409,284	78,110	67,686	78,270	105,936	28,624	3,018	39,862	7,778
Other land 8/	159,776	17,595	37,702	15,917	30,595	15,236	9,761	14,479	18,491
Total, non-Federal	1,575,980	122,810	274,392	135,553	372,043	278,987	188,008	117,938	86,249
Federal land:									
Rangeland	328,887	--	172	197	--	167,411	3,500	34,828	122,779
Forest land	276,417	2,569	9,852	9,054	8,931	90,697	1,211	52,765	101,338
Other land	73,504	1,028	1,802	1,571	4,460	9,812	1,209	2,105	51,517
Total, Federal	678,808	3,597	11,826	10,822	13,391	267,920	5,920	89,698	275,634
Total land	2,254,788	126,407	286,218	146,375	385,434	546,907	193,928	207,636	361,883
Land:									
Crop and pastureland	529,851	23,488	167,745	36,185	123,213	48,844	101,063	29,218	95
Rangeland	770,353	16	410	4,389	111,365	335,818	77,580	68,040	172,735
Transition land	35,603	3,601	1,021	989	934	17,876	86	1,167	9,929
Forest land	685,701	80,679	77,538	87,324	114,867	119,321	4,229	92,627	109,116
Other land	233,280	18,623	39,504	17,488	35,055	25,048	10,970	16,584	70,008
Total land	2,254,788	126,407	286,218	146,375	385,434	546,907	193,928	207,636	361,883
Water:									
Inland water:	61,181	5,183	7,487	8,583	11,142	5,774	2,840	3,813	16,359
Large area 9/	51,318	4,422	6,735	7,185	9,182	5,164	2,412	3,309	12,909
Small area 10/	9,863	761	752	1,398	1,960	610	428	504	3,450
Other water 11/	47,642	6,541	35,879	2,196	1,417	--	--	1,609	--
Total, water	108,823	11,724	43,366	10,779	12,559	5,774	2,840	5,422	16,359
Total land and water	2,363,611	138,131	329,584	157,154	397,993	552,681	196,768	213,058	378,242

1/ Data for forest land, rangeland, and other land as of 1982; data on inland water as of 1980; data on other water as of 1970.

2/ Includes Hawaii.

3/ Land used for the production of adapted crops for harvest, alone or in rotation with grasses and legumes. Adapted crops include row crops, small grain crops, hay crops, nursery crops, orchard and vineyard crops, and other similar specialty crops.

4/ Land used primarily for the production of adapted, introduced, or native forage plants for livestock grazing. Pastureland may consist of single species in a pure stand, grass mixture, or a grass-legume mixture. Cultural treatment in the form of fertilization, weed control, reseeding, or renovation is usually a part of pasture management in addition to grazing management. Native pasture is included in pastureland in these land area statistics.

5/ Land on which the climax vegetation (potential natural plant community) is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing and browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundra, and certain forb and shrub communities. It also includes areas seeded to native or adapted introduced species that are managed like native vegetation.

6/ Land that meets the definition of forest land based on cover characteristics but where the predominant vegetation is grasses or forage plants that are used for grazing. The Soil Conservation Service has classified and reported most of these lands as rangeland; the Forest Service has classified and reported these lands as forest land. In most instances these lands are noncommercial timberland ecosystems such as pinyon-juniper, chapparal, and post oak. Transition land is an interim category used in this report to classify part of the area in such ecosystems. Work is underway in the Forest Service and Soil Conservation Service to resolve classification differences and show all such land as rangeland or forest land in future reports. Some of the area in noncommercial timberland ecosystems is classified as forest or range land in this report.

7/ Land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use. The minimum area for classification of forest land is 1 acre and must be at least 100 feet wide. Forest land is distinguished from rangeland in transition vegetation types if the tree canopy cover exceeds 10 percent. Forest lands include cutover areas temporarily unstocked as well as young stands and plantations established for forestry purposes which do not yet have 10 percent crown cover.

8/ A category of land cover and land use that includes farmsteads, other land in farms, strip-mines, quarries, gravel pits, borrow pits, permanent snow and ice, small built-up areas, and all other land that does not fit into any other land cover or land use category.

9/ Lakes and ponds at least 40 acres in size; waterways 1/8 mile or more in width.

10/ Lakes and ponds between 2 and 40 acres in size; waterways less than 1/8 mile in width.

11/ Includes Atlantic, Pacific, and Gulf Coastal waters; Chesapeake and Delaware Bays; Long Island and Puget Sounds; New York Harbor; Straits of Juan de Fuca and Georgia; and the Great Lakes. Excludes Alaska and Hawaii.

Sources: Forest land - U.S. Department of Agriculture, Forest Service. Forest Statistics of the U.S. 1977. Rangeland - U.S. Department of Agriculture, Forest Service estimates based on data supplied by U.S. Department of Agriculture, Soil Conservation Service; U.S. Department of the Interior, Bureau of Land Management, Bureau of Indian Affairs, and National Park Service; and U.S. Department of Defense. Inland water - U.S. Department of Agriculture, Soil Conservation Service (preliminary data). All other land and water - U.S. Department of Commerce, Bureau of Census. Area Measurement Reports. GE-20 No. 1, 22 p. 1970.

Table 2.--Forest and range land areas in the United States, by ownership and region, 1982

(Thousand acres)

Ownership	All regions	Regions							
		Northeast	North Central	Southeast	South Central	Rocky Mountains	Great Plains	Pacific Coast 1/	Alaska
Forest 2/ and transition 3/ land:									
Federal lands administered by:									
Forest Service	136,328	2,257	8,636	5,108	6,832	67,154	1,080	35,449	9,812
Bureau of Land Management	84,318	--	24	--	234	18,644	12	13,483	51,921
Other Federal	55,771	312	1,192	3,946	1,865	4,899	119	3,833	39,605
Total Federal	276,417	2,569	9,852	9,054	8,931	90,697	1,211	52,765	101,338
Non-Federal lands	444,887	81,711	68,707	79,259	106,870	46,500	3,104	41,029	17,707
Total	721,304	84,280	78,559	88,313	115,801	137,197	4,315	93,794	119,045
Rangeland 4/:									
Federal lands administered by:									
Forest Service	40,663	--	65	--	--	27,233	2,552	8,334	2,479
Bureau of Land Management	201,294	--	--	--	--	123,294	323	19,177	58,500
Other Federal	86,930	--	107	197	--	16,884	625	7,317	61,800
Total	328,887	--	172	197	--	167,411	3,500	34,828	122,779
Non-Federal lands	441,466	16	238	4,192	111,365	168,407	74,080	33,212	49,956
Total	770,353	16	410	4,389	111,365	335,818	77,580	68,040	172,735
Forest, transition, and rangeland:									
Federal lands administered by:									
Forest Service	176,991	2,257	8,701	5,108	6,832	94,387	3,632	43,783	12,291
Bureau of Land Management	285,612	--	24	--	234	141,938	335	32,660	110,421
Other Federal	142,701	312	1,299	4,143	1,865	21,783	744	11,150	101,405
Total Federal	605,304	2,569	10,024	9,251	8,931	258,108	4,711	87,593	224,117
Non-Federal lands	886,353	81,727	68,945	83,451	218,235	214,907	77,184	74,241	67,663
Total	1,491,657	84,296	78,969	92,702	227,166	473,015	81,895	161,834	291,780

1/ Includes Hawaii.

2/ Land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use. The minimum area for classification of forest land is 1 acre and must be at least 100 feet wide. Forest land is distinguished from rangeland in transition vegetation types if the tree canopy cover exceeds 10 percent. Forest lands include cutover areas temporarily unstocked as well as young stands and plantations established for forestry purposes which do not yet have 10 percent crown cover.

3/ Land that meets the definition of forest land based on cover characteristics but where the predominant vegetation is grasses or forage plants that are used for grazing. The Soil Conservation Service has classified and reported most of these lands as rangeland; the Forest Service has classified and reported these lands as forest land. In most instances these lands are noncommercial timberland ecosystems such as pinyon-juniper, chapparal, and post oak. Transition land is an interim category used in this report to classify part of the area in such ecosystems. Work is underway in the Forest Service and Soil Conservation Service to resolve classification differences and show all such land as rangeland or forest land in future reports. Some of the area in noncommercial timberland ecosystems is classified as forest or range land in this report.

4/ Land on which the climax vegetation (potential natural plant community) is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing and browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundra, and certain forb and shrub communities. It also includes areas seeded to native or adapted introduced species that are managed like native vegetation.

Table 3.--Net volume of timber on commercial timberland 1/ in the United States, by class of timber, softwoods and hardwoods, and region, January 1, 1977

(Million cubic feet)

Class of timber	All regions	Regions							
		Northeast	North Central	Southeast	South Central	Rocky Mountains	Great Plains	Pacific Coast 2/	Alaska
Growing stock 3/:									
Sawtimber 4/:									
Softwoods	367,821	16,096	6,423	32,471	37,360	72,155	1,361	163,430	38,525
Hardwoods	137,007	32,337	23,101	32,330	36,337	1,895	836	9,065	1,106
Total	504,828	48,433	29,525	64,801	73,697	74,050	2,197	172,495	39,631
Poletimber 5/:									
Softwoods	87,958	14,894	6,103	15,267	12,954	21,153	409	15,084	2,095
Hardwoods	118,182	34,983	25,823	20,054	27,204	2,968	455	5,348	1,347
Total	206,140	49,876	31,927	35,321	40,158	24,121	863	20,432	3,442
Total, growing stock 3/:									
Softwoods	455,779	30,989	12,526	47,738	50,314	93,308	1,769	178,514	40,620
Hardwoods	255,189	67,320	48,925	52,384	63,540	4,863	1,291	14,413	2,453
Total	710,968	98,309	61,451	100,122	113,855	98,171	3,060	192,927	43,073
Rough trees 6/:									
Softwoods	7,396	2,372	444	925	813	1,707	26	1,069	40
Hardwoods	36,646	6,833	6,374	10,016	10,494	478	536	1,899	16
Total	44,042	9,205	6,818	10,941	11,307	2,185	562	2,968	55
Rotten trees 7/:									
Softwoods	8,261	878	115	170	352	1,408	4	3,651	1,682
Hardwoods	14,987	4,195	1,713	2,587	4,360	1,270	118	661	83
Total	23,247	5,073	1,828	2,757	4,712	2,678	123	4,312	1,765
Salvable dead trees 8/:									
Softwoods	13,197	--	103	123	52	7,379	28	4,710	804
Hardwoods	916	--	317	50	143	287	10	102	8
Total	14,114	--	420	172	194	7,666	38	4,812	813
Total, all timber:									
Softwoods	484,633	34,239	13,188	48,956	51,530	103,802	1,827	187,944	43,146
Hardwoods	307,738	78,347	57,329	65,037	78,537	6,898	1,955	17,075	2,560
Total	792,371	112,586	70,517	113,993	130,068	110,700	3,783	205,019	45,706

1/ Forest land which is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as commercial timberland have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

2/ Includes Hawaii.

3/ Net volume in cubic feet of live sawtimber and poletimber trees from stump to a minimum 4-inch top (of central stem) outside bark or to the point where the central stem breaks into limbs.

4/ Live trees of commercial species containing at least one 12-foot sawlog or two noncontiguous 8-foot logs, and meeting regional specifications for freedom from defect. Softwood trees must be at least 9 inches in diameter and hardwood trees 11 inches in diameter at breast height.

5/ Live trees of commercial species at least 5.0 inches in diameter breast height but smaller than sawtimber size, and of good form and vigor.

6/ Live trees of commercial species that do not contain a saw log, now or prospectively, primarily because of roughness, poor form, splits, and cracks, and with less than one-third of the gross tree volume in sound material; and all live trees of noncommercial species.

7/ Live trees of commercial species that do not contain a sawlog now or prospectively, primarily because of rot (e.g., when rot accounts for more than 50 percent of total cull volume).

8/ Standing or down dead trees that are considered currently or potentially merchantable by regional standards.

Note: Data may not add to totals because of rounding.

Table 4.--Simulated effects of selected futures on timber demands; stumpage prices; softwood lumber production, prices, and imports; and growing stock inventories in private ownership

(All projections at equilibrium levels)

Item and year	Unit of measurement	Selected futures: 1979 1/ Assessment	Supplement 2/	Intensified management--forest industry ownerships 3/	Low housing 4/	Ad valorem duty on softwood lumber imports 5/: 10 percent	20 percent	High exports 6/	High National Forest harvest 7/	Reduced commercial timberland area 8/
Softwood timber demand on domestic forests: 9/	Billion board feet, International 1/4-inch log rule									
1976		50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
1990		60.1	55.2	55.7	50.9	55.4	55.2	55.6	55.8	55.4
2000		61.9	56.9	56.7	53.4	56.1	55.0	56.7	57.5	56.2
2030		62.1	59.7	62.5	58.7	57.9	56.7	57.7	63.8	51.5
Hardwood timber demand on domestic forests: 9/	do									
1976		12.9	12.9	10/	10/	10/	10/	10/	10/	12.9
1990		15.9	17.8	10/	10/	10/	10/	10/	10/	17.8
2000		19.6	22.8	10/	10/	10/	10/	10/	10/	22.7
2030		30.2	32.6	10/	10/	10/	10/	10/	10/	32.1
Softwood stumpage prices: North	Indexes of prices per thousand board feet, International 1/4-inch log rule, 1967=100									
1976		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1990		160.0	126.2	124.8	126.2	126.2	126.2	126.8	126.2	128.9
2000		183.0	180.6	177.2	180.5	180.5	180.5	182.1	176.3	186.6
2030		279.2	373.4	362.0	373.6	373.6	373.6	381.0	365.0	393.6
South	do									
1976		138.9	116.7	116.7	116.7	116.7	116.7	116.7	116.7	116.7
1990		230.1	175.6	173.8	134.6	179.7	181.3	178.9	174.5	188.7
2000		280.8	202.4	194.0	163.5	214.2	231.6	213.0	189.4	229.0
2030		525.7	349.8	273.4	273.0	387.7	413.9	402.9	233.8	518.5
Rocky Mountains	do									
1976		138.7	142.3	142.3	142.3	142.3	142.3	142.3	142.3	142.3
1990		473.0	322.7	320.4	158.2	345.9	356.8	334.7	293.4	351.1
2000		514.4	292.9	270.6	156.3	326.6	377.7	321.8	204.4	365.5
2030		1,045.0	670.5	439.9	381.8	789.2	867.6	852.9	224.2	1,155.0
Douglas-fir subregion	do									
1976		164.2	151.5	151.5	151.5	151.5	151.5	151.5	151.5	151.5
1990		275.0	238.1	229.3	135.9	241.9	246.9	246.6	241.2	258.8
2000		228.2	203.1	186.0	142.6	225.8	257.3	213.8	175.0	234.2
2030		430.3	372.6	263.6	261.8	426.7	471.5	466.7	190.1	571.7

Table 4.--(continued) Simulated effects of selected futures on timber demands; stumpage prices; softwood lumber production, prices, and imports; and growing stock inventories in private ownership

(All projections at equilibrium levels)

Item and year	Unit of measurement	Selected futures								
		1979 1/ Assessment	Supplement 2/	Intensified management--forest industry ownerships 3/	Low housing 4/	Ad valorem duty on softwood lumber imports 5/: 10 percent	Ad valorem duty on softwood lumber imports 5/: 20 percent	High exports 6/	High National Forest harvest 7/	Reduced commercial timberland area 8/
Hardwood stumpage prices:										
Northeast	do									
1976		100.0	100.0	10/	10/	10/	10/	10/	10/	100.0
1990		104.1	93.6	10/	10/	10/	10/	10/	10/	96.4
2000		92.1	90.9	10/	10/	10/	10/	10/	10/	96.4
2030		105.1	116.8	10/	10/	10/	10/	10/	10/	141.3
North Central	do									
1976		100.0	100.0	10/	10/	10/	10/	10/	10/	100.0
1990		99.7	91.2	10/	10/	10/	10/	10/	10/	96.9
2000		93.1	98.4	10/	10/	10/	10/	10/	10/	111.8
2030		123.3	200.7	10/	10/	10/	10/	10/	10/	317.1
Southeast	do									
1976		100.0	100.0	10/	10/	10/	10/	10/	10/	100.0
1990		113.9	90.0	10/	10/	10/	10/	10/	10/	95.8
2000		99.1	84.0	10/	10/	10/	10/	10/	10/	95.9
2030		126.4	116.6	10/	10/	10/	10/	10/	10/	182.1
South Central	do									
1976		100.0	100.0	10/	10/	10/	10/	10/	10/	100.0
1990		136.3	99.4	10/	10/	10/	10/	10/	10/	110.8
2000		123.6	93.4	10/	10/	10/	10/	10/	10/	115.0
2030		203.0	142.5	10/	10/	10/	10/	10/	10/	245.4
Softwood lumber production:	Billion board feet, lumber tally									
1976		29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
1990		31.4	32.3	32.4	27.9	32.8	33.1	32.6	32.4	31.9
2000		29.4	33.3	33.7	31.0	34.6	36.3	33.7	34.7	31.9
2030		33.6	36.0	40.2	36.0	37.4	37.7	36.2	44.5	31.2
Softwood lumber prices:	Indexes of prices per thousand board feet, lumber tally, 1967=100									
1976		135.6	135.6	135.6	135.6	135.6	135.6	135.6	135.6	135.6
1990		199.8	167.8	166.9	155.3	171.5	173.2	169.5	166.7	172.0
2000		225.2	195.1	192.2	179.0	200.7	208.5	197.7	189.0	202.7
2030		296.2	252.0	221.0	218.8	266.1	271.2	273.0	207.7	301.7

Softwood lumber imports:	Billion board feet, lumber tally									
1976		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
1990		12.7	12.7	12.6	10.8	11.9	11.4	12.7	12.6	12.8
2000		13.7	11.1	10.9	8.2	9.4	7.2	11.5	10.2	11.9
2030		10.0	11.2	9.2	6.8	8.9	8.4	12.2	5.7	12.7
Softwood growing stock inventory (private ownerships)	Billion cubic feet									
North	do									
1977 11/		36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2
1990		45.9	44.8	45.3	44.8	44.8	44.8	44.8	44.8	44.2
2000		50.4	48.4	49.6	48.4	48.4	48.2	48.3	48.5	47.0
2030		58.1	42.9	46.9	42.9	42.9	42.9	41.6	43.6	38.1
South	do									
1977 11/		85.2	85.2	85.2	85.2	85.2	85.2	85.2	85.2	85.2
1990		97.7	105.6	106.3	106.4	105.5	105.5	105.5	105.6	99.3
2000		97.7	109.4	112.8	112.2	109.0	108.7	108.1	110.0	96.3
2030		60.8	73.2	99.0	84.3	69.9	66.7	61.6	84.3	31.8
Rocky Mountains	do									
1977 11/		21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
1990		20.1	21.3	21.3	21.8	21.2	21.2	21.2	21.3	20.5
2000		19.1	21.0	21.1	22.2	20.9	20.8	20.9	21.4	19.3
2030		16.1	17.5	19.1	21.2	16.5	15.5	16.4	21.3	12.0
Douglas-fir subregion	do									
1977 11/		30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6
1990		24.6	24.4	25.0	25.6	24.4	24.3	24.4	24.3	22.9
2000		21.4	21.9	23.5	23.9	21.6	21.3	21.7	22.1	19.2
2030		14.1	15.9	22.1	19.6	15.1	14.3	15.1	19.5	10.5
Hardwood growing stock inventory (private ownerships)										
Northeast	do									
1977 11/		57.0	57.0	10/	10/	10/	10/	10/	10/	57.0
1990		71.6	70.5	10/	10/	10/	10/	10/	10/	69.6
2000		79.6	76.2	10/	10/	10/	10/	10/	10/	74.3
2030		86.8	78.0	10/	10/	10/	10/	10/	10/	71.7
North Central	do									
1977 11/		47.4	47.4	10/	10/	10/	10/	10/	10/	47.4
1990		57.7	56.5	10/	10/	10/	10/	10/	10/	54.4
2000		62.4	57.7	10/	10/	10/	10/	10/	10/	53.1
2030		63.6	44.6	10/	10/	10/	10/	10/	10/	31.7

Table 4.--(continued) Simulated effects of selected futures on timber demands; stumpage prices; softwood lumber production, prices, and imports; and growing stock inventories in private ownership

(All projections at equilibrium levels)

Item and year	Unit of measurement	Selected futures: 1979 1/ Assessment	Supplement 2/	Intensified management--forest industry ownerships 3/	Low housing 4/	Ad valorem duty on softwood lumber imports 5/: 10 percent	Ad valorem duty on softwood lumber imports 5/: 20 percent	High exports 6/	High National Forest harvest 7/	Reduced commercial timberland area 8/
Southeast	do									
1977 11/		46.7	46.7	10/	10/	10/	10/	10/	10/	46.7
1990		59.3	58.7	10/	10/	10/	10/	10/	10/	56.7
2000		65.3	62.2	10/	10/	10/	10/	10/	10/	58.0
2030		63.9	52.5	10/	10/	10/	10/	10/	10/	39.5
South Central	do									
1977 11/		47.3	47.3	10/	10/	10/	10/	10/	10/	47.3
1990		56.8	58.6	10/	10/	10/	10/	10/	10/	53.4
2000		60.1	62.0	10/	10/	10/	10/	10/	10/	52.3
2030		48.3	50.7	10/	10/	10/	10/	10/	10/	27.6

1/ The future as described by the basic assumptions and other specified and implied assumptions in the report An Assessment of the Forest and Range Land Situation in the United States. U.S. Dept. of Agri. Forest Serv., For. Res. Rpt. No. 22, Washington, D.C. 352p. 1981. Housing starts, a chief determinant of demand for softwood lumber and a number of other timber products, was projected at 2.3 million units in 1990, 1.9 million units in 2000, and 1.7 million in 2030.

2/ The future as described by the basic assumptions and other specified and implied assumptions in this report. Housing starts, a chief determinant for demand for softwood lumber and a number of other timber products, is projected at 1.9 million units in 1990, 1.7 million in 2000, and 1.5 million in 2030.

3/ The future as described by the basic assumptions and other specified and implied assumptions in this report modified by assuming that all the economic opportunities on forest industry ownerships as described in the 1979 Assessment that would yield 4 percent or more net of inflation or deflation would be utilized.

4/ The future as described by the basic assumptions and other specified and implied assumptions in this report modified by reducing housing starts to 1.4 million units in 1990, 1.5 million units in 2000, and 1 million units in 2030.

5/ The future as described by the basic assumptions and other specified and implied assumptions in this report modified by the imposition of 10 percent and 20 percent ad valorem duties on softwood lumber imports effective in 1983.

6/ The future as described by the basic assumptions and other specified and implied assumptions in this report modified by increasing the projected exports of lumber, plywood, and pulpwood (includes pulpwood and the pulpwood equivalent of pulp, paper, and board) by 20 percent in 1990, 40 percent in 2000, 60 percent in 2010, 80 percent in 2020, and 100 percent in 2030.

7/ The future as described by the basic assumptions and other specified and implied assumptions in this report modified by increasing the timber harvests on the National Forests on a straight line basis from 8.8 billion board feet in 1982 (International 1/4-inch log rule) to 20 billion board feet in 2030.

8/ The future as described by the basic assumptions and other specified and implied assumptions in this report modified by further reducing the area in commercial timberland by 13 million acres in 1990, 22 million in 2000, and 43 million in 2030. The bulk of the reduction is in the South.

9/ Excludes fuelwood demands on nongrowing stock resources.

10/ No significant change from the data shown in the Supplement column.

11/ As of January 1, 1977.

Note: More details on the futures analyzed and the effects will be available in a supporting technical report to be published.