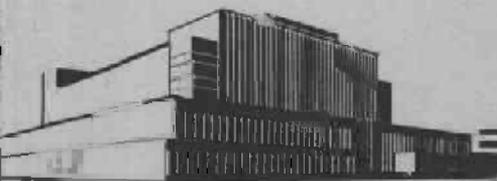
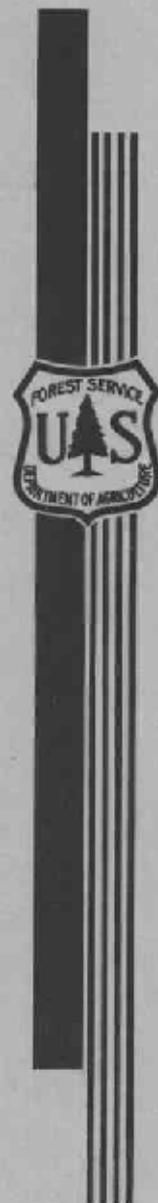


# THE CONTINUOUS YIELD OF OUR FORESTS

*(Report)*  
No. 2099

December 1957



FOREST PRODUCTS LABORATORY  
MADISON 5, WISCONSIN

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

In Cooperation with the University of Wisconsin

# THE CONTINUOUS YIELD OF OUR FORESTS<sup>1</sup>

By

L. J. MARKWARDT, Assistant Director

Forest Products Laboratory<sup>2</sup>, Forest Service  
U. S. Department of Agriculture

-----

## Introduction

This great nation of ours will celebrate its 200th anniversary in 1976. Economists predict that we can achieve, at our bicentennial, a new and increased measure of prosperity, provided we use our resources wisely, and maintain a peaceful economy. At that time our population will have reached 231 million, and the annual output of goods and services will total some 800 billion dollars -- double our present production.

I should like to point out, however, that it cannot be assumed that this great economic expansion will take place automatically. On the contrary, it can come about only through continued technological advances -- advances that bring about increased productivity and, more significantly, increased per capita production -- all the while never losing sight of the basic premise that we use our resources wisely.

America was eminently fortunate in having a wealth of natural resources and favorable conditions to invite development -- fertile lands and prairies, the finest stands of virgin forests the world had ever known; abundant waters and streams; invaluable iron ore and other varied mineral deposits; rich coal and oil resources; and, not last or least, a temperate, varied, stimulating, and healthful climate favorable to agriculture and human achievement. Among other elements present in the American formula for progress were the indomitable spirit of the composite population and a system of government based on freedom of thought that fostered free enterprise, with due reward for initiative and incentive.

---

<sup>1</sup>For presentation at Wood Industries Luncheon Meeting at annual convention of the American Society of Mechanical Engineers, New York City, December 5, 1957.

<sup>2</sup>Maintained at Madison, Wisconsin, in cooperation with the University of Wisconsin.

It should be noted in this connection that this system of free economic enterprise that contributes so much to our way of life has within it important dangers to our way of life. It puts a premium on using the best and most accessible of our resources first -- be it coal or iron or forest -- and thus tends to destroy the base on which it thrives. The challenge today comes back to our main theme -- the recognition of the need of conserving our resources by wise use, with due regard for the future. As our resources fare, so fares our way of life.

### Importance of the Forest Resource

With this brief perspective on our natural resources in general, I should like to review the part that one of our great resources -- the forests -- can be expected to play in our future economy and discuss their continuous yield potential. As you know, the forests comprise our only renewable material resource.

Everyone knows the part wood has played in our way of life. But what will be the place of forests in our future economy -- in the age of metals and their alloys, and of plastics and other products of the great chemical industries?

I can recall, shortly after the turn of the century, when we had lumber literally running out of our ears. The sawmills of the South and the Great Lakes states were in full production. Lumber reached a level of per capita consumption that we cannot again expect to equal, nor shall we need to. Lumbering, judged by present standards, was a wasteful process -- only one-third of the tree found its way into lumber -- and the huge waste burners were eloquent testimony of this waste.

The foundations of industrial expansion were getting under way. Only a beginning had been made in forest products research. As if obscured in the haze of the waste burners, the future role of the forests was far from clear. Would the need of forest products pass out with the passing of the wood sidewalk?

Since those early days the picture has become crystal clear. Wood, although in keen competition with other materials, has held its own in spite of their alluring claims. Forests and forest products have not only shown themselves to be essential in our modern way of life, but also serve in a greater number and variety of ways than any other product.

Even the modern defense agencies use wood and wood products extensively. The Navy used more wood than steel by volume in World War II. While much of this was for general construction purposes, special applications included the use of wood in the form of glued laminated construction as the basic material for the modern minesweeper. Even the building of steel ships requires forest products, as literally tons of paper are used for plans and drawings.

It is interesting to reflect on the significant progress that has been made in the synthesis of new fabrics such as nylon, orlon, dacron, and rayon. They

are examples of remarkable products created to meet a modern need. On the other hand, wood is such an old material and has so many common uses that it is too frequently taken for granted. So, if we did not have wood, it would be necessary to invent it in order to have a material to do the many jobs it is called on to perform.

Suppose one day your morning paper headlined this incredible story: "Scientists of the Atomic Chemical Company announced today the discovery of an amazing new material called 'Doow.' This material can be made so cheaply of earth, air, and water and has such amazing properties that it will soon find thousands of uses in every home and industry. You may some day live in a house and get up from a bed built of this new material, dress with "silk" clothing, breakfast at a table, and read a newspaper made from it." If "Doow," which you recognize is merely "Wood" spelled backwards, were a modern "invention," could you not imagine it being hailed this way? But we would still have trouble producing it synthetically as cheaply as in nature's great "factory" -- the forest -- through the process of photosynthesis, actuated by the free energy of sunlight.

As we stand today, one of the significant trends reflecting a confidence in the future of wood is the acquisition and consolidation of large tracts of forest land by pulp and paper and lumber companies. Under good management these forests can assure continuing availability of basic raw materials.

### The Timber Resource Review

I should like to outline for you some of the important findings of the recent Timber Resource Review conducted by the U. S. Forest Service with the help of every major segment of the timber industry. The facts presented in the review are pertinent to this appraisal of the continuous yield of our forests, and are of special interest to those who are actively working in the forestry and forest products fields. How have we managed our forest inheritance? What is the present balance between growth and cut? What of the future? What will be our forest products needs? A series of charts are presented that illustrate graphically and succinctly a number of basic facts about our forests and our forest products demands.

In this review I am not going to cover some of the other well-recognized and significant values of the forests. They should be obvious and familiar to all -- their recreational value, as an open sesame to the majesty of the great outdoors; their function as the home of the three F's, fur, fish, and feathers; and their important service as regulators of watersheds. These are values everyone can appreciate, but on which no one can place a specific dollar value.

### Population and Gross National Product (Fig. 1)

We are living in an era of tremendous growth. One of the principal reasons for the great expansion is the sharp increase in our population. Our death

rate has declined. Our birth rate has zoomed. The census bureau estimates there will be 275 million people in the United States in the year 2000. Likewise, economists estimate that our gross national product will continue to grow, reaching a total of 1,200 billions of dollars in the year 2000, in terms of 1953 values. These figures afford a concept of the job ahead in planning to provide forest products for those who come after us, so that they may enjoy the same abundance we have today.

### Use of Our Land (Fig. 2)

The timber resource report has revealed that 34 percent of our total land area in the United States and coastal Alaska, commercial and noncommercial, is in forest. Completing the picture of our total land use, we find that 36 percent is in pasture and range, 21 percent in crop land, and about 9 percent in commercial and urban use. It is significant to remember that one-third of the total land area is in forests.

### Ownership-Private Commercial Forest Land (Fig. 3)

A review of the ownership of private forest land as it relates to the job of forest management is revealing. The forest industries, especially lumber and pulp, own 13 percent of the private commercial forest land. Some 3-1/3 million farm owners hold 34 percent, and something over a million nonfarm owners own 26 percent. This analysis shows that some 73 percent of the forest land (359 million acres) is privately owned and 27 percent (130 million acres) is in public ownership. Particularly significant, from the standpoint of forest management, is the fact that only some 23,500 ownerships are in the hands of forest industries, whereas approximately 4-1/2 million are in the hands of farmers and other owners.

### Consumption of Industrial Wood (Fig. 4)

It is important in our appraisal to include a review of the consumption of industrial wood, which includes lumber, pulpwood, and a number of other products. Observing the trend in consumption beginning with the year 1900, it may be noted that there was a substantial dip in the forest drain during the depression, but that with the upsurge in the postwar economy the curve indicates a steep upward trend to the year 2000. Depending on the assumptions made, the Timber Resource Review indicates that the consumption may vary from a lower level estimate of 17 billion cubic feet by the year 2000 to an upper level drain of 21 billion cubic feet. This indicates that we will approximately double our use of industrial wood by the year 2000.

### Consumption of Timber Products (Fig. 5)

Where does all this wood go? The analysis shows that, in the consumption of timber products for 1952, comprising a total drain of 12.2 billion cubic

feet, lumber and lumber products represented 53 percent, pulpwood 22 percent, fuel wood 16 percent, veneer and plywood 3 percent, and miscellaneous other products some 6 percent. Looking ahead, we can expect the per capita consumption of lumber to decrease slowly, whereas in recent years consumption of some products like pulpwood and veneer logs has sharply risen. In the meantime, our use of certain other products has increased less rapidly and the use of fuel wood has markedly decreased. In the overall picture, the consumption of timber products in this country is at an all-time high.

The average American uses about 80 cubic feet of wood per year. Lumber is used in greater amounts than any other industrial timber product. Each one of us uses twice as much lumber as a Russian, four times as much as an Englishman, and six times as much as a Frenchman. Our use of paper, too, far exceeds that of any other country. Our paper and paperboard consumption reached the very substantial figure of 384 pounds per capita in 1954, and 436 pounds in 1956.

#### Sawtimber Volume (Fig. 6)

How much standing sawtimber do we have and where is it located? The Timber Resource Review estimates our total sawtimber stands at 2,057 billion board-feet, with softwoods predominating. The major portion of the softwoods -- 1,406 billion board-feet -- is in the West. This is a long haul from major markets. Only 242 billion board-feet are in the East. Most of the standing hardwoods, 381 billion board-feet, are in the East, and only 28 billion in the West.

#### Low Quality-A Problem (Fig. 7)

In the inventory of the forest resource, the quality of the timber in present stands needs to be considered because of its importance with respect to potential use. A particular problem is presented by the eastern hardwoods; almost three-fourths of this timber is of low quality and in need of stand improvement. Research in forest products can be an important factor in aiding forest management to solve this problem.

#### Sawtimber Growth and Cut (Fig. 8)

One of the most important phases of the forest inventory is the picture with respect to growth and cut. Are we anywhere near in balance and what is the picture by regions and types?

As of 1952, in the East, the growth of softwoods was 16.97 billion board-feet. This was a little more than the cut -- 14.09 billion board-feet -- to give us a favorable balance. For Eastern hardwoods the growth was 19.12 billion board-feet, as compared to a cut of 12.21 billion, to indicate an even larger budget margin. The contrast with the West is striking. There, sawtimber growth was 11.31 billion board-feet in 1952, as compared with a cut of 22.54 billion.

In considering growth versus cut, there is a tendency to make overall comparisons. Such comparisons are often meaningless and can be quite misleading. For example, our Nation is now growing nearly as much sawtimber (47.4 billion board-feet) as it is cutting (48.8 billion board-feet). However, we are cutting more softwoods than we are growing and it is hardwood growth (in excess of hardwood cut) that makes up the difference. Even an overall comparison of just the softwood growth and cut is not very logical. There are inherent differences between the East and the West -- unlike the East, the West still has virgin forests which are adding little growth and yet are being heavily cut. The reason we are not cutting hardwoods faster is that we do not know how to use them as widely as the softwoods, and for some uses they are still less adaptable.

### Sawtimber Growth Needed (Fig. 9)

It is reasonable to expect that wood will continue to play an important part in the life of every American. Now let us project ahead our present sawtimber requirements on the basis of anticipated population and industrial growth. The Timber Resource Review estimates a lower level demand by 1975 of 59 billion board-feet as compared to a growth of 61 billion; and an upper level need for 68 billion board-feet. For the year 2000, the lower level demand is estimated at 79 billion board-feet, with a growth of 67 billion; and a potential upper level demand of 105 billion board-feet as compared to a growth of 25 billion. The lower level estimate reflects a possible reduction in the per capita consumption of wood such as might be associated with a rise in the price of industrial wood compared with competing materials. The upper level reflects a maintenance of the present relative place in the economy with expected increase in population and improved living standards. This wide spread between growth and demand could take place if during the years ahead we cut into our timber reserves so much that our growth will not be able to keep up. This is the situation we need to take aggressive steps to prevent.

All of the findings bring out in relief the contrast between the timber we have today and the timber we may need tomorrow. To balance cutting in the year 2000, it will be necessary to raise the annual timber growth from today's 47 billion board-feet to between 80 and 100 billion board-feet, or even more. To do this and to meet our rising demands each year until 2000, means that we need to practice a lot more forestry on a lot more acres than we are doing right now -- a lot more than most of us have ever thought about. Where we stand in 2000 depends, from now on, on what we do in the years ahead. If we put every acre under good forest management, we can have the timber we need as the continuous yield of our forests.

### Utilization Efficiency and Input-Output Balance

To complete the overall picture, it may be asked, where do we stand with respect to the efficiency of the present forest products operation in terms

of the proportion of the timber cut that is not fully utilized? What is the status of the timber input and output in the present economy, particularly with respect to unused logging and plant residues?

#### Proportion of Timber Used (Fig. 10)

About one-fourth of the timber cut each year is not used. The amount of the unused material differs widely among the several different conversion fields. For example, of the timber cut for lumber, about 34 percent is not utilized either for fuel or for other purposes. On the other hand, the efficiency of pulpwood utilization continues at an extremely high level in that only 4 percent of the timber cut for this purpose is not used. Some residues are obviously inevitable in logging and in wood conversion and fabrication. However, we are confronted by the continual challenge of finding through research additional uses for residues from all sources, and particularly in the field of timber cut for lumber, in the overall job of making our timber supplies go farther and serve the Nation better.

#### Input and Output in Timber Economy (Fig. 11)

A review of the input and output in the overall timber economy is of interest in indicating the sources of our timber supply and the relative output in several principal categories. It was brought out by the Timber Resource Review that of our total timber input of 13,609 million cubic feet, 10,757 million are from timber cut from growing stock, 1,705 million are from dead and cull trees, and 1,147 million are from imports. With respect to output, the total in final products of 10,863 million cubic feet is comprised of: lumber, 3,469 million; pulpwood, 2,637 million; miscellaneous products, 997 million; and fuelwood, 3,760 million. It may be noted that our output -- the volume of final products -- comprises approximately 80 percent of our total timber input. This leaves a 20 percent volume of residues, comprising 1,364 million cubic feet from logging and 1,382 million from plant operations, that invite study for further improvement in utilization efficiency.

#### The Job Ahead to Meet Our Timber Needs

Now let us consider the implications of this brief review of some of the resource findings. What are the things that need to be done and what are some of the methods of putting them into effect? This is a job that requires a lot of skills among a lot of people. It involves, from the standpoint of forestry, putting every acre under good forest management to produce the timber we need. It requires, from the standpoint of forest products research, more efficient utilization to make our forest supplies go farther and serve the Nation better. But forest products research has another important role. There is a growing recognition of the thesis that the best way to achieve good forest management is to provide markets for all the wood that grows and there is no better -- in fact no other way -- to provide markets than by research.

Some of the major problems facing forest management in developing this "continuous yield of our forests" are quite obvious.

Our problem stems from the fact that most of America's 489-million-acre forest tract is in the hands of small owners -- farmers, businessmen, professional people, and others -- not associated with the forestry industry. Small forests of less than 100 acres each make up 86 percent of the total number of private ownerships. In the overall appraisal, it has long been recognized that our major deficiency in the growth of timber lies in these small ownerships. How many ownerships are there? The Timber Resource Review shows 4-1/2 million. One problem is how to get this number of small parcels of land to grow the kind and quality of timber needed.

Major commercial ownerships recognize the importance of good management of timber and are doing a good job. And of course it is taken for granted that public ownerships recognize the necessity of forest management and the importance of developing leadership in this work.

Another problem of the small owner is the need of better harvesting and marketing facilities. How can he combine with other small owners to provide marketable products with greatest potential returns?

While timber growing can be improved by better management of existing run-of-the-woods stock, it can be accomplished faster and more efficiently with the type of super trees now being developed by genetics research. Considerable progress in forest genetics has already been made in some areas and with some species. This involves developments in the selection and breeding of better trees, the pioneering of commercial-scale seed production areas and seed orchards, and an expansion of the planting program. Research is centered on the selection and breeding for superior wood properties, such as high density and low fibril slope, all combined with good form and growth rate.

This discussion would not be complete without a further word on forest products trends and development, and the challenge of research as related to the future of utilization.

Lumber for years had been the major product of the forest. Today we look on the forest as a source of raw material for a wide variety of uses and products, but lumber will continue to be an important item. In fact, a healthy lumber industry is an essential part of a diversified utilization program.

Forestry, in the years ahead, must be based on multiple product yield, with management geared to quality control for specific products. Improved efficiency by the forest products industries points to integrated utilization, and industrial consolidation and expansion to this end are already actively under way. An increasing portion of the Nation's demand for wood in all forms can be expected to come from the integrated operation. It will provide lumber, veneer, plywood, paper, fiberboards and particle boards, molding compounds, chemical products, and a great variety of others. Integrated

utilization has already contributed to the reduction in woods and mill waste, with the result that about two-thirds of the tree is now used, as compared with one-third in days when waste burners were a part of every sawmill operation. The material formerly unused is now the profit margin in many small plants.

### The Role of Research in Forest Products

The list of research accomplishments that have already had a significant effect on utilization is both varied and extensive. Included are such developments as the wide diversification of the species base for pulp and paper; the development of the semichemical and cold caustic soda pulping processes with significantly increased yields and special adaptation to hardwood utilization; fundamental studies of the chlorinated phenols as wood preservatives leading to the development of pentachlorophenol; significant progress in the development of the basic chemistry of wood sugars and their production from wood waste; with the advent of synthetic resins, the development of the glued laminating industry and the potentials of sandwich construction; the development of structural timber grades leading to improved utilization in the engineering field; the increased use by pulp mills of mill residues in place of forest wood; and the development of the extensive fiberboard industry, including particle boards, largely based on the utilization of wood residues. These are but a few of the many developments.

What are some of the significant problems awaiting further research? Among the first and foremost is that relating to the better utilization of low-quality hardwoods that occupy some 50 million acres of land that should be converted to the growing of better stands. A great deal of research and effort is needed to create new and different uses for hardwoods. We need to know more about the basic chemistry of hardwoods and softwoods, with the long-range objective of developing a great variety of useful chemical products. For example, hardwoods contain more furfural-producing pentosans than softwoods. The increasing demand for furfural suggests the refinement of the processes that have been developed for its production and the obtaining of the necessary design data for the construction of conversion facilities. Similarly, further studies are needed on lignin to obtain processes that reduce the degradation of this material and to develop fractions with properties that make it valuable. We need to know more about extractives and means of utilizing bark. There are opportunities for research in improved sawing and milling practices. The band mill of today has been little changed in the last 50 years. The losses through the saw kerf continue to be significant.

Lumber is cut and marketed much as in the past, and there is room for improvement of product and of seasoning. As yet we do not have comparability of grades or standard sizes of lumber associated with specific moisture content. Greater standardization of sizes and qualities is needed,

with consideration given to the reduction of installation costs. Continuous research is necessary to expand more fully the use of wood residues.

### Conclusions

In conclusion, it may be noted that although wood was among the first structural materials in the primitive world, it significantly maintains an indispensable place in the modern age. Forests and forest products in some way touch nearly every aspect of our daily life. The significant trend in increased population and increased output of goods, when projected into the future, carries with it implications of increased demands on our material resources, with very substantial increases in forest products requirements to meet the need for the diverse products essential to the future economy. The comprehensive Timber Resource Review has provided specific data on the status of our forest resource, our estimated forest products needs, and the potential of our forest resource to meet these needs. In this appraisal of the continuous yield of our forests, the analysis indicates that through expanded research in forestry and forest products utilization -- through the putting of every acre under good forest management -- we have the keys to providing the timber we need, for timber is a renewable resource. As our resources fare, so fares our way of life.

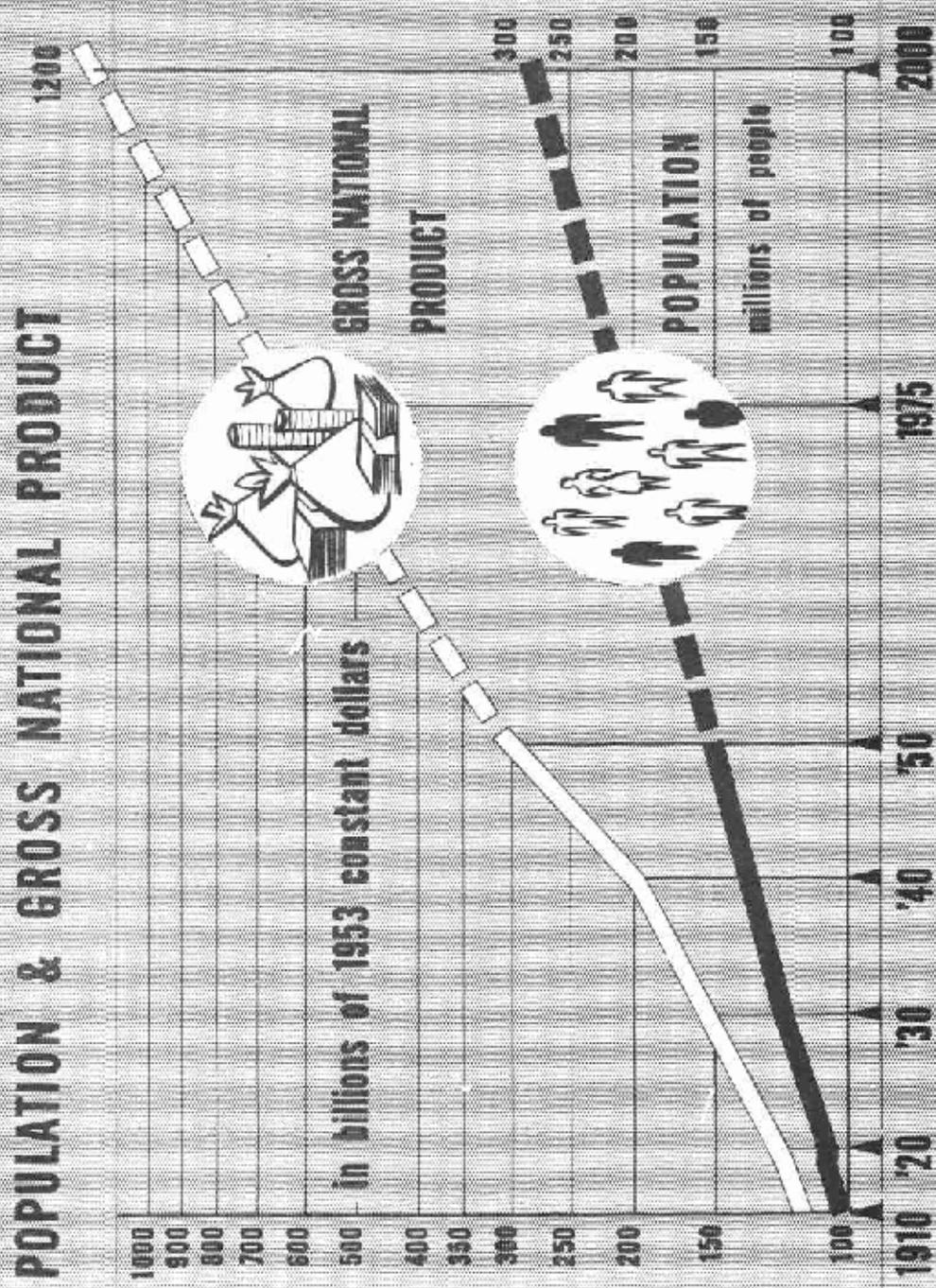


Figure 1. -- Trends in population and gross national product estimated through the year 2000. (Source: Timber Resource Review)

# USE OF OUR LAND

## U.S. & COASTAL ALASKA

- 1. FOREST LAND 34%
- COMMERCIAL 25%
- NON-COMMERCIAL 9%
- 2. CROPLAND 21%
- 3. PASTURE-RANGE 36%
- 4. OTHER 9%

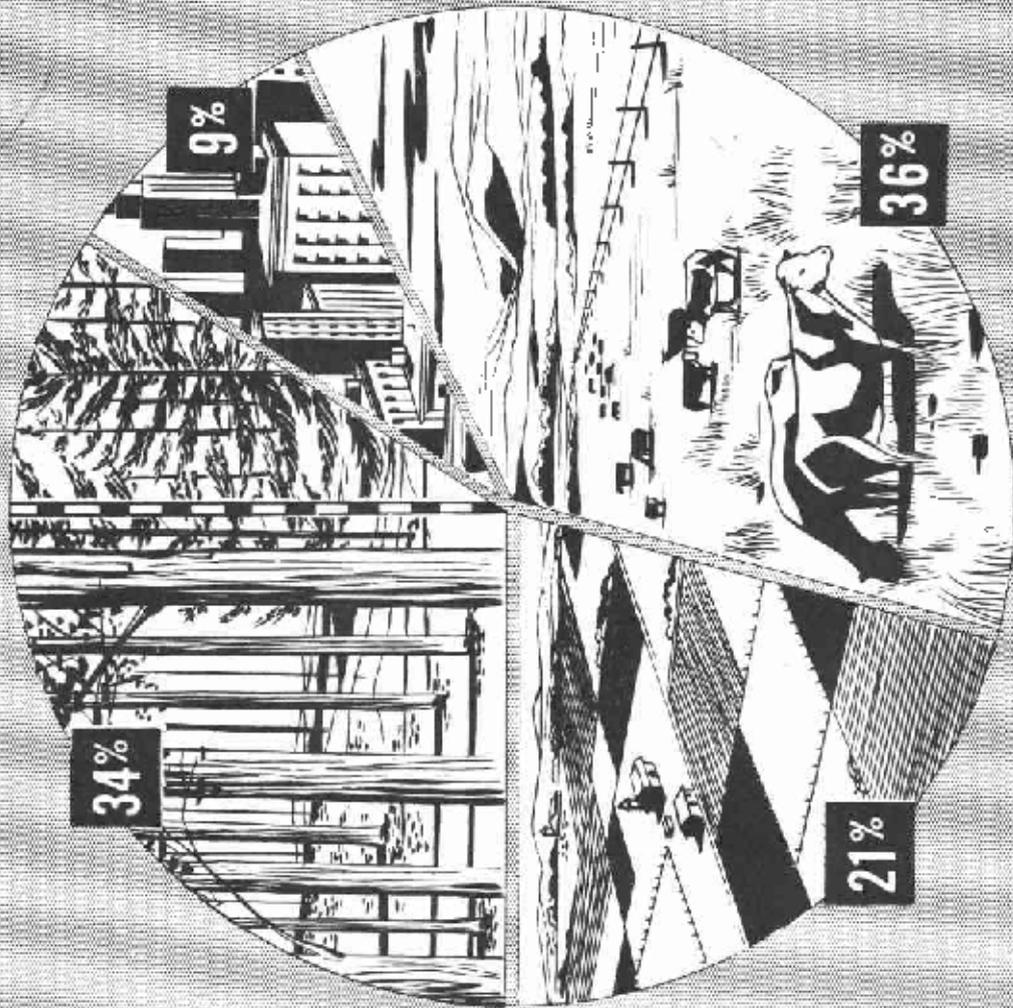


Figure 2. --How the land area of the United States and Coastal Alaska is used.

# OWNERSHIP

# PRIVATE COMMERCIAL FOREST LAND

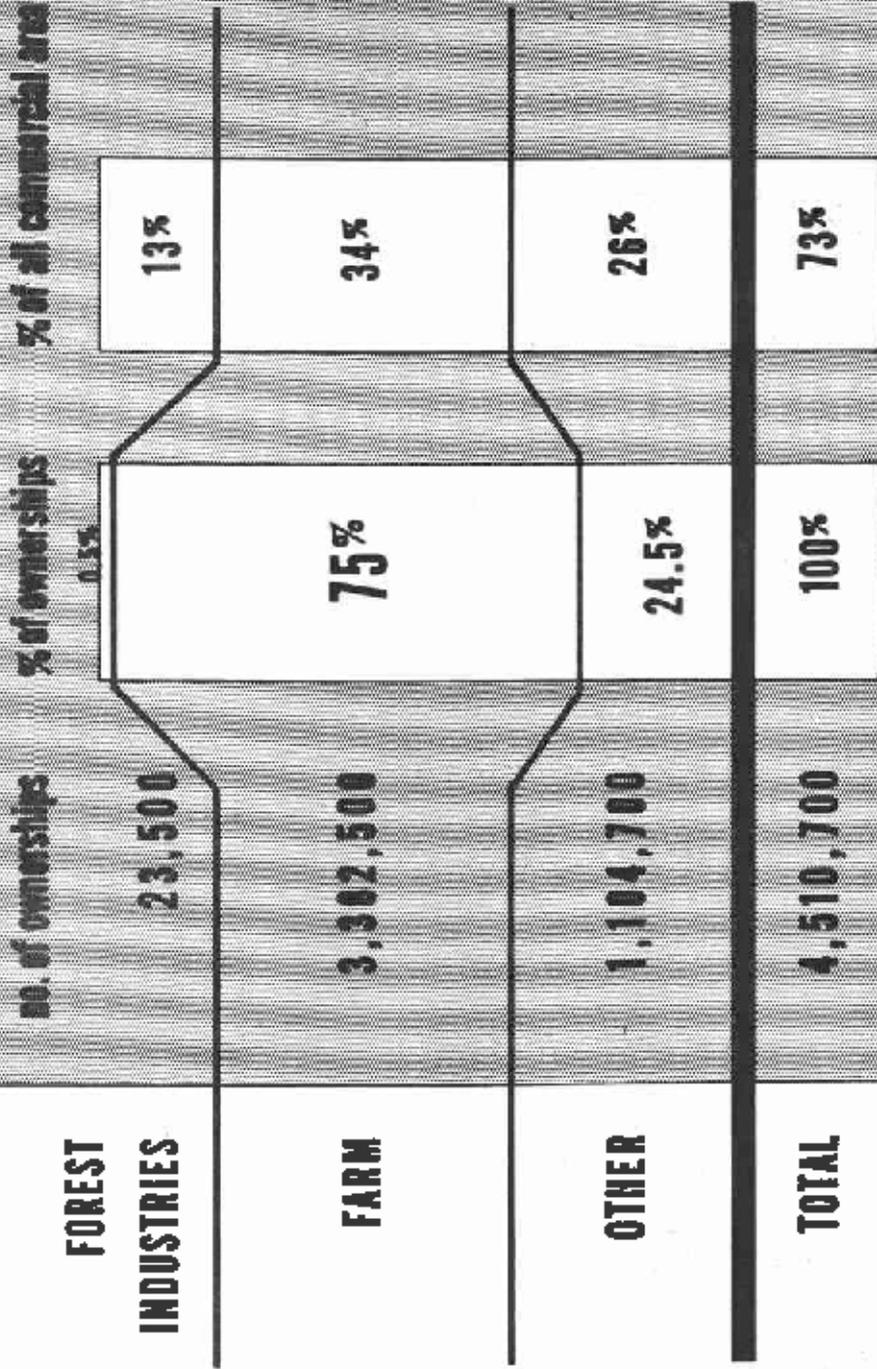


Figure 3. --Farmers are the largest single group of private commercial forest land owners. (Source: Timber Resource Review)

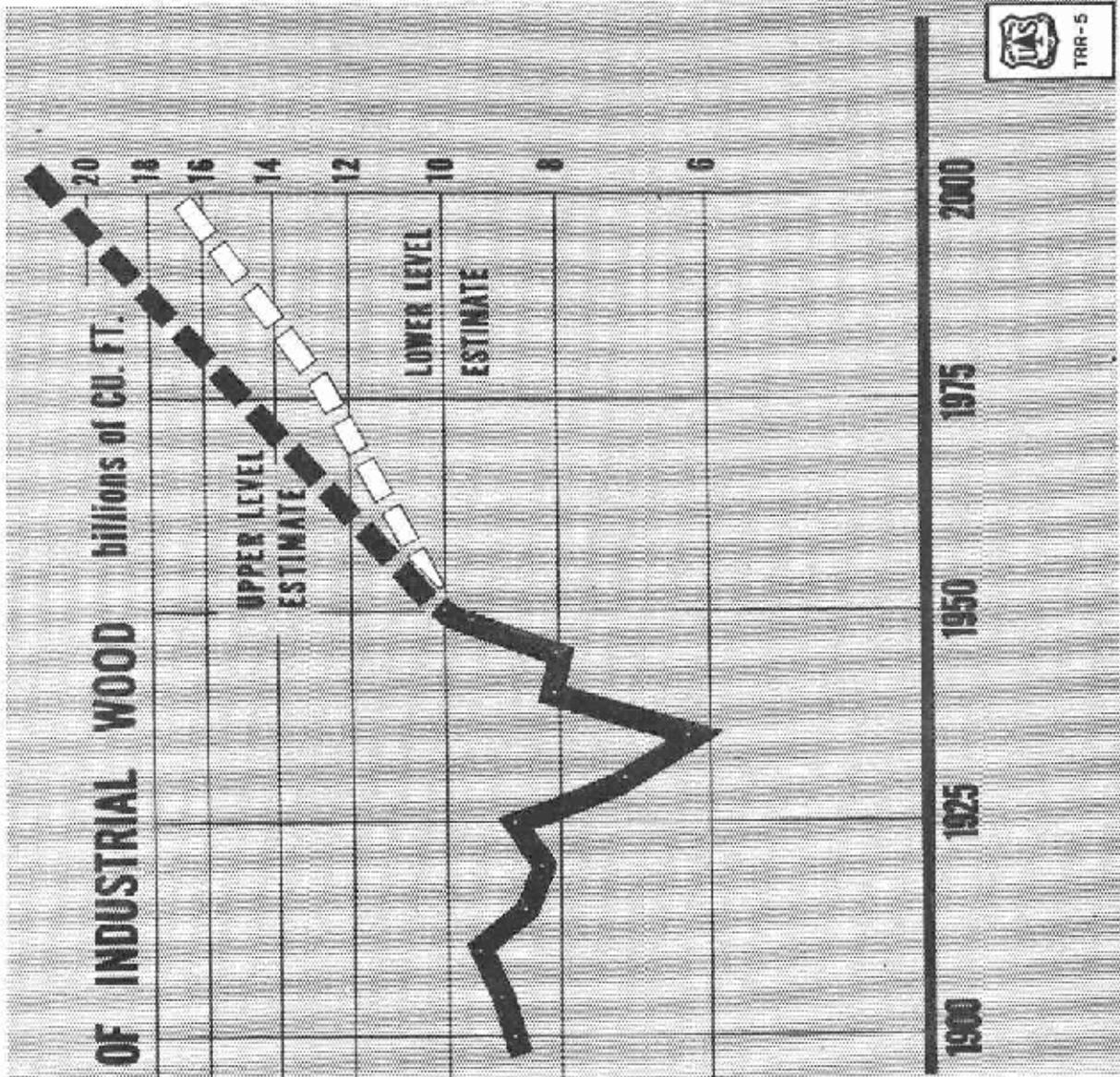
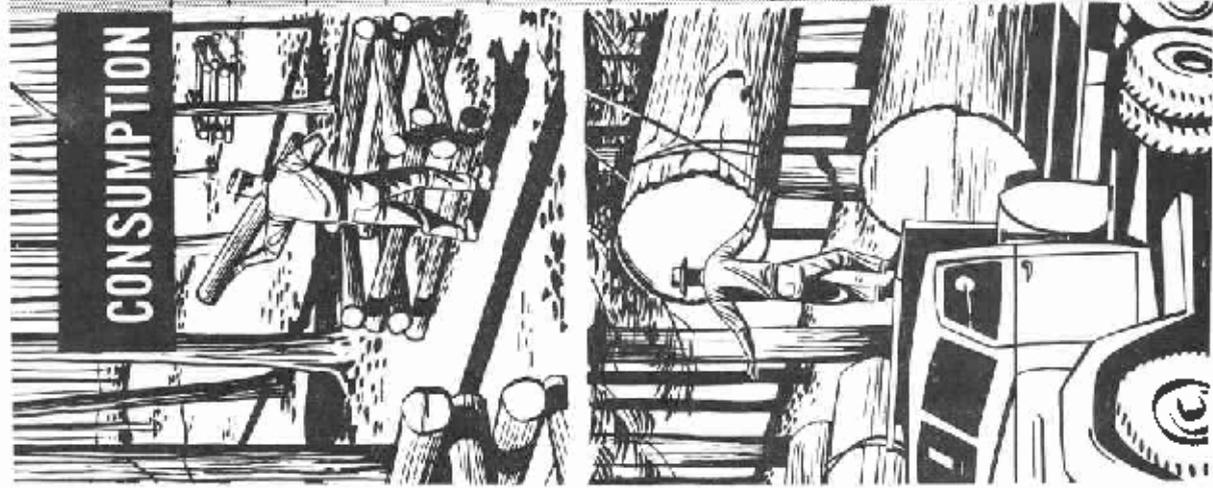
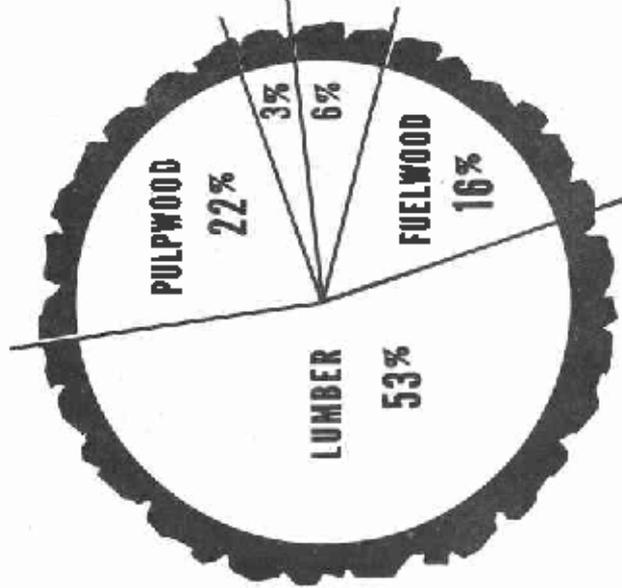


Figure 4. -- Estimated consumption of wood for all industrial purposes in 1975 and 2000. (Source: Timber Resource Review)

# CONSUMPTION OF TIMBER PRODUCTS-1952



**TOTAL - 12.2 billion cubic feet**

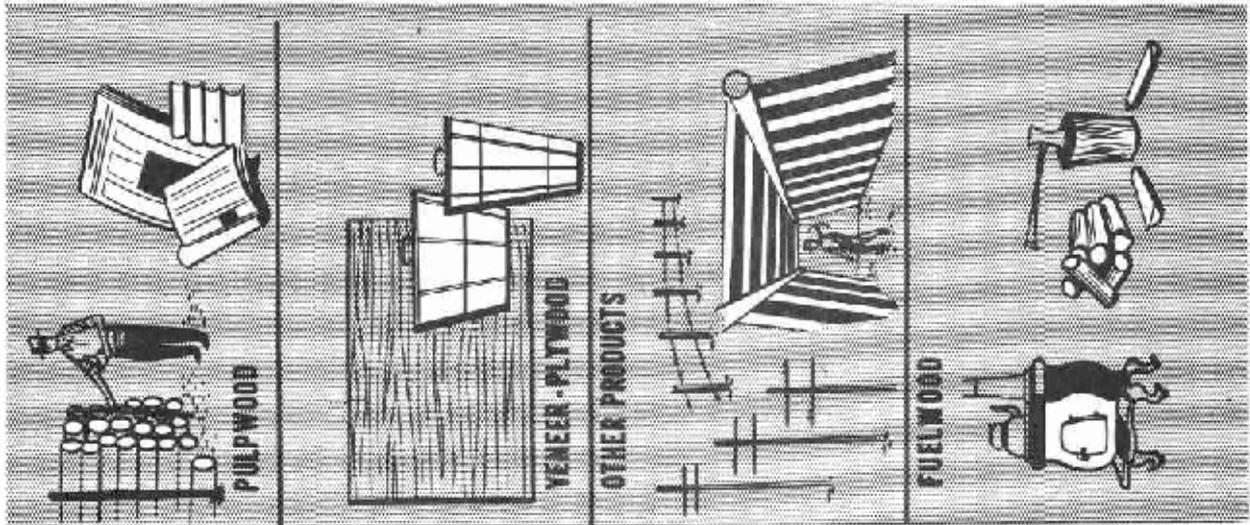
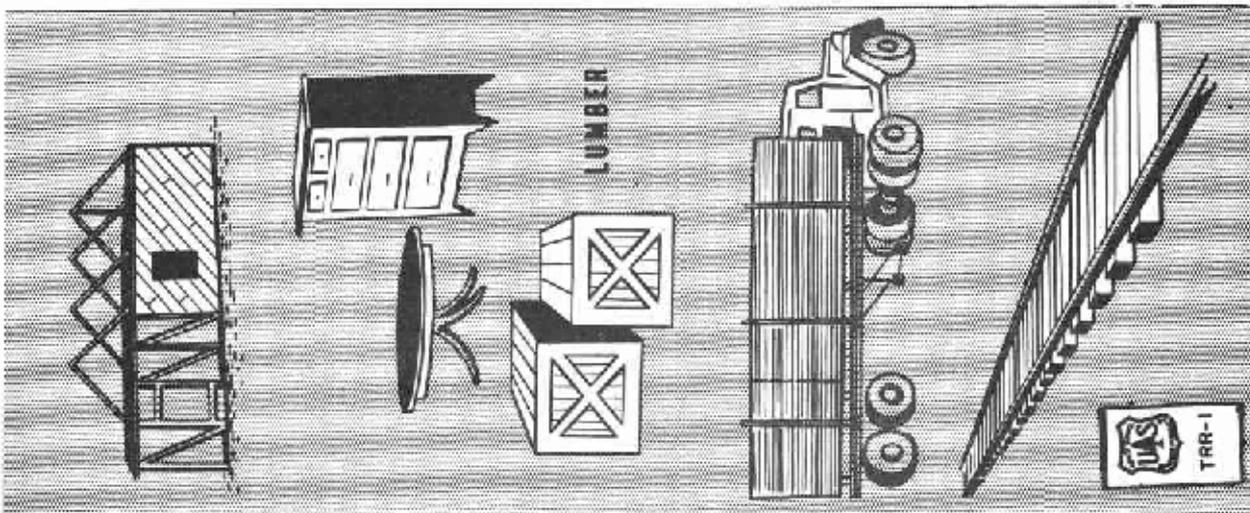


Figure 5. ---Comparative volume of various timber products consumed in the United States, 1952. (Source: Timber Resource Review)

# SAWTIMBER VOLUME

2.057 billion board feet

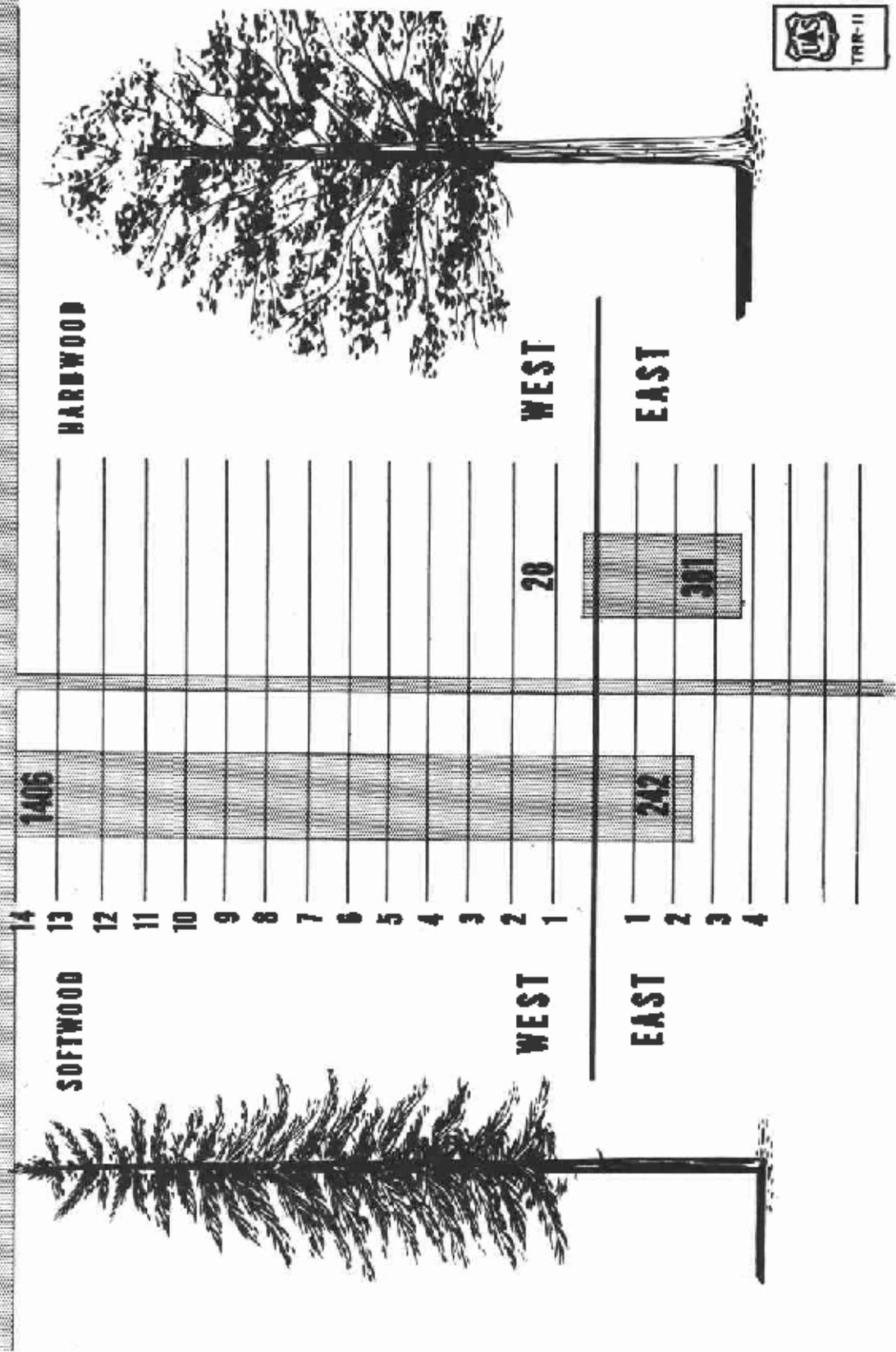


Figure 6. -- Distribution of softwood and hardwood sawtimber in the eastern and western United States, 1952. (Source: Timber Resource Review)

# LOW QUALITY--A PROBLEM

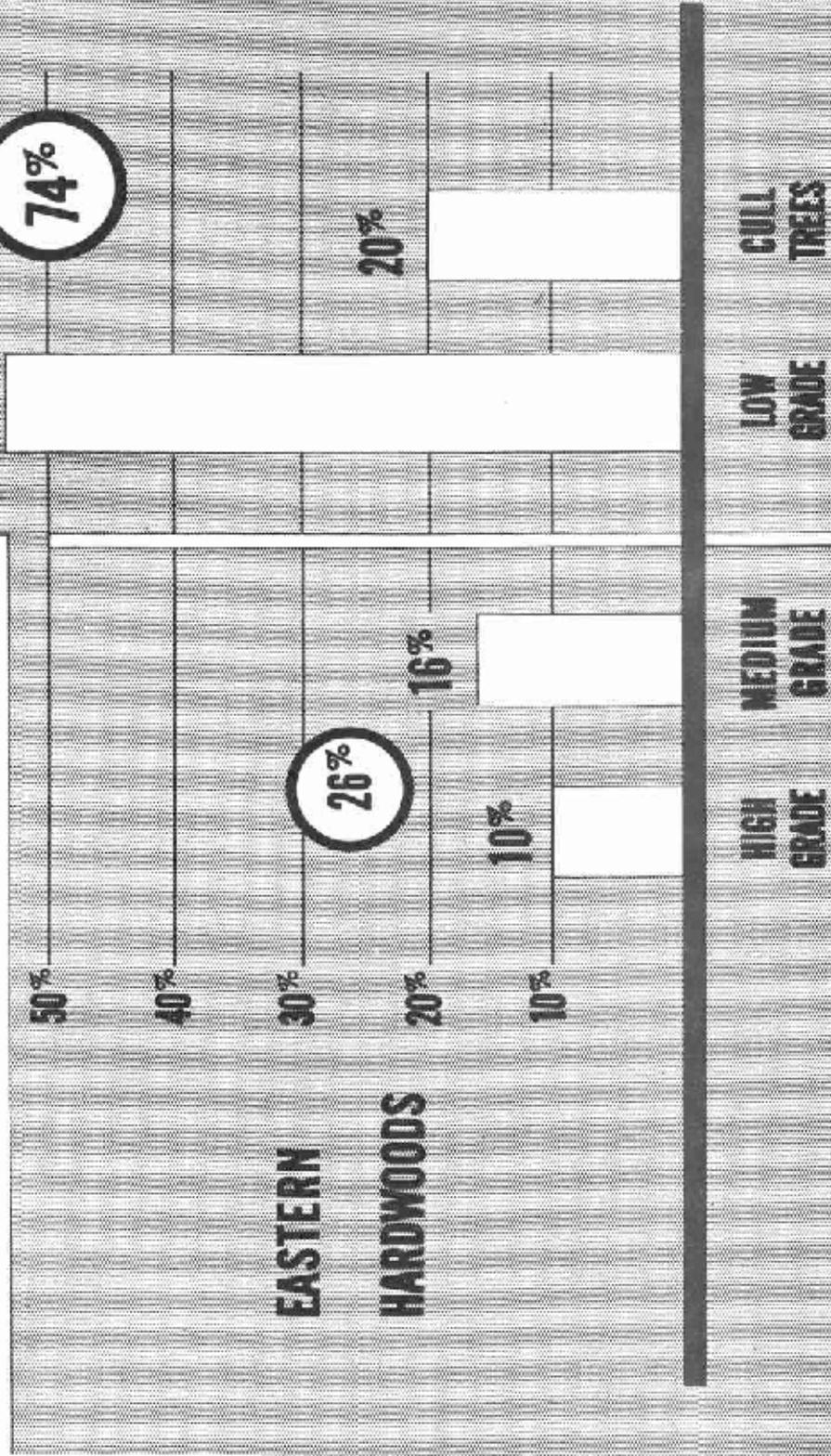
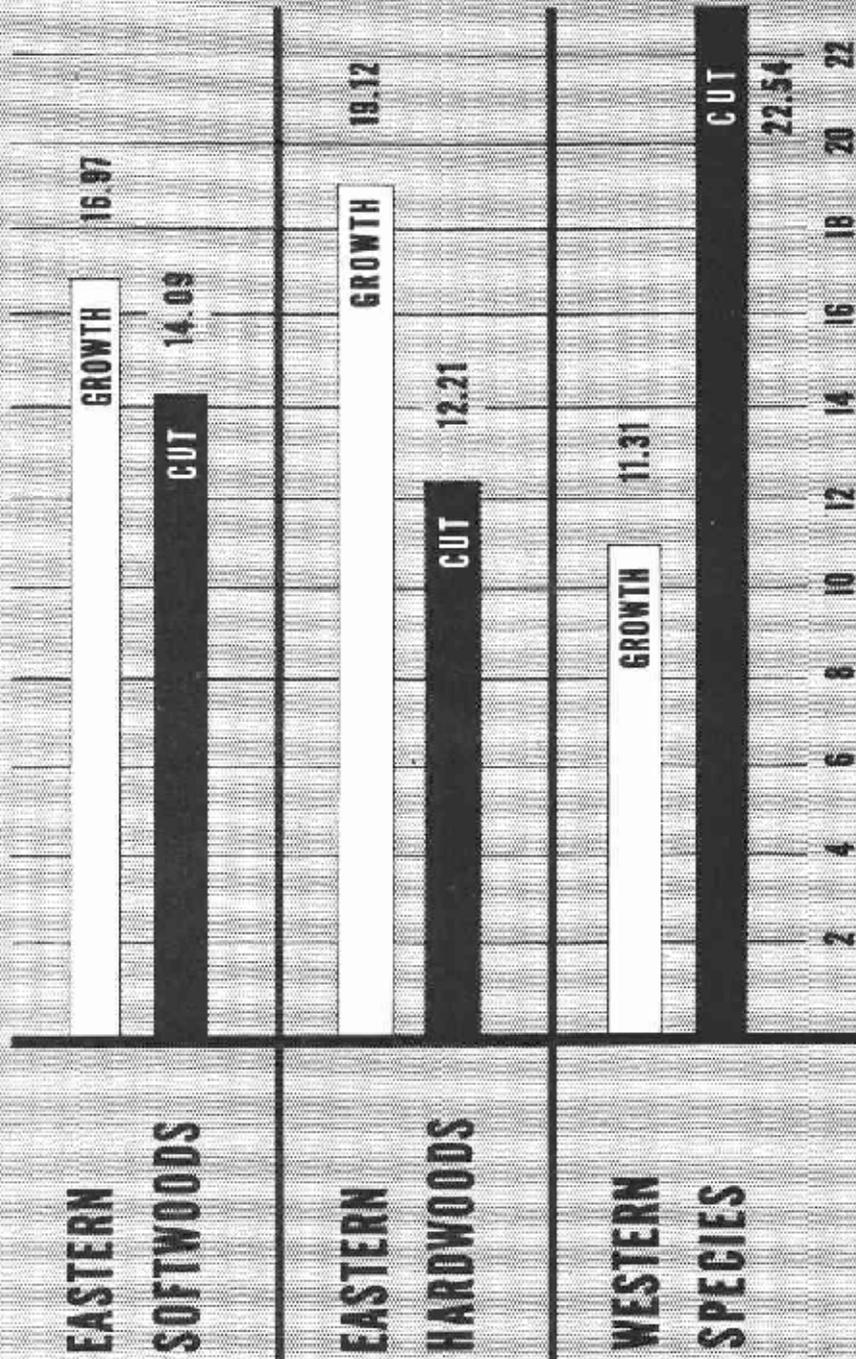


Figure 7. --Almost three-fourths of all eastern hardwoods are of low quality.  
 (Source: Timber Resource Review)

# SAWTIMBER GROWTH & CUT, 1952

in billions of board feet



TFR-18

Figure 8. --Sawtimber growth and cut for 1952. (Source: Timber Resource Review)

# SAWTIMBER GROWTH NEEDED & PROJECTED in billions of board feet

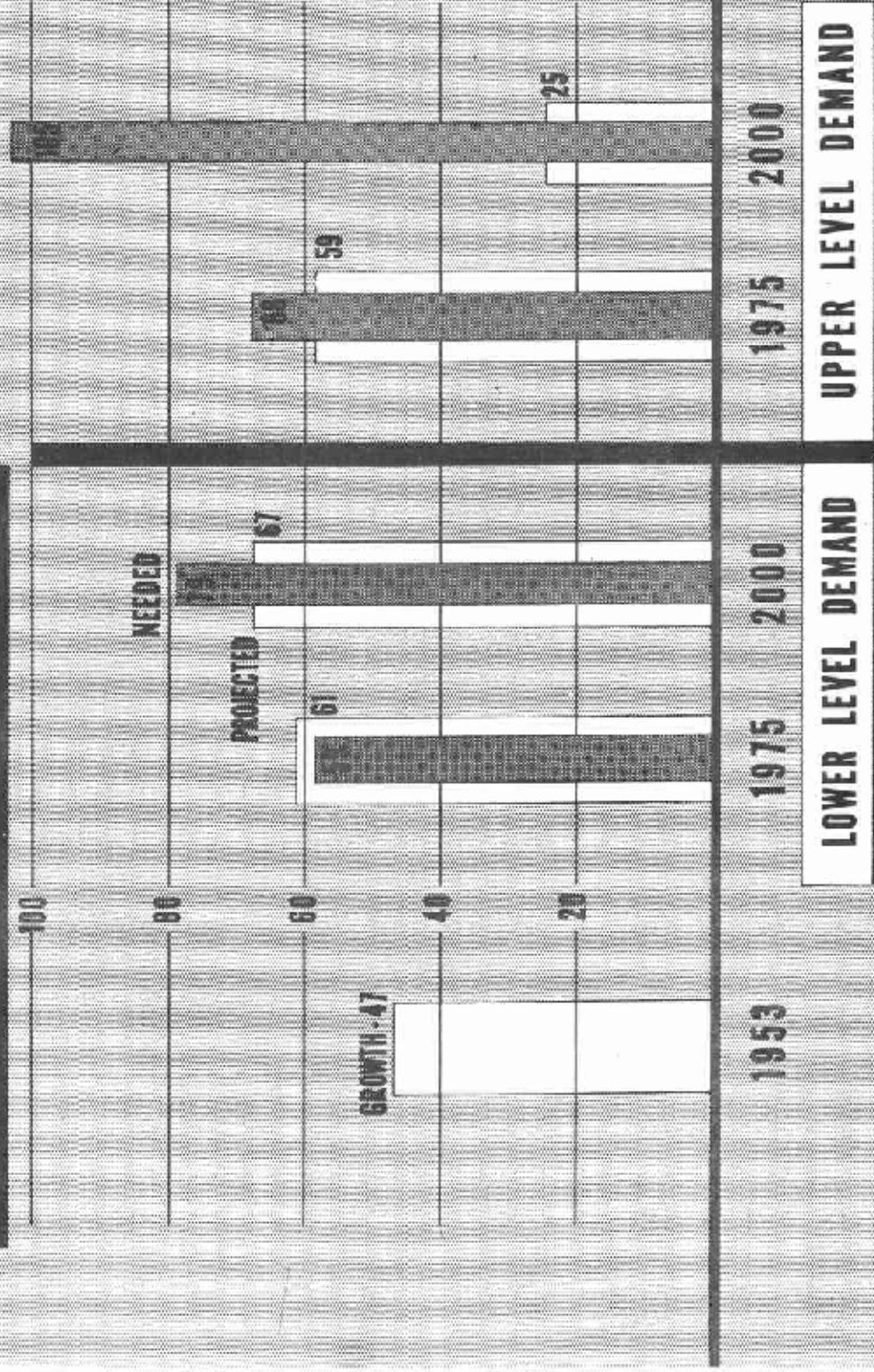
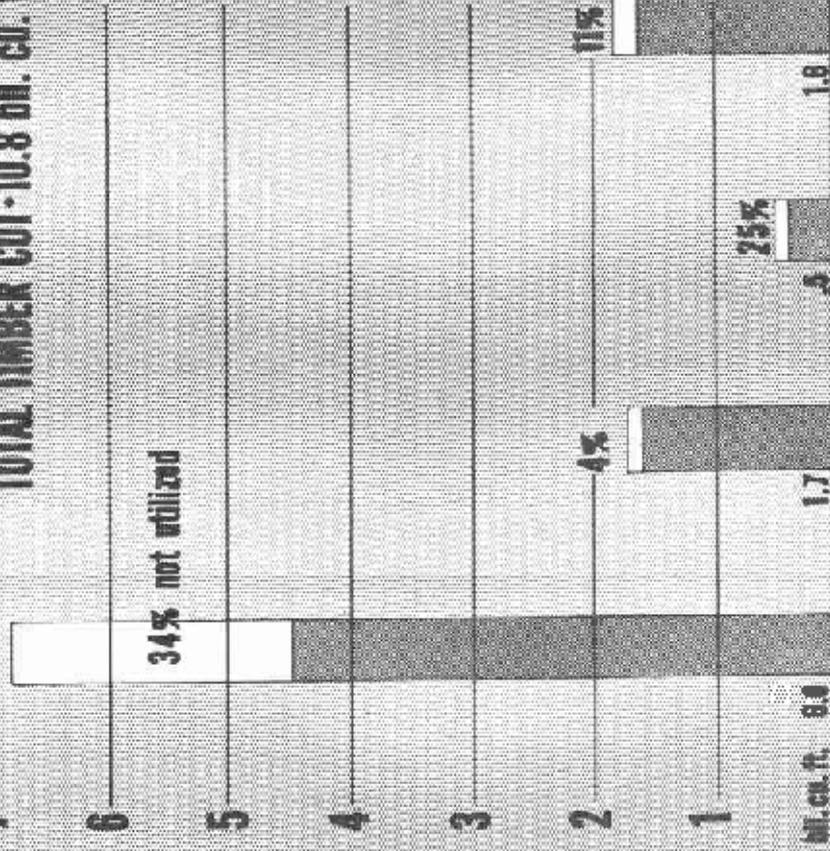


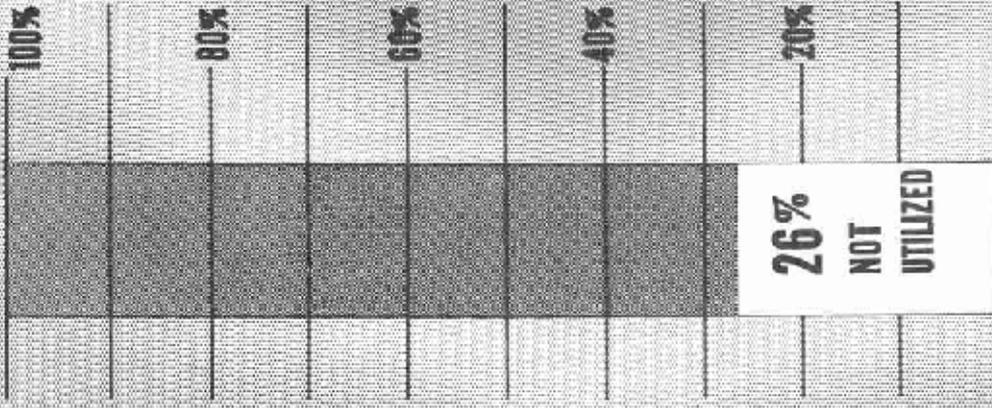
Figure 9. -- Estimates of sawtimber growth needed and expected, at two demand levels for the years 1975 and 2000. (Source: Timber Resource Review)

# 1/4 OF TIMBER CUT IS NOT UTILIZED

7 TOTAL TIMBER CUT - 10.8 bil. cu. ft.



LUMBER PULPWOOD VEN.-PLYWOOD OTHER



ALL TIMBER CUT

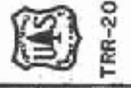
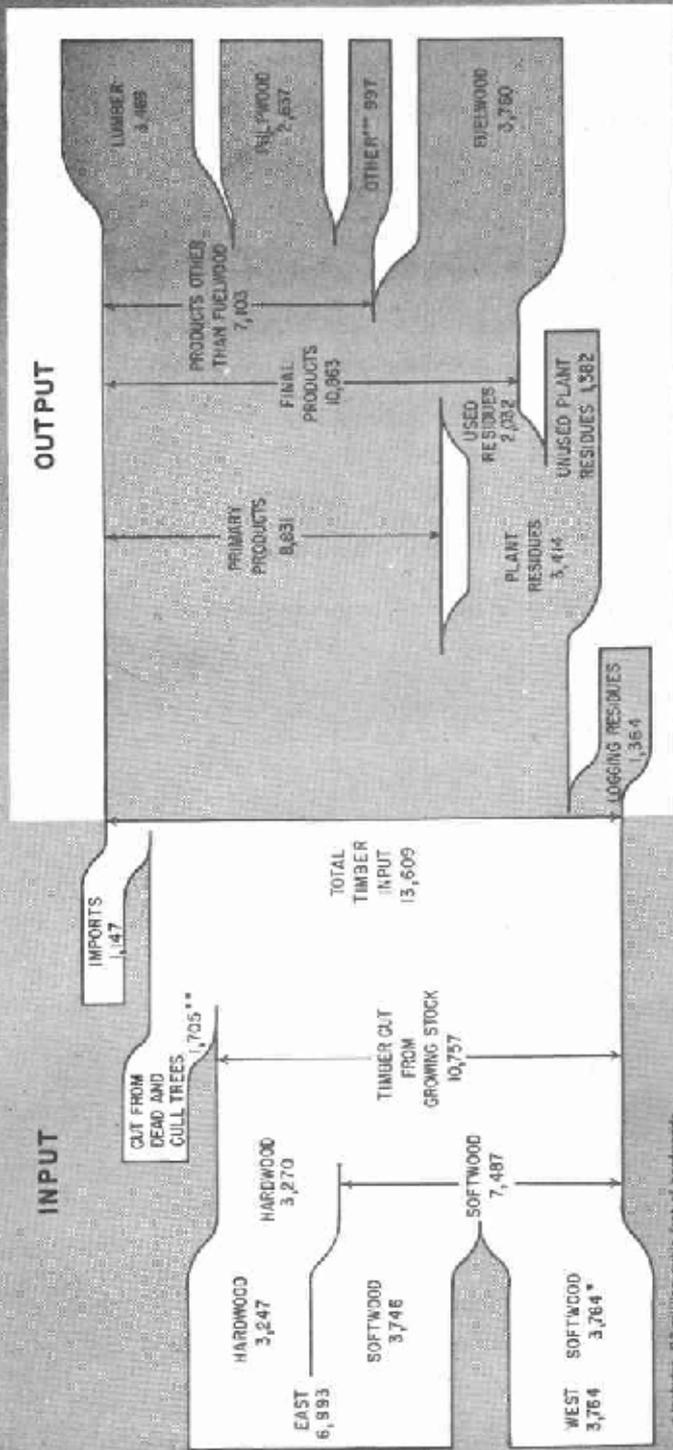


Figure 10. -- One-fourth of timber cut is not utilized. (Source: Timber Resource Review)

# INPUT AND OUTPUT IN THE TIMBER ECONOMY, UNITED STATES, 1952



All figures in million cubic feet.

\* includes 25 million cubic feet of hardwoods.  
 \*\* In addition to cull and dead trees, includes trunks of commercial species less than 4.0 inches in diameter and tops less than 4.0 inches in diameter, and trees from noncommercial forest land.  
 \*\*\* includes a small quantity of plant residues used in agriculture.

Figure 11. -- Input and output in the United States timber economy, 1952.  
 (Source: Timber Resource Review)

ORGANIZATIONAL DIRECTORY

of the

Forest Products Laboratory, Forest Service  
U. S. Department of Agriculture

-----

J. Alfred Hall.....	<u>Director</u>
L. J. Markwardt.....	<u>Assistant Director</u>
Florence Rose Steffes, <u>In Charge</u> .....	<u>Library (Madison Branch USDA)</u>
Claude A. Brown, <u>Chief</u> .....	<u>Fiscal Control</u>
Gardner H. Chidester, <u>Chief</u> .....	<u>Pulp and Paper</u>
Donald G. Coleman, <u>Chief</u> .....	<u>Research Publications and Information</u>
Herbert O. Fleischer, <u>Chief</u> .....	<u>Timber Processing</u>
R. P. A. Johnson, <u>Chief</u> .....	<u>Physics and Engineering</u>
Kenneth W. Kruger, <u>Chief</u> .....	<u>Packaging Research</u>
Ralph M. Lindgren, <u>Chief</u> .....	<u>Wood Preservation</u>
Edward G. Locke, <u>Chief</u> .....	<u>Wood Chemistry</u>
Gordon D. Logan, <u>Chief</u> .....	<u>Administrative Management</u>
Harold L. Mitchell, <u>Chief</u> .....	<u>Timber Growth and Utilization Relations</u>