

U.S. SOUTH
"LIMITS TO GROWTH"

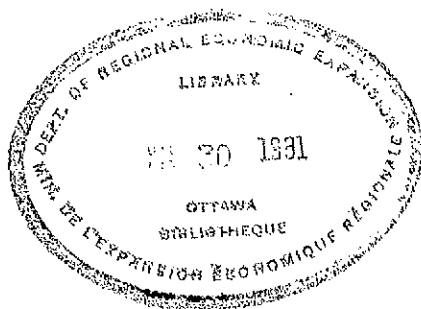
DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

JUNE 1978

HD
9757
A2
U5

NOT FOR QUOTATION

HD
9757
.A2
U5



U.S. South
"Limits to Growth"

June 1978

FOREWORD

This paper has been prepared by the staff of the Project Assessment and Evaluation Branch, Department of Regional Economic Expansion. Any views or opinion expressed in this paper do not necessarily represent those of the Department of Regional Economic Expansion nor of the Government of Canada. The material contained herein is based on both primary and secondary research, and while all reasonable care has been taken to corroborate the information we cannot guarantee the accuracy of facts obtained through interviews. This is one of a series of reports which provides background information on the prospects facing the Canadian forest products industry and is being made available so that the Department may have the advantage of informed comments from knowledgeable sources.

Table of Contents

	Page
Conclusions	i - iv
Executive Summary	v - xviii
1.0 Introduction	1
1.1 Methodology	1
1.2 Importance of U.S. South	2
1.3 Growth of Key Product Groups	5
1.4 Wood Cost Comparison with Canada	10
2.0 Present Wood Supply in the U.S. South	16
2.1 The Forest Resource	16
2.2 Ownership Structure	19
2.3 Wood Procurement System	20
2.4 Present Growth and Removals	24
3.0 Future Southern Wood Supply	28
3.1 U.S. Forest Service Projection for 2000 - Assuming 1970 Land Management Levels	28
3.2 Projected Wood Supply - Assuming Increased Management	32
3.21 Forest Industry Land	32
3.22 Public Land	40
3.23 Private Land	41
3.3 System Responsiveness to Local Shortages	51
3.4 Tree Utilization	54
3.5 Alternative Scenarios	55
3.6 Demand for Timber Products	59
3.7 Comparisons with Other Studies	66
4.0 Possible Constraints	70
4.1 Hardwoods/Softwoods Reversion	70
4.2 Labour	72
4.21 Wood Procurement	72
4.22 Labour Costs	72
4.23 Conclusions	74
4.3 Energy	75
4.31 Energy Conservation	78
4.32 Conclusions	79
4.4 Environmental Controls	80
4.5 Mill Sites	81
5.0 Appendices	84

Conclusions

As a result of the analysis conducted from our primary and secondary research, we have reached the following conclusions concerning:

- available wood supply in the U.S. South to meet projected increases in consumption of timber products in the U.S. by 2000
- constraints other than a wood shortage which might limit the growth of the forest products industry in the U.S. South.

Demand for timber products, to be sourced from U.S. forests by 2000, as projected by the U.S. Forest Service, is expected to grow to 23.7 billion cubic feet of roundwood equivalent, if imports are maintained at 1970 levels. Our analysis indicates the South is capable of doubling its 1970 level of output to 13 billion cubic feet, leaving a balance of 10.7 billion cubic feet of roundwood equivalent which will have to be supplied by either other wood producing regions in the U.S., or by an increase in imports to the U.S. In 1970, total removals from the U.S. forests were 14.0 billion cubic feet, 6.5 from the U.S. South and 7.5 from the balance of the U.S. The U.S.F.S., in their projections of available removals by 2000 from other wood producing regions in the U.S. (based on 1970

land management levels) indicate increases in output sufficient to meet the balance of 10.7 billion cubic feet of roundwood equivalent required for the projected demand of timber products in the U.S. by 2000.

In summary, given a reasonable set of assumptions concerning population and economic growth, and prices rising above 1970 levels, the best available data would suggest that the wood baskets in the U.S. are capable of meeting all incremental demand for timber products in the U.S. by 2000. It is our belief that only if areas other than the U.S. are able to produce timber products more economically, will imports into the U.S. increase above 1970 levels.

Other Constraints

Conclusions concerning other constraints such as softwood/hardwood reversion; labour; energy; and environment are listed below:

- The reversion of pine to hardwood must be considered among the most serious problems facing the South. Nevertheless, we believe this problem will be checked through combined industry and government programs, evidence of which has already been seen. It is important also to recognize that this is not a new problem and despite a significant loss of

acreage, softwood inventory in the South between 1950 and 1970 increased 42%.

- Labour shortages are not viewed as a constraint by companies interviewed. Increasing use of mechanization will lead to increased productivity and a reduced number of workers required. Labour costs are expected to rise due to mechanized harvesting, increased use of company crews for company harvesting operations and the pressure of higher wages of mill workers. Given the structure of the South, i.e. numerous small independent wood workers, we believe the South is likely to maintain its cost advantage over Eastern Canadian producers until 2000.

- Energy is considered a concern by all companies interviewed but they do not consider it a constraint to growth. In the South there is a trend away from using oil and natural gas to the utilization of waste fuels with companies becoming more self-sufficient and we expect this to continue. We believe the industry's potentially high degree of energy self-sufficiency will lessen the impact of future energy cost increases and shortages.

- The pulp and paper manufacturers in the U.S. are essentially in compliance with 1977 air and water pollution regulations

and capital expenditures on environmental controls for 1978 have decreased. Discussions are now being held concerning 1983 regulations and although technically pollution control is not a problem, increasing the efficiency will result in high capital cost. There is also a considerable lead time (2 years) for permission to build a new mill in the U.S.

- The availability of new mill sites in the U.S. South is not considered a constraint to growth by the industry. However, due to the high cost of environmental regulations, and the long lead time mentioned above, the industry's current emphasis is on upgrading and expanding existing facilities rather than building greenfield mills.

To summarize, our study indicates that the growth of the forest products industry in the U.S. South will not be limited by a wood shortage. Also, we believe that by 2000, the U.S. South will be able to double 1970 removals thereby reaching a level of supply adequate to meet expected growth in demand for timber products with moderate increases in fibre supply from other producing regions in the U.S.

It is not expected that there will be a wood shortage in the U.S. by 2000, and opportunities for the Canadian forest products industry in U.S. market are considered limited. This is particularly so for the Eastern Canadian industry.

Executive Summary

This study explores the "limits to growth" of the forest products industry in the U.S. South to the year 2000, focusing primarily on the future wood supply, and addresses the following questions:

- 1) Will a shortage of wood limit the expansion of the forest products industry in the South and significantly change relative prices?
- 2) Is the South able to meet projected increases in demand for timber products in 2000?
- 3) Are there other factors such as labour, energy and environmental pollution which could constrain the growth of the South?

The information contained in this report is based on both primary and secondary research.

Importance of the U.S. South

Through technological improvements in the use of small diameter logs and the successful pulping of Southern pine for newsprint, the U.S. South is today the primary competitor to Canadian producers of newsprint, market pulp, small dimension lumber, and softwood plywood. The South's market share of these products has increased dramatically since the second world war. Part of this increase has been at the expense of other producing

regions in the U.S., but also the South has cut into Canadian producers' share of their largest market - the U.S. For example, the Canadian share of the U.S. newsprint market dropped from 80% in 1946 to 63% in 1977. During this same period the U.S. South increased its share of U.S. newsprint capacity from 22% to 59%.

The South's forest products industry has grown rapidly in the last thirty years taking the leadership role in producing wood pulp (66% of U.S. total in 1976) and converting this into a wide range of products. Between 1946 and 1976 the South increased its share of paper and board production from 29% to 51% while total U.S. production increased 250%. The paper industry in the South consists of relatively large scale, integrated mills producing predominantly sulphate pulp. Also, since the development of the Southern newsprint industry has been fairly recent, they have relatively new newsprint machines. The South increased its share of total U.S. softwood plywood production from less than one percent in 1964 to 38% in 1977. Also the South produces 40% of U.S. hardwood veneer and plywood production and 49% of hardwood lumber production. Softwood lumber production is still dominated by old growth in the West, with the South supplying 25% of the total U.S. production.

The South presently has an advantage in delivered wood costs over Eastern Canadian producers. In 1976, average wood

cost in the U.S. South, delivered to the mill gate, was estimated at \$52. per hundred cubic feet, compared to \$80. in Northern Ontario and \$69. in Quebec. Wood cost differences include an \$8. per cunit cost advantage in stumpage price for Eastern Canadian producers, but considerable cost disadvantages in woods labour wages, camp costs, and road costs.

Present Wood Supply in the U.S. South

Commercial forest land in the U.S. South, in 1970 totalled 192.5 million acres, of which 73% was owned by non-industrial private landowners, 18% by the forest products industry, and the balance by federal, state and local governments. Firms in the forest products industry in the South procure proportionately higher quantities of both pulpwood and sawtimber from their own land (20% and 26% respectively), nevertheless, private non-industrial landowners are the major source of raw material for the forest products' industry, supplying between two-thirds and three quarters of both sawtimber and pulpwood.

Growth levels achieved by the three different categories of owners vary somewhat. Private non-industrial land, much of which is understocked and unmanaged, has the lowest annual growth per acre and represents the greatest potential for increased productivity. Public lands have the

highest average annual growth due to limited removals resulting in relatively heavy stocking.

The most recent U.S. Forest Service survey (1970) for the twelve Southern states, indicates total growth of growing stock exceeding removals by 33%. Sawtimber growth was 34% above removals for softwood and only 2% for hardwood. While the hardwood supply is tighter than the softwood, the softwood situation is of greater interest as any economic shortfall in the supply of softwood will effect the future growth of the forest products industry.

Future Southern Wood Supply

Recent trends indicate a smaller area of land available for timber production in the U.S. South in the future. Projections by the U.S.F.S. indicate a decline of commercial forest land in the South by 2000 of approximately 4 million acres to 188.3 million acres. A major portion of this decline has already taken place and total land area available by 2000 may be slightly below this figure. This decline is due mainly to the influence of urbanization, agricultural land use competition and wilderness withdrawals. The ownership structure in the South by 2000 is not expected to change materially, the major shift being an increase of 6% in forest industry ownership. This increase is expected to come primarily from the non-industrial private landowners.

The U.S. Forest Service in their publication, "Outlook for Timber in the United States" have projected timber growth through the year 2020, based on land management levels achieved in 1970. Their forecast of growth indicates that with no change in forest management practices, the forest products industry in the U.S. South could increase production by almost 50% by the year 2000, without drawing on the inventory.

Implicit in their projections are average annual growth rates of 55.7 cubic feet per acre on public lands, 57.6 cubic feet per acre on forest industry owned land, and 46.7 cubic feet per acre on private non-industrial owned land. These growth rates assume increases between 1970 and 2000 of only 8% on forest industry owned land, and 12% on private non-industrial land.

Our research indicates there are several factors which may bring about a greater expansion of the wood supply than is indicated in the U.S.F.S. projection. Developments in increased land management practices such as site preparation and planting, use of superior stock and other improved silvicultural practices as well as federal, state, and industry assistance programs for landowners and increased tree utilization are expected to increase productivity.

The impact expected from these various practices on the three categories of landowners is discussed below:

- The forest products industry will likely grow an average of 100-120 cubic feet per acre annually on the 37.3 million acres it is projected to own by 2000 - roughly doubling its 1970 average growth per acre. This will be achieved through intensive management including planting programs to put approximately 70% of industry land in sustained yield pine production. These planting programs are proceeding on schedule. Along with the acreage held in fee simple ownership, there are presently 6.7 million acres held in long term leases. These lands are also expected to yield high average annual growth rates.
- Government forest land (16.7 million acres) will have an average net growth per acre of 55 cubic feet increasing only slightly from the 1970 level of 51 cubic feet. This estimate is deliberately conservative because of the uncertainty of future government policy, and is in agreement with projections made by the U.S.F.S.
- Private landowners (non-industry) will own 71.3% of the commercial forest land in the South and increase their average growth per acre substantially from the 42 cubic feet achieved in 1970. The size of this increase will depend on the extent

to which stumpage prices increase and local wood shortages develop. We have found that when pulpwood stumpage prices rise to \$15-20 per cord, large private landowners substantially increase the management of their land and tend to replant after clearcutting. When local wood shortages occur, we expect the initiation of cost-sharing programs by state governments and industry to expand supply from the private landowners. The likelihood of this kind of response and its effectiveness has already been demonstrated. In Virginia, for example, when faced with the possibility of a regional wood shortage, industry and government initiated a land management assistance program which has been extremely successful. Also some other states are now following the Virginia example.

Considering the above, we project that average annual growth per acre on private land will be in the range of 50-60 cubic feet per acre and more than sufficient to meet a doubling of demand.

- Tree utilization will increase 5-20% due to more efficient logging with less residues left in the forest, increased use of whole tree chipping, and some degree of stump extraction. In addition, we expect a greater salvage of cull and dead trees.

If we apply the projections mentioned above, we can arrive at several different scenarios of how the South could achieve a doubling of wood supply from 6.5 billion cubic feet in 1970 to 13 billion cubic feet in 2000. The table below indicates the average annual growth per acre required from the non-industrial private landowner to allow a doubling of removals by 2000 and maintain a balance between growth and removals.

Table 3.2

Required Average Net Growth Per Acre On Non-Industrial Private Land to Allow a Doubling of Removals by 2000**

Increase in tree utilization Average annual growth per acre on industry lands	5%	10%	20%
	100 cubic feet	62 c.f.	57 c.f.	49 c.f.
110 cubic feet	59 c.f.	54 c.f.*	46 c.f.
120 cubic feet	56 c.f.	52 c.f.	43 c.f.

* E.g. With industry land growing an average of 110 cubic feet per acre per year and a 10% increase in tree utilization, private non-industrial land owners would be required to annually grow 54 cubic feet per acre in order to supply a sufficient amount of wood to meet a doubling in demand by 2000.

** Back up calculations are provided in Appendix 24. We are assuming growth to equal removals by 2000. For removals to double from 1970 would necessitate approximately a 50% increase in net growth as there was a 33% surplus of growth over removals in 1970.

The U.S.F.S. project demand for roundwood equivalent of timber products by 2000 in the U.S. to be 23.7 billion cubic feet, if imports are maintained at 1970 levels. If the South doubles removals to 13 billion cubic feet, as we have indicated it is capable of doing, the balance of roundwood equivalent required to meet projected demand for timber products by 2000 in the U.S. is 10.7 billion cubic feet. This volume must be supplied by either other wood producing regions in the U.S. or by an increase in imports to the U.S.

In 1970 removals from the U.S. forests totalled 14 billion cubic feet, 6.5 from the U.S. South and 7.5 from the balance of the U.S. Given the above-mentioned level of required roundwood in 2000 of 10.7 billion cubic feet to be met by the balance of the U.S., a 43% increase in supply by these other producing regions would be sufficient to meet all projected growth in demand for timber products, without increasing imports beyond the 1970 level. The U.S.F.S. consider this increase, averaging about 1% per year, within the growth potential of the other wood producing regions in the U.S. based on only 1970 land management levels.

In summary, given a reasonable set of assumptions concerning population and economic growth, and prices rising above 1970 levels, the best available data would suggest that

the wood baskets in the U.S. are capable of meeting all incremental demand for timber products in the U.S. by 2000. It is estimated that imports will increase from 1970 levels only if areas other than the U.S. are able to produce timber products more economically.

Comparison to Other Studies

The projected annual growths per acre in the South by ownership class which were developed in our analysis have been compared to growth levels projected in relevant studies by others. These studies include estimates by the U.S.F.S. of growth rates which can be expected from a fully stocked natural stand, which is a stand utilizing all of the growth potential of the site class of the land but with no land management practices. Our scenarios are also compared to a study done in 1969 by the Southern Resource Analysis Committee, entitled "The South's Third Forest". This study forecast that demand for timber in the South would increase 2.3 times between 1969 and 2000 and also gives estimates of average annual growth rates per acre by ownership class. The following table compares our projected growth rates to those developed in these other studies as well as the growth rates achieved in 1970.

Average Annual Growth Per Acre
(cubic feet)

Owner Class	U.S.F.S. 1970	Our Scenarios	U.S.F.S. Fully Stocked Natural Stands	Third Forest Report
Public	51	55	70	82
Industry	53	100-120	81	102
Private	42	43-62	75	73

Source: U.S. Dept. of Agriculture, Forest Service and the South's Third Forest, Southern Resource Analysis Committee 1969.

When compared to other projections, our estimates for growth on non-industrial private and public lands appear to be conservative. The major reason for the conservatism of our figures regarding public lands is the present uncertainty concerning these, especially regarding the limits being placed on the management of the national forest lands. Also, the Third Forest report included policy recommendations which would be necessary for their estimates to be achieved. Most likely some of these will not be implemented and therefore their estimates for both public and private lands should be scaled down to reflect this.

Our interviews with the industry suggest that the Third Forest projections regarding growth on forest industry

owned land are conservative. Since 1967, planting on these lands in the South has increased 107%, advances have been made in genetically superior stock and there is promise of substantially greater improvements.

Possible Constraints

The final section of this report deals with other possible constraints which may limit the growth of the Southern forest products industry. These constraints include reversion of pine to hardwood, labour and energy availability and costs, environmental pollution, and the availability of greenfield mill sites.

Softwood/Hardwood Reversion

The reversion of softwood stands to mixed or hardwood stands is considered a serious problem in the South. However, this is not a new problem to this area, as the climax forest in much of the region is hardwood not pine. The existing pine acreage is largely a result of man's impact. Our findings indicate that the problem will be controlled through combined industry and government landowners assistance programs. Evidence of this has already been seen in Virginia where through a joint industry and government program aimed at encouraging reforestation, pine acreage actually increased between 1966 and 1976 by 15%. Despite the loss of pine forest acreage of 11% over 10 years in the South, total softwood inventory increased by 42% between 1950 and 1970.

Labour

Due in part to the structure of the Southern wood procurement system which consists of numerous small independent contractors and wood workers, woods labour costs in the South are the lowest in North America. A recent study indicates the following labour rate per man hour, including fringe benefits for woods workers in 1976.

U.S. South	\$5 per hour
Eastern Canada	9 per hour (average)

Labour costs in the South are expected to rise due to mechanization and the increased use of company crews for harvesting operations on company owned land, however, this is also expected to result in increased productivity as well as a reduced number of workers. Woods labour shortages were not considered a constraint by the companies we interviewed. We believe the South is likely to maintain its woods labour cost advantage over Eastern Canadian producers until 2000.

Energy

Energy, although expressed as a concern by all companies interviewed, was not considered a serious constraint to growth. The forest products industry is unique because it generates over 45% of its energy requirements from non-fossil, self-generated waste fuels. In the South the trend away from using oil and natural gas to the use of more waste fuels is

expected to continue with companies becoming more self-sufficient lessening the impact of future energy cost increases and potential shortages.

Environmental Pollution

Air and water pollution regulations for 1977, as established by the Environmental Protection Agency (EPA), have essentially been met by the pulp and paper industry in the U.S. Capital expenditures on environmental controls for 1978 have decreased. The U.S. industry is currently discussing 1983 E.P.A. regulations which are likely to require the compliance of pollution control obtainable from the best available technology and, although pollution control is not a problem technically, increasing efficiency will result in high capital cost. Another problem facing the U.S. pulp and paper industry is the long lead time (approximately 2 years) for permission to build a new mill.

Mill Sites

Greenfield mill sites in the South were considered numerous by the persons to whom we spoke and were not thought to be a constraint. With advancing technologies reducing water requirements and pollution discharge, as well as the lower labour requirements for new mills, mill sites are numerous. However, because of the high cost of meeting environmental regulations and the long lead time for environmental approval of a new mill, the industry's current emphasis is on expanding and upgrading existing facilities rather than building greenfield mills.

This report will discuss the future growth of the forest products industry in the U.S. South. Its purpose is to evaluate, and attempt to anticipate, the expansion of the wood supply in the U.S. South, as well as examine other constraints which may limit the future growth of the Southern forest products industry. This report is intended as background for a further study on the problems facing the Canadian forest products industry.

1.1 Methodology

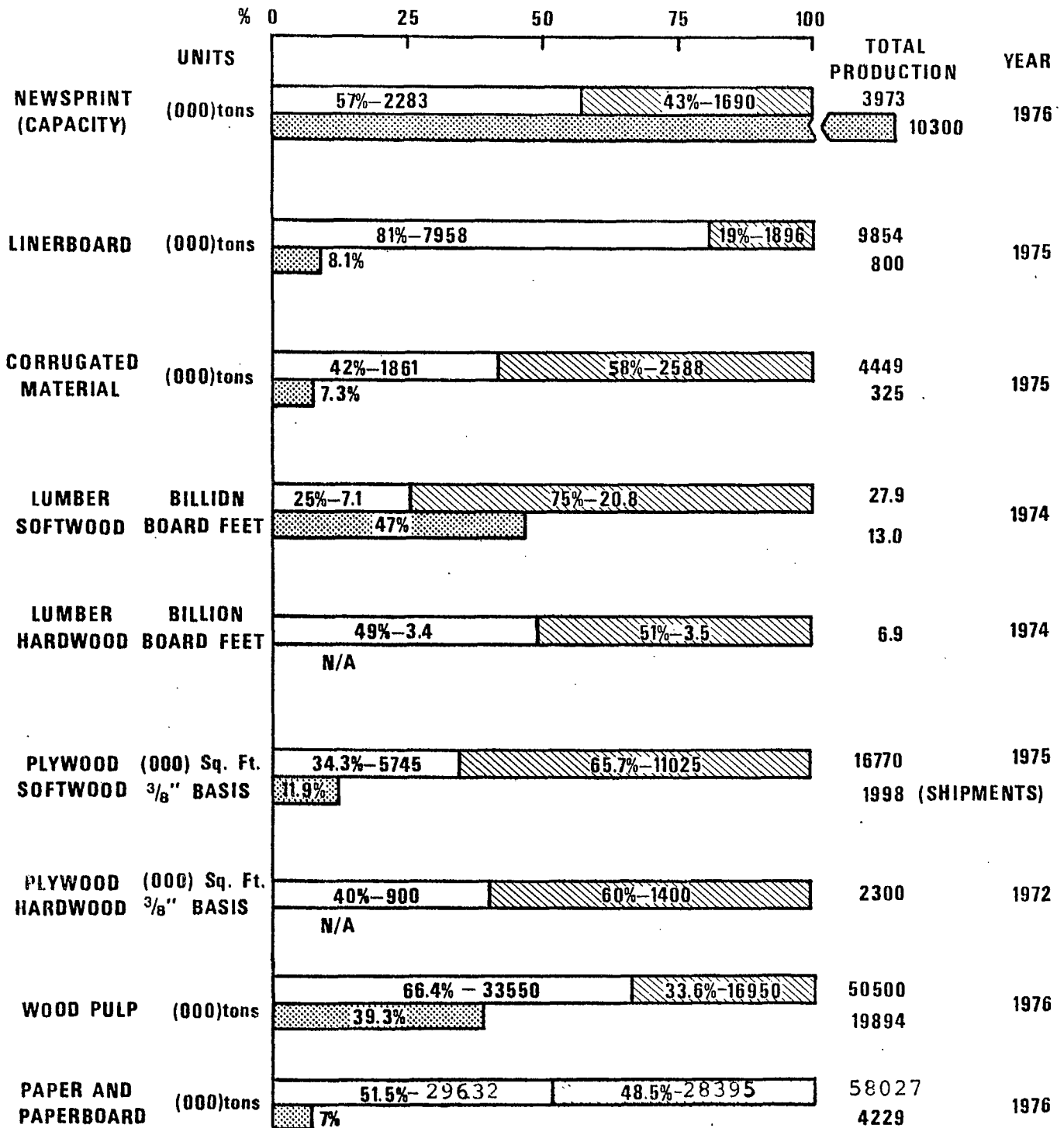
The information contained in this study is based on both primary and secondary research. The secondary research focused mainly on the "Outlook for Timber in the U.S." report which is prepared by the U.S. Department of Agriculture. A list of other secondary sources of information used in this study is contained in Appendix 29. In our primary research we have had interviews with senior planners and woodland managers of leading forest products firms in the South; trade associations; U.S. Government officials; and other industry experts. A detailed list of interviews conducted is contained in Appendix 30.

1.2 Importance of U.S. South

We are looking at the U.S. South because it is the primary competitor to the Canadian forest products industry in its largest market - the U.S. This is particularly so with respect to the Eastern Canadian industry where the U.S. South competes directly in such products as small dimension lumber, newsprint and pulp. In market pulp, the South competes with Canada in European as well as the Eastern and Central U.S. markets.

The U.S. South is the largest pulp and paper producing region in the world today - and if the forest resource is properly managed, it can continue to be the largest softwood producing area of the world. Figure 1.1, shows the South's production in relation to the U.S. and Canada by product group. This highlights the large quantities of paperboard (linerboard and corrugated material) produced by the South, particularly in relation to Canadian production. The South dominates all product groups shown with the exception of softwood lumber and plywood in which the old growth in the West still dominates.

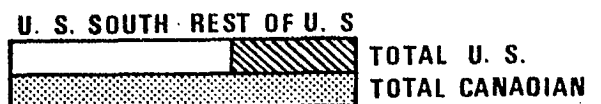
U. S. SOUTH (), UNITED STATES (), AND CANADIAN (), PRODUCTION BY PRODUCT GROUP



NOTE:

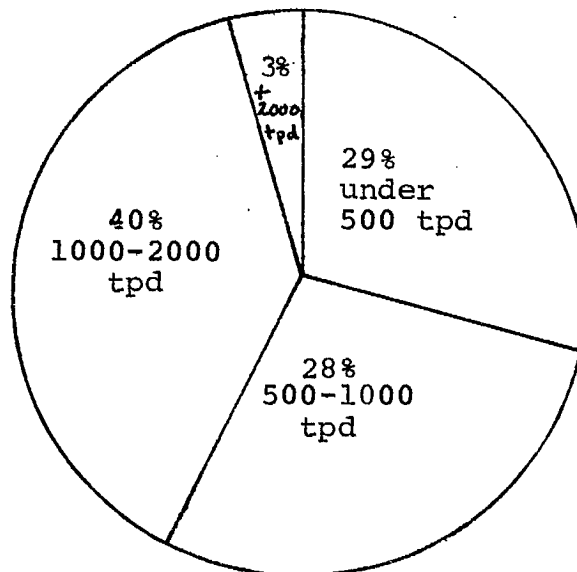
PERCENTAGE IN THIS CANADIAN BAR ARE CALCULATED IN RELATION TO TOTAL U. S. PRODUCTION

LEGEND:



The paper industry in the South consists of relatively modern, large scale, integrated mills producing mostly sulphate pulp and small amounts of groundwood and semi-chemical pulp. The largest mill in the world is the Union Camp mill in Savannah, Georgia with a pulping capacity of 3000 tons per day. This is an integrated mill producing unbleached sulphate and semi-chemical pulp, and converting this to paperboard, bags, containerboard and kraft linerboard. The size distribution of Southern mills by daily pulping capacity is shown below.

Size Distribution of Southern Mills
By Daily Pulping Capacity



A detailed size distribution of mills by state is contained in Appendix 1. As mentioned, the predominant pulping process is sulphate which, due to the economies of scale, is generally used in mills over 500 tons per day. The groundwood and other mechanical, and semi-chemical operations tend to be smaller with capacities of under 500 tons per day.

The South's forest products industry has grown rapidly in the last thirty years taking the leadership role in producing wood pulp and converting this into a wide range of products. Appendix 2 shows the growing importance of the South in the production of paper, paperboard, and wood pulp from 1946 to 1976. During this period the South increased its share of paper and board production from 29% to 51%, while total U.S. production increased over 250%. In 1976 the South produced over 66% of total U.S. wood pulp. The South has already penetrated traditional Canadian markets in the U.S. and with the forecast growth in Southern production, the South must be considered a growing threat to Canadian markets in the U.S.

1.3 Growth of Key Product Groups

The following section outlines the growth of the U.S. South in each of the key product groups.

Lumber

The U.S. South has always played an important role in the nation's lumber market (see Appendix 3) supplying 25% of U.S. softwood lumber production and 49% of hardwood lumber in 1974. Lumber production in the South reached a high of 21 billion board feet in 1909, nearly half the U.S. total. However, with the opening of the Panama Canal and the subsequent growth of the Western lumber industry, production declined steadily thereafter until 1961. Output rose after 1961 spurred by the overall economic growth of the South, the introduction of the chip and saw mill in the late sixties, and the growth of the softwood plywood industry. Plywood cores account for approximately three quarters of a billion board feet of lumber production annually.

The main product produced from Southern Pine is 2"x4" dimension lumber due to the small size of the tree. A recent study has indicated that the Southern Pine 2"x4" has dramatically penetrated traditional Eastern Canadian markets in the Eastern U.S.A. Purchases of lumber in Boston indicate that equal quantities of lumber are being purchased from Eastern Canada and the U.S. South while other cities in the Eastern U.S. are buying greater quantities of Southern Pine. The lumber industry appears to be dominated, to a certain degree, by the pulp

industry which sells the higher value saw logs and in return obtain the chips and sawdust for their pulping operations.

Plywood

Softwood plywood ceased being exclusively a West Coast product in 1964 as three mills began peeling Southern Pine in Arkansas and East Texas. Since then the growth rate has been dramatic and in 1977 the South accounted for 38% of total U.S. production. (See Appendix 4.) This rapid growth is attributable to:

- solving the technical problems of gluing and drying pine veneer
- the importance of sheathing plywood grades
- relatively static federal timber harvest in the West.

Since 1964, traditional West Coast markets in the Eastern U.S. have been captured by the Southern pine plywood producers. Canadian exports of softwood plywood, which originate almost entirely from British Columbia, have declined sharply over the last few years, due to severe price competition from U.S. producers and weak market conditions. The U.S. South is expected to continue gaining market share with continuing growth in plywood capacity and improved small log processing technology.

Hardwood plywood production in the U.S. has been static for the last twenty years. Appendix 5 illustrates the large quantities of cheap imports of this product into the U.S. (mostly from Southeast Asia) which is a limiting factor in the expansion of the U.S. production. The South is considered the most important producing region for the production of veneer and plywood with over 40% of total U.S. production. Appendix 6 illustrates Southern capacity for hardwood veneer and plywood by state.

Newsprint

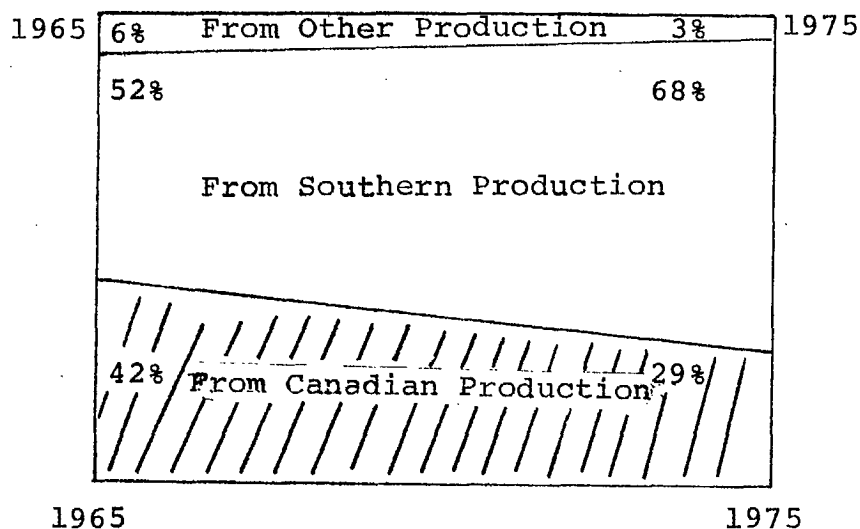
In 1946 there was only one newsprint mill in the U.S. South. Since then there has been a dramatic growth in the newsprint industry which increased its capacity more than ten-fold from 220,000 tons in 1950 to 2,435,000 tons in 1977. The South's percentage of total U.S. capacity increased from 22% to 59% over the same period. (See Appendix 7 and 8.)

The emergence of the newsprint industry in the U.S. South has been due to a combination of research and technological advances which allowed for the successful pulping of Southern pine, along with U.S. publishers' desire to diversify their almost total reliance on Canadian supply.

Successive waves of capacity increases in the U.S. South in the fifties and sixties reduced Canadian producers'

share of the U.S. newsprint market from 80% in 1946 to 63% in 1977. The U.S. South's growing penetration into traditional Canadian markets is further demonstrated by examining the regional sourcing of newsprint for 1965-1975 for daily newspapers shown in Appendix 9. While the information is not for total newsprint consumption, daily U.S. newspapers are considered a good barometer as the newspapers utilize some 90% of all newsprint production. In the decade 1965-75, regional sourcing of newsprint in the South shifted significantly as shown below:

Regional Sourcing of Southern Newspaper



During this same period, Southern mills also increased their share of the North Central newspapers from 6% to 10% at the expense of Canadian producers whose share dropped from 89% to 84%. There are currently various planned projects to expand newsprint capacity in the South. If all these projects are completed the South could achieve self-sufficiency or may even become a net exporter. These developments could totally erode the Eastern Canadian producers' markets in the South and intensify competition in the North Central and Northeast regions.

Paperboard

The South has traditionally been strong in producing paperboard by the kraft process and since World War II has rapidly expanded containerboard capacities. By 1963 the South produced 52% of U.S. paperboard production and increased its share to 64% in 1976, a period during which total U.S. production doubled. (See Appendix 10.) The South has achieved leadership in most high volume low priced product categories and in 1976 accounted for 81% of U.S. linerboard, 73% of boxboard and 43% of corrugated medium production.

1.4 Wood Cost Comparison with Canada

The following information on wood cost comparison has been extracted primarily from a survey conducted by Peat Marwick

and Partners, and completed in April of 1977. This study indicates the U.S. South currently has a cost advantage over the Eastern provinces of Canada. In 1976 the average wood cost delivered to the mill gate for the U.S. South was estimated at \$52 per cunit (cunit = 100 cubic feet) compared to \$80 in Northern Ontario, \$69 in Quebec and \$53 in New Brunswick. The reasons for comparing the U.S. South's wood costs to the Eastern Canadian regions (rather than Canada as a whole) are:

- they are competitors in the same markets - Eastern and Midwest U.S.A.
- the average size of timber harvested is similar (8"-10" Diameter at Breast Height (D.B.H.)).
- the primary uses of the timber are the same - wood pulp and small dimension lumber.

Appendix 11 summarizes the total wood costs delivered at the mill for regions in North America. In reviewing this cost data it must be born in mind that wood is not homogeneous. Variations in wood density are an important factor in considering delivered wood costs. For example, a ton of bleached kraft pulp requires approximately 1.8 cunits of Eastern Canadian softwood compared to 1.4 cunits of Southern pine. In addition, the Southern pine has an exceptionally long fibre which increases its advantage over competitors in Eastern Canada. Some of the more significant wood cost differences are examined on the following page:

Stumpage

The Eastern Canadian producers have an apparent cost advantage of some \$8 per cunit for pulpwood stumpage. Average stumpage prices are \$5 per cunit in Northern Ontario and \$4 per cunit in Quebec, while average stumpage prices in the South are \$12 per cunit. Stumpage prices in the South differ widely, however, depending on localized demand for stumpage. In highly concentrated regions, i.e. S.E. Georgia and N.E. Florida, pulpwood stumpage prices range between \$16 and \$25 per cord while in the less concentrated areas of Georgia, this range is between \$5 and \$8. It should be noted that some trees of sawtimber size are likely included in the pulpwood stumpage when prices are as high as \$16 to \$25 per cord. There is, however, a considerable difference in the South for stumpage of pulpwood and sawtimber, while in Canada, these are frequently not differentiated. In 1976 the average price for Southern pulpwood stumpage sold on National Forest land was \$10.78 (Appendix 12) while average sawtimber stumpage from the same source was \$107.95. For this reason, producers of small dimension lumber in Eastern Canada have a more significant stumpage cost advantage than pulpwood producers.

It is extremely difficult to make valid comparisons of stumpage and royalty charges between the two countries, particularly to assess the impact of:

- government road systems
- reforestration and other timberland policies

- differing tax structures; in particular the capital gains tax breaks available to holders of large tracts of private land in the United States are enormously significant
- the mix of private and public lands can influence considerably the price paid for stumpage.

Extraction Costs

The major components of extraction costs are labour, camp costs, and road costs.

Labour wage rates including fringe benefits in the U.S. South are half those in Northern Ontario and 30-40% less than rates in Quebec and New Brunswick. Productivity is similar across all regions and as labour accounts for some 25-30% of total wood costs, this gives the South a significant cost advantage. (Labour costs are discussed in detail in Section 4.2.) Logging camps are not required in the U.S. South, whereas Eastern Canadian producers incur camp costs of between \$1-10 per cunit. Producers in the U.S. South can use the public road system for hauling, and their secondary roads have a longer life than those in Canada due to the more favourable climate. These factors give U.S. South producers an additional cost advantage of some \$3-6 per cunit over Eastern Canadian producers.

Summary

The U.S. South enjoys the lowest wood costs because of:

- easy access to timber stands
- greater volume per acre
- better logging conditions
- year round operations (hauling limited only during wet season)
- existing public road system
- lower labour rates
- no camp operations

The following table summarizes wood costs differences between Eastern Canada and the U.S. South, as reported by the participants of the survey and are not necessarily the average costs for the region:

Table 1.1
Summary of Comparative Wood Cost (\$ per cunit)

	<u>Eastern Canada</u> Range	<u>U.S. South</u> Range
Stumpage and Royalties	\$ 3 - 5	\$ 10 - 15
Camp Cost	3 - 10	-
Falling and bucking	12 - 16	4 - 6
Delivery		
- stump to road	6 - 10	6 - 8
- road to mill	10 - 13	6 - 12
Road construction	2 - 3	0 - 1
Road maintenance	2 - 6	0 - 3
Equipment costs	T/C	T/C
Administration costs	3 - 10	5 - 10
Silviculture costs	T/C	2 - 4
Total Wood Cost including Overhead Delivered at Mill	50 - 75	45 - 60

T/C - Included in total wood costs

Source: Peat, Marwick & Partners

The U.S. South is expected to maintain its competitive cost advantage over the Eastern Canadian producers. Southern pine pulpwood stumpage prices, in real terms, have remained stable since 1955 (Appendix 13). Along with this, an A.P.A. forecast indicates that the U.S. South is likely to maintain its labour cost advantage.

The lower wood costs coupled with the higher density of Southern pine gave the Southern paper and paperboard producers an advantage of \$27 per finished ton of newsprint and \$48 per air dry ton of pulp in 1976 (Appendix 14). This final cost takes into account the differences in chemical pulp content and yield of chemical pulp from wood as well as wood density and wood cost differences.

2.0 PRESENT WOOD SUPPLY IN THE U.S. SOUTH

2.1 The Forest Resource

The most recent aggregate U.S. Forest Service (U.S.F.S.) survey (1970) estimates total commercial forest land in the South as 192.5 million acres. This acreage accounts for 39% of the total commercial forest land in the U.S. A detailed breakdown by state can be found in Appendix 15.

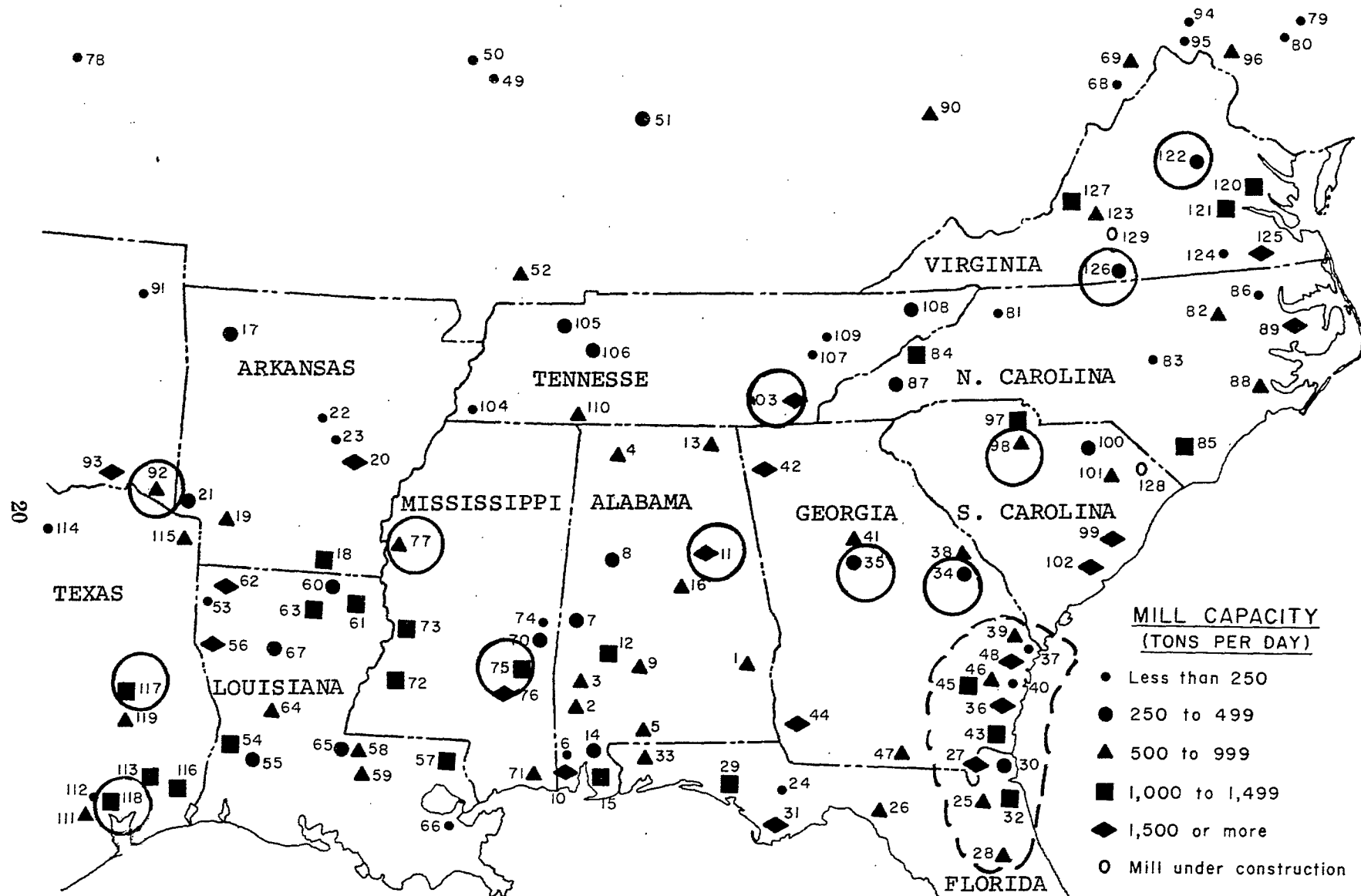
When considering aggregate data concerning the wood supply in the South or even data for individual states, it is important to recognize that there are major differences between different parts of the South and even within states.

The Atlantic and Gulf coastal areas are almost exclusively pine -- primarily slash and loblolly. As one moves Northward and inland, the proportion of hardwoods increases. To some extent, today's species mix is a historical accident. During the late 1930's, and early 1940's, the boll weevil and depressed farm prices caused widespread abandonment of farm land which naturally seeded to pines. Repeated fires in this period reduced the hardwoods and prepared a seed bed for the pine seedlings. In many parts of the South, pine stands which are clear cut will revert to hardwood if not replanted and carefully managed.

There are also important physiographic, climatic and economic differences within the South. For example, the soils are heavier and more fertile in the coastal areas of Virginia and North Carolina than further South in South Carolina, Georgia and Florida. Agriculture is thus a more important competing land use, land holdings tend to be smaller, and hardwoods more dominant. Along the Gulf Coast, coastal delta land is more fertile and recently substantial clear cut forest land in this area has been put into soy bean production. In many inland areas, the alternative land use is only grazing and little land has been converted to agriculture.

The development of the South has generally been from East to West and from the coast to inland areas. (There are some exceptions to this, for example, some of the earliest pulp mills were in Louisiana.) As can be seen on the following map, the most intense concentration of pulpmills is on the Atlantic coast, particularly in Southeastern Georgia and Northern Florida, followed by the Gulf coast and finally the least concentrated area is inland.

In general, kraftboard mills are located on the coast where there is sufficient water supply and predominantly



MILL CAPACITY
(TONS PER DAY)

- Less than 250
- 250 to 499
- ▲ 500 to 999
- 1,000 to 1,499
- ◆ 1,500 or more
- Mill under construction

○ Mills over 300 TPD producing primarily groundwood and other mechanical pulp

○ Greatest concentration of mills

Source: U.S. Department of Agriculture, Forest Service

softwood forest, while newsprint and fine paper mills generally are located inland, the latter because of their use of hardwoods. Newsprint mills on the other hand are located inland most likely because of their delayed beginning in the Southern region. The inland location of major Southern mechanical pulpmills is also shown on the attached map.

The leading States in both pulping capacity and pulpwood production in 1976 were Georgia (15,194 TPD/5.6 million cords) and Alabama (12,945 TPD/5.0 million cords). The top three states accounted for a total of 45% of Southern pulping capacity (including Louisiana - 12,745 TPD) and 44% of Southern pulpwood production (including Mississippi - 3.6 million cords).

. In contrast, lumber production is more evenly distributed in the South with the leading states being Arkansas, Alabama, North Carolina, Mississippi, Georgia, and Virginia all with production between 1.1 and 1.4 billion board feet in 1971. (See Appendix 16 for pulping capacity, pulpwood production, and lumber production by state.)

2.2 Ownership Structure

Southern commercial forest land is largely privately owned. Of a total of 192.5 million acres, private non-industrial ownership in 1970 totalled 139.9 million acres or

73%. Forest industry ownership accounted for 35.3 million acres, or 18% and the remaining 17.3 million acres (9%) was owned by federal, state, and local governments. Along with the fee simple land which the forest industry owns, they also hold 6.7 million acres in long term leases, bringing the total land over which they have a direct impact to 42 million acres or 22%.

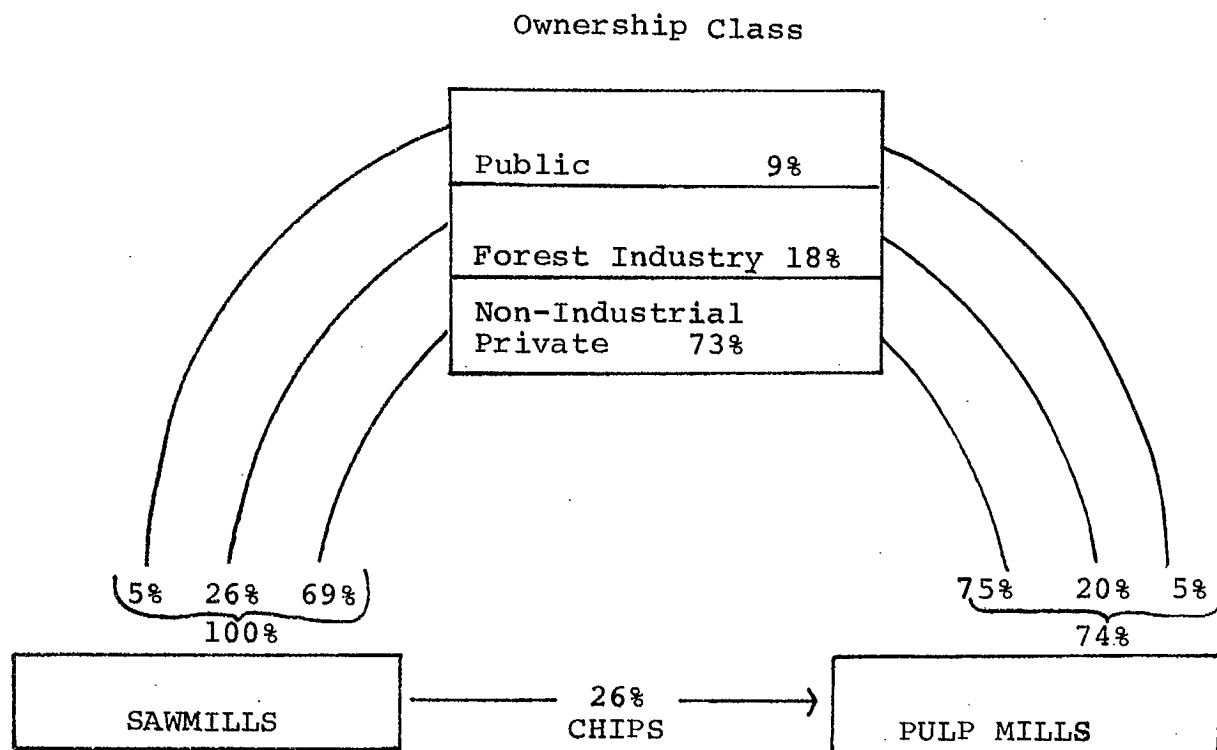
Growth levels achieved by the three different categories of owners vary somewhat. Annual growth on private ownership in 1970 averaged 42 cubic feet per acre per year whereas public lands averaged 51 cubic feet per acre and forest industry growth averaged 53 cubic feet per acre. Appendix 17 outlines in detail growth per acre by ownership class.

The high average growth per acre on public lands (most notably in the national forests) is due to limited removals resulting in relatively heavy stocking rather than intensive land management practices. Private non-industrial land, much of which is understocked and unmanaged has the lowest annual growth rate and represents the greatest potential for increased productivity.

2.3 Wood Procurement System

The proportion of raw materials supplied by the different categories of landowners is shown in the following diagram:

Figure 2.1
Southern Procurement System
of Raw Materials



Firms in the forest industry in the South procure proportionately higher quantities of both pulpwood and sawtimber from their own land. Almost all firms interviewed indicated they have lengthened their rotation cycle to 35 years. With a longer rotation companies are able to produce higher value saw logs and still obtain about 55% of the sawlog which is returned to the

pulp mill in the form of chips and saw dust. Nevertheless, it can be seen that the private landowner provides between two-thirds and three-quarters of the forest products industry's raw material requirements. In the South, in contrast to both Canada and Western U.S., public lands are a small factor, accounting for only 5% of raw material needs.

There are three basic methods by which companies can obtain wood in the U.S. South:

- Purchase by companies from intermediate market agents or dealers who purchase wood from landowners and harvest it themselves or hire independent contractors.
- Direct purchases by companies from private or public landowners for harvest through company operations or by contractors.
- Harvesting operations on company lands by either company crews or independent contractors.

In 1974 the dealer system provided 54% of the wood, direct purchases 39%, and 7% was obtained from company harvesting operations.

There are several functions which the wood dealers serve that make them of value to the pulp and paper companies.

Wood dealers limit the number of entities that the companies have to deal with. They handle relationships with a large number of landowners and independent loggers. They serve as a "shield" insulating companies from government regulations such as social security, OSHA as well as any liability for truck or logging accidents.

Wood dealers develop long-term relationships with the landowners in a local area. They provide the local knowledge and memory which is necessary for effective procurement. The mobility of personnel within large companies makes this difficult if not impossible for the companies to do themselves. It is important to have detailed knowledge of the terrain of the area, the logging conditions in different sections, the effect of weather on logging conditions which often creates a need for a seasonal logging plan, as well as the personal situation of the landowner - when he will be most likely to sell. In contrast to corporate personnel who remain in a job perhaps three to five years, cruisers working for a wood dealer often stay 15 to 20 or more years.

Wood dealers serve to reduce the planning requirements for pulp and paper companies. They allow the company to follow its long-term woods management program on company owned land

and adjust mill output to variations in demand. Thus, they serve as a buffer to insulate the pulp and paper companies from fluctuations in demand. It should be noted that companies differ in the extent to which they rely on wood dealers versus chip versus company land to absorb these fluctuations. In all cases, however, wood dealers serve to reduce the complexity of planning for an integrated production chain.

An additional function of wood dealers is to serve as financial intermediaries. They provide the companies with an off the balance sheet inventory of standing timber. For the logger, the wood dealer can provide access to financing. The wood dealer's bank credit can be used to buy equipment which is then leased to the logger.

Companies value dealers and contractors and are likely to continue to limit company crews mainly to their own land.

2.4 Present Growth and Removals

The most recent aggregate figures on growth and removals for the 12 Southern states are from the 1970 "Outlook for Timber in the United States". According to this report, total net annual growth exceeded removal in 1970 by

approximately 33% for the entire South. For softwoods, the excess of growth over removals was 35% while for hardwoods the excess was only 28%. Three states, Alabama, Louisiana and Texas had hardwood removals in excess of growth.

Total sawtimber net annual growth exceeded removals by 23% - with a 34% surplus for softwood and only a 2% surplus for hardwood. Hardwood sawtimber removals exceeded growth in Texas, Oklahoma, Louisiana, Arkansas, Mississippi and Alabama. Growth of softwood sawtimber exceeded removals in all of the Southern states. Although the hardwood sawtimber surplus was very low in 1970, this figure apparently reflects a distorted situation for a very brief period of time and this trend has since been reversed.

In Appendix 18 and 19, tables are presented which illustrate net annual growth and removals by state of total softwood and hardwood as well as growth and removal of softwood and hardwood sawtimber. The softwood net annual growth and removals are compared by state in Figure 2.2.

Although the present hardwood supply (especially sawtimber) is tighter than softwood the softwood situation is of greater interest as the industry would prefer to base its future growth primarily on softwood.

SOFTWOOD NET ANNUAL GROWTH & REMOVALS-1970 DATA

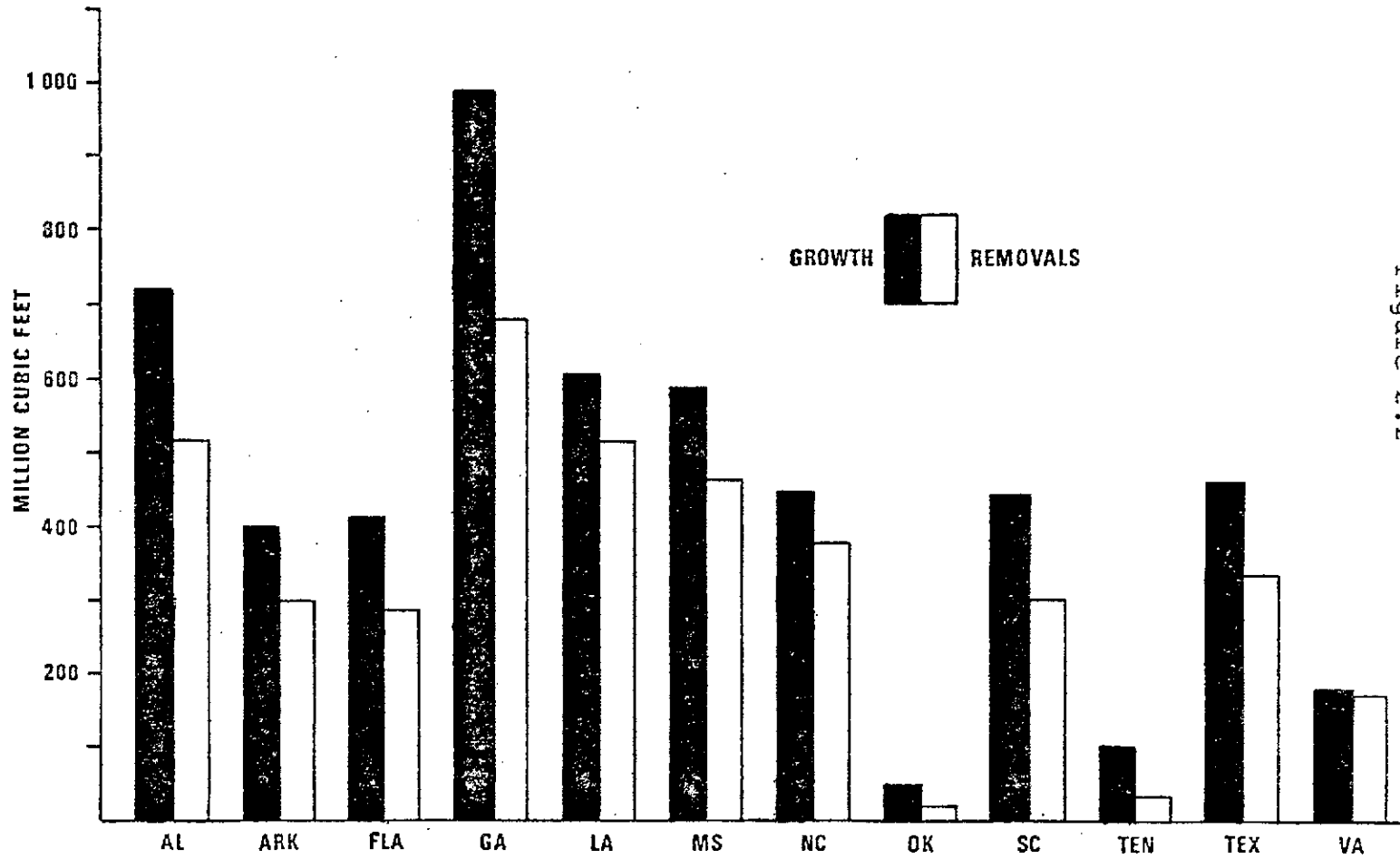


Figure 2.2

Source: U.S. Dept. of Agriculture, Forest Service

It should be noted that statewide data can be misleading in that the forest upon which the growth is being achieved is not necessarily geographically coincident with the forest from which removals are taken. For example, in Georgia there is a very tight balance between growth and removals in the important Southeastern region even though there is a large state-wide surplus because of growth and little harvesting activity in the Northern part of the state.

3.0 FUTURE SOUTHERN WOOD SUPPLY

3.1 U.S. Forest Service Projection for 2000 - Assuming 1970 Land Management Levels

Almost every projection of wood supply for the U.S. South is in some way based on the U.S. Forest Service publication "Outlook for Timber in the United States". This report, published in 1972, contains a projection of timber growth through to the year 2020. Since we will be presenting some of the data from this report, it is important to describe the purpose of the "Outlook" and its underlying assumptions.

The Forest Service "Outlook" is not a forecast of the most likely future scenario. Rather, it is a projection of what the timber supply will look like if there are no changes in forest management practices. Forest Service personnel are clear in explaining that the purpose of the "Outlook" report is not to predict what will actually happen in the future, but rather to define problems which will occur if things continue as they have in the past. Thus, the method employed is essentially a projection of growth in the forest resource assuming that removals increase at a steady rate so that growth equals removals in the year 2000. Removals are not intended to be a projection of future demand but are merely trended to equal growth in the year 2000. The most important assumption in the "Outlook"

projection is that the average level of forest management activities prevailing in the 1960's will be maintained (neither increasing or decreasing) for the length of the projection - 2020. The report states: "this management level is intended to provide a base level for judging the future outlook with and without intensification of timber growing and utilization".

Acreage and Ownership

Recent trends indicate a smaller area of land available for timber production. The Forest Service projects a decline in total commercial timberland in the South from 192.5 million acres in 1970 to 188.3 million acres by 2000 - a decline of approximately 2% averaging 140,000 acres annually. This decline is due mainly to the influence of urbanization, agricultural land use competition, and wilderness withdrawals. More recent state surveys for nine of the twelve Southern states report that between 1970 and 1977, decreases in commercial forest land totalled 3.2 million acres. A somewhat faster decline than projected by the U.S.F.S.

Between 1962 and 1970 the South encountered a net loss in commercial forest land of 7.4 million acres. Half of the Southern states showed decreases in commercial timberland during this period, most notably the Delta states of Mississippi, Arkansas, and Louisiana where large areas were cleared for agriculture. While additional shifts from forest to non-forest uses can be expected, a large portion of the idle farm land left in

the wake of rural to urban migration has now either reverted to trees or has been planted with pine. With a continuation of the trend towards a more stable agricultural land base in the South, additional reversions of farm land to forest appear likely, however, these are not expected to be significant. It is therefore assumed that commercial forest land in the South will continue to decrease although at a much slower rate than in the 1960's.

The ownership structure in the South by 2000 is not expected to change materially, the major shift being an increase in forest industry ownership from 35.3 million acres to 37.3 million acres, accounting for 19.8% of total Southern commercial forest land. This increase is projected to come mainly from the non-industrial private ownership class, whose land holdings are projected to decrease from 139.9 to 134.3 million acres by 2000. Along with this, the forest industry is expected to increase its holdings of leased lands above the present 6.7 million acres. Changes in ownership are illustrated in Appendix 20.

Growth/Removals

Assuming 1970 levels of management the Forest Service project the following net annual growth and removals for the year 2000:

Table 3.1

Net Annual Growth and Removals of Growing Stock - U.S. South
(billion cubic feet)

	Softwood		Hardwood		Total	
	<u>Growth</u>	<u>Removals</u>	<u>Growth</u>	<u>Removals</u>	<u>Growth</u>	<u>Removals</u>
1970	5.4	4.0	3.2	2.5	8.6	6.5
2000	5.8	5.9	3.6	3.6	9.4	9.5
% change	7%	48%	13%	44%	9%	46%

This "base line" projection thus indicates that the forest products industry in the U.S. South could increase production by almost 50% by the year 2000 while maintaining a balance between growth and removals and would require no significant changes in forest management practices. The 9% increase in annual growth is due primarily to the increasing inventory of growing stock reflecting the prior years of excess growth over removals.

Average Growth Rates

Implicit in the projections above are average annual growth rates of 55.7 cubic feet per acre for public lands, 57.6 for forest industry land, and 46.7 for private non-industrial owned land. A detailed breakdown of projected growth by ownership class can be found in Appendix 21. It should be emphasized that these projections would assume only an 8-10% increase for growth per acre on forest industry land. For the private landowner, an average increase of only 12% in growth per acre is projected.

3.2 Projected Wood Supply - Assuming Increased Management

In the previous section, we presented projections of the Southern wood supply assuming "1970 levels of management". There are, however, several factors which may bring about a greater expansion in the wood supply than is indicated in the "base line projection" presented above. Developments such as site preparation and planting, use of superior stock, other improved silvicultural practices and federal, state, and industry assistance programs will increase productivity. Their expected impact on the three categories of land owners will be discussed below.

3.21 Forest Industry Land

Increased land holdings

The extent to which companies will increase their land holdings is difficult to assess. A strong driving force is the dominant industry view that land ownership is needed to support between one third and one half the fibre needs of a mill.

There are a number of constraints, however, which may deter industry from large land purchases. It has been indicated the value of forest land in the South, especially in the more concentrated states, has increased rapidly over the last several years. No tabulated figures on forest land values are available, however, a study conducted in 1973 by the Southern

Forest Experimental Station (SFES) in New Orleans shows how recent changes in land values can be estimated. This study indicates that forest land values in the Mid-South have been rising markedly over the past couple of decades, and have skyrocketed during the last 3 to 6 years.

The U.S. Department of Agriculture, Economic Research Service publishes price indexes for recently sold agricultural land by state and region. Over the last 30 years the real value of farm land has been increasing at a rate of about 7% per year throughout both the Delta States and the Southeastern states of South Carolina, Georgia, Florida and Alabama. This rate is considerably higher than the national average of 5% per year. As mentioned these figures apply primarily to farm land, however, they are considered reasonable for estimates of forest land values also. Interviews conducted during the SFES study indicated no single rate of increase in forest land values, but all agreed, prices had been rising rapidly. Bank officials reported that farm land selling for \$200 per acre in 1971 typically sold for \$300 per acre in 1973. This increase (20%/year) is considerably higher than the average of 7% mentioned above, however, changes in land value vary greatly with local conditions. Other interviewees estimated forest land values in the range of \$100 to \$150 per acre with much land being sold as high as \$175 per acre (plus the value of standing timber). Some of the increase can be attributed to the general inflation of

prices throughout the economy, but much is due to fear of land shortages and speculation on future commercial development.

Another constraint in acquiring more land by the industry is the fragmented ownership in the South. There are an estimated 2 million non-industrial land owners in the South owning a total of 139 million acres of which approximately 40% are in holdings of under 100 acres. (See Appendix 22.) Some large tracts of land are still available, as are sawmilling companies with substantial timber base, however, accumulating small tracts in a localized area to support a greenfield mill will become increasingly costly.

The Forest Service projections indicate an increase in industry ownership by 2000 of 2 million acres to 37.3 million acres, an increase of 6%. In view of the constraints mentioned above, we believe this projection to be reasonable. More recent individual state data, however, indicates that in 1977 the forest industry owned a total of 36.8 million acres and therefore a strong possibility exists for increases in industry ownership in excess of 6%.

Silvicultural Practices

At present virtually all industry owned land is under some management plan. The silvicultural practices employed vary according to the site quality, the inventory of standing timber, companies raw material requirements and the like. Having a

management plan implies only that the site quality of the land has been examined and recognition given to the best possible course of action required to enhance its productivity. For a further description of silviculture practices see Appendix 23.

Annual planting on industry owned land has increased dramatically since 1952 from 124 thousand acres to 690 thousand in 1974 and up to 816 thousand acres in 1976, an increase of over 500%. All companies which we interviewed plan to continue to increase their acreage under pine plantation management and to eventually have all suitable acreage in plantations. Union Camp presently have 700 thousand of their 1.7 million acres under plantation and plan to increase this, adding 30 to 40 thousand acres annually. International Paper Company have 2.5 million acres in pine plantations. The company annually plants 86 million seedlings in the South - 5 for every tree harvested and they restock every acre within one year following harvest. The balance of International Paper Company's land holdings in the South are in the older stands which are the focus of current harvesting activity and will be added to their pine plantations as they become available.

According to a survey conducted by the American Pulpwood Association in 1975, acreage planted annually by industry in the South is expected to increase 19% by 2000.

Forest industry ownership in the Southern states is projected to be 37.3 million acres in 2000. It has been estimated that 70 per cent of industry land or approximately 26 million acres will be in plantations as early as 1990. If we assume a 30 year rotation cycle it would take 865,000 acres of planting annually to sustain these 26 million acres. The indicated rate of industry planting in 1976 in the South was 816,000 acres. If this increases 10-20% by 2000 (as the American Pulpwood Association survey projects) it would be at a level sufficient to keep 27 - 29.5 million acres of forest industry land in sustained yield production. A total of 11.5 million acres have been planted on forest industry land to date. Very few industry plantations have been harvested and it appears the industry is progressing towards having at least 70% of its acreage or 26 million acres in plantations by 2000 - at which time 850,000 - 900,000 acres of annual planting will serve to keep that acreage in annual production.

Other silvicultural practices could also increase yield. These include fertilization for soil with inadequate or improperly balanced nutrients, drainage for soil that is too wet, weed control, and precommercial thinning of weaker trees giving the remaining trees more light and space to grow in. These practices will be applied selectively where economical but

are not expected to have a major impact on the wood supply in the next two decades. Knowledge of planting has improved to the point where fewer trees are being planted per acre resulting in less requirement for pre-commercial thinning. The APA in their survey projects only a 16% increase in fertilized acreage and a decline in pre-commercial thinning between 1974 and 2000.

Over the last few years, International Paper Company has been conducting research in the use of Mycorrhizae. Their findings to date indicate growth of pine can be increased substantially (28%) in the first four or five years if seedlings are injected with Mycorrhizae in the nursery. Further work in this regard is being done and the company has recently established a research station for this purpose.

Superior Stock

Improved "supertrees" are expected to have an impact on productivity on company lands. Genetically superior trees are being grown and seeds from these are being used for company plantings. Recently a method has been developed to stimulate early tree flowering so that the time between successive generations of superior trees has been shortened considerably. Grafting from genetically superior first generation supertrees are now producing seeds for the second generation. The genetic impact will be substantial with about 20% growth improvement in the first generation alone. Estimates of subsequent

improvements range from an additional 10% to 15% for successive generations. Companies hope that eventually fourth generation stands will be growing 75% to 100% more wood than today's high yield stands. Weyerhaeuser, for example, is aiming to get twice as much volume of growth as nature gets in the same period.

It should be noted, however, that the aforementioned improvements from second and third generation stock are anticipated but have not yet been realized due to the length of rotation cycles involved.

Growth Levels

As stated earlier, the U.S.F.S. project annual growth per acre on forestry owned land to increase from 53.1 cubic feet in 1970 to 57.6 cubic feet in 2000, an 8% increase.

Company forest management programs would indicate a much higher rate of growth per acre. These programs involve acceleration of proven silviculture practices; increased thinning operations to allow the remaining trees to access more water, soil nutrients and sunlight, and increased planting efforts. Moreover, genetic research programs have been stepped up aimed at developing superior strains of various species.

Companies interviewed have typically indicated average growth rates of 130 to 160 cubic feet (1.5 - 1.9 cords) per acre

per year on current pine plantations. International Paper Company for example expect yields on plantations to increase by 75% by 2000 to a level two to three times that of unmanaged stands. Boise Cascade expect yields to continue to improve to the point where they can produce 100% more fibre from their Southern lands by 2000. Weyerhaeuser compare growth per acre on natural stands of 52 cubic feet (.60 cords) to areas planted and managed yielding 141 cubic feet (1.65 cords) and areas under intensive management including site preparation and fertilization yielding 178 cubic feet (2.1 cords). Numerous other companies indicated growth rates of 1.5 to 2.0 cords per acre per year as good estimates of future growth on their plantations.

Industry lands have not yet reached a sustained yield basis. It is estimated that on average, companies have only one half of their land in sustained yield production at present, however, by 1990 virtually all suitable company lands are expected to have reached this level. For example, in 1976 Union Camp produced only 28% of its wood fibre requirements from its company land. As their oldest plantations mature through the 1980's they plan to increase the proportion of their wood requirements harvested from their company's land. Weyerhaeuser is now self-sufficient in fibre needs, and are a seller of forest raw materials. Other companies appear to be similarly moving towards increased self-sufficiency.

The APA survey referred to earlier indicates that the companies surveyed plan to increase the quantity of furnish from company land from 16.6% in 1974 to 29.8% in the year 2000. For this same period sourcing from public land and private land is expected to decrease from 58.2% to 38.2% while use of sawmill chips are expected to increase from 25.1% to 32.0%.

Considering the above information it is our estimate that average growth per acre on company lands in 2000 will be at least 100 - 120 cubic feet (1.2 to 1.4 cords) per acre per year.

3.22 Public Land

In the past, public lands have been withdrawn, and other areas acquired from private owners for public recreation use and wilderness preservation. Much public land at the moment is under review for wilderness designation. In the U.S., land area qualified for potential study totals some 350 million acres. The U.S. Congress through various processes such as the Roadless Area Review and Evaluation (RARE I, 1970 and RARE II, 1974) is attempting to establish impacts of land management decisions on timber supply, as well as on recreation, wildlife, water and ranges. All roadless areas are now, and will continue to be treated as wilderness, with no commodity activity permitted. At the moment commercial forest land in the U.S.

South designated as wilderness totals only 23 thousand acres, however, if restrictions continue on the large areas of National Forest land in the Pacific, Northern, and Rocky Mountain areas, demand for wood from the Southern forest may be affected to a greater extent than anticipated. Given the degree of uncertainty regarding future policies we believe that the Forest Service projection of a moderate decline in public lands in the South classified as commercial forest land of about 3% (500 thousand acres) by 2000 to be a reasonable assumption.

Growth levels achieved on government land will also largely be a reflection of future government policies. Because of the small proportion of raw materials provided by public lands in the South - 5%, we have not attempted to forecast government policy regarding these. Thus, we consider the Forest Service projection of annual growth per acre of an average of 55 cubic feet (.68 cords) on National Forest lands and 53 cubic feet (.62 cords) on other public lands to be the best available estimates.

3.23 Private Lands

Because of the major amount of acreage in the hands of private landowners, and because of the relatively low growth on private lands in relation to their potential, it is clear that the key to the future of the wood supply in the South is the

private landowner. There are widely differing views on the anticipated level of land management by the private landowner in the future. The U.S. Forest Service indicate that with "1970 management levels" private landowners will achieve only a 12% increase in average annual growth from 42 cubic feet in 1970 to 47 cubic feet in 2000. The average growth in 2000 is more likely to be in the range of 50-60 cubic feet in view of the following considerations.

When discussing non-industrial private landowners, a distinction must be made between the small (under 200-300 acres) or the large (over 200-300 acres) private owners. The small landowner typically considers his trees a bank account - he cannot manage them economically for a continual flow of income; he generally has very limited capital, and is reluctant to make non-liquid investments in silviculture which have a long-term payoff period. The timing of his harvest is often determined by his financial needs i.e. - university education for his children, a new home, etc. The small landowner generally appears to be unresponsive to economic incentives other than cost sharing programs examples of which will be discussed later. Although the small private landowner does not manage his land, his inactivity is in fact still increasing the inventory. The large private landholder on the other hand is generally better educated, and more responsive to market forces as well as cost sharing. He has the opportunity to manage his land for

sustained yield, providing an annual flow of income, rather than cutting once in his lifetime. When stumpage prices rise he will often alter his timber management practices.

There is no available current information on the size of private timberland holdings. The best data available on the breakdown between large and small private landholders in the South is in Timber Resource for America's Future (1953) (Appendix 22). If one assumes the ownership structure has not markedly changed it is estimated that one third to one half of private timberland is in the hands of owners of 200 or more acres.

There are three main factors which are likely to influence how the private landowner manages his land:

- stumpage prices
- Government programs/assistance
- industry assistance and education programs

These are discussed below.

Stumpage Prices

Indications are that stumpage prices have an influence on the extent to which forest management is practiced, especially with owners of large tracts of land. State agencies, as well as companies who source a large degree of their fibre

supply from private landowners, have indicated higher levels of forest management in areas of high stumpage prices.

The relationship between stumpage prices and the timber land practices of private landowners can be seen in Georgia. The attached stumpage price map (Figure 3.1) of Georgia indicates that highest stumpage prices are in the concentrated areas of Southeast Georgia where pulpwood prices range from \$17 to \$25 per cord, while in Northern Georgia prices range from \$5-\$7 per cord. A large proportion of the land clear cut in S.E. Georgia is replanted unless being taken out of timberland. The forest land in this area of the state, is owned largely by companies or large private landowners. In Northern Georgia where stumpage prices are much lower we have been told that almost no forest management is being carried out. The forest land in the Northern part of Georgia is mostly owned by small landowners. The explanation provided is that a landowner will not spend \$100 to \$125 per acre to replant when he receives only \$5-7 per cord at harvest.

In the Southeast section of Georgia, artificially regenerated acreage more than doubled between 1960 and 1972. Stands originating from artificial regeneration prior to 1960 in S.E. Georgia totalled 502 thousand acres. Between 1960 and 1972 these increased to 1.1 million acres. Our findings show that since 1960 the majority of the plantations in the state of

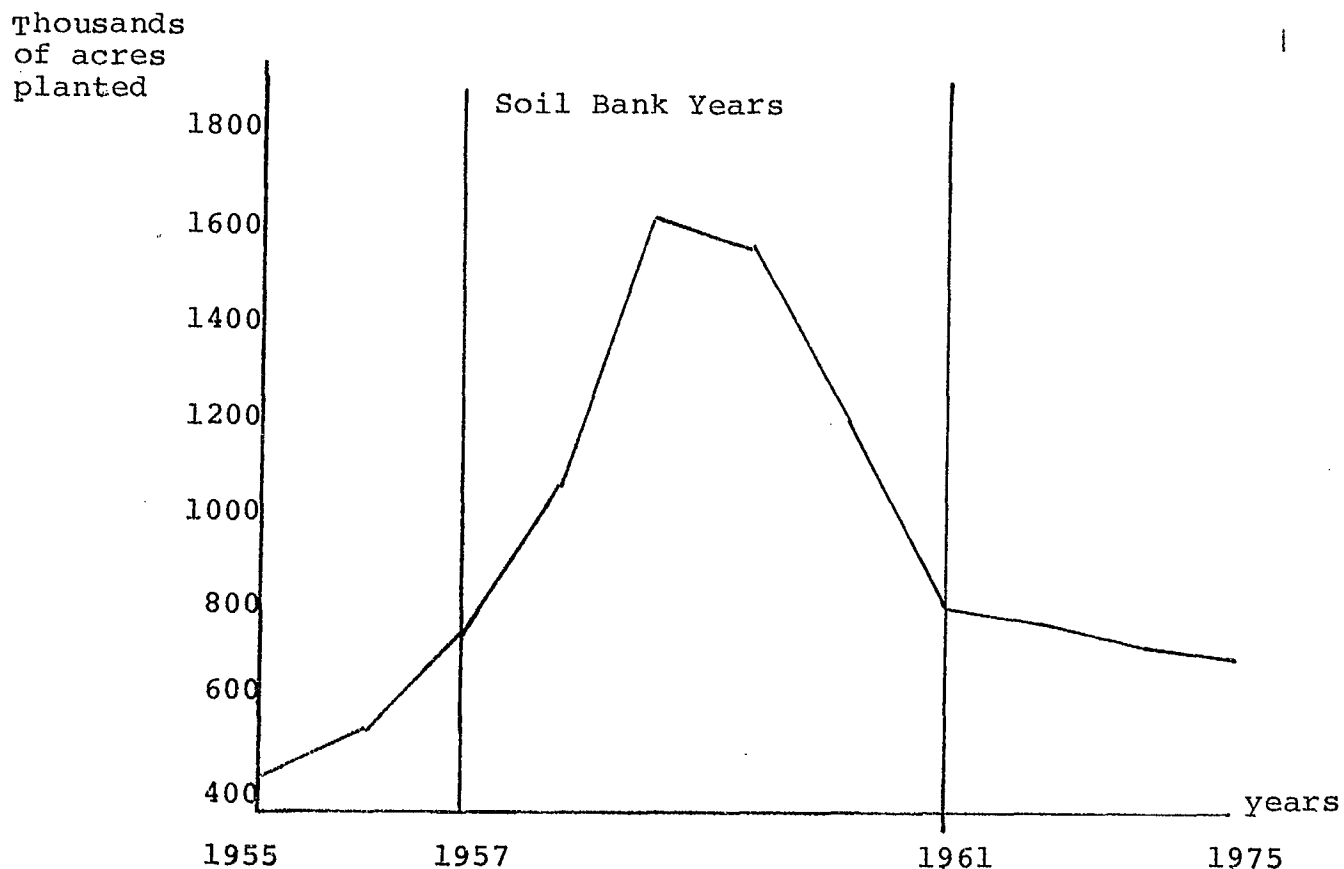
Georgia have been established in the Southeast section. Northern Georgia on the other hand, accounts for only about 3% of plantations since 1960.

Although it is difficult to assess how responsive the private landowner will be to stumpage prices, two points have been stressed repeatedly in our interviews. First, it appears that when stumpage prices increase to \$15-20 per cord, private landowners seriously consider clear cutting and replanting. Second, it is generally the large private landowner (200 acres or more) who acts first to adopt more intensive forest management.

Government programs/assistance

There are two kinds of government programs which appear to have a major effect on the level of land management carried out by the non-industrial private landowner. These are (1) subsidy/cost sharing programs for land management and (2) seed tree laws.

The most well known and successful of the subsidy and cost-sharing programs was the Federal Soil Bank program which provided farmers with direct payment for taking soil out of agriculture and planting trees. The impact of this program which ran from 1957 to 1961 is shown below:

Impact of Federal Soil Bank Program

Unfortunately, it is now believed that a fairly large proportion of the acreage planted under this program was later ploughed under and put back into agriculture.

Cost sharing programs in which the state or Federal Government pays for a proportion (usually 50% or 75%) of the

cost of site preparation and replanting also appear to be effective. (The experience of Virginia with this kind of program will be discussed later.) Subsidies and cost sharing programs are of particular interest because they influence the small private landowner who does not otherwise seem to be willing to invest in silviculture, even when stumpage prices increase.

Seed tree laws which provide that when pine land is clear cut, a certain number of seed trees per acre must be left standing (or the tract artificially regenerated) are on the books of several Southern states. Generally, these are not enforced although there appears to be a movement toward greater enforcement when a state's wood supply becomes tight.

Along with assisting landowners through programs for land management, governments can also affect the future actions of private landowners through changes in tax laws. At present the House Ways and Means Committee are discussing a Tax Reform Bill. It is expected that very soon amendments will be introduced to be incorporated in this Bill for a 10% investment tax credit with a 7 year amortization period for investments in forestry. This amendment is being strongly supported by industry and could very well affect the level of investments made in forestry by both small and large private landowners. In addition to the investment tax credit amendments, the inheritance tax laws are currently under review and are also to

be discussed by the Committee. These would also impact private landowners, especially the small private landowner. With an improved tax climate, productivity on privately owned land could substantially increase.

Industry Assistance/Educational Programs

The forest products industry, both through industry associations and individual companies, provides various types of land management assistance and educational programs for the private landowner.

The Tree Farm Program directed by the Southern Forest Institute and its parent organization the American Forest Institute, is a recognition program whereby small landowners develop a management plan for their forest land, and receive recognition from the association as a "Tree Farm". Membership to this program gives the farmers monthly publications on methods of land management, advice on where to get assistance with some management practices, i.e. - when best to thin, harvest, replant, fertilize, names of large equipment owners who can assist the farmer, etc.

The Tree Farm program began in 1941 and Tree Farm acreage in the South as at January 1, 1977 totalled 47 million acres. Although this is a fairly large percentage (34%) of total private ownership, it is difficult to determine what impact this type of program has on increasing volume of growth,

since each Tree Farm differs in its level of land management and site quality. Some management plans can mean as little as surveying the land to establish total acreage while others can include clear cutting and replanting.

Landowners assistance programs in one form or another are provided by almost all major companies operating in the South. Companies typically provide services such as site preparation, prescribed burning, providing seedlings and plantings, usually at cost. Our interviews suggest that these programs have not had a major impact on the wood supply except perhaps in a few local areas.

A very successful landowners' assistance program we have encountered is offered by a company operating in the highly concentrated Southeastern Georgia area and largely dependent on private landowners. Their landowners assistance program not only allows for replanting at cost but also includes advice to private landowners on various management practices. This company replants, at cost, as much as 90% of the private land from which they source their fibre supply. They believe their program to be very effective, but they also feel that the private land owner needs a stumpage price of at least \$15 per cord before he is willing to replant at cost.

Parsons and Whittemore are opening a new mill in Alabama. They own no land and plan to source all their fibre

needs from private landowners. The company has a planned landowners assistance program and believes that the majority of the land cut to supply the new mill will be replanted.

International Paper Company have a Landowners Assistance Program and their goal is to bring one million acres of independently owned forest lands into managed and productive status by 1980. To date, they indicate they are ahead of schedule.

3.3 System Responsiveness to Local Shortages

In forecasting wood supply (particularly from the private landowner), it is important to recognize the dynamic nature of the forest industry in the South - that is, the basic responsiveness of industry, governments and ultimately, the private landowner when shortages occur. The industry has been described as a crisis oriented one, and there is evidence that when necessary, it is capable of reversing a wood shortage by both actions on its own land and influencing the private land owner. Developments in the state of Virginia during the late 1960's provide a good example of joint industry/government response to a regional wood shortage.

The Virginia Program

Approximately every 10 years, the U.S. Forest Service conducts a state survey of each state in the South. The 1966

Virginia survey revealed that the total removals of softwoods exceeded growth by 15%. In the Easternmost part of the state, nearly half the counties showed deficits some as high as 60%. The seriousness of this problem was driven home in 1969 with the publication "The South's Third Forest" a report of the Southern Forest Resource Analysis Committee which highlighted Virginia as the only state in the South which had removals exceeding growth. When this realization occurred, the state forest service took the lead in pulling together representatives of industry, private large landowners, and the state legislature. Together, they initiated the "Reforestation of Timber Land" program, the first program of its kind in the U.S. This Program provided that landowners would be given 50% of the cost of replanting and site preparation up to a maximum of \$30.00 per acre (subject to certain conditions).

The money for this program was provided from two sources. The forest products industry agreed to a tripling of the severance tax (a tax on the volume of harvested wood). This revenue was matched by the state and together provided the funds for the program. This was complimented by a more strict enforcement of a "seed tree" law which had been on state books since the 1950's and stipulated that 8 seed trees per acre were to be left when pine stands were cut (or the acreage had to be replanted).

It appears that the situation has improved substantially since 1966. In the Eastern third of the state, although there has been a net loss of 76,000 acres of commercial forest land, the 1976 forest survey indicates that net growth has increased 8%. According to this survey, in 1976 growth would have been equal to cut in the area where the problem was most acute, if it had not been for an epidemic of the bark beetle. Nevertheless, the 1976 survey shows that there is nearly a balance between growth and cut in the Eastern part of the state. It has been estimated that 90% of the pine land which is cut today and does not go into alternative uses is successfully regenerated - a vast majority of it (at least 85%) through replanting.

The growth of the forest products industry in Virginia does not appear to have been affected in a major way (if at all) by the temporary deficit in growth/cut.

In 1966, there were seven pulp mills in the state, six in the pine growing Eastern region. Since then, one new mill has been added (1974), a new mill is planned (the land has already been purchased), and one pulp mill has expanded. In addition, another pulp mill has added a sawmilling operation. The state has not lost any major sawmills during this 12 year period.

3.4 Tree Utilization

In the preceding pages we have looked at factors affecting the future growth of the Southern forest. In addition to an increase in the net growth from silvicultural methods, we believe that significant increases in the use of residues presently left in the forest will be achieved.

The opportunities for this are quite clear. In 1970 U.S.F.S. indicate about 7% of softwood removals and 17% of hardwood removals were left in the woods as logging residues. Pulpwood markets do not exist in some areas of the South, and in some instances the sawlog portion of the tree is harvested but the pulpwood portion is simply left to rot in the woods. With increases in demand it is expected that markets will open to these fibre sources.

Other opportunities exist for increasing utilization and these can come from:

- Increased use of whole tree chipping which is capable of increasing the yield from a given tree.
- Stump/root extraction which is estimated at yielding 15% more wood per tree than conventional shears.

These techniques are already being used in Scandanavia. Roots are now being used by some

Southern firms as a portion of the furnish for linerboard.

- Salvage of cull and dead trees also exist as another opportunity for increasing fibre supply. In 1970 mortality of softwood was 8% and hardwood mortality totalled 22% of growth. Roundwood products from this source accounted for only 5% for softwoods and 14% for hardwoods. With intensified management a larger portion of these losses can be salvaged for utilization.

Along with increases in the use of logging residues, opportunities for pulp mills also exist in increasing their use of chips and sawdust from sawmilling operations. A recent study indicates saw and plywood mill residues in the South account for over 5% of total removals.

In view of the above points, we believe that a 5% to 20% increase in supply can be achieved from increased utilization.

3.5 Alternative Scenarios

In previous sections of the study, we have made the following forecast:

- An increase in the average net annual growth to 100-120 cubic feet per acre by 2000 on forest industry owned land and 55 cubic feet per acre on government owned land.
- Acceptance of the U.S. Forest Service estimates of a decline of 4.2 million acres in commercial timberland in the South by 2000 and the future ownership structure of the timberland.
- An increase in tree utilization ranging from 5 to 20%.

In our interviews and in much of our secondary research it has been indicated that to meet the expected growth in demand by 2000, the South will have to double 1970 removals. If we apply the assumptions mentioned above we can arrive at several different scenarios of how a doubling of demand for Southern wood could be met by 2000. In arriving at our alternative scenarios we have used only 95% of total commercial forest land in an effort to take into account only economically available forest land. Also, lands leased by the forest industry were not included in their ownership class but were kept in the private non-industrial ownership category although the majority of these lands are being managed and producing at almost the same level as industry owned lands. We compare these scenarios below to determine their implications for the

necessary average growth per acre on private lands to maintain a balance between net growth and removals by 2000.

Removals from the Southern forest in 1970 total 6.5 billion cubic feet, (4.0 softwood; 2.5 hardwood). The following table indicates the level of annual growth required by the non-industrial private landowners in the South to meet a doubling of removals (13 billion cubic feet) by 2000. With a minimum (5%) increase in utilization, average annual growth on company lands of 100 cubic feet per acre and 55 cubic feet on government lands, private owners would be required to increase their growth by 48% to 62 cubic feet per acre per year by 2000. The U.S.F.S. project an increase in growth by this ownership class of 12% based on "1970" land management levels. Alternatively, if one assumes that the forest industry owned land and increased tree utilization reach maximum levels, the required growth from the private landowner will be less than 1% above that attained in 1970. If all ownership classes reach the maximum growth levels illustrated in Table 3.2 below and tree utilization increases 20% the supply of wood from the South could reach a level 2.4 times that of 1970, without drawing on the inventory.

Table 3.2

Required Average Net Growth Per Acre On Non-Industrial Private Land to Allow a Doubling of Removals by 2000**

Average annual growth per acre on industry lands	Increase in tree utilization		
	5%	10%	20%
100 cubic feet	62 c.f.	57 c.f.	49 c.f.
110 cubic feet	59 c.f.	54 c.f.*	46 c.f.
120 cubic feet	56 c.f.	52 c.f.	43 c.f.

* E.g. With industry land growing an average of 110 cubic feet per acre per year and a 10% increase in tree utilization, private non-industrial land owners would be required to annually grow 54 cubic feet per acre in order to supply a sufficient amount of wood to meet a doubling in demand by 2000.

** Back up calculations are provided in Appendix 24. We are assuming growth to equal removals by 2000. For removals to double from 1970 would necessitate approximately a 50% increase in net growth as there was a 33% surplus of growth over removals in 1970.

The growth rates obtained from our calculations reflect volumes to be achieved on 95% of all forest lands in the U.S. South. As stated earlier, government lands in the South have in the past supplied only a small portion of the needs of the forest products industry. It is our belief, however, that should a wood shortage occur, government would react and permit

an increasing proportion of supply to be sourced from public lands rather than allow mill closures and resulting unemployment. Private non-industrial lands have in the past supplied about 70% - 75% of the industry's needs. Historically, however, approximately 30% of the forest land held in this ownership category has been unavailable for harvest at any given time. There are a variety of reasons for the unavailability of these forest lands which include the settling of estates and the holding of lands for non-commercial reasons such as conservation of wilderness and recreation. If the acreage in this ownership class is reduced by 30% (to 94 million acres), the quantity of wood to be supplied from this source (and the required growth per acre in order to meet a doubling of demand) would have to substantially increase. It should be kept in mind, however, that the holding of land for non-commercial reasons is a continuous process, and although 30% of the land may be "off the market" at any point in time, it is in fact still producing and increasing total inventory, and will likely be "on the market" at some future date.

3.6 Demand for Timber Products in 2000

The U.S.F.S. projection of demand for timber products in the U.S., as well as other studies, indicate a virtual doubling of demand for almost all products by 2000. The projection

of the U.S.F.S. takes into account increases in imports and exports, various levels of population and economic growth, as well as different price assumptions. The projected demand by product category is then converted to roundwood equivalent. The following table illustrates the total demand for roundwood equivalent in the U.S. by 2000 to meet the projected increases in demand for timber products, given a medium level of population and economic growth.

Table 3.3
Summary of Total Demand for Roundwood Equivalent
in U.S. by 2000

(billion cubic feet)

<u>Price Assumption</u>	<u>Total*</u>
1970 Relative Prices	24.6
Rising relative prices	21.0
Lumber 1.5%/yr.	
Plywood, misc. & fuelwood 1%/yr.	
Paper and board 0.5%/yr.	
above 1970 averages	
Prices above 1970 levels	
Lumber and plywood 30%	22.5
Misc. and fuelwood 15%	
Paper and board 10%	
above 1970 averages	

Source: U.S. Dept. of Agriculture, Forest Service

* Total demand is made up of U.S. production, including projected exports, plus projected imports.

In the above projections, 1970 relative prices could be expected to prevail only if supplies of stumpage meet demands at 1970 prices throughout the projection period and if productivity in the timber processing industry keeps pace with that in other industries. The U.S.F.S. considered this unlikely and state that in the past these conditions have not held for periods longer than a decade or two, and prices of most timber products have shown a persistent long run upward trend relative to the general price level. For some considerable length of time the relative wholesale price index for lumber increased at an average annual rate of 1.7%, pulp, paper and board prices have averaged 0.5% increases per year since 1926, and although relative prices of plywood declined sharply after 1950, on the basis of prospective timber demand supply balances, it has been assumed that future relative prices will rise 1% per year. Using the medium levels of population and economic growth mentioned previously, consumption of the various product categories is projected to grow at approximately the following annual rate:

Lumber	1%
Plywood	2.1%
Building Board	3.5%
Paper and Board	3.3%

Recent trends in consumption indicate lumber consumption in the U.S. remained at about the same annual level during the 1950's

and 1960's. In 1972 and 1973 lumber consumption rose about 15% above previous levels, however, since then this has dropped again to a level approximately equal to that of the 1950's and 1960's. Plywood consumption increased rapidly (8.5% per year) between 1950 and 1970 due to its substitution for lumber in sheathing and subflooring in residential construction. This growth slowed considerably between 1970 and 1975, averaging less than 1% per year. It is, however, expected that growth in construction and manufacturing is large enough to result in some increase in consumption of plywood. As with plywood, building board consumption also rose rapidly between 1950 and 1970 (5% per year) due to its fast growth in substituting both lumber and plywood in manufacturing furniture and in housing construction, etc. Demand for paper and board in the U.S. grew at an annual rate of 3.5% from 1950 to 1970. This rate has decreased to about 2.7% per year since that time.

Demand/Supply Balances

In looking at demand/supply balances, it should be noted that roundwood equivalent, as calculated by the U.S.F.S. from product output, was estimated to be 20% below total removals as determined by the state by state survey method. For example removals from the U.S. forests in 1970 totalled 14 billion cubic feet while roundwood equivalent from the U.S. forests for that year totalled 11.7 billion cubic feet. Estimates of future roundwood demand from the U.S. forests also

take into account increased levels of utilization thereby lowering estimates of required roundwood.

In an effort to allow for any downward bias in the projection of demand from the U.S. forests in 2000, based on roundwood equivalent, we have increased total production figures shown in Table 3.3 by 20%. We also added back projected imports to arrive at total adjusted demand for roundwood equivalent in the U.S. in 2000.

Adjusted Demand for Roundwood Equivalent in 2000 from U.S. Forest

28.9 billion cubic feet with 1970 relative prices

24.2 billion cubic feet with rising relative prices

26.1 billion cubic feet with prices 30% above 1970 levels for

lumber and plywood and 10% above for paper and board

Given the potential growth levels indicated in our alternative scenarios, the U.S. South could increase removals from 6.5 to 13 billion cubic feet in 2000. As indicated above, projected roundwood demand ranges between 24.2 to 28.9 billion cubic feet. If we assume the South doubles removals to 13 billion cubic feet the balance of the increased demand, to be supplied either from other producing regions in the U.S. or from imports, ranges from a high of 15.9 billion cubic feet to a low of 11.2 billion cubic feet. As mentioned previously, the high

estimate of demand is possible only if 1970 relative prices prevail throughout the projection period and the U.S.F.S. consider this unlikely given past trends in relative prices.

Below we compare the U.S.F.S. medium level of projected demand in 2000, which takes into account relative prices above 1970 levels, and the projected level of supply in the U.S. South developed in our alternative scenarios, to arrive at the balance of roundwood equivalent which will be required from other wood producing regions in the U.S. or by increased imports.

	<u>Billion Cubic Feet</u>
Estimated U.S. equivalent roundwood demand 2000	26.1
Estimated supply from the U.S. South in 2000	<u>13.0</u>
Balance of equivalent roundwood demand to be met by other producing regions of the U.S.	13.1
Less 1970 levels of imports	<u>2.4</u>
Balance of roundwood equivalent to be supplied by other wood producing regions in the U.S. or by increased imports.	10.7

In 1970, removals from the U.S. totalled 14 billion cubic feet, 6.5 from the U.S. South and 7.5 from all other producing regions of the U.S. Given the above level of increased demand in 2000 of 10.7 billion cubic feet, a 43% increase in production by these other regions in the U.S. would be sufficient to meet all projected growth for timber products

in the U.S. by 2000, without increasing imports above the 1970 level. This increase, averaging about 1% per year, is considered, by the U.S.F.S., within the growth potential of other producing regions in the U.S. In their analysis of available removals in 2000 (based only on 1970 land management levels) the U.S.F.S. project average annual increases of 1.2% for all other areas in the U.S.

In summary, given a reasonable set of assumptions regarding population and economic growth and prices rising above 1970 levels, demand for timber products in the U.S. as projected by the U.S.F.S. is expected to increase to 26.1 billion cubic feet of roundwood equivalent. Our analysis indicates the U.S. South is capable of doubling 1970 levels of output by 2000. Therefore, if imports are maintained at 1970 levels there remains a balance of 10.7 billion cubic feet of roundwood equivalent to be supplied by other wood producing regions in the U.S. or alternatively by an increase in imports. To meet this additional requirement, all other wood producing regions in the U.S. would have to increase output by 43%. The U.S.F.S. consider this increase in output of 43% from other regions of the U.S. realistic. Therefore, the best available data would suggest that the U.S. South as well as other regions of the U.S. are capable of meeting all projected incremental demand for timber products in the U.S. by 2000. If, however, areas other than the U.S. are able to produce timber products more economically, there is an opportunity for imports into the U.S to increase.

3.7 Comparison with Other Studies

We believe that the growth levels in the alternative scenarios described previously are likely to be achieved if not exceeded. This appears to be consistent with other studies. In the following section our projected growth rates for 2000 are compared to relevant studies by others.

U.S. Forest Service Estimates of Growth Per Acre on Fully Stocked Natural Stands

The U.S. Forest Service has made estimates of the growth rates to be expected from fully stocked natural stands without intensive management. Forest land is classified in terms of potential capacity to grow crops of wood. A fully stocked natural stand is a stand utilizing 100% or more of the natural growth potential of the land. In the table below we compare the growth rates required in our scenarios to meet a doubling of wood demand with 1970 growth rates and fully stocked natural stands.

Owner Class	<u>Average Net Annual Growth Per Acre</u> (cubic feet)		
	1970	Our Scenarios	Fully Stocked Natural Stands
Public	51	55	70
Industry	53	100-120	81
Private	42	43-62	75

Source: U.S. Dept. of Agriculture, Forest Service.

We estimate that public and private landowners will have annual growth well below that of the Forest Service estimates for fully stocked natural stands. The average growth on industry lands, due to the high degree of intensive management is estimated to be 25-50% greater than that of natural stands.

The South's Third Forest Report

In 1969 the "South's Third Forest" report, carried out by the Southern Forest Resource Analysis Committee was published. This study forecast that demand for timber in the South would increase 2.3 times between 1969 and 2000. It also estimated that the average growth per acre levels shown below could be achieved to meet that demand:

Owner Class	<u>Average Net Annual Growth per Acre - 2000</u> (cubic feet)	
	Third Forest Report Projections	Our Scenarios
Public	82	55
Industry	102	100-120
Private	73	43-62

When compared to the Third Forest report our estimates for growth on private and public lands appear to be conservative. A major reason for our conservatism regarding public lands is that since 1969, there has been increasing debate about timberland management on public lands. Recent court decisions - most notably that involving Monongahela National Forest - appear to be placing serious limits on the way the national forests will be managed in the future.

A second point is that the Third Forest report included a list of policy recommendations - steps that have to be taken for their estimates to be achieved. Most likely, some of these will not be implemented and thus their estimates for both public and private lands should be scaled down to reflect this.

The difference between our estimates for the private landowner are due to the point mentioned above, but also indicate the conservatism of our scenarios and the likelihood that they will be realized if not exceeded. That is, privately held timberland will be more productive than necessary to meet a doubling of demand.

Our interviews with industry sectors indicate that the Third Forest projections regarding growth on industry lands are

conservative. Since 1967, planting on industry land in the South has increased 107%, advances have been made on genetically superior stock and there is the promise of substantially greater improvements.

Georgia's Future Timber Supply

In 1976, a study¹ was completed which compared existing forest management practices in Georgia to those required to fulfill a doubling of timber demand by 2000. This report relied on a theoretical model that determined the economically efficient management practices to be employed on different categories of sites throughout the state. The conclusion of this study was that if public, private, and industrial landowners acted in an economically rational fashion, i.e. invested in alternatives with the highest return, a rise in stumpage prices of 7% (adjusted for inflation) would bring an increase in supply sufficient to meet a doubling of demand by 2000. The report also indicates that the industry is presently managing its land more intensively than prescribed by the model while public and private landowners are lagging behind.

1. Impacts of Land-Use Competition and Other Constraints on Georgia's Future Timber Supply, Georgia Research Council/ Report No. 36/July 1976.

4.0

POSSIBLE CONSTRAINTS4.1 Softwood/Hardwood Reversion

The reversion of pine forest to hardwood is a serious problem facing the forest industry in the South. There are two reasons why this is a problem. First, pine is the preferred specie both for lumber and packaging papers. Although there is some substitutability between hardwood and softwood in paper and board production, it adds costs (such as additional chemicals) and can result in a lower quality end product. Second, the growth per acre of hardwoods is lower than for pine -- less than half the rate of natural stands of pine and probably less than a third of the annual growth of plantation pines.

Over the last several decades in the South, there has been a definite reversion of pine forest to mixed and hardwood forest, particularly on private land. This is because the climax forest in much of the region is hardwood not pine. The existing acreage of pine forest is primarily the result of man's impact on the landscape, whether through his management or historical events.

It should be noted that the loss of pine forest acreage reflects conversion to agriculture and commercial uses as well as hardwood reversion.

This trend has continued in recent years and the loss of pine forest acreage between the two most recent Forest Service surveys totals 7.3 million acres (11%). A state breakdown of this pine to hardwood reversion in recent years is illustrated in Appendix 25 and 26.

Arkansas, Alabama, and Mississippi are the states most severely affected while Virginia, due to its joint government and industry program aimed at encouraging reforestation of pine has actually had an increase of 15% in pine acreage.

It is clear that the reversion of pine to hardwood must be considered among the most serious problems facing the South. Nevertheless, we believe that this problem will be partially checked by programs patterned after the Virginia one which already has been effective in reversing this trend. Secondly, it is important to recognize that the reversion of acreages in pine forest type to mixed or hardwood types is not a new problem, and despite the significant loss of acreage referred to above, total annual growth of softwood in the South has increased 50% from 1950 to 1970 and softwood inventory has increased 42% during this same period.

4.2 Labour

4.21 Wood Procurement

As mentioned previously, companies can obtain fibre through three basic methods - contractors via dealers (54%), contractors directly (39%), and company operations (7%). A large portion (93%) of the labour force is therefore independent contractors, 90% of whom employ less than 10 employees, are non-unionized and paid low wages with few fringe benefits. This source of cheap labour is a major factor in the low wood costs recorded in the South.

A study by the American Pulpwood Association forecasts a gradual change in the methods of wood procurement. Companies plan to increase sourcing from their own operations to 19% by the year 2000, and source 49% by the dealer system and 35% from direct purchases through contractors.

4.22 Labour Costs

Woods Workers

Due in part to the large number of independent loggers the labour costs for woods workers in the U.S. South

are the lowest in North America. A recent study indicates the following labour rate per man hour including fringe benefits for woods workers in 1976:

	<u>\$ per hour</u>
Northern Ontario	10.00
Lac St. Jean, Quebec	8.00
Bathurst, New Brunswick	8.50
Southeast U.S.A.	5.00

Source: Peat Marwick & Partners

As labour costs account for approximately 25% to 30% of total wood costs, the advantage to the producer in the U.S. South is very significant. Details of current wage settlements for woods workers in the U.S. are not available, but wage rate increases in the U.S. South would have to be 3% per annum more each year than those in Eastern Canada for the rates to equalize by the year 2000.

Mill Workers

The paper industry in 1977 continued the trend established in 1974 of escalation of wage and benefits above the national average. For the U.S. South the average first year negotiated wage increase was 11.3% with 10.5% for the next two years.

In the U.S. South newsprint mills labour costs in 1976 were \$38.30 per finished ton compared to \$49.40 per finished ton in Eastern Canada. The difference in wage rates for mill workers between the U.S. South and Canada is less marked than that of woods workers.

4.23 Conclusion

The companies interviewed did not foresee any shortage of labour in the future. The increasing use of more mechanized harvesting machines, particularly on plantations, will lead to increased productivity per man day and reduce the number of workers required. (It has also been suggested that mechanization will prove to be cost saving in the future, although this has not been the case to date.)

Labour costs are expected to rise, however, due to a number of factors. The increasing number of company harvesting operations, mechanization of timber harvesting, and the decrease in the supply of woods labour over the years has increased the opportunity for unionization and the resulting cost increases. However, we believe that the structure of labour relations is not likely to radically change. Given the small size of dealers and contractors, there is little likelihood of widespread unionization of forest workers.

As explained previously, wood dealers and contractors provide important functions in the procurement system and will remain the dominant method of procurement for the foreseeable future. Given this structure, the U.S. South is likely to maintain its substantial cost advantage over Eastern Canadian producers. Nevertheless, we expect moderate pressure to increase the wage rates of woods workers due to the increasing number of loggers employed directly by companies and the pressure of the higher wages of mill workers.

4.3 Energy

The O.P.E.C. oil embargo of 1973, administered price increases and temporary fuel shortages caused energy price increases of an unprecedented magnitude. The result has been a major rethinking of the technology and administration of energy use in the U.S. and the rest of the world.

The cost of energy is very important in the pulp and paper industry. In 1976 energy costs per finished ton of newsprint in Eastern Canada totalled \$26.10 vs. \$49.70 in Southeast U.S.

	<u>Eastern Canada</u> <u>\$ Finished Ton</u>	<u>South Eastern U.S.</u> <u>\$ Finished Ton</u>
Heat	\$ 12.80	\$ 10.70
Power	13.30	39.00
Total	26.10	49.70
 Total Average Newsprint Manufacturing Costs	 243.00	 210.00

Source: Sandwell & Co.

The difference in specific power requirements is due mainly to the wood species and the mechanical pulping processes employed. The manufacture of mechanical pulp from spruce by grinding with stones requires the least power, as is the case for Eastern Canadian Mills, while the manufacture of stone groundwood from Southern Pine requires appreciably more power. Eastern Canadian mills also enjoy lower fuel costs than the U.S. As Canada is committed to paying world prices for its energy by 1981 this advantage will be eroded. It is also likely that the U.S. will be paying world prices for its energy as a result of President Carter's proposed energy package.

Use of Waste Fuels

The industry is unique because it generates over 45% of its energy requirements from non-fossil, self-generated waste fuels. These waste fuels include bark, hogged wood (chipped residues from forest and manufacturing operations) and spent pulping liquors from which chemicals as well as energy are recovered. The self-generated portion of the U.S. industry's total energy requirement has been increasing - from 42% in 1972 to 45% in 1976. In this period the industry was reducing its use of the more efficient fossil fuel and purchased energy, by increasing its use of the less efficient self-generated and waste fuels. The pulp and paper industry in the U.S. South self-generates some 52% of its energy requirements the sources of which are shown in Appendix 27. There is likely to be an increasing trend towards mills becoming more self-sufficient for their energy supplies. Increasing self-sufficiency is capable of being achieved with current technology as evidenced by Georgia Pacific who have built a lumber sawmill at Woodland which is electrically self-sufficient. Also another company plant sells surplus electricity to local utilities. Although land ownership is a definite advantage in obtaining waste material for energy self-sufficiency, the new Parsons and Whittemore mill in Alabama is planned to be virtually self-sufficient.

4.31 Energy Conservation

In October 1974 the U.S. Federal Energy Administration (F.E.A.) met with the representatives of the six most energy intensive manufacturing industries with a view to establishing in each, a voluntary energy conservation program. The pulp and paper industry proposed an industry wide goal of reducing fossil fuel and purchased energy use per ton of product by 10% between 1972 and 1980 provided that environmental factors did not interfere. The industry actually achieved a 12% reduction by 1976, largely through attention to obvious waste and insulation housekeeping, and in 1977 the FEA set a new target of a 20% reduction by 1980.

The Canadian pulp and paper industry has also set voluntary targets for reducing fossil fuel and purchased energy use per ton of product by 12% between 1972 and 1980. The industry had achieved a reduction of 5.1% by June 1977.

Care however must be taken in comparing the two countries' achievements in reaching their energy reduction targets as their power requirements are significantly different.

Coal

Since the expended use of coal is a major element of President Carter's energy program, it is interesting to note

that the paper industry's use of coal declined from 11% in 1972 to 9% in 1975. More coal was used in 1976 and this trend is likely to gain momentum, particularly as the FEA implements its coal conversion program. In mid 1977 the FEA issued Notices of Intent requiring conversion to coal of 15 pulp and paper facilities which represent 11% of the industry's 1977 paper and paperboard capacity. The additional financial burden of these conversions, if finally implemented, is in excess of \$400 million. New mills are also required to use higher cost coal boilers, which will increase the total costs of new mills.

A recent study forecasts, for the South Atlantic region, an increase in coal supply of 4% per annum with cost increases of 6.5% per annum to 1985. This is compared to 2.7% per annum increase in the costs of residual fuel oil for the same region, although these forecasts could well be effected by the Carter legislation.

Offsetting this, some companies have coal and lignite deposits on their land which could be utilized.

4.32 Conclusions

Companies interviewed in the U.S. South expressed concern about the energy situation, but they did not consider it a serious constraint to growth. In the U.S. South the trend away

from using oil and natural gas to the utilization of waste fuels, with companies becoming more self-sufficient, is expected to continue. Although some temporary shortages may be experienced we believe that the industry's potentially high degree of energy self-sufficiency will lessen the impact of future energy cost increases and shortages.

4.4 Environmental Controls

Pulp and paper manufacturers in the U.S., after spending in excess of \$3 billion on capital expenditures for environmental improvement, are essentially in compliance with the 1977 air and water pollution regulations set by the Environmental Protection Agency (E.P.A.). In looking at the six year capital spending trends for the United States and Canada (Appendix 28), it should be noted that in the U.S., following the introduction of air and water pollution regulations (in 1972), considerable sums of money were diverted from increasing productive capacity to expenditures on environmental controls. Expenditures on environmental controls for 1978, however, are projected as 17% versus 24% for 1977, reflecting the completion of programs to meet the 1977 requirements. The Canadian manufacturers have diverted considerably less of their total expenditures to environmental control during the same period. Total expenditures for environmental control in 1977 were 14% and planned expenditures for 1978 total 16%.

The U.S. industry is currently discussing the 1983 E.P.A. regulations which are likely to require the compliance of pollution control obtainable from the best available technology. The impact of these regulations on the industry is uncertain but will probably result in increased capital expenditures for environmental control.

Enforcement of Environmental Regulations

The environmental regulations in Canada and the U.S. are considered comparable, but the enforcement of those regulations on the U.S. mills is much stricter than in Canada. In the U.S. it can take up to two years to obtain permission to build a new mill.

Technology

The current state of the art is that pollution control is not a problem technically, with the U.S. industry removing 97% to 98% of all particulate matter in its air discharges and 85% to 90% of the B.O.D. and suspended solids in its water discharges. While the technology is available to increase this efficiency it will be at a high capital cost.

4.5 Mill Sites

The availability of mill sites in the U.S. South is not considered a future constraint to growth by the industry.

One reason for this is the industry's current emphasis on upgrading and expanding existing facilities rather than building greenfield mills. This can be seen in capital expenditure forecasts, and is due to the high costs of new mills, the costs of environmental and energy regulations, and the length of time it takes to obtain permission to build a new mill.

Secondly, companies interviewed claim there are still numerous greenfield sites available in the U.S. South. We believe even more sites will become available with advancing technologies reducing the water requirements and pollution discharge (e.g. closed-cycle processes), as well as the lower labour requirements for new mills. (For example, the TMP process makes more mill sites available as less water is required to absorb effluents.) These new sites could therefore be located away from the present concentrated areas which are situated near major water sources, and would likely benefit from lower stumpage prices for some time.¹

1. It should be noted that TMP has high energy costs, and because of the higher density of Southern pine than Eastern Canadian species would indicate higher energy costs in the South.

We also expect that the norms in the industry regarding the size of a land base required to support a mill will gradually break down. That it is not necessary for a new mill to own a land base to supply its fibre needs is demonstrated by Interstate Paper Co. and the proposed Parsons and Whittemore mill which are totally dependent on unowned stumpage. Eventually, most companies do acquire some land base but in many cases this is a matter of economics rather than necessity.

APPENDICES

1. Size Distribution of Mills Using Southern Pulpwood in 1976.
2. Historical Paper, Paperboard and Wood pulp production, Total U.S. and U.S. South.
3. Lumber Production - U.S. and South Softwood and Hardwood 1950-1974.
4. Softwood Plywood - U.S. and South Production.
5. United States Consumption - Hardwood Plywood 1966-1976 (Imports and Shipments).
6. Hardwood Plywood Capacity in 1972 U.S. and South.
7. U.S. Newsprint Capacity - U.S. South Percentage of Capacity.
8. U.S. and Southern Newsprint Capacity 1950-1977.
9. Regional Sources of Newsprint for Daily U.S. Newspapers Reporting to A.N.P.A. 1965 and 1975.
10. Paperboard - U.S. South Percentage of Total U.S. Production by Product 1963-1975.
11. Harvesting Costs by Region - 1976 Costs.
12. Average Prices Received for Southern Pine Pulpwood Stumpage and Sawtimber Stumpage based on National Forest Timber Sales by State - 1957-1976.
13. Pulpwood Stumpage Prices, by Specie 1955-1976 - Louisiana.
14. Newsprint and Market Pulp Manufacturing Costs and Differences, U.S. South and Canada.
15. U.S. South Commercial Forest Land Area by state - 1970.
16. Pulping Capacity and Pulpwood and Lumber Production by State.
17. Net Annual Growth Per Acre for the U.S. South 1970, by ownership class.
18. Net Annual Growth and Removals of Growing Stock on Commercial Timberland in the U.S. South Softwoods and Hardwoods - by State 1970.

19. Net Annual Growth and Removals of Sawtimber on Commercial Timberland in the U.S. South Softwoods and Hardwoods - by State 1970.
20. Area of Commercial Timberland in the U.S. South by Ownership Class - Project to 2000.
21. Projected Net Growth of Growing Stock Per Acre in the South by ownership class and specie group to 2000.
22. Farm and Private Ownership by Size of Land Holding.
23. Silvicultural Practices.
24. Back-up Calculation for Required Growth Per Acre to Allow for a Doubling of Demand by 2000.
25. Pine to Hardwood Reversion by State Timber Type Changes Between Last Two Surveys.
26. Historical Change in Pine Forest Type.
27. % of Total Energy Input by Sources for the Pulp and Paper Industry - U.S. South.
28. Six-Year Capital Spending Trends, U.S. and Canada.
29. Major Secondary Sources of Information.
30. Interview participants.

Appendix 1

Size Distribution of Mills Using Southern Pulpwood in 1976

<u>State</u>	Number of Mills by Range in Tons per day				
	<u>Total</u>	<u>0-500</u>	<u>500-1000</u>	<u>1000-2000</u>	<u>Over 2000</u>
<u>Mid South</u>					
Alabama	16	3	7	6	-
Arkansas	7	2	3	2	-
Louisiana	15	6	3	6	-
Mississippi	7	1	2	4	-
Oklahoma	3	1	1	1	-
Tennessee	6	4	-	2	-
Texas	9	2	3	4	-
Total	63	19	19	25	-
<u>South East</u>					
Florida	10	2	3	5	-
Georgia	15	4	5	4	2
North Carolina	8	3	2	3	-
South Carolina	7	2	1	3	1
Virginia	9	3	2	4	-
Total	49	14	13	19	3
Total South	112	33	32	44	3

Source: U.S. Department of Agriculture, Forest Service Southern Forest Experiment Station and Southeastern Station Pulpwood Production Bulletins.

Appendix 2

Paper and Paperboard Total U.S. Production and Southern Share
(000's of tons)

<u>Year</u>	<u>Total Production</u>	<u>South as a % of Total Production</u>
1947	21,114	28.6
1950	24,375	33.7
1960	34,461	40.7
1969	54,187	47.5
1970	53,329	48.5
1971	55,092	49.2
1972	59,457	49.5
1973	61,684	48.9
1974	59,934*	49.9
1975P	52,801API	50.9
1976E	62,000	51.5

Wood Pulp Production-Total U.S. Production and Southern Share
(000's of tons)

<u>Year</u>	<u>Total Production</u>	<u>South as a % of Total Production</u>
1947	11,946	48.2
1950	14,849	54.7
1960	25,316	59.5
1969	42,813	63.2
1970	43,663	63.8
1971	43,933	64.9
1972	46,767	65.0
1973	47,937	65.2
1974	48,417	64.9
1975P	42,811E	66.0
1976E	50,500	66.4

Source: Industry Division, Bureau of Census, U.S. Department of Commerce. E-Estimate, P-Preliminary.

* - API reported this figure at 60,995.

Appendix 3

Lumber Production U.S. and South
and by Softwoods and Hardwoods,
1950-1974

(Billion board feet)

Year	Total	U.S.		Total	South		% Of Total	Hard- woods	% Of Total
		Soft- woods	Hard- woods		Soft- woods	Hard- woods			
1950.....	38.0	30.6	7.4	14.6	10.2	33	4.4	60	
1951.....	37.2	29.5	7.7	13.3	8.9	30	4.4	57	
1952.....	37.5	30.2	7.2	13.7	9.2	31	4.5	63	
1953.....	36.7	29.6	7.2	11.8	8.1	27	3.7	51	
1954.....	36.4	29.3	7.1	11.7	7.7	26	4.1	58	
1955.....	37.4	29.8	7.6	12.2	7.7	26	4.5	59	
1956.....	38.2	30.2	8.0	12.7	8.2	27	4.5	56	
1957.....	32.9	27.1	5.8	10.3	6.7	25	3.5	60	
1958.....	33.4	27.4	6.0	9.8	6.4	23	3.4	57	
1959.....	37.2	30.5	6.7	11.0	7.0	23	3.9	58	
1960.....	32.9	26.7	6.3	9.3	5.9	22	3.4	54	
1961.....	32.0	26.1	6.0	9.1	5.8	22	3.4	57	
1962.....	33.2	26.8	6.4	9.5	5.9	22	3.6	56	
1963.....	34.7	27.6	7.2	10.2	6.1	22	4.1	57	
1964.....	36.6	29.3	7.3	10.5	6.6	23	3.9	53	
1965.....	36.8	29.3	7.5	10.8	6.8	23	4.0	53	
1966.....	36.6	28.8	7.7	10.8	6.7	23	4.1	53	
1967.....	34.7	27.3	7.4	10.5	6.6	24	3.9	53	
1968.....	36.5	29.3	7.2	10.7	7.0	24	3.7	51	
1969.....	35.8	28.3	7.5	11.1	7.3	26	3.8	51	
1970.....	34.7	27.5	7.1	10.8	7.2	26	3.6	51	
1971.....	37.0	30.0	6.9	11.3	7.9	26	3.5	51	
1972.....	37.7	31.0	6.8	11.3	8.0	26	3.3	49	
1973P.....	38.6	31.6	7.0	11.4	8.0	25	3.4	49	
1974P.....	34.9	27.9	6.9	10.5	7.1	25	3.4	49	

P Preliminary estimates.

Sources: U.S. Department of Commerce, Bureau of the Census
U.S. Department of Agriculture, Forest Service.

Appendix 4

Softwood Plywood - U.S. and South Production

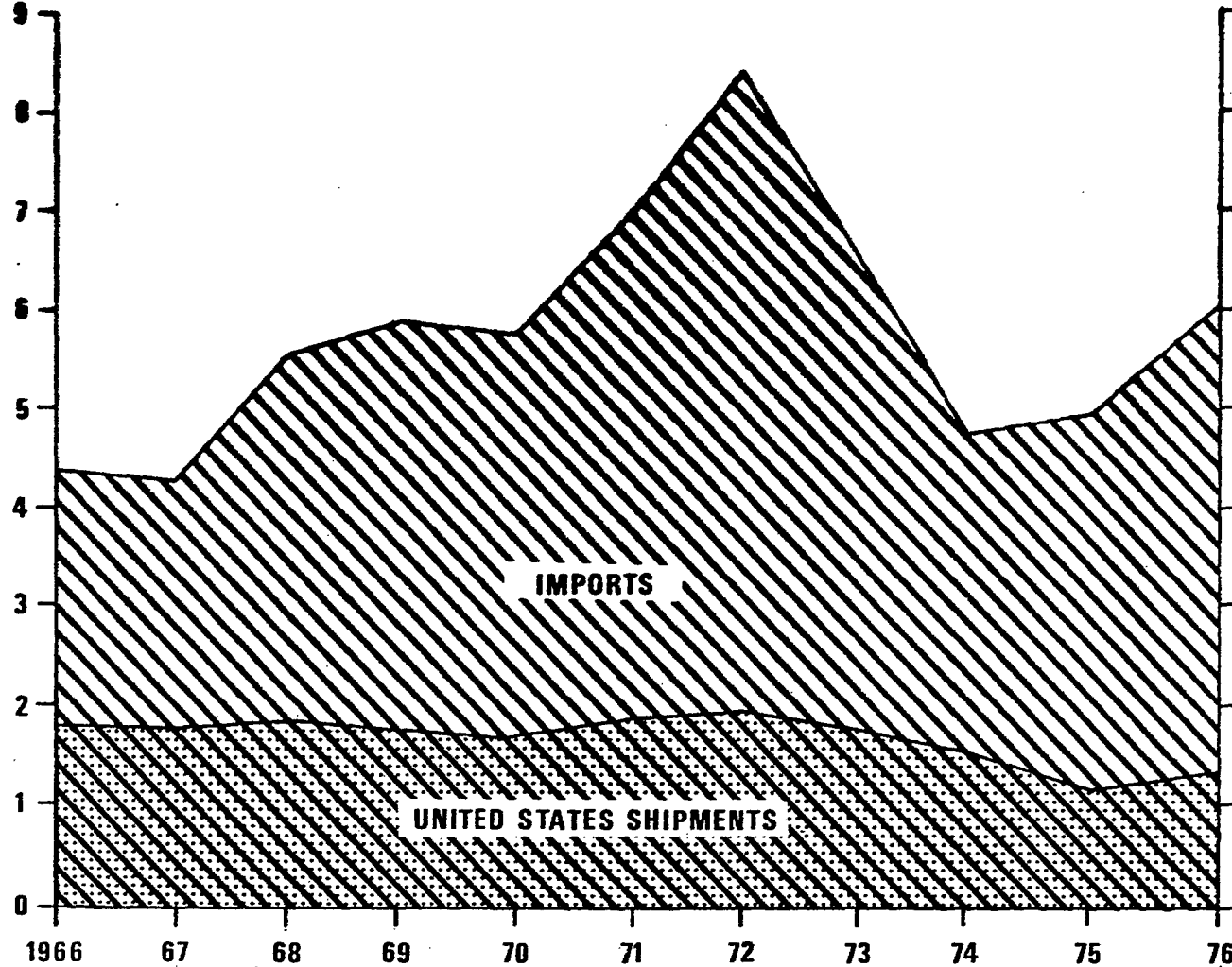
'000 Sq. Ft. 3/8" Basis

	<u>U.S.</u>		<u>South</u>		<u>% of Total</u>
	<u>No. of Plants</u>	<u>Production</u>	<u>No. of Plants</u>	<u>Production</u>	
1964	164	11,073	3	80	0.7
1965	174	12,260	12	402	3.3
1966	184	12,811	23	1140	8.9
1967	180	12,715	28	1779	13.7
1968	175	14,597	33	2259	15.5
1969	177	14,414	34	2637	18.0
1970	179	14,566	40	3419	23.5
1971	189	16,744	49	4463	26.7
1972	192	18,521	52	5233	28.2
1973	192	18,682	53	5538	29.7
1974	195	16,546	55	5193	31.4
1975	191	16,770	57	5745	34.3
1976	183	19,128	57	6937	36.3
1977	N/A	19,721	N/A	7533	38.2

Source: American Plywood Association.

UNITED STATES CONSUMPTION-HARDWOOD PLYWOOD 1966-1976

BILLIONS OF SQ. FT.
(SURFACE MEASURE)



SOURCE: U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS
CURRENT INDUSTRIAL REPORTS, HARDWOOD PLYWOOD

Appendix 6

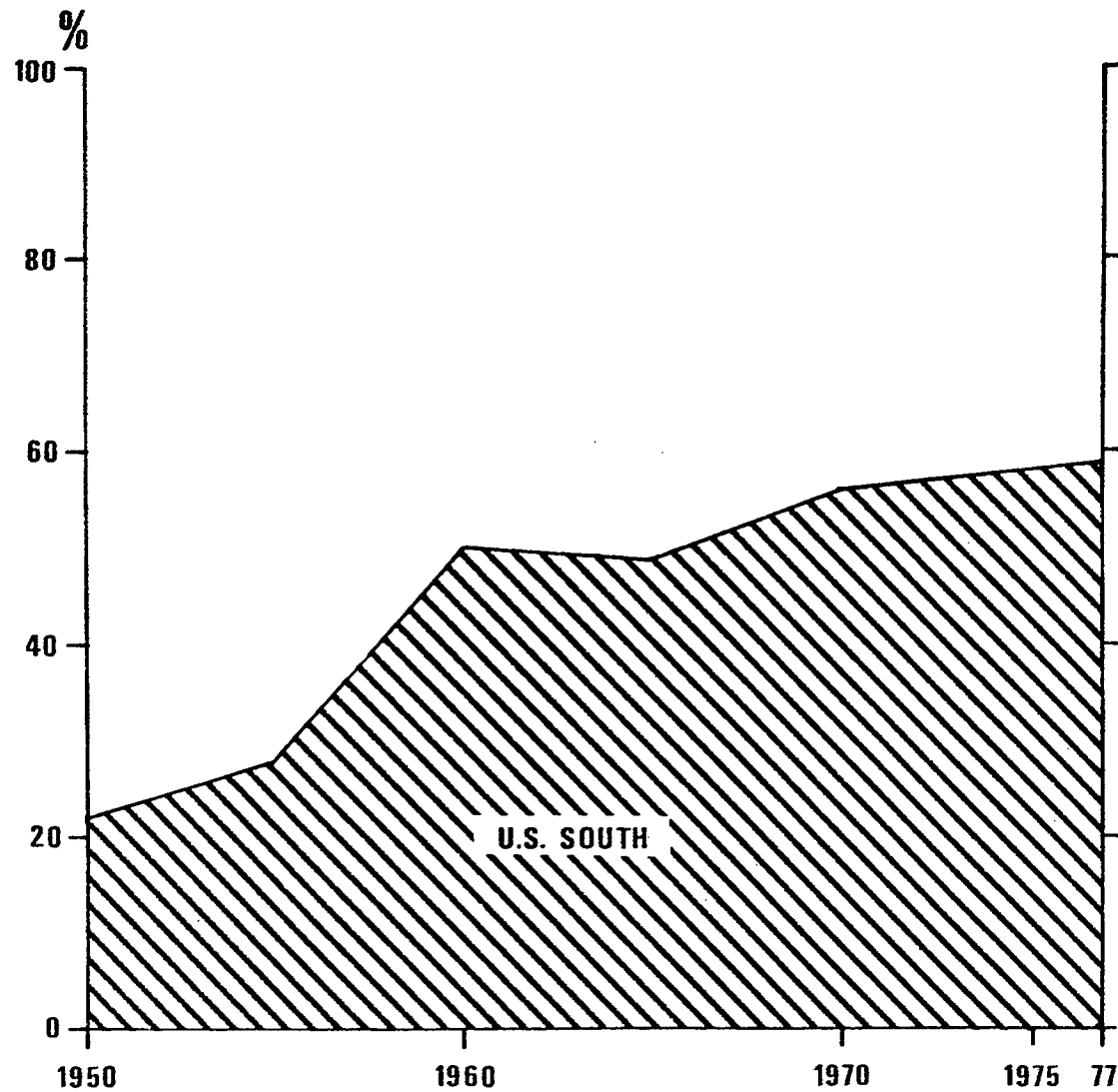
Hardwood Veneer/Plywood Plants and Capacity in 1972 U.S. and South

(In Millions of Sq. Ft. Surface Measure)

<u>State</u>	<u>No. of Plants</u>	<u>Capacity</u>
Alabama	8	74
Arkansas	4	35
Florida	3	53
Georgia	7	201
Louisiana	2	7
Mississippi	5	123
North Carolina	30	180
Oklahoma	-	-
South Carolina	14	228
Tennessee	6	35
Texas	4	15
Virginia	11	232
South Total	94	1183
U.S. Total	195	3500

Source: Hardwood Plywood Manufacturers Association, 1974

U.S. NEWSPRINT CAPACITY-U.S. SOUTH PERCENTAGE OF CAPACITY



SOURCE: C.P.P.A. A.P.I. NEWSPRINT DIVISIONS

Appendix 8

U.S. and Southern Newsprint Capacity 1950-1977

('000s tons)

	<u>Total U.S. Capacity</u>	<u>South</u>	<u>South as a % of Total</u>
1950	992	220	22
1955	1,407	400	28
1960	2,405	1,200	50
1965	2,517	1,223	49
1970	3,535	1,970	56
1975	3,835	2,225	58
1976	3,973	2,283	57
1977	4,150	2,435	59

Source: CPPA, API Newsprint Divisions

Appendix 9

Regional Sources of Newsprint
For Daily U.S. Newspapers Reporting to A.N.P.A.
 1965 - 1975 ('000s tons)

Supplies To	Supplies From	Canada		South		Other	
North Central Newspapers	1965	1774	89%	114	6%	91	5%
	1975	1665	84%	187	10%	111	6%
Southern Newspapers	1965	686	42%	854	52%	100	6%
	1975	596	29%	1412	68%	74	3%

Note: Above data is tabulated by American Newspaper Publishers' Association from the information submitted to them by daily newspapers.

Source: American Newspaper Publishers' Association.

Appendix 10

Paperboard - U.S. South Percentage of
Total U.S. Production By Product 1963-1975 (000t)

	<u>Total Paperboard</u>			<u>Linerboard</u>			<u>Corrugated Material</u>			<u>Total Boxboard</u>			<u>Other Paperboard</u>		
	U.S.	U.S. South %		U.S.	U.S. South %		U.S.	U.S. South %		U.S.	U.S. South %		U.S.	U.S. South %	
1963	18594	9685	52	6414	4661	73	2962	1219	41	5417	2752	51	3801	1053	28
1965	21331	11270	53	7481	5330	71	3438	1318	38	5811	3173	55	4601	1449	31
1970	25383	15078	59	9403	7307	78	4264	1618	38	6239	3836	61	5477	2317	42
1974	28915	17878	62	11305	8883	79	5179	2111	41	6399	4567	71	6032	2317	38
1975	24755	15753	64	9854	7958	81	4449	1861	42	5665	4108	72	4788	1826	38
1976	28440	18121	64	11376	9178	81	5062	2181	43	6565	4769	73	5437	1993	37

Note: The U.S. South data in this table includes the state of Kentucky which is not deemed to be part of the U.S. South for purposes of this study.

Source: American Paper Institute.

Appendix 11

HARVESTING COSTS BY REGION - 1976 COSTS

ITEM	B.C. INTERIOR PRINCE GEORGE \$/Cunit		B.C. COAST VAN. ISLAND \$/Cunit		NORTHERN ONTARIO \$/Cunit		LAC ST. JEAN QUEBEC \$/Cunit		BATHURST NEW BRUNSWICK \$/Cunit		NORTHWEST U.S.A. \$/Cunit		NORTHEAST U.S.A. \$/Cunit		SOUTHEAST U.S.A. \$/Cunit	
	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.
Total Wood Costs Including Overhead Delivered at Mill	35-45	39	75-85	77	60-90	80	50-75	69	50-60	53	45-140	59	50-65	59	45-60	52
Stumpage and Royalties ¹	1-3	1	4-6	5	5-6	5	3-5	4	1-4	3	1-85	5	1-15	6	10-15	12
Total Costs Before Stumpage and Royalties	34-44	38	70-80	72	55-85	75	46-66	65	49-53	50	40-55	54	40-55	53	35-45	40
COST COMPONENTS																
1. <u>Extraction Costs</u>	23-28		40-50		40-50		35-45		38-45		25-35		30-40		20-25	
- camp costs	1-2		10-15		1-10		3-10		1-6		-		3-5		-	
- falling and bucking	5-7		4-5		12-17		12-16		12-14		5-9		10-17		4-6	
- delivery cost (excluding road costs):																
- stump to roadside	6-9		9-12		6-9		6-10		5-8		8-10		5-8		6-8	
- roadside to mill	11-13		18-25		11-16		10-13		13-16		12-18		10-18		6-12	
2. <u>Road Costs</u>																
- primary and secondary road construction	0-3		8-10		3-8		2-3		2-3		1-3		2-3		0-1	
- primary and secondary road maintenance	0-1		1-3				2-6		1-2		1-3		1-3		0-3	
3. <u>Equipment Costs</u> (depre- ciation and leasing)	T/E		3-7		T/E		T/E		1-5		T/E		T/E		T/E	
4. <u>Administration Costs</u>	3-10		5-10		5-10		3-10		4-8		3-8		4-8		5-10	
5. <u>Silviculture</u> (including spraying)	1-3		T/E		T/E		T/E		1-3		1-3		T/E		2-4	

¹ The average stumpage rates are those reported by the participants and not necessarily the average cost for the region.

^e Depressed Rate

⁺ In comparing stumpage rates in the U.S.A. it must be borne in mind the income tax benefits available to holders of private land are enormously significant.

^{*} Stumpage rates in the Northwest U.S.A. are those reported by the companies and industry associations.

T/E = Included in Total or Extraction Costs.

NOTE: Values given are in Canadian and U.S. dollars considered at par.

Source: Peat, Marwick, & Partners.

AVERAGE PRICES RECEIVED FOR SOUTHERN PINE PULPWOOD STUMPAGE
Based on National Forest Timber Sales — 1957-1976

Year	No. Sales	Volume Cords	State										
			South	Ala.	Ark.	Fla.	Ga.	La.	Miss.	N. C.	S. C.	Tenn.	Tex.
1957	180	274,605	6.19	6.75	4.27	8.11	----	5.27	6.13	3.26	5.44	----	4.50
1958	240	382,958	5.73	5.72	3.56	6.97	4.12	4.44	6.35	4.01	6.10	----	4.22
1959	296	355,724	5.60	6.47	3.46	6.92	6.08	4.41	5.98	3.89	6.34	----	3.85
1960	237	325,162	5.62	5.42	3.76	7.50	4.17	4.32	4.92	3.68	6.40	----	3.78
1961	287	369,644	4.87	4.81	3.02	6.44	5.56	4.10	3.84	4.36	5.81	----	3.21
1962	252	343,997	5.07	4.58	3.29	6.30	6.00	3.86	3.77	3.67	6.48	2.67	3.66
1963	212	330,586	4.84	3.72	2.81	5.89	5.81	3.96	3.25	3.60	5.59	2.42	3.38
1964	186	312,781	5.15	4.11	3.45	6.02	4.28	3.75	3.73	3.25	6.05	----	2.61
1965	193	303,960	5.76	4.70	3.50	6.01	6.05	3.33	4.44	3.40	7.73	3.49	2.58
1968	261	361,978	6.05	6.36	3.92	8.05	7.17	5.39	4.87	4.08	6.86	1.99	3.72
1969	396	550,257	5.98	7.11	3.58	8.85	7.81	5.75	4.30	4.70	7.09	2.97	3.89
1970	344	553,284	6.42	7.04	3.28	10.14	6.17	5.43	4.89	3.05	7.85	2.08	4.10
1971	349	602,279	6.57	7.43	3.60	10.60	4.90	7.42	5.36	3.90	7.85	3.23	4.35
1972	415	677,445	7.82	11.08	4.82	12.63	5.16	10.03	5.90	4.11	9.32	1.99	4.28
1973	424	687,162	11.37	12.18	8.85 †	23.39	6.56	8.58	9.62	6.54	12.12	2.98	7.84
1974	304	571,319	11.44	10.89	8.67 †	22.27	4.97	8.80	8.13	10.26	11.59	2.60	9.03
1975	317	559,085	10.24	6.40	8.08 †	21.97	6.96	7.75	6.66	6.20	11.65	3.53	5.57
1976*	189	306,622	10.78	7.17	10.54 †	19.34	6.99	8.64	6.44	----	----	3.46	7.42

*First six months 1976 only. †Includes Oklahoma.

AVERAGE PRICES RECEIVED FOR SOUTHERN PINE SAWTIMBER STUMPAGE
Based on National Forest Timber Sales — 1957-1976

Year	No. Sales	Volume M. Bd. Ft. Scribner	State										
			South	Ala.	Ark.	Fla.	Ga.	La.	Miss.	N. C.	S. C.	Tenn.	Tex.
1957	250	260,006	32.50	33.96	29.84	34.49	31.62	29.25	32.69	20.63	39.20	----	35.23
1958	330	373,727	31.91	31.95	29.95	30.42	31.17	28.56	32.95	28.20	37.27	21.10	34.11
1959	337	357,842	36.05	36.89	34.77	33.79	38.66	32.09	37.82	31.97	44.29	----	34.39
1960	284	348,113	35.71	34.73	36.51	35.12	32.17	34.87	31.48	32.05	43.28	----	34.53
1961	374	378,950	27.45	28.42	27.90	31.64	32.41	24.18	23.17	21.59	35.34	----	26.72
1962	395	400,528	26.46	26.55	28.27	31.87	34.92	21.64	24.10	20.97	34.03	17.11	21.45
1963	411	429,861	25.32	25.64	27.60	27.72	31.66	21.46	21.62	24.49	32.81	17.05	22.46
1964	412	406,241	28.60	26.41	30.36	29.45	33.76	23.29	23.67	31.26	36.60	18.43	28.08
1965	407	394,566	32.64	28.56	35.28	30.81	32.51	30.80	27.30	25.98	39.37	23.25	34.71
1968	380	338,135	46.29	40.62	49.97	40.57	41.15	55.23	43.26	38.32	49.16	24.44	48.61
1969	489	435,200	57.35	52.97	58.92	55.75	50.23	72.18	50.05	39.60	56.13	25.64	66.82
1970	405	361,506	50.00	47.73	46.83	57.13	41.72	61.03	53.74	23.67	47.81	25.69	49.57
1971	447	389,730	60.98	51.79	51.25	64.25	46.95	76.60	65.97	35.44	56.25	24.77	66.08
1972	477	418,607	77.82	71.86	67.48	89.67	62.07	94.20	83.04	46.88	77.30	32.47	83.65
1973	390	468,979	110.81	97.74	91.15 †	156.01	79.91	132.64	112.66	89.58	113.80	49.16	125.14
1974	271	350,359	98.28	93.77	78.20 †	117.98	69.30	107.84	102.14	73.06	100.31	38.48	121.44
1975	279	354,466	77.51	69.68	62.44 †	85.49	65.57	85.15	94.28	43.02	67.19	30.02	90.48
1976*	195	246,681	107.95	89.42	101.71 †	123.35	81.85	112.78	113.36	----	----	45.24	122.05

*First six months 1976 only. †Includes Oklahoma.

Appendix 13

Pulpwood stumpage prices, species, 1955-1976

(dollars per cord)

LOUISIANA

Year	<u>Southern Pine</u>		<u>Hardwoods</u>	
	Current dollars	1967 dollars ¹	Current dollars	1967 dollars ¹
1950 .....	.....	.....	.....	.....
1951 .....	.....	.....	.....	.....
1952 .....	.....	.....	.....	.....
1953 .....	.....	.....	.....	.....
1954 .....	.....	.....	.....	.....
1955	3.45	3.95	.....	.....
1956	3.85	4.25	1.60	1.75
1957	4.25	4.55	1.60	1.70
1958	4.25	4.50	1.65	1.75
1959	4.25	4.50	1.70	1.80
1960	4.40	4.65	1.60	1.70
1961	4.25	4.50	1.55	1.65
1962	4.25	4.50	1.55	1.65
1963	4.30	4.55	1.55	1.65
1964	4.30	4.55	1.65	1.75
1965	4.40	4.55	1.60	1.65
1966	4.55	4.55	1.70	1.70
1967	4.60	4.60	1.75	1.75
1968	4.65	4.55	1.85	1.80
1969	4.65	4.35	1.90	1.80
1970	4.70	4.25	1.95	1.75
1971	4.75	4.15	1.90	1.65
1972	4.75	4.00	2.10	1.75
1973	5.20	3.85	2.40	1.80
1974 ²	6.00	3.70	2.60	1.60
1975	6.40		2.80	
1976	6.70		2.70	

¹Derived by dividing price in current dollars by the Bureau of Labour Statistics wholesale price index of all commodities (1967=100).

²Preliminary.

Source: Louisiana Department of Agriculture.

Appendix 14

Newsprint Manufacturing Costs and Differences - \$/F.T.¹

<u>Item</u>	<u>British Columbia Coast</u>	<u>Eastern Canada</u>	<u>South Eastern U.S.A</u>	<u>North Western U.S.A.</u>
Wood	61	71	44	45
Chemicals	7	6	10	10
Other Materials	25	19	25	24
Energy	24	26	50	39
Labour	51	49	38	43
Administration	25	27	19	14
Depreciation	11	8	13	20
Transportation	34	37	11	27
Total	<u>238</u>	<u>243</u>	<u>210</u>	<u>222</u>
Wood	+17	+27	0	+ 1
Chemicals	- 3	- 4	0	0
Other Materials	0	- 6	0	- 1
Energy	-26	-24	0	-11
Labour	+13	+11	0	+ 5
Administration	+ 6	+ 8	0	- 5
Depreciation	- 2	- 5	0	+ 7
Transportation	<u>+23</u>	<u>+26</u>	0	<u>+16</u>
Total	<u>+28</u>	<u>+33</u>	0	<u>+12</u>

Market Softwood Pulp Manufacturing Costs and Differences - \$/ADT²

<u>Item</u>	<u>British Columbia Coast</u>	<u>British Columbia Interior</u>	<u>North Western Ontario</u>	<u>South Eastern U.S.A.</u>	<u>North Western U.S.A.</u>
Wood	89	77	128	80	69
Chemicals	21	25	36	35	26
Other Materials	21	24	18	26	25
Energy	18	15	28	18	27
Labour	37	31	38	27	25
Administration	21	25	30	12	25
Depreciation	10	14	10	13	16
Transportation	33	45	26	31	31
Total	<u>250</u>	<u>256</u>	<u>314</u>	<u>242</u>	<u>244</u>
Wood	+ 9	- 3	+48	0	-11
Chemicals	-14	-10	+ 1	0	- 9
Other Materials	- 5	- 2	- 8	0	- 1
Energy	0	- 3	+10	0	+ 9
Labour	+10	+ 4	+11	0	- 2
Administration	+ 9	+13	+18	0	+13
Depreciation	- 3	+ 1	- 3	0	+ 3
Transportation	<u>+ 2</u>	<u>+14</u>	<u>- 5</u>	0	0
Total	<u>+ 8</u>	<u>+14</u>	<u>+72</u>	0	<u>+ 2</u>

Source: Sandwell Co.

1. FT = Finished Ton

2. ADT = Air Dry Ton

Appendix 15

U.S. South Commercial Forest Land Area - 1970

<u>State</u>	<u>Millions of Acres</u>	<u>Percent</u>
<u>South Atlantic</u>		
North Carolina	20	10.4
South Carolina	12	6.8
Virginia	16	8.3
<u>East Gulf</u>		
Florida	16	8.3
Georgia	25	13.0
<u>Central Gulf</u>		
Alabama	22	11.4
Mississippi	17	8.9
Tennessee	13	6.8
<u>West Gulf</u>		
Arkansas	18	9.4
Louisiana	15	7.8
Oklahoma	5	2.6
Texas	13	6.8
Total U.S. South	192	100.0

Source: U.S. Department of Agriculture, Forest Service.

Appendix 16

Pulping Capacity and Pulpwood and Lumber Production by State

<u>State</u>	<u>Pulping Capacity Tons/Day (1976)</u>	<u>Pulpwood Production (million cords of roundwood) (1976)</u>	<u>Lumber Production (billion board feet) (1971)</u>
Alabama	12,945	5.0	1.4
Arkansas	5,500	2.3	1.4
Florida	10,290	2.7	.4
Georgia	15,194	5.6	1.2
Louisiana	12,745	2.9	.8
Mississippi	6,470	3.5	1.1
North Carolina	6,435	2.5	1.2
Oklahoma	2,320	.3	.2
South Carolina	7,657	2.6	1.0
Tennessee	4,015	.5	.5
Texas	7,315	2.4	1.0
Virginia	7,158	1.7	1.1
All States	98,074	32.0	11.3

Source: U.S. Department of Agriculture, Forest Service.

Appendix 17

Net Annual Growth Per Acre for the U.S. South 1970

<u>Ownership Class</u>	<u>Cubic Feet Per Acre</u>	<u>Approximate Conversion to Cords¹</u>
National Forest	55	.65
Other Public	45	.53
Forest Industry	53	.62
Farm and Miscellaneous	42	.49
Average South	45	.53

Source: U.S. Dept. of Agriculture, Forest Service

1. Conversion of cubic feet to cord varies by Southern Pine species and for different parts of the South. We are using an average of 1 cord equal to 85 cubic feet.

Appendix 18

Net Annual Growth and Removals of Growing
Stock on Commercial Timberland in the U.S. South
Softwoods and Hardwoods - by State 1970

(millions of cubic feet)

Area	All Species		Softwoods		Hardwoods	
	Growth	Removals	Growth	Removals	Growth	Removals
<u>South Atlantic:</u>						
North Carolina	885	691	449	377	436	314
South Carolina	691	449	440	299	251	150
Virginia	564	443	169	166	395	277
TOTAL:	2,140	1,583	1,058	841	1,082	741
<u>East Gulf:</u>						
Florida	532	348	415	278	116	70
Georgia	1,357	928	993	679	364	248
TOTAL:	1,889	1,276	1,408	958	480	318
<u>Central Gulf:</u>						
Alabama	947	807	719	521	228	286
Mississippi	966	746	592	462	375	284
Tennessee	509	216	102	33	406	183
TOTAL:	2,423	1,769	1,413	1,016	1,009	753
<u>West Gulf:</u>						
Arkansas	779	620	403	299	375	321
Louisiana	744	722	605	524	139	199
Oklahoma	70	52	48	22	22	30
Texas	566	461	465	335	101	125
TOTAL:	2,159	1,855	1,521	1,180	637	675
Total South	8,609	6,483	5,401	3,996	3,208	2,487
% Increase	+ 33%		+ 35%		+ 28%	

Source: U.S. Department of Agriculture, Forest Service

Appendix 19

Net Annual Growth and Removals of Sawtimber
on Commercial Timberland in the U.S. South
Softwoods and Hardwoods - by State 1970

(millions of board feet)

	All Species		Softwoods		Hardwoods	
	Growth	Removal	Growth	Removal	Growth	Removal
<u>South Atlantic</u>						
North Carolina	2,718	2,028	1,669	1,209	1,050	820
South Carolina	2,127	1,513	1,487	999	640	514
Virginia	1,511	1,187	543	487	968	700
TOTAL	6,356	4,729	3,698	2,695	2,658	2,034
<u>East Gulf</u>						
Florida	1,687	1,153	1,322	934	365	220
Georgia	4,052	2,893	3,210	2,204	842	688
TOTAL	5,739	4,046	4,532	3,138	1,207	908
<u>Central Gulf</u>						
Alabama	3,073	2,900	2,547	2,029	525	872
Mississippi	3,229	2,757	2,347	1,825	882	931
Tennessee	1,428	820	309	124	1,119	696
TOTAL	7,730	6,477	5,203	3,978	2,526	2,499
<u>West Gulf</u>						
Arkansas	2,604	2,537	1,714	1,376	890	1,611
Louisiana	3,153	3,024	2,737	2,350	416	674
Oklahoma	192	189	157	102	35	87
Texas	2,254	1,838	2,054	1,406	199	431
TOTAL	8,203	7,588	6,662	5,234	1,540	2,353
TOTAL SOUTH	28,028	22,840	20,096	15,046	7,932	7,795
% Increase		+ 23%		+ 34%		+ 2%

Source: U.S. Department of Agriculture, Forest Service.

Appendix 20

Area of Commercial Timberland in U.S. South
by Ownership Class - Projected to 2000

<u>Ownership Class</u>	<u>1970 millions of acres</u>	<u>% of total</u>	<u>2000 millions of acres</u>	<u>% of total</u>	<u>Average increase (decrease) in percent</u>
National Forest	10.8	5.6	10.4	5.5	(4)
Other Public	6.4	3.3	6.3	3.3	(2)
Forest Industry	35.3	18.3	37.3	19.8	6
Farm and Misc.					
Private	139.9	72.7	134.3	71.3	(4)
All Owners	192.5	100.0	188.3	100.0	(2)

Source: U.S. Department of Agriculture, Forest Service

Appendix 21

Projected Net Growth of Growing Stock Per Acre in the South
(in cubic feet)

<u>Owner class and species group</u>	<u>1970</u>	<u>2000</u>	<u>% Increase</u>
National Forests:			
Softwoods	37.0	39.8	8
Hardwoods	17.6	18.0	2
Total	54.6	57.8	6
Other Public:			
Softwoods	27.9	32.6	17
Hardwoods	17.6	20.1	14
Total	45.5	52.7	16
Forest Industry:			
Softwoods	39.8	42.9	8
Hardwoods	13.3	14.7	11
Total	53.1	57.6	8
Farm and Misc. Private:			
Softwoods	24.4	26.6	9
Hardwoods	17.4	20.1	16
Total	41.8	46.7	12
All Owners:			
Softwoods	28.0	30.8	10
Hardwoods	16.7	18.9	13
Total	44.7	49.7	11

Source: U.S. Department of Agriculture, Forest Service.

Appendix 22

Farm and Private Ownership
by Size of Land Holding

	<u>Farm Ownership</u>	<u>Other Private Ownership</u>
1953		
Total acreage	90,000,000 (63%)	53,000,000 (37%)
Number of Owners	1,390,000	425,000
Average Ownership Size	65 acres	124 acres
Size of Holding		
Less than 100 acres	41%	21%
100 to 500 acres	39%	30%
500 to 5,000 acres	16%	22%
5,000 to 50,000 acres	4%	16%
50,000 or larger	-	11%
	20%	49%
1970-Total Acreage	65,137,000 (46%)	74,801,000 (54%)

Source: Timber Resource of America (1953).

Appendix 23

Silvicultural Practices

The specific land management practices employed by forest products industry vary according to site quality and the proximity to conversion facilities. Land can be managed from a choice of three plans of silviculture management - pine plantation, natural stand, and custodial. The pine plantation option represents the most intensive level of management; however, this choice cannot be applied to all forest land because of various site qualities. Specific practices under this option include slash-burn, site preparation, planting, prescribe burn, commercial thinning and harvest. Natural stand management, the second most intensive form of management, can be applied to all but the very poorest of sites. Practices included in this option are prescribe burn to prepare a seed bed, removal of lower quality seed trees, pre-commercial thinning, two or more commercial thinnings (depending on rotation cycle) and harvest. The third management alternative is custodial management and implies no management for cost purposes other than forest protection and harvesting.

Appendix 24

Back up calculations for required growth per acre to allow for doubling of demand by 2000

(millions of cubic feet)

	Increase Utilization			
	0	5%	10%	20%
Required Growth	13,000	12,376	11,830	10,790
Less Gov't Growth ¹	890	890	890	890
Sub Total	<u>12,110</u>	<u>11,486</u>	<u>10,940</u>	<u>9,900</u>
Less Industry's Growth ²				
@ 100 c.f.	3,597	3,597	3,597	3,597
Sub Total	<u>8,513</u>	<u>7,889</u>	<u>7,343</u>	<u>6,303</u>
@ 120 c.f./additional (total growth 3597 + 719 = 4316)	719	719	719	719
Sub Total	<u>7,794</u>	<u>7,170</u>	<u>6,624</u>	<u>5,584</u>
Required Private Growth per acre (95% of 134.3 million acres = 127.6)				
@ 100 c.f. on industry land (8333÷134) etc	66	62	57	49
@ 120 c.f. on industry land (7587÷134) etc.	61	56	52	43
¹ Gov't land =				
National Forest 95% of 10.4 million acres @ 58 c.f./acre/year			573	
Other public 95% of 6.3 million acres @ 53 c.f./acre/year			<u>317</u>	
Total			890	
² Industry land = 95% of 37.3 million acres.				
70% @ 130 c.f./per acre/per year			3225	
30% @ 35 c.f./per acre/per year			<u>372</u>	
Average growth 100.c.f./per acre/per year			3597	

Appendix 25

Pine to Hardwood Reversion by State
Timber Type Changes Between Last Two Surveys

(000's acres)

	PINE		
	<u>Previous Survey</u> ¹	<u>Most Recent Survey</u>	<u>% Change</u>
Alabama	9,436	7,864	(17)
Arkansas	6,486	3,668	(43)
Florida	8,795	8,206	(7)
Georgia	13,153	12,325	(6)
Louisiana	5,659	5,096	(10)
Mississippi	6,640	5,578	(16)
North Carolina	7,124	6,905	(3)
Oklahoma	795	847	7
South Carolina	5,589	5,524	(1)
Tennessee	1,198	1,038	(13)
Texas	5,267	4,762	(10)
Virginia	2,986	3,437	15
<hr/>			
Total	73,127	65,250	(11)

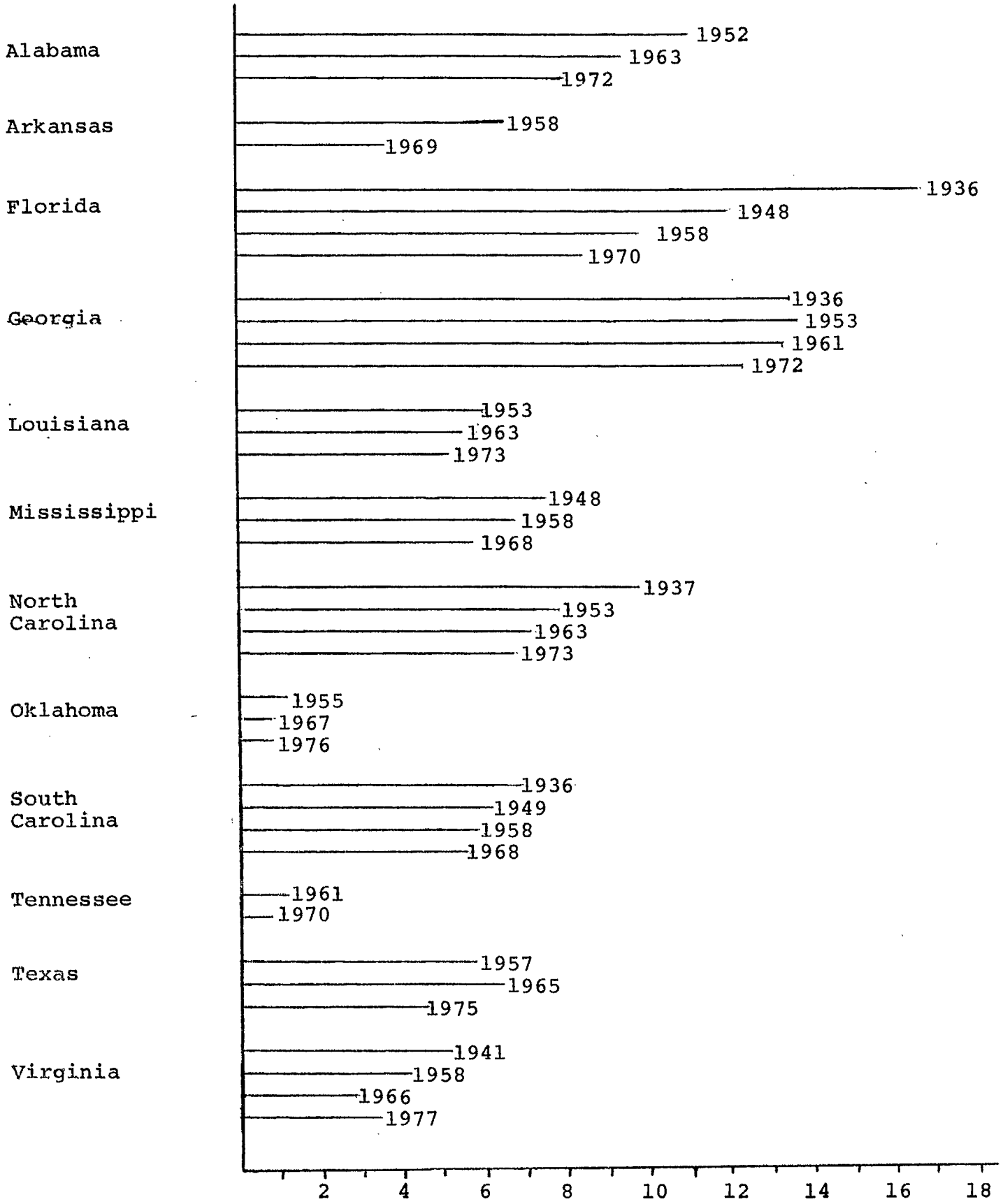
1. 10 years before most recent survey

Source: U.S. Dept. of Agriculture, Forest Service

Appendix 26

States

Change in Pine Forest Type



SOURCE: Task Force Report on "The South's Pine Reforestration Problems and Suggested Solutions." (million acres)

Appendix 27

% Of Total Energy Input* By Sources
For The Pulp and Paper Industry

SOURCES	<u>South Central</u>			<u>South Atlantic</u>		
	<u>First</u>			<u>First</u>		
	<u>Six</u>			<u>Six</u>		
	<u>Months</u>			<u>Months</u>		
	<u>1976</u>	<u>1975</u>	<u>1972</u>	<u>1976</u>	<u>1975</u>	<u>1972</u>
Purchased Electricity	4.0	3.9	3.3	2.4	2.3	1.7
Purchased Steam	0.9	0.9	0.9	0.1	0.1	0.1
Coal	3.8	3.4	3.7	10.7	10.1	11.4
Residual Fuel Oil	19.1	15.8	10.0	29.1	29.1	29.9
Distillate Fuel Oil	0.9	0.5	2.1	0.4	0.5	0.3
Liquid Propane Gas	0.1	-	0.2	0.1	0.1	-
Natural Gas	20.4	25.4	30.2	3.6	7.0	7.4
Other Purchased Energy	-	-	-	0.4	0.2	-
<u>Fossil Fuel & Purchased Energy</u>	<u>49.2</u>	<u>49.9</u>	<u>50.4</u>	<u>46.8</u>	<u>49.4</u>	<u>50.8</u>
Hogged Fuel	3.3	2.5	1.3	3.0	2.1	0.9
Bark	5.9	6.2	6.7	6.5	6.3	7.8
Spent Liquor	41.2	41.1	41.5	43.2	41.6	40.2
Self-Generated Hydro-Electric Power	-	-	-	-	-	-
Other Self-Generated Energy	0.4	0.3	0.1	0.5	0.6	0.3
<u>Total Self-Generated & Waste Fuels</u>	<u>50.8</u>	<u>50.1</u>	<u>49.6</u>	<u>53.2</u>	<u>50.6</u>	<u>49.2</u>
	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>
Paper and Paperboard Capacity (% of Total U.S.)**		26.0			22.6	
Pulp Capacity (% of Total U.S.)**		33.6			30.4	

* Determined by using "Total Energy
- "Energy Sold" as a denominator
A dash (-) indicates less than 0.05%

Source: American Paper Institute.

Appendix 28

Six-Year Capital Spending Trends

United States

P&P's reported 3-year spending (\$, billion)

Year	Period	Production	P&P's reported 3-year spending (\$, billion)				Total	Annual Capital Expenditures ^a	
			%	Water	%	Air			%
1978	1977-79	\$4.431	80.7	\$0.611	11.1	\$0.307	5.6	\$5.489 ^c	\$(3.95) ^b
1977	1976-78	3.455	69.1	0.783	15.6	0.433	8.6	5.001 ^c	(3.61) ^b
1976	1975-77	3.410	60.3	0.626	11.1	0.715	12.6	5.651 ^c	3.27
1975	1974-76	2.727	61.7	0.625	14.1	0.546	12.4	4.418	2.95
1974	1973-75	2.161	65.0	0.535	16.1	0.537	16.1	3.326	2.58
1973	1972-74	0.824	49.7	0.536	32.3	0.298	18.0	1.657	1.86

a Based on data from U.S. Commerce Dept.

b P&P estimate

c Includes unallocated funds of \$0.140 billion for 1978; \$0.320 billion for 1977; \$0.900 billion for 1976 surveys.

Canada

P&P's reported 3-year spending (\$, billion)

Year	Period	Production	P&P's reported 3-year spending (\$, billion)				Total	Annual Capital Expenditures ^a	
			%	Water	%	Air			%
1978	1977-79	\$1.442	83.8	\$0.166	9.7	\$0.112	6.5	\$1.720	\$(0.83) ^b
1977	1976-78	2.169	85.1	0.189	7.4	0.157	6.2	2.548	(1.22) ^c
1976	1975-77	2.062	85.0	0.228	9.4	0.135	5.6	2.425	1.07
1975	1974-76	1.814	90.6	0.128	6.4	0.060	3.0	2.002	0.83
1974	1973-75	1.258	87.5	0.126	8.8	0.054	3.7	1.438	0.84
1973	1972-74	1.030	88.3	0.097	8.3	0.040	3.4	1.167	0.62

a Includes capital and repair expenditures for equipment and facilities.

b P&P estimates based on five-year spending ratios between figures from P&P survey and those of Statistics Canada. Other figures from Statistics Canada.

c Intended expenditures.

Source: Pulp and Paper Magazine.

Major Secondary Sources of Information

Analysis of Wood Costs in Forest Products Industries, Peat Marwick and Partners, April 1977.

Impacts of Land - Use Competition and Other Constraints on Georgia's Future Timber Supply, Georgia Forest Research Council, July 1976.

North American Forest Products Industry Manufacturing Cost Analysis, Sandwell, April 1977.

The Outlook for Timber in the United States, U.S. Department of Agriculture, Forest Service, October 1973.

Predicted Forestry, Harvesting and Pulpwood Procurement Conditions for the Years 1980 and 2000, American Pulpwood Association, January 1977.

The South's Forest Industries, A statistical profile, Southern Forest Products Association, 1975.

The South's Pine Reforestation Problem and Suggested Solutions, Task Force Report organized by the Southeastern Area of State and Private Forestry, August 1977

The South's Third Forest, Southern Forest Resource Analysis Committee, 1969.

Various reports and statistics from:

- American Paper Institute
- U.S. Department of Agriculture, Forest Service
- Canadian Pulp and Paper Association

Appendix 30

Interview Participants

Georgia State Forestry Commission
Macon, Georgia

International Paper Company
New York, New York and Mobile, Alabama

Interstate Paper Company
Riceboro, Georgia

Albert A. Montgomery, Ph.D.
Georgia State University
Atlanta, Georgia

Parsons & Whittemore Incorporated
New York, New York

Vernon L. Robinson, Ph.D.
Southeastern Forest Experimental Station
U.S. Department of Agriculture, Forest Service
Asheville, N.C.

Scott Paper Company
Philadelphia, Pennsylvania

Southern Forest Institute
Atlanta, Georgia

Southern Forest Products Association
New Orleans, Louisiana

James D. Strange, B.Sc. Forestry
Consulting Forester
Atlanta, Georgia

Union Camp Corporation
Savannah, Georgia

U.S. Department of Agriculture
Forest Service
New Orleans, Louisiana (and)
Washington, D.C.

Virginia State Forestry Commission
Charlottesville, Virginia

Weyerhaeuser Company
Tacoma, Washington

