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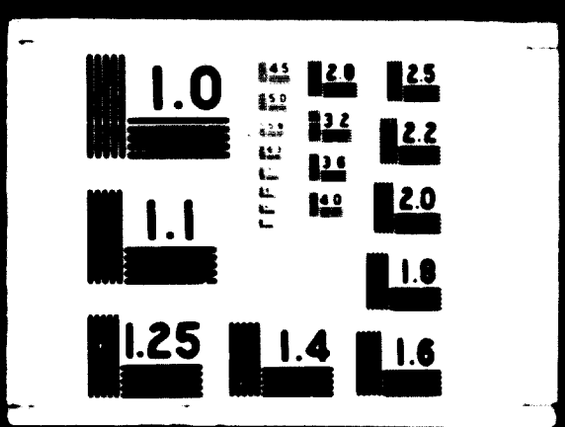

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FORESTRY AND FOREST PRODUCTS INDUSTRIES

Prepared for the Symposium

Presented by the Food and Agriculture Organization

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SUMMARY

1. Wood is one of the world's principal natural resources, one that is renewable and one which nearly all countries possess or have the capacity to create. The products of wood enter widely into the economy at every stage of development, and the industries which use wood form an important part of the manufacturing sector of most of the more advanced economies. In 1961 the wood-using industries accounted for 6.2 per cent of the total value added and 8.6 per cent of the numbers engaged in all industrial activity in the world.

2. The paper describes some of the characteristics of the primary forest industries - sawmilling, pulp and paper and wood-based panels (plywood, fiberboard and particle board). A brief note on miscellaneous and secondary forest industries is included as a separate annex. The paper goes on to outline trends and developments in wood consumption and production in the recent past. In 1961, about one half of all roundwood produced in the world was still consumed directly as fuelwood, and a further one tenth was consumed in its round form as pit props, poles piling and posts. The remaining roundwood was processed further: two thirds was used by the sawmilling industry, one quarter by the pulp and paper industry and about one tenth by the wood-based panel industries.

3. By 1975, according to the estimates given, world requirements of wood for industrial purposes are likely to rise by more than 40 per cent. A growing share of industrial wood will be required for pulp products and wood-based panels, consumption of which is expected to rise by 110 per cent and 150 per cent, respectively, over the period (Table 6). About 70 per cent of the extra industrial wood is likely to be needed in the presently advanced, high-use countries. In most of these countries over-all industrial wood use is, in fact, rising at a faster rate than it did in the first half of this century. In some of the leading wood-consuming regions, domestic wood supply is no longer keeping pace with this expanding and changing demand, either in terms of quantities or types of wood. More research is required to introduce species not utilized until now and for a fuller use of forest resources in general. Plantations of fast-growing species have been and could be further established to augment raw material supplies.

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4. The paper continues with estimates to show the order of magnitude of capital investment likely to be required for expanding the production capacity of forest industries to meet rapidly growing demand during the period 1961-75. Of this additional capital - estimated at around $US47,000 million - about $US39,000 million would be required for the establishment of new forest industries; about $US3,000 million for the harvesting of wood raw material for these industries, and the balance of around $US5,000 million for additional investment in forest management based on forestry development plans.

5. Of the investment anticipated for forest industries, the pulp and paper industry represents some $US33,600 million, or 86 per cent of the over-all total, and wood-based panels about $US3,200 million. Of these amounts, it has been tentatively estimated that around 25 per cent in the case of pulp and paper, and about 16 per cent in the case of wood-based panels, would be required for the developing countries.

6. The paper then discusses some of the issues and some of the needs which emerge. It points out the importance and heavy dependence of forest industries on progress in creating certain basic infra-structural facilities: power, water, road and rail communications and port facilities; on the need for careful planning and for moves towards economic integration, and the way in which these can help to bring new forest industries into existence - industries which will often represent the first major financial return on the infra-structural investment undertaken.

7. The need is argued for a specially close and intimate relationship between those authorities responsible for the forests (usually the Forest Service, a Department of the Ministry of Agriculture) and those responsible for planning and encouraging industrial development. If foresters, forest utilization officers, industrial economists and development planners are to reach a mutual understanding of each other's problems and to explore creatively the development opportunities that lie in the forests, working contacts must be multiplied at all levels. These, as the paper further points out, are the considerations which have led some countries, in which forest industries already play, or are clearly destined to play, a key role, to concentrate responsibility for forestry and forest industries in the same Department or Ministry.

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8. Forests have a great potential as a source of human welfare, and industrialization based on the forest can both contribute to and promote the general economic development process. But if the forest is to fulfil its role, there must be exact knowledge of the resource, the forest must be brought under proper management, working plans must be devised and extraction schemes worked out. Only thus can the resource base of industry be made secure.

9. The technical and economic conditions for establishing new forest industries in the developing countries are maturing fast. In the course of the coming years, many new areas of forests are inevitably going to be brought into use. The choice is between mobilization in the public interest based on sound planning and with adequate safeguards and with the Forest Services taking an active part and being built up in the process, and mobilization taking place in an uncontrolled and haphazard way while weak Forest Services stand by helpless.

10. It is in making this choice that the responsibility of government is engaged. This is not a question which concerns a Forest Department alone; it concerns Ministries of Agriculture, Economy, Industry and Trade; Planning Departments and Development Agencies; Finance Ministries and Budget Bureaux. Only concerted action on the part of all Departments can ensure that forest industries play their part in the attack on economic under-development and that the immense contribution which forests, rightly used, can make to the development process is fully realized.

Introduction

11. Wood is one of the world's principal natural resources, one that is renewable and one which nearly all countries possess or have the capacity to create. The products of wood enter widely into the economy at every stage of development, and the industries which use wood form an important part of the manufacturing sector of most of the more advanced economies. In 1961 the wood-using industries accounted for 6.2 per cent of the total value added and 8.6 per cent of the numbers engaged in all industrial activity in the world.[1/]

1/ United Nations, 1965. The Growth of World Industry, 1938-1961: International Analyses and Tables.

12. Forest products enter into world trade at all stages - as primary, semi-processed, processed, and manufactured products. There are few countries which are not either dependent on imports for at least some part of the supplies of forest products that they consume, or upon export markets as outlets for an appreciable part of their production. Many countries are both importers and exporters of forest products.

13. The purpose of the present report, which is concerned mainly with the primary forest industries - sawmilling, pulp and paper, and wood-based panels (plywood, fibreboard and particle board) - and resulting products, is to summarize and highlight:

1. some characteristics of the major forest industries;
2. trends and developments in the consumption and production of wood products in the recent past,
3. demand projections to 1975;
4. the future supply pattern;
5. estimated investment requirements in forestry and forest industries to 1975;
6. some issues and some needs which emerge.

A note on miscellaneous and secondary forest industries is included separately as an annex at the end of the report.

Sources.[2/] The main sources from which the information and data given have been derived are:

(1) "Wood: World Trends and Prospects"[3/]

(2) "The Role of Forest Industries in the Attack on Economic Underdevelopment".

14. Since 1950 FAO's Forestry and Forest Products Division in collaboration with the United Nations regional economic commissions has been engaged in a series of

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2/ For full details see under "References" given at the end of the report.

3/ FAO, Unasylva, Vol. 20 (1-2), Numbers 80-81, 1966.

regional timber trends studies[4/] which compiled information on a country-to-country basis into sub-regional and regional analyses of the trend in production, consumption and trade of wood-based products, projections of future requirements and resource appraisals, as well as an examination of the adequacy of forestry and forest industry policy and plans to provide for the changing situation. These culminated in the special review "Wood: World Trends and Prospects" which was submitted, as the major contribution of FAO, to the Sixth World Forestry Congress in Madrid in June 1966.

I. SOME CHARACTERISTICS OF THE MAJOR FOREST INDUSTRIES

15. A general idea of the relative importance of the major primary forest industries can be obtained from table 1. Some characteristics of the five main groups are compared in table 2.

16. The pulp and paper industry is a good deal more capital intensive than the other forest industries shown in table 1, and it yields the highest gross product per unit of raw material. Since both pulp and paper and board products (apart from plywood) operate mainly on small-dimensioned woods, do not make use of high value timbers and are in fact utilizing to an increasing extent wood residues, both from other forest industries and from forest operations, their lead over sawmilling in terms of value added per unit of raw material is even more pronounced than is shown in the table.

17. These aggregates and averages, however, conceal great differences in the scale of operations (and factor requirements) within each main group, as will be seen when some of the principal features of each industry group are discussed in turn. First, however, it should be noted that there are a number of minor primary forest industries omitted from these tables: other industries concerned with wood

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4/ European Timber Trends and Prospects, 1953 (with ECE);
Timber Trends and Prospects in the Asia Pacific Region, 1961 (with ECAFE);
Timber Trends and Prospects in Latin America, 1963 (with ECLA);
Timber Trends and Prospects in Africa, 1965 (with ECA);
European Timber Trends and Prospects: A New Appraisal, 1950-75 (with ECE), 1964.

Table 1

World's primary forest industries, 1961: Comparison of economic importance

Industry	Wood raw material equivalent of output		Gross value of output		Investment		Labour force	
	Million cubic metres[a/]	Percentage	Million U.S. dollars	Percentage	Million U.S. dollars	Percentage	Million	Percentage
Sawmilling	588	69	13,700	46.9	8,500	17.2	3.2	60.3
Paper and paperboard	212	24	12,900	44.2	38,300	77.4	1.6	30.2
Wood-based panels	53	7	2,600	8.9	2,700	5.4	0.5	9.5
Plywood	39	5	2,000	6.8	1,800	3.6	0.4	7.6
Fibreboard and particle board	14	2	600	2.1	900	1.8	0.1	1.9
Total	853	100	29,200	100	49,500	100	5.3	100

Source: FAO.

Note: Owing to the non-wood fibrous raw materials included in the wood equivalent and to the utilization of residues from sawmill and plywood industries, the use of roundwood is smaller than the wood raw material equivalent of the total output.

a/ Converted from average product volumes for 1960-1962.

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Table 2

World's primary forest industries, 1964: Selected evaluation criteria

Industry	Gross value of output per unit of raw material	Investment per unit of raw material	Rate of capital turnover: gross value of output per investment a/	Investment per unit of labour force	Employment per unit of raw material
	U.S. dollars per cubic metre (r)	U.S. dollars per cubic metre (r) per year		Thousand U.S. dollars per person	Persons per 1,000 m^3 (r) per year
Sawmilling	30	18	1.7	4	5
Pulp and paper	60	a/ 140	0.4	35	4
Plywood	45	25	1.8	4	7
Fibreboard	30	a/ 35	0.9	18	2
Particle board	45	a/ 35	1.3	14	2.5

Source: FAO.

Note: The data do not refer to the forestry and logging operations which are important, for instance, in employment.

a/ Based on three eight-hour shifts per day.

transformation, such as charcoal, wood-wool manufacture and wood distillation; and industries concerned with the extraction and refining of tanning materials, resins, lac, oils, and the like. Thus, total employment in the primary wood-transforming industries reaches close on 6 million, while about the same number are engaged in the secondary forest industries - furniture, container, box, match and other woodworking, and various paper-converting industries.

Sawmilling

18. In the sawmilling industry, the size of establishment varies from small mills (often mobile) in the forest, producing a few cubic metres a day for local needs, to highly mechanized mills with an annual capacity of several hundred thousand cubic metres, producing for export or serving large consumption centres. All have their place; optimum size and location can be determined only in the context of raw material supply, markets served, and communications between the two. Communications bulk largely in determining location, given the high incidence of transport costs on the raw material delivered mill and the finished product delivered to the market. Value added in processing is small, and economies of scale in the mill installation not of decisive importance. Typically the cost of logs delivered mill represents 50 to 70 per cent of mill production costs. Because of this, and because of the need to carry an adequate stock of logs to assure continuous operation and of processed sawnwood to meet customers' requirements, working capital needs are heavy, often amounting to as much as fixed investment.

19. Labour needs vary within very wide limits, depending on the type of material sawn, the degree of mechanization and on efficiency of operation. To produce 1 cubic metre of sawn softwood in a mill of 10-15,000 cubic metres of annual capacity in a less developed European country requires 10 to 14 man-hours; in a larger mill of 20-35,000 cubic metres of annual capacity, only 7 to 10 man-hours are needed. The more homogeneous the log intake, the greater the possibilities of mechanization and labour saving. Hence, labour productivity (as measured by output per man-hour or man-year) is normally much higher in sawn softwood mills than in mills sawing hardwood. In predominantly coniferous forest areas - North America, USSR and northern Europe - softwoods comprise 85 to 95 per cent of the raw material for sawmilling as compared with 10 to 40 per cent in Asia, Latin America and Africa.

20. A large proportion of the raw material entering the sawmill, about 30 to 40 per cent for the world as a whole, emerges from the process in the form of slabs, edgings and sawdust. This material, at one time wasted, today can be almost all turned to industrial account if there are appropriate forest industries in the vicinity to use it. The slabs and edgings can be chipped for pulp or board manufacture and even the sawdust and shavings from planing mills can be utilized in other wood-processing industries. The possibility of utilizing saw-mill residues has already considerably modified the economics of wood-based industries in the developed areas of the world and has in many cases encouraged the integration of forest industries. In wood-deficit countries, it has contributed to a considerable broadening of the wood raw material basis.

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21. Sawmilling is usually the first forest industry to be established. It does not require a high degree of technical skill on the part of its labour force, but only on the part of a few key technicians. It is much more flexible in location, in size of plant, and in finished product than any of the other primary forest industries. If export demand is good, the industry can concentrate on high-quality production of lumber to dimensions required by the overseas market, using sub-standard production resawn for the local market. Should export demand cease or require different specifications, the industry can quickly adapt itself to the changed requirements.

Pulp and paper

22. Second of the primary industries in terms of raw material requirements and value of output, but far and away the largest in terms of capital invested, the pulp and paper industry has grown rapidly in recent years. This industry is much more heavily concentrated than the sawmilling industry, mainly because, although wood costs represent the main item in total production costs and a cheap wood supply is essential, other process materials and production factors assume considerable importance. The pattern of production costs varies considerably with the process used, the size of plant, the location, and according to whether the process is integrated (pulp and paper) or not. Some of the main characteristics are deducible from table 3, though there is considerable variation between geographical areas and individual mills.

23. While wood costs still represent a third to a half of total production costs, it will be observed that, firstly, capital charges are high; secondly, process chemicals assume a considerable importance, especially for bleached grades; thirdly, power, steam and water represent a very important element; and fourthly, labour costs are relatively small.

24. Obviously wood costs have an important, though not as in sawmilling a dominant, influence on total costs. The wood costs shown in table 3 are for wood delivered mill. Labour represents the major element in this cost and thus, while the mill operation itself is not labour-intensive, the associated forest extraction operations are. Investment needs for this industry are certainly heavy. Typical requirements (fixed investment in the mill only, excluding working capital and any

necessary infra-structural investment) for medium-size mills of 100 tons per day capacity (or 30,000 tons per year) in a developing country range from US$1 million to over $US20 million, depending on location, process and production programme.

25. More than half this investment consists of equipment, engineering, fees, etc., normally requiring foreign exchange outlay in a developing country. On the other hand, pay-out time (total investment divided by annual gross output) is not long-ranging from 18 months to 4 years.

26. However, there are a number of indivisibilities in the technological process which make for sizable economies of scale. These are particularly pronounced for newsprint and for kraft pulp and paper. A general indication of the variation of capital costs with size of mill for some typical mills is afforded by table 4. Clearly, given the high impact of capital charges on production costs, a small mill must enjoy compensating advantages if it is to compete successfully with a larger rival.

27. Power requirements are also high, normally ranging from 350 to 550 kilowatt-hours per ton of bleached sulfate pulp to 1,700 to 2,000 kilowatt-hours per ton of newsprint. The freshwater requirements in pulp and paper manufacture are high, especially for bleached grades of chemical pulp and certain special papers. An integrated paper mill with a daily output of 100 tons consumes about 40,000 cubic metres of water, which equals the needs of a modern city of some 150,000 inhabitants.

28. For the production of chemical pulp considerable quantities of chemicals are required, both for cooking and bleaching: for every 1,000 tons of bleached pulp produced, 200 to 500 tons of chemicals are consumed. Where chemical pulp operations are concerned, this shows the importance of convenient access to basic materials, such as saltcake, salt and limestone.

29. Bringing large quantities of raw materials to the mill, and shipping the finished product, entails a considerable transport problem. Thus, not only is good transport organization necessary: heavy expenditure may be required on transport facilities such as roads, rail, harbours and trucks.

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Table 3

Relative importance of various cost items in the production of pulp and paper

	Mechanical pulp, integrated	Chemi-ground-wood integrated	NSSC-pulp a/ (broadleaved wood) integrated		Sulfate pulp a/ nonintegrated				Newsprint, integrated mechanical pulp	NSSC a/ corrugating board integrated
						Bleached				
			Unbleached	Bleached	Unbleached conifers	Conifers	Broad-leaved wood	Straw		
	Approximate percentage of total production cost at mill									
Fibrous raw material	40	29	36	32	50	43	35	32	39	31
Chemicals	-	12	3	16	4	12	14	15	-	3
Other materials	3	3	4	3	3	3	3	3	4	5
Power, steam, water	21	18	12	10	2	4	5	5	15	13
Labour, including repair	7	7	9	7	7	6	8	8	9	9
Supervision overhead	5	5	5	4	6	5	6	7	5	5
Capital costs	24	26	31	28	28	27	29	30	28	34

a/ With recovery of chemicals: NSSC - neutral sulfite semi-chemical process. Production capacities: about 100 tons per day.

Table 4

Influence of type and size of pulp and paper mills on fixed investment

	Daily capacity, metric tons			
	25	50	100	200
	Fixed investment in thousand $US per ton/day			
Non-integrated mill				
Unbleached chemical pulp	235	175	135	105
Bleached chemical pulp	325	240	190	150
Integrated mill				
Unbleached paper	300	230	180	140
Bleached paper	390	295	235	185

Source: UN/FAO. Report on Pulp and Paper Prospects in Asia and the Far East, 1962.

30. The major part, around 80 per cent, of the world's pulp and paper is still made from traditional coniferous species. Pulp from many hardwoods, however, can be used economically in paper furnishes and the proportion of hardwood pulp so utilized is increasing. There are processes also suited to a wide variety of non-wood materials, including bamboo, esparto and other grasses, cereal straw and bagasse (sugarcane waste), though "other pulps" based on these materials account for no more than 6 to 7 per cent of total world production of pulp for paper and paperboard.

31. Though quantitative requirements for pulp and paper manufacture are modest, a fairly high proportion, ranging from 35 to 45 per cent, needs to be skilled.

32. The question of the feasibility of small-scale pulp and paper production has been the subject of much discussion in recent years. The trend in the world is toward increasingly large production units in order to take maximum advantage of the considerable economies of scale. It is, however, necessary to distinguish between different types of mills and products, and there is no hard-and-fast rule that can be applied to all situations. Small scale units may be justified in some cases in the developing countries serving as a starting nucleus for developing local

markets and skills. Large-scale units, which cannot be supported by local markets, should be considered on a regional basis.

Wood-based panels (plywood, fibreboard and particle board)

33. Plywood. The most important factor in the location of plywood mills is the availability of large-diameter logs of good form, whether indigenous or imported, suitable for peeling or slicing. Much of the industry which has been built up in Europe and Japan has been based on imported tropical hardwoods. With veneer-size logs becoming progressively scarcer, technical progress in the industry has concentrated on making use of smaller diameter logs and lower quality material, for example, by cutting out defects, and reducing core size. The transformation coefficient in plywood manufacture is fairly low, losses on conversion amounting to 50 to 70 per cent (40 to 60 per cent on veneer manufacture). Frequently all or part of these residues will be used as fuel for steam and power needed in the plant for hot presses, dryers, etc. But, if a commercial outlet is available for them, this can have a decisive influence on the economics of operation. Blockboard manufacture is largely a branch of the plywood industry. There is also a notable trend to integrate the plywood and particle board industries, not only because the latter use the residues of the former, but also because much particle board is veneer-faced and because both industries serve the same consuming sectors, construction and furniture.

34. The cost of wood raw material represents 30 to 50 per cent of total manufacturing costs, the other important process material being adhesives (synthetic resins, casein, blood albumen, soybean, etc.) of which about 25 to 35 kilogrammes (or approximately 2 to 3 per cent by weight of finished product) are required per cubic metre of plywood. With the growing importance of moisture-resistant and waterproof plywood, the consumption of urea and phenol resins has increased rapidly.

Investment costs, though higher than for sawmilling, are much lower than for pulp and paper manufacture - about $US100 to $200 per cubic metre of annual capacity. Scale economies are less pronounced than for pulp and paper; they relate mainly to power and presses, and only mills operating on large quantities of uniform material (for example, Douglas fir) and manufacturing standard grades can fruitfully introduce much mechanical handling and some automation control.

35. Labour needs per cubic metre of output vary substantially, depending upon the degree of mechanization, log sizes, average thickness of veneer, need for patching, and so on. In less developed countries, more than 100 man-hours per cubic metre, may be used if circumstances imply heavy reliance on manual handling. The proportion of skilled labour needed may range from 20 to 35 per cent.

36. What has been said under sawmilling concerning the opportunities in developing countries for carrying out further processing before export applies also to plywood manufacture. It is perhaps useful to note a recent trend toward establishing non-integrated veneer plants, making green or drier veneer, to feed local or overseas plywood plants equipped simply with a press or drier and press. Such veneer mills require less investment, and can operate on a limited supply of veneer logs. Shipment of veneers saves weight and space compared with shipping logs.

37. Blockboard, laminated board, etc., are included in the broad category of plywood, and output of these products has increased parallel with the production of particle board. Blockboard can be manufactured almost manually, with but limited equipment. It is of considerable interest to many developing countries since it can not only replace imports, but also offers an outlet for thinnings and small-diameter logs for coniferous plantations as well as for sawmill residues.

38. Fibreboard. This industry has many affinities with the pulp and paper industry. The problems of wood supply are similar, as is the stage of pulp preparation, if the traditional wet process is employed. Process chemicals are not normally required, and the sizing materials and additives which impart particular qualities to the finished product do not represent an important element in total costs. Wood costs may account for 20 to 40 per cent of the total, depending on the size of mill (though they may fall to 10 per cent if cheap residues are available), while fixed charges (mainly depreciation and interest on working capital) may account for 20 to 30 per cent, again depending on size of mill. Thus, as with pulp and paper, scale economies are significant. Fixed investment per daily ton may range from $US90,000 to $100,000 for a mill of 6,000 tons annual capacity, down to around $30,000 for a mill of 50,000 tons annual capacity.

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39. An adequate supply of fresh water is required; water needs are similar to those for newsprint production. Power requirements, at 300 to 800 kilowatt-hours per ton of product, are less than for newsprint but more than for chemical pulp. Labour needs (in the mill) are modest, ranging from twelve to forty man-hours per ton. Fibreboard production can be based on a wide variety of coniferous and broadleaved species, including suitably blended mixtures, and is eminently suitable for utilising residues (including even bark and sawdust) from other forest industries. There is a growing trend toward the use of unbarked wood.

40. The dry process[5/] for the manufacture of hardboard in a rather new development of interest since there is no need for large supplies of fresh water. Resins, however, are needed for bonding purposes.

41. Particle board. This industry is essentially a postwar development. Like fibreboard, particle board can make use of a wide variety of species, coniferous and broadleaved, as well as flax, bagasse, and wood residues; indeed, this industry was developed in the first instance to make use of wood residues.

42. Investment in a particle board plant of intermediate size represents roughly half that in a fibreboard mill of comparable tonnage. Though there are economies of scale, relatively small mills may be economic, particularly if operating on locally available residues or serving a captive market. Investment cost ranges from about $US12,000 to $30,000 per ton per day, depending on the process used and hence on the type of board produced.

43. There are fewer restrictions on location than in the case of fibreboard. Water needs are minimal. Power requirements, too, are modest, 100 to 300 kilowatt-hours per ton of board, as are mill labour requirements, 5 to 20 man-hours per ton. A key consideration, however, is the availability and cost of resin, normally urea, or phenol formaldehyde. This bonding material, which represents about 5 to 8 per cent of the weight of the finished board, may account for 15 to 35 per cent of production costs, depending on the process used and the cost of resin. Thus, resin costs may frequently exceed wood costs. Obviously, if resin has to be imported, this sharply diminishes the import-saving value of the project.

5/ See "Plywood and Other Wood-based Panels", FAO, 1966.

II. TRENDS AND DEVELOPMENTS IN THE RECENT PAST

44. In 1961,[6/] about one half of all roundwood produced in the world was still consumed directly as fuelwood and a further one tenth was consumed in its round form as pitprops, poles, piling and posts. The remaining roundwood was processed further: two thirds was used by the sawmilling industry, one quarter by the pulp and paper industry and about one tenth by the wood-based panel industries (plywood, fibreboard and particle board).[7/]

Table 5

Change in recorded world consumption of wood products, 1950-52 to 1960-62

	Million units	1950-52	1960-62	Change 1951-61 (1951 = 100)
Fuelwood ...	m^3	865.6	876.5	101
Roundwood 8/ ...	m^3	129.2	116.2	90
Sawnwood ...	m^3	266.1	341.0	128
Plywood ...	m^3	6.8	16.8	247
Fibreboard ...	m.t.	2.2	4.5	210
Particle board ...	m.t.	0.04	2.3	
Paper and paperboard	m.t.	44.3	77.3	174

45. However, as table 5 above shows, the end-use pattern has been changing substantially in recent years, due to the varying degree of competition from substitutes on each forest product and a general shift in demand in developed countries towards the more highly processed products. Thus, since 1951 the quantitatively most important end-use of wood as fuel has shown a marked absolute decline in most high income countries, as fuel wood is being displaced by other fuels which are simpler, cleaner, and cheaper to use, and even in the developing

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6/ Annual average for 1960-62. Unless stated otherwise, data relating to 1952 and 1961 are three-year averages throughout this paper.

7/ The pulp and board industries also use very large quantities of wood residues from the sawmilling and other industries. In 1960-62 the residues used in this way were equivalent to about 8 per cent of the saw and veneer log intake, and made up about 17 per cent of the total wood raw material intake of the pulp industry, 35 per cent in fiberboard manufacture and 44 per cent in particle board production.

8/ Excluding pitprops: in 1961, an estimated 50.6 million m^3 of pitprops were consumed.

countries use has seldom been growing faster than population. Similarly, unprocessed roundwood use as poles, posts, piling and pitprops, fell in developed countries, due to replacement by more durable wood and non-wood materials. Growth in consumption did occur between 1951 and 1961 in developing countries, but in aggregate world consumption apparently declined.

46. World consumption of sawnwood grew from 266.1 million m^3 in 1951 to 341.0 million in 1961, an average annual rate of growth of 2.5 per cent. Since 1961 growth in consumption has been a little slower, reaching 373.0 million m^3 in 1965. In most developed countries, the main users of this product, consumption grew slowly because of more efficient use and competition from other materials, particularly in the construction industry. In developing countries, the pressures to replace sawnwood are not so great as in developed countries, but consumption growth has still been slow, due in many cases to a failure to develop local producing and marketing capacities. Much of the growth in sawnwood use between 1951 and 1961 took place in the centrally planned economies, notably the USSR where there was restricted availability of alternative materials (Table 6).

47. Some of the products competing most successfully with sawnwood in developed countries have been the wood-based panels - plywood, fibreboard and particle board. There was a widespread decline in panel prices at a time when sawnwood prices either rose or stayed unchanged. Moreover, wood-based panels can be placed in use with lower labour costs than sawnwood and can easily be adapted by mechanized processes. In addition to substituting for sawnwood, panels have found several new applications. As a result of these factors, consumption of wood-based panel materials, both as a group and separately, has been growing faster than consumption of any other wood product group. In aggregate, world consumption rose from 12.5 million m^3 in 1951 to 30.2 million in 1961, an average annual growth of 9.3 per cent. During the first half of the 'sixties, consumption grew even faster, at an average rate of 10.5 per cent a year, to reach 45.2 million m^3 in 1965. Fifty-five per cent of the 1961 volume was consumed as plywood, 33 per cent as fibreboard, and 12 per cent as particle board. The appearance of particle board, a new product, accounted for an important part of this rapid growth in panel use in the post-war period. But growth in use of the other products was also substantial. Between 1951 and 1961 consumption of plywood increased by

147 per cent and fibreboard by 110 per cent. Since 1961, use of these two products has grown by a further 42 per cent and 34 per cent, respectively. Eighty per cent of the growth in wood-based panel use took place in developed countries, which also accounted for the major part of total consumption (83 per cent).

48. In the last main end-use of forest products - paper and paperboard - the total world consumption rose from 44.3 million tons in 1951 to 77.3 million m. tons in 1961; an average annual growth of 5.7 per cent. Consumption has grown almost as fast in the four following years, reaching 95.8 million tons in 1965. In market economy countries this growth is closely related to the increases in per capita income levels. But income elasticities vary between different paper products, and over the range of income. At low levels of income, the demand elasticity for printing and writing papers is higher than for industrial paper, but the position is reversed as income grows. As most of the growth (86 per cent) of paper and paperboard consumption was in developed countries, use of the industrial grades of paper and paperboard grew appreciably faster than use of cultural papers, and accounted by 1961 for 63 per cent of all paper and paperboard.

49. Production of fuelwood, which account for about half of all roundwood production, is dispersed throughout most regions of the world. Production of other forest products, however, is mainly concentrated in the conifer-rich north temperate zone, which contains nearly all the high wood-use countries (Table 7). From 1951 to 1961 this zone's share of total world production of industrial wood declined slightly from 88 to 86 per cent, and in the same period it maintained its 89 per cent share of total production of sawnwood. Its share of wood-based panel production and paper and paperboard production fell only from 96 per cent to 93 and 92 per cent, respectively.

50. The continued concentration of the growth of the forest industries in the north temperate zone, in a period of rising wood costs and costs of labour, has been facilitated by two general developments. Wood-processing industries have increased the flexibility of their raw material requirements, thus improving their ability to draw more intensively upon the forests already in use. In particular, the pulp and board industries are rapidly bringing into use more small-sized and broadleaved wood and residues from logging and the mechanical wood-processing and manufacturing industries. Secondly, all branches of forest

Table 6

Consumption of industrial wood products 1950-52 and 1960-62, a/ and estimated requirements 1975
(Million Units)

	Roundwood (m^3 r)			Sawnwood (m^3 s)			Panels (m^3 s)			Paper and Paperboard (m.t.)		
	1950-52	1960-62	1975	1950-52	1960-62	1975	1950-52	1960-62	1975	1950-52	1960-62	1975
EUROPE	25.12	36.56	23.80	61.48	78.31	87.30	2.84	8.41	22.60	10.99	22.87	50.60
of which:												
Northwestern Europe		13.08	7.80		39.09	44.70		5.11	12.92		16.27	34.20
Eastern Europe		13.01	9.10		19.82	21.10		1.30	5.15		2.63	7.45
USSR	58.18	67.35	60.00	55.57	99.72	111.00	0.77	2.24	14.40	1.63	3.47	15.00
NORTH AMERICA	18.03	18.58	11.00	103.53	94.37	107.90	8.01	16.25	26.00	27.28	37.37	56.40
of which:												
United States		17.21	9.90		85.88	98.20		14.68	23.39		35.09	52.34
LATIN AMERICA	1.54	8.50	12.10	12.14	12.39	24.70	0.16	0.52	1.90	1.44	2.66	6.90
AFRICA	7.63	13.31	16.50	3.06	4.05	7.50	0.08	0.37	1.10	0.38	0.90	2.50
of which:												
Southern Africa		2.13	1.50		1.14	1.30		0.15	0.33		0.39	0.95
ASIA-PACIFIC	18.68	44.14	61.80	30.34	57.33	89.00	0.63	2.75	9.80	2.62	10.20	30.50
of which:												
Japan:		6.82	7.80		29.03	41.00		1.50	4.50		4.99	15.00
China (mainland)		14.50	20.00		10.53	20.00		0.19	2.50		2.43	8.00
Pacific		1.07	1.10		5.80	7.50		0.35	0.60		1.09	2.17
WORLD	129.20	188.43	185.20	266.12	346.17	427.30	12.49	30.45	75.80	44.34	77.47	161.90

a/ The figures for 1950-52 are derived from only recorded production and trade. They are therefore not comparable with the figures for 1960-62 and 1975, which refer to total consumption, in the case of roundwood, and to a much lesser extent sawnwood, as in some regions much production and consumption goes unrecorded or is not separately recorded (pitprops). By way of comparison the recorded consumption of roundwood, in million m^3, in 1960-62 was: Europe 22.45, USSR 45.64, North America 16.98, Latin America 2.62, Africa 8.36, Asia-Pacific 20.11. Recorded consumption of sawnwood, in million m^3, in 1960-62 was: Africa 3.70, Asia-Pacific 35.35 (in other regions unrecorded consumption was insignificant).

Table 7

Production of wood and wood products, 1950-52 to 1960-62[a/]
(Million Units)

	Industrial Wood		Fuelwood		Sawnwood		Panels		Woodpulp		Paper and Paperboard	
	1960-62	Change 1951-61	1960-62	Change 1951-61	1960-62	Change 1951-61	1960-62	Change 1951-61	1960-62	Change 1951-61	1960-62	Change 1951-61
	..... m^3 r		..... m^3 s		..... m.t.							
EUROPE	224.35	+ 43.78	107.59	- 10.01	72.44	+ 11.7	8.54	+ 5.55	17.89	+ 7.71	23.57	+ 11.38
of which:												
Northern Europe	85.23		20.01		18.56		2.34		10.77		5.58	
Eastern Europe	51.67		16.60		20.60		1.35		1.96		2.59	
USSR	256.83	+ 80.13	100.90	- 7.10	104.78	+ 49.46	2.34	+ 1.52	3.46	+ 1.71	3.45	+ 1.78
NORTH AMERICA	346.88	+ 36.47	45.69	- 21.04	87.26	- 10.37	15.71	+ 7.66	34.77	+ 12.22	38.89	+ 11.13
of which												
Canada	88.99		6.74		20.19		1.77		10.66		7.99	
United States	257.89		38.95		77.07		13.94		24.11		30.90	
LATIN AMERICA	38.50	+ 2.03	192.36	+ 16.81	12.57	- 0.09	0.50	+ 0.34	0.71	+ 0.47	1.74	+ 0.96
AFRICA	25.59	+ 7.82	182.69	+ 23.96	2.98	+ 1.10	0.35	+ 0.30	0.16	+ 0.13	0.38	+ 0.30
of which:												
Western Africa	12.92		83.14		1.51		0.11		0.01		0.002	
Southern Africa	4.71		2.47		0.70		0.22		0.12		0.22	
ASIA-PACIFIC	149.61	+ 41.77	457.09	+ 8.24	56.26	+ 22.62	3.12	+ 2.58	5.32	+ 3.99	9.27	+ 7.32
of which:												
South-East Asia	32.09		152.66		7.14		0.33		0.00		0.10	
Japan	48.40		64.01		28.90		1.85		3.95		5.19	
China (mainland)	34.00		134.00		10.53		0.16		0.68		2.43	
Pacific	15.42		23.31		5.11		0.34		0.61		0.72	
WORLD	1,041.76	+ 212.00	1,086.31	+ 10.86	346.29	+ 73.89	30.56	+ 17.95	62.31	+ 26.23	77.30	+ 32.87

a/ Figures for 1960-62 relate to total production - i.e. with an allowance for unrecorded production. The figures of the change in production between 1950-52 and 1960-62 relate only to recorded production.

industry have improved productivity, notably by increasing the size of the plant in order to realize the economies of large-scale production inherent in most processes.

51. The pulp and panel industries are in general proving to be more flexible in their raw material requirements than the sawmilling industry, and to have more scope for technological advances and improvement in productivity. In conjunction with the deteriorating market position of sawnwood, this has resulted in a further shift within the group of wood products in favour of the reconstituted forms of wood products.

52. The continued heavy concentration of consumption and production of forest products in the high income countries has been reflected in the pattern of trade in wood and wood products (Table 8). In 1959-61, the flows between high income countries (both market and centrally planned) accounted for more than 80 per cent of total trade in forest products (70 per cent between developed market economies alone). The balance was principally composed of a flow from the developed market economy countries to the developing and a smaller (in terms of value) reverse flow. The developing countries as a group had a trade deficit which in 1959-61 amounted to about $300 million annually.

53. The trade between the developed countries is composed largely of sawn softwood, chemical woodpulp, newsprint and kraft paper and paperboard. Most of this trade originated in Northern Europe and North America, with the USSR also exporting large quantities of relatively low-valued products such as roundwood and sawnwood. Supplies from developing regions, principally hardwood logs from western Africa and South East Asia, are now growing rapidly in volume.

Table 8

Net trade in wood products, 1955-57 and 1960-62

(Million units, net exports (+), net imports (-))

	Roundwood		Sawnwood		Panels[a]		Woodpulp		Paper and Paperboard	
	1956	1961	1956	1961	1956	1961	1956	1961	1956	1961
	.... m^3 r ...		.... m^3 s		... m^3 s ...		... n.t. ...		... m.t. ...	
EUROPE	-4.59	- 8.99	- 2.84	- 5.87	+0.09	+0.13	+0.03	-0.50	+1.02	+0.70
of which: Northern Europe	+4.87	+ 2.41	+ 7.77	+ 8.63	+0.93	+1.21	+4.34	+5.10	+2.21	+3.48
N.W. Europe	-9.35	-10.16	-15.03	-18.41	-0.86	-1.12	-4.14	-5.29	-1.43	-2.85
Eastern Europe	-0.51	- 0.73	+ 0.89	+ 0.79	+0.01	+0.05	-0.13	-0.22	+0.05	-0.04
USSR	+1.36	+ 5.33	+ 2.13	+ 5.06	+0.07	+0.10	+0.08	+0.16	-0.05	-0.02
NORTH AMERICA	+0.19	+ 0.66	+ 3.54	+ 2.89	-0.24	-0.50	+0.60	+1.25	+1.01	+1.51
of which: Canada	+3.82	+ 1.78	+ 9.55	+11.70	+0.08	+0.05	+2.07	+2.52	+5.35	+5.70
United States	-3.63	- 1.12	- 6.01	- 8.81	-0.32	-0.55	-1.47	-1.27	-4.34	-4.19
LATIN AMERICA	-0.05	+ 0.29	+ 0.12	+ 0.19	-0.02	-0.02	-0.46	-0.39	-0.80	-0.86
AFRICA	+2.71	+ 4.47	- 1.35	- 1.07	-	+0.02	-0.01	+0.04	-0.35	-0.45
of which: Western Africa	+2.82	+ 4.65	+ 0.38	+ 0.43	+0.04	+0.04	-	-	-0.03	-0.04
Southern Africa	-	- 0.02	- 0.79	- 0.45	+0.04	+0.03	+0.02	+0.07	-0.13	-0.17
ASIA-PACIFIC	+0.42	- 1.95	- 0.45	- 0.95	+0.16	+0.45	-0.25	-0.49	-0.83	-0.91
of which: South-East Asia	+3.27	+ 7.49	+ 0.75	+ 1.00	-0.05	+0.12	-0.01	-0.04	-0.27	-0.31
Japan	-2.26	- 8.46	+ 0.34	- 0.13	+0.27	+0.35	-0.14	-0.16	+0.10	+0.20
Pacific	-0.14	+ 0.01	- 0.69	- 0.69	-0.02	-0.02	-0.05	-0.10	-0.34	-0.36

a/ Excluding veneers.

III. DEMAND PROJECTIONS TO 1975

54. Table 9 below sets out the estimates of the aggregate growth in wood and wood products consumption to 1975. It is foreseen that if populations, incomes and prices develop as assumed,[9/] the world in 1975 will require annually about 560 million m^3 (r) more wood raw material than in 1961. Most of this growth in the aggregate use of wood will stem from its industrial application.

Table 9

Estimated change in world consumption of wood products, 1960-62 to 1975

	Million units	1960-62[a/]	1975	Change 1961-75 (1961 = 100)
Fuelwood	m^3	1088.0	1199.0	110
Roundwood	m^3	188.0	185.0	98
Sawnwood	m^3	346.2	427.3	123
Panel products[b/]	m^3	30.5	75.8	248
Paper and paperboard	m.t.	77.5	161.9	209

a/ The figures differ from those for 1960-62 in the first table by an allowance for unrecorded consumption. The latter is significant in the case of fuelwood and roundwood.

b/ Excluding veneer.

55. It is estimated that by 1975 the world will require about 430 million m^3 of sawnwood, an increase of a quarter above 1961 consumption. A large share of additional future requirement - probably in excess of one third of the aggregate world growth by 1975 - is likely to originate in the developing countries, underlining the importance of the potential for growth, and the challenge, facing the sawmilling industries in these countries. In developed countries a continued

9/ It is assumed that the world population will grow from 3.0 to 3.9 thousand million; that the average annual rate of growth in the real value of product per capita will be 2.5 in developing countries, 1.9 in North America, 3.4 in Western Europe and 6.0 in Japan (forward estimates of wood requirements in centrally planned countries are largely based directly on their plan dat and that the relationship between prices of wood products and the prices of their nearest substitutes will not change.

shift away from sawnwood will mean little, if any, growth in per capita use. In the centrally planned countries this shift is likely to accelerate, as alternative lower cost materials become increasingly available (Table 6).

56. To date there has been little evidence, even in the high-income, high-use countries, of any slowing down in the rapid rate of increase in consumption of wood-based panels. It is to be expected, however, that the relative importance of substitution on the growth in consumption must decline in the future as the fall in the price of panels is arrested, and the physical scope for further replacement of sawnwood becomes more restricted. Consequently, the forward estimates assume an appreciable slowing down in the rate of growth in consumption by 1975. Nevertheless, growth will still be very rapid - by 1975 annual consumption is expected to be about 60 per cent above the 1961 level in North America and up 145 per cent in Western Europe. In the centrally-planned economies it is planned actively to encourage the trend towards replacing sawnwood with wood-based panels and even more rapid increases in their present low levels of consumption can be expected. In the developing countries, wood-based panels are likely to become an important material where sawnwood is not available cheaply. A rapid growth is foreseen, but it is unlikely to be as fast as the spectacular substitution-based expansion in the developed countries. In aggregate, the expected 1975 world requirements of wood-based panels are 76 million m^3, two and a half times as much as 1961 consumption.

57. It is estimated that in 1975 the world will require about 162 million metric tons of paper and paperboard - more than twice the consumption in 1961. As growth starts from much higher initial levels of use in the developed countries, these countries will account for the larger part of the absolute increase. The use of industrial paper and paperboard will continue to grow faster than use of cultural papers and will account for nearly two thirds of all paper and paperboard consumed in 1975. In the centrally planned economies, growth in consumption of paper and paperboards has been restricted chiefly by limited supplies, but large increases in production are planned in these countries, and consumption is expected to rise more rapidly in the future.

58. In the world as a whole there will be little change in the enormous quantities of roundwood used as such, for fuel and construction. The rapid population growth foreseen in the developing countries is expected to offset the

concurrent reduction in the use of fuelwood in the developed countries and world consumption of this product in 1975 is likely to be somewhat above its 1961 level of roughly 1,000 million m^3 per year. For similar reasons, aggregate use of roundwood per poles and props is expected to remain at about the present level of 190 millon m^3.

59. The more highly manufactured of the industrial wood products, such as paper and panels, thus account for the major part of the expected growth in total wood requirements. As these are among the more highly valued of the wood products, the aggregate value of the wood products used in the world will grow even faster than the volume. The estimated 25 per cent increase in the volume of wood used annually, between 1961 and 1975, will mean a growth of 60 per cent in the value (at constant prices) of the primary forest products consumed.

IV. THE FUTURE SUPPLY PATTERN

60. There is no set of world-wide estimates of future production of wood comparable to the estimates of requirements presented earlier. But sufficient is known about the production possibilities of the principal consuming areas to be able to determine broadly what part of their additional requirements they are likely to be able to meet domestically. Table 10 shows[10/] the growth in requirements for each area of the world and the expected growth in output of the quantitatively more important of them.

61. A rapidly widening supply deficit is foreseen for northwestern Europe (EEC plus United Kingdom), net imports are expected to grow to 145 million m^3 by 1975. Because its present principal supplier, Scandinavia, is experiencing growing difficulties in procuring additional wood, there will be a rapid growth in annual net imports from other parts of the world, along with a shift in the pattern of intra-European trade towards more highly processed products. For Europe as a whole net imports are expected to supply 21 per cent of wood requirements in 1975 compared with 8 per cent in 1961.

10/ The table, and the trade volume figures in the text, are in terms of wood raw material equivalents.

Table 10

Expected change in the industrial wood balance, 1960-62 to 1975

(Million cubic metres of roundwood and wood raw material equivalent)

	Consumption[a]		Production[b]				Surplus (+) or Deficit (-)	
	1960-62	1975	1960-62		1975		1960-62	1975
EUROPE								
Northern Europe	33.3	39	85.2	(90.4)	99	(108)	+57.1	+69
EEC	103.4	160	54.1	(59.2)	64	(70)	-44.2	-90
British Isles	40.2	60	3.0	(3.2)	5	(5)	-37.0	-55
Central Europe	16.9	24	21.0	(22.5)	29	(32)	+ 5.6	+ 8
Southern Europe	11.7	21	9.3	(9.4)	17	(18)	- 2.3	- 3
Eastern Europe	53.9	72	51.7	(53.6)	58	(64)	- 0.3	- 8
Total	259.4	376	224.3	(238.3)	272	(297)	-21.1	-79
USSR	243.2	305	256.8	(259.0)[c]			+15.8	..
NORTH AMERICA								
Canada	32.5[e]	44[e]	89.0		[d]		+56.5	..
United States	288.0[e]	376[e]	250.3		326		-37.7	-50
Total	320.5[e]	420[e]	339.3		..		+18.8	..
LATIN AMERICA	39.9	76	38.5		..		- 1.4	..
AFRICA	25.0	36	25.6		..		+ 0.6	..
of which: Southern Africa	5.9	5	4.7		12		- 1.2	+ 7
NEAR EAST	9.5	14	6.4		..		- 3.1	..
FAR EAST	104.5	180	93.7		..		- 6.6	..
of which: Japan	63.0	112	48.4	(52.6)	72	(82)	-10.4	-30
PACIFIC	18.1	26	15.4	(16.1)	21	(22)	- 2.0	- 4
MAINLAND CHINA	34.0	62	34.0		..		-	..
WORLD TOTAL	1,054.1	1,495	1,034.0	(1,055.1)	..	..	+ 1.0	..

a/ Consumption of processed wood products and other industrial roundwood expressed in equivalent volumes of wood raw material.

b/ Removals of industrial wood with total domestic industrial supply (roundwood removals plus usable wood residues) shown in parentheses.

c/ The annual allowable cut in 1963 was reported to be almost 605 million m^3. It is estimated that total removals (including fuelwood removals) in 1970 will be about 390 million m^3.

d/ Allowable annual cut from presently economically accessible areas, assuming mixed pulpwood and sawtimber rotations, is 210 million m^3 of industrial wood. If prices were to rise by 10 per cent an additional allowable annual cut of 26 million m^3 could be taken from presently marginal forest lands. If presently economically accessible areas were managed on shorter pulpwood rotations, the annual allowable cut could probably be raised to about 315 million m^3.

e/ Excludes roundwood equivalent of wood residues consumed.

/...

62. The tightening raw material situation in Scandinavia is causing producers to integrate forward and to use more of their pulpable resources in production of higher value paper and paperboards rather than chemical pulp and sawn softwood. The additional supply of chemical pulp required in Europe is expected to come from North America, which is also likely to increase its share of the European market for such mass grades of paper and paperboard as newsprint and kraftliner. Difficulties in the USSR in building up the pulp and paper industry are likely to mean that only limited supplies of pulp and paper will be available in that country for export to the European market in the period up to 1975.

63. With the slackening of growth in sawn softwood output from Scandinavia, it is expected that the other principal suppliers, the USSR and Canada, will expand their supplies of this commodity to Europe, perhaps at higher prices. Large quantities of additional quality and large-size hardwoods will also be needed to meet the rapidly rising demand for plywood and veneer; the only source of adequate quantities of logs of appropriate size and properties is the tropics.

64. Japan is also rapidly emerging as a major wood deficit area: from 1956 to 1961 its net import volume grew by about 7 million m^3 to more than 10 million m^3, and is expected to continue to increase at a fast rate. A continued growth in coniferous wood supplies from northeastern USSR and the west coast of North America is foreseen, but probably with a mounting share in semi-processed form rather than as roundwood. A continued rise in imports of broadleaved woods for plywood, veneer and sawnwood is also foreseen, and these again will have to come from the tropics.

65. The third major flow of wood and wood products is from Canada to the United States. There are considerable reserves of coniferous sawlogs in the northwest of the United States and a considerable regrowth in the southeast, but a growing share of the country's sawn softwood requirements is expected to be imported from Canada, which has a cost advantage. Moreover, it is likely that with the further rationalization of the North American pulp and paper industry there will be a growing flow of wood pulp from Canada, linking Canadian pulp producing capacity with United States paper producing and marketing facilities. As in Europe and Japan, increased imports of hardwood plywood and veneer from the tropics are expected, but unlike the other two areas, these imports are, and will continue to be, of processed products rather than as logs.

66. The requirements of the rest of the world for additional imports of wood and wood products are likely to be comparatively small. Some of the most advanced of the other countries, such as New Zealand and South Africa, are rapidly improving their degree of self-sufficiency, as the large-scale man-made forests they have established come into use. In most developing countries forest products imports are made up mainly of pulp and paper, and the foreseen rapid rise in paper and paperboard requirements is likely to create growing opportunities for the esteblishment of domestic production capacity in these commodities. By 1975, many countries may be proportionately more self-sufficient than at present though the absolute level of aggregate imports into less developed areas is expected to rise. Some of these imports are likely to come from countries such as Chile, for example, which are developing an export potential based on man-made forests. In quantitative terms, the forward estimates of requirements discussed above point to an increased annual trade flow in 1975 of 25 to 35 million m^3 (r) of coniferous sawlogs (or the sawn equivalent) more than in 1961, and 35 to 50 million m^3 (r) of pulpwood (or the pulp of paper equivalent). The examination of the potential of the prospective suppliers indicates that this growth is quite consistent with the supply possibilities of the principal exporting regions.

67. It is much less certain, however, whether future demand for tropical broad-leaved woods can be met without an acceptable rise in costs, or a destructive depletion of tropical forest resources. The trade in these woods expanded at a remarkable rate to 17 million m^3 (r) in 1961,[11/] and the import demand in 1975 is expected to be in aggregate some 15 to 20 million m^3 (r) above the 1961 level. Much will depend upon the tropical producers' ability to introduce a wider range of species to the market than the few currently accepted; to improve the efficiency of harvesting and transport; and to export more of the output in processed rather than log form so as to improve the utilization of secondary species. This, in turn, will depend on some reorganization of the trade which is greatly dependent on the capital and expertise of consuming interests in the importing countries anxious to obtain raw material supplies. This pattern has been reinforced by tariff structures in most importing countries which discriminated against imports of plywood and veneer, and often against sawnwood.

11/ Including the wood raw material equivalents of trade in tropical hardwood, sawnwood, plywood and veneer.

68. Looking beyond 1975, there can be no doubt that most of the additional volumes of industrial wood that will be needed will continue to come from intensified management in the temperate forests - the existing concentration of markets, and of management and processing resources, in the temperate regions alone will ensure this. More intensive forest management, however, is likely to raise the cost of wood. Much of the increased output of Europe and Japan can even now only be obtained by such means. To meet demand beyond 1975, a prompt acceleration of forest programmes will also be needed in the United States and in due course in the other great natural coniferous resources in Canada and the north and east of the USSR. As markets grow around the world, the pressures to develop the wood resources of other regions will mount. These resources include not only the natural forests of the tropics and sub-tropics but areas endowed with highly favourable conditions for the establishment of man-made forests capable of producing wood at delivered costs substantially lower than from comparable investment efforts in the north temperate countries.

69. In the more distant future, growing attention is likely to be paid to the problems and prospects associated with the bringing into use of such areas, where often the wood resources will have to be developed from the beginning. Large inflows of capital and technical assistance will be called for, as well as the need for research into the particular conditions of these producing areas and the development of appropriate technologies. The shift in supply pattern that will emerge is likely to require adjustments in tariff structures and other trade barriers, in order to facilitate the development of the new trade flows.

70. These changes are particularly significant as the countries concerned are developing countries, in which the wood resource and the industries which draw upon this resource offer one of the more promising avenues for early expansion in exports of processed products as well as of the raw material.

V. ESTIMATED INVESTMENT REQUIREMENTS IN FORESTRY AND FOREST INDUSTRIES 1961-75

71. The limitations of data in making an estimate of this nature must be fully recognized and the estimates should be taken as no more than an indication of the order of magnitude involved. They rest upon a series of assumptions which are elaborated upon in the following paragraphs.

72. As a first step in determining the size of regional capital requirements, the likely distribution of production of wood and wood products between regions by 1975 was estimated on the basis of the projection of consumption and the tentative trade balances set out in "Wood: World Trends and Prospects". Estimates were then made of investments needed in the new processing capacity and in additional primary wood production (logging and forest management). (Tables 11 and 12.)

73. In evaluating the estimated investments in processing capacity and logging it should be borne in mind that no allowance is made for the costs of replacing depreciated, existing capacity in the estimates presented in Tables 11 and 12 (though they are considered, where possible, in the text). It was assumed that replacement costs are taken into account through amortization charges appearing as annual costs. Similarly, interest charges on capital invested in land, growing stock, processing plants, etc., are also excluded.

Investments in industrial processing

74. Table 11 presents the estimated cumulative investments needed through 1975 to expand productive capacity of the world's forest industries to make possible the estimated concurrent increase in regional production of sawnwood, wood-based panels and pulp and paper. The estimates refer to direct plant costs such as costs of construction and equipment and include an allowance for working capital. No provision, however, is included for costs of housing, power generation and infrastructural development.

75. It is foreseen that a total of close to $US40,000 million worth of additional productive capacity would have to be installed between 1961 and 1975.[12/] The highly capital intensive pulp and paper industry can be expected to account for as much as 86 per cent of total investments, followed by the wood-based panel industries (8 per cent) and sawmilling (6 per cent).

12/ Replacement of depreciated existing capacity over the period would add another $US15-16,000 million to the total. This seems rather modest compared with the investments in new capacity but is explained partly by the considerably lower investment costs to be expected in replacing existing plants and partly by the large absolute increase in pulp and paper capacity which is expected approximately to double over the period.

Table 11

Cumulative investments in additional wood processing capacity, 1961-75, by regions

(1,000 mill. $US, 1961 prices)

	Sawmilling	Wood-based panel industry	Pulp and Paper industry	Total
Europe	0.04	0.98	8.23	9.25
USSR	0.42	0.71	4.10	5.23
North America	0.37	0.59	9.26	10.22
Latin America	0.40	0.12	2.54	3.06
Africa	0.12	0.15	0.89	1.16
Asia (less Japan)	0.65	0.44	4.96	6.05
Japan	0.23	0.26	3.13	3.62
Pacific	0.035	0.006	0.49	0.53
TOTAL WORLD	2.26	3.26	33.60	39.12

Annex Table 11

Average capital requirements per unit of additional output, 1961-75, by region

($US, 1961 prices)

(Unit)	Additional investments needed to expand primary wood production		Investments in additional processing capacity, per unit of annual output			
	Forest management	Logging	Sawnwood	Wood-based panels	Pulp	Integrated pulp + paper
	(per additional m^3 of annual removals a/)		(... per m^3(s) ....)		(... per m.t. ...)	
Europe	40.5	5.80	28	55	245	360
USSR	4.5	7.00	24	47	240	350
North America	4.5	8.50	22	53	245	360
Latin America	12.0	6.60 b/	32	72	390	630
Africa	10.5	8.35 b/	35	87	330	520
Asia (less Japan)	10.0	8.50 b/	37	82	390	630
Japan	14.5	5.80	22	62	270	350
Pacific	13.5	5.80	30	51	305	450
WORLD AVERAGE	11.1	7.51	28	58	398	

a/ Industrial wood only.

b/ In tropical rainforests 11.00.

Table 12

Estimated capital required to expand primary wood production, 1961-75, by region

(1,000 mill. $US, 1961 prices)

	Forest Management	Logging	Total
Europe	2.10	0.30	2.40
USSR	0.40	0.63	1.03
North America	0.60	1.18	1.78
Latin America	0.45	0.25	0.70
Africa	0.25	0.20	0.45
Asia (less Japan)	0.70	0.60	1.30
Japan	0.35	0.14	0.49
Pacific	0.08	0.03	0.11
TOTAL WORLD	4.93	3.33	8.26

76. Most of the new capacity will continue to be installed in the developed countries although important progress is expected to take place in the development of forest industries in the rest of the world.

77. Thus, in the pulp and paper industry the developing countries' share of the additional productive capacity to be installed over the period is expected to be approximately twice the size of their present share of total production, but it will still amount to only 16 per cent of the total. Because of the high investment costs per unit of output, brought about by the small average mill sizes and by the high costs of machinery and equipment, most of which must be imported, these countries will require 25 per cent of total investments in this industry to achieve this increased production. (See Annex Table 11.)

78. In the field of sawnwood and board products proportionately more of the additional productive capacity is expected to be located in the developing countries (41 and 16 per cent of additional capacity, respectively, in 1975, as compared with 11 and 6 per cent of total production in 1961). There, again, somewhat higher investment costs per unit of output means that the developing countries will absorb higher shares of total investment in those industries (52 per cent).

Investments in primary wood production

79. The estimates of capital input in logging refer to the cumulative investments needed to expand harvesting capacity sufficiently to bring about the estimated increase in removals. The capital is intended to cover costs of enumeration surveys, logging equipment,[13/] forest camps and secondary logging roads.

13/ Equipment for felling, extraction, yarding and loading.

80. With respect to forest management, the estimates which follow cover only the increased capital input which can be expected between 1961 and 1975 over and above the current level of investments in forests already under regular management. It should be borne in mind that because of the continuous and long-term character of the forestry production process, much of this investment will materialize in the form of additional wood production only after 1975. But equally much of the additional output of wood during the period 1961-75 would accrue as a result of earlier investments. In other words, in contrast to the other stages of production considered earlier, the capital input in forest management cannot be directly related to the concurrent increase in the output of wood.

81. The estimates include the costs of the following silvicultural measures: improvement of the basic productive capacity of the forest land (by drainage, fertilization, etc.), conversion of presently degraded forest (including coppice) to productive high forest and initial planting on non-forest lands. The costs of extending the area presently under silvicultural treatment,[14/] as well as the costs of intensifying this treatment are also included.

82. It should be appreciated that the preceding estimates of investments in primary wood production are by no means complete. No world-wide estimates have been made of expenditure for fire, insect and disease prevention, protection and control measures,[15/] nor have capital requirements for road development other than secondary logging roads or long-distance log transport been allowed for.

83. For the world as a whole an additional $US8,200 million would have to be invested in primary wood production (as defined here) over the period from 1961 to 1975. About $3,300 million of this can be expected to go into logging and $4,900 million into management. The regional breakdown of these estimates reflects strongly the differential use of the world's forest resources.

14/ Including such measures as enrichment planting, weeding, release cutting, girdling, non-commercial thinnings and pruning.

15/ The United States expenditure for the main item of this, forest fire protection, amounted in 1961 to approximately $US140 million. However, at least part of this expenditure is not a capital investment but a current expenditure.

84. The developed countries of Europe, the USSR, North America, Japan and the Pacific, which presently produce about 85 per cent of the world's industrial roundwood, are expected to maintain a large share of the additional removals (70 per cent) and they therefore account for the major part (68 per cent) of estimated additional investments in logging.

85. Because of the relatively short lifetime of most logging equipment, and the large absolute size of present harvesting capacity,[16/] investment in replacements over the period will necessarily be substantially larger than in additional capacities. For the world as a whole, <u>total</u> capital requirements in logging over the period may possibly be 8 to 9 times higher than the estimate of <u>additional</u> capital input presented in table 12.

86. The estimates of additional investments in management, which are based on forestry development plans, national forest service accounts, and other information contained in country reports, reflect planned levels of increased management activities for most countries of the world. These investments can also be expected to be allocated largely to the forests in the developed countries - the existing concentration of management and processing resources in the developed region will ensure this. Europe, with its already relatively intensively managed forests and its mounting shortage of domestic wood raw material, accounts for the major part of the additional investments - both in total and expressed per additional cubic metre of annual removals (see annex table 11). The other major wood-deficit area of the world, Japan, also ranks high in silvicultural outlay per additional cubic metre. Even in the wood-surplus regions of North America and the USSR, considerable investments are foreseen, notably in south-eastern United States and south-western USSR, although these investments seem low when expressed per additional cubic metre of annual removals. In the developing countries a continued rapid extension of the area of man-made forests is expected, and the cost of this activity will make up the main part of the capital outlay. However, silvicultural treatment of the natural forests is expected to gain in importance.

16/ Estimated additional world removals of industrial wood by 1975 only amount to about 40 per cent of 1961 removals.

87. Again, total capital requirements in forest management over the period (including the current level of investments in forests already under regular management) will be considerably higher. On a world scale the total amounts required could possibly be in the order of two to three times the estimates of additional capital requirements presented here, of which Europe can be expected to account for an even greater part than its share of additional investments.

88. The estimates presented above indicate that additional capital investments in the order of at least $US47,000 million would be needed in order to provide for the estimated increase in world requirements for wood and wood products. The majority of this capital, $39,000 million, would have to go into the establishment of new forest industries, $3,000 million would be needed for the harvesting of the wood raw material for these industries, and the residue of $4,900 million in additional investments in forest management.

89. Finally, it is necessary to recall that estimates of this nature, which rely on basic data which are often incomplete or inaccurate, must necessarily rest upon a number of assumptions, some of which may be challenged on any of a number of points. But it is believed that the estimates given approximate the broad orders of magnitude involved.

VI. SOME ISSUES AND SOME NEEDS WHICH EMERGE

90. The location of forests in relation to population concentrations, the transport volumes and distances involved in both raw material procurement and product distribution, and the technical requirements of forest industries, all combine to make the development of this industrial sector - perhaps more than that of any other - heavily dependent on progress in creating certain basic infrastructural facilities: power, water, road and rail communications, and port facilities. At first sight, this fact might seem a discouraging one for developments in this sector. There can be no doubt that in the past it has had an inhibiting effect. Governments and private entrepreneurs, attracted by the idea of valorizing a particular forest resource by establishing a major forest industry unit, have often renounced the undertaking once it was realized that it would be

necessary to create those forms of social overhead capital which already exist in the industrially advanced countries. The cost of providing these facilities, when shouldered entirely by an individual project, would add perhaps 50 per cent to the cost of investment.

91. Today the situation has radically changed. Not only has the concept of industrialization as a conscious and organized process won full acceptance in the developing countries, it is understood that successful industrial development can take place only if Governments deliberately set about creating the necessary infrastructure. The important thing from the planning standpoint is that infrastructural investment plans should take full account of the forest industry development possibilities they can provide. This applies when mapping out new roads and railways, siting power stations and power lines, or developing new or improved port and harbour facilities. Not only can judicious planning help to bring new forest industries into existence, the industries they generate will often represent the first major financial return on the infrastructural investment undertaken. In some cases, they may provide the decisive element in determining whether to undertake a particular infrastructural investment or not.

Planing for specific areas

92. While there are certain forest industries that must clearly have a national range in order to prosper, there are other branches which can successfully operate on a smaller scale. From the standpoint of economic development (including industrialization), there is much to be said for studying the forestry and forest industry development possibilities of a country not simply in terms of the country as a whole, but also in terms of defined forest-economic areas within it. These areas should be defined not simply on the basis of existing or potential forest resources, but also by taking into account population concentrations, other physical endowments, current and future claims on the land, and so forth. This approach can be helpful in assuring a clear orientation of the aims of forest policy in each area. Thus, certain areas will be clearly marked to become principal wood reservoirs for major forest industries serving the whole country. In others, an ordered transfer of forest land to agricultural use, while retaining sufficient land under forest to supply industries serving local needs

and to assure maintenance of non-crop utilities, can be permitted. Finally, there will be areas where the main emphasis will have to be placed on protective forestry, with forest industries playing a subordinate and perhaps negligible role.

Economic integration

93. Some developing countries, oppressed by the prospect of a steeply rising import bill for forest products, have already resolutely undertaken programmes of forestry and forest industry development, and a careful examination of these programmes suggests that in one or two cases national self-sufficiency in forest products is the implicit, though seldom explicit, ultimate goal. The programmes already established do not overlook the fact that, in some instances, certain commodities produced from the indigenous forest resource will find difficulty in competing on even terms with the products of the industrially advanced countries. Justification is found in the pressing need to save foreign exchange, in the fact that industrialization in any sector is unlikely to succeed without a measure of protection, and perhaps even in the fact that a vigorous forestry programme is required in any case to assure the flow of non-crop utilities of the forest. Sound as these arguments may be, it would be a serious mistake to suppose that they can be held to justify the goal of self-sufficiency in forest products in all instances.

94. Moves toward economic integration among the less industrialized countries can favour the development of certain industries by extending the market and thus overcoming the obstacle presented by small national markets in branches of the industry where scale economies are pronounced (such as newsprint and chemical pulp). This in itself is a very strong argument in favour of the confrontation, and if necessary, adjustment, of national plans for forest industry development on the part of countries participating in economic integration schemes. Indeed, without such confrontation and adjustment, there is danger that mutually inconsistent plans may be pursued and the avowed aims of economic integration frustrated.

95. But small national markets and economies of scale are not the only reasons for giving special attention to the forest industries within areas of economic integration. In the less developed countries, where economic integration schemes are already moving forward or are at present being discussed, there is often a wide disparity in the natural forest endowment and in the suitability for growing different types of timber. Moreover, there is often a large measure of complementarism in the nature of the forest resource held by different countries within the area, for instance as regards short-fibred and long-fibred material for paper making. It is only common sense that these disparities, and this complementarism where it exists, should be taken into account in any mutual agreement on these national development plans which will make for optimum regional economic development. The advantages lie partly in the programmed international division of labour, partly in securing the optimum utilization of the region's forest resources. In many cases, the adoption of national self-sufficiency in forest products as the goal to be achieved will mean deliberately forgoing these advantages.

An organisational need

96. Whatever the role that may be accorded to public and private enterprise, respectively, in developing forest industries, there is, and must always be, an indissoluble link between the development of this sector and the forest resource on which it is to be based. This argues the need for a specially close and intimate relationship between those authorities responsible for the forests (usually the forest service, a department of the Ministry of Agriculture) and those responsible for planning and encouraging industrial development.

97. It is a regrettable fact in most developing countries (and for that matter in several more advanced countries) that as yet no effective link exists. That this has led in many cases to reckless and wasteful use of the forest resource is widely recognized; its legacy is felt in the significant proportion of total forestry effort which has now to be devoted to what are essentially rehabilitation measures. What is perhaps less widely understood is that this lack of effective collaboration has been largely responsible for the failure to recognise, plan and bring to

realization very many sound and feasible forest industry projects. There is the further and real danger of industrial enterprises being established without adequate steps being taken to safeguard and secure their future supplies of raw material.

98. It is idle to imagine that this situation can be remedied merely by establishing formal links. If foresters, forest utilization officers, industrial economists and development planners are to reach a mutual understanding of each other's problems and to explore creatively the development opportunities that lie in the forests, working contacts must be multiplied at all levels. These are the considerations which have led some countries, in which forest industries already play or are clearly destined to play a leading role, to concentrate responsibility for forestry and forest industries in the same Department or Ministry. This solution is not likely to be universally valid; but the problem of achieving an organic and creative working relation between the two sectors has to be solved if a vigorous programme of industrial development based on the forest is to be realized.

The choice

99. Forests have a great potential as a source of human welfare, and industrialization based on the forest can both contribute to and promote the general economic development process. If the forest is to fulfil its role, however, there must be exact knowledge of the resource, the forest must be brought under proper management, working plans must be devised, and extraction schemes worked out. Only thus can the resource base of industry be made secure. But these tasks require strong and effective forest administrations, and today forest services in many developing countries are still extremely weak.

100. It is an illusion to suppose that there exists a choice between mobilising the forests now, and leaving them intact until forest services have been built up to the point where it is safe to open the forest gate. The technical and economic conditions for establishing new forest industries in the developing countries are maturing fast. In the course of the coming years many new areas of forest are inevitably going to be brought into use. The choice is between mobilization in

the public interest based on sound planning and with adequate safeguards and with the Forest Services taking an active part and being built up in the process, and mobilization taking place in an uncontrolled and haphazard way, while weak Forest Services stand by helpless. This is the real choice.

101. It is in making this choice that the responsibility of government is engaged. For this is not a question which concerns a Forest Department alone; it concerns Ministers of Agriculture, Economy, Industry and Trade; it concerns Planning Departments and Development Agencies; it concerns Finance Ministries and Budget Bureaux. Only concerted action on the part of all departments can ensure that forest industries play their part in the attack on economic under-development, and that the immense contribution which forests, rightly used, can make to the development process is fully realized.

VII. MISCELLANEOUS AND SECONDARY FOREST INDUSTRIES

102. There are many industries other than sawmilling, pulp and paper and wood panels which are based on raw materials of forest origin. Though some are little more than extensions of the sawmilling and veneer industries, they may be separately established, particularly where the existence of a suitable resource or the needs of a consumption centre make this advisable. In some instances the raw materials may even be imported.

103. Some of these forest industries have a direct impact on agricultural development. One example is the production of packaging materials. Wooden crates and boxes are widely used. Investment requirements for box-board production are generally low, compared with the production of plywood boxes, or corrugated paperboard and multi-wall sacks. Wirebound veneer containers are extensively used for export fruit packaging; since relatively small diameter logs can nowadays be economically used for veneer and plywood production, the industrial production of such containers is attractive. For tea packaging, plywood chests have been traditionally used. Formerly, all of the plywood had to be imported, but India and Ceylon now have sizable plywood mills and produce substantial quantities of tea-chest plywood.

104. The use of corrugated board boxes for fruit packaging continues to increase (in the United States their share rose from 5 per cent in 1950 to 50 per cent

in 1960). Such boxes are also suitable for the packaging of tropical crops, but sulphate pulp and liner board, from which they are made, are normally manufactured in large industrial units.

105. In most developing countries, wood is an inexpensive, locally available raw material for the construction of rural housing, for storage facilities and for many other uses related to agricultural production. Developments in wood preservation have made it possible to use many wood species which hitherto have been considered non-durable. Investments required for sawmills, preservation and wood manufacturing facilities are low, and they can easily be established in the rural areas themselves. On the other hand, larger industrial units of this kind may also be established. Prefabrication of building and construction elements is frequently integrated with the sawmilling or wood-based panels industry.

106. Wood-based panels, in particular plywood, are now produced in many developing countries or are available at reasonable cost. Exterior type plywood withstands rigorous exposure to moisture, chemicals and manures. It is successfully used for a variety of purposes such as broiler and laying houses in the poultry industry, hog and calf houses and dairy structures, and also in large storage structures for grain, silage, fertilizer and fruit.

107. Wood turning, with handles for agricultural implements and sports goods, woodenware and spools as principal products, are a further example of the great variety of industries based on raw materials of forest origin. The manufacture of match blocks in the form of sawnwood or veneer is another. Small plants (or units within larger plants) are suitable for producing shingles, pencil slats and briarwood pipe blocks, often for export, where appropriate raw materials are available.

108. The chemical distillation of wood yields a variety of products, the more important of which are charcoal and methyl or wood alcohol. Charcoal alone may be produced by simple pit methods requiring no capital. The other products are, of course, lost in this case.

109. A number of extractives from wood and bark provide the raw material for several small but important industries. Some species of pine are suitable for the tapping of a resinous exudate used for the manufacture, by a distillation process, of turpentine and resin. A considerable amount of labour and little

capital are required in the industry. The trees may also be used for their timber. The production of tannins for the leather industries may be based on a great number of woody and herbaceous plants.

110. The final group of industries to be briefly summarized here are the secondary wood industries, which use as their raw materials the products of sawmills, plywood and veneer plants and board mills. They may be closely associated with mills producing their raw materials or may, in contrast, be widely decentralized near consuming centres. Among the more important of the secondary wood-using industries are furniture manufacture; joinery plants producing such things as doors, window sashes, and moldings: boat-building; manufacturing of vehicle bodies, etc. These industries tend as a group to be labour intensive - calling for a wide range of skills - and to use relatively high-cost raw materials. Capital requirements are generally modest to low. Plants can often be small and decentralized, but there are some economies of scale for the more mechanized. Even in countries with little or no forest resources they can be operated on imported materials saving appreciable foreign exchange on the value added. Many wood-deficient developing countries are now importing products of the secondary wood and paper industries to a value in excess of their imports of all other wood and paper products.

ANNEX

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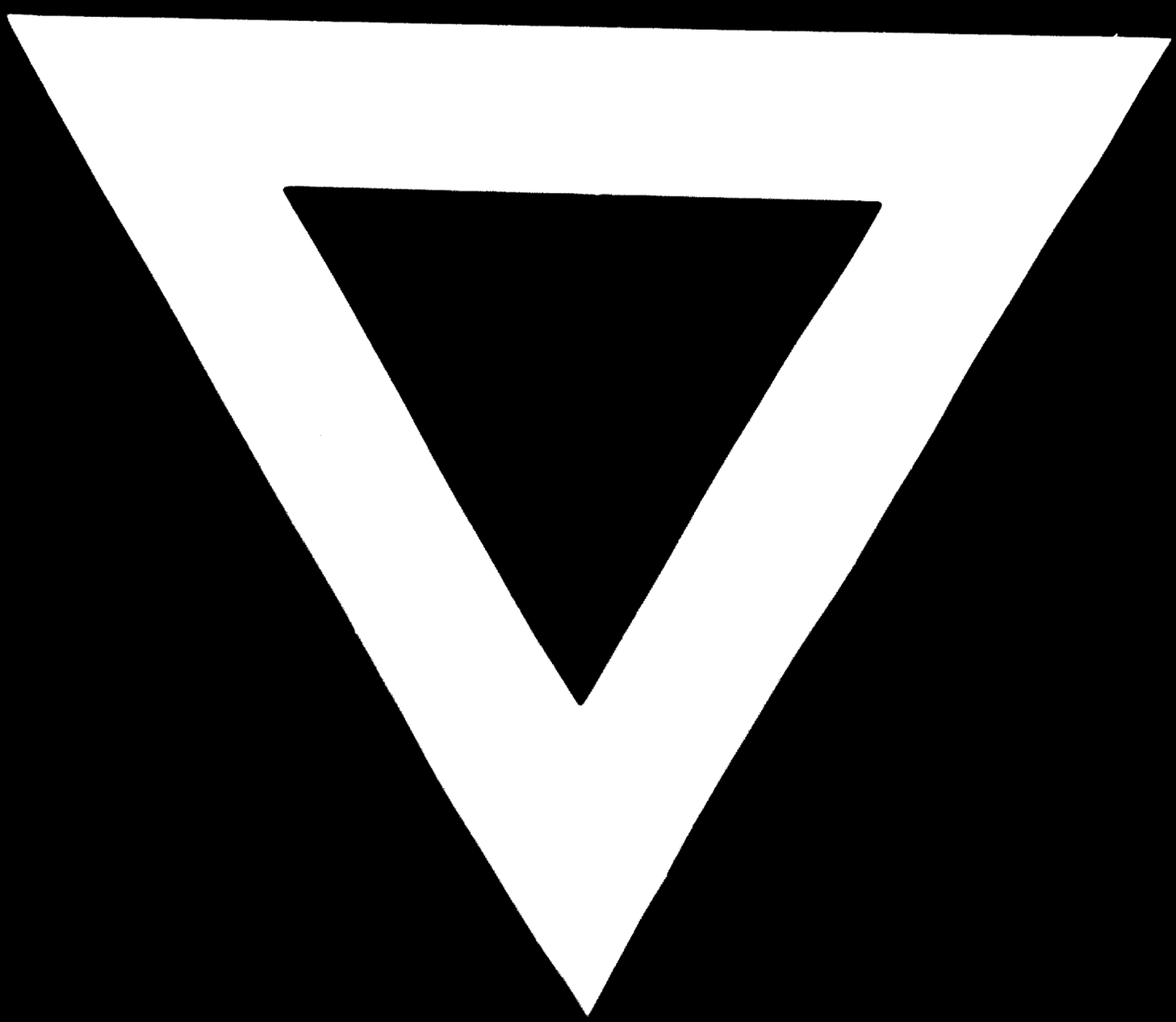

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