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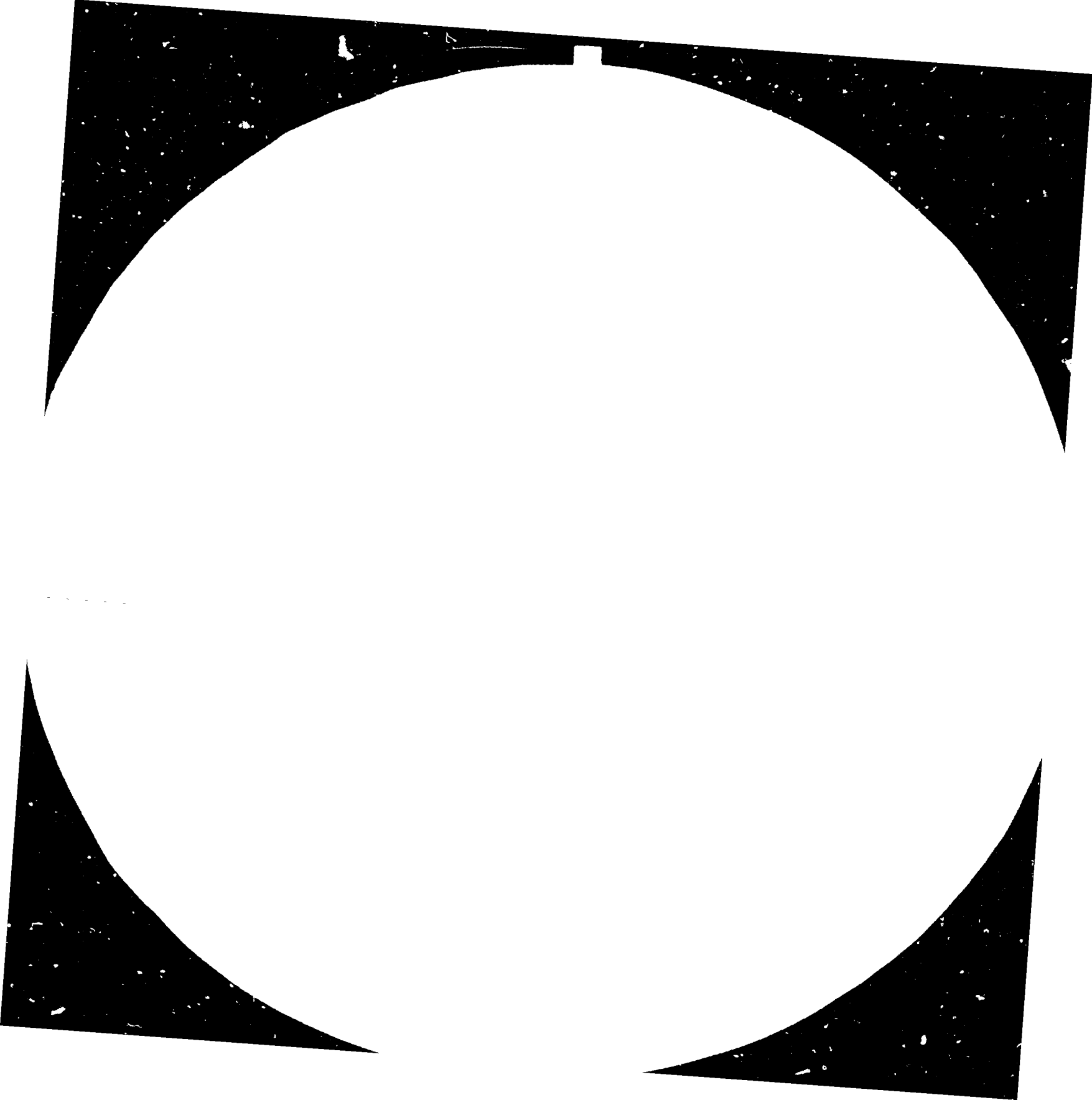
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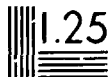
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The development of primary and secondary
wood-processing industries *

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I. RESOURCES AND PRODUCTION

1. About half of the world's area of closed forest and other woodlands - which is presently estimated at about 4.000 million hectares - and 63 % of the standing volume are located in the developing world. However, in 1978-80 the share of developing countries in world production of primary processed wood was 17 % for sawnwood and 12.7 % for wood-based panels compared with 1968-70 (12 % of the world production of sawnwood and 8 % of wood-based panels). ^{1/} Data on the share of developing countries in secondary processing is not available but it is certainly much lower.

Table 1

FOREST RESOURCES
(million ha)

1980

	Area (million ha)	Standing volume (million of m ³)
Developing countries	2.215 (53.7 %)	161.000 (62.6 %)
Developed countries	1.910	96.000
Total	4.125	257.000

Source: Balancing supply and demand worldwide by the year 2000 through resource management, FAO, March 1983, p.12.

PRODUCTION

1980

	Industrial roundwood	Sawlogs and vener logs	Sawnwood	Wood-based panels
(in million m ³)				
Developing countries	294 (21 %)	190 (29.2 %)	77 (18 %)	13 (12.8 %)
Developed countries	1.099	651	352	88
Total	1.393	841	429	101

Source: FAO, Yearbook of Forest Products.

2. The production of sawlogs and veneer logs in developing countries increased by 47 % between 1968-70 and 1978-80. At the same time, the share of logs in total developing countries' log production destined for export in unprocessed form fell only slightly from 25.9 % in 1968-70 to 23.3 % in 1978-80. ^{2/} However, there exist very marked regional differences: half of the logs produced in the Asia-Pacific region were exported, only one third in Africa and practically none in Latin America.

^{1/} According to UNIDO's statistics developing countries participated in 1979 with 11.5 % in world value added of the wood and cork sector compared with 9.8 % in 1970. See Handbook of Industrial Statistics, UNIDO, ID/284, 1982, p.8.

^{2/} An annual average of 42.5 million m³ of non-coniferous saw and veneer logs have been exported from developing countries during 1976-80.

3. Production of sawnwood and plywood in developing countries grew at very high annual rates during the last decade - 5.0 % and 13.2 % annually respectively. However, this growth was very unevenly distributed, since most of the growth in plywood production took place in the in-transit processing countries (Republic of Korea, Taiwan, Province of China and Singapore), which in turn exported a large part of their production.

The advantage of local processing

4. The principal advantage of processing near the source of logs is that it eliminates the need to transport a very heavy and bulky raw material - including some material which will end up as waste - over long distances and incur costs of multiple handlings before initial manufacture.

5. A recent study from the World Bank focuses on the cost advantages of increased processing in South-East Asia and highlights the benefits which log-exporting countries might derive from increased processing. These comprise: a) increasing domestic value-added, b) increased foreign exchange earnings, c) employment effects and d) regional development effects.

6. An indication of gross value-added to log material by processing can be obtained through the differences between the FOB export unit values for logs and the log equivalent FOB unit values for processed products. On this basis the World Bank study estimates that for Indonesia, Malaysia and Philippines the value-added (as defined) is equivalent to 23-65 % of the log export unit value for sawnwood and 26-150 % for plywood. ^{3/} However, this calculation neither does take into account the loss of resource rents which are collected in the form of local taxes nor leakages (domestic and foreign). The results of UNCTAD's calculations on gains in gross added value are shown in Table 2.

Table 2
SUMMARY OF GROSS ADDED VALUE (G.A.V.)
IN WOOD-PROCESSING
(US dollars per cubic metre)

<u>Country</u>	<u>Log price</u>	<u>Sawnwood</u>		<u>Plywood</u>	
		<u>Price ^{a/}</u>	<u>G.A.V.</u>	<u>Price ^{a/}</u>	<u>G.A.V.</u>
Indonesia	46.4	62.3	15.9	214.9	168.5
Malaysia	43.0	68.6	25.6	103.3	60.3
Philippines	65.8	81.8	16.0	94.4	28.6
Papua New Guinea	35.6	76.3	40.7	250.2	214.6
Total, Asia ^{b/}	47.7	73.6	25.9	124.8	77.1

Source: Prospects for the Expansion of Timber Processing Activities in Developing Countries, UNCTAD, TD/B/IPC/Timber 37, Geneva, 1982. Based on Takeuchi, op. cit.

^{a/} Average unit export price after conversion into log equivalent.

^{b/} Including exports from log-importing processing countries such as Singapore and the Republic of Korea.

^{3/} K. Takeuchi, Mechanical Processing of Tropical Hardwood in Developing Countries, World Bank, Division Working Paper No. 1982 - 1 Jan. 1982, p.75.

7. Foreign exchange earnings in the case of plywood production for export have been calculated by the same author to be over 100 % of the roundwood equivalent cost. Referring to Indonesia, with an FOB price of plywood of US\$ 170 per m³ in roundwood equivalent compared with a log price of \$ 80 per m³, this would imply an additional value of \$ 90 per m³ for roundwood equivalent. The obvious assumption underlying this reasoning is that processed products are actually sold in the international market at remunerative prices. Besides, leakages will occur in the form of foreign exchange costs for machinery, inputs and remittance of profits in the case of foreign equity, thus reducing the net effect on the balance of trade.

8. Employment effects have been calculated to be around 14 persons per 1,000 m³/annum of plywood and up to 6.0 persons per 1,000 m³/annum of sawnwood for South-East Asia. ^{4/} The potential of this sector in the creation of employment has not yet been effectively realized in many developing countries. Employment in forestry and logging of industrial wood was estimated to have been in 1975 of 2,9 million man-years and of 3,6 million man-years in the primary industries producing sawnwood, panel products, pulp and paper. ^{5/} Any increase in production or shift of production from developed to developing countries would have far reaching effects on employment. This would be specially the case in secondary processing, which as a whole is more labour intensive than primary processing.

9. Another factor pointed out is that the establishment of processing facilities in remote areas will have a significant impact on employment and industrialization in regions which are otherwise out of reach of the market economy.

10. However, developing countries are faced with a number of constraints if they intend to get into further processing. These are, among others, the following: ^{6/}

- a) Presently undeveloped and often small domestic markets due, inter alia, to prejudices against the use of wood (e.g. in construction);
- b) Lack of a long-term raw material supply, due to the absence of a long-term forestry strategy, deforestation and insufficient use of commercially less accepted species;
- c) Lack of skilled labour capable of operating and maintaining the equipment and of middle management;
- d) Inadequate selection, maintenance, adaptation and development of equipment;
- e) A low recovery rate and inadequate use of residues as raw materials for other products or as fuel;
- f) Lack of applied research in the properties of commercially less accepted species;
- g) Inadequate road infrastructure and port facilities;
- h) High domestic and international transport costs, especially in shipping;
- i) Lack of marketing channels for exports of processed products to developed countries;
- j) Tariff and non-tariff barriers in both developed and developing countries.

^{4/} K. Takeuchi, op.cit., p.79.

^{5/} Agriculture toward 2000, FAO, c/79/24, Rome, 1979, p.125.

^{6/} Conclusions of the regional preparatory meetings for Asia, Africa and Latin America, see documents ID/WG.371/16, ID/WG.373/12, ID/WG.380/13, UNIDO, 1982.

II. ON THE ESTABLISHMENT OF WOOD-PROCESSING INDUSTRIES

11. Increased per capita incomes and a growing population are expected to more than double the local demand for wood products in developing countries from now to the year 2000. Demand for sawnwood is expected to grow by 95 %, for wood-based panels by 200 %. ^{7/} This will increase the total amount of industrial wood used for domestic consumption in developing countries from 150 to 285 million m³ and augment the pressure on the available raw material. Besides, the need to meet the growing housing deficit with (among others) wood building materials will increase the domestic demand of wood in developing countries.

12. On the other hand, the demand in developed countries is expected to grow at a somewhat slower pace, but the reliance of many developed and developing countries on imports of wood will increase in the years to come. According to a scenario elaborated by FAO, the trade of wood and wood products would nearly double from 1974-76 to the year 2000. Even admitting that those figures are based on very high growth rate assumptions, the deficit will be covered by increased imports from developing and East European countries. ^{8/} Regional imbalances among developing countries will also increase, which will add to the intra-regional trade of these products. Table 3 summarizes the main trends.

Table 3
PRODUCTION AND TRADE IN WOOD AND WOOD PRODUCTS

<u>Region</u>	<u>(million m³)</u>		<u>Net Trade</u>	
	<u>Production</u>		<u>of industrial roundwood</u>	
	<u>1974-76</u>	<u>2000</u>	<u>1974-76</u>	<u>2000</u>
WORLD	1.326	2.085	-	-
Developed Market Economies	704	1.093	- 75	- 130
North America	436	642	+ 44	+ 48
Western Europe	200	320	- 60	- 75
Oceania	21	58	+ 2	+ 27
Japan	36	58	- 59	- 118
Other	11	15	- 2	- 10
Developing Market Economies	193	365	+ 41	+ 80
Africa	33	60	+ 5	+ 17
Latin America	59	124	0	+ 15
Far East	87	161	+ 41	+ 61
Near East	14	20	- 6	- 13
Centrally Planned Economies	429	627	+ 34	+ 50
USSR and E. Europe	372	531	+ 34	+ 50
Asia	57	96	0	0

Source: World Forest Products, Demand and Supply 1990 and 2000. FAO, Forestry Paper No. 29, Rome, 1982.

^{7/} Balancing supply and demand worldwide by the year 2000 through resource management
FAO, ID/WG.395/6, 1983, p.12.

^{8/} ibidem, p.17.

13. Some wood producing countries in the developing world have formulated and are implementing policies to increase domestic processing and to promote exports with high value-added. In the case of Asia, Indonesia's efforts to increase plywood production and its reduction of logs exports will undoubtedly affect the regional scene. On the other hand timber deficit countries are experiencing difficulties to maintain production levels due to shortages in raw material. This is the case in Japan, Republic of Korea, and Taiwan Province of China, but also in developing countries like India, Thailand, Algeria, and others.

14. This new situation of reduced availability of raw materials and of increased domestic processing in resource rich countries gives scope for new forms of international co-operation. While satisfying the legitimate wish of producing countries for more value-added local production, they could ensure to importing countries the supply of wood in unprocessed and semi-processed form. Importing countries could provide capital, know-how, equipment and training and in return ensure the supply of wood in semi-processed form.

15. On the other hand developing countries might find it useful to enter marketing or management arrangements with partners from developed and other developing countries to make use of the existing distribution channels or of managerial know-how. These new forms of co-operation should be compiled and developing countries should be made aware of them.

16. A certain division of labour is bound to emerge in which both developed and developing countries will have to decide in what products they are going to specialize. The unimpeded operation of competitive market forces might create a situation of over-production harmful to the aims of developing countries. Complementary agreements between producing countries establishing specialization patterns might be a way to cope with such a complex situation.

Development planning in the wood-processing sector: The choice of the degree of processing

17. On the basis of an assessment of the availability of raw material, the markets, the existing physical infrastructure and the manpower available, a decision has to be made on a governmental and/or entrepreneurial level on the degree of processing which is sought and as a consequence on production lines, capacities and technologies. The range of products can go from rather simple primary products like sawnwood and plywood, to more sophisticated ones like the different types of particle board and fibreboard. For secondary processing the production of building components (parquets, panel and flush doors, windows and window frames), other joinery products and all types of furniture, as well as packaging material has to be considered. Also, the

degree of horizontal and vertical integration desirable is to be considered to make use of the large amounts of residues - around 50 % of the total roundwood input - which in developed countries are converted into various products, but have yet to find a market in developing countries.

18. Sawmilling is the natural first step in the development of forest industries. It is the least capital intensive among primary wood-processing industries and most flexible with respect to economies of scale, degree of mechanization and complexity of technology. In developing countries this industry is characterized by low recovery rates from the wood material, ranging between 25 and 40 % instead of the 50 to 70 % generally obtainable from developed countries. This is due to the lower quality logs used, the scarcity of skilled personnel, especially of saw doctors, head sawyers and maintenance mechanics and to the low precision of the equipment used.^{9/} The limited absorption power of the local market for short and narrow sawnwood also contributes to the lower yield.

19. Plywood is the first wood-based panel to have been developed and still accounts for about 40 % of the volume of all wood-based panels produced around the world. Plywood and veneer have the highest requirements from the wood raw material among all primary forest products. Over the decades, however, the continuous growth in production led to the general depletion of the high quality and large size logs on which the plywood industry was traditionally based. The trend is world-wide, but the degree of its influence on the industry varies depending on the size and type of forest resources in different regions of the developing world. One of the problems of the plywood industry arises from the lowering of quality of the wood raw material which requires in depth adjustments or changes in the technology. Other main problems are the scarcity of qualified personnel, especially skilled operators, maintenance personnel and technicians.^{10/} Many developing countries are at an advantage if compared with developed countries regarding the quality of the raw material available.

20. During recent years, technologies of particle board manufacture allowing the use of a more diversified raw material base have been adapted to the specific needs of developing countries with an abundance of labour and limited markets for the products. Several models of such labour intensive, small-scale plants have been developed by engineering companies and equipment suppliers. Particle board mills are usually offered by equipment suppliers or specialized engineering companies on a "turn-key" basis. The suppliers also offer the training of personnel. The proper formulation of guarantees for quality and quantity of production and utilization of various inputs is particularly important in view of the high cost of such turn-key plants. There are

^{9/} J. Swiderski and G. Heilborn, Mechanical wood-processing industries in developing countries, Problems - Causes - Search for solutions, FAO/UNIDO, ID/WG.395/5, para.2.

^{10/} For a discussion of the problems arising from plywood industries' development programmes, see J. Swiderski and G. Heilborn, op.cit., para.84.

now numerous examples of outstanding particle board operations which show that there is scope for the development of this production in developing countries.

21. Fibreboard, like particle board, can be produced from a wide range of types of wood and wood residues, some sawdust can also be used. Softwoods and hardwoods are acceptable, separately or in mixture. Unlike particle board, fibreboard production is less sensitive to the density of wood. ^{11/}

22. The last decade has seen the development or expansion of new types of particle board: cement-bonded particle board, waferboard, thin particle board and oriented strand board (OSB). Thin particle board and cement-bonded particle board are already produced in developing countries. All types of these "new" panels could find a set of conditions in certain developing countries under which they could make a useful contribution to their economies. In each case, however, economic and technical aspects of their manufacture and uses and particularly their market acceptance have to be carefully examined and fitted into the general plans of forest industries development.

23. The furniture and joinery industry is highly fragmented and composed of units in widely ranging sizes. The existing levels of technology range from the hand tools stage to mechanized and conveyORIZED factories, although the last case applies mainly to export-oriented firms. The small series production, which is run more on an artisanal rather than industrial base, leads to a costly and low-quality product. Much of the effort to upgrade these industries will have to be directed towards improving the type of machinery used, its maintenance and the training of middle management, professional designers and machine operators.

24. The use of wood in construction and housing is facing specific problems related to the fact that wood is not used only for its appearance but also for structural purposes. This makes processing techniques different from the ones used in other wood-processing industries. The use of wood in construction in developing tropical countries faces deterioration problems due to the climate and fungi, which makes the need of research and use of preservation treatments more acute. Also, the range of species available for the use in construction is wider in developing countries and calls for increased knowledge about their mechanical properties. ^{12/}

The need to integrate wood-processing activities

25. To enable the most rational use of the wood raw material the wood-processing industries development plans should incorporate to the extent possible the possibility of manufacturing various types of products within one processing complex. Such

^{11/} On examples in developing countries, see J. Swiderski and G. Heilborn, *op.cit.*, para.130.

^{12/} For the use of wood in construction, see M. Tejada, Promoting the use of wood in construction, UNIDO, ID/WG.395/2, 1983.

integrated operations may comprise plywood production combined with sawmilling and a particle board or fibreboard mill or the integration of primary (sawnwood, panels) with secondary processing activities (joinery, furniture). See Annex I.

26. There is a major difference between a timber processing factory where several production lines are simply set up one next to another and an integrated timber complex because it means that such different production lines are not only existing next to each other but there is also a vertical and/or horizontal integration of such production lines. The intentions of doing it are to provide for the best possible use of the most valuable raw materials and securing the maximum of added value by:

- a) The widest possible utilization of the available raw material;
- b) The utilization of residues of one production line as raw material for another product;
- c) The utilization of semi-finished or finished products out of one production line as base or intermediate product in another line.

27. Developing countries with limited wood resources and small markets can justify the establishment of wood-processing centres with only small capacities. Integrated complexes comprising small sawnwood and plywood centres producing a variety of wood products and using common facilities for power generation, maintenance, etc. exist already in several developing countries and are successful both technically and economically. ^{13/} Actions should be undertaken by the appropriate international organizations to disseminate the existing experience and to encourage the establishment of integrated wood-processing centres.

III. TECHNOLOGY, CHOICE AND ADAPTATION

28. The technological gap between developed and developing countries has been increasing dramatically in the last years with the introduction of computerized and automated production systems. Some of the new technologies used are intended mainly to reduce labour utilization and they may not be advisable for developing countries. Others, however, will increase yields and quality in such a manner that they cannot be neglected by developing countries if they want to remain competitive. More often than not, firms in developing countries rely on the recommendations of machinery suppliers for the choice of technology, which, of course, does not provide the machinery and equipment buyer the desired latitude to determine what is best appropriate for his needs from among the various technologies available in the market. Developing countries require guidance in the choice of the most appropriate technology and machinery by impartial international organizations.

^{13/} J. Swiderski and G. Hellborn, op.cit., p.88.

29. On the machinery to be used for tropical hardwoods it can be said that machinery with feed rates and cutting speeds appropriate for processing of tropical wood have been designed and are now widely used in both developed and developing countries.^{14/} The development and current use of tungsten-carbide-tipped (TCT) saws, bits and knives in both developed and developing countries, have further complemented the array of available machinery and equipment for processing tropical wood. Thus, within the sphere of current industry needs, machinery and cutting tools specifications should not pose a problem to the development of the wood-processing industry in developing countries. Problems should be expected, though in the proper use and maintenance of the machines and cutting tools.

30. Some countries have already started with the local production of machinery and equipment for the wood-processing industry. The degree of precision and sophistication is lower than those produced in developed countries, but in many cases the equipment is better adapted to local needs and the cost is considerably lower. Besides, many developed countries are phasing out the production of simpler equipment, which might be produced in developing countries under joint-venture or licensing agreements.

IV. TRAINING

31. Few of the developing countries are in a position to train the skilled machine operators and supervisors necessary to operate machinery in an efficient way. As mills become more complex, and they will become so, the need for well trained technicians will increase. Training for secondary industries is currently more often than not for craftsmen, not machine operators.

32. Current training facilities for the middle and upper management levels in the industry are inadequate, if non-existent, in most developing countries. Thus, industry development programmes in wood producing countries very often suffer serious set-backs as a result of lack of adequately trained middle higher management personnel. The more advanced developing countries have realized the importance of a solution to this problem, and have availed themselves to the management personnel training assistance programmes offered by international or regional organizations--such as the Asian Productivity Organization based in Manila, and Technonet-Asia base in Singapore. Also, the ANDEAN Pact nations have provided for the installation of training facilities

14/ H.P. Brion, Current status and future development of the secondary wood-processing industry in developing countries, UNIDO, ID/WG. 395/4, 1983, p.37.

to meet the needs of their growing wood and wood-processing industries. However, in African developing countries such plans still have to be implemented.^{15/}

33. Action in this field, both in primary and secondary processing should be oriented towards the establishment - or use of existing - training centres, preferably attached to outstanding vocational schools, which should be of sub-regional character in the case of plywood industry, and also for the sawmill industry in smaller countries. Often on-the-job training is the only available form in developing countries to obtain training, and international assistance will be needed to find the best ways to carry this out. Training institutions of regional character are also needed for secondary processing, especially for machine operators, technicians, designers, product engineers and middle management.

34. The natural choice of location for such centres would be countries with strong and diversified wood industries, which could provide on-the-job training,^{15/} and which could be used, after negotiations, by international organizations as venues for regional courses.

V. RESEARCH AND DEVELOPMENT

35. Research and development in forestry has been traditionally centred around silviculture and subjects related to it, like tree breeding, soil conditioning, pest control and the like, and around timber utilization and its connected subjects, such as ascertaining the physical, chemical and mechanical characteristics of timber, and its suitability for specific end-uses. In the last decades, the development of new panels have revolutionized wood utilization and created new exacting demands on the knowledge of wood properties and behaviour in processing and use.

^{15/} H.P. Brion, op.cit., p.25.

^{16/} For further details, see J. Swiderski and G. Heilborn, op.cit., paras. 18-22 and 75-82.

36. Most research institutes connected with forest products are still located in developed countries and the research undertaken is oriented mainly towards the local temperate zone timber species. Although a lot of research has been done on tropical species, this was limited to the main species in demand and on properties related to the specific uses in consuming countries.

37. In some developing countries research and development have been conducted and are being conducted on the physical, seasoning and mechanical properties of tropical hardwood species. Some developing countries, individually or in co-operation with neighbouring countries (e.g. the ANDEAN Group, in South America) have investigated the possibilities of using commercially less accepted species of timber in housing and other structural uses. The investigation of properties and potential end uses of solid tropical timber (with special attention to the commercially less accepted species) will undoubtedly be the main forms of research in the next years. However, the list of other subjects on which research is needed is long and includes non-traditional woods (like rubberwood and coconut) grouping of species for structural end uses, stress grading, preservation treatments, development of low-cost drying kilns, production of adhesives, etc. and could easily be expanded.

38. Since resources are scarce, there is ample scope for international co-operation between developed and developing countries and also among developing countries themselves. Research programmes aimed at solving the problems of developing countries in this sector should be promoted in the research centers of developed countries. There is a need for effective systems for dissemination of available information and on the results of research and development programmes. These objectives will be more easily attained through increased regional and interregional co-operation, ensuring at the same time an adequate linkage with the industrial sector. A possible action in this area would be the establishment of regional systems of technical information and co-ordinated research programmes through a more rational use of existing facilities, and involving actively local and regional associations.

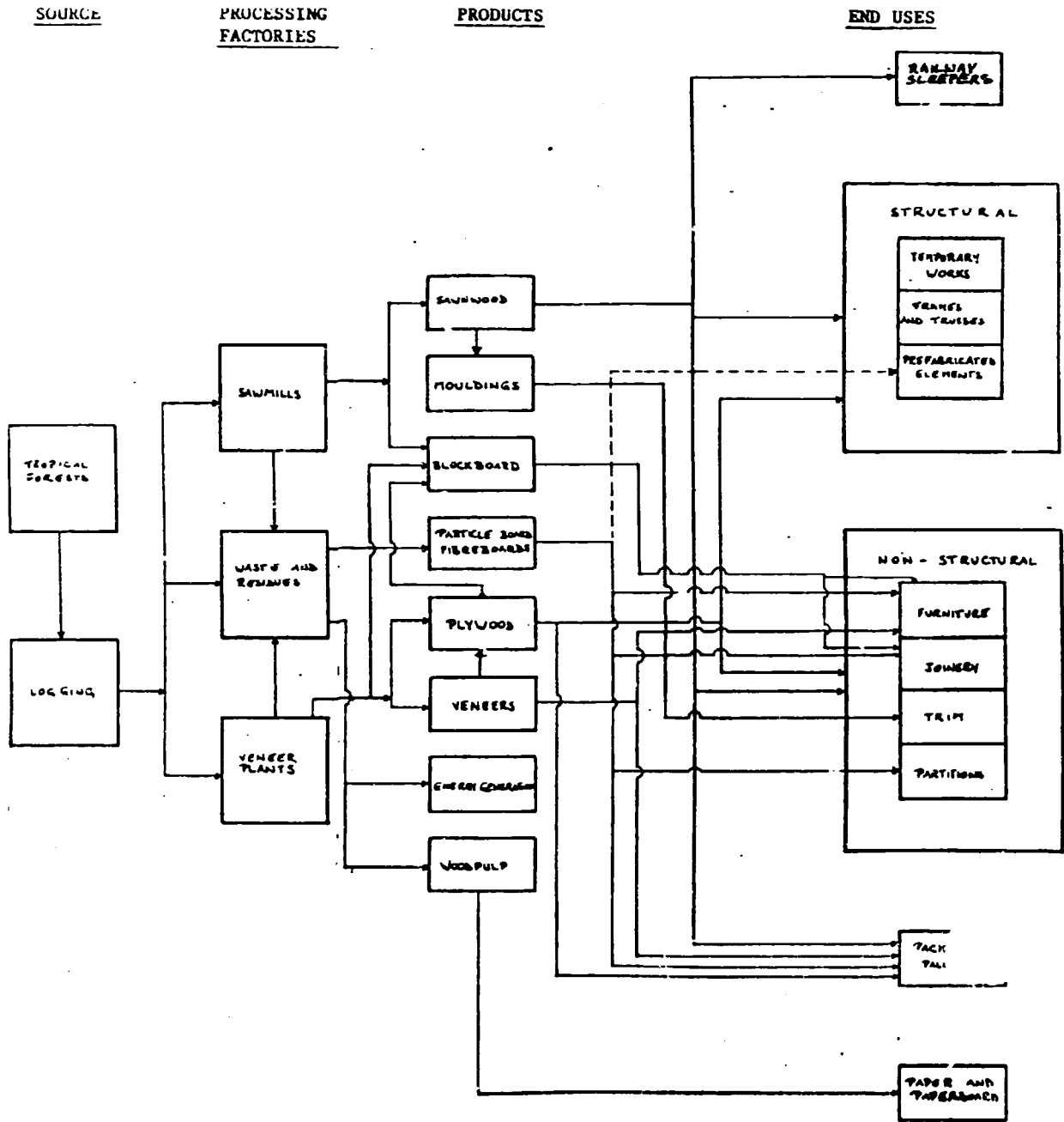
Points for discussion

Participants are invited to devote special attention to the following points:

- (1) To what extent the international environment is conducive to enable the resource rich developing countries to enter or increase the processing of wood in order to meet the needs of domestic and international markets in wood and wood products ?
- (2) What type of collaboration arrangements would be required in order to stimulate mechanical processing activities in developing countries, with particular reference to assurances of supply, processing and marketing of products, development and adaptation of technology, selection and production of machinery, training of required skilled manpower, technical and managerial personnel ?
- (3) To what extent existing research and development centres (organizations) and institutions in developed and developing countries would be willing to co-operate and under which conditions this co-operation might take place ?

ANNEX I

PROCESSING OF TROPICAL HARDWOOD LOGS



Source: UNIDO, based on the World Bank Division Paper No. 1982 - 1 Jan. 1982, p.92.



