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**INTERNATIONAL FOREST PRODUCTS MARKET AND  
ITS DEVELOPMENT PROSPECTS**

A. Yakunin  
V. Skvortsov

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INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS  
2361 Laxenburg, Austria

## **FOREWORD**

The objective of the Forest Sector Project at IIASA is to study long-term development alternatives for the forest sector on a global basis. The emphasis in the Project is on issues of major relevance to industrial and governmental policy makers in different regions of the world who are responsible for forest policy, forest industrial strategy, and related trade policies.

The key elements of structural change in the forest industry are related to a variety of issues concerning demand, supply, and international trade in wood products. Such issues include the growth of the global economy and population, development of new wood products and of substitute for wood products, future supply of roundwood and alternative fiber sources, development of new technologies for forestry and industry, pollution regulations, cost competitiveness, tariffs and non-tariff trade barriers, etc. The aim of the Project is to analyze the consequence of future expectations and assumptions concerning such substantive issues.

The research program of the Project includes an aggregated analysis of long-term development of international trade in wood products, and thereby analysis of the development of wood resources, forest industrial production and demand in different world regions. Research is carried out in collaboration between IIASA and the collaborating institutions of the Project. This article is an overview prepared by our Soviet collaborators on historical development and future prospects of forest products trade.

Markku Kallio  
Leader  
Forest Sector Project

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## **INTERNATIONAL FOREST PRODUCTS MARKET AND ITS DEVELOPMENT PROSPECTS**

A. Yakunin and V. Skvortsov

### **1. WOOD RAW MATERIALS SHARE OF THE INTERNATIONAL FOREST PRODUCTS MARKET**

Wood raw materials play an important role in the international forest products trade. The trends of the last two decades show more rapid rates of development for wood raw materials trade than for processed wood products trade. The reason for this development lies in the increasing discrepancy between regions of wood surplus and regions with advanced wood processing facilities, but limited wood resources. Consequently, the dependence of the wood deficit regions on imports of wood raw materials has grown.

The dynamics and significance of wood raw materials trade compared to processed wood products trade are shown in Table 1 for the period from 1961 to 1981.

The international volume of wood raw material exports increased from 41.2 million m<sup>3</sup> in 1961 to 104.1 million m<sup>3</sup> in 1981, i.e., 2.53 times larger with a mean annual increase of 4.7%. For sawnwood exports increased 1.42 times, 5.1 times for pulp, and 2.92 times for paper and board. It is important to note that during the last two decades growth rates in the world trade of wood raw materials were higher than those of sawnwood and pulp, corresponding to paper and board growth rates (see Table 1).

It is characteristic that wood raw materials still dominate the world forest products market, even if *all* other wood and paper product groups are included, with the exception of sawnwood, for which the roundwood

**TABLE 1.** Comparative export data for wood raw materials and processed wood products.

	1961	1965	1970	1975	1981
<i>(A) Volumes of export</i>					
Wood raw materials (million m <sup>3</sup> )	41.2	55.2	96.4	100.4	104.1
Sawnwood, crossties included (million m <sup>3</sup> )	41.6	50.2	57.4	52.4	72.8
Plywood (million m <sup>3</sup> )	1.5	2.5	4.8	5.4	7.0
Particleboard (million m <sup>3</sup> )	.4	1.0	2.0	4.2	5.2
Fiberboard (million m <sup>3</sup> )	1.4	1.6	2.1	1.9	2.4
Pulp (million t)	9.8	12.5	16.9	15.1	20.6
Paper and board (million t)	12.8	16.5	23.4	22.9	35.6
<i>(B) Wood raw material equivalent</i>					
Wood raw materials (million m <sup>3</sup> )	41.2	55.2	96.4	100.4	104.1
Sawnwood, crossties included (million m <sup>3</sup> )	72.5	87.6	100.2	91.5	127.0
Plywood (million m <sup>3</sup> )	3.5	5.9	10.9	12.4	16.1
Particleboard (million m <sup>3</sup> )	.5	1.4	2.7	5.5	6.7
Fiberboard (million m <sup>3</sup> )	4.3	4.9	6.2	5.6	7.3
Pulp (million t)	41.6	54.2	76.4	69.2	95.6
Paper and board (million t)	34.0	43.8	62.1	60.8	104.1
<i>(C) Export costs (million dollars)</i>					
Wood raw materials	708.9	1006.8	1898.3	3751.0	6894.3
Sawnwood, crossties included	1629.8	1668.1	2687.8	4978.3	10203.2
Plywood	215.7	358.1	650.5	1205.7	2737.2
Particleboard	24.4	60.4	130.9	468.5	905.3
Fiberboard	77.2	110.5	138.9	237.8	457.5
Pulp	1204.8	1598.1	2498.4	5349.9	9234.5
Paper and board	2088.3	2686.8	4332.7	9486.6	20175.0

equivalent volume is higher. However, the cost of the international wood raw materials trade is less than that of sawnwood, pulp, and paper and board.

That the wood raw materials market expanded so quickly in spite of having the highest level of specific transportation costs per product costs of all the other wood and paper product groups proves that the wood deficit is increasing in all major wood consuming regions of the world. The only possible way to cover this shortage is to import wood raw materials. This trend is expected to develop further and sharper in the future.

Development prospects for the wood raw materials trade are directly connected with the present state of production and the international market for wood raw materials. So all the structural and quality shifts in the above mentioned spheres should be analyzed and all the forecasts of national and

international organizations should be studied in order to formulate a general logical concept as to the development prospects of wood raw materials production, consumption, and international trade up to the year 2000.

## 2. WOOD REMOVAL AND ITS PATTERN

Aggregate removal of wood in the world amounted (according to FAO data) to 3142.8 million m<sup>3</sup> in 1981 (2640.1 million m<sup>3</sup> in 1970). Over the last 20 years removal growth has increased to 1084 million m<sup>3</sup> from 2049.3 million m<sup>3</sup> in 1961. The share of developed market-economy countries in the growth volume accounts for only 154 million m<sup>3</sup>. This fact explains the increasing disproportion between wood consuming and wood producing countries. The percentage share of market-economy countries decreased for the period under review from 35.2 to 27.8% and the share of developing countries increased from 36.8 to 48.5% of the total removal (see Table 2).

The above cited indices should be treated with caution. The FAO Forest Committee estimates for fuelwood were based on arbitrary samplings of per capita consumption norms because of the lack of reliable statistics. Therefore, the estimates may be in a serious discrepancy with the actual levels. According to the estimates, fuelwood share of aggregate removal increased from 50.2 to 52.7% for the period under review.

The indices of industrial wood removal are considerably more reliable, based on actual report data, and so they are of most interesting for analysis of the international market for wood raw materials. Industrial wood dominates the international market. The share of fuelwood accounts for only 0.5% of the aggregate wood raw materials trade by volume and 0.02% by cost.

**TABLE 2.** Dynamics of world wood removal from 1961 to 1981. (million m<sup>3</sup>)

	1961	1965	1970	1975	1980	1981
Total removal	2049.3	2222.9	2640.1	2773.1	3159.3	3142.9
Developed market-economy countries	721.2	759.0	799.5	729.3	910.6	874.9
Developing countries	753.8	849.0	1145.8	1303.0	1508.6	1524.3
Industrial wood removal	1019.7	1133.3	1277.6	1286.0	1441.7	1384.0
Developed market-economy countries	577.8	645.7	712.0	660.3	770.9	722.9
Developing countries	99.8	122.4	161.2	188.5	252.7	242.0

The assortment roundwood removal pattern suffered notable changes over the last two decades in the world as a whole. First of all the share of fuelwood increased to some extent; not only because of growing household consumption, but also because of fuelwood use as pulpwood and other types of industrial wood. The changes in the use of industrial wood are mainly due to the replacement of one type by another, e.g., sawlogs by small diameter pulpwood logs, and pulpwood logs are being partly replaced by technologic chips produced from woodworking and logging residues.

The share of the softwood industrial sector decreased from 74.1 to 68.2% and increasing the hardwood share. This change arose from a more widespread use of hardwood as pulpwood and sawlogs and shows a growing industrial softwood deficit.

For the period under review industrial wood removal in the world increased by 35% and the growth index for hardwood was 67% (versus only 25% for softwood). For the type found to be the most deficit, i.e., sawlogs, the index was 17% and at the same time the index for hardwood sawlog-veneer logs grew to 176%.

Sawlog and veneer log removal maintains a dominant position in the pattern of world wood removal in spite of the substantial decrease in the specific share of this type from 72.8% in 1961 to 58.1% in 1981 and the deficit suffered by softwood sawlogs, for which the decrease was from 46.9 to 40.6%. This does not imply an improvement in the quality pattern of the wood cut. In practice, the process was accompanied by an increasing use of smaller logs, commonly used as pulpwood. Technological progress (the development of chip and saw headrigs, of new and improved woodworking machinery, and of equipment for smaller logs) made it possible not only to use additional volumes of veneer and saw timber, but also to obtain substantial volumes of raw materials in the form of chips.

For the period under review the greatest growth of removals occurred for pulpwood (an increase by 1.74), 2.95 times for softwood and 1.43 for hardwood pulpwood, i.e., the specific share of pulpwood in the total removal pattern increased from 21.0 to 26.9%.

Along with the above-mentioned changes it should be noted that other sectors stabilized, with the exception of pitprops, for which the share tended to decrease, because pitprop logs are, to an increasing extent, being used as raw material in wood processing industries.

Removal volume of industrial wood for the period from 1961 to 1981 increased by 364.2 million m<sup>3</sup> (see Table 3), of which 287.0 million m<sup>3</sup> is due to the market-economy countries. This share also increased over the period, from 66.5 to 69.7%.

As for the geographic allocation of world wood removal, there have been no significant changes in the 20 years period. The North American share of world wood removal amounts, as before, 33%, i.e., 50% of removal due to the market-economy countries. The Western Europe share has slowly decreased at the same interval, but the present level is still rather high (16.2-14.5% of world wood removal and 24.4-20.8% that of market-economy countries). Development rates for Latin American wood removal were the highest (with a mean annual growth of 18.7%), and as a result the specific share of this region in world wood removal increased from 2.7% to 3.6%. The

**TABLE 3.** Pattern of the world wood removals (million m<sup>3</sup>).

	1961	1965	1970	1975	1980	1981
Total world	2049.3	2222.9	2640.1	2773.1	3159.3	3142.9
Fuelwood	1029.6	1089.6	1285.9	1400.3	1617.8	1656.5
Industrial wood	1019.7	1133.3	1277.7	1286.0	1441.7	1384.0
Industrial softwood	755.6	821.4	911.0	907.7	990.4	943.6
Industrial hardwood	164.2	311.9	366.6	378.4	451.4	440.3
Softwood sawlogs and veneer logs	478.7	501.7	550.0	524.5	611.5	562.1
Hardwood sawlogs and veneer logs	159.7	181.7	210.3	213.9	255.2	242.0
Softwood pulpwood	175.5	182.9	234.5	237.1	256.0	258.8
Hardwood pulpwood	38.5	55.5	79.6	85.6	114.4	113.8
Pitprops	42.6	43.6	36.1	34.3	33.5	33.2
Other industrial	124.8	168.0	167.1	172.7	171.1	174.2

leading, developed market-economy countries with the highest wood removal levels were the US, Canada, Sweden, Japan, and Finland, and among the leading developing countries were Indonesia, Malaysia, Brazil, and the Philippines (see Table 4).

The increase in total world wood removal for the period is over 1 billion m<sup>3</sup> and the growth pattern is on a large scale. The main problem for the present period is not with the rates of development, but with the absolute level of cut and its ratio to the growing wood stock. Until the middle of the 1960s the world wood removal level was far below the level of annual growth. At present the removal volume is quite close to the annual growth level. Thus, the present world annual cut amounts to 81% of the net annual growth, and in the main wood producing countries the ratio is considerably higher: in the EEC countries it amounts to 84%, in England 87%, and in Sweden 99%. In the US the ratio is estimated to be the high level of 92%, and this is in a country rich in wood resources. Increasing wood removal by involving new forest areas is associated with many difficulties, and overcutting in exploited forests has developed not merely as a local occurrence, but as a widespread phenomenon. It is especially characteristic of softwood resources.

The net annual growth/annual cut ratio seems to be more favorable in the countries of Africa, Asia, and Latin America, but actually the situation is to a considerable extent different. Further increase of wood removal in the tropical forest regions is rather difficult, for of the thousands of tropical species only some dozens are commercially usable and have markets. As a result, only 5–20 m<sup>3</sup>/ha can be efficiently used in the forests of Africa (with a biomass mean growing stock per ha amounting to 200–400 m<sup>3</sup>). Selective cutting systematically depletes tropical forests of valuable tree species and decreases the commercial value of the stands.



**TABLE 4.** Apparent industrial wood consumption by world regions and countries, 1960-1981 (million m<sup>3</sup>).

Countries	1961	1965	1970	1975	1981
World total	1019.7	1133.3	1277.6	1286.0	1384.0
Market-economy countries	677.6	768.0	873.2	844.8	964.9
Asia	131.9	148.1	172.7	187.0	209.4
India	6.5	8.3	12.8	16.5	19.8
Indonesia	5.5	6.3	12.6	18.8	16.3
Malaysia	1.2	2.4	19.7	30.0	32.6
The Philippines	8.1	11.4	12.3	10.6	8.1
Japan	49.3	49.5	45.4	34.2	32.6
North America	341.6	398.1	439.3	411.5	454.6
Canada	86.7	98.4	117.3	111.6	131.2
US	248.3	291.0	312.7	288.6	312.4
Latin America	27.6	29.6	39.2	48.6	85.2
Brazil	16.8	16.5	23.8	30.6	57.4
Argentina	2.0	2.4	3.1	3.6	4.1
Africa	24.9	31.5	39.6	42.7	49.8
Ivory Coast	1.6	3.0	3.8	4.4	5.4
Republic of South Africa	4.6	7.5	8.9	10.2	9.0
Western Europe	165.1	171.6	198.5	184.1	200.8
Finland	37.5	32.6	37.5	25.5	39.8
Sweden	40.2	46.3	56.7	54.8	45.4
France	23.4	25.1	26.5	26.7	28.1
Federal Republic of Germany	23.9	23.6	26.3	25.5	27.3
Oceania	15.8	17.6	20.3	23.1	27.5
Market-economy countries consumption	882.2	776.0	886.7	861.5	975.4
deficit	4.6	8.0	13.5	12.7	10.6
deficit as a % of consumption	0.6	1.0	1.5	1.5	1.1

The Philippines have the most valuable forests of all the region of South-East Asia. The growing stock of commercial timber is also high in the dipterocarp forests, which include some dozens of species known by commercial names, such as lauan, apitong, meranty, keruing, damar, etc. However, the intensive cutting during the 1950-1960s depleted the forests of the Philippines to such an extent that the growing stock of mature stands has decreased sharply, and forest regeneration efforts now bring only modest results, despite regeneration conditions in South-East Asia being more favorable than those in Africa.

Expansion of the exploitation of low quality forests in Malaysia and Indonesia resulted in removal of lower quality wood and a depletion and degradation of the countries' wood resources. Mountain areas of virgin

forests in Saravak (Malaysia), South Kalimantan, and West Irian (Indonesia) present serious difficulties for logging. Wood from the forest regions of South-East Asia is of lower quality than African wood. Asian wood materials are mainly of too slight a color and without the texture needed for such common products as plywood and solid wood panels (in comparison to products from coniferous and deciduous moderate zone wood).

The Latin American wood growing stocks are concentrated in the Amazon basin forest areas (tropical rain forests). But the commercial wood share in the forest growing stock is even lower than in South-East Asia and there are quite a few valuable species that are useful in conjunction with modern technology. Difficult access to the forests (situated in swampy areas) makes exploitation in the near future problematic. In Brazil, Columbia, and other countries of Latin America incentive is given to local processing of wood and there are direct prohibitions on the export of unprocessed valuable wood. Latin America as a whole will remain an insignificant wood exporter.

### **3. INTERNATIONAL INDUSTRIAL WOOD TRADE AND THE MOST IMPORTANT MARKETS**

The international industrial wood trade in the period of 1961-1981 developed at faster rates than those of wood removal and consumption of industrial wood. This created the conditions for a continuous increase of imports and an increasing dependence of industrial wood consumption on the world wood market.

Table 5 presents data for the most important wood types for world trade and for countries.

The results of the statistical analysis of international industrial wood markets for the period under review can be summarized as follows:

- (1) Industrial wood international trade increased for the period from 38.5 to 102.0 million m<sup>3</sup> (with a growth rate of 2.65 and a mean annual growth of 2.5%).
- (2) Market-economy countries dominate the industrial wood world market, with their imports of industrial wood being over 90%.
- (3) The trade assortment pattern of the above-mentioned countries suffered the following changes:
  - the share of saw-veneer logs significantly increased (in exports from 12.6 to 19.3% and in imports from 16.9 to 23.1%), the share of hardwood saw and veneer logs decreased somewhat (in exports from 45.9 to 40.9% and in imports from 37.5 to 31.7%);
  - the level of pulpwood export increased from 31.2 to 36.4% and pulpwood imports grew from 35.7 to 41.3%;
  - the assortment share for other industrial woods decreased in exports from 4.3 to 2.8% and in imports from 3.9 to 3.6%.

TABLE 5. Industrial wood trade, 1961-1981.

	1961	1965	1970	1975	1980	1981
<i>Exports</i>						
World total (million m <sup>3</sup> )	38.50	52.83	93.62	98.18	115.08	101.97
Market-economy countries	31.03	39.25	74.42	84.81	93.58	80.89
softwood saw and veneer logs	3.92	6.81	16.71	14.84	20.51	15.74
hardwood veneer logs	14.23	21.08	33.33	36.00	41.75	33.07
pulpwood	9.67	9.60	17.26	19.73	28.71	29.45
other industrial wood	1.33	1.33	1.49	3.77	2.27	2.26
USA	2.64	5.80	16.29	17.33	21.93	19.65
Canada	3.78	4.95	5.60	2.40	4.25	3.74
USSR	5.48	10.58	15.55	17.90	15.53	15.39
Finland	6.05	0.93	1.21	0.64	2.06	2.67
Sweden	0.89	2.31	4.61	2.34	1.70	1.61
Ratio of export to removals (%)	4.7	5.2	7.3	7.6	8.0	7.4
<i>Imports</i>						
World total (million m <sup>3</sup> )	38.39	52.08	92.91	95.90	116.63	100.45
Market-economy countries	35.61	47.26	87.91	87.52	105.94	91.44
softwood and veneer logs	6.02	9.94	23.23	22.92	26.27	21.05
hardwood saw and veneer logs	13.36	19.22	34.08	31.28	35.26	28.98
pulpwood	12.71	14.85	26.91	29.64	40.84	37.79
other industrial wood	1.41	1.92	2.96	3.17	3.51	3.33
Great Britain	1.74	1.59	1.05	0.47	0.32	0.30
Belgium & Luxembourg	0.79	1.01	1.89	1.95	3.47	3.23
The Netherlands	0.89	1.01	1.08	0.90	1.07	0.73
France	2.30	2.25	2.89	2.55	2.95	2.34
Italy	3.33	3.38	4.59	4.29	5.97	5.02
FRG	4.52	4.28	4.83	2.70	3.58	3.34
Denmark	0.17	0.19	0.16	0.14	0.12	0.09
Norway	1.62	2.19	4.10	2.56	1.37	1.51
Sweden	1.49	0.58	0.80	3.45	4.54	6.81
Austria	0.59	0.97	2.08	2.41	3.96	3.36
Switzerland	0.87	0.42	0.98	0.60	1.02	0.97
Finland	0.43	3.01	2.91	5.05	4.00	4.03
Japan	9.04	16.27	45.63	44.37	53.91	42.02
Import ratio to consumption (%)	5.8	6.2	10.6	11.3	11.4	10.4

After the Second World War two main wood importing markets were formed, the Western Europe market and the Pacific market importing 30 and 60%, respectively, of the total imports of industrial wood for market-economy countries. Japanese imports amount to 50% (of the 60% Pacific market share).

International wood trade in Western Europe occurs mainly between bordering countries. Wood from borderlands (where processing facilities have not been developed for some reason) is exported to the nearest processing mills of neighboring countries. Significant amounts of unprocessed wood enter these kinds of market from the planned-economy countries and countries of Africa. The leading importers are the countries with developed export-oriented wood processing industries (Sweden, Norway, Finland, Austria) as well as wood deficit countries (Italy, France, Federal Republic of Germany, Belgium). The main commodities of the Western Europe market are pulpwood, hardwood sawlogs and veneer logs, and wood-working residues, the latter accounts for three-quarters of world wood residue imports.

The share of North American countries in the world wood trade has gradually decreased because the wood deficit in the region has sharpened. Traditional wood exporting regions (especially British Columbia) have suffered from the growing deficit and now orient their wood production to home markets. Besides, the traditionally low prices of the North American market make the Pacific market more attractive for wood suppliers from the US and Canada.

The Far East market is characterized by the domination of saw and veneer logs, and technological chips. In the past Japan was practically the only wood importing country of the region, but at present large-scale importers of industrial wood are companies in South Korea, Hong Kong, Taiwan, and Singapore. Wood (imported into the countries) is processed at the export-oriented mills into half-finished wood products. Hardwood saw and veneer logs are supplied mainly by countries of South-East Asia and the western regions of the US, these regions accounting for 40-45 and 20-25%, respectively, of the world total of unprocessed wood raw material exports (market-economy countries only). The main direction of export is the Pacific market. South-East Asia supplies mostly hardwood veneer logs and chips, whereas the western regions of the US supply softwood saw and veneer logs and chips.

The principal factors that cause high growth rates of industrial wood export from South-East Asia are the following:

- (1) Geographic location (proximity to main consumer markets).
- (2) Unique character of South-East Asia wood resources, with comparatively homogeneous dipterocarp species groups, and woods with similar properties that by processing can produce high quality finished materials as well as woodpulp (mostly woodworking residues).
- (3) As national facilities exist for wood processing in the regions, woodpulp is produced from low quality wood at local mills or the wood is processed into export chips; medium quality wood is exported to the countries of the Far East; and valuable roundwood

is exported to the Western Europe market, resulting in a comparatively effective use of wood resources. Compared with other tropical regions (in which of an exploitable growing stock of 300–500 m<sup>3</sup> per ha only 5–20 m<sup>3</sup> is removed) in South-East Asia the wood removal per ha of commercial forest amounts to 50–150 m<sup>3</sup>, i.e., profitability in the region is several times higher than in other regions for practically the same investment.

- (3) Availability of low cost labor creates favorable conditions for foreign capital investments.

The economic efficiency of unprocessed wood export from western regions of the US is also based on the unique character of the regions' wood resources. Mean growing stock volume per ha is 300 m<sup>3</sup> (in the north-west region) compared to the country average of 100 m<sup>3</sup> (in Finland this index is 77 m<sup>3</sup> per ha and 98 m<sup>3</sup> per ha in Sweden). The share of trees with a diameter above 50 cm amounts to 60% for forestry regions of the US (the average for the country as a whole is 30%, and for Sweden and Finland only 20% of the growing stock comprises trees over 30 cm in diameter).

The available wood resources in western regions occur in comparatively favorable economic conditions for logging, with a low level of costs, and consequently prices for wood are also relatively low in North America. The situation makes it highly profitable to export some part of the unprocessed wood to Japan, where prices for wood are traditionally high.

Exporting wood from the western regions to Japan is a part of the efficient utilization of these regions' wood resources. Wood removal in the north-west of the US amounts to 100 million m<sup>3</sup>, utilization of woodworking and logging residues accounts for about 5 million m<sup>3</sup>, and the share of wood raw material exports is only 10–15%.

The countries of western and equatorial African should also be noted as industrial wood exporters to the Western Europe market. This region traditionally exports hardwood saw and veneer logs of high quality, commonly used for veneering in furniture production. Low-value wood exports have increased gradually because of the growth in prices for hardwood saw and veneer logs. However, future utilization of the vast African forest resources for the world market of pulpwood is limited because of unsolved problems such as the cost of wood removal from remote forest areas. It would be necessary to increase prices of ordinary woods to a level that justified and covered the costs of logging and transportation of wood to a consuming country. The problems of Latin America are the same in terms of exploiting forest resources.

A comparatively large-scale wood exporter is Oceania. Softwood saw and veneer log exporting from the region had already started in the 1960s and later softwood chips were supplied by New Zealand to Japan. Within the last few years the developing countries of Papua New Guinea and the Solomons became notable exporters of hardwood saw and veneer logs and chips to Japan.

Note that the increase in pulpwood trade growth rates is mostly due to technological chip and wood residue contributions to the world market, the export share of which is over 60%; their import provides 50% of pulpwood trade of market-economy countries. Pulpwood world trade increased for

the period 1975–1981, from 18.4 to 19.4 million m<sup>3</sup>, and technologic chip trade grew from 10.7 to 18.1 million m<sup>3</sup>. The development of pulpwood trade to increase the share of chips is because wood in the form of chips is more convenient for transportation, importers of chips incur energy savings, and producers of chips can achieve a more complete and complex utilization of wood resources. In practice, chipping gives a half-finished product ready for further processing. Not so long ago the chip trade was limited to shipments between the US and Canada and exports from the US to Japan. Some years ago Australia, Malaysia, the Republic of South Africa, Papua New Guinea, and New Zealand were enlisted as large-scale exporters of technologic chips. Several long-term contracts were signed for shipments of large amounts of chips from North America to Western Europe, and the hardwood chip trade developed rapidly. At present all reconstructed and new saw mills and plywood mills are equipped with facilities for chipping and such mills produce commercial chips in the US, Canada, and the Scandinavian countries.

#### **4. INDUSTRIAL WOOD PRODUCTION AND CONSUMPTION FORECASTS FOR WORLD REGIONS AND COUNTRIES**

Future production and supplies of industrial wood to the year 2000 depend on several factors. The most important among these is the potential of forest resources and logging prospects in the main wood producing and exporting regions of the world, i.e., in North America, Western Europe, and Japan.

Developing countries of South America, Africa, and South-East Asia have vast, underexploited tropical wood reserves, but these regions will play only a secondary role in meeting the requirements to the year 2000 for softwood materials, which dominate the manufacturing wood products. That is why the wood supplying prospects of these regions are not discussed.

The long-term demand and supply balance of the main industrial wood types is discussed in this section. The discussion is based on the analysis of demand trends and possibilities of supply according to the latest FAO paper (*World Forest Products, Demand and Supply 1990 and 2000*, FAO, 1982, 345 pp).

World production and consumption of industrial wood, i.e., all wood excluding fuelwood, will increase by 47% for the period 1980–2000, according to the FAO forecasts. The index of growth for the previous two decades was 41%. This is indicative of the development of long-term growth rates, not only in absolute, but also in relative terms. For the period of 1960–1980 industrial wood consumption increased by 422 million m<sup>3</sup>, the mean annual growth rate being 1.75%. The 1980–2000 forecasts predict an increase of 622 million m<sup>3</sup>, by a mean annual growth rate of 2%. The highest growth forecasts are for pulpwood (+75%).

## North America

### The US

Total forest area of the US is less than that of the USSR and Canada, but the net annual growth of softwood and hardwood growing stock is considerably higher for the US forests than for the other two, being 3.02 m<sup>3</sup>/ha for hardwoods (for softwoods 4.13 m<sup>3</sup>/ha) compared to 1.12 m<sup>3</sup>/ha in the USSR and 1.07 m<sup>3</sup> in Canada.

The US total forest area amounted to 298.3 million ha in 1977, of which 195.4 million ha (two-thirds) accounted for productive commercial forest, 92.7 million ha (about one-third) for other noncommercial forests (where no logging is carried out), and 10.2 million ha for unproductive reserved forests. The commercial forest area decreased for various reasons by about 3.5% for the period 1952-1977. At the beginning of 1977 growing stock of the US forests amounted to 20.14 million m<sup>3</sup>, of which softwood share was 12.91 million m<sup>3</sup> (i.e., 64%). Table 6 presents data and estimated for commercial forests in the period 1952-2000 (million m<sup>3</sup>).

Total annual cuts in the US during the 1970s were within the limits of net annual growth, but with overcuttings in softwoods and underutilization of the allowable hardwood cut. The highest overcut occurred in softwoods of saw timber grade. In the west of the US (the main producing softwood lumber and plywood region) the general overcuts during the 1970s were 20% higher than the allowable cut level, and still higher for the saw timber

**TABLE 6.** (Source: *Forest Resource Report* No. 23, 1982; million m<sup>3</sup> unless stated otherwise).

	1952	1970	1976	Forecasts	
				1990	2000
<i>Softwood</i>					
Net growth*	143.2	248.2	282.8	305.1	307.7
Removals	220.1	264.0	284.5	347.3	333.6
Actual supplies	213.5	246.5	269.4	293.7	313.3
Growing stock (billion m <sup>3</sup> )	12.04	12.74	12.91	13.27	13.89
<i>Hardwood</i>					
Net growth*	141.4	198.8	219.8	208.3	185.5
Removals	115.8	133.9	118.4	162.5	189.9
Actual supplies	95.2	96.1	93.3	138.4	170.7
Growing stock (billion m <sup>3</sup> )	5.06	6.53	7.23	8.94	9.83
<i>Total softwood and hardwood</i>					
Net growth*	284.6	447.0	502.6	513.4	493.2
Removals	335.9	379.9	402.9	509.8	523.5
Actual supplies	308.7	342.6	362.7	432.1	484.0
Growing stock (billion m <sup>3</sup> )	17.10	19.27	20.14	22.21	23.72

\* Excluding natural losses.

grade. For example, in 1976 wood removal in Washington, Oregon, and California reached 114 million m<sup>3</sup>, i.e., 137%, for the volume of annual growth was only 83 million m<sup>3</sup>.

The wood supply problem, and especially the problem of softwood saw timber supplies, became more complicated because of the unfavorable distribution of stocked forest lands between different owners; Table 7 illustrates this. Note that a section of the national forests is already reserved or will be reserved. The softwood saw timber growing stock of the reserved forests is significant. Some owners of small forest areas exploit their wood resources too intensively and others, on the contrary, do not exploit their forest, using them as parks and for other nonindustrial purposes. Hence, overcutting is forecast for the US softwood growing stock of saw timber category and prospects of meeting requirements for softwood saw logs are rather poor. A further increase in softwood lumber imports from Canada is expected.

Table 8 gives comparative FAO statistics (million m<sup>3</sup>) for wood supplies for the period 1960–1980 and forecasts for 1990–2000; the FAO data are somewhat different from the US estimates.

From Table 8 industrial softwood supply will grow by 18% within the period 1980–2000 and that of hardwood by 61%; the growth for the total industrial wood supply is estimated to be 29%. It is characteristic that the type of most deficit, i.e., softwood was timber, is estimated to increase by only 6.3% and exports of this type will decrease by 22.6%. Softwood pulpwood supplies will increase by 43% and that of hardwood by 61%.

**TABLE 7.**

Owners	Softwood saw timber growing stock (%)	Softwood saw timber removals (%)	Resource utilization level (%)
National forests	51	23	45
State and social organization ownership	12	10	83
Farmer and other private forest lands	22	30	136
Industrial companies' forest ownership	16	37	231
Total	100	100	



**TABLE 8**

	1960	1970	1980	1990	2000	2000 in % to 1980
<i>Softwood</i>						
Saw timber	136.4	163.9	177.1	186.9	188.2	106.3
export	1.7	10.4	11.5	12.9	8.9	77.4
Usable residues	16.3	43.3	62.7	68.9	71.2	113.6
export	—	3.5	3.8	1.6	—	—
Pulpwood	64.7	88.6	90.1	103.3	128.7	142.8
Total	201.1	252.5	267.2	290.2	316.9	118.6
<i>Hardwood</i>						
Saw timber	28.2	34.5	31.0	32.2	32.7	105.5
Usable residues	2.4	6.3	8.7	12.3	13.4	154
Pulpwood	27.3	40.7	56.9	76.5	109.0	191.6
Total	55.5	75.2	87.9	108.7	141.7	161.2
Total wood raw materials	256.6	327.7	355.1	398.9	458.6	129.1

### *Canada*

Total forest area of Canada is second only to that of the USSR and will make an important contribution to meeting future world demands for wood, primarily that of the US. Last year about three-quarters of Canadian forest product exports were sent to the US.

The forest area of Canada amounts to 303 million ha, of which unproductive reserved forests account for 104 million ha (about one-third). Of 199 million ha of productive forest lands 24 million ha are at present unforested and can be enlisted as productive forest lands only in the future. Therefore, commercial forest areas of Canada amount to 174.5 million ha (i.e., 58% of the total forest area), of which 43.8 million ha are located in British Columbia, 39.7 million ha in Ontario, and 33.8 million ha in Quebec.

National forests (mostly province forests) account for 92% of the productive forest area, the rest being in private ownership. Growing stock volume is 19.3 million m<sup>3</sup> of which softwood accounts for 15.2 million m<sup>3</sup> (79%) distributed mostly in British Columbia (50%), Ontario (17%), and Quebec (12.5%).

The domination of national forest ownership gives Canadian forestry a definite advantage in that forestry operations (forest regeneration and forest management in order to increase productivity) can be centrally intensified according to expert opinion.

In 1979 the level of allowable cut was 205.3 million m<sup>3</sup> and wood removal reached (in Canada) 150 million m<sup>3</sup>. The difference in volume of 55.3 million m<sup>3</sup> includes 39.4 million m<sup>3</sup> of wood of low economic value (low

quality, lack of infrastructure, hilly terrain, high transportation costs, etc.). Nevertheless, the Canadian forest service predicts it possible to increase, under certain conditions, the level of removals to 227 million m<sup>3</sup> by 2000 and softwood lumber output to 43.7 million m<sup>3</sup> by 1990 and to 53.3 million m<sup>3</sup> by 2000. Since the level of lumber production for 1990 was nearly achieved in 1983 it is evident that the above forecasts of Canadian experts were underestimated.

Canadian softwood lumber export to the US was expected to reach 27.1 million m<sup>3</sup> by 1990 and increase further to the level of 32.1 million m<sup>3</sup> by 2000. But in 1978 softwood lumber shipments from Canada to the US exceeded the 1990 forecast level and reached 27.6 million m<sup>3</sup>, though other forest and paper product exports were near to the level of the 1971-1974 period.

Recent research carried out in Canada produced numerous papers seriously concerned with problems of future wood raw material supplies for further development of the woodworking industries. Though wood reserves are stated to be of rather significant volumes a considerable share of the reserves is economically inaccessible at present; also a part of the wood resource is to be reserved and another part lost as a result of forest fires and diseases.

Industrial softwood supply is expected to increase in Canada by 27.4% within the period 1980-2000; the expected growth for hardwood industrial assortments is 43%, and that of the total wood raw materials is 29%.

It should be stated that the wood supply forecast level to 2000 is somewhat underestimated for Canada, in spite of a growing wood raw materials disbalance. It should be also taken into account that within the period 1960-1980 softwood raw material supplies increased by 73% and that of hardwood by 270%, the increase for total wood raw materials being 79%. The dynamics of Canadian wood supplies in 1960-2000, according to FAO forecasts, is presented in Table 9 (million m<sup>3</sup>).

**TABLE 9.**

	1960	1970	1980	1990	2000	Increase from 1980 to 2000 (%)
<i>Softwood</i>						
Saw logs	36.6	56.8	85.4	103.7	114.3	133.8
Residues used	4.7	17.8	36.8	45.7	50.2	136.4
Pulpwood	38.8	52.8	45.5	50.7	52.7	115.8
Total	75.4	109.6	130.9	154.4	166.8	127.4
<i>Hardwood</i>						
Saw logs	2.6	3.4	4.8	5.7	6.5	135.4
Residues used	0.2	1.1	1.6	1.9	2.2	137.5
Pulpwood	1.8	4.2	7.2	8.9	10.5	145.8
Total	4.4	7.6	11.9	14.6	17.0	142.9
Total wood raw materials	79.8	117.2	142.8	169.0	183.8	128.7

### Western Europe

The forest area of this subregion accounts for 138.3 million ha (or 32.6% of the total subregion area), of which three-quarters (102.7 million ha) are under exploitation. The share of unexploited productive forest lands is 7.2 million ha, and 28.7 million ha is the share of noncommercial forests.

Forest lands under exploitation (commercial forests) are distributed by countries as follows (million ha): Sweden, 22.1; Finland, 18.1; France, 13.2; Spain, 9.3; Turkey, 8.1; Federal Republic of Germany, 7.1; Norway, 6.8; Italy, 5.3; Austria, 2.8; Portugal, 2.8; Greece, 2.3. These 11 countries accounts for 97.9 million ha (95% of all commercial forests).

Western Europe growing stock volume is considerable (9.4 billion m<sup>3</sup>), and is distributed by countries as follows (billion m<sup>3</sup>, over-bark): Sweden, 2.3; Finland, 1.4; Federal Republic of Germany, 1.0; Turkey, 0.9; Austria, 0.7; Spain, 0.5; Norway, 0.5; Italy, 0.35; Portugal, about 0.15; Greece, about 0.15; Great Britain, about 0.15.

The share of softwood in Western Europe growing stock and softwood annual growth averages at two-thirds, but for the northern countries the ratio amounts to 82% (for Sweden even 85%) and for EEC countries and Southern Europe it is only about 50%. The share of these 12 countries amounts to 9.4 million m<sup>3</sup>, the rest of Western Europe accounting for only 6% of wood growing stock.

Net annual growth (losses excluded) amounts to 325 million m<sup>3</sup> (over-bark), distributed as follows: Sweden, 63; Finland, 56; France, 41; Federal Republic of Germany, 34; Spain, 30; Turkey, 22; Austria, 17; Norway, 16; Italy, 14. The total share of these nine countries accounts for

293 million m<sup>3</sup> (over 90%); Sweden, Finland, and Austria are net exporters.

Private ownership (mostly farmers) is a negative factor for wood supply prospects in Western Europe. In the north and EEC countries farmers own almost 60% of forests. This kind of ownership makes it difficult to intensify forest management and results in limited growth rates of the forest growing stock.

The latest FAO forecasts (1982) to 2000 are based on the assumption that all forest areas of Western Europe (Yugoslavia, with 7.3 ha, is included) will increase to 153 million ha (compared to 147 million ha in the mid-1970s), and the area of forests under exploitation will grow to 124.6 million ha (112.7 million ha in the mid-1977s). The increase is due first of all to including low quality stands in the category of productive forest lands and secondly to afforestation of waste and agricultural lands.

Wood growing stock is expected to increase to 11.6 million m<sup>3</sup> (over-bark), i.e., by 8.5% compared to 1970, with the same average volume per ha of 93 m<sup>3</sup>. Net growth will increase from 347 million m<sup>3</sup> to 415 million m<sup>3</sup>, i.e., by 20% (over-bark) and to 361 million m<sup>3</sup> (from 302 million m<sup>3</sup>, under-bark). Forecasts for industrial wood supply to 2000 in Western Europe are presented in Table 10.

Based on the above forecasts it can be stated that Western Europe wood resources are not adequate to meet demand and the subregion dependence on imported wood raw materials and wood products will grow notably.

According to FAO research it is practically impossible to determine future wood products export possibilities for the countries of Western Europe. It was only possible to determine saw log and pulpwood surplus and deficit, the data being included in summary tables in international trade prospects for wood products.

## **Japan**

Forest lands of Japan account for 24 million ha, i.e., two-thirds of the country's area. Most of the forests are small and owned by farmers. Forest areas are evidently the smallest of all the developed countries, the mean forest area being 6.7 ha. Besides, some of the forest lands are situated in the mountains and subjected to soil erosion and earthquakes; also access roads are not sufficient. Forests, planted after World War II, are expected to achieve commercial maturity in the near future.

This will create conditions for considerably increasing wood removal, but logging costs in the mountain areas will be higher. The high cost of local wood has always been a limiting factor for logging in Japan and therefore in the 1970s imports of more competitive wood increased rapidly. As a result the softwood saw timber self-sufficiency of Japan steadily declined, but in the 1980s this trend is expected to slow down and even reverse. Thus, softwood saw timber self-sufficiency ratio declined from 88% in 1960 to 54% in 1980, but it is expected to reach 59% in 2000. The situation is about the same for softwood pulpwood, the imports of which have been forecast to grow to 24.8 million m<sup>3</sup> by 2000.

**TABLE 10.** Industrial wood supply for Western Europe, 1960–2000 (million m<sup>3</sup>, over-bark).

Roundwood assortments	1960	1970	1980	1990	2000	% ratio 2000/1980
<i>Softwood</i>						
Locally produced saw logs	66.9	85.9	93.7	100.4	105.7	113
Imported saw logs	0.8	1.0	1.5	4.5*	6.1*	407
Residues used	16.4	18.2	28.6	35.0	40.0	140
Locally produced pulpwood	49.5	75.4	88.4	103.1	126.5	143
Imported pulpwood	2.0	7.9	4.1	4.0	3.2	78
Total						
local	116.4	161.3	182.1	203.2	232.2	128
imported	2.8	8.9	5.6	8.5	9.3	166
<i>Hardwood</i>						
Locally produced saw logs	18.2	24.5	27.6	30.0	30.4	110
Imported saw logs	4.8	6.5	3.8	3.7*	5.2*	137
Residues used	3.1	5.2	6.3	7.2	8.8	140
Local pulpwood	18.7	33	42.2	51.7	63.8	151
Imported pulpwood	0.1	—	0.9	1.4*	1.6*	178
Total						
local	53.3	218.8	251.9	285.2	346.4	130
imported	7.7	15.4	10.3	13.6*	16.1*	156
Total softwood and hardwood	161.0	234.2	262.2	298.8	342.5	131

\* Assuming that the wood will be exported from the USSR and other countries.

According to FAO forecasts US wood exports are expected to decrease and so Japan's future pulpwood supplies will come mainly from the USSR. The share of hardwood raw materials supply will increase and imports of pulp and paper products will also increase. The forecasts concerning hardwood are based on the fact that about 50% of Japan's forest area is covered with hardwood. Since forest regeneration is carried out with softwood species, hardwood removal may be limited to some extent. Hardwood saw timber supply is expected to decrease from 6.9 million m<sup>3</sup> at the end of the 1960s to 1.9 million m<sup>3</sup> in 2000, and that of pulpwood from 14.6 million m<sup>3</sup> in 1970 to 6.6 million m<sup>3</sup> in 2000. Wood supply prospects in Japan are characterized by the data in Table 11.

As follows from Table 11, Japan's wood demand will be met mostly by imports. It is important for countries exporting wood products to take this into consideration.

Import of pulpwood in the 1980–1990s will grow at especially high rates (imports of softwood pulpwood will increase 27 times and that of hardwood 4 times). General wood supply in Japan is expected to increase by 39% on the

basis of domestic wood production and wood imports. This is not an easy challenge in view of the considerable depletion of South-East Asian forest resources and because export policy of the region is directed to increasing exports of processed wood products. Besides, the US softwood saw timber supply will suffer increasing deficit until 2000 and so US softwood exports will decrease.

**TABLE 11.** Industrial wood supply in Japan, 1960–2000 (million m<sup>3</sup>).

	1960	1970	1980	1990	2000	% ratio 2000/1980
<i>Softwood</i>						
Saw timber	28.8	43.4	45.7	57.5	63.4	139
local	25.4	25.0	24.5	34.3	37.2	152
imported	3.4	18.4	21.2	23.2	26.2	124
Residues used	1.9	10.0	20.6	23.9	13.5	66
imported	–	4.5	13.6	13.3	–	–
Pulpwood	9.3	4.0	2.4	10.9	37.2	1550
local	9.0	3.8	1.5	3.9	12.4	827
imported	0.3	0.2	0.9	7.0	24.8	2756
Total softwood	38.1	51.9	61.7	81.7	100.6	163
local	34.4	28.8	26.0	38.2	49.6	191
imported	3.7	23.1	35.7	43.5	51.0	143
<i>Hardwood</i>						
Saw logs	11.1	26.6	24.9	17.3	14.0	56
local	5.3	6.6	3.9	2.8	1.9	49
imported	5.8	20.6	21.0	14.5	12.1	58
Residues used	0.3	3.7	4.5	3.4	3.2	71
Pulpwood	6.5	15.0	17.3	23.8	29.4	170
imported	6.5	14.6	11.5	8.6	6.6	57
Total hardwood	17.6	41.6	42.2	41.1	43.4	103
local	11.8	21.2	15.4	11.4	8.5	55
imported	5.8	20.4	26.8	29.7	34.9	130
Total wood	55.7	93.5	103.9	122.8	144.0	139
local	46.2	50.0	41.4	49.6	58.1	140
imported	9.5	43.5	62.5	73.2	85.9	137

## 5. INTERNATIONAL TRADE FORECASTS TO 2000 FOR INDUSTRIAL WOOD

World wood trade prospects are characterized first of all by an increase of wood products consumption and by a growing wood raw materials deficit in a number of developed market-economy countries (the US, Japan, and Western Europe) (see Table 12).

The volumes of the forecasts are estimates with no account of market conjuncture changes and, according to the authors of the paper, the estimates show only approximate levels of future production, consumption, and trade. The pattern of the market to 2000 will be preserved and the leading exporters (USSR, US, South-East Asia, Africa, and Oceania) and importers (Western Europe, Japan, small countries of the Pacific) will be the same. According to FAO forecasts net imports for developed market-economy countries are expected to increase to 78 million m<sup>3</sup> towards 2000, compared to 45 million m<sup>3</sup> in 1980, i.e., absolute growth will be 33 million m<sup>3</sup>.

Japan will be again a leading importer of the world with net imports of 86 million m<sup>3</sup> estimated for 2000 (compared to 54 million m<sup>3</sup> in 1980), as follows: softwood saw logs, 26.2; softwood pulpwood, 24.8; hardwood saw logs, 12.1; hardwood pulpwood, 22.8 million m<sup>3</sup>. A sharp increase of the pulpwood share in industrial wood imports is quite notable compared to the level of 6.7 million m<sup>3</sup> (of which 0.9 million m<sup>3</sup> is softwood pulpwood) in 1980.

Deterioration of the raw materials balance in the US and South-East Asian countries means that meeting the import demand for industrial wood of Japan to 2000 will be problematic.

North America and Oceania will be the only regions to preserve an export balance of trade for industrial wood in the developed market-economy countries. The specific share of North America (primarily the US) in industrial wood world exports having achieved a maximum level at the end of 1970s (26.2 million m<sup>3</sup> in 1980) is estimated to be only 10 million m<sup>3</sup> in 2000. An expected considerable decrease of industrial wood exports from North America is, in our opinion, fully justified by the increasing shortage of softwood raw materials in the US.

Western Europe net imports of industrial wood are expected to decrease to 16 million m<sup>3</sup> in 2000 (compared with 18 million m<sup>3</sup> in 1980). This decrease predicted by the above-mentioned FAO forecast is not obvious in the authors' opinion. Western Europe is the second largest world consumer of wood (after the US) and is not likely to meet all wood raw material requirements with its own regional wood resources, a fact more true for the future than for the present.

Developing countries will preserve their position as leading exporters of wood raw materials. According to FAO forecasts the countries' net exports will amount to 44 million m<sup>3</sup> in 2000 (compared to 32.5 million m<sup>3</sup> in 1980), of which 29 million m<sup>3</sup> will be from South-East Asia. However, the growth rates for the region's exports will slacken. It is also expected that low-cost pulpwood and saw and veneer logs share of the region's exports will increase.

A significant increase in export potential is expected for Latin American and African regions by 2000; Latin America is expected to have exports reaching 5 million m<sup>3</sup> (compared to 0.4 million m<sup>3</sup> in 1980) and Africa is

**TABLE 12.** Summarized world balance of wood production, consumption, and trade in 1974–1976 and forecasts to 2000, by three main country groups (10<sup>6</sup>m<sup>3</sup>, source: *FAO Forest Report No. 29*, Rome, 1982).

Regions	Mean annual cut		Consumption of industrial wood for processing***	Trade balance (– imports, + exports) for industrial wood
	Fuelwood*	Industrial wood*		
World	1473/1820	1326/2085	1185/1930	–
Developed market-economy countries	57/70	704/1093	732/1138	–44/–78
North America	18/28	436/642	412/617	+22/+10
Western Europe	29/30	200/320	208/325	–18/–16
Oceania	1/2	21/58	17/41	+3/+16
Japan	–	36/58	86/143	–50/–86
Others	8/10	11/15	9/12	–1/–2
Developing countries	1112/1350	193/365	109/274	+32/+42
Africa	294/300	30/60	10/28	+5/+10
Latin America	250/400	59/124	47/108	0/+5
South-East Asia	495/600	87/161	46/128	+22/+29
Near East countries	73/50	14/20	6/10	–
Planned-economy countries	304/400	429/627	344/518	+12/+34
USSR and Europe	96/100	372/531	278/444	+12/+34
Asia	208/300	57/96	57/74	–

\* The numerator represents average volumes for 1974–1976 and the denominator for 2000.

\*\* Including consumption of unprocessed roundwood (about 10% of pitprops, etc.).



expected to have exports amounting to  $1 \cdot 10^7 \text{m}^3$  (compared to 5 million  $\text{m}^3$  in 1980).

European planned-economy countries (the USSR included) will be the most important suppliers of industrial wood (after the developing countries) to the Western Europe market and to Japan.

## **6. IMPROVEMENT OF THE USSR WOOD RAW MATERIAL PRODUCTION AND CONSUMPTION PATTERN**

The dominant trend in the USSR forest economy of the 1970–1983 period (particularly in the sphere of wood production and consumption as well as development of the wood raw material base) has been represented by successive increase of levels and rates for complex use of harvested wood based on accelerated development of chemical and chemical-mechanical processing.

This has been objectively preconditioned by significant expansion of wood-based panel production capacities, resulting in an increased output level in 1983: 3.1 times for particleboard and 2.5 times for fiberboard compared to the output in 1970, as well as a considerable increase in new and recycled paperboard container output and in chips for pulping. It should be noted that sawmilling residues and low quality wood (fuelwood) were the main raw material sources for manufacture of these products. The shift in raw material use at that time permitted stabilization of harvested volumes, also increasing total wood and paper product output.

Stabilization of the harvest volumes proceeded along with forest management intensification and strict control of allowable cut levels. This is of special importance in the period under review when a significant share of the logging activities was shifted from the European to the Asian part of the country, leading to an increase in Asian harvests of 6 million  $\text{m}^3$ .

Increased utilization of wood residues and low quality wood for processing has been until the present a characteristic feature of general policies directed to reduction of unprocessed roundwood consumption.

Industrial unprocessed roundwood consumption decreased from 28.8% in 1970 to 23.2% in 1983; accordingly, consumption of processed roundwood share increased.

Fuelwood consumption as a raw material for processing increased even more, from 9.1% in 1970 to 32.5% in 1983; i.e., 3.6 times.

Installation of new capacities for chemical and chemical-mechanical wood processing make it possible to expand hardwood exploitation resulting in a 30% increase in soft hardwood harvests.

It should be taken into consideration that the allowable cut of hardwood has been to a significant extent underexploited and possibilities for further expanding of this wood raw material use have not yet been exhausted; therefore the development trend to increase of soft hardwood harvests would be of a permanent character in future.

Consumption of residual chips and fuelwood for processing as substitutes for high grade pulpwood increased in 1983 by 9.6 million  $\text{m}^3$ ; i.e., about 2 times compared to the 1970 level.

As a result of all these changes in the pattern of wood raw material production and consumption as a whole, the share of effective industrial wood-substituting materials has considerably increased. The material output for the period under review amounted to 1133 million m<sup>3</sup>; that is, over 6 million ha of forest lands have been conserved from cutting.

## **7. SUMMARY**

The latest FAO forecasts are only approximate estimates, but it is evident that the wood raw materials balance will be maintained to 2000, but with increasing strain. Demand for imported softwood saw logs and pulpwood is expected to grow to a considerable extent.

The prices for high quality, large diameter logs will inevitably increase in the situation described and the rate of increase will be higher than for other wood products. The market conjuncture will create rather favorable conditions for wood product exports, which is especially true for countries with surplus softwood growing stock, i.e., primarily for Canada and the USSR.

Western Europe and Japan (situated geographically near to the USSR) will suffer from wood products shortage to a greater extent than all other countries and regions of the world. Considerable interest in imports from the USSR will be preserved in the planned-economy and Northern countries of Europe.

The USSR's prospects as one of the leading wood exporters will depend directly on solving the most important problems of the forest complex as a whole.