Table B-3 Trends in Production of Substitute Materials for Wood

	Panels for prefabricated buildings ($1,000 m^3$)					Metal fittings (MT)				Plaster goods ($1,000 m^3$)				Cement goods (1,000 pieces)				
	Total	Concrete panels	Light steel frame panels	Wooden panels	Other panels	Steel sashes	Steel doors	Aluminum sashes	Aluminum doors	Total	Plaster board	Lath board	Sound-absorbing board	Corrugated asbestos slates	Asbestos cement board	Exelsior cement board	Concrete balls (MT)	Hollow concrete blocks (1,000)
Actual figures																		
1965	-	-	-	-	-	93,826	41,679	21,222	6,017	117,026	43,437	69,752	3,838	33,260	13,514	10,765	518,626	394,854
1966	-	-	-	-	-	83,904	37,119	36,557	6,561	124,584	49,141	71,466	3,977	37,532	15,877	12,416	522,297	415,709
1967	9,706	2,195	576	6,206	729	94,386	40,712	56,524	6,547	144,964	54,741	86,238	3,984	48,718	18,268	15,028	619,407	451,893
1968	12,100	2,746	944	7,603	808	96,835	44,159	88,395	7,589	166,663	61,397	100,690	4,576	55,784	17,704	16,802	641,363	513,641
1969	16,259	3,490	1,282	10,135	1,352	109,363	53,028	143,157	9,179	187,135	68,148	114,980	4,008	59,975	20,678	18,445	730,224	560,529
1970	22,038	4,499	1,852	14,229	1,458	123,320	64,224	197,404	11,622	213,113	79,639	129,445	4,029	64,399	25,754	22,597	875,438	583,877
1971	22,484	4,734	1,629	14,800	1,321	88,396	64,079	234,709	13,709	194,238	79,962	110,635	3,641	47,451	29,213	18,641	786,671	563,608
1972	26,859	5,134	2,237	18,422	1,065	90,989	66,956	322,346	18,696	227,941	101,597	122,263	4,081	41,915	35,471	20,721	906,085	569,265
1973	36,121	5,246	3,539	26,222	1,114	118,453	88,276	458,478	26,440	238,179	90,582	144,311	3,286	57,566	46,427	23,583	1,100,267	699,538
1974	31,417	4,759	2,714	22,954	990	99,152	85,667	417,919	34,386	200,625	81,081	116,780	2,764	45,516	40,174	21,467	1,007,416	637,211
1975	18,820	3,510	2,527	12,551	231	61,739	66,480	355,559	31,399	165,047	67,882	95,503	1,662	38,261	31,342	17,288	754,566	506,537
1976	20,688	2,866	3,009	14,435	378	52,481	68,341	463,957	45,764	170,477	77,555	91,297	1,625	40,085	39,131	17,680	1,018,597	390,608
1977	20,270	3,154	2,284	14,577	254	49,125	70,264	439,219	36,761	191,345	93,913	95,631	1,801	40,787	35,892	16,645	1,212,158	375,051
1978	20,116	3,213	2,389	14,457	58	45,460	72,583	458,294	34,254	214,966	111,651	101,182	2,133	34,783	34,812	16,740	1,454,157	377,650
Index*																		
1965	-	-	-	-	-	106.1	65.0	9.0	43.9	60.2	54.3	63.0	105.4	70.1	46.3	57.7	65.9	70.1
1966	-	-	-	-	-	94.9	57.9	15.6	47.9	64.1	61.5	64.6	109.2	79.1	54.3	66.6	66.4	73.8
1967	43.2	46.4	35.4	41.9	55.2	106.8	63.5	24.1	47.8	74.6	68.5	77.9	109.4	102.7	62.5	80.6	78.7	80.2
1968	53.8	58.0	57.9	51.4	61.2	109.5	68.9	37.7	55.4	85.8	76.8	91.0	125.7	117.6	60.6	90.1	81.5	91.1
1969	72.3	73.7	78.7	68.5	102.3	123.7	82.8	61.0	67.0	96.3	85.2	103.9	110.1	126.4	70.8	98.9	92.8	99.5
1970	98.0	95.0	113.7	96.1	110.4	139.5	100.2	84.1	84.8	109.7	99.6	117.0	110.7	135.7	88.2	121.2	111.3	103.6
1971	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1972	119.5	108.4	137.3	124.5	80.6	102.9	104.5	137.3	136.4	117.4	127.1	110.5	112.1	88.3	121.4	111.2	115.2	101.0
1973	160.7	110.8	217.2	177.2	84.3	134.0	137.8	195.3	192.9	122.6	113.3	130.4	90.2	121.3	158.9	126.5	139.9	124.1
1974	139.7	100.5	166.6	155.1	74.9	112.2	133.7	178.1	250.8	103.3	101.4	105.6	75.9	95.9	137.5	115.2	128.1	113.1
1975	83.7	74.1	155.1	84.8	17.5	69.8	103.7	151.5	229.0	85.0	84.9	86.3	45.6	80.6	107.3	92.7	95.9	89.9
1976	92.0	60.5	184.7	97.5	28.6	59.4	106.7	197.7	326.5	87.8	97.0	82.5	44.6	84.5	134.0	94.8	129.5	69.3
1977	90.2	66.6	140.2	98.5	19.2	55.6	109.7	187.1	268.2	98.5	117.4	86.4	49.5	86.0	122.9	89.3	154.1	66.5
1978	89.5	67.9	146.7	97.7	4.4	51.4	113.3	195.3	249.4	110.7	139.6	91.5	58.6	73.3	119.2	89.8	184.8	67.0

* Base year: 1971

Source: Investigation and Statistics Department of the Ministry of International Trade and Industry, Monthly Report of Ceramic Building Material Statistics (in Japanese)

field of metal fittings, aluminum sashes for example moved from 24.1 in 1967, to 61.0 in 1969, 100.0 in 1971, 195.3 in 1973, 151.5 in 1975, and 195.3 in 1978. In the realm of plaster goods, plaster board for example changed from 68.5 in 1967, to 85.2 in 1969, 100.0 in 1971, 113.3 in 1973, 84.9 in 1975, and 139.6 in 1978. In cement goods, for example asbestos cement pieces, the movement shown was from 62.5 in 1967, to 70.8 in 1969, 100.0 in 1971, 158.9 in 1973, 107.3 in 1975, and 119.2 in 1978. On the other hand, general sawtimber, mainly house timber, changed from 92.6 in 1967, to 99.6 in 1969, 100.0 in 1971, 103.7 in 1973, 92.5 in 1975, and 96.3 in 1978. Thus, it may be said that substitute materials for wood generally are more active in the market than wood.

In all developed industrial countries substitute materials have appeared and entered the market in a remarkable way, even if overall not as much as in the case of Japan.

According to calculations made by Ueno and Tatemoto, the relationship between charcoal and processed ground charcoal, and between charcoal and firewood is complementary.[1] The results of calculations by Allen's formula based on the data obtained throughout the country shows that the relationship between firewood and charcoal is complementary, because in terms of consumption it is not competitive. In contrast, the relationship between firewood and other fuels is competitive. From the quantitative point of view especially, the substitutability between firewood and propane gas, fuel oil or electricity is high. This is due to the ease of use of firewood compared with charcoal and to the difference in their competitiveness due to of pricing.

1) The reason for the relationship between charcoal and firewood being complementary is that the patterns of use and the consumption structures of charcoal and firewood are interdependent, and their demand increases or decreases together. This is unlike the case in which charcoal is replaceable by propane or kerosene.

C. INTERNATIONAL TRADE

I. Trade Trends

1. Trade Trends by Product

The volumes of exports and imports and the trade balance by regions for non-conifer logs, non-conifer sawnwood, non-conifer plywood and non-conifer wood chips, which have been derived from the FAO's Yearbook of Forest Products, are shown in Tables C-1 to C-4 and Reference Table 1. It can be seen in these Tables that the world volume of trade in the major non-conifer forest products reached a peak in 1973, bottomed out in 1975, then began to increase again, reaching another peak in 1979, whereupon it subsequently decreased due to the worldwide recession.

On the whole, the products from the Asian tropical rain forests hold a large share of world non-conifer trade.

1.1 Non-Conifer Logs for Sawnwood and Plywood (Refer to Table C-1)

In 1980, the volume of world trade in non-conifer sawlogs and veneer logs totaled approximately 42 million m^3. The volume of exports from the temperate forests in Europe and North America was approximately 3 million m^3, while that from the world's tropical rain forests was approximately 38 million m^3; comprising 31 million m^3 from the Philippines and other regions in Asia, 6.5 million m^3 from West Africa and other regions in Africa, and 100,000 m^3 from Latin America. Regarding the regional balance of trade, countries under the "Other developed" category in the Tables (mainly Japan) are importing most of this output. The net volume of imports hit an unprecedented peak of 26 million m^3 in 1973, and decreased afterwards to approximately 19 million m^3 in 1980. This tendency towards decline appears to have continued in 1981 and 1982. One point worthy of attention is that North America had been a net importing region until 1971, but after that it changed to become a net exporting region, with net exports increasing to the level of 300,000 m^3 in 1980, in spite of the world recession. The West European countries naturally constitute an importing region. The net volume of log imports to the region reached a peak of 9 million m^3 in 1973, and are expected to be maintained at a level of 7 million m^3 in in the future. With regard to imports to the Asian countries with centrally planned

Table C-1 Trade Trends of Non-conifer Logs
(Balance of trade = quantity exported - quantity imported)

(1,000 m^3)

Region and countries	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Developed																
North America	-49	-4	-65	-26	-37	-109	-76	38	108	130	10	179	187	113	128	313
Western Europe	-5,197	-5,315	-5,129	-5,798	-7,104	-6,430	-6,710	-7,521	-9,102	-6,985	-5,320	-7,025	-7,352	-6,330	-6,897	-7,043
Oceania	-155	-51	-69	-98	-105	-116	-80	-81	-92	-94	-38	-45	-23	-15	-10	2
Other developed countries	-9,626	-12,376	-13,949	-14,650	-17,481	-20,042	-21,241	-21,458	-26,473	-25,187	-17,415	-22,156	-21,332	-22,187	-22,254	-19,364
Subtotal	-15,026	-17,746	-19,213	-20,572	-24,727	-26,696	-28,108	-29,023	-35,560	-32,134	-22,763	-29,046	-28,519	-28,420	-29,033	-26,090
Developing																
Africa	5,521	5,475	5,477	6,336	7,673	6,606	6,577	7,177	8,576	6,529	5,035	6,059	5,808	5,492	6,131	6,200
Latin America	171	214	86	159	169	138	78	38	390	57	-102	18	-10	-45	25	49
Near East	-68	-42	-28	-73	-17	-9	-45	-21	-16	-29	-51	-122	-110	-96	-38	-39
Asia	11,236	12,871	13,970	16,690	20,032	23,876	25,039	26,323	33,124	28,410	22,024	28,034	28,195	28,784	26,268	24,149
Other developing countries	56	98	198	273	310	421	685	647	679	866	580	663	654	650	699	699
Subtotal	16,916	18,616	19,703	23,385	28,166	31,033	32,335	34,162	42,752	35,833	27,485	34,652	34,538	34,785	33,085	31,058
Centrally Planned Economies																
Asia	-649	-683	-723	-1,111	-1,186	-1,521	-2,240	-3,972	-3,985	-3,798	-3,870	-4,012	-5,805	-7,053	-7,053	-7,053
USSR + Eastern Europe	-137	-115	-265	-346	-362	-187	-239	-190	-243	-144	-234	-344	-221	-114	6	0
Subtotal	-786	-798	-988	-1,458	-1,547	-1,708	-2,479	-4,162	-4,228	-3,942	-4,104	-4,356	-6,026	-7,167	-7,047	-7,053
Total	1,106	72	-498	1,319	1,893	2,627	1,747	978	2,965	-244	618	1,251	-9	-803	-2,995	-2,084
Brazil	51	58	79	117	114	78	95	77	360	69	-70	-26	-35	-67	-36	-49

Source: FAO, Yearbook of Forest Products

Table C-2 Trade Trends of Non-conifer Sawnwood
(Balance of trade = quantity exported - quantity imported)

(1,000 m^3)

Region and countries	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Developed																
North America	-336	-354	-390	-431	-603	-334	-329	-423	-660	-707	-156	-473	-504	-90	-464	-232
Western Europe	-1,389	-1,407	-1,415	-1,753	-1,919	-2,037	-1,904	-2,229	-3,403	-2,174	-2,013	-2,634	-3,027	-2,864	-4,154	-3,641
Oceania	-231	-167	-140	-207	-193	-238	-245	-227	-284	-398	-250	-322	-414	-281	-263	-263
Other developed countries	-172	-29	-200	-318	-342	-537	-532	-579	-782	-776	-420	-411	-371	-527	-478	-648
Subtotal	-2,127	-1,957	-2,146	-2,711	-3,057	-3,145	-3,011	-3,457	-5,130	-4,057	-2,839	-3,840	-4,315	-3,762	-5,360	-4,785
Developing																
Africa	561	592	540	571	588	587	518	575	765	595	512	574	566	494	506	509
Latin America	217	236	252	304	359	434	361	435	668	150	-152	245	253	119	488	326
Near East	-73	-78	-83	-96	-141	-78	-92	-75	-57	-329	-380	-444	-826	-816	-663	-656
Asia	1,173	1,138	1,227	1,444	1,858	2,049	2,026	2,458	3,145	2,549	2,317	4,090	3,628	3,618	4,889	4,332
Other developing countries	1	3	4	5	4	-3	9	17	20	37	19	30	37	46	51	55
Subtotal	1,878	1,892	1,933	2,229	2,668	2,990	2,822	3,410	4,541	3,003	2,316	4,494	3,667	3,462	5,271	4,566
Centrally Planned Economies																
Asia	45	39	42	54	49	33	101	169	151	91	110	106	53	59	59	59
USSR + Eastern Europe	287	340	309	410	478	538	563	456	471	326	307	348	339	426	332	316
Subtotal	331	379	352	463	527	571	664	625	622	416	417	454	391	485	391	375
Total	83	314	97	-18	139	414	473	578	33	-638	-106	1,109	-257	185	302	156
Brazil	65	71	75	82	90	147	160	199	333	243	110	81	48	31	191	105

Source: FAO, Yearbook of Forest Products

Table C-3 Trade Trends of Plywood
(Balance of trade = quantity exported - quantity imported)

(1,000 m^3)

Region and countries	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Developed																
North America	-656	-798	-732	-1,270	-1,507	-1,420	-1,975	-2,531	-1,767	-1,150	-1,469	-1,753	-1,595	-1,696	-1,164	-286
Western Europe	-531	-488	-710	-801	-772	-942	-838	-1,025	-1,499	-1,097	-1,088	-1,644	-1,498	-1,763	-2,118	-1,650
Oceania	-22	-26	-26	-33	-29	-32	-36	-38	-47	-77	-60	-98	-79	-55	-48	-36
Other developed countries	424	416	366	457	395	93	306	178	-601	-319	-35	173	133	73	68	5
Subtotal	-784	-896	-1,104	-1,648	-1,913	-2,304	-2,542	-3,417	-3,914	-2,642	-2,653	-3,422	-3,039	-3,440	-3,262	-1,967
Developing																
Africa	64	55	49	68	67	68	20	56	71	11	18	3	-58	-29	-52	-59
Latin America	-16	-18	-24	-21	-32	-19	-40	-31	-12	-48	-59	-10	4	27	47	95
Near East	-66	-70	-46	-44	-62	-72	-93	-133	-204	-278	-255	-370	-524	-566	-673	-643
Asia	248	382	475	903	1,008	1,235	1,531	1,888	2,313	1,568	1,818	2,487	2,516	2,657	2,509	2,127
Other developing countries	6	5	2	3	3	3	3	1	5	9	5	4	-1	-1	-4	-3
Subtotal	236	354	461	911	985	1,215	1,421	1,782	2,172	1,264	1,526	2,114	1,935	2,088	1,828	1,518
Centrally Planned Economies																
Asia	247	282	305	413	522	589	809	947	954	686	764	860	936	1,230	1,230	1,230
USSR + Eastern Europe	269	244	256	280	269	266	264	256	329	258	449	281	341	348	345	338
Subtotal	516	526	560	693	791	855	1,073	1,203	1,282	944	1,011	1,141	1,278	1,578	1,576	1,568
Total	-33	-17	-82	-42	-137	-228	-48	-433	-459	-435	-115	-167	174	224	143	1,119
Brazil	6	7	6	12	11	29	29	32	43	30	32	45	50	76	110	115

Source: FAO, Yearbook of Forest Products

Table C-4 Trade Trends of Wood Chips
(Balance of trade = quantity exported - quantity imported)

(1,000 m^3)

Region and countries	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
USA	-613	-530	-111	1,177	2,663	2,629	2,226	2,978	4,248	4,953	4,157	5,051	4,942	4,311	5,206	5,004
Canada	839	985	1,205	1,216	778	976	852	753	800	652	522	780	1,015	1,231	1,291	1,488
China (incl. Taiwan)	-	-									-81	-192	-192	-192	-192	-192
Japan	-320	-596	-1,387	-3,880	-4,879	-5,966	-4,179	-5,772	-8,770	-10,028	-8,434	-9,631	-13,820	-13,116	-10,974	-12,075
Malaysia	-	-	-	-	287	613	480	737	731	962	906	585	715	498	282	301
Europe (total)	-38	-181	-2	-99	-73	-60	-77	-170	-142	-133	-376	-452	-842	-297	-595	-826
Australia	-	-					319	829	1,930	2,490	2,613	3,457	4,786	4,635	4,957	6,599
New Zealand	-	-				183	217	204	237	309	379	329	498	400	350	400
Papua New Guinea	-	-								10	68	143	115	115	115	193
USSR	-	-	-	19	11	27	19	23	22	51	226	226	226	226	482	367
Total	-131	-322	-297	-1,568	-1,214	-1,598	-143	-418	-945	-734	-19	295	-2,557	-2,188	922	1,259

Source: FAO, Yearbook of Forest Products

economies of the Table C-4, the volume of imports of Taiwan are also included in this category.

Asia is largest net exporter of non-conifer logs. After a record volume of 33 million m^3 was exported in 1973, exports from this region decreased to the level of 24 million m^3 in 1980. Exports from Africa reached a peak of 8.5 million m^3 in 1973, and have subsequently remained at around 6 million m^3. Although the volume of production in Latin America reached 25 million m^3 in 1980, net exports were only 49,000 m^3 because of active domestic consumption and the policy restricting the export of logs. In 1975, 1977 and 1978, Latin America became a net importing region. Consequently, this region plays a comparatively insignificant role in international log trade at the moment.

Recently, many developing countries, especially in Southeast Asia and West Africa, have begun to take measures for promoting their domestic industry, to effectively utilize the forest resources they own, and a tendency toward severe restrictions on log exports and toward local industrialization is appearing. Consequently, log exports from these countries are begining to be replaced by processed wood exports, resulting in a change in the international hardwood trade. Quantitative changes in industrialization in Indonesia and Malaysia are particularly noticeable. The wood industry, especially the plywood industry, in Japan, Republic of Korea, Taiwan, Singapore, etc., which had been relying on logs from Southeast Asia, is consequently beginning to experience a significant adverse effect, and the volume of log imports by Taiwan has drastically decreased.

1.2 Non-Conifer Sawnwood (Refer to Table C-2)

In 1980, non-conifer sawnwood trade saw a volume of exports from Asia of 6.3 million m^3, the largest share, at approximately 50% of total world exports. Regarding the regionwise balance of trade, the developed countries are net importers of non-conifer sawnwood, which is covered by net exports from countries in tropical Asia and Africa, following the pattern of the log trade. A notable aspect is that the volume of imports by the Near East has recently been rapidly increasing, reaching ten times the volume of imports before the first oil crisis. This is thought to be due to increased demand and consumption of wood in this region following the increase in income from oil exports. It can be expected that the volume of exports to the region will continue to increase.

The total volume of production in Latin America is 12 million m^3, while net exports amount to only 300,000 m^3. This is considered to be because the general-purpose sawnwood produced is consumed within the region and only special non-conifer sawnwood

is exported. The volume of production in and exports from tropical Asia are 16 million m^3 and 4 million m^3 respectively, and the policy of promoting exports seems to have borne fruit in Asia. In spite of the fact that the volume of production in Africa has more than doubled, the net volume of exports has been maintained at around 500,000 m^3, with marginal fluctuations, over the past 15 years. This tendency is expected to continue in the future.

1.3 Plywood (Refer to Table C-3)

For trade in plywood, the exports from the Southeast Asian countries such as Indonesia, Malaysia and the Philippines hold the largest share, at approximately 40% of the world total, as in the case of logs and sawnwood. When the volume of exports from Taiwan and Republic of Korea is included, more than half of the plywood traded internationally comprises tropical wood produced in Southeast Asia. This situation is more apparent when the regional balance of trade is studied, in which the increasing volume of exports to the world market of plywood made of wood from Southeast Asia can be seen. The net volume of imports by the Near East has been rapidly increasing, multiplying to ten times the volume imported a decade ago, and imports by this region are expected to show continued growth in the future.

1.4 Wood Chips (Refer to Table C-4)

Most of the wood chips traded internationally, except for a small volume traded as the raw material for fiber board and particle board, are used as a raw material for pulp. The aquisition of inexpensive raw materials and technical innovations to enable raw materials of low grade to be utilized have been important features of the history of the paper and pulp industry. For example, conifer wood was replaced by low quality non-conifer wood, bagasse, etc., and the European pulp industry began to move to Canada, where abundant pulp wood was available. Moreover, as the cost of pulp wood rose, residues wood produced in the sawing and manufacturing of plywood, which had previously been discarded or burnt, began to be generally utilized as a pulp material after being chipped. On the West Coast of North America, where sawnwood and plywood were being produced, the paper and pulp industry began to use this chipped wood as the main raw material. Thus, an increasing number of factories do not own on-site facilities for producing chips from logs, but buy residues wood chips from elsewhere to use for pulp. As it permits smoother handling, transportation and storage, it is advantageous to trade pulp material in the form of chips instead of logs. In comparison with logs, chips can be readily handled at low cost without requiring any special technique, can also be stored without being damaged

significantly even by fire, and so offer fewer management problems.

Furthermore, chips from residues wood are usually cheaper than chips from logs. Therefore, pulp companies tend to buy residues wood chips, even when they are of a slightly lower grade.

Table C-4 is based on data on the wood chips trade from the FAO, Yearbook of Forest Products. Apart from the export of conifer wood chips from North America (mainly the United States) to Europe (mainly Sweden and France), Japan can be said to be playing a central role in the trade of wood chips. Japan imports wood chips from various regions. The trends of wood chip demand in Japan have a major impact on the industry, particularly in North America, Southeast Asia and Oceania.

For the importation of wood chips into Japan, comparatively small chip carriers are used to transport them from Southeast Asia because of the short distances involved, while for imports from North America and Oceania larger chip carriers are employed to reduce transportation costs over these greater distance.

According to the pulp material acquisition plan of the pulp industry in Japan, the relationship between the quantities of domestic and imported materials used is as follows:

(1,000 m^3)

	Total	Logs		Chips		Total	
		Domestic	Imp.	Domestic	Imp.	Domestic	Imp.
1981	28,463	1,763	105	14,751	11,844	16,514	11,949
1982	28,700	1,740	80	15,150	11,730	16,890	11,810
Breakdown							
1981	100	6.2	0.4	51.8	41.6	58.0	42.0
1982	100	6.1	0.2	52.8	40.9	58.9	41.1

Note: These data are based on materials prepared by the Japan Paper Association.

The volume of production of paper and paperboard increased in 1982, rising to 103.7% of the level of the previous year, while the volume of pulp materials collected remained almost unchanged, the reason for this being that the volume of recycling and utilization of waste paper increased.

Since the ocean transportation costs of imported chips rose, domestic sources for the materials were sought, and the quantity

of waste paper recycled in Japan rapidly increased with the development of waste paper recycling technology.

The volume of waste paper used and the ratio of recovery of waste paper in the Japanese paper and pulp industry are shown below. There is currently a tendency toward reducing the volume of wood chips imported and toward importing waste paper from North America instead, and waste paper is becoming a serious competitor of wood chips as the transportation costs of the latter rise.

	Volume of used waste paper (1,000 tons)	Ratio of waste paper utilization			Recovery rate of waste paper
		Total	Paper	Paperboard	
1976	6,318	38.7%	16.2%	65.7%	41.5%
1977	6,611	39.6	16.9	66.9	43.0
1978	6,989	39.9	17.9	67.8	42.1
1979	7,826	41.2	18.5	69.1	43.4
1980	7,931	41.5	20.0	70.2	46.2
1981	7,990	44.7	23.5	73.0	47.3

Note: 1) The ratio of waste paper utilization is the volume of waste paper used as a percentage of the total volume of fibrous materials used for manufacturing paper, paperboard and other related products.
2) Compiled from data prepared by the Japan Paper Association.
3) The ratio of recovery of waste paper in Japan is the highest in the world.

Features of international transactions in wood chips are as follows:

a. Chips of a single type of wood are bulked together for shipping. For example, spruce, fir and pine are treated as being of the same kind, but among the conifers, Douglas fir, hemlock, red cedar and yellow cedar are treated separately. Also, the mixing of non-conifer wood chips is not favored, because it tends to cause problems when used for producing pulp.

b. Since the transportation cost of low specific-gravity chips is rather high, the FOB price tends to be lower.

In Japan, which is the main consuming country, wood pulp production is not expected to increase in the future, partly because there is little possibility of pulp production facilities being significantly expanded due to environmental problems and the

difficulty of securing water supplies, and also partly because the volume of waste paper used will continue to increase. The domestic production of chips from residues wood, especially from conifer residues wood, has been tending to decrease due to a reduction in the volume of logs imported and an increase in imports of sawnwood. There is also the possibility of an increase in the volume of domestic logs being produced, and so the relationship among the various pulp materials is expected to remain unchanged for the present. Since movements in the price of oil strongly affect the transportation costs of imported chips, it is considered that cost restrictions on the importation of chips from distant regions will become more severe.

2. Inter-Regional Trade in Tropical Forest Products

As shown in Table C-5, which has been compiled from data provided in FAO, EC is importing tropical forest products mainly from Africa, with the remainder coming from Asia. Japan imports tropical forest products from Southeast Asia, mostly in the form of logs. On the other hand, the United States imports tropical sawnwood from Latin America and Asia, and tropical plywood for interior use from Asia. Long distance transportation of tropical fancy wood, e.g., teakwood, is possible because the high transportation costs can be recovered. However, common wood is usually imported from regions which are as close as possible in order to avoid long-distance transportation, because the selling price of the wood is too low in relation to its weight. The reason why the EC is importing sawnwood and plywood in large quantities from Southeast Asia rather than logs is thought to be that there are limitations on the export capability of Africa and Latin America. Since it seems to be difficult for Africa to expand its export capacity due to forest resource problems, it can be said that there is a fairly large possibility for the volume of exports from Latin America to the United States and Western Europe to increase.

II. Major Exporting and Importing Countries

1. Situation in Major Exporting Countries (Export and Other Conditions)

The Southeast Asian region, which exports the largest quantity of hardwood products (logs, sawnwood, plywood, etc.) mutually cooperate within the framework of ASEAN. Moreover, the forest industries of Indonesia, Malaysia (Sabah) and Papua New Guinea have

Table C-5 Major Trade Flows of Tropical Forest Products, 1977

(1,000 m^3)

From \ To / Article	EC			Japan			USA		
	Logs	Sawn-wood	Ply-wood	Logs	Sawn-wood	Ply-wood	Logs	Sawn-wood	Ply-wood
Africa	3,528	406	35	52	-	-	15	37	1
Asia & Oceania	767	1,731	584	21,030	286	42	3	259	1,761
Latin America	21	87	25	9	4	-	1	281	10
Total	4,316	2,224	644	21,091	290	42	19	577	1,772

Source: FAO, Major Trade of Tropical Logs, Sawnwood and Plywood, 1977

organized SEALPA (South East Asia Lumber Producers Association) and expect to achieve results similar to those of OPEC.

UNCTAD also has plans to undertake various measures, such as measures for maintaining and reforestation of tropical woods, R & D projects, etc., by way of concluding commodity agreements.

1.1 Indonesia

Indonesia, the country which produces the largest volume of wood in Southeast Asia, announced a total ban on log exports beginning from 1985; with the upper limit of annual log exports set at 4.5 million m^3 for 1982, 3 million m^3 for 1983, 1.5 million m^3 for 1984 and coming to a complete halt from 1985 onwards.

Although the facilities, capacity and volume of plywood production in Indonesia greatly increased from 1980 to 1982, this was unable to be followed up by sufficient marketing. The volume of sales abroad did not increase as rapidly as expected due to the worldwide recession, and the plywood manufacturers in Indonesia are said to now be in difficulties. In particular, the export price to the United States, which had been expected to become the main importing country for their products, has dropped, and the manufacturers are said to have been forced to sell their plywood below cost. The plywood industries in Republic of Korea, Taiwan, Singapore and other countries which import logs as a raw material from Southeast Asia, and produce plywood for export, now cannot compete against the plywood exports from Indonesia. As a matter of fact the export price of logs is much higher than that of logs for domestic use, because an export tax, high royalties, etc. have to be included. In the Republic of Korea, a number of plywood

manufacturers went bankrupt one after another. According, the plywood industry was reorganized and some of the facilities were disposed of under the guidance of the Government. The industry has now been obliged to switch to the production of plywood for domestic use instead of for export.

To maintain the export price of plywood, Indonesia recently adopted a registration and permit system for exporters. Furthermore, a check price system has also been established, with an export tax now being levied on all logs and sawnwood exported.

With regard to veneer, only the export of kiln dried veneer is permitted at present, and there is a strong likelihood that Indonesia will place a general ban on exports of veneer in the near future, in which case Singapore, Republic of Korea, Taiwan and other countries, which are competing with Indonesia in plywood production and are also large-scale veneer importers, are expected to be significantly affected.

1.2 Malaysia

Peninsular Malaysia, together with Singapore, has the most highly developed wood manufacturing industry in Southeast Asia. However, logs from the region are already short in supply, and log exports from the region are banned. Most of the products are exported to the EC. It is considered that an increase in the volume of production will be difficult to achieve.

In Sabah State on the Island of Borneo, most of the tax revenue of the State Government comes from royalties on log exports. However, although the volume of logs exported decreased by half over the five years ending in 1982, there is an argument that the volume of log exports could not be reduced any further because of financial reasons. This is partly because it is not desirable to increase the rate of felling in view of sustaining forest resources. At present, the State Government has likely to give the new cutting right only to the Sabah Foundation to strengthen its control over felling, and is also probably planning a rise in the price of logs for export. To cope with the shortage of tax revenues, the State Government has begun to levy export taxes on forest products such as sawnwood, plywood and veneers for the first time, and has also announced a restriction and registration system for exporters in Sabah commencing from the beginning of January 1983 to maintain the log export prices.

Furthermore, artificial reforestation has been commenced in Sabah, using fast growing tree species, and the State Government has announced the possibility of the export of pulpwood felled in the man-made forests from 1985.

In Sarawak State, which is also on Borneo Island, the trade in wood is less important from an economic viewpoint because of the revenues from oil exports. The state is not a formal member of SEALPA. Although measures are taken to promote industrialization in its wood industry, the state also has the principle of exporting logs. Since large-scale forest exploitation started in Sarawak later than in Sabah and the volume of forest resources is large, timber exports from Sarawak can be expected to continue for a long period. Consequently, it is considered that Sarawak will become a major log exporting country, and this is expected to compensate for the decrease in the volume of log exports after the ban on log exports comes into effect in Indonesia. Saw mills started operation in Sarawak a comparatively long time ago, producing sawnwood, mainly "Ramin" (Gonystylus spp.) for Italy.

1.3 The Philippines

Although the Philippines was a major log exporting country, exporting 8.5 million m^3 of logs annually until a decade ago, the annual volume of exports is now less than 1.5 million m^3. This is partly because the growing stock has decreased due to excessive felling, and partly because the Government has taken measures to restrict log exports and switched to domestic processing. The volume of exports of processed wood (sawnwood and plywood) has greatly increased, and the main importing country is the United States.

1.4 Papua New Guinea

Although Papua New Guinea is expecting to develop its wood industry, the number of tree species found in this country is large because of the forest type, and the commercialization and export of lesser known species is said to be difficult. With the exception of certain species, there are no restrictions on log exports at present. However, the volume of log production is limited because of the limits imposed by the availability of labor, and is expected to remain at the present level for the time being. The check price system has also been adopted for products to be exported, as in the case of other countries.

1.5 West and Central Africa

Since the forests in West and Central Africa are tropical rain forests, the volume of hardwood logs produced in the region is large. The countries in the region maintain close relations with their former colonizers, mainly France, which is a particular feature of the region and is not generally found in other tropical

regions. Recently, the volume of wood used domestically has been increasing in these countries due to population growth and economic development. The Ivory Coast, the Central African Republic, Cameroon, Liberia and Gabon now permit the export of logs only when linked with the manufacturing and export of processed wood, under these countries' policies for the promotion of industrialization, which are commonly adopted by resource-holding countries, and also because the volume of their forest resources is decreasing due to excessive felling, also a common phenomenon found in resource-holding countries. Ghana, which had previously been exporting a significant volume of logs, placed a ban on the export of the major species from January 1979. According to the FAO Trade Yearbook, the volume of logs exported annually from the region is approximately 6 million m^3, and is expected to gradually decrease in the future.

The tropical rain forests of West and Central Africa are located deep inland, and the infrastructure for logging is not well developed. Southeast Asia possesses a geographical advantage in that logs can be readily transported by rafting them down rivers. However, this is not possible in West and Central Africa, and logs have to be transported for long distances overland from the felling site. Since the roads are in poor condition, the use of large trucks is limited, and in many cases, only high-grade logs of certain species are extracted due to restraints imposed by the cost factor.

The processing of logs is often carried out with investment made by the former colonizers, with the products being exported through the same route back to these countries in Europe. These exports of wood products compensate for the reduction in log exports.

2. Situation in Major Importing Countries (Import Duties and Other Conditions)

Japan, Republic of Korea and Taiwan import tropical hardwood logs in large quantities, and the volume of imports by these three countries amounts to more than half of the total volume of logs traded internationally. The West European countries hold the second-largest share of imports.

Almost all of the logs imported by Japan are used as the raw material for processed wood (70% for plywood and 30% for sawnwood), which is produced and consumed domestically. Only very few commodities are exported. In Japan, the consumption of logs for plywood production is larger than in other countries, because plywood for construction, including that for use in concrete panels, is also being produced from tropical hardwood logs.

Republic of Korea and Taiwan have a flourishing processing trade, and most of the logs imported are used as raw materials for export wood products.

Among the West European countries, some mainly import logs (e.g. France, Italy and Greece) and others mainly import finished products and semi-finished products (e.g. the United Kingdom and the Netherlands), depending on their wood processing facilities and production capacity. The attitudes towards timber importation of the West European countries appear to be determined by the overall policy of the EC. Although imports of sawnwood and plywood by Western Europe from Southeast Asia have become active due to a lack of expansion of the export of logs and sawnwood from West Africa, rising transportation costs are becoming a problem. Refrigerated container ships are occasionally used for the transportation of Ramin to West European countries to prevent damage from fungi and staining. The West European countries intend to expand their imports from Southeast Asia, to the extent that this is viable considering the transportation costs involved.

The United States and Canada are the major countries exporting coniferous plywood, mostly plywood for construction use, and they are also major importers of plywood manufactured from logs produced in Southeast Asia, mostly "lauan" (Dipterocarpaceae) plywood. It is to be noted that the price competition between this imported plywood and non-coniferous plywood or the recently developed wood panels products (wafer board, etc.) produced in North America is becoming keen. In particular, the production cost of wood panels is comparatively low due to the fact that adhesives are inexpensive in North America, creating an unfavorable environment for imported "lauan" plywood.

Generally speaking, countries without forest resources or wood processing facilities place little or no restrictions on wood imports. However, in countries with domestic wood industries, the products of which have to compete with imported products, measures to protect the domestic industries, e.g., by means of customs duties, are usually taken to the extent possible within the free trade system. Although most of these countries do not impose import duties on tropical hardwood logs or semi-finished wood products, they usually impose import duties on finished forest products depending on their domestic circumstances.

As for customs duties on wood products, the preferential duties on products imported from developing countries and the preferential allotment of duties by the EC on plywood are well known. Tropical Products: Information on Commercial Policy Situation and Trade Flow, (COM. TD/W/345), published by GATT in November 1981 should be referred to in this regard. This publication provides the details of the customs duties on tropical wood products in each country after the Tokyo Round.

The following is an example of friction generated in the trade of wood products. Softwood products are now exported from Canada to the United States at low prices under subsidies from the Canadian Government, which has an adverse effect on the domestic manufacturers in the United States. The wood products manufacturers group (U.S. Coalition for Fair Canadian Lumber Imports) in the United States asked the Government to impose countervailing duties on the products imported from Canada, as a result of which the U.S. Government has begun to study the problem. France has also been complaining about the dumping of coniferous plywood by the United States in Western markets. There is a possibility that further friction may be caused in the importing countries by the highly competitive imported products. Just as in the case of agriculture, the wood industry, or basically forestry, is a primary industry important to a country. It should be taken into consideration that attitudes towards and restrictions on timber imports are quite different among the West European countries depending on the importance of forestry and the wood industry, which, for example, is low in the United Kingdom and high in France and the Federal Republic of Germany.

In international trade, another problem is the difference in standard and grading of timber in each country. In some cases, both the importing country and the exporting country consider their own inspection criteria for grading and their standards to be the best and endeavor to compel the other side to adopt them. However, in other cases the exporting country completely accepts the grading and standards used in the importing country, and prepares its products accordingly. In the trade of softwood products used as construction materials, the regulation for construction in the importing countries should be taken into consideration. On the other hand, there seem to be no problems of this kind in the trade of hardwood products, except in some special cases. In the trade of non-conifer plywood, however, there may be a possibility of chemical damage due to the glue used in plywood. In any case, it is necessary to make a sufficient study of the situation on the other side prior to the commencement of actual trade transactions.

Lastly, China (mainland) is expected to become an important timber importing country in the future, although it has not to date been counted as such. The consumption volumes of wood overall and of sawnwood in China at present are estimated to be approximately 50 million m^3 and 13 million m^3 respectively, and the per capita consumption of sawnwood is estimated to be about 1/10 of the average volume of world consumption. Recently, a shortage of timber for furniture and buildings is becoming serious due to increased consumption, and the volume of imports of softwood logs from the United States, and hardwood logs, sawnwood and plywood from Southeast Asia has been drastically increasing. China is a huge country with a population of one billion and should be considered as a market with high potential for the future.

3. Recent Trade Aspects of Forest Products

Recent trends in the trade of tropical forest products, especially log, sawnwood and plywood, highlighted by the effect of both the world-wide business recession and policies for the control of log exports as well as the promotion of processed wood exports will be described below on the basis of the situation in Indonesia and Malaysia (the states of Sabah and Sarawak).

a. Indonesia

Indonesia was the largest timber exporter in Southeast Asia in the 1970s, mainly in terms of log exports. Restrictions on log exports since 1980, however, have resulted in the decrease in log exports and the increase in sawnwood and plywood exports (see Table C-6).

Table C-6 Indonesian Export Trend of Logs, Sawntimber & Plywood

(1,000 m^3)

Year	Logs	Sawntimber	Plywood
1970	7,800	56	-
1971	10,760	80	-
1972	13,590	132	-
1973	19,433	338	1.5
1974	18,083	354	-
1975	13,921	410	2
1976	18,521	644	10
1977	18,634	594	15
1978	18,904	724	68
1979	18,106	1,270	140
1980	12,800	1,130	282
1981	6,000	1,206	765

Source: Indonesia Wood Panel Association, Directory of the Plywood Industry in Indonesia 1983

Recent Indonesian sawnwood exports have not been affected by the global recession, nor have they increased as had been expected. Two interesting aspects in the destination of sawnwood exports are: a. the export of mixed grade sawnwood to Middle East countries; and b. the attempt to export Red Meranti and low-grade White Meranti for agriculture and construction material to China via Hong Kong.

The Indonesian Government attaches the most importance to plywood among its exports of forest products. The domestic plywood industry achieved a production increase from 9,000 m^3 in 1973 to 2.359 million m^3 in 1982, and an increase in exports from 1,500 m^3 in 1973 to 1.232 million m^3 in 1982. There were 60 plywood mills as of 1982, with 48 under construction and 31 building applications being considered.

Traditional plywood producing countries such as Japan, the Republic of Korea and Taiwan are losing the advantage they once held. As a result of Indonesia's restricting log exports these three countries have had difficulty in obtaining material which has led, noticeably, to the closure of mills, even though all three have begun to import log from Sabah, Sarawak and Papua New Guinea. On the other hand, the price of Indonesian plywood is fundamentally competitive in overseas markets. Moreover, Indonesian plywood exports have increased in recent years, and exports to China, where there is great potential demand for plywood, are expected to increase.

Indonesian plywood exports amounted to 1.1 million m^3, or US$250 million in 1982, the main importers being the West European countries, the United States, Japan and the Middle East countries. The annual demand for plywood in West European countries was about 600,000 m^3, of which approximately 70,000 m^3 was met by Indonesian plywood. The annual demand for plywood in the United States was about 3 million m^3, of which 1 million m^3 was met by imported plywood, with 30% coming from Indonesia.

Recent trends in overseas markets, however, are not necessarily encouraging for the Indonesian plywood industry. It is predicted that Indonesian plywood exports in 1983 will decrease overall by more than 20% compared with last year.

The FOB price of Indonesian plywood (3.6 mm) exported to the United States is expected to fall from US$260-270 per m^3 to US$230-240 per m^3. Plywood exported to the Middle East is low-grade, and is expected to be US$190-220 per m^3.

b. Malaysia (Sabah and Sarawak)

Malaysia exports timber only from the states of Sabah and Sarawak.

Main importers of log from these states are Japan, the Republic of Korea and Taiwan; those of sawnwood are Singapore, Thailand, the Middle East countries, Japan and Western European countries; and those of plywood are West European and the Middle East countries.

Main importers of veneer are the same as those of log, i.e., Japan, the Republic of Korea and Taiwan.

Sabah State reduced log exports in order to sustain the yield of timber. It aimed to halve the 1977 total of 12.336 million m^3 and, although in 1980 the figure for exports stood at 8.234 million m^3, they have tended to rise since 1981. This is presumably because Indonesian restrictions on its log exports led to increases in the export of Sabah logs to Japan and others despite the global recession. The impact was remarkable in Sarawak, whose exports in 1981 were 6.923 million m^3, almost double the 1977 level of 3.481 million m^3.

The export price of log, mainly Dipterocarps in Southeast Asia, has recently been stagnant. For this reason, SEALPA (South East Asian Lumber Producers Association) intends to form a price cartel in order to maintain and raise the export price of log, although agreement has not yet been reached. Producers in Sarawak are not members of SEALPA.

China is keenly interested in log imports from Sarawak. Although total purchases in 1981 showed a decrease owing to Chinese domestic economic affairs, there is great potential demand for tropical timber in China, and the future Chinese market is drawing attention from not only Sabah and Sarawak, but also Indonesia and Papua New Guinea.

Log exports from Sabah and Sarawak are shown in Tables C-7 and C-8.

Table C-7 Sabah Log Exports — Volume by Major Markets

(1,000 m^3, %)

Year	Japan	Korea, Rep. of	Taiwan	Hong Kong	Other	Total
1970	4,097 (66)	1,357 (22)	320 (5)	271 (4)	121 (2)	6,165 (100)
1971	4,274 (65)	1,476 (22)	270 (4)	439 (7)	108 (2)	6,567 (100)
1972	5,145 (67)	1,252 (16)	450 (6)	747 (10)	125 (2)	7,719 (100)
1973	7,092 (70)	1,573 (16)	621 (6)	626 (6)	232 (2)	10,144 (100)
1974	7,490 (77)	1,418 (15)	477 (5)	233 (2)	115 (1)	9,733 (100)
1975	6,206 (69)	1,679 (19)	704 (8)	212 (2)	191 (2)	8,991 (100)
1976	8,918 (74)	1,756 (15)	962 (8)	191 (2)	234 (2)	12,062 (100)
1977	9,314 (75)	1,460 (12)	1,174 (10)	273 (2)	117 (1)	12,338 (100)
1978	9,627 (78)	966 (8)	1,386 (11)	225 (2)	160 (1)	12,364 (100)
1979	8,074 (83)	852 (9)	648 (7)	120 (1)	87 (1)	9,781 (100)
1980	6,475 (79)	913 (11)	660 (8)	95 (1)	91 (1)	8,234 (100)
1981	5,827 (67)	1,795 (21)	819 (9)	102 (1)	155 (2)	8,698 (100)

Source: Statistic Department, Sabah

Table C-8 Export of Logs from Sawarak by Port of Clearance, 1980 & 1981

Port of Clealance	1980		1981	
	m^3	M$1,000	m^3	M$1,000
Kuching	376,737	39,757	374,002	34,069
Sematan	-	-	-	-
Sibu	46,324	3,986	86,625	5,947
Tanjong Mani	1,420,662	160,481	1,606,436	188,536
Miri	2,601,630	327,191	2,376,278	275,731
Bintulu	1,935,053	235,284	2,156,773	259,478
Limbang	129,616	22,592	140,822	24,182
Lawas	1,803	353	483	54
Kuala Lawas	162,375	24,407	144,835	19,553
Sundar	21,165	2,447	36,921	4,807
Total	6,695,365	816,498	6,923,175	812,357

Source: Forest Deparment, Forestry Statistics, 1981

Turning to sawnwood, the sawmill industry is the core of wood processing industry in Sabah and Sarawak. Although low compared to its log exports, Sabah's sawnwood exports have increased since 1978, registering 283,000 m^3 in 1981. The country of destination has shifted from the United States to Japan, and exports to West European countries via Singapore are increasing.

There is strong export potential to the Middle East countries. Sarawak's sawnwood exports, which amounted to 163,000 m^3 in 1981, are, like the Sabah case, low compared with its log exports (about 10% of the value of log exports). Sarawak's sawnwood exports decreased in 1981 by 6% in amount and 20% in value compared with the previous year. Among the importers, more than 80% are West European countries (especially the Federal Republic of Germany), and almost all the tree species are Ramin (Gonystylus spp.). Sawnwood exports to Japan accounts for less than 10% of total exports. The price of Sarawak's sawnwood like that of log has fallen since 1979.

Finally, in regards to the plywood and veneer industry, there are six mills in Sabah but only three in Sarawak. Sabah's plywood exports amounted to 4.481 million m^2 (equivalent to 22,000 m^3 in volume of 5 mm plywood) in 1980, but decreased in the following year. Veneer exports stood at 14.189 million m^2 (in area, not volume of wood). Main importers of the plywood are Japan (for concrete panels), Hong Kong and the West European countries, while it is also transported to Sarawak and mainland Malaysia. Main importers of veneer are Japan, Taiwan, Hong Kong and Singapore. Sarawak's annual plywood exports, which are much less than those of Sabah, are 8,000-14,000 m^3. In Sarawak, as well, exports decreased in 1981.

III. International Transactions

1. Market Structure

The structure of the timber market and the method of distribution differs according to the country or region, and also depends on the tree species or timber specifications involved.

In this subsection, the structure of the timber market in the United States, Europe, Southeast Asia and Japan is described. Although the distribution flow of sawnwood and plywood in the United States slightly varies according to the region, the general pattern is shown in Fig. C-1.

In the principal flow route, the products prepared by the manufacturers are forwarded to wholesalers, and then sold to builders directly or through retailers.

In this timber distribution route, the wholesalers play a comparatively important role. Manufacturer-owned wholesalers, independent wholesalers and commission salesmen are the major types of wholesalers in the United States.

Among these three types, manufacturer-owned wholesalers and independent wholesalers are more important.

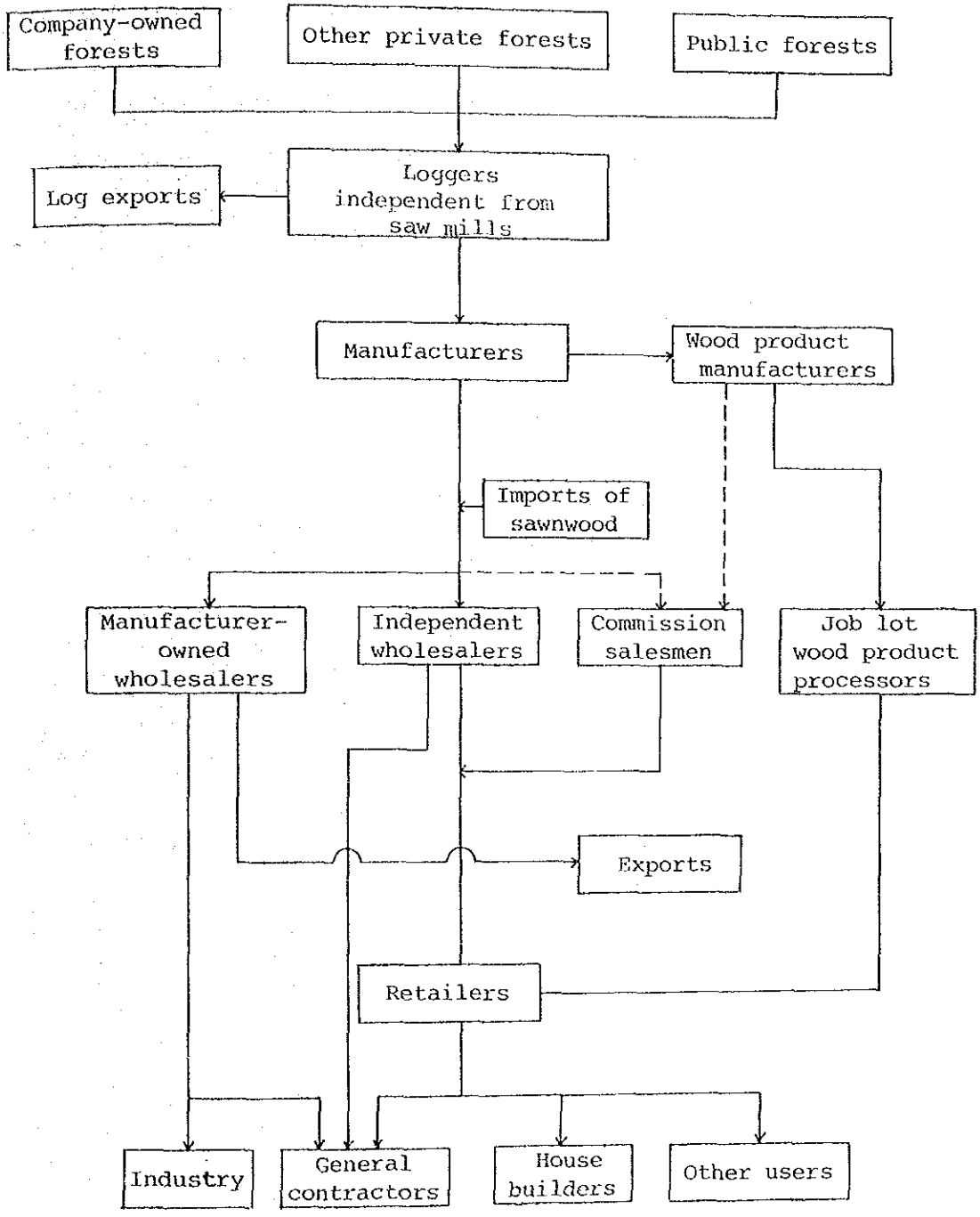
Wholesalers generally buy the products in the factory, 2% below the list-price, and sell them to retailers at the listprice.

Retailers handle slightly more than 60% of the total volume of wood products distributed.

The timber distribution flow in Europe also differs according to the region. Generally speaking, however, local markets have developed independently. Distribution in an individual market is said to be very simple. Logs are sent from forest owners to sawmills, and after being processed in accordance with the requirements of the consumers in the local market, are directly sold to the consumers.

The system of timber distribution in the countries of Southeast Asia is similar to that in the European countries. The national or local government gives a logging concession to certain processors, who produce and process the materials and sell the products to domestic and overseas dealers. These processors usually carry out only the processing, although some larger processors also act as shippers and export the products.

Fig. C-1 Flow Chart of Major Distribution Routes of Sawnwood and Plywood for General Use



Note : The dotted lines indicate less significant routes.

Source: Compiled from Rinfret Boston Associates Inc., Prices and Production, 1971-1973, p.22. Only major flows are shown here.

The situation in Japan is very complicated. The wood distribution flow structure in Japan largely differs with the region and also according to the type of timber; i.e., whether it is domestically produced timber or imported timber. The general flow structure is shown in Fig. C-2.

There are both private forests and national forests in Japan, with the former accounting for approximately 70% and the latter 30% of the total forest area of 25 million ha. Most of the domestically produced wood is sold by the forest owners to loggers, who then forward it to sawnwood or plywood manufacturers, hereinafter referred to as processors. The larger portion of the domestically produced wood goes to sawnwood manufacturers in the form of logs, directly or through log auction markets.

The processors manufacture sawnwood or plywood from logs and sell it to various types of wholesalers such as wholesalers (trading by mutual transactions), in wood auction markets (wholesale markets in which wood is sold by auction) or in wood selling centers (organizations of credit wholesalers). Then, the products are usually distributed by the wholesalers to carpenters or building contractors via retailers. In some cases, however, when the quantity is large they may be sold to the carpenters or building contractors directly.

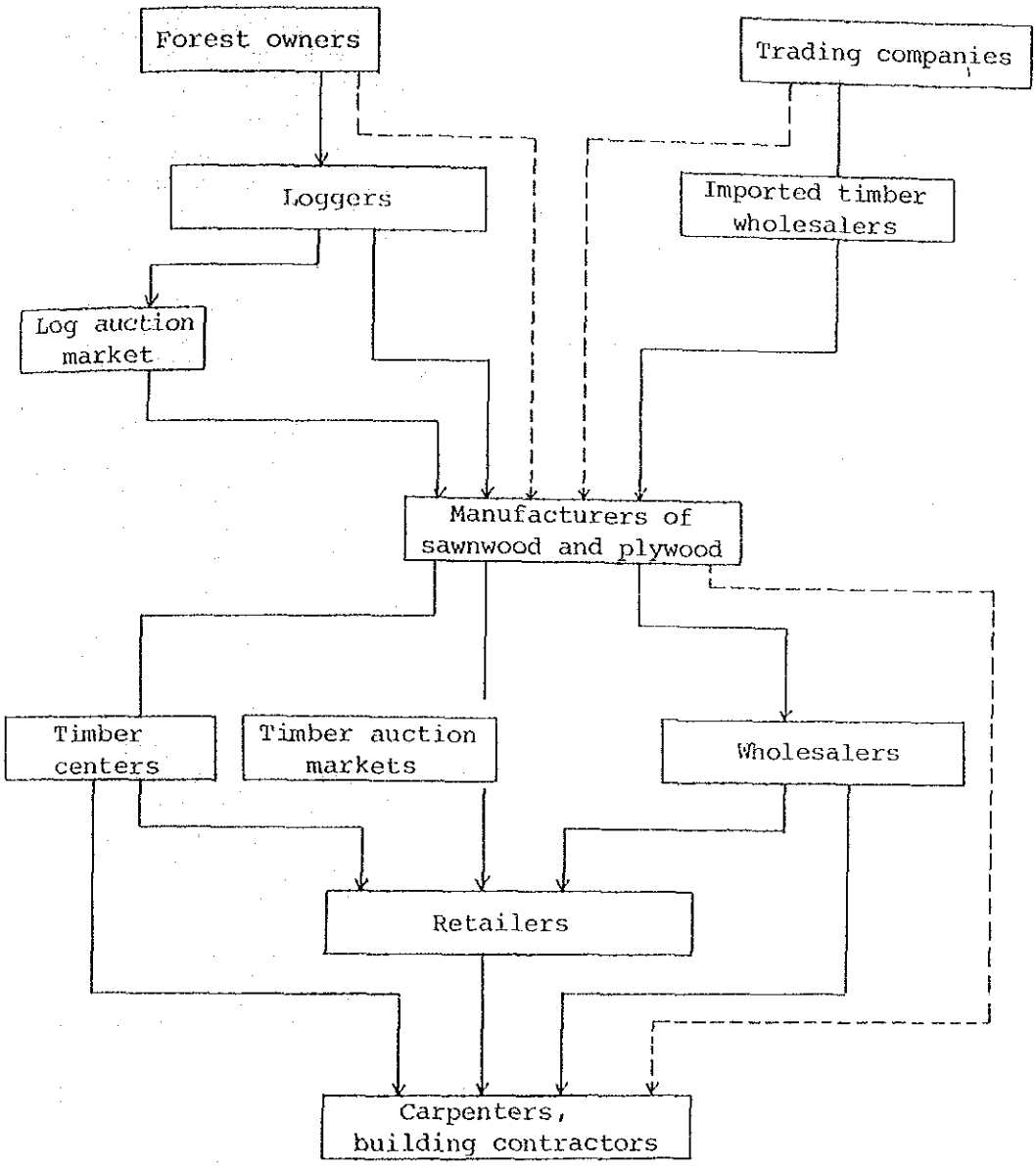
As for the distribution routes of imported wood, major Japanese trading companies import logs from shippers in log producing countries and sell them to processors via wholesalers of imported timber, who are wholesalers trading in imported woods by mutual transaction. The distribution of timber products after processing is virtually the same as for timber products made of domestic logs.

Imported timber products are sold by trading companies to wholesalers of each type of product, either directly or through imported-wood wholesalers.

The general situation of the timber markets in the major countries and regions has been outlined above, without specifying whether the wood is coniferous or non-coniferous. It can be said, however, that the distinctiveness in the distribution of non-coniferous wood is much more marked.

Consequently, concrete and detailed information on the market situation is required when selling non-coniferous wood.

Fig. C-2 Flow Chart of General Structure of Timber Distribution in Japan



Note: The solid lines show major flow routes, and the dotted lines the minor routes.

2. Organization of Trade

2.1 United Kingdom

In the United Kingdom, the following two national organizations exist: The Timber Trade Federation (TTF) and the National Hardwood Importer's Section; of which the latter is only for hardwood dealers. The market structure for timber imported into the United Kingdom is generally as follows: shippers or manufacturers in timber producing countries → import agent → importer → consumer. At present, 37 hardwood import agents and 125 hardwood importers are registered with TTF.

Importers usually own stock yards, hardwood machining and kiln drying facilities, and handling facilities and equipment. Some importers have stock yards throughout the country and endeavor to provide better services to small consumers in order to succeed over other competing importers. Recently, with the improvement and development of communications and transportation, the dealers in timber producing countries have been making efforts to increase the volume of exports, and in many cases, major importers are now able to buy timber directly from dealers in timber producing countries without requiring the services of import agents.

2.2 West European Countries

In Western Europe, there is an organization known as the Union of Tropical Timber Trade in the EC (UCBT), and also an importers' organization known as the European Association of Importers of Tropical Timber. Similarly to the case in the United Kingdom, the market structure of timber imports is as follows: import agent → importer → consumer. The import agents in Western Europe overall play a less significant role than those in the United Kingdom, with some acting merely as intermediaries. In the 1970s, when the market was brisk, consumers frequently concluded import contracts with shippers. Due to the recent recession, however, importers are now recovering their original role of acting as stock keepers and financiers.

2.3 North America

In the United States, the International Hardwood Products Association was established in 1956 by a small number of hardwood and plywood importers to cope with the lobbying of the Hardwood and Plywood Manufacturers' Association for a levy on imported plywood. Later, the Association expanded when dealers of general hardwood products such as sawnwood, plywood, doorskins, hardboard and veneer joined.

Since both the United States and Canada are net timber exporting countries, the governments of these two countries have been making efforts for the promotion of exports of their timber, and are subsidizing exhibitions held all over the world for publicity purposes. In Canada, there are large export companies, most of which have been established by the major manufacturers, dealing in general timber products. These companies conduct trading activities with the aim of expanding exports, and maintain stock yards throughout the world.

2.4 Japan

In Japan, there is a large market for timber imported from all over the world. The Japan Lumber Importers' Association has a membership of more than 300 importers, including the large trading companies. Generally speaking, imported timber is distributed by importers via wholesalers to retailers. As in other countries, however, there are variations; for example, non-conifer sawnwood is imported directly by wholesalers, and logs for plywood are imported directly by manufacturers. It should be noted that the volume of timber imported by world-renowned trading companies has been decreasing recently.

IV. Marine Transportation

In general, it is more advantageous to transport forest products by water than by land for international or even domestic trade. In particular, long-distance transportation is preferably conducted via waterways or the oceans. In marine transportation, however, there are some difficulties characteristic to the conveyance of forest products. For example, products with a low degree of processing such as logs and hewn lumber are difficult to handle because they are very bulky with a large void volume. Moreover, in the marine transportation of processed wood such as sawnwood or plywood, there is the possibility of deterioration in grade due to damage by rot, staining or mold. On the other hand, the cost of preventing this damage cannot be borne by other than the highly-priced products. Wood chips are comparatively easy to handle, but the void volume is large and the recovery rate is low.

Marine transportation systems to cope with these problems, and technical developments involved, as discussed in the report by UNCTAD,[1] although a little out of date, will be described below.

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1) UNCTAD, Level and Structure of Freight Rates - The Maritime Transportation of Tropical Timber Report, 1970

1. Marine Transportation Systems

1.1 Transportation from West Africa to Western Europe

Tropical hardwood timber produced in Africa is exported from West Africa to the West European countries mainly in the form of logs for plywood, on log carrier ships of the regularly scheduled liner services. In the Ivory Coast, Gabon and the Congo, there is a state trading organization known as CABE (Cooperative Africaine des Bois Equatoriaux), and the above three countries account for 70% of West African log exports. In 1967, the volume of log cargo shipped from the port of Abidjan in the Ivory Coast was 1.088 million tons, with the number of voyages made amounting to 615. Consequently, the average log cargo per sailing was 1,750 tons. In Gabon and the Congo, logs are loaded at ports or at anchorages, and loading is made up at two or three ports or anchorages. The number of voyages was 539 in 1967 with logs, sawnwood or plywood shipped from the port of Takoradi in Ghana, and the average cargo per one sailing was 1,010 tons, comprising 734 tons of logs, 260 tons of sawnwood and 16 tons of plywood. Logs produced in West Africa are mostly unloaded in the United Kingdom, France, the Netherlands, Belgium or the Federal Republic of Germany. The major ports for unloading are London, Liverpool and Glasgow in the United Kingdom, Le Harvre, Bordeaux, La Pallice and La Rochelle in France, Amsterdam and Rotterdam in the Netherlands, Antwerp in Belgium, and Hamburg and Bremen in the Federal Republic of Germany. Of the 326 voyages made by log carrier ships from the Ivory Coast, Gabon and the Congo to Western Europe in 1966, 21 voyages were with deck-loaded cargo, while most of the remaining 305 voyages were with below-deck cargo. The majority of the ships were large vessels with a bale space of more than 300,000 cubic feet. The largest ship used in 1967 was a newly-introduced log carrier with a bale capacity of more than 800,000 cubic feet, equipped with large hatches and heavy-duty booms. The smallest ship used in 1967 was a log carrier with a bale space of 110,000 cubic feet. The bale capacity of ships from the Ivory Coast was generally very large, and the most of the ships loading at the Port of Abidjan had a bale capacity of around 500,000 cubic feet. On the other hand, most of the ships loading at ports in Gabon and the Congo had a bale space of around 400,000 cubic feet.[1] The reason for this is that the Port of Abidjan is large and it is equipped with advanced port facilities. Those tropical logs which float are usually transported in the form of rafts from the production area to the nearest loading point, and are then loaded on ocean-going vessels. Consequently, the scale of ships loading at ports with poor facilities is necessarily small, due to limits on capacity. Since the cruising distance of such small ships is short, these ships usually unload at ports in France which are the nearest to West Africa.

1) Journal de la Marine Marchande, and from Reports of CABE

Regarding the log traffic from the Port of Abidjan to Western Europe, the loading capacity per voyage to the United Kingdom is smaller than the average for exports to Western Europe overall, while the loading capacity per voyage for western Mediterranean trade is greater than the average. The volume of log imports from West Africa by unloading port is as follows: 609,000 tons, the largest figure unloaded at the ports of the Federal Republic of Germany, West European countries in 1966, mainly from the Ivory Coast, the Congo and Gabon; 328,000 tons, the second largest figure, to the Port of Rotterdam from the Ivory Coast and Nigeria; and 180,000 tons to the Port of Genoa, mainly from the Ivory Coast. The volume of exports of logs produced in West Africa can be summarized as follows: approximately 1,040,000 tons, the highest in 1966, from the Port of Abidjan on the Ivory Coast; followed by approximately 440,000 tons from Port Gentil in Gabon; 310,000 tons, the third-largest volume shipped, from the Port of Sapele, Nigeria; 300,000 tons, in fourth place, from Takoradi Port in Ghana; and fifthly, 270,000 tons from the Port of Pointe Noire in the Congo. The export capacity of these countries is closely related to the level of equipment and facilities at ports as well as the log production capacity.

Seven principal tropical hardwood producing countries and six major importing countries participate in the log trade from West Africa to Western Europe. The number of exporting ports in Africa is approximately 20, while the number of importing ports in Western Europe stands at approximately 10. Although log carrier ships are mainly used, converted mineral carriers have come into use since 1967.

The shortest nautical distance from West Africa to Western Europe is 3,300 miles from Abidjan on the Ivory Coast to La Pallice in France, and the longest is 5,100 miles from Matadi in the Congo to Hamburg in the Federal Repulic of Germany. As a comparison, the former distance is 65% of the latter, and the difference in the direct round-trip sailing distance amounts to 3,600 miles, resulting in a significant difference in the marine transportation cost.

The log and lumber trade from West Africa to Western Europe is characterized by a multiplicity of small firms both at the producing and consuming ends. This market structure originated when the West African countries were formerly the colonial territories of Western Europe, and special production-consumption chains still remain in the marine transportation system.

1.2 Transportation from Southeast Asia

The world's three largest exporters of tropical hardwood are

the Philippines, Malaysia and Indonesia. In 1980, approximately 73% of total world exports of tropical hardwood were from these three countries. In terms of volume, this share stood at 23.5 million m^3 in 1968, and increased to approximately 30.7 million m^3 in 1980. Thus, Southeast Asia is an important region in the world's tropical log trade. In the 1960s, approximately 90% of Southeast Asian tropical timber exports were in the form of logs. The principal log producing areas were West Malaysia (Sabah and Sarawak) and the Philippines (Mindanao Island). The logs from West Malaysia were exported to Singapore overland, and then reexported from Singapore. The principal movement by sea was of exports from Mindanao Island or Sabah/Sarawak to Japan. The sea distance from Mindanao to Tokyo is approximately 2,000 nautical miles, while the distance from Sabah/Sarawak to Japan is a little under 2,500 nautical miles, varying according to the loading point. The major consuming countries besides Japan are the Republic of Korea and Taiwan, with the distances from the log source being approximately 2,000 and 1,000 nautical miles respectively. In the consuming countries, the logs are unloaded and placed in the water for storage in log ponds until ready for use. The period from felling until use is usually more than 6 months, and the logs are stored in log ponds for most of this time. Indonesia has also been a dominant source of supply since 1965. From the 1970s, the volume of production in the Philippines drastically dropped, and most of the ships used in the trade between Southeast Asia and Japan, Republic of Korea or Taiwan were replaced with special-purpose log carriers by the end of 1968. The average displacement of these carriers in 1968 was 5,000 to 6,000 deadweight tons (DWT). In the case of imports to Japan, these specially built log carriers are directly chartered by trading companies and sometimes by plywood industries. They usually call at one or two loading ports and also at one or two unloading ports. These carriers have a single deck and two large hatches with four booms for log handling. It takes only 25 days for the round voyage between Sabah and Japan by a new log ship built in 1967. The factors enabling concentrated log exports to be carried out by Southeast Asia are as follows:

a. A geographically concentrated, relatively homogeneous raw material supply could be depended upon. There is a large volume of dipterocarpaceae stock in Southeast Asia.

b. The volume of production increased due to the introduction of mass production systems.

c. A large center of concentrated demand, consisting of Singapore, Japan, Republic of Korea and Taiwan, was located geographically close to the production areas.

d. The market structure was capable of dealing in large-volume contracts.

Both the shippers and the consignees tried to realize economically efficient log transportation methods for the above reasons, and log carrier ships of high loading efficiency were developed, resulting in reductions in loading and sailing time. Moreover, the cargo capacity per voyage was increased due to the large size of the ships.

In an examination of tropical hardwood timber transportation from Southeast Asia, the plywood trade cannot be neglected. The plywood industry first developed in the Philippines and Japan, and later in Taiwan and the Republic of Korea. Plywood is relatively perishable and may be extensively damaged in transit if not handled carefully. Therefore, the trade in plywood tends to be carried out directly between the supplier factories and the distributing organizations in the consuming areas. As a result, ship space is not usually chartered because the volume per transaction is small. Under these conditions, plywood is treated as general cargo at ocean freight conference rates. In case of the Philippines, "the Philippines Lumber Producers' Association" was established in 1967, and is a member of the Philippine-North America Conference of Ocean Freight.

2. Problems with Marine Transportation System and Future Innovations

There is a worldwide tendency in which the production areas of tropical logs are moving further and further inland from the seacoast. As a result, the extraction cost is increasingly high because the cost of improving the infrastructure, including roads, is rising. As the transportation distance from the production areas to the loading ports lengthens, the truck transportation cost or the rafting cost also increases. Consequently, the only way to reduce the log price in the importing countries (i.e., the CIF price) and to compete in the international timber market would appear to be the rationalization of the marine transportation system. As concrete measures, the following can be possibly adopted:

a. Improvement of port facilities and expansion of log ponds at loading ports.

b. Reduction of time and improvement of efficiency in loading/unloading by adoption of modern power-operated boom-gear systems which can be used on both sides of the ships without any rigging change.

c. Reduction in the log transportation cost per unit volume, using larger ships with a capacity of more than 200,000 cubic feet in volume or 5,000 tons in weight.

d. Stabilization of and reduction in marine transportation cost, by determining the freight conference rates between exporting and importing countries.

e. A higher operating ratio leading to the better utilization of ships, by using ships of high crusing speed to reduce the time taken per voyage between loading and unloading ports.

f. Improvement in port facilities and expansion of log ponds at unloading ports.

Since logs show a greater deterioration in grading as the period from felling to use becomes longer, it is important to rationalize the marine transportation system and reduce the transportation time to maintain the grades of the logs. At the Port of Tokyo, logs are off-loaded by ships' tackle directly into the water alongside the ship, and are made into rafts for floating to municipal log ponds for storage. In some cases, however, logs have to be left unattended in the neighborhood of log ponds due to a lack of sufficient log pond capacity, resulting in deterioration in the grade of the logs. In Sabah, 1,500 to 2,000 tons of logs can now be loaded on to large new ships within a single 13-hour day of work. This means that the loading of a 4,000 ton ship can be completed in 24 hours. Consequently, the ship can make 23 round voyages in 19 months, taking 25 days per round voyage. When two or four ships of this kind are used, a biweekly or weekly service, respectively, is possible, and the transportation cost can be reduced owing to concentrated large-scale operation.

The following aspects of marine transportation of tropical non-coniferous plywood should be noted:

a. In the conventional marine transportation of plywood as general cargo by mixed loading with other commodities on liners operating under conference terms, plywood is easily damaged and the quality deteriorates.

b. To cope with this problem, standard unitization may be further employed in transporting plywood; e.g. palletization, packaging or containerization. This cannot be effected unless trade is carried out on a large scale, because it is practicable only for the mass handling of plywood in a scheduled service.

c. The transportation cost may be reduced by making freight conference agreements within certain areas, or agreements for mass transportation by non-conference liners, as is done in the case of transporting logs.

In particular, it is expected that containerization of the transportation of plywood will spread further in the future. Con-

tainer transportation is suitable for plywood, because the capacity of the standard 8 ft x 8 ft x 20 ft or 8 ft x 8 ft x 40 ft containers is 27 metric tons (1,100 cubic feet) and 60 metric tons respectively, with a maximum weight capacity of 20 DWT and 30 DWT respectively. Damage caused by external shocks is small, and the degree of deterioration in grade is low in this form of transportation. However, fully containerized ships are now plying only the major routes. Large-scale containerization cannot be expected for the transportation of plywood, unless feeder services from the ports in Africa and Southeast Asia begin.

3. Marine Transportation Systems and Distances

The competitiveness of tropical hardwood timber for export depends on the FOB price in the exporting countries, the ocean freight rates, the grade of the timber, the preferences in consuming (importing) countries, etc. In the competitiveness of CIF price in the importing countries, however, the transportation distance from the exporting country to the importing country becomes an important factor. For the trade conducted between West Africa and Western Europe, the round-voyage distance between Abidjan and Hamburg is 8,000 miles, and the transportation cost for 1 ton of cargo is approximately US$10.00. The round-voyage distance between Abidjan and La Pollice is 6,700 miles and the break-even freight rate lies between US$8.62 and US$9.32. As the transportation distance lengthens, the time required for a round voyage increases and the transportation cost per unit weight rises, so that large-scale ships with large capacity should be used to improve competitiveness. Although large ships (40,000 DWT) may call at ports with adequate facilities, such as the Port of Takoradi and the Port of Abidjan, without encountering difficulties regarding the depth of water available, they cannot call at ports with poor facilities, and this appears to constitute a bottleneck in marine transportation between West Africa and Western Europe. There is no serious problem in distance in marine transportation between Southeast Asia and Japan because the distance involved is short. Even so, one factor limits the overall marine transportation system, which is that ships larger than 25,000 tons cannot call at some ports in major timber producing countries and regions such as Indonesia, the Philippines, Sabah, Sarawak, etc., which have poor port facilities.

V. Ocean Freight

1. Ocean Freight for West African Tropical Timber

1.1 Ocean Freight for West African Logs to the Port of Hamburg

The rates of the West African Lines Conference (known as the Walcon Conference) were used as the ocean freight rates for logs from West African range ports, extending from the Port of Matadi and the Port of Abidjan, to the Port of Hamburg. The rates have changed over the years, as follows: US$22.40 per metric ton in 1955, US$18.76 in 1960, US$25.03 in 1965 and US$27.60 in 1968. The tree species handled include the obeche, ayous, wawa and samba.

1.2 Ocean Freight for West African Logs to Atlantic and Gulf Ports in the United States and Canadian Atlantic Ports

The ocean freight rate for West African logs such as mahogany, but excluding ebony, to Atlantic and Gulf ports in the United States and the Canadian Atlantic ports was US$29.75 in 1957, US$26.00 in 1960, US$28.50 in 1965 and US$32.75 in 1968, showing a slight increase per long ton. The average of the CIF prices of West African logs in Western Europe in 1955, 1960 and 1965 was US$80.00 per ton, with the ocean freight accounting for approximately 30% of the CIF price.

2. Ocean Freight of Southeast Asian Logs

An import freight convention was agreed upon by the Philippines as a log producing country and Japan as a log importing country in 1962. The State of Sabah, Malaysia joined the convention in January 1965. The convention developed into the Import Freight Convention Agreement of South Sea Logs,[1)] which is still in effect, when the State of Sarawak, Malaysia and New Britain joined in July 1973. The movements in the ocean freight rates determined under this Agreement for each country are shown below:

1) Import Freight Convention of South Sea Logs between Japan and Southeast Asia

2.1 The Philippines

1962	US$19.75	per 1,000 BMF (Board Measured Feet)
1963	US$19.00	"
1964	US$19.65	"
1965	US$ 6.75	per cubic meter
1966	US$ 7.00	"
1967	US$ 7.20	"
1970	US$ 7.45	"
1975	US$12.80	"
1977	US$16.50	"
1979	US$22.40	"
1981	US$25.60	"

2.2 State of Sabah, Malaysia

1965	US$20.00	per 1,000 BMF
1966	US$20.50	"
1967	US$21.00	"
1968	US$21.00	"
1969	US$21.00	"
1970	US$21.00	"
1975	US$36.88	"
1980	US$73.25	"

2.3 Indonesia

1973	US$12.00	per cubic meter
1975	US$14.80	"
1977	US$18.50	"
1979	US$24.90	"
1981	US$28.10	"

2.4 State of Sarawak, Malaysia

1973	US$34.50	per 1,000 BMF
1975	US$43.04	"
1977	US$49.10	"
1979	US$69.65	"
1981	US$70.45	"

2.5 New Britain

1973	US$37.00	per 1,000 super feet [1]
1975	US$45.68	"
1977	US$19.00	per cubic meter
1979	US$27.40	"
1981	US$30.60	"

1) 1 super foot = 1.273 BMF

D. PRICE TRENDS

I. Trends in International Prices

Details of the trends in the international prices of forest products are found in FAO Forest Paper No. 23, Forest Products Prices (1961 to 1980). According to this report, the prices of all kinds of tropical forest products show a similar trend. These prices were steady till the first oil crisis in 1973, after which they rose sharply, dropped during the recession in 1975, and again started to rise in 1976. Although the FAO price data are not available after 1980 when the worldwide recession started, it can be conjectured from the trend of timber prices in Japan that the international prices have generally dropped.

The changes in the export prices of tropical logs, sawnwood and plywood given in the above-mentioned FAO report are summarized in Table D-1.

1. Non-Conifer Sawlogs and Veneer Logs (Refer to Table D-1)

On an average, the export prices of logs produced in Africa are higher than those of Asian logs due to differences in grade, transportation cost, etc. In Table D-1, a tendency can be seen for African logs to be replaced with the Asian product, partly because it is difficult to increase the production volume of African logs and partly because of the difficulty in reducing the prices of logs of lower grades.

2. Non-Conifer Sawnwood (Refer to Table D-1)

The trends in the prices of non-conifer sawnwood and plywood are similar to those in the prices of non-conifer logs. It should be noted that the CIF price in the United Kingdom of "Keruing" sawnwood produced in Southeast Asia and the export price of plywood produced in Malaysia rose steeply again in 1979.

II. Mechanism of Price-Setting

The price fluctuations of general commodities are categorized

Table D-1 Movements in the International Prices of Tropical Forest Products

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Export price of tropical logs (US$/m^3)															
African	29	29	30	30	32	31	31	38	59	78	68	80	84	91	91
(index)	(94)	(94)	(97)	(97)	(103)	(100)	(100)	(123)	(190)	(252)	(219)	(258)	(271)	(294)	(294)
Asian	19	19	20	21	20	19	21	21	34	41	31	43	46	48	49
(index)	(100)	(100)	(105)	(111)	(105)	(100)	(111)	(111)	(179)	(216)	(163)	(226)	(242)	(253)	(258)
Export price of tropical sawnwood (US$/m^3)															
World average	57	55	55	55	59	58	57	63	99	113	114	124	127	138	161
(index)	(98)	(95)	(95)	(95)	(102)	(100)	(98)	(109)	(171)	(195)	(197)	(214)	(219)	(238)	(278)
CIF price of Southeast Asian Keruing (UK)															
Actual value	-	-	-	-	61.11	67.54	70.87	73.61	130.30	145.2	133.44	125.5	142.2	150	206.2
(index)	-	-	-	-	(91)	(100)	(105)	(109)	(193)	(215)	(198)	(186)	(214)	(222)	(305)
Export price of plywood															
World average	141	144	145	141	147	145	147	166	216	255	231	260	278	291	320
(index)	(97)	(99)	(100)	(97)	(101)	(100)	(101)	(114)	(149)	(176)	(159)	(179)	(172)	(201)	(221)
Malaysian plywood															
Actual value	42.11	77.14	77.17	91.28	84.36	97.83	78.38	92.07	158.6	169.9	134.4	169.3	209.8	204.4	263.2
(index)	(43)	(79)	(79)	(93)	(86)	(100)	(80)	(94)	(162)	(174)	(137)	(173)	(214)	(209)	(269)
Export price of charcoal (US$/MT)															
World average	46	46	48	46	39	49	53	61	62	81	110	118	123	132	158
(index)	(94)	(94)	(98)	(94)	(80)	(100)	(108)	(124)	(127)	(165)	(224)	(241)	(251)	(269)	(322)
Retail price in Indonesia	-	-	-	-	-	30	38	36	41	42	36	67	96	141	
(index)	-	-	-	-	-	(100)	(127)	(120)	(136)	(140)	(120)	(224)	(320)	(469)	
Export price of pulpwood (US$/m^3)															
World average	12	11	10	10	11	12	13	14	17	22	25	24	25	26	25
(index)	(100)	(92)	(83)	(83)	(92)	(100)	(108)	(117)	(142)	(183)	(208)	(200)	(208)	(217)	(208)

Source: FAO, Forestry Paper No. 23; Forest Products Prices, 1961 - 1980.

into three types: seasonal fluctuations, cyclic fluctuations and trend fluctuations. The cyclic fluctuations and the trend fluctuations of timber prices are briefly studied in this subsection.

Roughly speaking, the cyclic fluctuations in the prices of timber show a trend similar to that in prices of general commodities. It can be said, however, that the price of timber is less stable and fluctuates more widely than the prices of general commodities.

Although the long-term trend fluctuations differ according to the country and the kind of timber, the general tendency of the price of timber is to increase as steeply as, or slightly steeper than, that of general commodities.

The reason why the price of timber is less stable than that of general commodities and why the cyclic fluctuations in the prices of timber are wider is that the elasticity of both the demand price and the supply price of timber is small.

The factors which determine the level of these cyclic or trend fluctuations in timber prices of course lie both on the demand side and on the supply side, as in the case of general commodities, but the factors which determine or affect the relationship between demand and supply are different in the case of timber.

Timber demand is influenced not only by general long-term factors such as the national income per capita, the population, etc., but also by direct short-term factors such as the number of housing starts, the degree of preference for and the cost of substitute materials, etc. The timber supply, however, is governed by the available growing stock, the production cost, the total stock, the price of imported timber, etc., but the price elasticity of demand and supply is not so large.

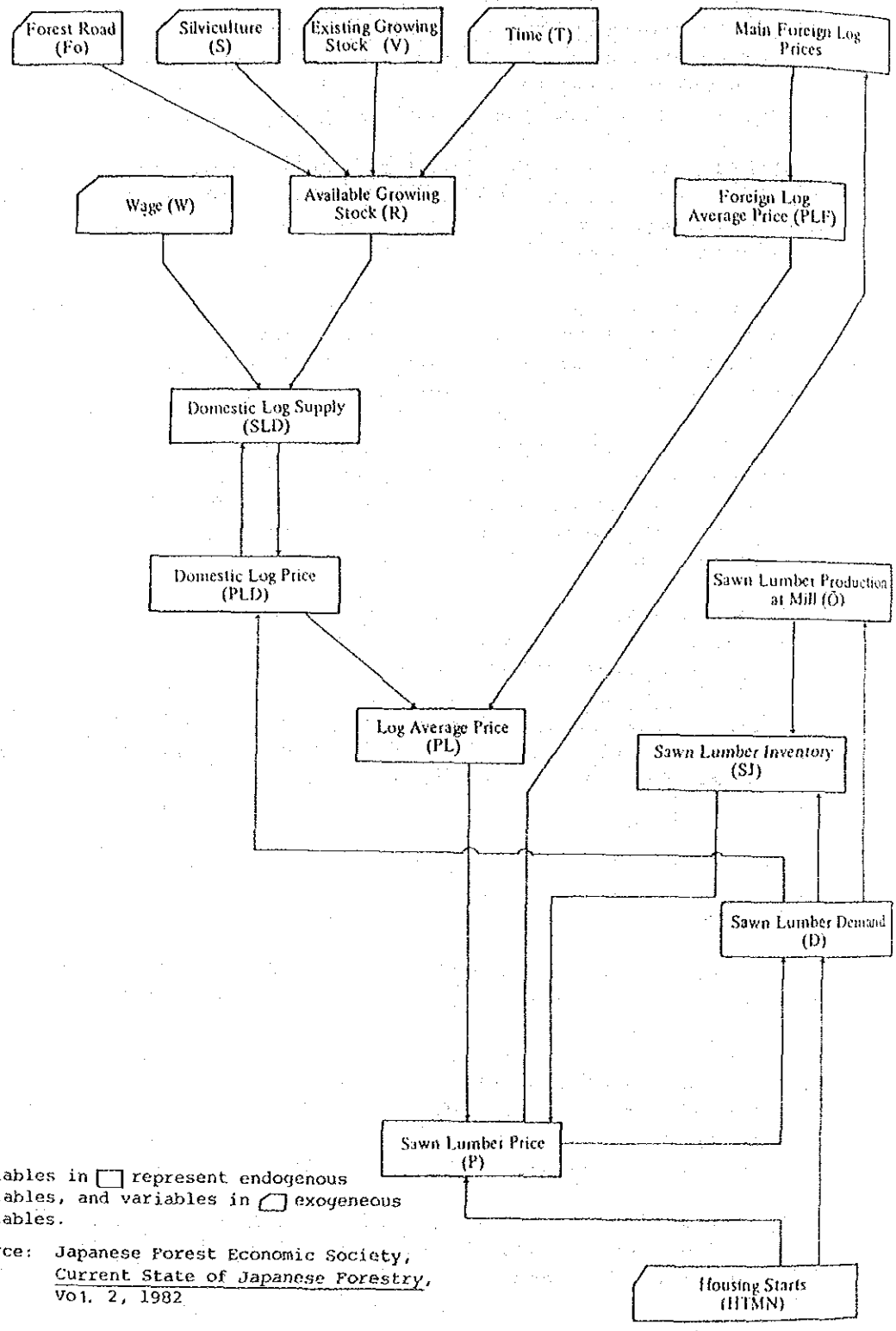
It may be noted that timber price setting has recently tended to be more or less influenced by the conditions of international trade according to the situation in each country.

For example, the causal flow diagram for the latest fluctuation in prices of timber in Japan is shown in Fig. D-1.

It can be seen that the prices of logs are both influenced by the number of housing starts, which is a factor on the demand side, and by the volume of domestic log supply and the price of imported timber, particularly by the price of imported timber from North America, which are factors on the supply side.

The situation and the causes of fluctuation in prices of timber have been described above. Now let us look at the future prospects of the fluctuation in prices.

Fig. D-1 Summary Causal Flow Diagram of Forest Sector Model in Japan



Variables in ☐ represent endogenous variables, and variables in ⬠ exogeneous variables.

Source: Japanese Forest Economic Society, Current State of Japanese Forestry, Vol. 2, 1982

Note to Fig. D-1:

The causal relationships of the principal factors are briefly as follows:

1) The Available Growing Stock R is determined as the function of Forest Road Fo, Silviculture Investment S, Existing Growing Stock V, and Time T.
2) The Domestic Log Supply Volume SLD is determined by the Available Growing Stock R, Wage W and Domestic Log Price PLD.
3) The Domestic Log Price PLD is determined by Domestic Log Supply SLD and Sawn Lumber Demand D.
4) The Log Average Price PL is determined by Domestic Log Price PLD and Foreign (Imported) Log Average Price PLF.
5) The Foreign Log Average Price PLD is determined by North American Log Price PLA, South Sea Log Price PLS and USSR Log Price PLN.
6) The Sawn Lumber Production at Mill $\bar{O}$ is determined by Sawn Lumber Demand (mill shipment) for the preceding term D_{-1} and Production Capacity $\bar{CO}$.
7) The Sawn Lumber Demand D is determined by Sawn Lumber Price P, Housing Starts HTMN, and Sawn Lumber Demand for the preceding year D_{-1}.
8) The Sawn Lumber Price P is determined by Log Average Price PL, Housing Starts HTMN, Sawn Lumber Undesirable Inventory SJU, and Sawn Lumber Price for the preceding term P_{-1}.
9) The factors, Forest Road, Silviculture Investment, Existing Growing Stock, Time, prices of principal foreign logs (North American Log Price, South Sea Log Price, and USSR Log Price) and Housing Starts are treated as exogenous variables.

It is generally expected that the level of trend fluctuations in the price of timber will almost be equal to or a little higher than those in the prices of general commodities.

The prices of large tropical logs are expected to rise higher if the above-mentioned future conditions of demand for timber, forest resources, and production and supply of timber are taken into consideration.

E. DEMAND PROJECTIONS

I. Existing Projection Models

1. Examples of Projection

Recently, the global supply-demand forecast for forest products were presented in report by an industrial team supported by the FAO,[1] and also in a special survey report made by the Government of the United States.[2] Governments of various countries cooperated in the preparation of the former paper to promote the development of forestry and forest industries, and the forecasted figures were given in the papers after regional adjustment. In the U.S. Government report, existing world forest resources were analyzed from the viewpoint of global preservation of the environment.

There are a number of projections available for specific regions and countries. Among these, a projection report by the U.S. Government [3] also includes a view of the future international market intended for use in the analysis of trade trends in the United States. FAO also presented regional projection report [4] including estimation and forecast of the forest resources in detail.

The summary of this Regional Report follows.

Although the trends of and outlook for timber production and forest resources were analyzed for each region, the classification of products, the study items and methods used in the analyses differ from region to region.

In the report for Europe (in 1976), for instance, emphasis is placed on review of past trends and, more particularly, on analysis of supply and evaluation of resources, rather than on estimates of future demand, on the understanding that the European forestry and forest industries now stand at a turning point where the whole

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1) FAO, Forestry Paper No.29, World Forest Products Demand and Supply 1990 and 2000, 1982

2) The United States Government, Council on Environmental Quality and the Department of State, The Global 2000 Report to the President

3) U.S. Forest Service, An Analysis of the Timber Situation in the US 1952 - 2030

4) FAO/ECE, European Timber Trends and Prospects 1950 to 2000, 1976, etc.

economy is in a difficult situation. Forest products are classified into four groups: sawnwood, wood-based panels, paper and paper boards, and other industrial wood, and the demand volume is projected for each group using the following regression model with explanatory variables of increases in the demand volume per capita and in GDP per capita:

$$\log Ct = a + b \log Yt + c \log Ct\text{-}n + d \log Yt\text{-}n$$

where

Ct, Ct-n : Apparent per capita consumption at times t and t-n
Yt, Yt-n : GDP per capita at times t and t-n
a, b, c, d: Constants

In order to complement the projections derived from the model, market surveys were also carried out, with a breakdown of each product to the final consumption goods such as housing materials, furniture materials, etc.

With regard to the future volume of supply, the following four items were analyzed in detail: European removals; utilization of wood residues; recycling of waste paper; and trade with other regions. For the study item of trade, in particular, details of resource endowment, the forestry policy, distribution costs, etc., were analyzed separately for North America, the USSR and the tropical regions, the places from which forest products are mostly imported.

According to the analysis, the annual rates of increase in the demand from the year 1970 to 2000 are projected to be: sawnwood, 0.5% to 1.6%; wood-based panels, 5.9% to 6.3%; and paper & paperboard, 3.7% to 4.9%. The supply of fiber type products (particle boards, pulp, etc.) is forecasted to fall short by 50% as against the forecasted demand in 2000.

There are also a number of papers which focuses on analyses of specific products, for example, a World Bank report [1] on hardwood, the supply of which has recently been falling rapidly. Though a little academic in character, the IIASA [2] is now carrying out a project to formulate a global supply-demand and trade model for forest products, which is scheduled for completion by 1985.

In this project, researchers from member countries are responsible for formulating country models for their own respective countries or regions, and these country models are synthesized to make a integrated simulation model. Many of the prototype country models have already been presented.

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1) Kenji Taguchi, Tropical Hardwood Trade in the Asia - Pacific Region, World Bank Staff Occasional Papers No.17
2) International Institute for Applied Systems Analysis, Forestry Sector Model

Since the present Study is aiming at projections of wide range of forestry products in a world-wide context, only the paper by the FAO industrial team is thought to be capable of providing the reference data required for this Study. Therefore, its outline is given below.

2. Outline of the FAO Report

2.1 Elements of the FAO Report

In the FAO report, projections of the volume of production and consumption of forest products such as sawnwood, and the future demand for logs are carried out. Specifically, the volumes of production and consumption of five groups of forest products for industrial-use, of both conifer and non-conifer woods, in each of 22 regional blocs [1] are projected. In addition, the supply volume, the demand volume and the degree of self-supportability are projected separately for sawlogs (including veneer logs) and fiber logs, which are the raw materials of the products of conifer and non-conifer woods mentioned above.

2.2 Method of Projections Used in the FAO Report

In this report, the ten-year annual averages growth rate for the products are originally estimated for the periods of 1980-90 and 1990-2000, each being calculated by various methods as considered appropriate for the group of products and the regional bloc, then figures derived are adjusted so to reach consistent projected figures. Generally speaking, an econometric type model that employs several explanatory variables such as population, incomes, etc., is formulated for regions such as North America and Western Europe in which the volume of demand is large and sufficient data are available; whereas simple extrapolation methods of past trends is employed for regions in which the volume of demand is small and only sketchy data are available.

The log supply volume is estimated by collecting data in a similar way. For developed countries such as West European countries and Japan, periodic survey data given by the forestry departments of the respective governments are used as a basis. For regions such as North America, the situation of forest resources and the tree age class breakdown are taken into consideration in the analysis. In the case of developing countries, the situation was studied together with the team cooperation with

1) Refer to FAO, Forestry Paper No.29, given above.

the FAO, with emphasis on countries in Latin America and Asia, because the supply of resources from these countries is expected to expand.

The historical data base used in the analysis is mainly the FAO forest product statistics. Data not available were estimated and problems such as inconsistencies in data for trade were adjusted. Although this analysis, as stated in the report, is a comprehensive and challenging one, it is too early to pass judgement on some of the items for various reasons: The work was done in a short period although the method of analysis used is collective; the volumes of softwood and hardwood are estimated separately; and the relationships between the volumes of production and consumption and the balance of trade of various products in various regional blocs are adjusted for consistency.

2.3 Content of the FAO Report

2.3.1 Estimated world consumption (processed wood)

The total volume of consumption of forest products, excluding fuel wood, in the world is expected to increase from 1,233 million m^3 in 1980 to 1,493.4 million m^3 in 1990, and further to 1,818.5 million m^3 in 2000 (Refer to Table E-1). Of the various products, pulp and reconstituted panels will show marked increases in volume of consumption, the respective indices being — with 1980 as a base of 100 — 130 and 133 in 1990, and 175 and 165 in 2000. As a result, the ratios of the volumes of consumption of pulp and reconstituted panels to the total volume of consumption will increase, respectively, from 41.5% and 7.6% in 1980 to 49.2% and 8.6% in 2000.

In the softwood and hardwood category, the volumes of consumption of hardwood pulp, softwood and hardwood reconstituted panels,[1] and softwood and hardwood solidwood panels will increase very sharply, the indices in 2000 being 200, 164 and 168, and 142 and 145, respectively. When the shares in 1970 and after 1980 are compared for each hardwood product, those of reconstituted panels and pulp have increased. The share of the total consumption accounted for by hardwood products increased from 28.8% in 1970 to 30% in 1980, and is expected to increase further to 32.2% in 2000. This is because increases in volumes of production of reconstituted panels and pulp from low-grade hardwood are anticipated, in spite of decreases in the volume of hardwood resources available.

1) Reconstituted panels mean particle boards, fiber boards, etc. and solidwood panels mean sawnwood, veneer, plywood, etc.

Table E-1 Outlook of World Consumption of Forest Products by FAO [a)]

(million m^3)

		1960			1970			1980			1990			2000		
		Consump-tion	Share (%)	Index [c)]	Consump-tion	Share (%)	Index	Consump-tion	Share (%)	Index	Consump-tion	Share (%)	Index	Consump-tion	Share (%)	Index
Sawnwood & sleepers	H [b)]	73.5	10.0	74	91.2	8.8	92	99.3	8.1	100	123.9	8.3	125	143.1	7.9	144
	S	252.1	34.4	77	300.6	29.1	91	329.5	26.7	100	368.6	24.7	112	399.4	22.0	121
	T	325.6	44.4	76	391.8	37.9	91	428.8	34.8	100	492.5	33.0	115	542.5	29.8	127
Solidwood panels	H	6.8	0.9	28	17.3	1.7	72	24.1	2.0	100	29.6	2.0	123	35.0	1.9	145
	S	10.0	1.4	41	18.7	1.8	77	24.3	2.0	100	30.6	2.0	126	34.5	2.0	142
	T	16.8	2.3	35	36.0	3.5	74	48.4	3.9	100	60.2	4.0	124	69.5	3.8	144
Reconstituted panels	H	7.2	1.0	22	19.9	1.9	60	32.9	2.7	100	44.1	3.0	134	55.2	3.0	168
	S	12.0	1.6	20	35.0	3.4	57	61.4	5.0	100	81.0	5.4	132	100.7	5.5	164
	T	19.2	2.6	20	54.9	5.3	58	94.3	7.6	100	125.1	8.4	133	155.9	8.6	165
Other ind. products	H	69.4	9.5	85	77.3	7.5	95	81.5	6.6	100	83.6	5.6	103	88.3	4.9	108
	S	74.4	10.2	109	66.9	6.5	98	68.5	5.6	100	67.7	4.5	99	67.7	3.7	99
	T	143.8	19.6	96	144.2	14.0	96	150.0	12.2	100	151.3	10.1	101	156.0	8.6	104
Pulp	H	39.8	5.4	30	91.7	8.9	69	132.0	10.7	100	187.1	12.5	142	263.6	14.5	200
	S	187.6	25.6	50	314.0	30.4	83	379.5	30.8	100	477.3	32.0	126	631.0	34.7	167
	T	227.5	31.0	44	405.7	39.3	79	511.5	41.5	100	664.4	44.5	130	894.6	49.2	175
Total	H	196.7	26.8	53	297.4	28.8	80	369.8	30.0	100	468.3	31.4	127	585.2	32.2	158
	S	536.1	73.2	62	735.2	71.2	85	863.2	70.0	100	1,025.1	68.6	119	1,233.3	67.8	143
	T	732.8	100	59	1,032.6	100	84	1,233.0	100	100	1,493.4	100	121	1,818.5	100	147

a) Data from estimates in FAO's Forestry Paper No.29
b) H, S and T indicate Hardwood, Softwood and Total.
c) Index: 1980 = 100
d) Product classifications and regional classifications are as follows:
Product classifications : Sawnwood & sleepers, Solidwood panels, Reconstituted panels, Other industrial products, and Pulp.
Regional classifications: World, North America, Western Europe, Japan, Latin America, Countries with centrally planned economies, and other Eastern Hemisphere (Oceania, Middle East, Far East, Africa)

In conclusion, among hardwood products, the consumption of hardwood pulp and reconstituted panels is expected to increase, the indices being 142 and 134 in 1990, and 200 and 168 in 2000, respectively.

2.3.2 Estimated regional consumption (processed wood)

The trends in regional consumption and production of hardwood products, of which the rate of world consumption is expected to increase, is forecasted as follows.

Of the world consumption of pulp in 1970, 83% was accounted for by North America, Western Europe and Japan, and these countries are expected to continue to be large markets, but there are signs that the rate of increase will drop. On the other hand, there are strong expectations of increases in the consumption in Latin America, the Middle and Far East and other regions, where the present consumption is small. If the consumption in 1980 is taken to be 100, the indices in 2000 for the regions showing sharp increases are estimated to be: 514 for the Middle East & North Africa; 392 for the Far East; 290 for Oceania; 280 for the USSR and 268 for Latin America.

The inbalance of timber production and consumption will continue in Japan and West European countries excluding the Scandinavian countries. The shortages are estimated at 12.3 million m^3 in Japan and 11 million m^3 in West European countries in 2000. On the other hand, it is expected that Africa south of the Sahara, the Far East and Oceania will by 2000 join the group of countries with export potential — currently only North America and the Scandinavian countries — and production will exceed consumption. The export capacity in 2000 from Africa south of the Sahara is estimated to be 7.1 million m^3; from the Far East, 66 million m^3; and from Oceania 1.8 million m^3.

The regions with a high rate of increase in the consumption of reconstituted panels are the centrally planned economies in Asia (the index for 2000 being 225), Canada (206), United Kingdom (190), other Western European countries (195), Africa south of the Sahara (188). The regions with high export capacities are France (the export capacity in 2000 being 4.4 million m^3), Scandinavian countries (1.9 million m^3) and Africa south of the Sahara (400,000 m3). The regions which will require imports of reconstituted panels are the Federal Republic of Germany (requiring 2.4 million m^3 in 2000), the United Kingdom (1.7 million m^3), other EC countries (2 million m^3) and other West European countries (500,000 m^3).

It is also expected that the consumption of solidwood

panels will increase in the Far East (the index in 2000 being 275, based on a 1980 figure of 100), the Middle East and North Africa (250), Africa South of the Sahara (238), Latin America (338), centrally planned Asian countries (200), etc. The importing regions will be the United States (requiring imports amounting to 3.2 million m^3 in 2000), Japan (2.9 million m^3) and other EC countries (1.1 million m^3).

2.3.3 Estimated demand for logs

It is expected that the total world demand for logs, which are the raw materials of the products mentioned in the previous sections, will increase from 1.47 billion m^3 in 1980 to 2.086 billion m^3 in 2000, but the rate of annual increase will drop from the 2.4% between 1960 and 1980 to 1.8% for the following two decades. However, the ratio of demand for hardwood logs to the total demand will increase slightly (from 30.1% in 1980 to 32.0% in 2000).

II. Projections in this Study

1. Features of the Present Projections

The present demand projections were made on the basis of the following:

1.1 In the present Study, projections was made for each type of product and each regional bloc. Consequently, the future trends of a particular product of a certain type or in a particular country belonging to a certain region are judged on the basis of trend analyses described in the previous sections.

1.2 For the sake of a quantitative supply projection, it is theoretically conceivable to build a quantitative model on the basis of the stock of forest resources with the following explanatory variables such as the production costs in each producing area and the price relationships with substitute commodities.

In this report, however, a quantitative supply projection will not be made for the following reasons:

- Incompleteness of world-wide data on tropical forest resources;

- The lack of reliable data on regional conditions to which production costs are subject;
- The price data require a more detailed classification of commodities;
- Hence, results of a long-term and world-wide quantitative supply projection are likely to be unreliable due to the problems stated above, even if it is conducted; and
- The supply of forest products is derived almost entirely from the existing forest resources because of the length of growing, and the physical quantity of forest resources can continue to satisfy demand at least until the year 2000.

For similar reasons to the above, even in the FAO survey,[1] a quantitative supply projection is not made and only the supply potential is discussed. In the United States' survey, a limited number of commodities with much detailed classification is analyzed only for a certain region.

Thus, in this report, a qualitative examination through expert analysis is made on the supply side by incorporating the foregoing factors.

1.3 In the present Study, quantitatively projected figures obtained from certain projection models (e.g., the regression analysis with, for instance, the national income as an explanatory variable), explained in detail in the next Item, which covers mothods of estimation, were examined qualitatively on the basis of the trend analysis described in the previous sections and corrected whenever required. This was done because the world economic situation has significantly changed over the past few years, partly because of political factors, and the mechanism of world supply and demand of timber may now be at a turning point. It was thought that when projections based on trends in the period of worldwide economic growth from the 1960s to the early 1970s were used in analysing the demand following this period, individual qualitative reexamination was required.

2. Projection Methods Used in the Present Study and their Evaluation

The following five methods of demand projection were examined in the present Study:

a. Linear trend method
b. Exponential trend method
c. Logistic curve method

1) FAO, Forest Paper, No.29

d. Regression analysis using economic indices such as the national income
e. Regression analysis as in d., but having a lagged independent variable.

These five methods will be briefly described here.

In all these five methods, "price" is not adopted as a variable in the projection model. The reasons for this are, a. that the price statistics which properly represent each classification of forest products which was adopted in this Study are not available (the use of prices as variables requires a more detailed classification of commodities), and b. a standard international price of some classes of forest products are difficult to determine, requiring instead regional estimation, but the conformity of data on prices among regions is difficult to secure. Accordingly, for this projection, similar to the demand projection of other products, the method based fundamentally on past trends was adopted.

a. In the linear trend method, the volume of demand is projected by

$$X_t = \beta_0 + \beta_1 t$$

where X_t: volume of demand in year 't'
t: year
β_0, β_1: estimated parameters

Although this method is effective when the commodity market situation does not vary largely, or when used for short-term estimation, it is not suitable for long-term estimation or when the market structure itself is changing. This method may be used, however, in case there is no special theoretical basis for projection.

b. In the exponential trend model, the volume of demand is projected by the following exponential curve:

$$X_t = K_0 e^{\beta t}$$

where X_t: volume of demand in the year 't'
t: year
K_0, β: parameters

c. In the logistic curve method, the following basic equation is used:

$$\frac{dX_t}{dt} = \gamma X_t \left(1 - \frac{X_t}{K}\right)$$

where X_t: volume of demand in the year 't'
t: year
γ, K: estimated parameters

This equation may be used to estimate the volume of demand on the assumption that there is a certain saturation level in consumer demand.

d. In the econometric method with economic indices such as the national income as explanatory variables, a single equation or simultaneous equations models can be constructed. Although there are various economic indices which can be used as explanatory variables, the following equation with the dependent variable of GDP per capita was used in projecting demand in a certain country or regional bloc:

$$X_{ti} = \beta_0 + \beta_1 y_{ti}$$

where X_{ti}: volume of demand per capita in the regional bloc 'i' in the year 't'

y_{ti}: GDP per capita in the regional bloc 'i' in the year 't'

β_0, β_1: estimated parameters

e. In the regression analysis method having a lagged independent variable, the following equation was used:

$$X_{ti} = \beta_0 + \beta_1 y_{ti} + \beta_2 y_{t-1,i}$$

where $y_{t-1,i}$: GDP per capita in the regional bloc 'i' in the year 't-1'

β_2: estimated parameter

The regression equation d. with an explanatory variable of GDP per capita generally gave satisfactory results. However, regression equation e., which has the lagged explanatory variable, did not necessarily give satisfactory results judging from significance of the estimated parameters. The linear trend method and the exponential trend method were second to regression analysis method d., giving meaningful results with satisfactory parameter significance.

On the basis of the above results of evaluation, the regression analysis method with the variable of GDP per capita was mainly used in this Study. The linear trend method and the exponential trend method were also used for the regional blocs for which it was not possible to find significant parameters for in the regression analysis method. For the regional blocs to which none of the above methods could be used in a satisfactory manner, projections were made by qualitative estimation based on extrapolation of the recent trends (1978 - 1980).

The growth rate of GDP per capita, which was required for projection of demand for forest products, was re-computed for each of the regional blocs, as shown in Table E-2.

Table E-2 Projected Annual per Capita Growth Rate of GDP by Regional Blocs

(%)

	1980 - 1985		1985 - 2000	
	High	Low	High	Low
Brazil	4.5	2.4	2.9	1.9
Japan	4.0	2.2	3.1	1.9
N. America	4.0	2.2	3.0	1.8
W. Europe	4.0	2.2	3.4	2.2
Oceania	3.8	2.0	2.9	1.7
Africa	3.3	1.5	2.0	0.6
M. & N. East	4.4	2.6	3.8	1.9
C. Plnd. Asian countries	3.5	1.0	3.7	1.3
C. Plnd. European countries	2.3	1.8	2.3	1.8
Other developed countries	2.7	0.8	1.3	0.2
Latin America	3.3	1.2	2.8	1.8
Far East	2.5	0.9	1.3	0.7
Tropical Asia	4.4	2.5	3.2	1.9
World	3.0	1.4	2.2	1.1

Source: Volume 1, Chapter II in this Study

The projection methods for obtaining the projection results given in Tables E-4 to E-9 in the next section are described below.

a. In principle, the projected demand in each Table were estimated according to the regression analysis equation with a variable of GDP if a figure is given in the elasticity column. Where the data for the annual rate are given in parentheses, however, the projection data were estimated by qualitative examination instead of using the regression equation.

b. Where the figure in the elasticity column is given in such a manner as shown in the following examples, the projection data were estimated with a trend method:

Examples: If (5145.8, 187.4) is given, $Q_T = 5145.8 + 187.4T$
If <8.57, 0.028> is given, $Q_T = e^{(8.57 + 0.028T)}$
where T = 20 (1985) or T = 30 (2000) in both cases.

c. In cases other than those described above, the annual rates were

determined on the basis of the trends in the past six years, referring to the FAO estimates, the projections by the government of each country, etc. In these cases, the demand on the basis of a three-year average for 1975-1977 and 1978-1980 is also given in the Tables.

d. The 1978-1980 three-year average demand was taken as the demand in 1979, which provided a base for demand projection.

e. In each Table, the figures in double parentheses in the spaces for the world annual rates were derived by adding demands in all the regional blocs.

3. Results of the Present Projection

3.1 Outline of Results

The results of projection of world demand for each product are shown in Table E-3.

In the short-term projection until 1985, demand for each product will increase, and increase in demand for particle boards and pulpwood and particles is especially large. In the high case projection, the annual rate of growth of demand for particle boards is 4.4%, and the low case projection, 2.1%. Consequently, the present demand of 40 million m^3 is projected to increase to 52 million m^3 (or 46 million m^3 in the low case). The present demand of 330 million m^3 for pulpwood and particles is projected to increase to 438 million m^3 in 1985, an increase of approximately 32%. Demand for plywood will increase rather sharply, at an annual growth rate of 2.1%.

On the other hand, the annual growth rates for sawnwood, sawlogs and veneer logs (non-conifer), and sawlogs and veneer logs (conifer) are low, at 1.5%, 1.5% and 1.3% respectively. Moreover, the growth rates of these three types of products in the low case projections are all less than 1%. In particular, demand for sawlogs and veneerlogs is expected to increase only slightly, at an annual growth rate of 0.2 to 0.3%.

The major reasons why increase in demand for particle boards is sharper than for other products are that prices of particle boards are lower than those of other products for similar purposes and that particle boards can be made of logs of smaller size and lower grade than plywood or sawnwood. Although a comparatively high level of technology is required in the production of particle boards, the recent transfer of technology to developing regions has induced the rise in the rate of demand growth.

Table E-3 Summary of Projected World Demand

(1,000 m^3)

Product	1978-1980 Average qty.	1985				2000			
		High		Low		High		Low	
		Annual rate (%)	Qty.	Annual rate (%)	Qty.	Annual rate (%)	Qty.	Annual rate (%)	Qty.
Particle board	40,636	4.4	52,624	2.1	46,040	3.2	84,409	1.6	58,425
Plywood	41,336	2.7	48,434	1.3	44,684	2.2	67,817	1.3	54,020
Sawnwood (NC)	100,959	1.5	110,415	0.8	105,960	1.3	133,386	0.7	116,976
Sawlogs & veneerlogs (C)	616,984	1.3	665,670	0.2	624,484	1.1	785,994	0.6	685,425
Sawlogs & vennerlogs (NC)	240,920	1.8	268,228	0.3	245,028	0.7	298,639	0.3	256,865
Pulpwood & particles	331,847	4.8	438,320	1.0	332,826	3.1	691,604	1.0	410,612

Notes: 1) The annual rates for 1985 and 2000 are the average annual growth rates (%) during the periods 1981-1985 and 1986-2000 respectively.

2) All the projected values (Qty.) are in 1,000 m^3. The projection was made taking the value in 1979 as the base, which was actually the three-year average for 1978-1980.

It is estimated that approximately 85% of pulpwood and particles are used for pulping. The high growth rate of demand for pulpwood and particles reflects a large increase in demand for paper and pulp. It is known that demand for paper and pulp expands in proportion to the rate of economic growth.

In the long-term projections until 2000, the trends in increase of demand for products do not show much difference among themselves, but the growth rate of demand is generally lower owing to the fall in the economic growth rate. The annual growth rate of demand for non-conifer sawlogs & veneerlogs is especially low, varying between a high case of 0.7% and a low case of 0.3%. This is because the effect of the decrease in resources of big non-conifer trees of high grade will become significant.

The growth rate of demand for non-conifer sawnwood and conifer sawlogs & veneerlogs will also drop for the same reason.

In the high case projection, the volume of demand for particle boards, plywood, sawnwood (NC), sawlogs & veneerlogs (C), sawlogs & veneerlogs (NC) and pulpwood & particles in 2000 will be, respectively, 2.07, 1.64, 1.32, 1.27, 1.24 and 2.08 times the present volume of demand.

The results of the present projection were compared with the results of the FAO forecast [1] described in the previous section. Since the ways of classifying the products, regions and period of coverage differ between the two projections, a strict one-to-one comparison was not possible. Consequently, the world demand data covering the same fields and obtained separately from the two surveys were compared, as shown in Table E-4.

It can be seen in this comparison that the average value for particle board in the present high and low case projections is at a level similar to the value for reconstituted panels in the FAO forecast.

The value for sawnwood and logs in the present projection is smaller than that for sawnwood & sleepers and solidwood panels in the FAO forecast by 0.5 to 1.0%. The reason for this is thought to be that the future prospects for world economic growth differ according to the time when the analysis was made. It can be said, however, that the scale and the tendency of demand are quite similar in the two surveys.

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1) FAO, Forestry Paper, No.29

Table E-4 Comparison of the Present Projection to the FAO Forecast

(%)

Product	1980 - 1985/90 *	1985/90 - 2000
Present projection (particle board)	4.4-2.1	3.2-1.6
FAO forecast (reconstituted panels)	2.8	2.2
Present projection (non-conifer sawnwood)	1.5-0.8	1.3-0.7
FAO forecast (hardwood - sawnwood & sleepers)	2.2	1.5
Present projection (sawlogs & veneer logs)	1.4-0.2	1.0-0.5
FAO forecast (solidwood panels)	2.2	1.4

* For the years, a division into 1980-1985 and 1985-2000 was used in the present projection, and a division into 1980-1990 and 1990-2000 was used in the FAO forecast.

3.2 Results of Projection for Each Product

3.2.1 Particle board (Refer to Table E-5)

The projected demand for particle boards in most regions can be obtained using the income-elasticity value. The elasticity in all the regions except the Far East is larger than 1, and is as high as 3 to 4.5 in some regions. The elasticity in Europe and Japan is small, at 1.057 and 1.069, respectively. On the other hand, that in Brazil, North America and other developed regions is high: 2.565, 4.528 and 3.048, respectively. This is thought to be due to the factors in the relationship between particle board and its rival, plywood, such as conditions of material supply, preferences, suitability to climate, possibility of production plant expansion, etc.

The average annual growth rate of demand up to 1985 is extremely high for North America at 10.0 to 18.1%, and is quite high for Brazil and other developed regions at 6.2 to 11.5% and 2.4 to 5.2%, respectively. This tendency is expected to continue up to 2000, the rate being in the range from 4.9 to 7.4% in Brazil and North America, and 2 to 4% in other regions. The data marked with "*" in this Table are projections of volumes of demand in the large-consumption regions such as North America, Western Europe, etc., and should be discounted considerably for conformity with the data for world demand. The same statement is valid for the data for centrally planned European countries.

Table E-5 Results of Projection of Demand for Particle Board

(Qty: 1,000 m^3; Rate: %)

Region/Country	Historical consumption quantity (three-year average) 1975-77	Historical consumption quantity (three-year average) 1978-80	Elasticity Qty./GNP/C'op.[a] Trend method for ( ) or < >	Projected demand - 1985 High Annual rate[b]	Projected demand - 1985 High Qty.	Projected demand - 1985 Low Annual rate[b]	Projected demand - 1985 Low Qty.	Projected demand - 1990 High Qty.	Projected demand - 1990 Low Qty.	Projected demand - 2000 High Annual rate[b]	Projected demand - 2000 High Qty.	Projected demand - 2000 Low Annual rate[b]	Projected demand - 2000 Low Qty.
Brazil		544	2.565	11.5	1,045	6.2	780	1,493	991	7.4	3,049	4.9	1,598
Japan		974	1.069	4.3	1,245	2.4	1,123	1,464	1,240	3.3	2,026	2.0	1,512
North America		8,573	4.528	18.1*	23,261*	10.0	15,188	33,239	19,292	7.4	44,316*	4.9	31,120*
Western Europe		19,430	1.057	4.2	24,836	2.3	22,267	29,640	24,948	3.6	42,221*	2.3	31,307*
Oceania		628	1.541	5.9	886	3.1	754	1,104	857	4.5	1,714	2.6	1,108
Africa		185	1.692	3.3	225	2.5	215	266	226	3.4	371	1.0	250
M.N. East[c]		694	1.124	5.6	963	2.9	824	1,189	914	4.3	1,810	2.1	1,126
C.P.A.C.[d]		45	(24, 1.65)	(5.0)	60	(3.0)	54	76	61	(4.8)	121	(2.4)	77
C.P.E.C.[e]		8,551	(1.390, 523.0)	(5.6)	11,860	(2.8)	10,090	14,709	11,926	(4.4)	22,629	(3.4)	16,659
O.D.C.[f]		254	3.048	8.2	408	2.4	293	496	302	4.0	735	0.6	321
Latin America		682	1.492	4.9	908	1.8	759	1,115	867	4.2	1,683	2.7	1,132
Far East		4	-1.060	-1.0	4	-2.7	3	4	3	-0.7	4	-1.4	2
Tropical Asia	71	68		0.2	69	0.1	68	70	68	0.2	71	0.1	69
World		40,636	1.473	4.4	52,624	2.1	46,040	61,600	49,843	3.2	84,409	1.6	58,425

a) The figures for elasticity are not given here when an appropriate elasticity is unable to be calculated.
b) Values in parentheses are annual rates obtained by qualitative projection.
c) Middle & Near East
d) Centrally Planned Asian countries
e) " " European countries
f) Other developing countries
* Refer to the text.

In this Table, the average annual growth rates of demand in the low case projection turn out to be about 50 to 60% of the corresponding rates in the high case projection.

The average annual growth rate of world demand is projected at between 2.1% and 4.4% in 1985, and from 1.6% to 3.2% in 2000. Although these values are fairly high, the value for the volume of world demand obtained by summing up the data for all the regions is much larger than the figure for the volume of world demand calculated using the rate given above, which is thought to be more reliable.

Negative values are given for the Far East, and this is thought to be partly because the data used for countries having a low particle board consumption (e.g. Pakistan, Bangladesh, Nepal and Bhutan) were not fully satisfactory.

3.2.2 Plywood (Refer to Table E-6)

From the viewpoint of income elasticity, there are two groups of regions: tropical Asia and Africa, each of which has an elasticity larger than 1, and others, which have an elasticity smaller than 1 (0.5 to 0.9). Demand for plywood is expected to expand in the former regions because the raw materials for plywood can be provided by natural forest resources in the regions and also because of transfers of technology to the region. In the latter regions, plywood is thought to be competing with particle boards in price and supply of materials.

There are regions for which appropriate elasticities cannot be computed. This is thought to be due to maturation of and stagnation in the overall economy of Western Europe, and also due to unsatisfactory data in other regions. The demand for plywood in Oceania and centrally planned European countries is expected to drop owing to utilization of substitute materials. The demand in the Far East and in countries with centrally planned economies in Asia can be expected to grow because of the low level of present demand.

The annual growth rates in Brazil, Africa, the Middle and Near East, countries with centrally planned economies in Asia, the Far East and tropical Asia are projected at around 4% (low case projection: 2 to 3%) up to 1985 and 3 to 7% up to 2000. In North America and Japan, at present the largest consumers, the annual growth rate will, according to these projections, maintain its level of 2 to 3% (low case projection: 1 to 1.6%), in spite of the accelerating utilization of substitute products. Since the growth rate of demand in tropical Asia projected using the value of income elasticity is too high, it was reduced by approximately one-half on the basis of qualitative judgement.

Table E-6 Results of Projection of Demand for Plywood

(Qty: 1,000 m^3; Rate: %)

Region/Country	Historical consumption quantity (three-year average) 1975-77	1978-80	Elasticity Qty./GNP/C'op.[a] Trend method for ( ) or < >	Projected demand - 1985 High Annual rate[b]	Qty.	Low Annual rate[b]	Qty.	Projected demand - 1990 High Qty.	Low Qty.	Projected demand - 2000 High Annual rate[b]	Qty.	Low Annual rate[b]	Qty.
Brazil		648	0.770	3.5	796	1.8	727	887	777	2.2	1,103	1.5	901
Japan		8,239	0.567	(2.0)	9,277	(1.0)	8,750	9,994	9,196	(1.5)	11,596	(1.0)	10,159
North America		20,685	0.740	3.0	24,698	1.6	22,754	27,537	24,272	2.2	34,231	1.3	27,623
Western Europe	4,094	4,521		0.2	4,575	0.1	4,548	4,621	4,571	0.2	4,712	0.1	4,616
Oceania	189	176		-1.3	163	-2.3	153	153	136	-1.3	134	-2.3	108
Africa		442	1.345	4.4	572	2.0	498	654	518	2.7	853	0.8	561
M.N. East[c]		741	0.919	4.0	937	2.4	854	1,113	929	3.5	1,569	1.7	1,100
C.P.A.C.[d]	284	334		5.6	463	2.8	394	532	422	2.8	701	1.4	510
C.P.E.C.[e]	2,859	2,632		-1.3	2,433	-2.6	2,247	2,361	2,105	-0.6	2,347	-1.3	1,847
O.D.C.[f]	70	67		0.2	68	0.1	67	69	67	0.2	76	0.1	68
Latin America		671	0.624	2.1	760	0.7	670	827	708	1.7	979	1.1	795
Far East	459	707		5.0	947	2.5	820	1,209	928	5.0	1,969	2.5	1,187
Tropical Asia		1,458	4.493	(9.9)	2,569	(5.6)	2,022	3,639	2,496	(7.2)	7,289	(4.3)	3,801
World[g]	38,193	41,336		((2.7))	48,434	((1.3))	44,684	54,001	47,665	((2.2))	67,817	((1.3))	54,020

a) The figures for elasticity are not given here when an appropriate elasticity is unable to be calculated.
b) Values in parentheses are annual rates obtained by qualitative projection.
c) Middle & Near East
d) Centrally Planned Asian countries
e) " " European countries
f) Other developing countries
g) Values in double parentheses in the columns showing world annual rates were projected from the total of demand in all the columns.

The annual growth rate of world demand was calculated backwards from the total demand of all the regional blocs, with the following results: 2.7% (low case projection: 1.3%) in 1985 and 2.2% (low case projection: 1.3%) in 2000, as shown in Table E-6.

3.2.3 Sawnwood: non-conifer (Refer to Table E-7)

The values of income elasticity are all less than 1, and are negative for North America and Oceania. This is thought to be a result of the limits of non-conifer forest resources, a shift to materials of higher processibility and their growing use as fuel (Non-conifer wood is widely used for firewood and charcoal in North America).

The income elasticity in Brazil, Africa and the Middle and Near East is generally low. Tropical Asia is the only region showing comparatively high income elasticity.

Excluding the 4.1% (low case, 2.3%) projection for tropical Asia, the annual growth rate of demand in all the regions including the centrally planned Asian countries and Latin America (a little over 2%) is generally low.

In Japan, centrally planned European countries, other developed countries and the Far East, the annual growth rate will remain at the same level or increase slightly. In Western Europe, however, the conditions of resources and consumption habits of people lead to the expectation that demand will continue growing, though at a low rate.

The value of world income elasticity turned out to be negative, and this seems to be very credible. Since the total of the values for all the blocs agreed with the value obtained for the world as a whole, this value was taken as the projected volume of demand, and the world growth rates of 1.5% up to 1985 (low case projection: 0.8%) and 1.3% up to 2000 (low case projection: 0.7%) were obtained. By this is meant that the world demand in 2000 will increase from the present level by approximately 30%.

3.2.4 Sawlogs and veneerlogs: conifer (Refer to Table E-8)

The values of income elasticity are generally small, the largest being 0.5 for North America. The values are negative in Japan and Oceania. This is mainly due to shift to materials of higher processibility, as in the case of sawnwood.

Table E-7 Results of Projection of Demand for Sawnwood (Non-Conifer)

(Qty: 1,000 m^3; Rate: %)

Region/Country	Historical consumption quantity (three-year average) 1975-77	Historical consumption quantity (three-year average) 1978-80	Elasticity Qty./GNP/C'op.[a] Trend method for ( ) or < >	Projected demand - 1985 High Annual rate[b]	Projected demand - 1985 High Qty.	Projected demand - 1985 Low Annual rate[b]	Projected demand - 1985 Low Qty.	Projected demand - 1990 High Qty.	Projected demand - 1990 Low Qty.	Projected demand - 2000 High Annual rate[b]	Projected demand - 2000 High Qty.	Projected demand - 2000 Low Annual rate[b]	Projected demand - 2000 Low Qty.
Brazil		6,510	0.428	1.9	7,291	1.0	6,914	7,739	7,195	1.2	8,720	0.8	7,792
Japan	8,608	6,797		0.2	6,878	0.1	6,838	6,947	6,872	0.2	7,084	0.1	6,941
North America		18,302	-1.055	(0.5)	18,851	(0.2)	18,522	19,327	18,708	(0.5)	20,321	(0.2)	19,078
Western Europe	14,024	16,112		2.0	18,142	1.0	17,111	19,544	17,543	1.5	22,678	0.5	18,446
Oceania		2,280	-0.285	-0.6	2,199	-1.1	2,134	2,145	2,050	-0.5	2,040	-0.8	1,892
Africa		4,372	0.751	2.5	5,072	1.1	4,669	5,464	4,787	1.5	6,340	0.5	5,033
M.N. East[c]		1,635	0.382	1.7	1,808	1.0	1,736	1,948	1,798	1.5	2,260	0.7	1,927
C.P.A.C. d)		7,978	(5,145.8, 187.4) <8.57, 0.028>	2.4 h)	9,228	1.8 i)	8,894	10,594	9,772	2.8 h)	14,044	1.9 i)	11,705
C.P.E.C. e)	19,679	18,307		0.5	18,856	0.2	18,527	19,332	18,713	0.5	20,327	0.2	19,083
O.D.C. f)	399	309		1.0	328	0.5	318	345	326	1.0	381	0.5	343
Latin America		5,572	(3,858, 125.8) <8.275, 0.0260>	2.8 h)	6,601	2.3 i)	6,374	7,505	6,969	2.6 h)	9,703	1.8 i)	8,262
Far East	5,789	5,580		0.5	5,747	0.2	5,647	5,892	5,704	0.5	6,195	0.2	5,816
Tropical Asia		7,116	0.923 <11.36, 0.0126>	4.1	9,059	2.3	8,155	10,502	8,916	3.0	14,114	1.8	10,659
World g)		100,959	-0.174	1.5 i)	110,415	((0.8))	105,960	117,781	109,721	1.3 i)	133,386	((0.7))	116,976

a) The figures for elasticity are not given here when an appropriate elasticity is unable to be calculated.
b) Values in parentheses are annual rates obtained by qualitative projection.
c) Middle & Near East
d) Centrally Planned Asian countries
e) " " European countries
f) Other developing countries
g) Values in double parentheses in the columns showing world annual rates were projected from the total of demand in all the columns.
h) Values were projected by the exponential trend method using data in < > in the column showing elasticity.
i) Values were projected by the linear trend method using data in ( ) in the column showing elasticity.

Table E-8 Results of Projection of Demand for Sawlogs and Veneer Logs (Conifer)

(Qty: 1,000 m^3; Rate: %)

Region/Country	Historical consumption quantity (three-year average)		Elasticity Qty./GNP/C'op.[a] Trend method for ( ) or < >	Projected demand - 1985				Projected demand - 1990		Projected demand - 2000			
				High		Low				High		Low	
	1975-77	1978-80		Annual rate [b]	Qty.	Annual rate [b]	Qty.	High Qty.	Low Qty.	Annual rate [b]	Qty.	Annual rate [b]	Qty.
Brazil		16,009	0.334	1.5	17,498	0.8	16,793	18,391	17,303	1.0	20,315	0.6	18,372
Japan		37,121	-0.143	-0.3	36,458	-0.6	35,805	36,824	35,984	(0.2)	37,551	(0.1)	36,342
North America		267,772	0.514	2.1	303,386	1.1	285,980	326,833	299,083	1.5	379,233	0.9	327,161
Western Europe	84,263	96,531		2.0	129,930	1.0	102,516	139,972	105,105	1.5	162,413	0.5	110,512
Oceania		6,067	-0.170	-0.3	5,959	-0.6	5,852	6,019	5,881	(0.2)	6,138	(0.1)	5,940
Africa		1,203	0.315	1.0	1,278	0.5	1,239	1,317	1,251	0.6	1,398	0.2	1,276
M.N. East [c]		5,534	0.129	0.6	5,739	0.3	5,634	5,884	5,691	0.5	6,187	0.2	5,803
C.P.A.C. [d]		22,943	(12,416, 714.4) <9.479, 0.0389>	2.6 [i]	26,704	1.3 [h]	24,801	29,920	26,850	2.3 [i]	37,420	(1.6)	31,472
C.P.E.C. [e]	158,710	148,683		-1.0	139,982	-2.1	130,905	141,387	131,561	0.2	144,181	0.1	132,869
O.D.C. [f]	2,932	2,644		-1.6	2,400	-3.2	2,175	2,424	2,186	0.2	2,472	0.1	2,208
Latin America	8,617	7,980		0.2	8,076	0.1	8,028	8,157	8,068	0.2	8,318	0.1	8,148
Far East	237	379		1.0	402	0.5	390	414	394	0.6	440	0.2	402
Tropical Asia		4,088	0.439	1.9	4,579	1.1	4,366	4,909	4,543	1.4	5,719	0.8	4,920
World [g]		616,984	(505,238, 8,021.6) <13.137, 0.0142> -0.144	1.3 [i]	665,670	((0.2))	624,484	703,096	643,445	1.1 [i]	785,994	((0.6))	685,425

a) The figures for elasticity are not given here when an appropriate elasticity is unable to be calculated.
b) Values in parentheses are annual rates obtained by qualitative projection.
c) Middle & Near East
d) Centrally Planned Asian countries
e) " " European countries
f) Other developing countries
g) Values in double parentheses in the columns showing world annual rates were projected from the total of demand in all the columns.
h) Values were projected by the exponential trend method using data in < > in the column showing elasticity.
i) Values were projected by the linear trend method using data in ( ) in the column showing elasticity.

The annual growth rates of demand in centrally planned Asian countries are the largest, with 2.6% up to 1985 (low case projection: 1.3%) and 2.3% up to 2000. The rates of demand in North America, Western Europe and tropical Asia are at the same level: 2% in 1985 (low case projection: 1%) and 1.5% (low case projection: 0.5 to 0.9%) in 2000.

In Japan, Oceania, centrally planned European countries and other developed regions, it is expected that the volume of demand will continue decreasing until around 1985 and level off thereafter.

It is projected that the world demand will continue to increase slightly. However, it may tend to decrease for the time being because of the negative income elasticity.

3.2.5 Sawlogs and veneerlogs: non-conifer (Refer to Table E-9)

Among the regions where elasticity was computed at reliable level, Brazil, Africa and the Far East are the regions with positive income elasticity, whereas North America and Oceania have negative income elasticity. Among regions in which the future demand has been projected without using elasticity, Japan, the Middle and Near East, and centrally planned European countries show a tendency to decrease in the future demand. This is partly because plywood itself is being replaced by substitute materials, and partly because non-conifer forest resources are decreasing.

In this overall trend, the volume of demand in tropical Asia and centrally planned Asian countries is expected to increase considerably, because forest industrialization started in these regions on the basis of their own forest resources.

In Brazil and Western Europe, a certain scale of increase can be expected in future demand, although the resource situation is not very advantageous. The world annual growth rate is 1.8% (low case projection: 0.3%) and 0.7% (low case projection: 0.3%) in 2000, showing a tendency to increase slightly.

3.2.6 Pulpwood and particles (Refer to Table E-10)

There is a general tendency towards increase in the volume of demand for plywood & particles in all the regions. In particular, the growth rate is expected to be large in regions which have developed to certain extent, namely, tropical Asia, the Far East, centrally planned Asian countries, Africa and Brazil.

Table E-9 Results of Projection of Demand for Sawlogs and Veneer Logs (Non-Conifer)

(Qty: 1,000 m^3; Rate: %)

Region/Country	Historical consumption quantity (three-year average)		Elasticity Qty./GNP/C'op.[a] Trend method for ( ) or < >	Projected demand - 1985				Projected demand - 1990		Projected demand - 2000			
				High		Low				High		Low	
	1975-77	1978-80		Annual rate [b]	Qty.	Annual rate [b]	Qty.	High Qty.	Low Qty.	Annual rate [b]	Qty.	Annual rate [b]	Qty.
Brazil		13,148	0.380	1.7	14,542	0.9	13,871	15,360	14,363	1.1	17,130	0.7	15,397
Japan	24,210	24,984		-0.2	24,686	-0.5	24,244	24,440	23,644	-0.2	23,956	-0.5	22,488
North America		41,864	-0.606	(0.5)	43,120	(0.2)	42,366	44,209	42,791	(0.5)	46,483	(0.2)	43,637
Western Europe	27,676	30,008		1.3	32,439	0.6	31,118	33,424	31,588	(0.6)	35,488	(0.3)	32,549
Oceania		6,103	-0.459	-0.9	5,781	-1.7	5,506	5,553	5,157	-0.8	5,125	-1.3	4,525
Africa		11,168	0.214	0.7	11,648	0.3	11,369	11,883	11,426	0.4	12,370	0.1	11,540
M.E. East [c]	1,551	1,366		-1.8	1,225	-3.6	1,096	1,171	1,001	-0.9	1,070	-1.8	835
C.P.A.C. [d]		21,761	(7,367, 968.1)	3.5	26,727	(1.8)	24,220	30,834	26,092	2.9	41,251	(1.5)	30,275
C.P.E.C. [e]	35,776	33,965		-0.8	32,367	-1.7	30,645	31,725	29,439	-0.4	30,478	-0.8	27,167
O.D.C. [f]	498	604		1.1	645	0.5	622	681	638	1.1	760	0.5	671
Latin America	11,798	11,669		0.2	11,809	0.1	11,739	11,928	11,798	0.2	12,163	0.1	11,915
Far East		15,623	0.400	1.0	16,592	0.4	15,998	17,011	16,239	0.5	17,886	0.3	16,734
Tropical Asia		28,451	(13,028, 1,184.3)	4.3	36,714	(2.1)	32,234	41,742	34,384	2.6	54,479	(1.3)	39,132
World [g]		240,920	(182,388, 4,292)	1.8	268,228	((0.3))	245,028	277,748	248,726	((0.7))	298,639	((0.3))	256,865

a) The figures for elasticity are not given here when an appropriate elasticity is unable to be calculated.
b) Values in parentheses are annual rates obtained by qualitative projection.
c) Middle & Near East
d) Centrally Planned Asian countries
e) " " European countries
f) Other developing countries
g) Values in double parentheses in the columns showing world annual rates were projected from the total of demand in all the columns.

Table E-10 Results of Projection of Demand for Pulpwood and Particles

(Qty: 1,000 m^3; Rate: %)

Region/Country	Historical consumption quantity (three-year average)		Elasticity Qty./GNP/C'op.[a] Trend method for ( ) or < >	Projected demand - 1985				Projected demand - 1990		Projected demand - 2000			
				High		Low				High		Low	
	1975-77	1978-80		Annual rate [b]	Qty.	Annual rate [b]	Qty.	High Qty.	Low Qty.	Annual rate [b]	Qty.	Annual rate [b]	Qty.
Brazil		8,580	0.668	3.0	10,245	1.6	9,438	11,256	10,068	1.9	13,585	1.3	11,458
Japan		23,229	0.335	1.3	28,200	0.7	24,228	29,638	24,964	1.0	32,740	0.6	26,505
North America	129,990	138,457		2.0	186,363	1.0	147,041	205,760	154,542	2.0	250,845	1.0	170,715
Western Europe	88,873	91,276		2.0	122,857	1.0	96,935	132,352	100,875	1.5	153,571	0.8	109,246
Oceania	3,715	2,795		0.2	2,829	0.1	2,812	2,857	2,826	0.2	2,914	0.1	2,854
Africa		2,153	1.046	3.5	2,646	1.6	2,368	2,936	2,440	2.1	3,614	0.6	2,590
M.N. East [c]		1,071	0.563	2.5	1,242	1.5	1,113	1,378	1,176	2.1	1,697	1.1	1,311
C.P.A.C. [b]		5,291	(1,143, 296.9)	5.0	7,081	(2.5)	6,138	8,329	6,645	3.3	115,345	(1.6)	7,789
C.P.E.C. [d]	47,249	44,666		2.0	60,120	1.0	47,435	69,696	51,101	3.0	93,667	1.5	59,294
O.D.C. [e]		3,826	0.215	0.6	3,968	0.2	3,872	4,028	3,911	0.3	4,151	0.2	3,988
Latin America		8,278	0.881	2.9	9,826	1.1	8,841	11,117	9,571	2.5	14,228	1.6	11,219
Far East		439	1.593	4.0	555	1.4	477	616	504	2.1	758	1.1	562
Tropical Asia		1,782	1.342	(5.0)	2,388	(3.0)	2,128	2,948	2,408	4.3	4,489	2.5	3,081
World [c]	319,346	331,847		((4.8))	438,320	((1.0))	352,826	510,604	370,824	((3.1))	691,604	((1.0))	410,612

a) The figures for elasticity are not given here when an appropriate elasticity is unable to be calculated.
b) Values in parentheses are annual rates obtained by qualitative projection.
c) Middle & Near East
d) Centrally Planned Asian countries
e) " " European countries
f) Other developing countries
g) Values in double parentheses in the columns showing world annual rates were projected from the total of demand in all the columns.

On the other hand, the growth rate is generally low in developed countries. It is especially low in the regions where forest resources are limited. The rate in 1985 is projected at 1.3% (low case projection: 0.7%) in Japan and 0.6% (low case projection: 0.2%) in other developed regions. In the regions such as North America, Western Europe and centrally planned European countries where forest resources are less limited, the annual growth rate up to 1985 is expected to be around 2% (low case projection: 1%), which is higher than the rate in Japan or other developed regions. The projected rate in 2000 is 2.0% (low case projection: 1.0%) in North America, 1.5% (low case projection: 0.8%) in Western Europe and 3.0% (low case projection: 1.5%) in centrally planned European countries, the regional variation being due to difference in the level of economic development and also in the amount of forest resources.

The average annual growth rate of world demand projected from the total of demand in all the regional blocs is 4.8% (low case projection: 1.0%) up to 1985 and 3.1% (low case projection: 1.9%) up to 2000.

F. FIREWOOD AND CHARCOAL

I. Trends in Consumption of Firewood and Charcoal

The worldwide consumption of firewood and charcoal increased by 32% in fourteen years from about 1.1 billion m^3 in 1966 to about 1.628 billion million m^3 in 1980.[1)]

The consumption in developed countries, however, decreased by about half between 1966 and 1980. The per capita consumption in 1980 was 0.08 m^3 in North America, 0.06 m^3 in Western Europe, 0.08 m^3 in Oceania, and 0.02 m^3 in Japan. Thus, the dependency on firewood and charcoal as energy sources is low in developed countries. On the other hand, the consumption in developing countries, which is huge, has gradually increased in the past fourteen years. In 1980, it was about 340 million m^3 in Africa, about 285 million m^3 in Latin America, and about 560 million m^3 in Asia — a total of about 1,185 million m^3, which accounts for 73% of the total world consumption of about 1,628 million m^3.

The per capita consumption of firewood and charcoal in developing countries in 1980 was 0.24 m^3 in Africa, 0.25 m^3 in Latin America, and 0.37 m^3 in Asia. Each figure is 4 to 5 times more than that in developed countries. It is especially large in Asia, but not uniform: the annual per capita consumption in Southeast Asia. That is only 0.26 m^3 in tropical Oceania,[2)] but much higher, 0.54 m^3, in South Asia.[3)]

Table F-1 shows the amount of the consumption of firewood and charcoal by region.

II. Charcoal Trade Situation

In 1980, the imports of firewood and charcoal throughout the world, which amounted to about 1.07 million m^3 and about 390,000 tons, respectively, were small in scale. Charcoal imports into developed

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1) FAO, Yearbook of Forest Products, 1980.
Consumption was calculated using the formula: output + imports - exports.

2) Southeast Asia refers to Indonesia, the Philippines, Malaysia, Thailand, Burma and Laos. Tropical Oceania refers to Papua New Guinea and the British Solomon Islands.

3) South Asia refers to India, Nepal, Pakistan, Sri Lanka and Bangladesh.

Table F-1 Annual per Capita Consumption of Firewood and Charcoal, 1966 - 1980

Region		1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
North America	Consumption	34,926	26,887	25,975	27,089	21,573	19,886	18,789	19,455	19,509	19,103	20,737	19,776	19,855	19,952	19,878
	Population	216,610	219,120	221,440	223,710	226,370	229,250	231,730	233,980	236,250	238,700	241,060	243,520	246,070	248,750	251,600
	C/P	0.16	0.12	0.12	0.12	0.10	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.08
Western Europe	Consumption	54,409	50,893	47,834	45,938	43,979	41,103	35,620	32,224	31,391	30,102	31,268	28,831	29,253	30,020	30,140
	Population	428,490	431,700	434,260	437,670	440,360	443,390	335,300	449,350	452,380	454,930	456,770	458,650	460,780	463,500	465,640
	C/P	0.13	0.12	0.11	0.10	0.10	0.09	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06
Oceania	Consumption	3,298	3,181	3,060	3,249	3,123	3,041	2,996	2,673	3,115	2,125	1,524	1,503	1,413	1,413	1,412
	Population	14,280	14,520	14,760	15,030	14,320	15,790	16,080	16,340	16,610	16,840	17,010	17,180	17,360	17,520	17,720
	C/P	0.23	0.22	0.21	0.22	0.20	0.19	0.19	0.16	0.19	0.13	0.09	0.09	0.08	0.08	0.08
Japan	Consumption	8,644	7,551	6,397	1,766	2,104	2,288	2,470	2,549	2,443	2,170	2,319	2,520	2,526	2,120	2,285
	Population	99,790	100,830	101,960	103,170	104,340	105,700	107,150	108,710	110,160	111,570	112,770	113,860	114,900	115,870	116,780
	C/P	0.09	0.07	0.06	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Other developed countries	Consumption	878	898	916	6,823	6,849	6,869	6,892	6,909	6,929	6,947	6,946	6,943	6,935	6,935	6,935
	Population	22,790	23,410	24,090	24,760	25,440	26,100	26,820	27,580	28,300	28,930	29,660	30,550	31,390	32,270	33,160
	C/P	0.04	0.04	0.04	0.28	0.27	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.21	0.21
Africa	Consumption	209,552	215,848	221,018	250,730	257,528	264,190	271,774	279,916	287,677	295,755	304,283	313,040	322,187	331,444	341,274
	Population	1,019,150	1,026,130	1,051,790	1,078,950	1,106,140	1,133,840	1,162,770	1,191,650	1,220,180	1,252,690	1,283,470	1,319,490	1,352,140	1,392,690	1,430,000
	C/P	0.21	0.21	0.21	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Brazil	Consumption	130,000	130,000	135,000	127,562	131,250	135,039	138,927	142,928	147,044	151,279	155,637	160,116	164,716	169,937	174,406
	Population	82,930	85,240	87,620	90,070	92,520	95,170	97,850	100,560	103,350	106,230	109,180	112,240	115,400	118,650	123,030
	C/P	1.57	1.53	1.54	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.43	1.43	1.43	1.43	1.42
Latin America	Consumption	83,518	83,806	84,047	89,342	90,930	92,934	94,426	96,541	97,867	99,492	102,473	105,158	106,572	108,308	111,117
	Population	710,020	727,180	743,940	759,970	775,290	795,050	813,790	832,740	853,500	875,380	898,060	922,040	946,330	985,960	1,009,730
	C/P	0.12	0.12	0.11	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Near East	Consumption	37,963	38,256	38,983	63,273	63,930	64,152	66,088	66,670	70,138	72,027	74,678	74,381	76,185	59,665	60,784
	Population	343,160	355,550	368,100	383,470	400,630	418,630	438,460	460,020	482,150	502,520	521,240	539,510	560,990	582,550	610,720
	C/P	0.11	0.11	0.11	0.17	0.16	0.15	0.15	0.14	0.15	0.14	0.14	0.14	0.14	0.10	0.10
Southeast Asia & Tropical Oceania	Consumption	139,571	142,879	147,403	267,248	181,677	186,309	191,253	196,485	201,716	207,462	212,741	215,056	220,660	226,140	231,466
	Population	651,080	665,930	680,720	695,830	711,510	727,010	760,550	777,930	796,060	813,610	831,180	849,230	866,750	885,550	903,980
	C/P	0.21	0.21	0.22	0.38	0.26	0.26	0.25	0.25	0.25	0.25	0.26	0.25	0.25	0.26	0.26
Other Asian countries	Consumption	143,192	145,740	148,186	159,398	255,475	261,422	267,423	274,347	280,784	287,800	294,509	304,778	311,939	319,721	326,817
	Population	426,680	437,270	449,070	459,930	479,110	488,260	500,480	504,810	520,250	537,430	550,920	565,320	573,570	595,400	602,840
	C/P	0.34	0.33	0.33	0.35	0.53	0.54	0.54	0.54	0.54	0.54	0.53	0.54	0.54	0.54	0.54
Asian centrally planned economies	Consumption	140,980	144,670	147,330	183,233	187,491	190,885	195,262	198,541	202,753	207,186	211,490	215,913	220,451	225,089	229,645
	Population															
	C/P															
USSR and Eastern Europe	Consumption	117,546	112,334	106,611	103,718	101,927	101,762	101,022	97,907	98,195	95,459	96,315	94,376	91,517	91,715	91,790
	Population															
	C/P															
World	Consumption	1,104,477	1,102,943	1,112,760	1,329,369	1,347,836	1,369,880	1,392,942	1,417,145	1,449,561	1,476,907	1,514,920	1,542,391	1,574,209	1,592,459	1,627,949
	Population	4,014,980	4,086,860	4,177,750	4,272,560	4,377,030	4,478,190	4,602,020	4,703,670	4,819,190	4,938,830	5,051,320	5,171,590	5,285,680	5,438,710	5,565,200
	C/P	0.28	0.27	0.27	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.29	0.29

Units : Consumption: 1,000 m³; Population: 1,000 persons; C/P: Consumption/Population

countries were: the United States, 37,000 tons; France, 32,000 tons; the Federal Republic of Germany, 49,000 tons; and Japan, 66,000 tons in 1980; totalling 286,000 tons. The total of charcoal imports into developing countries in 1980 amounted to 102,000 tons.[1)]

Imported charcoal is used in industry as a reducing material in metalic silicon manufacture and carbon disulphite manufacture. In this manner the charcoal produced is fully consumed, with only a few exceptions, and is the type of forest product that is both domestically produced and domestically consumed, not being distributed as an international commodity on a large scale. Japan imports charcoal from Thailand, Peninsular Malaysia, Indonesia, Singapore and other Southeast Asian countries and the Far East, but both the quantity and the value of this are small. Charcoal imports into Japan are shown in Table F-2.

Table F-2 Charcoal Imports into Japan, 1976 - 1980

1. Quantity

(MT)

	1976	1977	1978	1979	1980
Thailand	97	-	-	49	10
Malaysia	269	-	-	49	34
Indonesia	6,747	6,899	6,644	7,793	7,301
Singapore	7,332	2,515	5,827	9,830	6,636
Others	251	259	473	747	1,082
Total	14,696	9,673	12,944	18,468	15,063

2. Value (Exchange rate: US$1 = 220 yen)

(US$)

	1976	1977	1978	1979	1980
Thailand	21,314	-	-	23,655	4,309
Malaysia	32,318	-	-	7,645	4,336
Indonesia	1,581,373	1,164,018	1,118,995	1,999,822	2,038,895
Singapore	1,035,895	266,659	735,509	1,479,818	948,236
Others	139,191	130,655	222,673	305,505	451,986
Total	2,810,091	1,561,332	2,077,136	3,816,445	3,447,764

Source: Ministry of Agriculture, Forestry and Fisheries, Government of Japan, Forest Agency Annual Statistics, 1981

1) Source: FAO, Yearbook of Forest Products, 1980.

In Japan, imported charcoal is employed as a reductant in the iron industry, and imported activated coconut-shell charcoal is used for water treatment and as a deodorizing agent for commercial purposes. The quantity of imported charcoal which is used in such ways is small — in 1977, about 10,000 tons in industry and about 32,000 tons commercially.

The domestic charcoal produced in Japan totalled 94,600 tons in 1977, and the use distribution of this was: as household fuel — 36,000 tons (38%); as reconstituted charcoal such as briquettes and oval briquettes — 37,000 tons (39%); as activated charcoal powder — 21,000 tons (22%); and for fireworks, castings and so on — 6,000 tons (1%). The trend of decreasing demand is expected to continue after 1980.

The price of domestic charcoal in Japan was ¥56 per kg in 1977 and that of imported charcoal, ¥200 per kg. In 1982, the average price of imported charcoal in Japan was ¥58,683 per ton (US$266.74/ton). Thus, the price of imported charcoal in Japan is about 3.6 times as high as that of domestic charcoal, and the demand for it is decreasing both for industrial use and as a household fuel. For these reasons, there seems to be no possibility of large imports of charcoal into Japan in the future.

III. *Current Research and Development of Charcoal and Energy from Wood*

In the United States and EC countries, too, the use of energy from wood began to be considered after the first oil crisis in 1973, and has attracted much attention. The results of many researches have recently been published.[1] In Japan, however, it was not until 1979 that wood based energy was given much attention and the research and development of charcoal was re-considered.

On the other hand, France has a long history in this field. The Energy Research Institute at the University of Paris carries out basic research, and the Research Institute of Charcoal Making Technology at

1) J.S. Bethel et al, Energy from Wood, University of Washington, 1979; R. Hodam, Economical Energy Conversion Promised by Wood Gasification, 1978; D.W. Rose, Cost of Producing Energy from Wood in Intensive Cultures, 1977; D.E. Garett, Environmental Consideration in Forest Residue Energy Production, 1978; J.F. Shoeman, Energy and Materials from the Forest Biomass, 1977.

the University of Nancy performs research and development of wood carbonization techniques.

Other countries in Europe that have advanced in charcoal manufacturing technique since ancient times include Italy and Spain, where the Meiler Process has been in the process of development for a very long time. Sweden has developed on its own a small-scale charcoal plant operated by 5-6 persons.

In the United States, large-scale charcoal plants (production capacity, 10-50 tons/day) that make charcoal from wood residue from the timber industry have been built, and some manufacturers are exclusively engaged in such activity. A production plant has also been developed to make briquettes from pulverized and carbonized wood residue, and produces about 800,000 tons of briquettes throughout the year for barbecues.

In Japan, charcoal-making techniques peculiar to each locality have existed for many years, and charcoal of good quality and high combustion efficiency has been produced. It is in Japan that the technology of large-scale charcoal plants — horizontal screw plants with a production capacity of 10 tons/day — for making industrial charcoal has reached the highest level in the world, and Japan's techniques for fluidized bed carbonization of saw dust are also said to be as good as those of any other country.

In the USSR, a vertical-type charcoal plant has been developed, and there are ten types of large-scale plants in use.

Let us now look at the current situation of Japan's research and development of charcoal and wood energy in some detail. In Japan, a plant making "Ogalite" mainly from sawdust in sawmills has been developed. Each unit priced at about ¥20 million (approx. US$90,000) has a monthly production capacity of 150 tons. One of the merits of Ogalite as a fuel is that it has high combustion efficiency because its water content is around 10% and its specific gravity is 1.0-1.3, whereas the water content of wood residue in sawmills is 50-60% and its specific gravity is 0.4-0.5. In Japan, too, plants for making briquettes from pulverized wood residue have been developed, as has a highly efficient combustion device for making charcoal in the form of pellets. At the same time, an equipment which has automatic ignition, automatic supply and automatic extinction has been developed. The Japanese techniques of making charcoal have a long history and tradition as local industries, and can produce much hard charcoal of satisfactory size and shape. The European and American techniques produce less charcoal with much charcoal dust, and the making of the charcoal kiln is expensive. Japanese local charcoal making require only a saw and a shovel, and have the merit of low cost for kiln construction. Research is in progress in Japan to use powdered charcoal mixed with heavy oil as a

colloidal fuel for power generation and industry. Techniques of using a mixture of dust charcoal, sawdust and lignin as a fuel have also begun to be studied. There has been very productive research on production techniques and utilization methods for the wood vinegar, wood gas and pineroot oil that are produced in the process of wood carbonization; and other research is progressing into the production of deodorants from by-products of charcoal, methods of use for soil conditioners, applications to mushroom cultivation, and in other uses.

The sawdust fuel, "Ogalite", developed in Japan is a kind of firewood, and is formed by compressing sawdust at high pressure. Its surface is dark brown because it has been heated in the process of production, and no bonding substance is used. "Ogalite" was developed in 1950 and since then, several kinds of equipment for making it have been developed and marketed in other countries. "Woodex", which was developed in the United States, is formed by shaping sawdust, bark and farm waste in pellets under high pressure. "Gromera", a Swiss product, is similar to "Ogalite", and is made by shaping sawdust into firewood sticks at high pressure. It has a calorific value of 4,500-5,000 cal/g, the highest value in the wood fuels, and it has a high combustion efficiency.

The wood fuel industry is desirable from the point of view both of the effective use of wood residue and of the increase in a country's domestic energy production.

Charcoal manufacture and research and development activities related to charcoal are proceeding in Southeast Asia. The Forestry Laboratory in Bogor in Indonesia, for example, which has a charcoal plant, carries out basic studies on charcoal manufacture. In Malaysia, a continuous charcoal-making device which was developed in the United Kingdom is in operation. Also, in the Philippines, there is a research project into the use of "ipil-ipil" (*Leucaena spp.*) as colloidal fuel by carbonizing it and mixing in alcohol made from cassava. Research on the production of wood energy in the form of methanol is in progress, but it will take some time to reach the stage of commercial production.

IV. Industrial Use of Charcoal

As examples of the large-scale production of industrial charcoal in developing countries, several joint venture's undertakings between Japan and Southeast Asian countries are introduced below.

1. The Philippines

In the district of Cagayan de Oro on Mindanao Island, a Japanese company, Kawasaki Steel Corp. and a Philippine company, Mabuhay Vinyl Co. set up a joint venture called Mabuhay Agroforestry Co. (MAFCO) in 1977 to produce 260,000 tons of charcoal per year, to be used as the reducing agent for the production of ferro alloy in electric furnaces, as fuel in the production of sinter, and as a raw material for carbide. The raw material for this charcoal is mainly Leucaena loucocephala, grown by artificial reforestation, the reforestation target area of which is about 70,000 ha.

The market price of local charcoal is US$98 per ton, while the CIF price of imported coke used, in competition with local charcoal as a reducing agent, is US$120 per ton. Accordingly, this Project can be regarding as being feasible, provided the production cost of charcoal is kept within the US$88-113 per ton range.

MAFCO is aiming to produce charcoal at a cost of US$83 per ton when it is operating at full capacity, the details of which are as follows:

. Reforestation cost	27.5	(US$ per ton)
. Logging cost	8	"
. Carbonization cost	28.2	"
. Depreciation cost	5	"
. Other direct charges	4.3	"
. General administrative expenses	4.8	"
. Corporate taxes	0.9	"
. Interest rate expenses	2.4	"
. Other overhead charges	1.8	"

The following assumptions have been made regarding the production costs:

a. Mean annual increment of Leucaena loucocephala as raw material in man-made forests is 50 m^3/ha.
b. Cutting age is 5 - 4 years.
c. Charcoal recovery rate (charcoal output/raw log consumption) is 18%.

To establish the previously mentioned 70,000 ha man-made forest an area of about 4,100 ha had been planted by 1982 as a trial plantation.

Two problems have arisen so far:

a. It is difficult to attain the target of mean annual increment of 50 m^3/ha because Leucaena loucocephala is too sensitive to soil conditions to guarantee constant growth; and
b. Damage incurred by rats has begun occurring.

2. Malaysia

In the district of Prai in the province of Penang, a joint venture, Malayawata Steel Co., was established as a joint venture in 1966 by the Japanese company, Yawata Steel Corp. (its name at that time) and a Malaysian company. It was set up to produce 60,000 tons of charcoal per year for each blast furnace of the parent company which produces sinter. The raw material of this charcoal is the waste logs of rubber trees cut down during regeneration of rubber plantations, and more than 400,000 tons of logs per year are gathered.

In this project, seven charcoal production centers were constructed within a radius of 48 km from Prai —— the location of the blast furnaces (producing 170 tons of pig iron per day per unit). As well, several rubber plantations, each with an area no less than 1,200 ha are located within 16 km of each center. In the whole region, rubber forests total an area of 120,000 ha.

The gathering of rubber logs as raw material for charcoal is planned as follows:

1) Average growing stock of rubber forests per ha: 150 tons/ha
2) Annual regeneration rate (annual cutting rate): 4%
3) Availability as raw material for charcoal: 70%
4) Gross area of rubber forests: 120,000 ha

Accordingly,

1) x 2) x 3) x 4) = 150 tons x 0.04 x 0.7 x 120,000 = 504,000 tons

Sixty trucks was made available for the gathering of these material logs. In each of the above-mentioned centers, dozens of beehive-type kilns or square steel-type kilns have been installed.

The specifications and performance of the beehive-type kiln are as follows:

- Capacity of kiln: 5,600 m^3
- Amount of material logs used: 60-70 tons
- Charcoal production: 10-12 tons
- Period for carbonization: 25 days
- Specific gravity of charcoal: 1.4-1.7
- Fixed carbon rate of charcoal: 82-84%

V. Projection of Firewood and Charcoal Demands

The projections for firewood and charcoal demands mostly can be derived from the trend model. As shown in Table F-3, the projections

Table F-3 Firewood and Charcoal

(1,000 m^3)

	1975-77	1978-80	Trend model 1) $Q_T = \alpha + \beta T$ α	β	2) $Q_T = e^{\alpha+\beta T}$ α	β	1985 H Annual rate(%)	H Qty.	L Annual rate (%)	L Qty.	2000 H Annual rate (%)	H Qty.	L Annual rate (%)	L Qty.
Brazil		169,686	111,291	4,091.8	11.640	0.0285	2.9	2)200,787	2.1	193,131	2.9	2)307,891	1.9	1)254,511
Japan	2,336	2,310					0.3	2,352	0.2	2,337	0.3	2,460	0.2	2,407
North America	19,872	19,895					0.3	20,253	0.2	20,134	0.3	21,185	0.2	20,738
Western Europe		29,804	53,893	-1,992	10.919	-0.050	(-3.1)	24,673	-6.2	2)20,230	(-1.6)	19,371	(-3.1)	12,614
Oceania		1,412	3,819	-166.3	8.359	-0.0747	(-0.1)	1,404	(-0.5)	1,370	(-0.1)	1,383	(-0.5)	1,271
Africa		331,634	219,716	7,814	12.322	0.0277	2.8	2)390,819	2.1	1)375,996	2.8	2)592,141	1.8	1)493,206
Middle and Near East	73,695	65,544					-0.1	65,152	-0.5	63,602	-0.1	64,182	-0.5	58,995
Centrally planned Asia		225,061	167,289	4,062	12.038	0.0204	2.0	2)254,231	1.7	1)248,529	2.1	2)345,242	1.4	1)309,459
Centrally planned Europe		91,674	113,335	-1,636	11.641	-0.016	-1.7	2)82,537	-2.1	80,615	-1.6	2)64,926	-2.4	56,075
Other developed countries		6,935	6,779	13.2	8.822	0.0019	0.3	2)7,044	0.3	1)7,043	0.2	2)7,248	0.2	1)7,241
Latin America		108,665	81,734	1,890.6	11.320	0.0195	1.9	2)121,783	1.6	1)119,546	2.0	2)163,162	1.4	1)147,905
Far East		218,646	149,778	4,849	11.935	0.0258	2.6	2)255,506	2.0	1)246,758	2.6	2)376,247	1.7	1)319,493
Tropical Asia		326,934	230,253	6,814	12.362	0.0240	2.4	2)377,755	1.9	1)366,533	2.4	541,447	1.6	468,743
World		1,598,309	1,229,881	25,607	14.030	0.0178	1.7	2)1,769,133	1.4	1)1,742,021	1.8	2)2,310,559	1.3	1)2,126,126

for regions were made from the model. However, figures in parentheses in the Annual Growth Rate column show projection values amended from the model. For the regions to which the model was not applied, projections that were reasonable from the technical point of view were made for the annual growth rate.

As shown in Table F-3, it is clear that the rate of increase of demand is high in developing countries such as Brazil, African nations, Asian centrally planned economies, and Latin American, Far Eastern and tropical Asian nations. The figure is at most 2 to 3% and at least 1.6 to 2%. On the other hand, demand is stagnant in Japan, North America and other developed nations, and on the decrease in Western Europe, Oceania and European centrally planned economies. From the global point of view, it is projected that the increase will continue at an annual rate of 1.7% (at least 1.4%) until 1985 and at an annual rate of 1.8% (at least 1.3%) until the year 2000, when it will reach a level 45% higher than at present.

G. SUMMARY AND CONCLUSION

I. Trends in and Prospects for Timber Demand

1. The consumption index of non-conifer sawnwood increased to 113 in 1970, 114 in 1975, and to 125 in 1980, the consumption of 81.89 million m^3 in 1965 being taken as 100.

The outlook until the year 2000 (hereinafter referred to as the "outlook") is that the consumption will continue to increase, though not at a very high rate. A view of the individual regions suggests that demand for non-conifer sawnwood will grow substantially in those regions where there are ample hardwood resources but small consumption because the development of forests has been slow — such as Africa, Southeast Asia and tropical America.[1)]

2. The consumption index of non-conifer sawlogs and veneer logs showed a marked increase, standing at 114 in 1970, 117 in 1975, and 135 in 1980, compared with the consumption of 178.79 million m^3 in 1965 taken as 100.

A slight increase worldwide is expected in the future. Regionally, considerable increases are expected in Africa, Southeast Asia and tropical America, but only minor rises in developed countries.

3. The consumption of conifer sawlogs and veneer logs increased to 110 in 1970, and decreased slightly to 106 in 1975, then again increased to 122 in 1980 (1965 consumption of 501.72 million m^3 = 100). It is thought that the demand will decrease for some time and then level off. In developed countries except for North America and Western Europe, falls are projected. In developing countries, on the other hand, rises are foreseen.

4. The consumption of plywood increased to 137 in 1970, 141 in 1975, and 161 in 1980 (1965 consumption of 24.34 million m^3 = 100).

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1) Tropical Africa and tropical America refer to the countries listed in the Footnotes to Table A-4 on p. [6]-22.

The demand for plywood on the whole is projected to continue to increase in the future —— markedly so for some time. A high increase is expected in tropical America and North America, and a decrease in European centrally planned economies and Oceania.

5. The consumption of particle board showed the most marked increase, reaching 208 in 1970, 335 in 1975, and 439 in 1980 (1965 consumption of 9.22 million m^3 = 100).

The worldwide outlook is of sustained marked increases. Regionally, it is expected that there will be significant increases in North America, European centrally planned economies (USSR and Eastern Europe) and Brazil, but the rate of increase will be low in Africa.

6. The consumption of pulpwood and particles increased to 133 in 1970, 136 in 1975, and 144 in 1980 (1965 consumption of 236.85 million m^3 = 100).

The worldwide outlook is that the increasing trend will continue. Regional projections are that the demand will be large both in quantity and in rate of increase in Asian centrally planned economies, North America and European countries, and will have a high rate of increase in developing countries.

7. Finally, the consumption of firewood and charcoal in 1980 was 1.6 billion m^3, which was 53% of the total wood consumption of about 3 billion m^3. It gradually increased to 124 in 1970, 136 in 1975, and 150 in 1980, taking the 1965 consumption of 1,083.6 million m^3 as 100. A continuous gradual increase is expected, but regionally, the demand is projected to fall gradually in developed countries, and to rise markedly in developing countries.

II. Forest Resources, Current and Projected

The gross area of the world's forests is about 3.7 billion ha, of which one-third, or 1.2 billion ha, is coniferous forest, and two-thirds, or 2.5 billion ha, is non-coniferous forest. If the total coniferous forest area is taken as 100, the USSR accounts for 46% and North America for 37%, together making about 80% of the total. With the gross area of the non-coniferous forests as 100, Latin America,

Africa and Asia excluding Japan and the USSR account for 30%, 28% and 17%, respectively, together accounting for 75% of the total. The forests in these countries are mainly of tropical and sub-tropical non-coniferous trees.

Though the figures for the worldwide growing stock are not as clear as those for area, it is estimated that there is a total of about 357 billion m^3 of growing stock. The breakdown into coniferous and non-coniferous forest is similar in proportion to the area covered by these types.

In the future, world forests are expected to decrease, both in area and stock, but the decreases will depend on natural and socio-economic conditions. Thus, it is projected that they will not be significant in developed countries or in the coniferous forest regions; but in developing countries or in the tropical non-coniferous forest regions such as Africa, Southeast Asia and tropical America, the decrease is expected to be marked.

III. Trends in and Prospects for Timber Production and Supply

World timber production and supply increased in the past fifteen years. With the total wood production and supply of 2,210 million m^3 in 1965 as an index of 100, it rose to 119 in 1970, 124 in 1975, and 137 in 1980 (Strictly speaking, production is different from supply, but the term "production" is used below to represent both production and supply because their trends do not differ, especially in the long term).

Trends in the production of non-conifer logs and processed wood reveal a leveling off or gradual fall in North America, Western Europe, other developed countries, the USSR and Eastern Europe. In the Asian tropical zones (Southeast Asia and South Asia), however, the production of processed wood such as sawnwood and plywood has increased, but that of non-conifer logs has shown little change since the first oil crisis in 1973.

On the other hand, in Africa, Asian centrally planned economies, and Latin America, there has been a tendency for the production of non-conifer logs and processed wood to increase. This has been significant, especially in Latin America, although in Africa the production of non-conifer logs seems to have reached a limit in recent years.

These tendencies reflect the appearance of limitations on resources in those regions of both developed and developing countries where forest exploitation has been in progress for a long time, and also the advance of industrialization in developing countries.

It is expected for the future that forest resources will gradually diminish if the current technological and economic conditions remain.

However, the decrease in forest resources will not be particularly great in developed countries or in coniferous forest regions. It is likely to be concentrated in Africa, tropical Asia, and tropical America, so that in tropical non-coniferous forests the large trees especially will be heavily depleted, and accordingly, their production is expected to decrease sharply.

IV. Reforestation and Forest Production

In connection with reforestation, let us begin by considering tree species and harvesting time.

From the standpoint of investment efficiency, fast-growing species with an early cutting age (e.g., Eucalyptus spp., Acacia spp. and Pinus spp.) can be used for reforestation. These species allow thinning after seven years and final cutting after fifteen. Their prices are, however, generally low because they are used as firewood or pulpwood.

On the other hand, among the general-purpose sawtimber species and rather valuable tree species with a medium cutting age (e.g., Mahogany, Cordia and Lapacho) can be used in reforestation. These species may be thinned after 20-30 years and finally cut after 30-80 years. Their timber is generally expensive because they provide good quality sawtimber. Further, since a worldwide shortage of valuable hardwood sawtimber is projected particularly after the year 2000, rises in hardwood timber prices are expected.

Since the special hard and heavy woods known as fancy woods (e.g., Dalbergia and Pterocarpus), which will probably be depleted and so show price rises, have final cutting ages of eighty years or more, reforestation with these species is worthy of studying under the direct control of the government.

As for the value of resources related to felling and harvesting, tropical natural forest stock per unit area is quite ample generally in Southeast Asian tropical rain forests from the viewpoint of physical stock, commercial availability and increments in this moment. These forests are followed, as far as these considerations are concerned, by the tropical rain forests of Africa and South America.

At present, the natural forests in the basin of the Amazon River are not highly evaluated as forest resources compared with other

tropical rain forests in the world. Thus, it is to be recommended that hasty felling and harvesting might be avoided until the value of the forest resources in the region has risen. It would be recommendable to improve the silvicultural techniques and the infrastructure.

Regarding the cost of commercial logging projects, it currently varies widely according to the forest and the condition of the infrastructure: from US$30 to US$60 per m^3.

In the Carajas area, where conditions will not become known until a subsequent survey is conducted, there seems currently to be considerable difficulty in confining logging costs to within the above limits and in implementing internationally competitive logging operations.

Accordingly, it seems desirable that logging operations in natural forests in this area be implemented, keeping low cost in mind, in accordance with the degree of development of the area, rises in the prices of tropical hardwood, and progress in utilization and marketing of lesser known species.

The production costs in the sawnwood and plywood industry in the Carajas area, in view of its tree species, the infrastructural conditions and unit wages, like those of the logging operations, seem to make it difficult for the industry to cope with Southeast Asia.

Thus, it seems that efforts need to be made to improve competitiveness by carrying out operations in appropriate scale with kinds of commodities, and enhancing manufacturing technology, suitable for material logs.

It seems in the long term, however, that the sawnwood and plywood industry in the Carajas area may hold an advantageous position over its competitor, West Africa, in relation to the limits on resources and distances from the markets of North America and Europe.

In the case of the production of pulpwood including wood chips, the production cost must be kept low — US$10 to US$15 per m^3 — because of the present market price for wood chips. Furthermore, in North America and the European areas which are this region's prospective trading partners, there is a considerable domestic supply of pulpwood including wood chips, which makes the export of wood chips and pulpwood difficult for reasons both of cost and freight-bearing capacity. Thus, their utilization within Brazil as raw materials will be promoted.

Charcoal has historically been produced mainly by family labor or by local industry rather than by companies relying on strict cost calculation. The overall demand for charcoal, as already stated, is small in developed countries, whereas it is large in developing

countries; but the latter countries are very reluctant to charcoal imports. Thus, it seems that the production of charcoal in the Carajas area, as in the case of wood chips and pulpwood, should be largely reserved for consumption within Brazil (especially, for iron manufacture).

Cost considerations suggest that reforestation projects is carried out in accordance with the progress of felling operations and the conditions of areas felled, in such a way that the system of roads and facilities that have been constructed for felling operations can be effectively utilized for reforestation.

V. Timber Market Situation

The share occupied by hardwood timber in the world timber trade is small compared with that of softwood timber. As far as sawnwood is concerned, the total world trade volume of softwood timber is about 62 million m^3, whereas that of hardwood timber is 12 million m^3 — about 20%.

Comparison of the conifer sawnwood output of 330 million m^3 with the non-conifer sawnwood output of 100 million m^3 also makes it clear that the trade volume of hardwood timber is small. This is probably because hardwood timber is not often used for structural materials, which have high consumption and are distributed as international commodities.

1. Non-Conifer Sawlogs and Veneer Logs

The current trade in non-conifer sawlogs and veneer logs has two main routes: one links an importing group led by Japan and including Republic of Korea, Taiwan and an exporting group of Southeast Asian countries; and the other links an importing group with France in the lead and including European countries, and an exporting group of West African countries.

In either route, there occur phenomena such as the limiting of production capacity and restrictions on log exports, and changes such as increases in the log exports, for example, from North America and Southeast Asia to Western Europe instead of through the conventional routes. It is projected that the worldwide trade volume of non-conifer sawlogs and veneer logs will not rise.

As of 1980, however, the trade volume of non-conifer sawlogs and veneer logs between Japan, the Republic of Korea and Taiwan, on

the one hand, and Southeast Asia, on the other, reached 28 million m^3, accounting for about 67% of the world total, thus forming the major stream in the trade.

2. Non-Conifer Sawnwood

The share of exports of non-conifer sawnwood from Southeast Asia to developed countries, which totaled about 2.9 million m^3 in 1980, is the highest on the regional basis. Brazil, however, which exported of 452,000 m^3 of non-conifer sawnwood, stands nearly equal to Southeast Asian countries on the country basis. The main exporting country in West Africa is Ivory Coast, which exported 263,000 m^3 of non-conifer sawnwood.

The future international market for non-conifer sawnwood will probably see increases in the exports of sawnwood from Southeast Asia as a result of restrictions on log exports in the countries of the area and the development of the policy of wood industrialization. The West European market, where imports of tropical non-conifer sawnwood amounted to 2.443 million m^3 in 1980, is the largest import market. The Netherlands seems to rank first as an importer, but some of its imports are re-exported to EC countries, and in fact Italy holds the top position, followed by the United Kingdom, Federal Republic of Germany and France.

In the United Kingdom market, unlike other markets in Europe, log imports are small and sawnwood imports are large in quantity. Of imports of tropical non-conifer sawnwood into the United Kingdom, 66% come from Southeast Asia, 18% from Africa, and the remaining 16% from South America (mainly Brazil). Trends in the imports in the last ten years show that imports from Africa have continued to decrease while those from Southeast Asia have risen.

Though Brazil is expected to serve as a main supplying country of tropical non-conifer sawnwood for the United Kingdom market, the increase in its exports is at present low, and instead, the exports from Southeast Asia, which take at least twice the time to transport to the United Kingdom, are increasing. This is because Southeast Asia can punctually supply sawnwood which is favored by the United Kingdom market. The United Kingdom market will continue to be oriented towards the import of more-processed wood because of rises in labor costs. It is said that the importation of, say, kiln-dried timber rather than green low timber, or semi-finished lumber such as moldings and machined parts, is under examination. This requires the sophistication of local processing techniques and improvement of mill management capability. The reason why the United Kindgom market can accept more-processed wood is that, compared with other West European countries, there are only a few

industries which process imported logs, and thus, there is little resistance to the importation of more-processed sawnwood into the market.

French and Italian markets have a feature which imports more logs and less sawnwood compared with the United Kingdom and this tendency is expected to continue in the future.

In the North American market, much of the tropical non-conifer sawnwood imports are from Latin America, especially Brazil which is geographically close. The total imports from all over the world, however, are no more than 400,000 m^3 throughout the year (about half being from Brazil). This figure represents only a two percent share of the world market.

The exports of non-conifer sawnwood from West Africa have not risen because of the obsolescence of sawmills and deficiency of shipping facilities, and may show no change in the future.

For this reason, of the exports of tropical non-conifer trees from West Africa to Europe, 90% are in the form of logs and 10% in the form of sawnwood, as previously.

3. Plywood

The main exporting countries of plywood made of tropical non-conifer trees are Republic of Korea, Taiwan, Singapore, Malaysia, the Philippines, and Indonesia. In the future, the exports from the countries which have their own logs, such as Indonesia, may overtake those of Republic of Korea, Taiwan and Singapore which import logs for the manufacture of plywood which they export.

As an import market for plywood, the United States ranks first, followed by the United Kingdom and the other EC countries, but recently oil producing countries in the Middle East, and China (via Hong Kong), have come to be significant import markets.

Currently, the main exporters to the United States market are Republic of Korea, Taiwan and the Philippines, and those to the United Kingdom are Singapore, Republic of Korea, Malaysia and the Philippines.

VI. Problems in Marine Transportation

It goes without saying that the quality of goods, their export