Appendix Table 13 World Cotton Consumption, by 5-Year Averages

5-year average	World total	Developed countries	Developing countries	Planned economy countries	Major producing countries													Share of world total (%)
					USA	EC 9	Other Western countries	Japan	Brazil	ASEAN	NICs in Asia	India	Pakistan	Egypt	USSR	East Europe	China	Total	
Quantity (million bales)																		
1965-69	54.03	19.87	15.19	18.97	8.84	4.94	2.01	3.34	1.28	0.52	1.56	5.27	1.59	0.84	7.69	2.64	8.58	49.10	90.9
1970-74	59.28	17.99	18.74	22.55	7.46	4.14	2.21	3.49	1.66	0.84	2.02	5.61	2.21	0.99	8.69	2.76	11.00	53.08	89.5
1975-79	62.50	16.57	21.99	23.95	6.68	3.49	2.56	3.22	2.29	1.26	3.20	5.70	1.96	1.24	8.84	2.79	12.18	55.41	88.7
1980-81	66.15	15.03	23.32	27.80	5.61	3.02	2.57	3.19	2.55	1.45	3.36	6.17	2.09	1.41	9.15	2.82	15.65	59.04	89.3
Quantity (million MT)																		
1965-69	11.71	4.31	3.29	4.11	1.92	1.07	0.44	0.72	0.28	0.11	0.34	1.14	0.34	0.18	1.67	0.57	1.86	10.64	90.9
1970-74	12.85	3.90	4.06	4.89	1.62	0.90	0.48	0.76	0.36	0.18	0.44	1.22	0.48	0.21	1.88	0.60	2.38	11.51	89.5
1975-79	13.55	3.59	4.77	5.19	1.45	0.76	0.55	0.70	0.50	0.27	0.69	1.24	0.42	0.27	1.92	0.60	2.64	12.01	88.7
1980-81	14.34	3.26	5.05	6.03	1.22	0.66	0.56	0.69	0.55	0.31	0.73	1.34	0.45	0.31	1.98	0.61	3.39	12.80	89.3
Share of world total (%)																		
1965-69	100.0	36.8	28.1	35.1	16.4	9.1	3.7	6.2	2.4	1.0	2.9	9.7	2.9	1.6	14.2	4.9	15.9	90.9	
1970-74	100.0	30.4	31.6	38.0	12.6	7.0	3.7	5.9	2.8	1.4	3.4	9.5	3.7	1.7	14.7	4.6	18.5	89.5	
1975-79	100.0	26.5	35.2	38.3	10.7	5.6	4.1	5.2	3.7	2.0	5.1	9.1	3.1	2.0	14.1	4.5	19.5	88.7	
1980-81	100.0	22.7	35.3	42.0	8.5	4.6	3.9	4.8	3.8	2.2	5.1	9.3	3.2	2.1	13.8	4.3	23.7	89.3	
Quantity index (1965-1969 = 100.0)																		
1965-69	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		
1970-74	109.7	90.5	123.4	118.9	84.4	83.8	110.0	104.5	129.7	161.5	129.5	106.5	139.0	117.9	113.0	104.5	128.2	108.1	
1975-79	115.7	83.4	144.8	126.3	75.6	70.6	127.4	96.4	178.9	242.3	205.1	108.2	123.3	147.6	115.0	105.7	142.0	112.9	
1980-81	122.4	75.6	153.5	146.5	63.5	61.1	127.9	95.5	199.2	278.8	215.4	117.1	131.4	167.9	119.0	106.8	182.4	120.2	

Source: ICAC

Appendix Table 14 World Cotton Exports, by Countries

[1,000 bales (478 lb net)]

Countries		Cotton year (August - July)																
		1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82(P)
Developed countries																		
North America	USA	2,942	4,669	4,206	2,731	2,769	3,740	3,229	5,326	6,149	3,942	3,325	4,804	5,507	6,206	9,267	5,951	6,700
	Canada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal	2,942	4,669	4,206	2,731	2,769	3,740	3,229	5,326	6,149	3,942	3,325	4,804	5,507	6,206	9,267	5,951	6,700
9 EC countries	France	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Germany, FR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Italy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EC 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other European countries		206	253	356	188	299	332	328	267	236	116	177	89	108	137	88	77	160
Other developed countries	Japan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Australia	-	-	-	19	67	19	13	45	14	44	69	24	49	110	280	244	350
	S. Africa	3	10	4	6	21	14	5	17	9	3	-	-	10	15	3	10	5
	Subtotal	3	10	4	25	88	33	18	62	23	47	69	24	59	125	283	254	355
Total		3,151	4,932	4,566	2,944	3,156	4,105	3,575	5,655	6,408	4,105	3,571	4,917	5,674	6,468	9,638	6,282	7,215
Developing countries																		
Central America	Mexico	2,118	1,386	1,233	1,623	1,221	756	905	859	737	954	492	520	710	975	915	820	765
	Other Central America	1,206	903	865	983	724	861	1,023	1,105	1,056	1,425	1,320	1,333	1,492	1,561	1,046	973	793
	Subtotal	3,324	2,289	2,098	2,606	1,945	1,617	1,928	1,964	1,793	2,379	1,812	1,853	2,202	2,536	1,961	1,793	1,558
South America	Brazil	941	1,018	839	1,772	1,940	1,015	1,415	1,339	663	270	358	54	193	141	1	75	150
	Argentina	32	127	25	1	56	210	1	-	45	30	395	348	427	321	543	150	200
	Colombia	42	84	152	296	224	205	241	214	155	450	305	370	245	125	235	223	130
	Peru	542	399	296	394	353	271	269	163	242	158	153	133	87	88	126	180	200
	Other South America	39	23	24	33	58	48	47	122	174	169	243	256	356	449	323	357	390
	Subtotal	1,596	1,651	1,336	2,496	2,631	1,749	1,973	1,838	1,279	1,077	1,454	1,161	1,308	1,124	1,228	985	1,070
Asia	ASEAN countries	-	-	7	31	4	2	8	5	-	-	1	-	-	5	30	35	30
	Newly industrializing countries in Asia																	
	Rep. of Korea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Taiwan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hong Kong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix Table 14 (cont'd.)

[1,000 bales (478 lb net)]

Countries		Cotton year (August - July)																
		1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82(P)
Developing countries (cont'd.)																		
Asia (cont'd.)	Southwest Asia																	
	India	141	190	172	138	166	138	166	157	267	82	304	33	10	102	400	520	300
	Pakistan	496	565	891	609	394	471	1,013	826	197	1,062	420	66	492	256	1,229	1,511	900
	Others	105	88	70	35	35	70	110	70	96	105	154	202	107	132	72	72	93
	Subtotal	742	843	1,133	782	595	679	1,289	1,053	560	1,249	878	301	609	490	1,701	2,103	1,293
Middle East	Iran	461	274	300	422	430	495	440	605	445	555	593	324	337	319	150	-	-
	Iraq	20	10	15	15	10	10	10	-	-	-	-	-	-	-	-	-	-
	Israel	25	38	56	35	79	91	67	74	58	100	136	143	160	227	267	245	350
	Turkey	920	1,049	1,040	953	1,138	1,078	1,469	1,427	1,004	585	2,172	582	1,224	966	620	1,050	750
	Yemen	5	5	5	5	2	2	3	3	20	25	30	15	20	20	20	20	20
	Yemen P.D.R.	20	20	13	20	28	26	25	25	16	11	25	13	5	17	11	15	10
	Syria	711	579	492	551	597	617	548	571	563	387	469	678	533	553	459	350	330
	Subtotal	2,162	1,975	1,921	2,001	2,284	2,319	2,562	2,705	2,106	1,663	3,425	1,755	2,279	2,102	1,527	1,680	1,460
Africa	Egypt	1,582	1,433	1,176	1,092	1,469	1,403	1,372	1,393	1,204	882	778	608	689	674	800	725	1,000
	Sudan	572	685	798	852	1,086	1,053	994	1,096	726	543	991	674	689	817	808	400	500
	Uganda	278	357	255	239	337	314	272	300	300	116	104	62	46	34	16	5	10
	Tanzania	313	350	285	209	287	305	185	299	288	241	182	266	135	177	229	200	135
	Mozambique	130	175	166	208	208	178	154	195	191	132	95	35	40	75	45	50	50
	Others	663	663	730	882	1,122	1,181	1,069	1,004	1,017	933	1,093	1,094	972	1,188	1,277	1,069	1,042
	Subtotal	3,538	3,663	3,410	3,482	4,509	4,434	4,046	4,287	3,726	2,847	3,243	2,739	2,571	2,965	3,175	2,449	2,737
Total		1,362	10,421	9,905	11,398	11,968	10,800	11,806	11,852	9,464	9,215	10,813	7,809	8,969	9,222	9,622	9,045	8,148
Planned economy countries																		
Europe	USSR	2,350	2,500	2,550	2,100	2,400	2,550	3,000	3,350	3,400	3,700	4,050	4,480	3,950	3,650	3,900	4,650	4,500
	Others	5	28	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal	2,355	2,528	2,578	2,100	2,400	2,550	3,000	3,350	3,400	3,700	4,050	4,480	3,950	3,650	3,900	4,650	4,500
Asia	China	-	15	50	50	-	-	-	-	100	200	300	300	150	100	-	-	-
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal	-	15	50	50	-	-	-	-	100	200	300	300	150	100	-	-	-
Total		2,355	2,543	2,628	2,150	2,400	2,550	3,000	3,350	3,500	3,900	4,350	4,780	4,100	3,750	3,900	4,650	4,500
Grand Total		6,868	17,896	17,099	16,492	17,524	17,455	18,381	20,857	19,372	17,220	18,734	17,506	18,743	19,440	23,160	19,977	19,863

Source: ICAC

Appendix Table 15 World Cotton Exports, by 5-Year Averages

5-year average	World total	Developed countries	Developing countries	Planned economy countries	Major exporting countries													Share of world total (%)
					USA	Mexico	Other central America	Brazil	Argentina	India	Pakistan	Turkey	Syria	Egypt	Sudan	USSR	Australia	Total	
Quantity (million bales)																			
1965-69	17.18	3.75	11.01	2.42	3.46	1.52	0.94	1.30	0.05	0.16	0.59	1.02	0.59	1.35	0.80	2.38	*	14.16	82.4
1970-74	18.66	4.77	10.63	3.26	4.48	0.84	1.09	0.94	0.06	0.16	0.71	1.11	0.54	1.25	0.88	3.20	0.03	15.29	81.9
1975-79	19.52	6.05	9.29	4.18	5.82	0.72	1.35	0.15	0.41	0.17	0.49	1.11	0.54	0.71	0.80	4.01	0.11	16.39	84.0
1980-81	19.92	6.75	8.60	4.58	6.33	0.79	0.80	0.11	0.18	0.41	1.21	0.90	0.34	0.86	0.45	4.58	0.30	17.34	87.0
Quantity (million MT)																			
1965-69	3.72	0.81	2.39	0.52	0.75	0.33	0.20	0.28	0.01	0.04	0.13	0.22	0.13	0.29	0.17	0.52	**	3.07	
1970-74	4.05	1.03	2.30	0.71	0.97	0.18	0.24	0.20	0.01	0.04	0.12	0.24	0.12	0.27	0.19	0.69	0.01	3.31	
1975-79	4.23	1.31	2.01	0.91	1.26	0.16	0.29	0.03	0.09	0.04	0.11	0.24	0.12	0.15	0.17	0.87	0.02	3.55	
1980-81	4.32	1.46	1.86	1.99	1.37	0.17	0.19	0.02	0.04	0.09	0.26	0.20	0.07	0.19	0.10	0.99	0.07	3.76	
Share of world total (%)																			
1965-69	100.0	21.8	64.1	14.1	20.1	8.8	5.5	7.6	0.3	0.9	3.4	5.9	3.4	7.9	4.7	13.9	#	82.4	
1970-74	100.0	25.5	57.0	17.5	24.0	4.5	5.8	5.0	0.3	0.9	3.8	5.9	2.9	6.7	4.7	17.2	0.2	81.9	
1975-79	100.0	31.0	47.6	21.4	29.8	3.7	6.9	0.8	2.1	0.9	2.5	5.7	2.8	3.6	4.1	20.5	0.6	84.0	
1980-81	100.0	33.9	43.1	23.0	31.8	4.0	4.4	0.5	0.9	2.0	6.1	4.5	1.7	4.3	2.3	23.0	1.5	87.0	
Quantity index (1965-1969 = 100.0)																			
1965-69	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	
1970-74	108.6	127.2	96.5	134.7	129.5	55.3	116.0	72.3	120.0	100.0	120.3	108.8	91.5	92.6	110.0	134.5		108.0	
1975-79	113.6	161.3	84.4	172.7	168.2	47.4	143.6	11.5	820.0	106.3	83.1	108.8	91.5	52.6	100.0	168.5		115.7	
1980-81	115.9	180.0	78.1	189.3	182.9	52.0	93.6	8.5	360.0	256.3	205.1	88.2	57.6	63.7	56.3	192.4		122.5	

* Less than 5,000 bales
** Less than 5,000 tons
\# Less than 0.05%

Source: ICAC

Appendix Table 16 World Cotton Imports, by Countries

[1,000 bales (478 lb net)]

Countries		Cotton year (August - July)																
		1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82(P)
Developed countries																		
North America	USA	98	63	145	66	49	36	71	30	48	34	92	38	5	4	5	28	10
	Canada	451	419	373	360	346	355	370	341	334	235	261	225	250	266	302	288	250
	Subtotal	549	482	518	426	395	391	441	371	382	269	353	263	255	270	307	316	260
9 EC countries	France	1,230	1,275	1,100	1,162	1,117	1,065	1,083	1,180	1,068	999	1,117	960	986	808	943	771	850
	Germany, FR	1,255	1,222	1,336	1,132	1,200	1,089	1,109	1,199	912	1,064	1,045	893	972	818	891	727	780
	Italy	1,017	1,190	997	990	1,059	819	912	896	935	777	889	878	863	1,024	1,123	874	900
	UK	968	836	906	781	747	746	593	770	563	479	584	463	506	432	406	200	250
	EC 5	767	768	751	644	628	621	532	592	434	418	376	339	278	315	351	289	330
	Subtotal	5,237	5,291	5,090	4,709	4,751	4,340	4,229	4,637	3,912	3,737	4,011	3,533	3,605	3,397	3,714	2,861	3,110
Other European countries		1,592	1,492	1,398	1,822	1,392	1,590	1,733	2,023	1,838	1,540	1,921	1,770	1,948	1,804	2,009	1,985	1,809
Western Europe Subtotal		6,829	6,783	6,488	6,531	6,143	5,930	5,962	6,660	5,750	5,277	5,942	5,303	5,553	5,201	5,723	4,846	4,919
Other developed countries	Japan	3,091	3,571	3,514	3,144	3,462	3,684	3,570	3,899	3,744	3,241	3,234	3,050	3,163	3,396	3,350	3,220	3,300
	Australia	65	40	57	24	20	38	34	8	47	12	19	24	17	5	4	7	5
	S. Africa	128	177	116	133	106	157	185	185	202	91	79	89	51	25	56	16	60
	Subtotal	3,284	3,788	3,687	3,301	3,588	3,879	3,789	4,092	3,993	3,344	3,332	3,163	3,231	3,426	3,410	3,243	3,365
Total		10,662	11,053	10,693	10,258	10,126	10,200	10,192	11,123	10,125	8,890	9,627	8,729	9,039	8,897	9,440	8,405	8,544
Developing countries																		
Central America	Mexico	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other Central America	97	84	108	104	110	112	111	115	129	126	160	163	154	168	193	187	188
	Subtotal	97	84	108	104	110	112	111	115	129	126	160	163	154	168	193	187	188
South America	Brazil	-	-	-	-	-	20	5	1	-	-	5	-	-	-	-	-	-
	Argentina	71	49	28	86	37	37	135	37	40	50	15	12	38	37	22	60	85
	Colombia	66	6	3	5	4	7	5	4	30	9	6	5	5	35	40	-	5
	Peru	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other South America	205	205	183	189	195	190	186	221	221	187	125	151	163	179	92	110	105
	Subtotal	342	260	214	260	236	254	331	263	291	246	151	168	206	251	154	170	195
Asia	ASEAN countries	328	474	399	405	542	587	745	780	1,071	713	1,187	1,095	1,127	1,194	1,248	1,251	1,115
	Newly industrializing countries in Asia																	
	Rep. of Korea	325	367	403	425	473	539	531	525	791	725	1,017	913	1,318	1,369	1,634	1,533	1,550
	Taiwan	306	359	473	466	509	738	586	660	914	655	1,028	804	1,057	858	1,273	985	1,050
	Hong Kong	644	773	818	802	767	876	658	774	846	834	1,259	1,000	1,026	878	1,168	712	650
	Subtotal	1,275	1,499	1,694	1,693	1,749	2,153	1,775	1,959	2,551	2,214	3,304	2,717	3,401	3,105	4,075	3,230	3,250
	ASEAN + Newly industrializing countries in Asia	1,603	1,973	2,093	2,098	2,271	2,740	2,520	2,739	3,622	2,927	4,491	3,812	4,528	4,299	5,323	4,481	4,365

Appendix Table 16 (cont'd.)

[1,000 bales (478 lb net)]

Countries		Cotton year (August - July)																
		1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82(P)
Developing countries (cont'd.)																		
Asia (cont'd.)	Southwest Asia																	
	India	456	624	647	378	725	748	579	430	156	60	168	369	464	25	-	-	40
	Pakistan	7	15	15	5	10	5	5	3	2	2	4	8	2	3	3	4	5
	Others	37	58	52	56	72	70	217	374	329	293	263	236	241	298	276	281	281
	Subtotal	500	697	714	439	807	823	801	807	487	355	435	613	707	326	279	285	326
Middle East	Iran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Iraq	-	-	-	-	-	-	-	-	25	70	-	35	50	80	80	85	125
	Israel	44	28	27	22	10	5	7	6	5	1	2	4	1	2	18	45	25
	Turkey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yemen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yemen P.D.R.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Syria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal	44	28	27	22	10	5	7	6	30	71	2	39	51	82	98	130	150
Africa	Egypt	-	-	-	-	-	-	-	-	-	20	-	115	110	110	-	-	-
	Sudan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uganda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tanzania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mozambique	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Others	131	100	142	132	124	172	141	170	239	319	234	225	230	224	265	233	291
	Subtotal	131	100	142	132	124	172	141	170	239	339	234	340	340	334	265	233	291
Total		2,717	3,142	3,298	3,075	3,578	4,106	3,911	4,100	4,798	4,064	5,473	5,135	5,986	5,460	6,312	5,486	5,515
Planned economy countries																		
Europe	USSR	800	670	630	800	1,200	1,100	750	600	650	650	550	450	300	400	230	270	200
	Others	2,609	2,527	2,612	2,476	2,651	2,707	2,592	2,666	2,671	2,826	2,630	2,737	2,674	2,833	2,935	2,740	2,705
	Subtotal	3,409	3,197	3,242	3,276	3,851	3,807	3,342	3,266	3,321	3,476	3,180	3,187	2,974	3,233	3,165	3,010	2,905
Asia	China	600	525	350	300	350	450	700	1,800	1,800	700	900	600	1,600	2,400	4,000	3,400	2,600
	Others *	115	140	90	115	170	180	180	200	225	200	245	280	290	365	325	345	345
	Subtotal	715	665	440	415	520	630	880	2,000	2,025	900	1,145	880	1,890	2,765	4,325	3,745	2,945
Total		4,124	3,862	3,682	3,691	4,371	4,437	4,222	5,266	5,346	4,376	4,325	4,067	4,864	5,998	7,490	6,755	5,850
Grand Total		17,503	18,057	17,673	17,024	18,075	18,743	18,325	20,489	20,269	17,330	19,425	17,931	19,889	20,355	23,242	20,646	19,909

* Viet Nam and the Democratic Republic of Korea

Source: ICAC

Appendix Table 17 World Cotton Imports, by 5-Year Averages

5-year average	World total	Developed countries	Developing countries	Planned economy countries	Major importing countries									Share of world total (%)
					North America	9 EC countries	Other W. Europe	Japan	ASEAN	NICs in Asia	USSR and E. Europe	China etc.	Total	
Quantity (million bales)														
1965-69	17.67	10.56	3.16	3.95	0.47	5.02	1.53	3.36	0.43	1.58	3.40	0.55	16.34	92.5
1970-74	19.03	10.11	4.20	4.73	0.37	4.17	1.75	3.63	0.78	2.13	3.44	1.29	17.56	92.3
1975-79	20.17	9.15	5.67	5.35	0.29	3.65	1.89	3.24	1.17	3.32	3.15	2.20	18.91	93.8
1980-81	20.28	8.47	5.50	6.30	0.29	2.98	1.90	3.26	1.18	3.24	2.96	3.35	19.16	94.5
Quantity (million MT)														
1965-69	3.83	2.29	0.69	0.86	0.10	1.09	0.33	0.73	0.09	0.34	0.74	0.12	3.54	
1970-74	4.13	2.19	0.91	1.03	0.08	0.90	0.38	0.79	0.17	0.46	0.75	0.28	3.81	
1975-79	4.37	1.98	1.23	1.16	0.06	0.79	0.41	0.70	0.26	0.72	0.68	0.48	4.10	
1980-81	4.40	1.84	1.19	1.37	0.06	0.65	0.41	0.71	0.26	0.70	0.64	0.73	4.16	
Share of world total (%)														
1965-69	100.0	59.8	17.9	22.3	2.7	28.4	8.7	19.0	2.4	9.0	19.2	3.1	92.5	
1970-74	100.0	53.1	22.1	24.8	1.9	21.9	9.2	19.1	4.1	11.2	18.1	6.8	92.3	
1975-79	100.0	45.4	28.1	26.5	1.4	18.1	9.4	16.1	5.8	16.5	15.6	10.9	93.8	
1980-81	100.0	41.8	27.1	31.1	1.4	14.7	9.4	16.1	5.8	16.0	14.6	16.5	94.5	
Quantity index (1965-1969 = 100.0)														
1965-69	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	
1970-74	107.7	95.7	132.9	119.7	78.7	83.1	114.4	108.0	181.4	134.8	101.2	234.5	107.5	
1975-79	114.1	86.6	179.4	135.4	61.7	72.7	123.5	96.4	272.1	210.1	92.6	400.0	115.7	
1980-81	114.8	80.2	174.0	159.5	61.7	59.4	124.2	97.0	274.4	205.1	87.1	609.1	117.3	

Source: ICAC

Appendix Table 18 Summary of Cotton Supply and Demand Situation, by Areas and by 5-Year Averages

(million bales)

5-year average	North America				Western Europe				Other developed countries				Central America			
	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption
1965-69	10.60	3.46	0.47	9.24	0.78	0.26	6.55	6.95	0.21	0.03	3.53	3.68	3.26	2.45	0.10	0.89
1970-74	11.85	4.48	0.37	7.78	0.81	0.26	5.92	6.35	0.27	0.04	3.82	3.86	3.01	1.94	0.12	1.02
1975-79	11.88	5.82	0.29	6.93	0.80	0.12	5.54	6.07	0.42	0.11	3.31	3.58	2.80	2.07	0.17	1.08
1980-81	13.45	6.33	0.27	5.85	0.84	0.12	4.88	5.59	0.75	0.30	3.30	3.60	2.58	1.68	0.19	1.10

5-year average	South America				Asia (I) ASE & AAC				Asia (II) SWA				Middle East			
	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption
1965-69	4.32	1.94	0.27	2.46	0.14	*	2.01	2.08	7.33	0.82	0.63	7.09	3.36	2.07	0.03	1.26
1970-74	4.52	1.58	0.28	3.03	0.09	*	2.91	2.86	8.64	0.97	0.65	8.26	4.25	2.27	0.02	1.63
1975-79	4.54	1.26	0.19	3.71	0.15	*	4.49	4.45	8.50	0.80	0.47	8.26	4.02	2.20	0.05	2.10
1980-81	4.89	1.03	0.18	3.71	0.35	0.03	4.42	4.82	9.79	1.70	0.31	8.87	3.61	1.57	0.14	2.15

5-year average	Africa				Planned economy countries (I) EEU				Planned economy countries (II) EAS				World Total			
	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption	Production	Exports	Imports	Consumption
1965-69	5.23	3.72	0.13	1.41	9.28	2.39	3.40	10.33	8.18	0.02	0.55	8.64	52.68	17.18	17.67	54.03
1970-74	5.71	3.87	0.21	1.92	11.40	3.20	3.44	11.45	10.04	0.06	1.29	11.10	60.59	18.66	19.03	59.28
1975-79	4.83	2.94	0.30	2.39	12.36	4.01	3.15	11.63	10.07	0.17	2.20	12.32	60.37	19.52	20.17	62.50
1980-81	5.10	2.59	0.26	2.67	14.02	4.58	2.96	11.97	13.10	0	3.35	15.83	68.49	19.92	20.28	66.15

* Less than 5,000 bales

Appendix Table 19 World Cotton Prices, CIF Northern Europe Quotation

(US$/lb)

Cotton year	Outlook Index A SM 1-1/16"/ M 1-3/32	Egypt [b] Menoufi/ Giza '68 FG	Sudan G5VS	Peru Pima G 1 1-9/16"	USA California SM 1-3/32"/ 1-1/8"	USA Orleans/ Texas M 1"	Mexico SM 1-1/16"/ M 1-3/32"	USSR Pirvyi 31/32 mm/ M 1-3/32"/ Vtoroi	Brazil Sao Paulo Type 5 1-1/16"	Pakistan N.T. Sind S.G.
1965-66	28.27 [a]	49.81	43.75 [j]	41.18 *	33.41	26.13	28.27	29.03	24.95 *	27.95 [f]
1970-71	31.09	61.14	45.25	47.40 *	33.31	29.75	33.12	33.30 *	30.31	31.30 [f]
1975-76	65.26	122.30	77.25	95.94	72.39 [d]	65.24	68.45	65.74	55.96	56.23 [g]
1980-81	94.11	155.87 [c]	115.00 *	134.36	101.85	89.14	94.91	92.80	74.82 *	84.94 [g]
1981-82	73.76 [i]	132.72	93.22	111.54	79.79	66.76	75.28 [i] *	73.02 [e,i]	72.90	65.65 [h]

a) 1966/67 average.
b) Official selling price.
c) Since 1977/78 season, quotations are for Giza '68.
d) Since March 1975, quotations are for Calif. SM 1-1/8".
e) Since Nov. 1981, quotations are for Vtoroi.
f) For 289F Punjab S.G.
g) For AC-134 Punjab S.G.
h) Since Oct. 1981, quotatons are for N.T. Sind S.G.
i) Since Aug. 1981, quotations are for M 1-3/32".
j) For G5S.
* Average for less than twelve months

Source: ICAC

Appendix Table 20 Prices Received by Farmers, USA

(cotton: cents per lb.; other crops: dollars per bushel)

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Agricultural commodities																	
Cotton	22.54	22.67	20.53	21.63	24.40	29.04	32.46	51.26	41.17	59.74	60.50	55.20	58.00	69.04	66.89	55.27	59.13*
Soybeans	2.62	2.46	2.43	2.60	2.94	3.30	6.50	6.42	5.24	5.58	6.82	6.28	6.86	6.75	6.92	5.78	
All wheat	1.47	1.30	1.26	1.33	1.36	1.57	3.16	4.48	3.68	3.15	2.29	2.82	3.51	3.88	3.88	3.52	N.A.
Corns	1.17	1.04	1.13	1.23	1.27	1.17	1.89	2.92	2.70	2.49	2.03	2.10	2.36	2.70	2.92	2.37	

* Jan.-June average
N.A.: not available

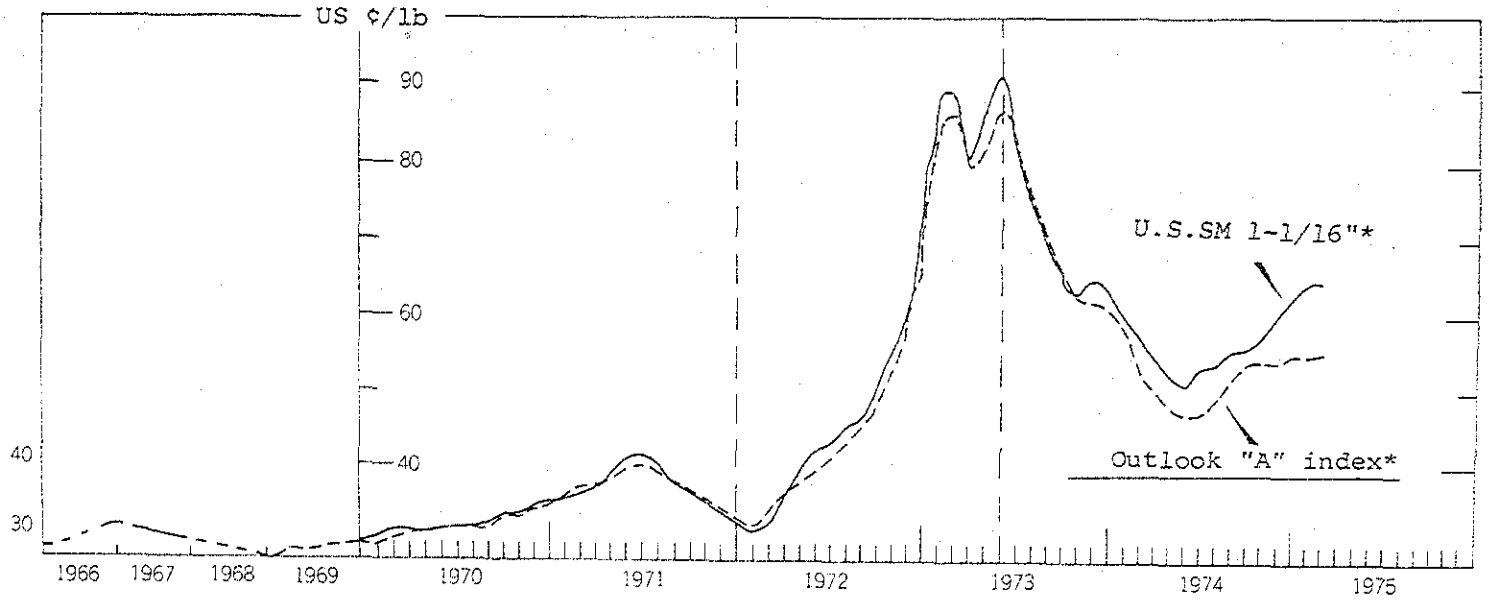
Source: USDA

Appendix Table 21 Competing Situation between Cotton and Soybean, USA

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cotton																	
Total acreage (million a/c)	9.45	10.91	11.88	11.95	12.36	14.00	12.48	13.68	9.45	11.64	13.68	13.38	13.98	14.53	14.33	11.34	8.30
Change in acreage (")	-	1.46	0.97	0.07	0.41	1.64	-1.52	1.20	-4.23	2.19	2.04	-0.31	0.60	0.55	-0.20	-2.99	-3.04
Prices received by farmers (cents per lbs.)																	
Highest	30.48	26.51	21.74	22.77	28.37	31.71	47.60	54.90	49.70	68.80	70.10	61.10	61.90	80.90	76.60	59.90	61.70*
Lowest	19.70	19.35	19.23	19.09	21.11	25.21	22.39	43.80	32.60	50.50	47.90	49.10	53.50	60.90	51.20	49.10	56.00
Average	22.54	22.30	20.49	21.63	24.40	29.04	32.46	51.28	41.17	59.68	60.28	55.18	58.00	69.04	66.89	55.27	58.76
Change in average	-	-0.24	-1.81	1.14	2.77	4.64	3.42	18.82	-10.11	18.51	0.60	-5.10	2.82	11.04	-2.15	-11.62	3.49
(%)		-1.0	-8.1	5.6	12.8	19.0	11.8	58.0	-19.7	45.0	10	-8.5	5.1	19.0	-3.1	-17.4	6.3
																	*Jan.-July
Soybean																	
Total acreage (million a/c)	40.82	42.27	42.53	43.08	43.48	46.87	56.55	52.48	54.59	50.27	58.98	64.71	71.63	70.09	68.54	72.16	63.35
Change in acreage (")	-	1.45	0.26	0.55	0.40	3.39	9.68	-4.07	2.11	-4.32	8.71	5.73	6.92	-1.54	-1.55	3.62	-8.81
Prices received by farmers (dollars per bushel)																	
Highest		-	-	-	-	-	-	8.17	6.30	6.73	9.24	6.77	7.36	8.18	7.80	6.13*	
Lowest		-	-	-	-	-	-	5.13	4.28	4.46	5.17	5.53	6.27	5.63	6.00	5.88	
Average	2.62	2.49	2.43	2.60	2.94	3.30	6.50	6.42	5.24	5.58	6.82	6.28	6.86	6.75	6.92	6.02	
Change in average	-	-0.13	-0.06	0.23	0.34	0.36	3.20	-0.08	-1.18	0.34	1.24	-0.54	0.58	-0.11	0.17	-0.90	
(%)		-5.0	-2.4	9.5	13.1	12.2	97.1	-1.2	-18.4	6.5	22.2	-7.9	9.2	-1.6	2.5	-13.0	
																	*Jan.-Mar.

Source: USDA

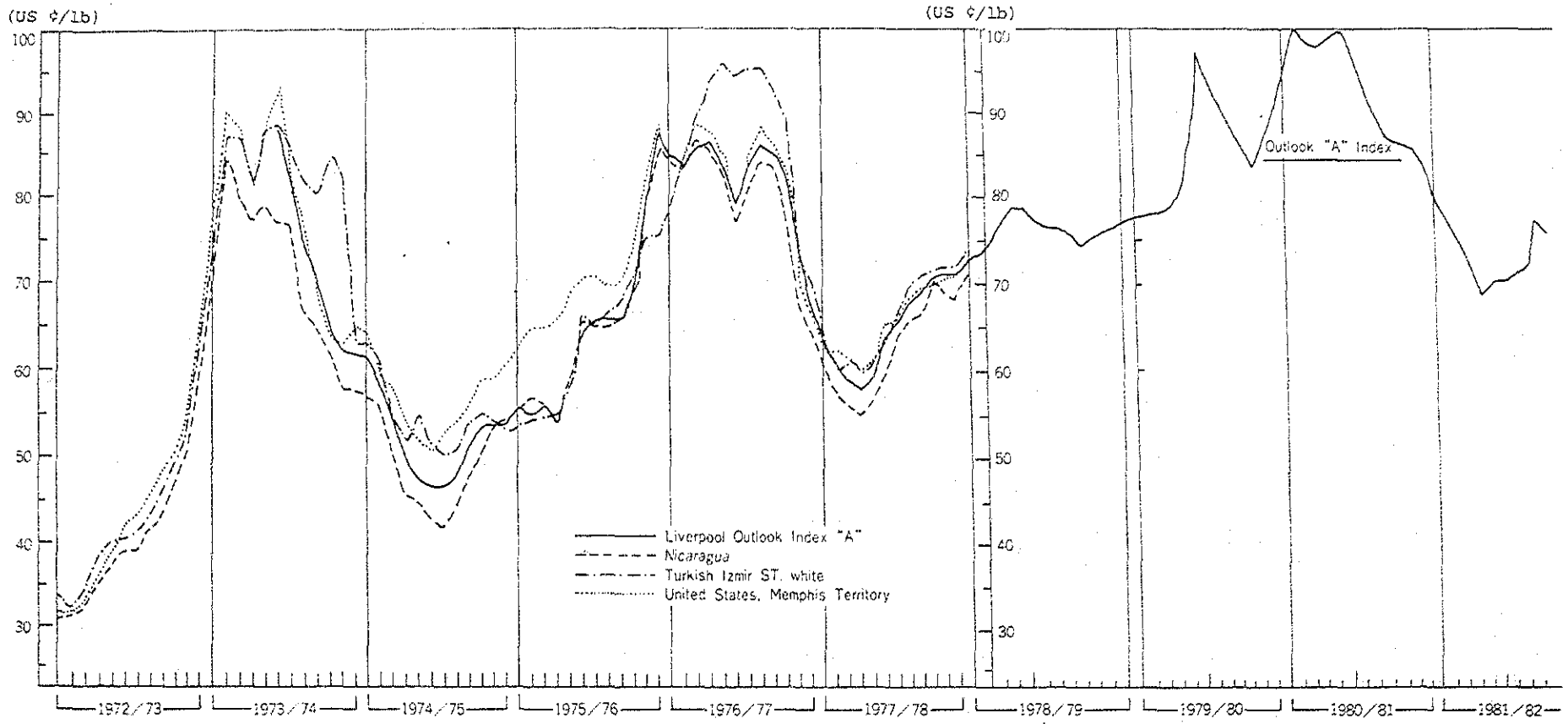
Appendix Fig. 1 Trends in Cotton Prices*



Notes: Year beginning August 1
* CIF Northern Europe

Source: ICAC

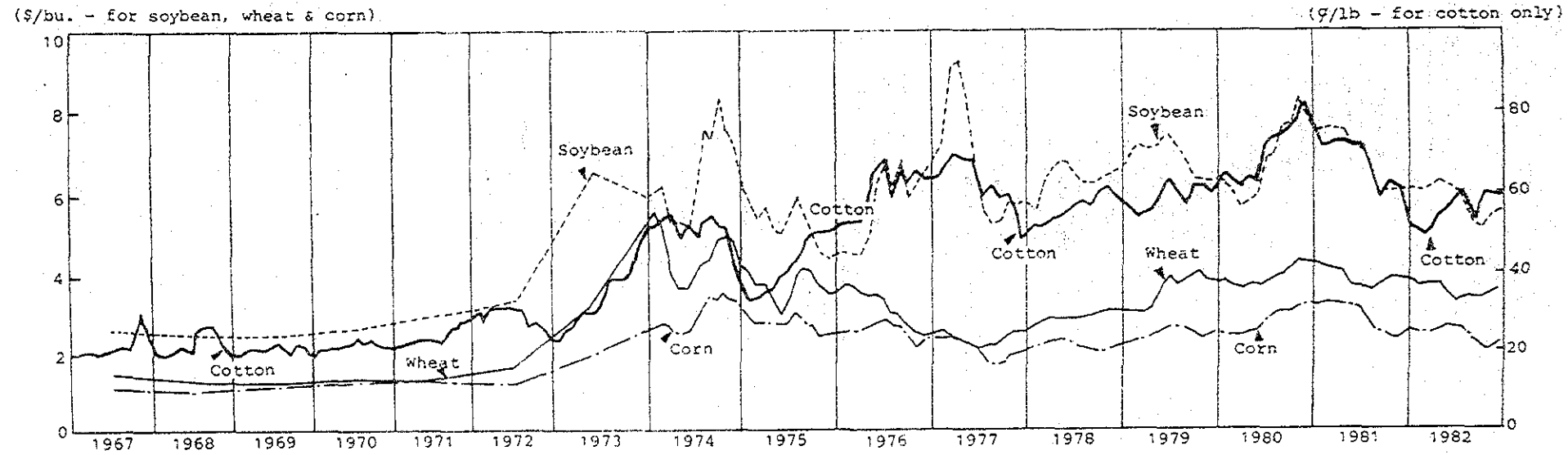
Appendix Fig. 2 Trends in Cotton Prices*



* Years beginning 1 August

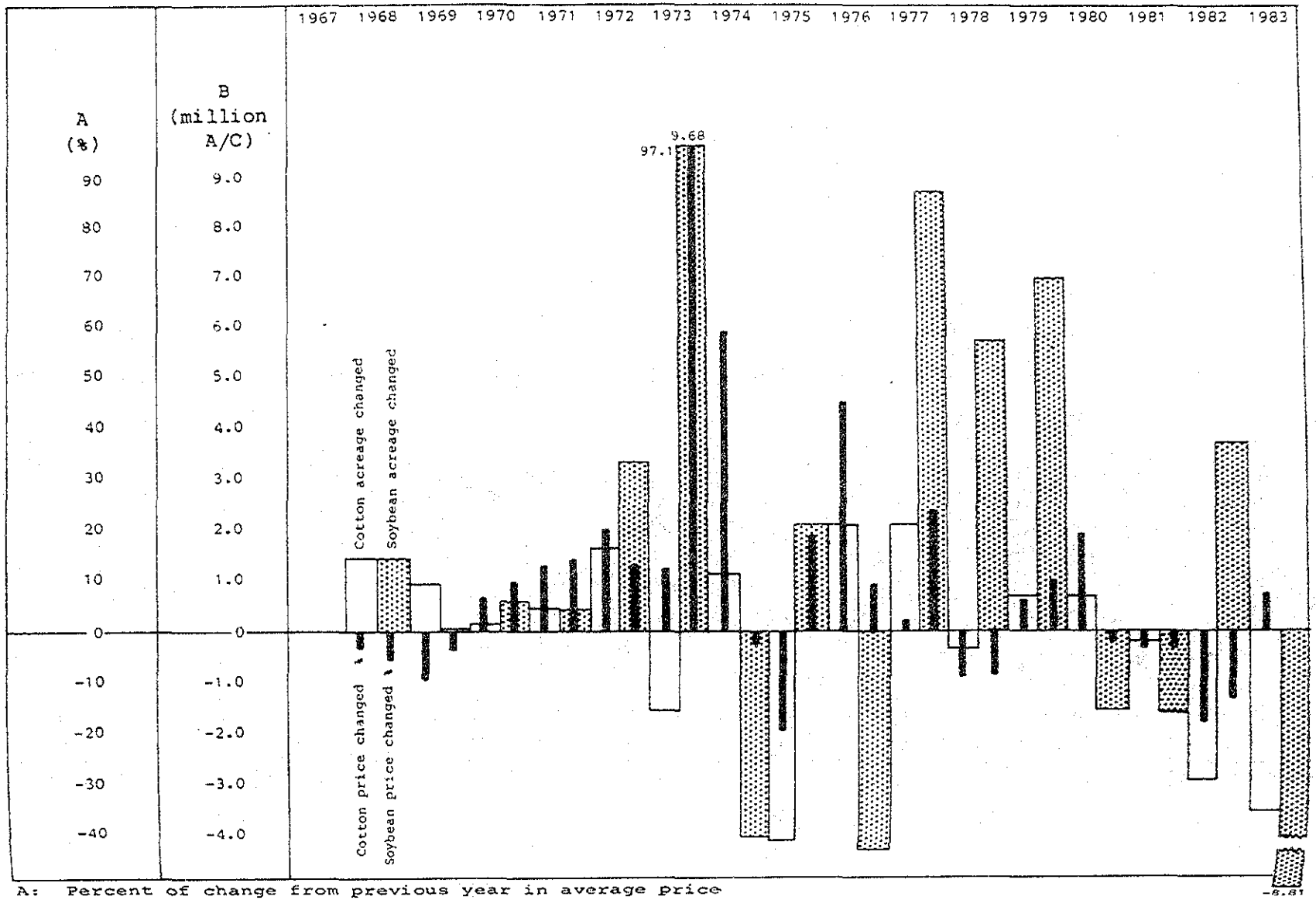
Source: ICAC

Appendix Fig. 3 Prices Received by Farmers, USA



Source: USDA

Appendix Fig. 4 Competing Situation between Cotton and Soybean, USA



A: Percent of change from previous year in average price
B: Change from previous year in acreage
Source: USDA (arranged by the Japan Cotton Traders Association)

[6] FOREST PRODUCTS

[6] FOREST PRODUCTS

CONTENTS

[6] FOREST PRODUCTS

A. PRODUCTION

I. Trends in Production

An overall view of trends in the production of forest products shows a clear difference between charcoal and other forest products, and also between those of the developed countries, developing countries and countries with centrally planned economies.

Regarding the production of non-conifer sawlogs and veneer logs, plywood, pulpwood and particles, the developed countries have tended to be in the state of stagnancy since 1965, experiencing a significant decline during the period of recession, especially shortly after the first oil crisis, whereas the production in Latin America, Africa and the Asian centrally planned economies [1] has tended to steadily increase independent of such crises. In Asia (Southeast Asia and South Asia), production has rapidly increased since 1965, and after the oil crisis, the trend of increase has continued on the whole despite the decline in the production of some items. In the USSR and Eastern Europe, the level of production has increased slightly since 1965, but has fallen somewhat since the first oil crisis.

Charcoal is one of the important forest products in developing countries, and its production has steadily increased in all of those countries since 1969.

The above-mentioned trends are described in more detail below:

1. Non-Conifer Sawlogs and Veneer Logs (See Fig. A-1)

In North America,[2] the production of non-conifer sawlogs and veneer logs has generally leveled off since 1965. The decline in

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1) Five countries, i.e., China, Democratic Republic of Korea, Democratic Kampuchea, Mongolia and Viet Nam.
2) Two countries, i.e., the United States and Canada.

production was significant during the recession in 1975 after the oil crisis.

In Western Europe, the USSR and Eastern Europe, however, the level of production has shown little change.

In Asia (Southeast Asia and South Asia),[1] production sharply increased as a result of rapid exploitation of forests between 1965 and 1973, but fell markedly at the time of the first oil crisis. In spite of its subsequent recovery, it fell again due to the second oil crisis of 1979.

In Latin America, Africa and centrally planned economies in Asia, the level of production has tended to increase since 1965 independent of the oil crisis.

2. Non-Conifer Sawnwood (See Fig. A-2)

The production of non-conifer sawnwood in North America has shown the same tendency as the non-conifer sawlogs and veneer logs, that is, a slight increase since 1965. It fell markedly in 1975 after the first oil crisis, and has again leveled off despite an interim recovery.

In Western Europe, production had increased since 1965 before the first oil crisis led it to decline significantly. It could not recover to the 1973 level until 1980.

The level of production in the USSR and Eastern Europe did not show much change from 1965 to 1976, while subsequently it has tended to decline.

Production in Asia (Southeast Asia and South Asia) showed rapid growth from 1965 until the second oil crisis of 1979, when it fell considerably.

In other developed countries [2] (mainly Japan), the production of sawnwood from logs imported from Southeast Asia increased from 1965 until the first oil crisis caused its rapid fall. It has leveled off since 1977.

The level of production in the developed countries of Oceania,

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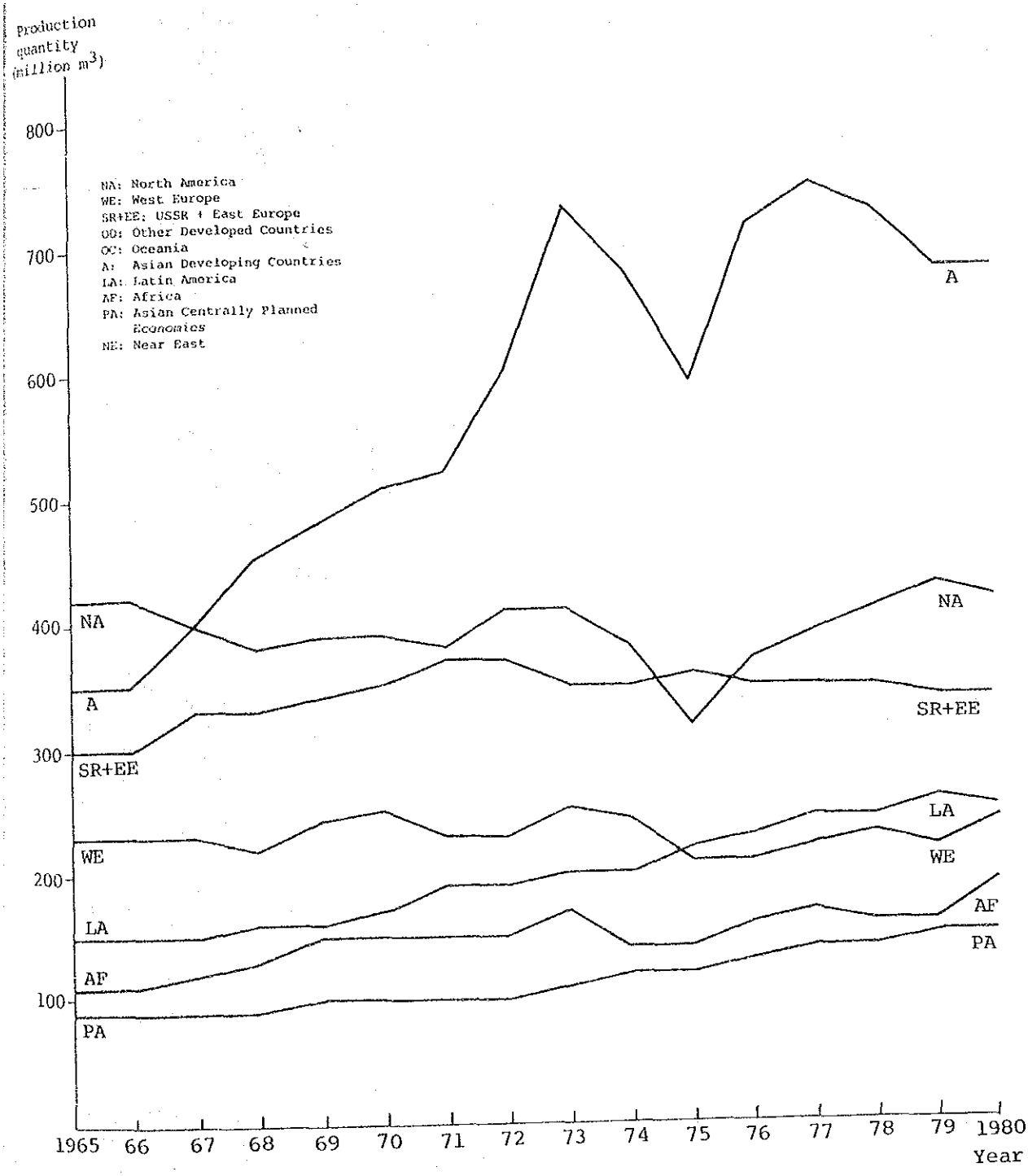
1) Sixteen countries, i.e., Bangladesh, Brunei, Burma, Hong Kong, India, Indonesia, Lao, Macau, Malaysia, Nepal, Pakistan, the Philippines, Republic of Korea, Singapore, Sri Lanka and Thailand.

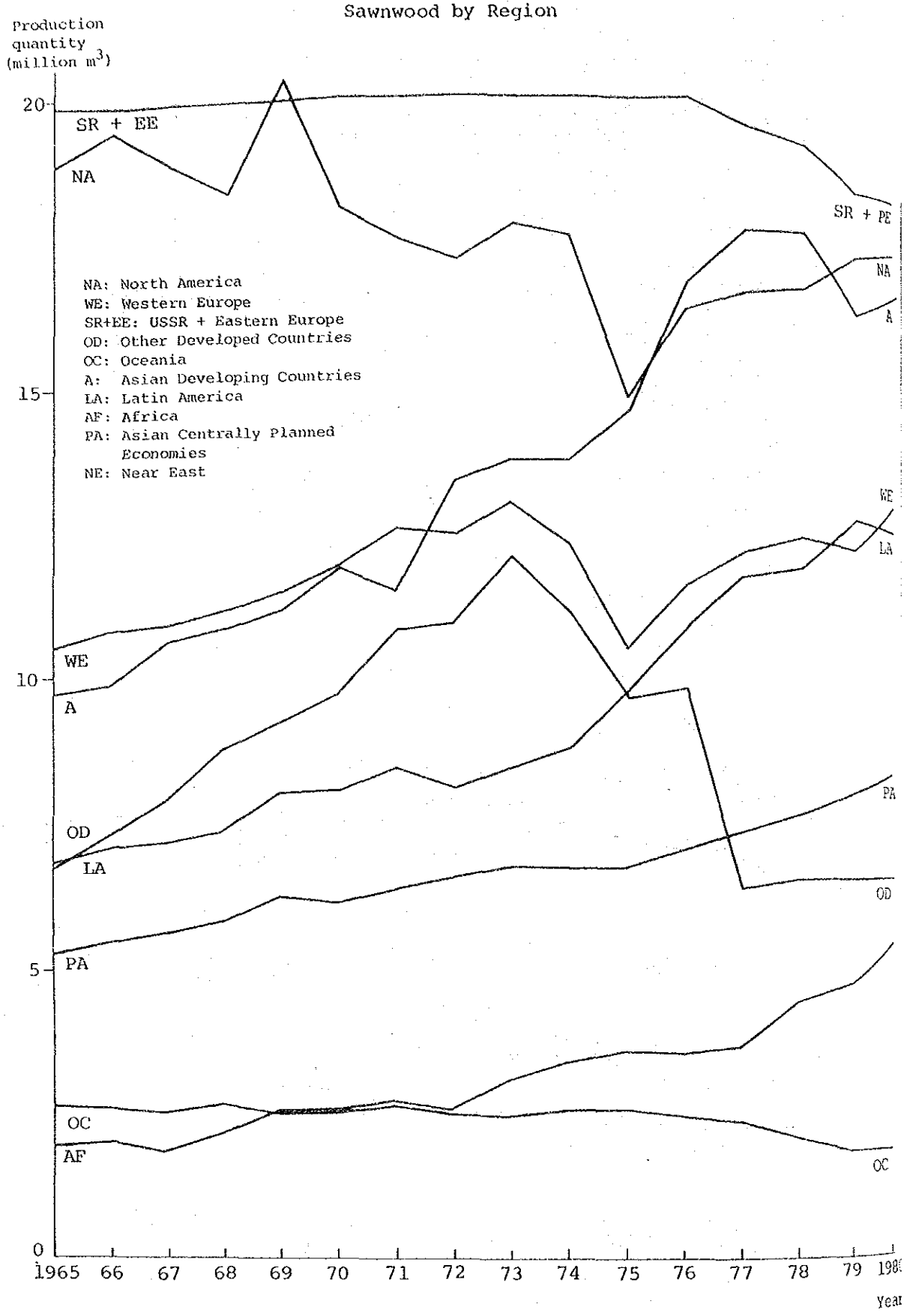
2) Three countries, i.e., Japan, Israel and South Africa.

Fig. A-1 Trends in Production of Non-conifer Sawlogs and Veneer Logs by Region



Source: FAO, Yearbook of Forest Products

Fig. A-2 Trends in Production of Non-conifer Sawnwood by Region



Source: FAO, Yearbook of Forest Products

i.e., Australia and New Zealand, has tended to slightly decrease since 1965.

The production in Latin America, Africa and the centrally planned economies in Asia has steadily increased, like that of non-conifer sawlogs and veneer logs, since 1965, independent of the oil crisis. The increase is especially marked in Latin America.

3. Plywood (See Fig. A-3)

The production of plywood in North America showed an increasing trend during the period 1965-1971, but since then it has shown little change.

In Western Europe, production increased from 1965 until 1974, but considerably declined in 1975 and again in 1978 despite recovering in 1977, and since then it has leveled off.

The production of plywood in the USSR and Eastern Europe, like that of non-conifer sawlogs, veneer logs and non-conifer sawnwood, showed a slight increase until 1975, but since then it has been stagnant or decreased slightly.

In Asia (Southeast Asia and South Asia), the production of plywood, like that of non-conifer sawlogs and veneer logs, had increased before the first oil crisis. It fell in 1974, but again recovered in 1977.

The production in other developed countries (mainly Japan), as in the case of non-conifer sawnwood showed a steep increase between 1965 and 1972, based on logs imported from Southeast Asia. After that, it declined as a consequence of competition with secondary producing countries and the first oil crisis. Despite recovering after 1976, it has recently leveled off.

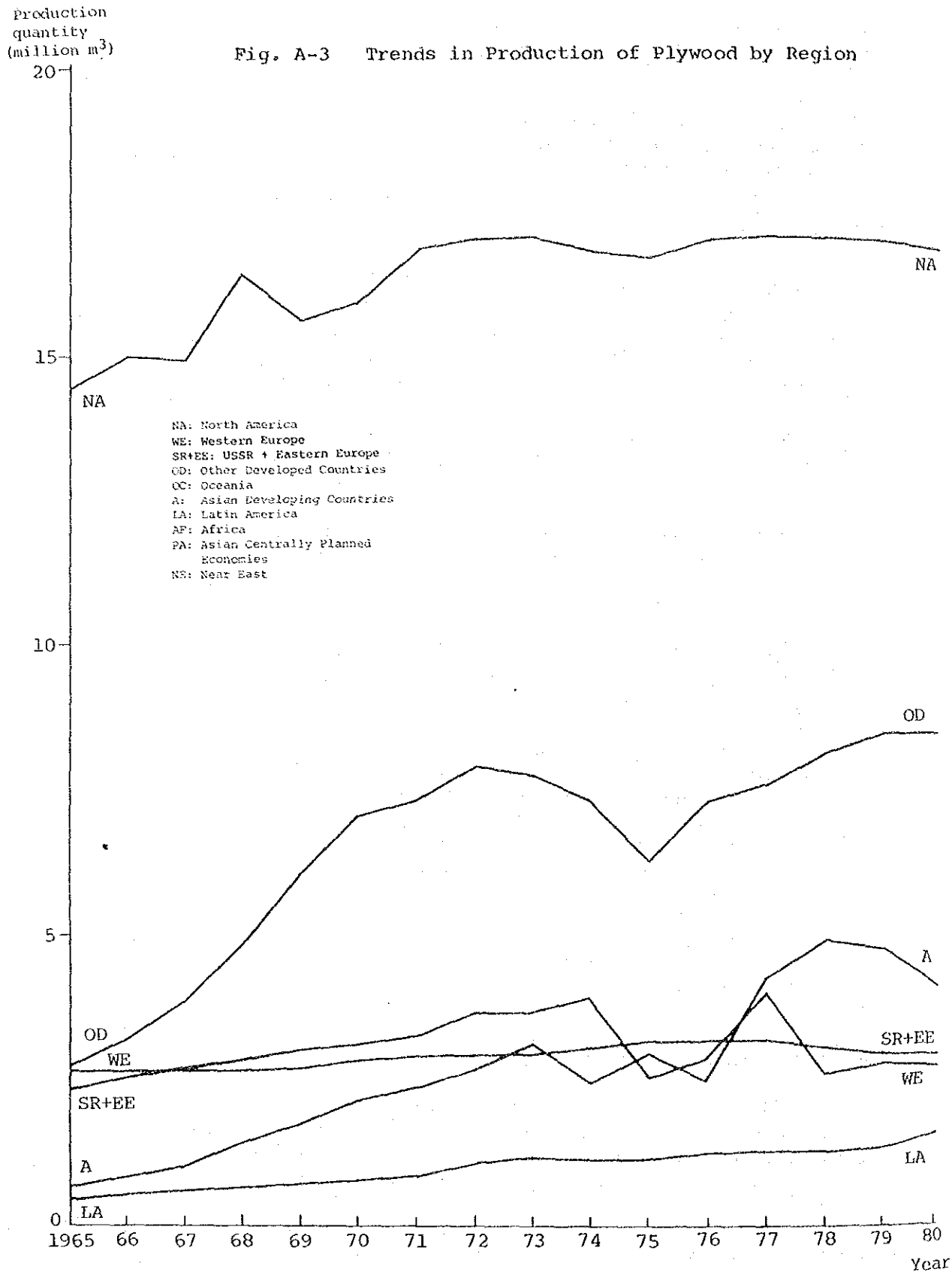
On the other hand, the level of production in Latin America has gradually increased since 1965.

4. Pulpwood and Particles (See Fig. A-4)

The production of pulpwood and particles in North America showed an increasing trend from 1966 until the first oil crisis. It has gradually recovered since registering a sharp decline in 1975, but in general it has shown no major increase.

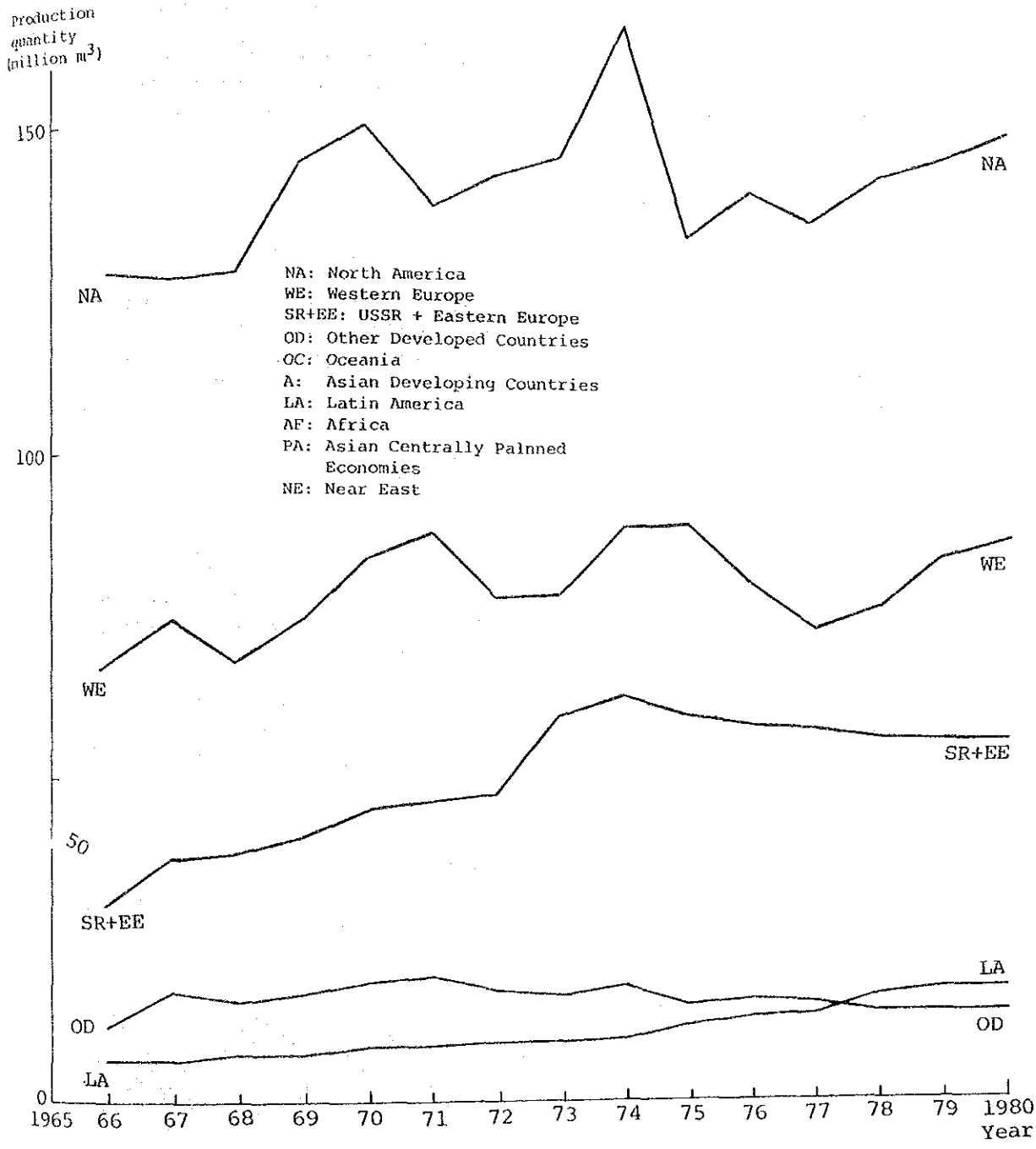
Production in Western Europe has gradually increased since 1966, except for declines in 1968, 1972 and 1977.

Fig. A-3 Trends in Production of Plywood by Region



Source: FAO, Yearbook of Forest Products

Fig. A-4 Trends in Production of Pulpwood and Particles by Region



Source: FAO, Yearbook of Forest Products

In the USSR and Eastern Europe, the level of production continued to increase until 1974, but since then it has slightly declined.

Production in other developed countries has leveled off in general since 1966, but it has decreased very slightly since 1971.

The production in Latin America has shown a steady and gradual increase since 1966 independent of the fluctuations in production cost and selling prices, because the early stage of production structure compared with other regions.

5. Charcoal (See Fig. A-5)

Since almost all of the production of charcoal is concentrated in four regions, i.e., Latin America, Africa, Asia and the Near East, the production increases in each of these regions follow the increases in population and income, up to a certain level. The rate of production growth is high, especially in the former two regions.

II. Harvesting Time

It goes without saying that the harvesting time (cutting age) of trees varies with the specific growth of the tree species, site class, management system, and the uses of the tree.

The cutting age of tropical trees can be, however, classified for the sake of convenience into fast growing species, common sawtimber species, and special hard and heavy wood species.

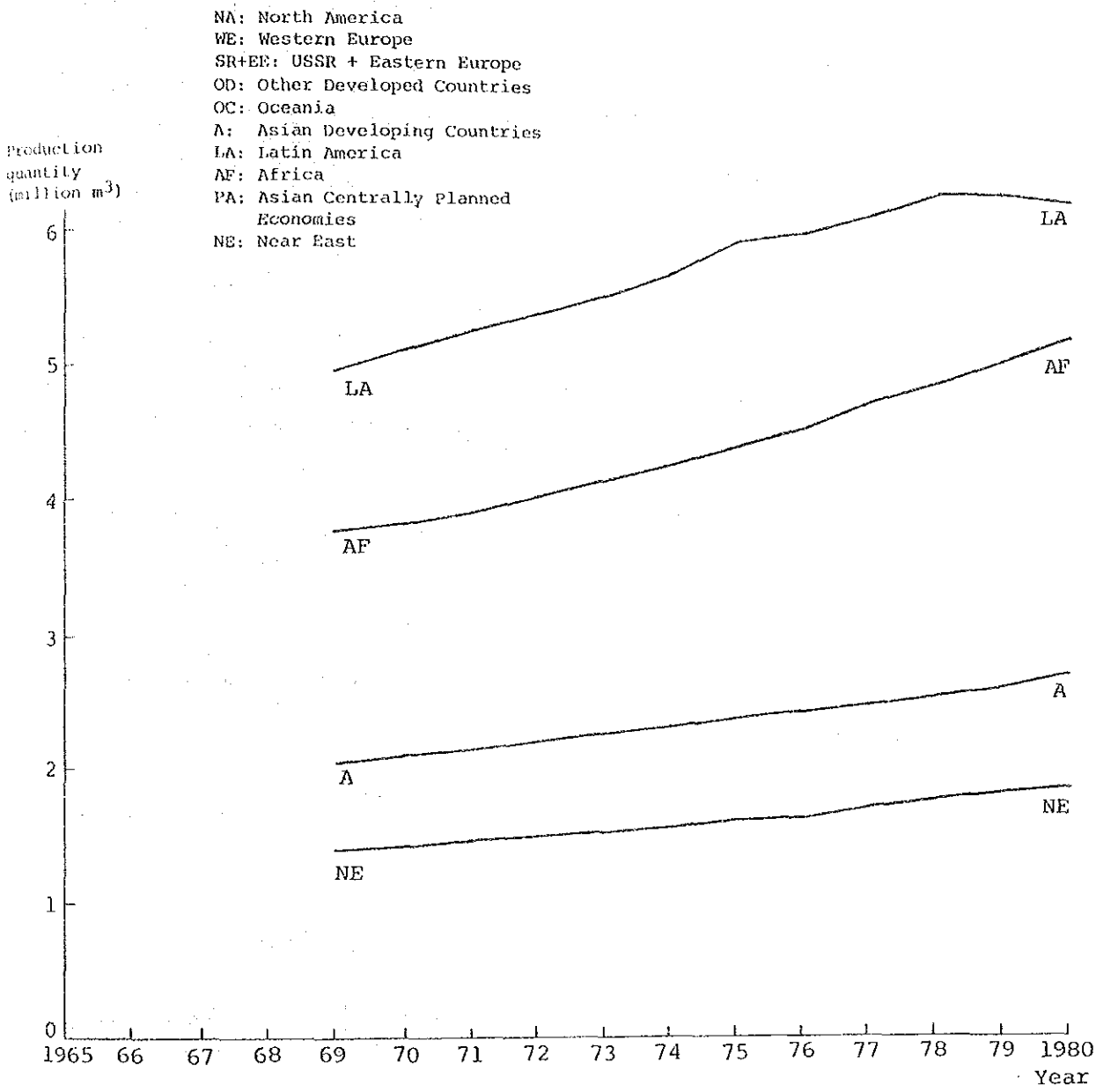
1. Harvesting Time of Fast Growing Species

The fast growing species are used for pulpwood or as wood for fuel (charcoal and firewood) and the following are some common examples:

Broadleaved trees such as Albizzia spp., Eucalyptus spp., Terminalia spp., Acacia spp., Anthocephalus spp., Gmelina arborea and Melia spp., and coniferous trees such as Pinus caribaea and Araucaria spp.

The cutting age of these fast growing species for pulpwood and particles is approximately 10 to 15 years and the thinning is done

Fig. A-5 Trends in Production of Charcoal by Region



Source: FAO, Yearbook of Forest Products

between 5 and 7 years after planting. If these species are, however, used for common sawtimber, the relatively longer cutting ages mentioned below will apply.

Since almost all of the fast growing species are intolerant trees, clear cutting and artificial reforestation is often adopted as the forest management system.

Examples of the harvesting time of fast growing species in the tropical rain forest zone are as follows:

Philippines — Mindanao Is.

Eucalyptus deglupta	Final cutting age:	16 years
	(Cutting volume:	235 m^3/ha)
	Thinning age :	8 years
	(Cutting volume:	75 m^3/ha)
Albizzia falcata	Final cutting age:	14 years
	Thinning age :	8 years
Pinus caribaea	Final cutting age:	15-20 years
	(Cutting volume:	200 m^3/ha)
	Thinning is not done.	

Indonesia — Kalimantan

Anthocephalus chinensis	Final cutting age:	15 years
	(Cutting volume:	225 m^3/ha)
Eucalyptus deglupta	Final cutting age:	10 years
	(Cutting volume:	200 m^3/ha)
Pinus caribaea	Final cutting age:	15 years
	(Cutting volume:	225 m^3/ha)

Papua New Guinea — New Britain Is.

Eucalyptus deglupta	Final cutting age:	
	Pulp and particles :	8-12 years
	Sawtimber :	25-30 years

Highlands of Peru

Eucalyptus globulus	Final cutting age:	
Pinus radiata	(wood for fuel and timber)	10-30 years

Gabon

Aucoumea klaineana	Fianl cutting age:	Sawtimber:	60 years
	(Cutting volume:	390 m^3/ha)	

Congo

Terminalia superba	Final cutting age:	Sawtimber:	40 years
	(Cutting volume:	270 m^3/ha)	

2. Harvesting Time of Common Sawtimber Species

The common sawtimber species are used mainly for sawnwood (include furniture) and plywood, and consist of the following species:

Broadleaved trees such as Dipterocarpus spp., Dryobalanops spp., Hopea spp., Shorea spp., Parashorea spp., Anisoptera spp. (all of which fall under Dipterocarpaceae), Alstonia spp., Cedrela spp., Cordia spp., Swietenia spp., Virola spp., Tectona grandis, Khaya spp. and Entandrophragma spp., and coniferous trees such as Agathis spp. and Pinus kesiya.

Of these species, those which are at least 40cm or more in D.B.H. (diameter breast height), preferably 60cm or more, are harvested for sawnwood or as materials for plywood. Accordingly, the cutting age (rotation) of these species is between approximately 30 and 80 years.

Since many of these species are tolerant trees, the selective cutting system or the shelterwood system is often adopted as the forest management system. Though the cutting cycle in the selective cutting system varies with the tree species, the selective felling rate, diameter for cutting and so on, it covers an approximate range of 25 to 55 years.

Examples of cutting age (rotation) or cutting cycle in each region are as follows:

Philippines
Selective cutting of natural dipterocarpus forest (Selective Logging System)
Cutting cycle: 30-45 years (varies with site class)
Felling rate : 100% for trees of 80cm or more, 55% for those of 70-79cm and 25% for those of 60-69cm, in D.B.H.
Rotation : 70 years

Indonesia
Selective cutting of natural dipterocarpus forest (TPI system)
Cutting cycle: 35 years (trees with a D.B.H. of 50cm or more)
45 years (trees with a D.B.H. of 40cm or more)
55 years (trees with a D.B.H. of 30cm or more)

Malaysia
Selective cutting of natural dipterocarpus forest (Selective Management System)
Cutting cycle: 25-40 years (trees with a D.B.H. of 60cm or more)

Thailand
Selective cutting of natural teak forest (Revised Brandis Method)
Cutting cycle: 30-40 years

Trinidad and Tobago
Selective cutting of tropical rain forest (Timber Selection System)
Cutting cycle: 30 years

Ghana
Selective cutting of tropical rain forest (Gestion Selective)
Cutting cycle: 15 years

Fiji
Line planting under shade trees
Swietenia macrophylla — Final cutting: 55 years (Cutting volume: 290 m^3/ha)
Thinning: 20, 30 or 40 years (Total cutting volume: 150 m^3/ha)

Solomon Islands
Line planting under shade trees
Campnosperma brevipetiolata — Final cutting: 25-35 years

Surinam
Line planting under shade trees
Virola suranamensis, Simaruba amara } Final cutting: 50 years or less

Venezuela
Line planting under shade trees
Cedrela odorata, Swietenia macrophylla, Cordia alliodora, Samanea saman, etc. } Final cutting: 35-40 years

Indonesia (Java)
Clear cutting and artificial reforestation system
Tectona grandis — Final cutting: 60-80 years
Agathis loranthifolia — Final cutting: 30-50 years

Thailand
Clear cutting and artificial reforestation system
Tectona grandis — Final cutting: 60-75 years
Pinus merkusii and Pinus kesiya — Final cutting: 25 years

Philippines (hilly districts in Luzon)
Seed tree system
Pinus kesiya — Final cutting: 50 years (Cutting volume: 280-420 m^3/ha)

3. Harvesting Time of Special Hard and Heavy Wood Species

These species, which are called fancy wood or valuable timber

because of their quality and beauty, are used mainly for craftwork and furniture and as sliced veneer in plywood overlay.

These include Dalbergia spp., Diospyros spp., Pterocarpus spp., Cassia spp., Intsia spp., Eusideroxylon zwageri and Guojacunt officinale, all of which are hard and heavy, and slow growing. Although tentative planting of these trees is being carried out in some regions, most of the harvest currently comes from natual forests.

These species require a cutting age of at least 80 years, and normally 100 years or more. In Malaysia, for example, the rotation of hard and heavy trees in selective logged forest is usually 130 years. In the selective cutting system of tropical forests on the island of Reunion in the Indian Ocean, the rotation of hard and heavy tree species such as Diospyros melanida, Mimusops calophylloides and Elaeodendron orientale is normally 150 years.

III. Forest Resources

1. Current Situation of World Forest Resources

The forest physiognomy depends on two factors, i.e., warmth and precipitation. Numerically, the former is indicated by an index of warmth and the latter by an index of aridity.[1),2)]

The coniferous forest zone appears in the sub-polar (sub-frigid) zone where the index of warmth is from 15 to 45 or 55 and the index of aridity is 7.0 or more.

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1) The following indices proposed by Mr. Tatsuo Kira are used herein:

Index of warmth : Since plants require a certain quantity of heat for growth, the limits of temperature which effect their growth are set. The temperatures which exceed the limits are lumped together and known as the integrated temperature. Mr. Kira has determined this limit value at 5°C over the average monthly temperature, and uses the integrated temperature as the index of warmth.

Index of aridity: For a warmth index (W) of less than 100, the index of aridity (M) is given by $M = P/(W+20)$, where P is the annual precipitation (in mm). Given a warmth index of more than 100, $M = 2P/(W+140)$.

2) a. Kinji Hachiya, Ecological Approach to Forests, Japan Forestry Technology Association, May 1970 (in Japanese)

b. Isamu Nomura, Problems of World Forest Resources, National Forestry Extension Association, November 1969 (in Japanese)

There are relatively few species of high trees in this forest zone, where Picea and Abies dominate, coexisting with pine, Larix and white birch.

In the areas which are warmer than the sub-polar zone, i.e., where the index of warmth is from 45 or 55 to 85 and the index of aridity is more than 7.0, deciduous broadleaved forest appears.

This forest is also known as the summer green forest because the leaves fall in the winter. In this zone, in the areas where the humidity coefficient is relatively high, Fagaceae is the most typical of the dominant species, whereas in the continental areas where the coefficient is low, instead of Fagaceae, linden, maple, elm and quercus constitute the forest.

There are some areas, which are not obvious forest zones corresponding to climatic zones, where coniferous forests grow among the deciduous broadleaved forests which widely dominate the temperate zone. These are known as the temperate coniferous forests. These forests, which include many valuable species such as Tsuga, fir, sugi, cypress, Pseudotsuga and Thuja, play an important role in the timber industry.

Moving on to the area (warmth index, 85 to 180) which is higher in temperature than the temperate deciduous broadleaved forest area, warm evergreen broadleaved forests grow in humid climates (aridity index, 10.0 or more), and warm deciduous broadleaved forests exist in sub-humid climates (aridity index, 7.0-10.0).

To begin with, the warm evergreen broadleaved forests are known as the laurel forests because the leaves of the trees which constitute them are generally small, coriaceous, thick and shiny in order to resist the winter cold. Dominant tree species are evergreen Fagaceae (e.g., ever green oak), Lauraceae and Theaceae (e.g., camellia and Thea).

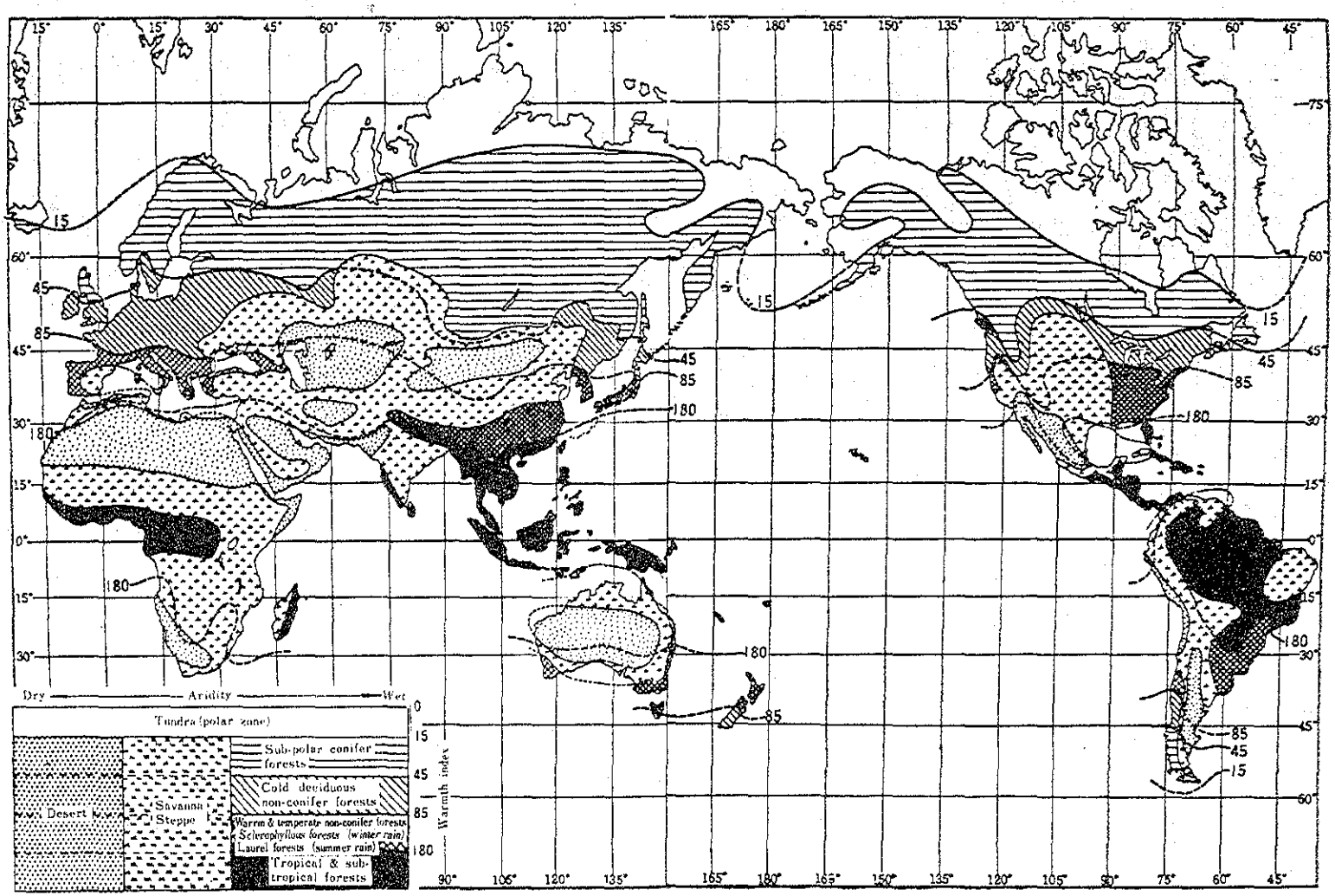
The evergreen broadleaved forests on the coast of the Mediterranean are known as the sclerophyllous forests, whereas the warm evergreen broadleaved forests of eastern Asia are known as bright leaved forests.

The name of the sclerophyllous forests is derived from the characteristics of its dominant species; cork-oak and olive which have coriaceous leaves and strong resistance to dryness.

As already mentioned above, warm deciduous forests appear in the warm and sub-humid climates.

Dominant tree species in these forests are quercus and chestnut, and defoliation is seen in winter owing to dryness and cold.

Fig. A-6 Map of World Ecological Climatic Zones



Source: Tatsuo Kira, Forest Ecology Guideline, Kawade Shobo, 1971, p. 150

In the sub-tropical zones (warmth index, 180 to 240) and the tropical zones (240 or more) where the temperature is higher than in the warm zones, the deciduous broadleaved forests appear, the leaves of which fall in the dry season in the sub-humid climates where the difference is clear between the rainy and dry seasons. These forests are known as the tropical seasonal forests because the leaves turn green in the rainy season. In Southeast Asia, they are known as the monsoon forests because the appearance of the rainy and dry seasons are subject to the monsoons.

The physiognomy of the tropical seasonal forests, or monsoon forests, varies according to the length of the dry season and geographical conditions such as the soil conditions. The more these conditions are favorable for evergreen rain forests, as described below the less deciduous trees can be found. The less favorable they are, the forest becomes more open, to what is called the open-forest type, or beyond, to the savanna type.

Although tropical seasonal forests do not have as many valuable large-diameter trees as the tropical rain forests described below, a relatively large number of precious wood tree species have come to appear. For example, teak in Southeast Asia and Baikiaea plurijuga in Africa.

The tropical rain forests are found in the humid climates in the tropical zones.

A high precipitation of rain spread throughout the year facilitates the thick growth of plants, and as a result of their competition for light, their crowns overlap each other to form the canopy of a dense forest.

Thus, the physiognomy of the tropical rain forest is complicated, and in general stratified. The forest as a whole has 5-7 strata; the first three strata consist of high trees: i.e., the giant tree stratum (height, 30-60m), the high tree stratum (around 20m) and the sub-high-tree stratum (around 10m); and below these, the low tree strata in various sizes and the grass stratum exist.

Tropical rain forests are on the whole distributed on or near the equator, in a range from lat. 10°N. to 10°S.

The proportion of large valuable trees growing in a forest varies from area to area. In Southeast Asia, Dipterocarpaceae are the dominant species present, whereas in Africa, such species as Leguminosae, Burseraceae, Meliaceae, Sterculiaceae and Combretaceae all grow together. In Central and South America, forests are composed of such species as Anacardiaceae, Meliaceae, Leguminosae, Lauraceae and Vochysiaceae.

The distribution of world forests has been generally examined above from the point of view of forest physiognomy. In summary, it may be said that coniferous forests and warm and temperate non-coniferous forests are distributed in the sub-polar zone and the warm and temperate zones where many advanced countries are located, while the tropical non-coniferous forests are distributed in the sub-tropical and tropical zones where many developing countries are located.

From the point of view of statistics as shown in Table A-1, of the gross world forest area of 3.7 billion ha (which accounts for about 28% of the gross land area), about one-third, or 1.2 billion ha, consists of coniferous forests.

Non-coniferous forests cover about two-thirds of the gross forest area, or 2.4 billion ha. Taking this figure to be 100.0%, Latin America, Africa and Asia (excluding Japan and the USSR) account for 30.4%, 28.3% and 16.9% respectively, and thus, these

Table A-1 Land and Forest Area in Main Regions of the World

(million ha)

Region	Gross land area	Forest area				Productive forest	
		Total		Coniferous forest	Non-coniferous forest		
North America	1,875	710	19.1%	440	260	410	18.0%
USA	919	292	(7.9)	-	-	238	(10.0)
Canada	916	420	(11.3)	-	-		
Latin America	2,031	794	21.4	35	741	349	15.0
Europe	457	148	4.0	86	62	126	6.0
Western Europe	371	122	(3.3)	72	50	104	(5.0)
Africa	2,970	711	19.2	4	688	295	13.0
Asia (excluding Japan & USSR)	2,663	495	13.4	74	411	330	14.0
Southeast & East Asia	469	272	(7.3)	7	260	187	(8.0)
Japan	100	24	0.6	10	13	23	1.0
USSR	2,144	737	19.9	553	175	700	31.0
Pacific region	842	92	2.5	3	85	48	2.0
Total	13,033	3,712	100.0	1,205	2,435	2,281	100.0

Notes: 1) The totals are inconsistent due to rounding of figures and conversion.
2) One million acres has been converted into 4.047 million ha.

Source: Forest Service, U.S. Department of Agriculture, The Outlook for Timber in the United States, 1973, p.133

three regions combined account for the majority, or 75.6%, of the total. The non-coniferous forests which are distributed in these regions are mainly tropical seasonal forests and tropical rain forests.

The world growing stock has not been fully grasped.

The following is an examination of the current situation of the world growing stock by species and area as shown in Table A-2. The total growing stock is 12,623 billion cu. ft, which is the equivalent of about 357 billion cubic meters. Classifying this by coniferous and non-coniferous trees and regions, the situation is naturally similar to that from the point of view of forest area.

2. Outlook of World Forest Resources

As examples of long-term global forecasts of forest resources, The Global 2000 Report to the President compiled by the U.S. Government in 1980 and the FAO forestry paper, World Forest Products; Demand and Supply 1990 and 2000 of January, 1982 deserve our atten-

Table A-2 Growing Stock by Species in Main Regions of the World

(billion cu. ft)

Region	Total		Coniferous trees		Non-coniferous trees	
North America	2,083	16.5%	1,395	31.7%	689	8.4%
Latin America	4,340	34.4	99	2.3	4,241	51.5
Europe	473	3.7	290	6.6	184	2.2
Africa	1,232	9.8	11	0.2	1,222	14.9
Asia (excluding Japan & USSR)	1,444	11.4	212	4.8	1,232	15.0
Japan	67	0.5	35	0.8	32	0.4
USSR	2,807	22.2	2,345	53.3	463	5.6
Pacific region	177	1.4	11	0.3	166	2.0
Total	12,623	100.0	4,396	100.0	8,227	100.0

Notes: 1) The totals are not necessarily consistent due to rounding of figures.
2) Figures remain in their original form because of the problem of the application of a conversion factor to convert cu. ft into m^3.

Source: Forest Service, U.S. Department of Agriculture, The Outlook for Timber in the United States, 1973, p.133

tion. Since both of these forecasts have almost the same basis, except that the latter is more severe than the former with regard to the decrease in tropical forests, the discussion below is based on the former.

According to the data in the reports of Persson and of Sommer and in those from American Embassies in developing countries, forests will decrease by 18 to 20 million ha in area from 1973 through the year 2000.

If this turns out to be true, the area covered by forests would be about 2.1 billion ha in the year 2000, as shown in Table A-3. It is projected that the forested area will decrease by about 460 million ha, from the approximately 2,560 million ha in 1978 to about 2,117 million ha in the year 2000. Such a steep overall decrease is itself a big problem, and becomes all the more serious when viewed more closely on a regional basis.

Table A-3 Forecast of World Forest Resources

(million ha, billion m^3)

Region	Forest area		Commercial growing stock	
	1978	2000	1978	2000
USSR	785	775	79	77
Europe	140	150	15	13
North America	470	464	58	55
Japan, Australia and New Zealand	69	68	4	4
Subtotal 1	1,464	1,457	156	149
Latin America	550	329	94	54
Africa	188	150	39	31
Developing countries in Asia and the Pacific region	381	181	38	19
Subtotal 2	1,009	660	171	104
World total 1+2	2,563	2,117	327	253
World population (billion)			4.3	6.4
Growing stock per capita			76	46

Note : Forests here referred to are closed forests.

Source: The Global 2000 Report to the President, 1980

It can be seen that there is no significant decrease projected in the area of forests in the so-called developed countries (which are geographically located in the warm, temperate and sub-polar zones) such as the USSR, Europe, North America, Japan, Australia and New Zealand, whereas there is an extremely marked decrease in the area of forests in the so-called developing countries (which are geographically located in the sub-tropical or tropical zones) such as Latin America, Africa, Asia and the Pacific region.

In the statistics shown above, the area under forests will almost level off, with a slight decrease from 1,464 million in 1978 to 1,457 million ha in the year 2000, in the developed countries, whereas it will sharply decrease from 1,099 million to 660 million ha in the developing countries.

Turning from the forest area to growing stock, the gross stock is projected to decrease from 327 billion in 1978 to 253 billion m^3 in the year 2000. Changes in stock by region naturally show the same trends as the changes in area. The stock will show a projected decrease from 156 billion in 1978 to 149 billion m^3 by the year 2000 in the developed countries, whereas in contrast it is projected to sharply decrease from 327 billion to 253 billion m^3 in the developing regions.

It would be safe to say that the decrease in global forest resources will be concentrated in the developing countries as mentioned above. It is pointed out in the above-mentioned report, the Global 2000 Report to the President, 1980, that forests with potential for development in the developing countries will be destroyed by the year 2020 at the present rate of decrease.

In other words, the exhaustion of valuable tropical large-diameter tree resources is extremely serious compared with the situation regarding coniferous timber.

The reasons for the destruction of forests currently occurring or being projected to occur concentratedly in the developing countries located in the tropical zones are as follows:

Firstly, tropical forests (mainly non-coniferous forests) are hardly to recover from destruction. This is because the tropical climate is hot enough for humus to quickly decompose and erode to form poor soil. Such poor soil, the surface of which is made hard by the directly falling sunlight, prevents the germination of seeds falling on it. The dry season which appears clearly and severely in the so-called monsoon zones such as the continental area of Southeast Asia also disturbs the recovery of forests.

Secondly, shifting cultivation is widely carried out. An estimated 190 million ha of tropical forests in developing countries are

currently used for shifting cultivation. After extremely rough clearing and firing, crops are cultivated for a couple of years. As the land is left in fallow during the following more than ten years, it more or less regains its fertility by the time of the next clearing, firing and cropping. Such a system of recovery, however, will be changed with the increase in population, which results in the inevitable reduction of the period for which the land lies fallow, with the land losing the ability to recover its fertility. Since such land is often abandoned, sooner or later forests will stop growing there.

Thirdly, trees are widely and intensively used for firewood and charcoal. It is considered that the increase in demand for firewood and charcoal has a very critical impact on the environment because the transformation of forests into barren land is very rapid in the case of open forests in the tropical and sub-tropical zones. In these zones, the cutting of trees more often leads to the formation of a desert than to sterile land.

Fourthly, firing for grazing is overdone. This is one of major causes of forests becoming barren land, especially in the open forest zones.

Fifthly, currently used forests, which contain only five to ten valuable big trees per ha, generate a very small amount of profit per ha. This situation as well as the generally poor state of the economy makes intensive forest management impossible in almost all of the developing countries.

Finally, the history of reforestation techniques in the tropical zone is not old as much as in the developed countries.

The current situation of and prospects for worldwide forest resources have been described above. In this context, discussion will be focused on the forests in the tropical zones, including Brazil, (hereinafter referred to as the tropical forests) in the following item.

3. Current Situation of Tropical Forest Resources

The gross forest area is about 2 billion ha in tropical America, tropical Africa and tropical Asia combined (hereinafter, the term tropical shall be omitted for Africa.) Taking the total as 100%, the distribution in tropical America, Africa and tropical Asia is 46%, 36% and 17%, respectively (See Table A-4).

There is a relatively large amount of growing stock. As for the closed forests (see footnote to Table A-4) which are suitable for timber production, the gross area of such forests is about 1.2

Table A-4 Current Situation of Forests by Region

(1,000 ha)

Region	Closed forest	Open forest	Total	
			Area	Percentage
Tropical America	678,650	217,000	895,650	46.28
Tropical Africa	216,650	486,450	703,100	36.33
Tropical Asia	305,500	30,950	336,450	17.39
Total (76 countries)	1,200,800	734,400	1,935,200	100.00

Notes: 1) The regions are comprised of the following countries.
Tropical America: Central and South America (excluding Argentina and Uruguay), south of Mexico, and Caribbean countries.
Tropical Africa : Countries on the African Continent and Madagascar excluding the following countries: Egypt, Libya, Tunisia, Algeria, Morocco, Mauritania, South Africa, Zimbabwe, Swaziland and Lesotho.
Tropical Asia : South and Southeast Asian countries to the east of Pakistan and west of Papua New Guinea.
2) Closed forests are those which by their different strata and their undergrowth cover a large part of or all the ground.
3) Open forests are those in which the canopy is generally less closed.

Source: FAO, Second Expert Meeting on Tropical Forests, 1982.

billion ha, of which the majority, or 96.6%, is covered with broadleaved trees, while 2.9% is covered with coniferous trees and 0.5% with bamboo.

The statistics of closed forests by tree species, coniferous or non-coniferous, are shown in Tables A-5 and A-6. Non-coniferous forests, which constitute the major portion, will now be briefly discussed here.

Of the gross broadleaved forest area of 1.16 billion ha, tropical America, Africa and tropical Asia account for a little more than 56%, 18% and 25%, respectively.

Productive closed broadleaved forests where the wood products are mainly industrial materials cover 860 million ha or 74% of the total, of which tropical America, Africa and tropical Asia account for 59%, 19% and 22%, respectively.

Table A-5 Areas of Closed Broadleaved Forests

(1,000 ha)

	Productive				Unproductive			Total	
	Not managed				For	For			
	Undis-turbed	Logged	Managed	Total	physical reasons	legal reasons	Total	Area	Percen-tage
Tropical America	453,000	53,500	—	506,500	133,550	13,900	147,450	653,950	56.36
Tropical Africa	118,200	41,850	1,700	161,750	43,650	9,000	52,650	214,400	13.48
Tropical Asia	97,250	58,400	36,200	191,850	83,600	16,450	100,050	291,900	25.16
Total	668,450	153,750	37,900	860,100	260,800	39,350	300,150	1,160,250	100.00

Notes: 1) Productive forests are those where the terrain and the regulations applicable to their use allow the production of wood for industry.
2) Managed forests are those to which rules governing logging are applied in a strict and controlled way and for which silvicultural and protective measures are adopted.
3) Undisturbed forests are those where logging or clearing has not been done in the last 60 to 80 years.
These notes shall also apply to the Tables below.

Source: FAO, Tropical Forest Resources Assessment Project, 1981

Table A-6 Areas of Coniferous Forest

(1,000 ha)

	Productive				Unproductive			Total	
	Not managed				For	For			
	Undis-turbed	Logged	Managed	Total	physical reasons	legal reasons	Total	Area	Percen-tage
Tropical America	1,500	13,150	500	15,150	9,400	150	9,550	24,700	72.19
Tropical Africa	300	300		600	450	100	550	1,150	3.27
Tropical Asia	1,750	950	2,900	5,600	1,700	1,100	2,800	8,400	24.59
Total	3,550	14,400	3,400	21,350	11,550	1,350	12,900	34,250	100.00

Notes of the previous Table apply to this Table.

Source: Same as Table A-5

Rationally managed closed forests cover only 37.9 million ha, or 4.4% of the gross area of the closed broadleaved forests, of which the major part, or 95.5%, is in tropical Asia and 4.5% is in Africa.

Shifting our attention regarding the situation of forests from area to growing stock, the total of productive closed broadleaved forest stock is 146.9 billion m^3, as shown in Table A-7. Taking this figure as 100.0%, tropical America, Africa and tropical Asia account for 52.7%, 26.4% and 20.9%, respectively.

The average volume of stock per ha of undisturbed productive closed broadleaved forests is 155 m^3 in tropical America, 255 m^3 in Africa and 215 m^3 in tropical Asia.

4. Forecast of Tropical Forest Resources

According to the Discussion Paper of the Second Expert Meeting on Tropical Forests held in Rome in January 1982, the forecast for deforestation (i.e., natural forest cutting for agricultural and other uses including shifting cultivation) is as shown in Table A-8.

This Table shows, for example, that an area of about 1.2 billion ha of closed forests will be exploited, and will decrease at an average annual rate of about 7.47 million ha.

This makes it clear that the area of the world's tropical forests will be reduced in the future.

In the Philippines, for instance, the area of closed forests is 15.9 million ha, or 53% of the total land area. Of this area, about 69%, or 11 million ha, may be considered to be operable closed forests; i.e., whose exploitation is or will be possible.

Now, the question arises as to how much potential for exploitation these forests have.

Since there are no reliable data on this subject available, a projection of available growing stock can be made by subtracting the quantity of actual cutting from the quantity of stock, which is estimated from the area of operable forests, on the assumption that they have not been exploited at all. The average volume of stock of valuable big trees in the whole of the Philippines is estimated at about 50 m^3 per ha, in virgin forest (although 80-100 m^3 in Mindanao Island). Accordingly, it is estimated that there were about 500 million m^3 stock in total in the whole of the country in former times. The remaining stock at moment is estimated at about 100 million m^3 by subtracting the approximately 400 million m^3 of actual cutting volume logged over during several decades.

Table A-7 Gross Volume of Growing Stock of Closed and Productive Forests

(million m^3)

	Non-conifer				Conifer		
	Productive closed forest	Unproductive closed forest	Total	Productive open forest	Productive forest	Unproductive forest	Total
Tropical America	77,450	12,200	89,650	7,750	1,200	650	1,850
Tropical Africa	38,750	6,150	44,900	4,700	50	50	100
Tropical Asia	30,650	13,100	43,750	400	850	250	1,100
Total	146,850	31,450	178,300	12,850	2,100	950	3,050

Note : The gross bole under bark trees of more than 10 cm in diameter.

Source: Same as Table A-5

Table A-8 Average Annual Deforestation during 1981 - 85

(1,000 ha)

	Closed forest					Open forest		Total	
	Productive			Total					
	Undisturbed	exploited and managed	Unproductive	Area	Rate of decrease (%)	Area	Rate of decrease (%)	Area	Rate of decrease (%)
Tropical America	1,299 (79)	1,867 (142)	1,173 (88)	4,339 (309)	0.64	1,272	0.59	5,611	0.63
Tropical Africa	226 (1)	1,032 (4)	73 (2)	1,331 (7)	0.61	2,345	0.48	3,676	0.52
Tropical Asia	395 (7)	1,278 (17)	153 (6)	1,826 (30)	0.60	190	0.61	2,016	0.60
Total	1,920 (87)	4,177 (163)	1,399 (96)	7,469 (346)	0.62	3,807	0.52	11,303	0.58

Notes : 1) Figures in parentheses indicate the decrease in coniferous forests only.
2) The rate of decrease is the average annual rate of decrease on the basis of forest area in each region.

Source: Same as Table A-5

It follows that forest resources will remain for about ten years, if exploitation will proceed at a rate of 10 million m^3 per year. This is, however, no more than a paper estimate. There is a rather pessimistic view prevalent that judging from the actual conditions, it is more realistic to assume that resources will be exhausted in five to ten years.

In Sabah State, the gross area of the closed forests is about 6 million ha, of which about 83%, or 5 million ha, comprise operable forests. If the above method of projection is applied to Sabah, it is projected that the remaining stock is 50-100 million m^3 and will be exhausted within ten years if cutting continues at a rate of 10 million m^3 per year.

In Sarawak State, there are closed forests with an area of 9.4 million ha, of which about 74%, or 7 million ha, comprise operable forests. The application of the above method of projection shows that the stock remaining is about 200-300 million m^3, and will last for 40-60 years despite cutting at an annual rate of 5 million m^3.

Concerning this state, however, it should be noted that the figure of 7 million ha of operable closed forests seems to be too high for Sarawak, despite the variation in figures given by different sources. Those areas which have been exploited so far are mainly swamp land, where almost all of the forests are said to have been cut, and the growing stock remains in the hilly areas, inland from these areas. The terrain of these areas is, however, probably too inaccessible to permit cutting, and strictly speaking, the actual area of operable forests may not be as large as the figure given above. Assuming that the figure of 7 million ha in area of operable forests is correct, the exploitation of hilly areas, which may be gradually carried out, will necessarily result in a steep rise in production cost.

Finally, although Indonesia apparently has at present the largest area of natural tropical broadleaved forests in Southeast Asia, in fact the actual conditions are not precisely known.

The area under closed forests in this country is about 85 million ha, of which about half, or 42 million ha, is assumed to be operable. The above-mentioned projection on which this figure is based shows that the remaining stock is 1-1.5 billion m^3 and will last for more than 50 years if cutting continues at the present rate of 20-30 million m^3.

The operable forests described above include forests deep in the interior regions of Sumatra and Kalimantan, and therefore, the exploitation of the forest resources will involve an enormous increase in production cost, even if the estimate of the remaining stock is reasonable.

Thus, the present situation of tropical timber resources in Southeast Asia, which has been so far considered, has led to the above outlook on the resources available.

If the present conditions of regeneration and the present rate of cutting remain unchanged, the time will possibly come when forest resources are exhausted in each country or state, despite such a difference of reserves as 5-10 years for the Philippines to dozens of years for Indonesia. Another certain factor is that the exploitation of forest resources existing deep in the interior regions of these countries will sharply raise production costs.

5. Harvesting Volume

The harvesting volume of wood per ha varies according to tree species, site class, maintenance work, cutting age and forest management system (e.g., selective cutting and natural regeneration, clear cutting, and artificial regeneration, etc.).

The harvesting volume of tropical wood will be considered here based on FAO reports on selective cut natural forests and clear cut artificial forests.

5.1 Harvesting Volume of Natural Forests

It may be considered that most of tropical timbers are now or will be in coming twenty years harvested from natural forests by the selective cutting system. In other words, the harvesting of tropical timber strongly depends on the present resources of closed tropical broadleaved forests, especially undisturbed productive forests (i.e., those which can be expected to produce harvest in view of their natural and economic conditions).

In tropical forests, however, not all of growing stock which physically exists will yield a harvest, with only a limited volume being commercially exploitable. Table A-9 shows the situation by region and country.

A large volume of stock of undisturbed closed productive broadleaved forests is available, both physically and commercially, especially in Southeast Asia and Oceania compared with other parts of tropical area. Moreover, in Southeast Asia and Oceania, the ratio between the commercial availability and the physical availability is higher, amounting to 18% on the average in these regions. This can be largely attributed to the presence of exploitable tree species such as Dipterocarpaceae and teak. In these regions, the islands of the Philippines, Malaysia and Indonesia have the highest growing stock of virgin forests.

Table A-9 Growing Stock in Closed Undisturbed Productive Tropical Broadleaved Forest

Region/Country	Average stock A (m^3/ha)	Average volume exploitable B (m^3/ha)	B/A (%)
Southeast Asia & Tropical Oceania			
Indonesia	265	27	10
Malaysia	291	69	24
Philippines	305	90	30
Kampuchea	230	20	9
Lao	220	12	5
Viet Nam	220	30	14
Burma	180	15	8
Thailand	80	25	31
Papua New Guinea	130	30	23
Africa			
Guinea	180	7	4
Ivory Coast	270	25	9
Liberia	170	8	5
Nigeria	205	35	17
Togo	200	10	5
Cameroon	280	6	2
Central African Rep.	320	15	5
Congo	345	8	2
Equatorial Guinea	220	25	11
Gabon	250	10	4
Zaire	250	15	6
Madagascar	147	24	16
Kenya	180	27	15
Uganda	180	27	15
Latin America			
Costa Rica	175	25	14
Guatemala	140	10	7
Honduras	140	10	7
Nicaragua	135	10	7
Panama	180	30	17
Guyana	210	20	10
French Guyana	290	7	2
Surinam	210	15	7
Bolivia	129	12	9
Brazil	156	5	3
Colombia	129	19	15
Ecuador	124	15	12
Paraguay	80	10	13
Peru	195	12	6
Venezuela	154	11	7

Source: FAO, Tropical Forest Resources Assessment Project, 1981

Even such highly exploitable virgin forests as in the Philippines and Malaysia normally yield a harvest of no more than 60-70 m^3 per ha, or 6-10 trees.

In Indonesia and Papua New Guinea, the normal yield is less than 50 m^3 per ha, i.e., less than 5 tress per ha.

The annual allowable cut of these undisturbed closed productive broadleaved forests is no more than 2.2 m^3/ha for Dipterocalpus forests in Malaysia. A first harvest of selective cut is about 70 m^3/ha in the State of Sabah in Malaysia, and the remaining exploitable stock of 20 m^3/ha expected to show an increment of 2 m^3/ha/year and to be harvested again in a 60-year cutting cycle.

The harvesting volume shown above represents the production of logs for sawn timber and plywood. In the case of logging for wood chips bears a harvest of more than 60 m^3/ha. In the latter case, the clear cutting and artificial regeneration system is often adopted. There are, however, not many cases of the production of wood chips from tropical forests.

Natural forests in the African tropical rain forest zone are on a par with those in Southeast Asia in terms of gross growing stock (per ha), especially the areas with much rain in central and western Africa, which are rich in forests of large-diameter trees.

The exploitable or commercial stock per ha of undisturbed closed productive broadleaved forests in Africa is, however, much less than that in Southeast Asia, and its proportion of the gross stock is an average of less than 10%. This is because there are a limited number of tree species which are profitable. Among the hundreds of tree species which make up the African tropical rain forests, the exploitable trees are composed of two species, i.e., okoume and ozigo in Gabon. Moreover, it is limited to five species in Togo, while 85% of the harvest comes from seven species in Nigeria, 80% from nine species in Cameroon, and 94% comes from three species in the Central African Republic. Other species which cannot be used are called "lesser known species" in the world market. The geographical situation of the landlocked forests in Africa compared with those of Southeast Asia reduces the proportion of expoitable stock.

Closed forests in Africa are lower than those in Southeast Asia in terms of the mean annual increment and annual allowable cut, which has its effect on the harvest. That is, the mean annual increment in Africa is 1-2 m^3/ha, but the exploitable stock is less than 1 m^3/ha and the rotation is considered to be more than 80 years. The annual allowable cut is 0.4 m^3/ha both in Uganda and Kenya, and 1.8 m^3/ha in Ghana.

Thus, in general it is rare for harvesting volume per ha in the selective cutting system to exceed 35 m^3 in the African tropical rain forests.

Finally, undisturbed closed productive broadleaved forests in Latin America, as shown in Table A-9, are poor both in terms of gross stock per ha and exploitable stock compared with those in Southeast Asia and Africa. This is because there are generally fewer big trees and commercial tree species such as Dipterocarpaceae, teak, okoume, acajou, sipo, sapelli and the like in Latin America compared with Southeast Asia and Africa.

For example, 90% of the harvest is produced from only ten species in Panama; while three species account for 50% and 76% in Trinidad and Tobago, and Paraguay, respectively; eight species cover 70% in Peru; and ten species cover more than 95% in Bolivia.

Among these commercial tree species, it is worthy of note that cativo (Prioria copaifera) in Panama accounts for 51% of the harvest, green hart (Ocotea rodiaei) in Guyana 62%, and mahogany (Swietenia macrophylla) in Bolivia 45-55% (between 1970 and 1976).

The harvest of natural Pinus spp. in Mexico, Honduras and Guatemala characterizes the harvest of natural forests in Latin America. Exploitable stock of undisturbed natural pine forests, which reaches 35-40 m^3/ha, is higher in proportion to gross stock than that of natural broadleaved forests.

The mean annual increment of undisturbed mixed broadleaved forests in Latin America, which is at most 0.1-0.5 m^3/ha, is considerably lower than that not only in Southeast Asia but also in Africa.

5.2 Harvesting Volume of Man-made Forests

As described in the preceding item, tropical wood is at present mainly harvested from natural forests. On the other hand, the harvesting of existing man-made forests of teak and pine in Southeast Asia, and new man-made forests of fast-growing species which have been developed worldwide in the tropical zones, can be expected to some extent.

The harvesting volume of man-made forests depends on tree species, cutting age, thinning system, maintenance work and growing environment (e.g., amount and distribution of precipitation, and soil conditions).

Fast-growing species, for example, bear more harvest per period than non-fast-growing species, and the appropriate cutting

age for maximum yield and proper thinning and maintenance systems lead to an increase in the total harvesting volume. Much precipitation throughout the year (more than 1,500 mm) and regular precipitation throughout the year (with no long dry season) generally facilitate the growth of man-made forests.

Some kind of soil types enhances the harvesting volume of man-made forests, for example Nitosols and Cambisols, which are less eluviated and argillated; soils containing volcanic ash; and those which are rich in organic materials such as humus shortly after cutting. On the other hand, soils such as Acrisols, which is eluviated and aged, or soils which are left in the state of grassland for a long time, being poor in humus, cannot be expected to produce a large harvest.

Examples of the harvesting volume of man-made forests by region are listed in Table A-10.

As shown in this Table, from such fast-growing species as Acasia, Eucalyptus, Gmelina arborea and Albizzia falcataria, a 200-300 m^3/ha harvest and a 15-20 m^3/ha mean annual increment can be normally expected at a cutting age of 10-15 years. The harvest of Pinus spp., which is slightly less than that of the broadleaved tree species mentioned above, is no more than 150-250 m^3/ha over fifteen years. Non-fast-growing species such as teak, okoume, limba and acajou normally bear a 200-300 m^3/ha harvest at a cutting age of 40-80 years. The mean annual increment of these species rarely exceeds 10 m^3/ha. In the case of species with a long cutting age such as Dalbergia sisso, sipo and sapelli, the harvesting volume is 200 m^3/ha and the mean annual increment is about 2-7 m^3/ha at the cutting age of 50-100 years.

The differences in the yields of man-made forests are not macroscopic differences between the regions —— Southeast Asia, Africa and Latin America —— but are determined by the variations in the growing conditions mentioned above.

IV. Production Cost

The production cost in forestry involves mainly the timber extraction cost, reforestation cost and wood processing cost. These costs are described below.

Table A-10 Harvesting in Tropical Man-made Forest [1)]

Location Region/Country	Tree species	Rotation years	Harvesting volume (m^3/ha)	Mean annual increment (m^3/year/ha)	Average DBH at final cutting age (cm)	Number of trees at final cutting age (trees/ha)	Remarks
Southeast Asia & Tropical Oceania							
Sabah/Indonesia	Acacia auriculiformis	10-12		16.8			fast growing species
Philippines	Albizzia falcataria	8-10		25-30			"
Indonesia	Anthocephalus cadamba	4-11		10-20			"
Burma	Eucalyptus camaldulensis	10-12		6-10			"
Philippines/ Papua New Guinea	Eucalyprus deglupta	10-16		18-40			"
India/Burma	Eucalyptus grandis	10		18-35			"
India	Eucalyptus tereticornis	15		3-5			"
Bangladesh	Tectona grandis	60	140-265	2.3-4.4			
India	Dalbergia sisso	50		3.6-7.0*			* at age of 25
Philippines	Pinus caribaea	15		10			
Papua New Guinea	Araucaria cunninghamii	40		20**			** at age of 20
Africa							
Lowland humid zone in West & Central African countries (over 1,500 mm/year rainfall)	Eucalyptus deglupta, grandis, urophylla, cloeziana	7-10	175-200	20-25	30		fast growing species
	Gmelina arborea	10-15	100-200	7-20			"
		30-40	200-300	5-10			suitable for high rainfall
	Terminalia ivorensis (framire)	30-35	215-230	6.1-7.7	60	65-70	"
	Terminalia superba (limbo, frake)	30-40	225-250	5.6-8.3	60	70-80	"
	Khaya ivorensis (acajou)	45-60	210	3.5-4.7	45-60	70	
	Aucoumea klaineana (okoume)	50	300	6	60-75	100	
	Tarrietia utilis (niangon)	60	240	4	60	70	
	Tectona grandis (tiek)	60-80	250-300	4.1-3.7	60-70	85-100	suitable for climate having clear dry season
	Entandrophragma spp. (sipo, sapelli, tiana)	85-100	210	2.1-2.5	60	50	
	Triplochiton scleroxylon (samba)	40-45	225-240	5-6	60	70-75	suitable for rather dry climate
	Pinus caribaea	8-12	240	20-25			
Semi-humid tropical zone in African countries (1,000-1,500 mm/year rainfall)	Eucalyptus camaldulensis, citriodora, pilularis	5-6	150-200 (trees/ha)	12-20			fast growing species for fuelwood
	Cassia siamea	7-8	80-100(")				"
	Casuarina spp.	8-15		15-20 (trees/year/ha)			"
Latin America							
Venezuela		10	200	20			
Peru	Eucalyptus spp.	20		10	19-25		
Colombia		10-15	200	25			
Ecuador	Eucalyptus globulus	20	452	26			
Venezuela	Pinus caribaea	15	150	10			
Ecuador	Corbia alliobora	30	620	24			
Colombia	Tectona grandis	over 30	318				
Brazil [2)]	Eucalyptus grandis, saligna	7	200-300	30-40	16-20	1,300	for pulp wood in Rio Doce/MG

1. Timber Extraction Cost

The timber extraction cost here refers to the total of the direct costs of felling, yarding, bucking, timber transportation and stacking, depreciation of equipment and overhead charges, but excluding stumpage, taxes and the cost of constructing access roads.

This cost varies markedly according to forest type, terrain, felling system, scale of operation, accessibility and unit wage. The following are examples of the costs of current commercial logging operations in tropical areas.

The commercial logging costs of natural Dipterocarpus forests in Southeast Asia cover a range from approximately US$30 to $60 per m^3. In the case of natural forests in Papua New Guinea, for example, the costs, which are US$37 per m^3, are composed of — labor costs: $3.7; depreciation: $6.7; fuel and consumable material cost: $9.1; maintenance costs of roads $7.5; repairs to machines: $2.1; and overhead costs: $7.9.

The logging costs in man-made forests with fast-growing species for pulpwood must be restricted to less than $25 per m^3 because of the low selling price of pulpwood. In the case of man-made forests with fast-growing species in Kalimantan in Indonesia, the logging costs are set at US$23.5 per m^3, comprising felling: $1.5; yarding: $7.5; timber transportation (including road repairs): $8.5; stacking: $1.5; and overhead costs: $5.0.

On the other hand, the logging costs of natural coniferous forests in North America, which are no more than $10 per m^3, are cheap compared with those of natural tropical forests. Therefore, the stumpage price of tropical wood is invariably lower than the North American stumpage price.

Since a comparison of logging costs among different regions is difficult because they are each subject to particular forest conditions and unit wage rates as previously stated, the yarding efficiency in tropical natural forests is shown in Table A-11 as an example.

2. Reforestation Cost

The reforestation cost is classified into two kinds, i.e., artificial reforestation cost and natural regeneration cost. The former is described here because natural regeneration is still at the extensive stage.

Table A-11 Examples of Efficiency in Yarding by Tractor

	Size and type of tractor	Average yarding distance (m)	D.B.H. of logged tree (cm)	Actual working time (h/day)	Average yarding volume (m^3/day)
Malaysia	20 t crawler	200- 400	70-80	4	90
"	7 t wheel	1,000-1,200	70-80	4	40
Philippines	30 t crawler	200- 400	80-90	6	150
"	"	1,000-1,200	80-90	6	80
Indonesia	20 t crawler	400- 600	80-90	6	40
Papua New Guinea	14 t crawler	1,100-1,300	60-70	6	32
"	8 t wheel	1,100-1,300	60-70	6	80

Source: JICA, Report of the Survey for Implementation Planning of the Technical Cooperation Project for the Forestry Development in the ARAKAN Range in BURMA, 1978

This cost also varies according to geographical conditions, tree species, planting system and unit wage. Examples of procedures and costs of artificial reforestation are given here mainly for the fast-growing species in tropical rain forest areas.

Generally speaking, the reforestation costs of fast-growing species in Southeast Asia and tropical Oceania range from US$500 to US$1,200 per ha. Such costs include the seedling cost, land preparation cost, planting cost, weeding cost, vine cutting and improvement cutting cost, protection cost, the cost of facilities such as feeder roads and reforestation camps, and overhead cost for management.

Major factors which have an impact on reforestation costs are the tree spacing, the weeding method (number of times), unit wage, and the proportion of the cost of facilities and management cost to the scale of operation.

Some examples are shown in Table A-12, although the variation in these factors shown among the various regions makes the comparison of reforestation costs as difficult as that of logging costs.

Table A-12 Examples of Reforestation Costs and Efficiency

Location	Indonesia - Kalimantan	Malaysia - Sabah	Philippines - Mindanao	Papua New Guinea - New Ireland	Papua New Guinea - Madang	Solomon Is.
Tree species	E. deglupata, A. falcata, Gmelina, Acacia, etc.	E. deglupta, A. falcata, etc.	E. deglupta, A. falcata, Acacia, etc.		E. deglupta, Acacia	Campnosperma
Spacing	1,100 trees/ha	1,100 trees/ha	1,100 trees/ha	1,000 trees/ha	625 trees/ha	850 trees/ha (line planting)
Labor wage	US$2/man day	US$5.6/man day	US$4.6/man day	US$5.2/man day	US$5.6/man day	US$6.0/man day
Seedling	US$110/ha (US$0.1/tree)	US$165/ha (US$0.15/tree)	US$ 66/ha (US$0.06/tree)	US$130/ha (US$0.13/tree)	US$ 50/ha (US$10.08/tree)	US$ 85/ha (US$1/tree)
Land preparation	US$ 73 (38 man day/ha)	US$140 (25 man day/ha)	US$ 92 (10 man day/ha)	US$235 (45 man day/ha)	US$235 (42 man day/ha)	US$120 (20 man day/ha)
Planting	US$ 32 (17 ")	US$ 62 (11 ")	US$ 64 (14 ")	US$157 (30 ")	US$ 90 (16 ")	US$ 54 (9 ")
Weeding	US$105 (55 ")	US$135 (24 ")	US$290 (63 ")	US$157 (30 ")	US$213 (38 ")	US$330 (55 ")
Vine cutting and improvement cutting	US$ 27 (14 ")			US$ 52 (10 ")	US$ 50 (9 ")	
Protection				US$ 10 (2 ")		
Fertilizing	US$ 33 (4 ") (US$26/ha)	14				
Road, camp and other facilities	60	38		384	69	
Overhead cost	100	315	146	75	165	
Total	US$540/ha	US$868/ha	US$658/ha	US$1,200/ha	US$872/ha	US$589/ha

Source: JOFCA, Report of Study on Overseas Forestry Development Project, 1975-1981
JICA, Report of Development Plan of Reforestation Project in MADANG, PNG, 1977
JICA, Report of Forestry Development Project in NEW IRELAND, PNG, 1980
JICA, Report of Development Plan of Reforestation Project in SOLOMON Is., 1981

3. Wood Processing Cost

Of the various wood processing costs, three types of costs, i.e., saw milling costs, plywood production costs and wood chipping costs, are described below.

The saw milling cost of tropical wood largely depends on the size and quality of logs, type of commodity produced, scale of production, economic stage of development of the locality, recovery rate and unit wage. This makes an estimation of the standard saw milling cost difficult. However, the cost is US$25 to US$30 per 1 m^3 of sawn timber excluding the cost of logs in local sawmills with one or two band-saws and an annual sawn timber production of 7,000 to 10,000 m^3. The percentage of the saw milling cost in the total production cost including the cost of logs is usually about 30%. Estimates of saw milling costs are shown in Table A-13.

The plywood production costs, like the saw milling costs, are dependent on the conditions of the logs, the types of commodities produced and the scale of production. In a mill, for example, which produces plywood employing two rotary veneer lathes with a log consumption rate of 250 m^3/day, the cost of producing standard plywood of 4ft x 8ft x 4mm or 3ft x 6ft x 9mm (i.e., the production of 40-45 pieces per log of 1 m^3) is US$1.2 to US$2.0 per piece, excluding the cost of logs.

Generally speaking, in the log-producing countries in developing regions, the cost of logs is low, while the cost of adhesives, depreciation costs, overhead costs and repair costs are high. This situation is, however, reversed in the mills working with imported logs in the developed industrial countries. The proportion of the log cost in the total cost of plywood is 50% in the log-producing countries and 70% in the log-importing countries. Examples are given in Table A-14.

Since wood chips made of tropical wood are in many cases exported from the producing countries to consuming countries as raw materials for paper and pulp, the chipping cost in the producing countries is inevitably very low. Thus, the production cost of chips which are exported from Southeast Asia and tropical Oceania to Japan is US$10 to US$15 per m^3 excluding the cost of logs. Table A-15 shows an example of calculated chipping costs.

Table A-13 Examples of Saw-milling Costs of Tropical Hardwood

	Indonesia - Kalimantan	Papua New Guinea - New Ireland	Kenya
Scale of production	8,250 m^3/year	25,000 m^3/year	6,480 m^3/year
Number of workers	80 x 2 shifts		50
Recovery rate	55%		45%
Equipment and facility cost	Machines US$433,000 Buildings US$134,000 Total US$567,000		Machines US$ 299,000
Production costs			
Labor cost	US$ 8.95 /m^3	US$ 7.58 /m^3	US$ 1.78 /m^3
Power	US$ 4.17 /m^3	US$ 10.04 /m^3	US$ 2.37 /m^3
Repairs		US$ 1.44 /m^3	US$ 2.37 /m^3
Overhead costs	US$ 4.66 /m^3	US$ 1.52 /m^3	US$ 5.16 /m^3
Depreciation cost	US$ 7.30 /m^3	US$ 7.17 /m^3	US$13.80 /$m^3$
Total	US$25.08 /$m^3$	US$ 27.75 /m^3	US$25.48 /$m^3$
Cost of logs	US$48.00 /$m^3$	US$104.00 /$m^3$	US$22.00 /$m^3$
Total cost	US$73.08 /$m^3$	US$131.75 /$m^3$	US$48.48 /$m^3$

Source: JICA, Report of Study on Utilization of Lesser Known Species in Central KALIMANTAN, INDONESIA, 1980

JICA, Report of Forestry Development Project in NEW IRELAND, PNG, 1980

JICA, Report of Study on Modernization of Wood Processing

Table A-14 Examples of Plywood Milling Costs of Tropical Hardwood

	Indonesia - Kalimantan	Japan (plymill with imported logs)
Type of commodity	4 ft x 8 ft x 4 mm	3 ft x 6 ft x 9 mm
Scale of production	10,000 pieces/day Material log consumption 250 m^3/day	
Number of workers	170 x 2 shifts	
Recovery rate	65 ∿ 70%; 40 pieces / m^3	44 pieces / m^3
Cost of facilities	Machine US$1,047,000	
Production costs		
Labor cost	US$0.48 /piece	US$0.48 /piece
Cost of adhesives	US$0.49 /piece	US$0.35 /piece
Depreciation cost/ overhead cost	US$0.96 /piece	US$0.38 /piece
Total	US$1.93 /piece	US$1.21 /piece
Cost of Logs	US$2.88 /piece	US$3.75 /piece
Total cost	US$4.81 /piece	US$4.96 /piece

Source: JICA, Report of Study on Utilization of Lesser Known Species in Central KALIMANTAN, INDONESIA, 1980

Table A-15 Examples of Chipping Costs of Tropical Wood

	Indonesia	Solomon Is.	Malaysia
Scale of production	300,000 m3/year		
Cost of facilities	US$11,400		
Production costs			
Labor cost	US$0.27 /$m^3$	US$0.42 /$m^3$	
Power	US$1.19 /$m^3$	US$2.49 /$m^3$	
Repairs	US$1.91 /$m^3$	US$0.94 /$m^3$	
Depreciation	US$3.80 /$m^3$	US$2.53 /$m^3$	
Overhead cost	US$2.76 /$m^3$	US$2.53 /$m^3$	
Loading cost	US$0.05 /$m^3$	-	
Total	US$9.98 /$m^3$	US$8.91 /$m^3$	US$13.00 /$m^3$

Source: JOFCA, Report of Study on Overseas Forestry Development, 1980, 1981

V. Production Policies and Systems

This subsection describes the forest production plans, forest development policies and wood industry policies of the major producing countries of tropical hardwood in Southeast Asia and Africa (mainly west Africa), but excluding tropical America (where the main producing country is Brazil.)

1. Production Plans

The following is a discussion on the present situation of the production plans of the Philippines, Malaysia and Indonesia, which are the major timber producing countries in Southeast Asia, beginning with the Philippines.

The gross area of forests in the Philippines is about 13 million ha, of which national forests comprise 88%, or 11.5 million ha, and private forests 12%, or 1.5 million ha.

In this country, the Bureau of Forest Development, which is under the control of the Ministry of Natural Resources, administers forestry.

In the Philippines there are no concrete nationwide plans for forest products. Instead, there is merely a kind of guideline given for production aimed at sustaining the yield of forest resources. There are, however, various very positive reforestation plans that are part of the production plan.

The Philippine Government has a plan to realize a gross area 1.36 million ha of man-made forests on national lands under the Reforestation Plan, which aims at achieving a gross forested area of 1.42 million ha between 1976 and the year 2000.

Artificial reforestation is being promoted by both the Government and the private sector, with the former aiming mainly at the conservation of national land rather than wood production. As an example of reforestation by the Government, there is the PR-Japan Technical Cooperation Project for the Afforestation of Pantabangan Area. This is a project to promote a reforestation program for about 50,000 ha of grass land in the basin of the Pantabangan River, which is one of the most important rivers in the Philippines, through cooperation between the Japanese Government (JICA) and the Philippine Government.

As examples of reforestation by the private sector, there is the reforestation being carried out by forest concessionaire companies and reforestation under such schemes as private reforestation on private lands and agro-forestry farms. Agro-forestry farms are a

system under which the Government and forest concessionaire companies have farmers cultivate crops for self-consumption, cash crops and valuable species of trees in public forests and on private land, and entrust them with the management of such crops. When the valuable species of trees have reached the cutting age they are purchased by the Government or concessionaire companies.

Next, with regard to Malaysia, the region of West Malaysia and the States of Sabah and Sarawak, all of which are a part of Malaysia, have an independent economic status. For this reason, the description of each of these regions has been separately made.

The gross area of forests in West Malaysia is about 8.1 million ha, most of which is occupied by national forests (federal and state forests).

Forestry in West Malaysia is administered by the Federal Forestry Headquarters which is under the control of the Ministry of Primary Industries.

The production plans of the Federal Forestry Headquarters aim to:

a. Determine as soon as possible which forests are to be diverted to farm land and mining areas,

b. In this connection, to promote the timber production before forests are cleared and burnt, and at the same time, to encourage the wood processing industry to fully use such timber in the short term,

c. In the long term, to set lowland forest reserves, and

d. To carry out the forest production in consideration of the tree species for which the country will have future demand, in the areas which are geographically unsuitable for agriculture.

A Land Utilization Plan and Forest Management Plan have been worked out and put into practice on the basis of these fundamental policies.

Although there is no special long-term plan for reforestation, the Malayan Uniform System for natural forest management has been implemented, whereby the regeneration of forests with a gross area of 370,000 acres was achieved from 1962 to 1971. At the same time, the restoration of 17,400 acres of land was carried out by enrichment planting, and a further 9,100 acres of land by means of the artificial regeneration.1)

1) Isamu Nomura, Southeast Asian Forestry through a Forester's Eyes, Japan Wood News, 1970, pp. 109-113 (in Japanese)

The gross area of forests in Sarawak State is about 9.43 million ha, most of which comprises national forests.

From the point of view of forest management, forests are classified into permanent forests, which are permanently treated as forests, and alienable forests. The former are subdivided into forest reserves; productive forests; protected forests and communal forests.

Forestry in Sarawak is administered by the Forest Department which is under the control of the Ministry of Land and Forestry. Its policies are as follows:

a. The sustainable management of forests for the benefit of the public.

b. The administration of permanent forests in order to provide the utmost benefits according to the purpose above.

c. The complete utilization of forest products in alienable land other than permanent forests.

d. The encouragement of the export of forest products in harmony with the demand within the state.

The production plan has generally been made based on these policies, but overall it is lagging behind that of West Malaysia, and the forest plan for the whole of the state has not been completely established, either. Reforestation has as yet made no progress, and swamp forest regeneration, mainly under the Malayan Uniform System, is still at the planning stage.

Next, the area of forests in Sabah State is about 6 million ha, most of which is state forest.

These forests are classified into forest reserves and other forests for the sake of administration, and the former are subdivided into five categories: protection forests, which require protection for natural environmental reasons; commercial forests, which are designed to supply wood and other forest products for export; domestic forests, which are designed to supply wood and other forest products to meet local demand; amenity forests, which are for amenity and arboretum work in the local districts; and mangrove forests, which are used to meet both the domestic and export demand.

Forestry in the state is administered by the Forest Service, which is under the control of the State Ministry of Natural Resources.

The purpose of forest administration here is to manage and

operate forests to earn the most income for the permanent benefit of the present and future population, in accordance with sustained-yield principle, on which the production plan is based. It is not known, however, whether the working plan has been fully established or not.

Forest regeneration is performed largely by means of natural regeneration, which is mainly carried out under the Malayan Uniform System. Some trial artificial regeneration is also performed with fast-growing species.

From the situation in Malaysia given above, we shall now move on to Indonesia.

The gross area of forests in Indonesia is about 124 million ha, all of which is owned by the Government.

In this country, forests are classified by use [1] into four kinds of forests: production forests, which are for the production of wood and other forest products and occupy an area of 47.24 million ha, or 39% of the gross forest area; protection forests, which account for 20%, or 24.54 million ha; nature reserves, which account for 3% or 3.75 million ha; and reserved forests, which are not classified yet occupy 38%, or 45.96 million ha.

The forestry in this country is administered by the Directorate General of Forestry under the control of the Department of Forestry.

There are two main types of plans, i.e., the overall management plans and operation plans, and each forest management unit has further working plans or schemes ranging over a period of 1, 5, 10 or 20 years under the system of central planning of the Directorate General of Forestry. The production plan is worked out and managed under this system.[2]

In this connection, there is an organization known as Perum Perhutani (National Forest Corporation) in Indonesia. This performs the management of teak and other forests in Java under the control of the Forestry Department.

Before the war, the reforestation was carried out mainly with teak and pine in Java Is.

Since the war, reforestation has been performed in Java and outer Java under the control and guidance of the Directorate General of Forestry.

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1) Takeo Shinohara, Forestry in Southeast Asia and Oceania, Chikyusha Co., 1981, pp. 211-212 (in Japanese)
2) Directorate General of Forestry, Forestry National Plan 1975-2000, 1975, p. 6

The area of artificial reforestation during the period 1950-1979 was about 3.06 million ha, which is largest in the Southeast Asian region.

An outline of the general situation of the production plans in the major wood producing countries in Southeast Asia has been given above, and the following discussion is about West Africa, especially Nigeria, Ghana, Gabon, the Ivory Coast and Cameroon.

The area of forests in Nigeria is said to be 31 million ha, of which the so-called forest reserves, which are permanently utilized as forests, occupy 30% or 9.35 million ha.[1)]

The designation of forest reserves in this country has been continuing since 1898 when this system was established, and the proportion of these reserves to the total area of the country (192 million ha) increased from 0.01% in 1900 to 10% in 1970. It is planned to further increase this to 25% in the future.

A large part, i.e., 85% of the entire country, is occupied by savanna land, and the remainder by tropical rain forests which produce industrial wood, and also by a small proportion of mangrove forests.

The forests in Nigeria, almost all of which are national forests, are administered and managed independently by the State Department of Forestry of each of the twelve states, with independent aims and methods of implementing policies. The Federal Department of Forestry, which is in Ibadan, formulates the general policies regarding forestry for the whole nation as a rule, but in practice, each state is entrusted with actual policies according to the provisions of the constitution.

At present, the policies which the Federal Department of Forestry is actually carrying out are to bear the cost of reforestation for pulpwood and to provide subsidies for reforestation for the purpose of windbreaking in the northern states.

The production plan in this country is designed to regulate the cutting of forests under the control of the Department of Forestry, in order to maintain the long-term sustainable yield plans. Towards this purpose, attempts are being made to achieve the enrichment of the forest management system through the surveying of natural forests, the establishment of working plans for natural forests, stock surveys, reforestation plans and inspection.

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1) Resources Investigation Institute, Science and Technology Agency, Basic Data on Forest Resources Development and Utilization in Tropical Rain Forests and Savanna Areas in West African Countries: Nigerian Forestry, 1976. (in Japanese)

The core of the production plans promoted by each of the states is reforestation, especially in savanna areas, as indicated in the Third National Development Plan, 1975-1980. This is based on the present situation that the majority of forests in this country comprise savanna.

The savanna areas at present contain few valuable species of trees, which has led this country to undertake artificial reforestation. However, for tropical rain forests, natural regeneration is generally adopted as the regeneration method.

The gross area of forests in Ghana is about 9.06 million ha, two-thirds of which is occupied by the northern savanna area, while the remaining one-thirds is the the western closed forest area.

The 28% of the total area of forest reserves that is for wood production, or 2.54 million ha, is included mainly in the closed forest area.

The forests in this country are national forests, and are administered and managed by the Forest Department under the Forestry Acts.

Recently, cutting has been carried on at too fast a pace for the growth rate of the forest resources to catch up with. Accordingly, this country attaches importance to the active promotion of reforestation in its production policies, and has proceeded with a plan to attain a rate of artificial reforestation of 19,310 ha per year since 1971.

The gross area of forests in Gabon is about 22.5 million ha, accounting for 85% of the area of this country, and commercial forests cover about 3 million ha.

The production plan in the three regions of the country, which is now being promoted by the Government, is described later, in Production Policies. Reforestation is generally slowing down in this country despite the efforts being made.

The gross area of forests in the Ivory Coast is 5.4 million ha, accounting for about 34% [1] of the area of this country.

This country is blessed with a relative abundance of forest resources, since the exploitation of forests in the western or southwest regions has started only recently.

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1) Japan External Trade Organization, Trends in Production and Distribution of Special Forest Resources, Ivory Coast, March, 1980. (in Japanese)

The forests in this country are all owned by the Government, and are administered and managed by the Department of Irrigation and Forestry.

It was not until 1966 that the Government undertook reforestation as a part of its policy "to protect, regenerate and utilize forest resources by rational means." This operation is actually entrusted to the Society for the Development of Forests (SODEFOR), which carried out the planting of about 25,100 ha in the decade from 1966 to 1976, with a further plan to implement the planting of 10,000 ha per year in the five years from 1976 to 1980.

Finally, the gross area of forests in Cameroon is about 24 million ha. The forestry policies established by Presidential Order No. 73 (Supplementary Forest Low) in May 1973 are considered to have established the forestry system of the country.

It may be said that these policies are based on a harmonious relationship between forest conservation and exploitation. Considerable efforts are now being put into the establishment of rational forest management plans, for which purpose the surveying of soils and the growing stock of forests are now under way. In the zones where the forests are superior in quality, an exploitation project is in progress, with survey and analysis being carried out with assistance from the United States and Canada besides conventional cooperation with FAO and UNDP.

2. Production Policies

In order to describe the production policies of the major tropical wood producing countries, these production policies are divided here into basic forest development policies and basic wood industry policies.

2.1 Forest Development Policies

Similarly to the preceding item, Production Plans, this item begins with an introduction to the policies of the main Southeast Asian countries.[1)]

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1) Source: Forest development policies of Southeast Asian countries are derived from Forestry Agency, Urgent Investigation Report on Trends in Foreign Wood Import, 1982 (in Japanese)
Particular parts quoted are not noted.

In the Philippines, post-war forest development, which was carried out mainly under ordinary timber licenses which were renewable every year, has substantially changed since Forestry Reform Cord was promulgated by President Marcos in 1966.

The aim of this Cord by President Marcos was "to thoroughly promote the enrichment of forestry policy, the encouragement of the wood industry in the Philippines, and the protection and preservation of forests against reckless and excessive exploitation of forest resources." For this purpose, he implemented a plan to enlarge the scale of forest licensing.

Under this policy, administrative guidance was given toward the integration of small- and medium-scale ordinary timber licenses into licenses with an allowable cutting volume of 25,000 m^3 and a minimum area of 20,000 ha as the unit, and the organization of a joint body for such integration within one year.

As a result, the number of ordinary licenses fell from 244 in 1968 to 41 in 1980, whereas the number of timber license agreements, which grant a 25-year license, rose sharply from 52 in 1968 to 191 in 1980.

In addition to such large-scale and intensive licensing policies, the standard annual cut was limited to 1.5% of stock to secure permanent wood production at a 40-year rotation cycle, and selective cutting of Dipterocarpaceae forests was ordered. Thus, the current development system in this country was established.

The 1967 policy restricting log exports was implemented as a part of this 1966 reform. Although an export ban was placed on logs from May 1, 1982, it is anticipated that several hundred thousand cubic meters of log exports at least will be allowed under a special provision.[1)]

In West Malaysia, the development of forests, especially forest reserves, is carried out by concessionaire companies working under permissions from the Department of Forestry. Concessions are assigned by agreement, negotiation, tender and allocation.

According to the 1971 Annual Forestry Report of West Malaysia, the exportation of logs in general was restricted in order to allow the domestic wood industry to develop with the maximum supply of domestic logs, without competition from foreign companies for logs.

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1) Yoshio Utsuki, "Export Restrictions of South Seas Wood Producing Countries and Guidelines to Countermeasures by Japan", Tropical Forestry, October, 1982 (in Japanese)

The development of forests in the State of Sarawak began in 1970, later than in the Philippines and the State of Sabah.

The system of licensing in Sarawak is classified into three categories, i.e., timber logging licenses, Belian licenses and mangrove licenses. The timber logging license is subdivided into two types: the annual license and the long-term license. The latter is further subdivided into the five-year-term license and ten-year-term license, and requires the establishment of management plans. On the other hand, the annual license requires the establishment of a felling plan, in which the clear cutting system is generally adopted. Under this plan all the wood is used, including trees small in diameter, and the clear cut land is used as farm land. The management plan, as provided under the Forest Law, must cover the felling of all big trees which are up to a certain diameter grade. This results in the production of wood of various species and diameter grades in this state.

The felling of forests is regulated according to the area. The forests in the state are mainly divided into two types, i.e., swamp forests and hill forests. In the case of the former, an area amounting to one-sixtieth of the area of licensed forests is allowed to be felled per year, while in case of the latter, an annual area amounting to one-seventieth is allowed. Thus, on the basis of the annual allowable cutting area which is determined first, the annual yield is determined.

In this connection, expectations regarding the export of logs from Sarawak are increasing as a result of the recent reinforcement of restrictions on log exports by Indonesia and the limited resources in the State of Sabah. Although log exports from Sarawak are not restricted except for "Ramin", the concessions in permanent forests involve such duties as the development of industry and the processing of 66% of the trees felled in the ninth year.

In the State of Sabah, concessions for forest exploitation are classified into three systems; i.e., long-term concessions —— in which the term of agreement is 21 years and one-hundredth of the permitted forest area is felled in one year, although restrictions on the felling of trees are placed on certain diameter grades, which differ according to the species; special licenses —— with a term of 1-10 years; and annual licenses —— with a term of one year, in which limited felling is permitted for forest clearing and other such purposes.

With regard to the allowable cutting area in the period 1970-1974, the special license was the most prevalent system, followed by the long-term concession system.

In recent years, the annual cut has remained constant at about 10 million m^3, but as a result of the decrease in resources from early 1975, log exports have begun to be restricted since 1977.

The target for log exports was set at 6 million m^3 for 1981, but actual exports were considerably more than that. Thus, the export quota system in the state seems not to be as strict as in Indonesia, details of which are given later.

As one of the features of forest development in this state, the Sabah Foundation, which was set up in 1966, should be mentioned here.

The Sabah Foundation was initially designed to promote activities related to education and culture in the state, but it has come to play an actively committed role in the administration and development of forests since the 1970s. About one half of the commercial forests are administered by the Foundation, and it handles about 15% of log exports from the state. Thus, it may be said that the Foundation has become a part of the tertiary sector, playing a major role in the various aspects of forest development and timber exports.

Lastly, in Indonesia, a change in the development of forests was triggered by a re-examination of the introduction of foreign capital in 1970. The Foreign Capital Law was revised so as to allow selective introduction of foreign capital, and to replace the undiscriminating preferential policy that had existed until that time. This review, which became more intense in 1974, led to clear restrictions on foreign capital and the encouragement of domestically-capitalized companies under the policy for localization.

On the basis of this alteration of policy, the development of forests is now positively performed through private concessionaire companies. Concessions are classified into four categories: a. less than 1,000 ha of producing area; b. less than 5,000 ha, in which operations are to be completed within five years; c. less than 10,000 ha, with the operations to be completed within twenty years; and d. large-scale concessions of 10,000 ha or more. The large-scale concessions are issued by the Directorate General of Forestry, while those of smaller scale are granted at the level of the regional office of the Directorate General of Forestry.

These concessions have been actively issued since the establishment of the Forest Law in 1967, and the number of concessionaires increased to 382 in 1978, 462 in 1979 and 503 in 1980. As a result of the issue of concessions to many private companies, timber production in this country has shown rapid growth.

Since it is conceivable, however, that oil resources in Indonesia will decline in the future, the policies of restricting log exports and the modernization of the wood industry have recently begun to be promoted in order to achieve the industrialization of resources other than oil.

Since May 1981, the export of logs has been permitted only for owners of plywood mills, in the ratio of domestic demand to exports of 4 to 1 for operating mills and 1 to 2 for mills under construction. However, these restrictions will be made more severe by imposing limits on the quantities exported from March 1982, with the total quantity of log exports from this country being reduced to 4.5 million m^3 in 1982, 3 million m^3 in 1983 and 1.5 million m^3 in 1984.

The forest development policies of the major Southeast Asian countries have been described above. Next, those of the major west African countries are discussed.

Nigeria designates forest reserves for the purposes of production of raw materials, environmental protection, the fostering of water sources, and the prevention of erosion. Such forests are sold to forest developers owning wood processing mills on concession.

In Ghana, the development of forests is also performed by means of concessions. Most of the productive timber land is available for concession. Statistically, productive timber land covers about three-fourths of the forest reserves, with an area of 6,941 square miles, of which about 85% is available for concession. Almost all of the productive unreserved forest land has already been assigned on concession. Trends in the policy for issued concessions are shown in Table A-16.

The figures for after 1970, which are not shown in this Table, have shown no major change.

The term of concession covers a very wide range from 3 to 99 years. Concessionaire companies have generally obtained concessions at a low price; however, the price is now an issue being dealt with.

In Gabon, the following three development districts, which were classified under the Forest Law of 1961, each have different policies for development.

a. First Development District

The coastal area of this country is designated as the First Development District. In this district, okoumé (Aucoumea

Table A-16 Number, Area and Average Scale of Concessions in Ghana, 1900 - 1970

	Number of consessions			Area (square miles)			Average concession (square miles/ concession)		
	Ghana-ian	Non-Ghanaian	Total	Ghana-ian	Non-Ghanaian	Total	Ghana-ian	Non-Ghanaian	Total
1900-60	10	19	29	1,152	6,531	7,683	115.2	343.7	264.9
1961-65	57	2	59	2,045	397	2,442	35.9	198.5	41.4
1966-70	43	0	43	698	0	698	16.2	0	16.2
Total	110	21	131	3,895	6,928	10,823	35.4	329.0	82.6

Source: John M. Page, Jr., Scott R. Pearson, and Mayne E. Leland, Capturing Economic Rent from Ghanaian Timber

klaineara) was once abundant, but has substantially decreased in stock. Since the district is blessed with water resources, logs can be easily transported as rafts. Hence this district is mainly alloted to family-managed forestry for the Gabonese inhabitants.

b. Second Development District

This district covers the Cristal mountainous area, Haut-Ogoue State, N'Gounie State and the lowland area of Nyauga State. Although there is a considerable stock of okoumé in the district, the difficulty lies in cutting and transporting logs. For this reason, large companies with immense facilities and capital such as Royier, Luterma and Lerey undertake the development, and further development by foreign companies is being hoped for in the future.

c. Third Development District

This district has many tree species other than okoume, and is not planned to be developed at present.

Timber exploitation in the Ivory Coast, which commenced at the beginning of this century, had made little progress until the independence in 1960, with a total output of wood of only 9,000-370,000 m^3. However, since then it has rapidly become active, and total output is now at a level of 4-5 million m^3.

Initially, the production of wood was limited to mahogany, but after the war this was extended to many species such as Entandrophargma cylindricum, E. utile, Jhieghemella heckelii (all redwoods) and Triplochiton sceroxylon (a white wood). It was estimated that there would be 49 commercial species by 1978, and the total merchantable volume of trees with a diameter of 60 cm or more would be about 166.4 million m^3.

The whole high forest zone of this country is divided into 5,000 districts, each of which has an area of 2,500 ha, and which comprise the units for licenses or concessions (usually from one to several districts constitutes a unit) for log dealers. In 1974, licenses or concessions for a total of 2,495 districts were granted.

The Document (No. 80/c/38) of the Ministerial Conference held by the African Timber Organization (ATO) in 1980, Forestry Practice in ATO Member States, makes the following observations concerning the Ivory Coast:

> "According to the forest authorities of this country, there are presently some 700 loggers registered but only about 500 are operational. The majority of Ivorians in the logging business operate as individuals as against the tendency among non-Ivorian loggers to group themselves into companies. The Ministry of Water Resources and Forests has tried without much success to group the individual Ivorian loggers into more rational units. The failure to unite the loggers has been blamed on the lack of affinity between the various individuals in the logging business. The existence of so many small logging units has unfavourable repercussions on the process of harvesting control and the collection of revenue from royalties.
>
> "Licences to log are granted for a period of 5 years to those who carry out logging only, for 10 years to those with a simple mill and for 15 years to those with an industrial complex for timber processing.
>
> "Applications for licences to log are processed by the Ministry of Water Resources and Forests in close collaboration with the local administration of the area the applicant is interested in."

With regard to Cameroon, the Document also states:

> "In 1976, about 7 million hectares of forest land were under exploitation within the national forest estate and in communal forests. The average annual production has been 1.4 million m^3 and this figure is expected to increase to 2.5

million m^3 by 1980. The increased production will be met by extending harvesting activities into less accessible areas and by increasing the average production per ha by exploiting more of the lesser known species.

"Most of the exploitation has been concentrated in the west of the country because it is more easily accessible."

According to Presidential Order No. 73 (Supplementary Forest Law) dated May 22, 1973 and the Ordinance (regulations for enforcement) dated April 17, 1974, the regulations on forest development in this country are:

a. All concessions for forests with an area of 10,000 ha or less shall be granted to Cameroon nationals or Cameroon-nationalized companies, but not to other persons or companies.

b. The concession of an area of 250,000 ha or more shall not be granted to one person.

c. Developers of forests with an area of 10,000 ha or more must process 60% or more of the logs felled within Cameroon.

Needless to say, these are based on the policy of Camerooniz-ation, but it is a very loose policy because concessions for forests with an area of 10,000 ha or more are granted to foreigners or foreign companies, and because the export of logs is allowed for forests with an area of 10,000 ha or less without limit, and for forests of 10,000 ha or more with a limit of 40%.

The area of forest concessions granted under the above conditions amounted to 9 million ha as of 1975.

2.2 Wood Industry Policy

Similarly to the items above, the wood industry policies of the major Southeast Asian countries will be described below.[1)]

The Philippines, which revised its Forest Law in 1974, adopted the optional log export system in 1976. Despite the announcement of an overall export ban on logs from May 1, 1982, a special exception was provided later, and it is expected that log exports of at least several hundred thousand m^3 will continue in the future.

1) Information on Southeast Asian countries is mainly based on the Forestry Agency's Urgent Investigation Report on Trends in Circumstances of Foreign Wood Import, 1982. (in Japanese)

At any rate, the development of the domestic wood industry was promoted along with the strict restrictions on log exports. The preferential measures enacted by the Investment Agency are summed up as follows:

a. Accelerated depreciation
b. Carry-over of net operation loss
c. Exemption, reduction and deferment of import tax on imported capital goods
d. Reduction or deferment of taxes
e. Permission for the employment of foreign engineers etc., for a period of five years.
f. Deduction of cost of personnel training
g. Preferential treatment concerning loans from the Government Financial Agencies.
h. Protection from tariffs after start of operations

In spite of these preferential measures, however, wood production has not developed smoothly. The number of mills in the sawmilling industry, for example, has been on the decline since 1976, and this industry is said to have shown no steady rise in daily output per mill. In connection with timber licenses, the mills with no license have markedly decreased in number accompanying the general decrease. It is said, furthermore, that a large proportion of these mills are lying idle.

Plywood and veneer mills, too, have not shown any increase in their number or output.

Judging from these facts, it can be considered that the wood industry in this country is in a stagnant condition, despite the positive encouragement policies, owing to energy problems and the worldwide recession dating from the oil crisis.

In Malaysia, West Malaysia has already begun to experience a shortage of logs, and logs are therefore brought in from the States of Sabah and Sarawak besides a ban on log exports having been effected.

Since the development of forests is at an early stage, Sarawak State, rather than restricting the exportation of forest products including logs, has adopted an active policy of exporting them.

In this state, those who have obtained a long-term concession must formulate a management plan. The plan is required to include the construction of a saw mill within 3-5 years after starting production, a veneer mill after 8 years, and after 4 more years, a plywood or wood processing mill.

A policy of industrialization is being promoted using advantageous long-term concessions as a lever.

Sabah State has adopted policies for the conservation of resources and the development of the domestic wood industry which are fundamentally the same as those of Indonesia, although the former may be more flexibly enforced than the latter.

This is exemplified by the fact that although the export quota of 10 million m^3 in 1979 was reduced to 8.8 million m^3 in 1980, with a policy of gradual reduction having subsequently been adopted, an additional quota of 20 million cu. ft was added to the state's export quota of 200 million cu. ft in November 1981.

Underlying such trends is the fact that the income from wood products plays a critical role in the economy of the state, and this is the reason that strong one-sided restrictions are not imposed on log exports.

Moreover, regarding the policy for the development of the wood industry, the state aims to implement the policy for localization like that of Indonesia, but cannot expect a large-scale project in the wood industry to be undertaken by the private sector because of the difficulty of raising domestic capital in an area with a relatively sparse population.

The policy of developing the wood industry will possibly be oriented towards the promotion of a project like that of the Sinora Co., which was set up as a joint venture between Yuasa, a Japanese company, and the Sabah Foundation.

Indonesia has increasingly strengthened its restrictions on forest exploitation and log exports since the Fundamental Forestry Law was established in 1976. Along these lines, a new forestry policy was formulated on April 22, 1981.

This policy has three aims: firstly, the expansion of employment and added value on the basis of the development of the wood industry; secondly, the satisfaction of domestic demand for wood at the proper price; and thirdly, an increase in the level of the export price for logs. The achievement of log export restrictions and the promotion of the wood industry is being attempted by making good use of the forest concession system.

Next, the policies of the major West African producing countries are discussed here. The ATO Document (No. 80/c/38) mentioned above states in connection with Nigeria that:

"For many years Nigeria's forest industry was limited to primary processing in sawmills. This has continued to be the

dominant activity to this day to the exent that at the end of 1977 there were 638 sawmills registered in the country producing 1.25 million m^3 of sawn wood. The sawmills are of various sizes, a vast majority of them being small with a low rate of recovery, underutilization of capacity and low-quality products. This leads to considerable waste, largely due to low conversion ratios (33% to 47% depending on species and the technical and managerial competence of operators).

"A number of larger sawmills are in existence and are of a higher standard and have higher conversion ratios. The state and federal governments are increasingly getting involved in the ownership of sawmills either directly or as joint ventures.

"Forest products trade (both domestic and foreign) in Nigeria has changed dramatically over the years. Nigeria was in the 1950s a leading exporter of logs in tropical Africa. From the mid-1960s the export role of forest products began to decline and in the mid 1970s a complete ban on the export of timber in the round and in squared forms was imposed."

The ATO Document (80/c/38) also states concerning Ghana that:

"Over 50% of the total log production in Ghana is processed locally mainly in the primary industries of sawmilling, plywood and veneer manufacture.

"The sawmills are of various capacities ranging from 2,000 m^3 to over 20,000 m^3. Most of them are characterized by low conversion percentage.

"Charcoal production is an important wood industry in Ghana especially in the rural areas. Although consumption of charcoal in Ghana has been estimated at 300,000 tons annually for domestic purposes, production is still being carried out by the traditional earth mound method. A UNDP sponsored project is currently in progress in Ghana to study the possibility of creating a charcoal center which will develop improved designs of small and medium sized kilns leading to large scale charcoal production for local consumption and export.

"Ghana has been carrying out a flourishing export timber trade since the beginning of the century. In 1975 Ghana exported 0.44 million m^3 in log form and 0.17 million m^3 as sawn timber (These figures represent respectively 33% and 41% of the total log and sawn timber production). In this year, Italy was the leading log buyer and the United Kingdom the leading buyer of sawn timber."

In Gabon, according to the data for 1978 of the aggregate supply and demand situation for wood, 48%, or 1.11 million m^3 was for timber, while 52%, or 1.18 million m^3 was for firewood. This shows that the share held by timber is relatively high compared with that in developing countries overall, and furthermore that importance is attached to the timber industy in this country. The timber which is produced in Gabon is exported to the European Community countries.

The following features can be pointed out regarding the wood industry policies in this country:

Firstly, the wood industry has an obligation regarding the domestic processing of wood products. That is, forest developers are required to process one-fourth of their log production into commodities within the country and allowed to export the remainder in the form of logs. In the future, however, the aim is for all logs to be processed domestically.

Secondly, the state-owned corporation, Société Nationale du Bois Gabonais (SNBG) exclusively handles the export of the two main species, i.e., okoumé and ozigo.

The export of species other than okoume and ozigo is not, however, operated under such a system, which is a great disincentive to foreign companies attempting to develop forests and export the wood to their countries.

Concerning the Ivory Coast, the ATO Document (No. 80/c/38) states that:

> "At least 30% of the total log production in 1976 in the Ivory Coast was processed locally. There are presently 76 mills and complexes processing timber with a total log intake capacity of 2.1 million m^3.
>
> "In an effort to encourage further local processing of timber, the government has set up a quota system which requires that for every state metre cube of the well known species exported an equivalent amount has to be delivered to a local mill. This regulation is being adhered to reluctantly and has led to the creation of "window dressing" industries which are not operating effectively.
>
> "It is the intention of the government to rationalize, plan and establish quotas of forest exploitation by dividing the forest area into a number of industrial zones in which will be established integrated pilot industrial complexes to carry out logging and processing of the raw material to semi-finished (saw mills, etc.) and finished products (joinery shops). Such

an approach will lead to a concentration of activities and better mobilization of resources, thus considerably lowering the production costs. These industrial complexes would also serve as poles of economic development.

"There is no official body controlling the marketing of timber in the Ivory Coast. Prices are determined by production costs and external market conditions. Export of timber is in the hands of several officially approved timber export companies and agents."

In Cameroon, the relatively retarded development of forestry presents a striking contrast to the abundant forest resources. The following are pointed out as reasons for this: a. the port is far from the forests, and roads connecting them have not been fully constructed; b. the domestic market for wood is small; and c. although port facilities have recently been rapidly improved and a large timber storage facility has been completed, these facilities are not yet adequate.

The principle of a five-year-term concession forms a barrier for industry, with the long period of gestation of investment required in forestry, to plan to secure logs profitably.

Despite such conditions, this country is making considerable efforts in the field of its domestic wood industry with the aid of the United Nations.

With regard to Cameroon, the ATO Document (No. 80/c/38) states that:

"A practical application of this policy can be seen in the newly launched joint venture company called SOFIBEL (Société Forestiere et Industrielle de Belabo). The company has been allocated 210,000 ha in Deng-Deng forest near Belabo. The integrated unit being put up at Belabo by SOFIBEL will be in a position to absorb a large variety of species found in Ndong forest."

B. CONSUMPTION

I. Trends in Consumption

1. Trends in World Consumption

Trends in the worldwide consumption of wood, mainly of the items designated in Table B-1, will be studied here.

With regard to the consumption of conifer logs (sawtimber and plywood logs), taking the consumption of 501.72 million m^3 in 1965 as 100, this figure gradually increased, to 110 in 1970 and 122 in 1980, except for a slight decrease to 108 in 1975.

On the other hand, taking the 1965 level of consumption of non-conifer logs (for sawtimber and plywood) — namely 178.79 million m^3 — as 100, there was a much larger increase than for conifer logs, the level reaching 114 in 1970, 117 in 1975 and 135 in 1980.

The consumption of pulpwood and particles also substantially increased, to reach 133 in 1970, 136 in 1975 and 144 in 1980, taking the consumption of 236.85 million m^3 in 1965 as 100.

The growth of consumption of particle board was the highest of all, with an increase to 208 in 1970, 335 in 1975, and 439 in 1980, taking the consumption of 9.22 million m^3 registered in 1965 as 100.

The consumption of plywood increased to 137 in 1970, 141 in 1975, and 161 in 1980, taking the 1965 consumption level of 24.34 million m^3 as 100.

For non-conifer sawnwood, consumption increased to 113 in 1970, 114 in 1975 and 125 in 1980, taking the consumption of 81.89 million m^3 in 1965 as 100.

Finally, the consumption of firewood and charcoal gradually increased to 124 in 1970, 136 in 1975 and 150 in 1980, on the basis of the consumption of 1,083.6 million m^3 in 1965 being similarly taken as 100. The growth of consumption in this sector was particularly significant in the developing countries, as described later.

Table B-1 Changes in Consumption of Industrial Logs and Other Main Forest Products by Region

(10,000 m^3)

Regions		Sawnwood (NC)		Plywood		Particle-board		Pulpwood + particels		Sawlogs(NC) + veneerlogs		Sawlogs(C) + veneerlogs		Firewood + charcoal	
Developed regions															
North America	1965	1,920	100	1,517	100	163	100	12,001	100	4,174	100	20,883	100	3,689	100
	70	1,851	96	1,735	114	344	211	14,493	121	3,904	94	21,614	104	2,157	58
	75	1,499	78	1,810	119	482	296	12,803	107	3,212	77	21,164	101	1,910	52
	80	1,869	97	1,862	123	773	474	14,145	118	4,200	101	24,560	118	1,988	54
Western Europe	1965	1,193	100	317	100	523	100	7,183	100	2,776	100	7,680	100	5,800	100
	70	1,401	117	408	129	1,048	200	9,153	127	3,115	112	8,615	113	4,398	76
	75	1,254	100	368	116	1,637	312	9,477	132	2,612	94	7,620	99	3,010	52
	80	1,664	139	435	137	1,971	377	9,600	134	3,139	113	9,612	125	3,014	52
Oceania	1965	288	100	14	100	10	100	254	100	757	100	566	100	343	100
	70	277	96	19	136	31	310	337	133	711	94	600	106	312	91
	75	276	96	18	129	51	510	455	179	653	86	582	103	213	62
	80	225	78	17	121	66	660	220	87	611	81	644	114	141	41
Japan	1965	659	100	225	100	17	100	932	100	1,591	100	3,418	100	973	100
	70	1,003	152	686	305	37	218	2,187	235	2,576	162	4,061	119	210	22
	75	953	145	620	276	70	412	2,052	220	2,124	134	3,484	102	217	22
	80	689	105	841	374	102	600	2,284	245	2,308	145	3,464	101	229	24
Other developed countries (Israel, S. Africa)	1965	27	100	8	100	4	100	234	100	58	100	211	100	86	100
	70	48	178	12	150	12	300	326	139	60	103	453	215	685	797
	75	49	181	9	113	22	550	381	163	53	91	310	147	695	808
	80	31	115	7	88	26	650	383	164	61	105	264	125	694	807
Developing regions															
Brazil	1965	264	100	21	100	1	100	216	100	555	100	577	100	12,500	100
	70	335	127	31	148	11	1,100	351	163	739	133	932	162	13,125	105
	75	455	172	63	300	41	4,100	535	248	1,024	185	1,102	191	15,128	121
	80	670	254	65	310	55	5,500	858	397	1,340	241	1,632	283	17,441	140
Latin America	1965	387	100	28	100	13	100	264	100	901	100	626	100	8,220	100
	70	428	111	43	154	27	208	462	175	989	110	697	111	9,093	111
	75	535	138	55	196	46	354	610	231	1,167	130	815	130	9,949	121
	80	563	145	76	271	85	654	855	324	1,191	132	881	141	11,112	135
Africa	1965	143	100	13	100	2	100	76	100	572	100	68	100	20,770	100
	70	206	144	18	138	6	300	96	126	813	142	95	140	25,753	124
	75	303	212	34	262	8	400	207	263	877	153	107	157	29,576	142
	80	498	348	47	362	20	1,000	212	279	1,314	230	124	182	34,127	164
Middle and Near East	1965	55	100	16	100	6	100	29	100	101	100	264	100	3,787	100
	70	75	136	17	106	16	267	92	317	127	126	339	128	6,393	169
	75	107	195	35	219	43	717	88	303	134	133	493	187	7,203	190
	80	178	324	75	469	71	1,183	109	376	107	106	570	216	6,078	160
Southeast Asia and Tropical Oceania	1965	581	100	16	100	1	100	12	100	1,586	100	13	100	13,644	100
	70	635	100	79	494	1	100	15	125	1,589	100	23	177	18,168	133
	75	891	153	77	481	1	100	51	425	2,330	147	16	123	20,746	152
	80	700	120	78	488	(0.3)	30	66	550	3,347	211	40	308	23,147	170
Other Asian countries	1965	271	100	27	100	3	100	40	100	784	100	210	100	12,560	100
	70	363	134	14	52	4	133	58	145	1,173	150	242	115	25,548	203
	75	350	129	36	133	?	-	153	383	1,430	182	310	148	28,780	229
	80	552	203	121	448	9	300	151	378	946	121	2,080	990	32,682	260
Planned economy countries															
Asian centrally planned economies	1965	526	100	11	100	3	100	159	100	963	100	1,505	100	13,837	100
	70	611	116	22	200	3	100	256	161	1,025	106	1,529	102	18,749	135
	75	663	126	27	245	4	133	438	275	1,596	166	1,958	130	20,719	150
	80	834	159	35	318	5	147	551	347	2,236	232	2,397	159	22,965	166
Eastern Europe and USSR	1965	1,875	100	221	100	176	100	2,285	100	3,061	100	14,151	100	12,151	100
	70	1,983	106	257	116	374	213	3,724	163	3,527	115	15,976	113	10,193	84
	75	2,019	108	290	131	684	389	5,008	219	3,659	120	16,325	115	9,546	79
	80	1,800	96	257	116	863	490	4,620	202	3,373	110	14,924	105	9,179	76
World total	1965	8,189	100	2,434	100	922	100	23,685	100	17,879	100	50,172	100	108,360	100
	70	9,216	113	3,341	137	1,914	208	31,550	133	20,348	114	55,176	110	134,784	124
	75	9,354	114	3,442	141	3,086	335	32,258	136	20,871	117	54,286	108	147,692	136
	80	10,273	125	3,916	161	4,046	439	34,054	144	24,173	135	61,192	122	162,797	150

Note : Figures on the right of each column indicate indexes (1965 = 100).

Source: FAO, Yearbook of Forest Products

2. Trends in Consumption by Region

Trends in the consumption of conifer logs (for sawtimber and plywood) by region show that the total of world consumption increased from 100, taking 1965 as the base year, to 122 in 1980. Compared to this overall rate of growth, the rate was higher in Western Europe (from 100 in 1965 to 125 in 1980), other developed countries (125), Brazil (283), Latin America (141), Africa (182), the Near East (216), Southeast Asia (308), other Asian countries (990), and Asian countries with centrally planned economies (159), but it was lower in other regions.

Trends in the consumption of non-conifer logs (for sawtimber and plywood) by region show that the total of world consumption increased from 100 in 1965 to 135 in 1980. In comparison with this rate of increase, the rate was higher in Japan (145), Brazil (241), Africa (230), Southeast Asia and tropical Oceania (211) and the Asian countries with centrally planned economies (232), whereas it was lower in other regions.

The total world consumption of pulpwood and particles increased from 100 in 1965 to 144 in 1980. Compared with this rate of growth, the growth rate was higher in Japan (245), other developed countries (164), Brazil (397), Latin America (324), Africa (279), the Near East (376), Southeast Asia and tropical Oceania (550), other Asian countries (378), the Asian countries with centrally planned economies (347), and Eastern Europe and the USSR (202), but was lower in other regions.

The consumption of plywood in the world increased to 110 in the period described above, compared with which the rate was higher in North America (123), Western Europe (137), Oceania (121), Japan (374), Brazil (310), Latin America (271), Africa (362), the Near East (469), Southeast Asia and tropical Oceania (488), other Asian countries (448), the Asian countries with centrally planned economies (318) and the USSR (116).

The consumption of non-conifer sawnwood in the world rose to 125 in the 1965-1980 period, compared with which the rate was higher in Western Europe (139), Brazil (254), Latin America (145), Africa (348), the Near East (324) and the Asian countries with centrally planned economies (159).

Finally, in the case of firewood and charcoal, world consumption increased to 150 in the 1965-1980 period, compared with which the growth rate of consumption was higher in other developed countries such as Israel and South Africa (807), Africa (164), the Near East (160), Southeast Asia and tropical Oceania (170), other Asian countries (260) and the Asian countries with centrally planned economies (166).

II. Characteristics of Consumption Trends

1. Relationship between Income and Consumption

The consumption of timber, like other goods, is subject to the factors of both income and price.

Firstly, the relationship between timber consumption and income is discussed here.[1),2)]

Table B-2 shows the results of a cross-sectional analysis of the numerical relationship between per capita income and per capita timber consumption by products in the countries which are referred to in the literature mentioned in Footnotes 1) and 2); namely the income elasticity coefficient of timber demand, based on FAO data for 1962 and 1972.

The income elasticity coefficient of demand for timber excluding firewood was higher in 1972 than in 1962. This means that the increased levels of income in the developing countries raised the level of timber consumption, and it can be supposed that this complemented the inelasticity shown during the same period in the developed countries.

On the item basis of products, the more processed the product, the higher the coefficient is, i.e., from sawnwood, rising to wood panel, paper and board paper. This means that increased levels of income lead to a rise in the consumption of more highly-processed products, both in developed and developing countries.

When the figures for 1962 are compared with those of 1972, the income-demand elasticity can be seen to have generally risen.

As stated above, however, when viewed in terms of a time series the elasticity coefficient has moved differently in the developed countries and the developing countries. In this context, for example, the income elasticity coefficient of demand for timber (general sawtimber, mainly house timber) in Japan as a whole, which was around 0.6 in the period 1960-1965, gradually fell to 0.5-0.4 in the 1965-1970 period, and further to 0.3-0.2 in the 1970-1973 period.

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1) Kiyoshi Yukitake, Quantitative Study of Structure of Forest Products Demand and Supply (V), Transactions of the 87th Japan Forestry Society, October 1976, pp.29-30 (in Japanese)

2) I. Nomura, Long Range Timber Demand/Supply Prospects in Japan and Some Problems, the North American Conference on National Forest Sector Models of IIASA, 1981

Table B-2 Income Elasticity Coefficients of Timber Demand by Item

Item	1962	1972
Sawnwood, ties	0.533727	0.771693
Wood panel (veneer, particle and fiberboard)	0.775011	1.188507
Paper, board paper	0.810770	1.014945
Firewood	-0.389154	-0.701209

As reasons for this, three factors besides income are involved: the first is the relative decline in building construction work as a result of the rise in price of land; the second is the gradual decrease in the proportion of wooden houses in newly-built houses; and the third is the decrease in the use of wood per unit area of buildings.

From the worldwide point of view, the coefficient for firewood is negative, that is, the higher the level of income the less the consumption, and it became more elastic in 1972 than in 1962.

The relationship between firewood demand and income elasticity appears, however, to vary from region to region.

It is estimated that while the income elasticity coefficient for firewood demand is not known exactly, it is positive in the developing countries in tropical America, Africa and tropical Asia; but it is negative and exhibits much elasticity in the developed countries.

2. Relationship between Price and Consumption

According to a recent report [1] published by the U.S. Forest Service, the price elasticity coefficient of demand for timber, which varies from region to region, is -0.3 to -0.4 for timber and -0.2 to -0.8 for plywood. This means that if the price rises by 10%, the demand for timber falls by 3 to 4% and the demand for plywood falls by 2 to 8%.

1) U.S. Forest Service, The 1980 Softwood Timber Assessment, Market Model Structure, Projections and Policy Simulation

The results of an assessment made in Japan [1] show a coefficient of -0.5 to -0.55. Judging from these figures alone, the relationship in this country is slightly more elastic than that in the United States. This is possibly because in Japan, forest resources are more limited and the rationalization of the production of substitute materials has progressed at a faster tempo than in the United States.

As mentioned below, it is expected that the appearance of diverse substitute materials which are easily usable and the production cost of which is easily rationalized will strengthen the elasticity factor.

Regarding the price elasticity of demand for firewood and charcoal, and for the material wood used in these applications itself, a statistical survey,[2] made at the time of the rapid decrease in demand for firewood a few decades ago in Japan, estimates the elasticity coefficient of charcoal demand at -0.4 to -0.6. Present demand for charcoal in Japan is almost negligible.

3. Relationship between Substitute Materials and Consumption

The inroads made by and the rate of growth of substitute materials in the market for general sawtimber, which mainly comprises timber for building purposes, are very marked throughout the world, especially in the developed countries.

In the case of Japan, one aspect of the influence of substitute materials on timber consumption can be numerically grasped through observing the gradual decrease in the use of timber per unit of building area.

The general situation of the inroads made by the substitute materials into the market for wood are discussed below.

Table B-3 indicates trends in the production of the main substitute materials for wood.

Taking the figure for 1971 as 100, the production of prefabricated panels for structures changed from 43.2 in 1967 to 72.3 in 1969, 100 in 1971, 160.7 in 1973, and in the period of slow economic growth which followed, to 83.7 in 1975, and 89.5 in 1978. In the

1) Isamu Nomura, "Construction of Price Theory of Forest Products", Forestry Economy, No.116, June 1958 (in Japanese)

2) Isamu Nomura, Picture of Charcoal Economy in Recent Years, transactions of the 70th Japan Forestry Society Conference, April 1960 (in Japanese)