forest resources in the asia and far east region

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FOREST RESOURCES IN THE ASIA AND FAR EAST REGION

FOOD AND AGRICULTURE CRGANIZATION OF THE UNITED NATIONS
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Australia
Bangladesh
Burma
Fiji
India
Indonesia
Japan
Korea, Republic of
Malaysia
New Zealand
Pakistan
Papua New Guinea
Philippines
Sri Lanka
Thailand

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ABBREVIATIONS AND SYMBOLS

ha	122	Hectare
E _m 3	ton	Cubic metre
m	100 2	Metre
cm		Centimetre
m^3/ha $m^3/ha/a$	100	Cubic metre per hectare
$m^3/ha/a$	æ	Cubic metre per hectare per annum
604	=	Nil or less than half the appropriate unit
90	age .	Not available

INTRODUCTION

The Forestry Department of FAO has over the years published the results of its enquiries into the forest resources of the world in a series of World Forest Inventories. The last in this series was published in 1963. An imperfection of the earlier inventories stemmed from the fact that knowledge of the total forest resource was incomplete and these inventories were not designed to make use of the fuller information available about economically important parts of that total. In the work carried out since 1963 the scope of enquiries, particularly in the developing regions, has been directed towards gathering information in greater depth on the state of knowledge of resources of the individual countries.

This document is the first of a new series which presents estimates of the area of the forests and the volume of their timber growing stock in the countries of the Asia Far East Region. Notes on detail of forest types, species, ownership and inventories are provided for a number of countries in Appendix 3. The function of such a regional examination of the data of forests is to provide a basis for estimating their ability to meet requirements of the community of the region for products and services, and to indicate their potential to contribute to the economies of the individual countries, to the region as a whole and to the world. Furthermore, beyond stating the facts about existing forests, the potential development of production of the forests over the next decade is explored. This potential will be further reviewed in a study of regional timber trends in relation to estimates of future demand for the forest products of this region.

Collection and analysis of the basic information were prepared in FAO. The notes on the forest resources by country were submitted to governmental forest services for comments. Revisions and corrections received were incorporated before finalizing the preparation of this appraisal.

The Quality of the Information

The estimates were assembled and compiled during the period 1971-1973 from material available from the countries in the region. For some countries comprehensive inventory and analyses are available. For others only partial data could be obtained. The date to which the inventory or analysis for particular countries relates varies. An indication of the dates of available inventory material for particular countries is given in the country notes.

Statistical information about the forest resources of this region has been developed to only a limited extent. It is important therefore that the limitation of the data should be recognised before drawing conclusions on the basis of the estimates presented. There are difficulties which arise from imperfections of the definitions of the quantities and from the unreliability of the basic statistics. A comparison of statistics presented in this paper with those in the World Forest Inventory - FAO 1963 - illustrates the importance of caution in interpretation.

In 1963 the total area of "forest land" in countries of this region was given as 790 million ha. In this study it was considered that the available data do not allow a satisfactory estimate of the area of open woodland and serub brushland to be made. Thus the statistics given are restricted to the area of closed forest which excludes these, closed forest being defined as forest land more than 20% of whose area is covered by tree crowns.

The 1963 figure for "forest", whose definition is approximately equivalent to that of "closed forest" used have, was 725 million ha compared with the 540 million ha of closed forest in this paper. However, the 1963 figure explicitly includes the area of unstocked forest lead for a large proportion of the countries. Subtracting the area of unproductive forests where it is stated in the 1963 statistics leads to a total of 535 million ha. It

would not be correct to conclude that this is approximately the same area as the area of "closed forest" given in this paper. It does, however, make it clear that the difference between figures in this paper and the 1963 paper may be more apparent than real and that comparison of the two sets of figures does not provide dependable information on the change in the state of forests.

Examination of the basis for the country statistics makes it clear that knowledge of these areas is still very incomplete and that the statistics presented provide only broad indicators of the state of the forests in the region. Inventories are known to have been prepared for about 150 million ha, of which 50 million were in Japan, Australia and New Zealand with 70 million ha of closed forest (maximum intensity 70%), and 100 million ha were in developing market economies with 315 million ha of closed forest (maximum intensity 30%). The extent of inventory in the centrally planned economies is not known and only very limited data are available; for this reason countries in this region are considered in less detail in the following discussion.

One of the objectives of reproducing country notes is to provide a more complete impression of the quality of the information on the forests of the region by giving fuller detail of the extent and nature of inventories carried out, as well as providing more detail of the findings.

Grouping of Countries within the Region

In this study the same grouping of countries as is adopted for the timber trends study is used. The countries are grouped according to type of economy and in geographical sub-regions. The sub-regions are made up as follows:

Developing market economies:

South Asia: Bangladesh, Bhutan, Nepal, Pakistan, India,

Sri Lanka

Continental Southeast Asia: Burma, Cambodia, Laos, South Vietnam, Thailand

Insular Southeast Asia: Brunei, Indonesia, Malaysia, Philippines,

Singapore

East Asia: Korea Republic, Hong Kong

Oceania Developing: Fiji, Papua New Guinea, New Caledonia, Solomon

Islands, New Hebrides

Daveloped market economies:

East Asia: Japan

Oceania Developed: Australia, New Zealand

Centrally planned economies: China, Korea Democratic People's Republic,

Vietnam Democratic Republic

In each of the following sections, these regions are considered in turn.

TABLE I

ESTIMATED LAND USE 1970

		losed forest		Agricultural	Other	Land	area
Sub-region	Total	Per caput	% of total land area			Total	Per caput
	million ha	l ha	%		million ha		ha
Asia Far East Region	537.1	0.3	18.4	837.3	1 538.2	2 912.6	1.5
South Asia	70.6	0.1	15.8	206.4	169.7	446.7	0, 6
Continental South East Asia	91.1	1.0	51.1	38.7	48.3	178.1	1.9
insular South-East Asia	124.8	0.7	49.1	29.4	99.9	254.1	1.4
East Asia developing	6,5	0.2	64.7	2.3	1.1	9.9	0.3
Oceania developing	39.3	12.0	71.9	1.8	13.7	54,8	16.6
East Asia developed	25. 2	0.2	6 6. 8	6.5	6.0	37.7	0,4
Oceania developed	49,5	3.2	6.3	256.6	481.3	787.4	51.2
Centrally Planned	130.1	0.1	11.4	295.6	718,2	1 143.9	1.1

TABLE 2

ESTIMATED COMMERCIAL FOREST AREAS

	Operable of	losed forest		
Sub-region	În use	Total	Inoperable closed forest	Total area of closed forest
*		المستعدد والمستعدد والمستعد والمستعدد والمستعد	llion ha	
Asia and Far East Region	279.8	378.3	158.7	537.0
South Asia	53.2	58.5	12.0	70.5
Continental South-East Asia	52.3	72.6	18.5	91.1
Insular South-East Asia	36.0	71.9	52. 9	124,8
East Asia developing	4.0	5, 2	1,4	6. 6
Oceania developing	2.1	16.3	23.0	39.3
East Asia developed	24.1	24.1	1.1	25.2
Oceania developed	29.2	29.2	20, 2	49,4
Centrally Planned	78. 9	100.5	29.6	130.1

PRESENT AREAS OF CLOSED FOREST IN RELATION TO OVERALL LAND USE AND POPULATION

Table I gives an estimate of the region's overall land use and the extent of its forests in relation to the 1970 population and total land area, by sub-regions. Corresponding country data are shown in Appendix I.

Closed forest area refers to the total area of all lands with a "forest cover", i.e. with trees whose crowns cover more than 20% of the area, and which are not used primarily for purposes other than forestry, whether reserved forests or not. This area includes also temporarily unstocked areas, i.e. forests in which trees have been temporarily removed by cutting or burning to such an extent that less than 20% of the area is covered by tree crowns. It excludes areas deforested by shifting cultivation and other wooded areas such as savanuah and open woodland.

Total area of closed forests in the region amounts to 537 million ha which represents approximately 18% of the total land area or an average of 0.3 ha per caput.

Agricultural land comprises arable lands, orchards, vineyards, meadows, pasture, other grassland, agricultural land producing concurrent tree crops and lands under shifting cultivation which are part of a recognized fallow rotation.

Total area of agricultural land is estimated to be 837 million ha, some 29% of the total land area of the region.

Other lands include open woodland, scrub and brushland, lands under shifting cultivation which are not part of a recognised fallow rotation and which will return to brushland when abandoned: it also includes deserts, send dunes and rock surfaces bearing little or no vegetation, swamps and bogs not classifiable as forests or too not to be included in other land classes, areas of towns and roads. The data are not svailable to show the area of open woodland, scrub and brushland separately. This area, however, is certainly appreciable in the region and constitutes a significant source of wood particularly for fuel and other rural uses.

The area of other lands, not classified as either agricultural or closed forest, amounts in the region to 1 540 million ha, some 53% of the total land area. As a rough estimate "other land" includes some 150-200 million ha of open forest and sorub forest. Accurate information about the content of this type of forest is available only for one or two countries of the region.

In the following, some points regarding the variation of situation between the sub-regions are noted and a brief description of main forest types and species is given.

South Asia

This subcontinent has an area of closed forest of 71 million ha which represents approximately 16% of its total land area. It is among the less forested subregions with a large population and consequently a small forest area per head of population. Furthermore most indigenous forests are not well located in relation to population centres with pressing fuelwood needs.

Due to a wide range of climatic conditions from tropical at sea level to artic in the Himalayan higher altitudes, forest types are particularly varied.

The tropical evergreen forests of the lower altitudes cover approximately 9 million has two thirds of which are in India, but the type also occurs in Nopal, Bhuten, Bangladesh end. Sri Lanka. Main species are Artocarpus spp., Chloroxylar suitonia, Ilopea adoreta, Steroulia abata, Tetramoles nudiflora, Vitex prinata, Dipterocarpus spp.

The tropical moist deciduous forests occur mainly in India (22 million ha) and in the southern part of Bangladesh. The most important species are Dalbergia latifolia (rosewood), Shorea robusta (sal), Tectona grandia (teak), Terminalia tomentosa (laurel), The tropical dry forests cover approximately 21 million ha in India, Acadia app., Albigia app., and Santalum album being main species groups.

The subtropical forests have an approximate area of 6.5 million ha and are found in the foothills of the Himaleyas, in Pakistan, India, Bhutan and Mepal. Main species groups are conifers Abies app., Picea app., Pinus app., and non-conifers Alnus app., Acacia app., Quercus app.

The temperate forests which cover some 5 million ha mainly in India but also in Nepal are made of Abies. Alnus, Cedrus, Inglans, Pinus, Quercus. They represent important concentrations of conferous timber, although much of these resources grow in hardly accessible conditions in the Himalayas.

Principal commercial species in the sub-region are sal and teak. Although commercial quantities may be found in Bangladesh and Nepal, richest concentrations of sal are in north and north-east India. Main teak resources are in central and south-western India where in places these account for the bulk of standing crop.

Continental Southeast Asia

With a closed forest area of 91 million ha accounting for almost half of the total land area and with a moderate population density, Continental Southeast Asia has a relatively high forest area of nearly 1 ha per head of population.

The tropical evergreen and semi-evergreen forests of the lower altitude are the most frequent forest type in Burma and Thailand where they represent an approximate area of 16 million ha. Main species are Agathis, Dipterocarpus, Hopea, Lagarstroemia, Parashorea, Pentacma, Shorea, Tetramelis.

The tropical moist broadleaved and mixed deciduous forests, also called monsoon forest type, cover large areas in Indochina, with Agathis, Casuarina, Dypterocarpus, Legerstroemia, Parashorea, Pinus, Sterocarpus, Tectona as main species.

The tropical dry non-coniferous and mixed deciduous forest account for more than 30 million ha, mainly in Laos and Thailand but also in Cambodia and South Vietnam. Dipterocarpus and Shorea are dominant, with Pinus in some occurrence.

The subtropical evergreen forests are found in the eastern part of Burma (9 million ha) with Kharga, Pinus and Querous as main species. Coniferous forests cover some 4 million ha which are found mostly in mixed stands with non-coniferous species among the two previous forest types: locations are generally in inoperable conditions with low average growing stock.

Throughout the subregion dipterocarps species and teak are the main currently commercial species. They constitute most (60 to 70%) of the commercial wood in the forest growing stock of Burma and Thailand. Teak alone is estimated to account for some 3 to 9 percent of the total timber stock in these two countries. Dipterocarps species, mostly dark and heavy timbers, gain in importance relative to teak towards the east of the subregion.

Insuler Southeast Asia

The closed forest area amounts to approximately 125 million ha, a little less than half of total land area, whereas agricultural land represents only 12% of the total. In relation to population there is 0.7 ha of closed forest per caput. Forest types in this sub-region are similar to those in Continental Southeast Asia.

Tropical evergreen and semi-evergreen forests are by far the more important type with 80 million ha in Indonesia alone and some large areas in Malaysia and the Philippines. Among the species already mentioned and which characterize this type of forest in this continent, dipterocarps of the genera <u>Parashorea</u>, <u>Pentacme</u> and <u>Shorea</u> are well known in the trade as lauan, meranti, Philippine mahogany, seraya, depending on the exporting country.

The tropical moist forests cover a limited area, some 2 million ha, mainly in the Philippines and Indonesia where Eucalyptus adds to the species composition described above. Erratic occurrence of conifers, mostly Agathis and Pomerkusii, is found with some pure stands in Java and Sumatra.

The dipterocarps which include the main commercial species in this subregion have their richest concentration in the Philippines (some 80% of the growing stock), Malaysian States of Sabah (80%) and Sarawak (50%) and Indonesian Kalimantan: the proportion is somewhat smaller in West Malaysia (about 43%).

East Asia

Despite a substantial proportion, almost two thirds, of forested land the area of forest per head of population is only 0.2 ha per caput as the population density is very high. A wide range of climate, relief and soil conditions can be found in this sub-region and consequently forest types are extremely varied, especially in China, from sub-tropical to temperate. Unfortunately information on forests of China and North Korea are scarce.

The temperate deciduous forest is the more common type in Japan and South Korea where it covers some 14 million ha as a whole, main genera are Abies, Acer, Alnus, Betula, Juglans, Larix, Pinus, Quercus.

The sub-tropical evergreen forest covers approximately 9 million ha in southern Japan with Abies, Lithocarpus, Pinus, Quercus, Tsuga, as main species groups.

The cool temperate coniferous forest is found mainly in Japan, where its area is apparently 5 million ha, but is also found in South Korea. More frequent species are Abies, Alnus, Picea, Tasens, Tsuga.

A striking feature of the sub-region's forests is the high proportion of man-made forests, about a third of the total forest area in Japan and a sixth in South Korea. Furthermore coniferous resources are fairly substantial with higher increment and generally better form than non-coniferous: their commercial importance is thus higher.

Oceania developing

This sub-region with almost two thirds of its total area being forested and a low population density has by far the largest forest area per caput of population, over 10 ha. Climates and forest types vary markedly in the many islands within a short distance, mainly through the influence of relief and altitude.

Tropical mixed and broadleaved evergreen rain forests of the low to medium altitude are the more common type, whereas tropical evergreen montane forests can be found above 1 500 m altitude. Main areas are in Papua New Guinea, Solomon Islands and Fiji, with only small relicts in New Hebrides and New Caledonia. Main species are Agathis, Calophyllum, Endospermum, Podocarpus. Coniferous stands are of occasional occurrence.

Mangrove forests occur along most coasts. Tropical eucalyptus savanna covers some of the coastal plains of Papua New Guinea.

In the forests of this sub-region there are no genera with groups of species of fairly uniform characteristics as are in the dipterocarp ferests. On the contrary, species differ greatly in their wood properties and those currently accepted for commercial use account for a smaller portion of the growing stock than in the dipterocarp area. Total stand volumes per unit area are generally lower as well.

Oceania developed

This sub-region has less than 6% of its total area under forest. However it also has a low density of population and consequently the area of forest per head of population (nearly 3 ha) is relatively large.

Tropical and sub-tropical rainforest covers an extensive area in the northern and eastern states of Australia. Main coniferous species of Agathis, Araucaria and Flindersia are present.

In terms of standing volumes, sucalypts are by far the most important species in Australia and form 90% of the total timber stock in the country; however, in terms of annual increment the coniferous plantations appear to have a much greater relative commercial potential than the stock volume data suggest as they account for some 32% of the total annual increment in the country. The dry and wet sclerophyll forests cover large areas and are essentially made of Eucalyptus sop. These areas are distributed all over the country in varying conditions of soil and climate.

New Zealand's forests are essentially of the temperate type with a northern broadleaved type with Nothofagus and Agathis, the coniferous type with Podocarpus and Jacridium as main species, and a cold southern broadleaved type with Nothofagus. In New Zealand the coniferous species constitute almost 80% of the total standing volume and even more of the total annual increment in the country.

Table 3 presents a summary of the rough distribution of the main forests types in the sub-regions for the Asia Far East region, with the exception of the centrally planned economies for which no information is available. The importance of the tropical evergreen forests of Southeast Asia, both continental and insular, appears very clear as they constitute one third of the total area of closed forest and almost three-quarters of the area of tropical evergreen forests in the region.

Table 3 Forest Types Distribution

	Tropical ever- green forests	Tropical moist deciduous forests mi	Tropical dry deciduous forests llion ha	Sub-tropical evergreen forests	Temp= crate forests
South Asia	30	23	22	9	5
Southeast Asia	128	40	31	10	
Rest Asia				10	22
Oceania developing	34				
Oceania developed 1/	2			26	16
Total	174	63	53	55	43
%	(44.8)	(16.2)	(13.7)	(14.2)	(11.1)

^{1/} For the purpose of this table the breakdown of the Australian closed forests has been mainly based on their geographical distribution.

CLOSED FOREST AREAS WITH CONMERCIAL POTENTIAL - OPERABLE FOREST

Table 2 gives by sub-region a rough indication of the extent of forests having commercial potential.

Operable closed forest is defined as closed forest where the current or potential accessibility would allow forest operations under actual or foreseeable conditions, i.e. including forest areas that could be opened up for exploitation by the provision of access roads, but excluding areas which are considered unexploitable due to unfavourable terrain conditions. This provides a first estimate of the area of potentially commercial production forest. This definition does not take account of the proportion of timber stocking which is of commercial species, or the possible existence of legal restrictions on logging (e.g. for protection or recreational reasons). These forests are classified as being in use when included in concession agreements, whether actually cut over or not, and are subject to regular or periodical logging activities or regular fuelwood cutting.

The area classified as inoperable closed forests includes closed forest where operations are considered infeasible under the actual conditions due to adverse site, to unfavourable terrain conditions or to a location which makes the area economically inaccessible. The classification of closed forests as operable or inoperable may change over time as techniques and economic conditions of forest operations evolve.

Approximately one fourth of the total area of closed forest is regarded as inoperable either because it is economically inaccessible, or not suitable for commercial utilisation. The area regarded as both operable and already in use as a source of timber supply amounts to 52% of the total area and the remaining 18% is potentially operable.

Oceania developed and Insular Southeast Asia have higher than average ratios of inoperable forest and Insular Southeast Asia has a lower proportion of forest classified as in use. Closed forests of Insular Southeast Asia apparently amount to about a third of the total forest area — with a relatively large proportion of the resources occurring in mountainous regions, in the islands of Borneo, Sumatra and West Irian in particular.

A point to note is how Indonesia's large forest area is dominant in the forest resources of Insular Southeast Asia. Although forests currently considered as in use cover only 28% of the total area of operable forests in that country, forest lands carrying timber stock with immediate commercial potential are actually being committed in harvesting concessions to a much greater extent than this suggests. Two factors contribute to this situations West Irian has an estimated 10 million ha of operable forests but these will only have industrial potential in the more remote future due to a currently unfavourable species composition, and lack of infrastructure and labour, and only a part of the operable forests in the rest of the country will be available for long term forest management in the country. In fact of the 42 million ha, 24 million ha have been designated for permanent production forestry, while the balance of 18 million ha has been designated for conversion to agricultural and other non-forestry purposes.

The rest of the sub-region offers less scope for opening up new resources to industry. In Malaysia some 68% of operable forests are estimated to be in use. In the Philippines most operable forest resources have already been committed under licence agreements. In East Asia and Oceania Developed, practically all operable forests are classed as being in use, reflecting the high intensity of forest management in these sub-regions. The one-tenth of operable resource estimated as not in use in South Asia is mostly located in the Himalayan regions of Nepal and India. Oceania Developing has a small proportion — 13% — of its operable forests in use at present. This is due to its low population in relation to the forest area and industrially less attractive species composition of its forests relative to those of the dipterocarp region. This sub-region has considerable potential for increasing supplies in the future.

GROWING STOCK AND INCREMENT

The estimates of growing stock volumes are only crude approximations made in the absence of country-wide inventories for much of the region. The volume information available from various countries often refers to different diameter classes or is not fully comparable for other reasons. Any comparisons should therefore be treated with caution. These qualifications apply even more to the estimates of increment. Furthermore, the current growth is in largely unmanaged and untouched tropical forests and gives little indication of the prospective yield from these forests once they are brought into use and placed under proper management. Tables 4 and 5 present the available information on growing stock.

The total volume of growing stock in closed forests of the region is estimated to be about 40 000 million m³. In the open forest and scrub forest there may be a further 4-5 000 million m³. Three quarters of the total volume in closed forest is in operable forests. Approximately 80% of the growing stock of closed forests is non-coniferous and 20% coniferous species. Most of the coniferous forest is in more temperate parts of the region - the centrally planned countries account for 70% and the mountain region of South Asia, and the forests of East Asia Taveloped and Oceania Daveloped contain most of the rest. The average volume per ha is relatively low (76 m³/ha) but two thirds of the volume are in currently commercial species. The closed forests of developing East Asia (12 m³/ha) and South Asia (50 m³/ha) have appreciably lower volumes than average.

The average net annual increment of natural forests of the region is considered to be in the range 1-2 m³/ha. Annual increment in plantations is generally very much higher: for Eucalyptus 10-17 m³/ha, for other non-coniferous species 5-16 m³/ha and for coniferous species 4-18 m³/ha. Growth rates are lower in the more temperate climate of East Asia and the centrally planned sub-region, where the average for non-coniferous species is 4-5 m³/ha.

On the basis of an average net annual increment of 1.4 m³/ha, the total volume of annual increment in closed forests would be of the order of 700-750 million m³ and the increment in operable closed forest 500-550 million m³, and in operable forest classified as in use 350-400 million m³. Of the total about 100 million m³ is the current annual increment of plantations. Where the forests are to a substantial degree natural and unmanaged, the concept of increment as a utilisable potential is less clear than for the case of managed plantations. It does, however, provide a broad indication of the forests' capacity to maintain a certain level of cutting.

South Asia

The deficiency of forest area in South Asia is accentuated by the low average stocking associated with the great proportion of nearly exhausted broadleaved forests.

The coniferous resources in the Himalayas are estimated at 508 million m³. Although much of these are unexploitable due to terrain conditions, the operable part, some 150 million m³ in India, 95 million m³ in Nepal and 38 million m³ in Pakistan, still has considerable commercial potential. The most important tree species are decdar (Cedrus decdara), pines (F_c roxburghii, P_c excelse, P_c kesiya), spruce (P_c smythiane) and fir (A_c pizdrow, A_c spectabilis).

Nepal has the richest concentrations of coniferous timber, with a country-wide average stocking of 190 m 3 . In India and Pakistan coniferous forests average 140 m 3 /ha and just over 70 m 3 /ha respectively, but individual stands occasionally carry over 190 m 3 /ha. Due to a grossly overmeture state in much of the coniferous stands, annual net increment is currently presumed to be at most 2 m 3 /ha for the whole resource.

Sal (Shorea robusta) makes up the bulk of the estimated stock volume of 2 696 million m³ in operable non-coniferous forests. The species occurs in deciduous forests in eastern and northeastern India, Bangladesh and over the Terai of Nepal, usually accounting for 60 to 90% of the stand volume, most of the balance being also made up of commercial timber species.

TABLE 4

GROWING STOCK IN CLOSED FOREST

		Operable clo	sed fore	sts	P	all closed forests	
Sub-region	Total	Coniferous	Non	coniferous	Total	Coniferous	Non coniferous
		·	Total	Currently commercial		CONTRACTOR	
				million m	2		According to the last one can the sea that the same and that are any and the same a
Asia Far East Region	28 900	5 600	23 300	15 300	38 700	7 100	31 600
South Asia	3 000	400	2 600	1 900	3 500	600	2 900
Continental South-East Asia	5 000	1	5 000	3 400	6 300	50	6 200
Insular South-East Asia	9 200	40	9 200	5 200	13 300	50	13 200
East Asia developing	60	30	30	30	80	40	40
Oceania developing	1 600	30	1 500	700	3 000	30	3 000
East Asia developed	2 000	1 100	900	800	2 100	1 100	1 000
Oceania developed	1 500	400	1 100	1 000	2 000	500	1 500
Centrally Planned	6 500	3 600	2 900	2 300	8 400	4 700	3 700

TABLE 5

AVERAGE GROWING STOCK IN CLOSED FORESTS

Sub-region	Total	Coniferous	Non coniferous	Curre	ntly commercial
			Comment Table Management Comment and Comment C	Total	Non coniferous
	was and was one old the gas are the tool too the old two too			the man and sub-that op and the size also	, the case who can happen and the case who can have the the the the $m_{\rm c} \sim 10^{-3}$
Asia Far East Region	76	e o	0 0	53	0 O
South Asia	51	• •	4 0	38	0.6
Continental South East Asia	75	0 0	0 0	52	• •
Insular South-East Asia	106	88	106	66	65
East Asia developing	13	o •	a e	10	0 6
Oceania developing	88	90	87	30	30
East Asia developed	75	105	58	68	46
Oceania developed	41	39	78	64	70
Centrally Planned	67	o •	o o	54	o ø

Tesk, the second most important industrial species in South Asia, grows in deciduous formation mainly in central and southwestern parts of India.

In both sal and teak forests the standing volumes are generally above the sub-regional average of 44 m³/ha for non-coniferous types. Large dry deciduous forest formations, featuring species like sandalwood (Santalum album), acacias and albizzias have generally the lowest stocking per unit area because of poor growth and the fact that they are generally located closer to the population centres and consequently have been more heavily drawn upon in the past to meet the pressing fuelwood needs. Therefore, these forests are currently of little relative importance in terms of commercial wood production.

Although teak and sal stands may occasionally have an annual increment of 9 to 10 m³/ha in moist deciduous formations, the high proportion in the total forest area of dry deciduous forests with low stocking means that the average annual increment of industrial and fuelwood in the sub-region probably does not exceed 1.1 m³/ha.

Continental Southeast Asia

Throughout the sub-region the generally dark, heavy timbers of the genus <u>Dipterocarpus</u> make up the largest fairly uniform part of the commercial growing stock in the non-coniferous forests. In Burma and Thailand, together with the other most important genera Shorea, <u>Parashorea</u>, and <u>Pentacme</u> and teak, they make up some 60 to 70% of the total standing volume.

The principal teak resources are located in Burma, as a belt around the central dry zone, and in Thailand in the northern region. Further east the occurrences become occasional but the species is still found in parts of Laos and Cambodia. Although teak does not probably form more than 3 to 10% of the national growing stock in Burma and Thailand (310 million m³ and 40 million m³ respectively), it generally accounts for more than 50% of the stand volume in the teak bearing forests. In Thailand the average stock volume of teak in teak bearing forests has recently been estimated at as much as 80 m³/ha and annual net increment at 4 to 5 m³/ha.

Coniferous forests, mainly P. merkusii and P. kesiya are estimated to cover some 4.1 million ha in the sub-region, mostly in a mixture with non-coniferous species, with some 2 million ha in Burma, 1.3 million ha in Thailand and the rest in Laos, South Vietnam and the Cardomome mountains in southern Cambodia. Much of these resources occur in inoperable mountain areas and with a few exceptions they lie in too scattered locations and generally occur at too low an average stocking due to fire damages, resin tapping and shifting cultivation to be industrially usable. No reasonably accurate estimate could be given on the total timber volume or growth rate of these resources. However, in north and northeast Thailand pine resources, nine-tenths of which are P. merkusii, total some 54 million m³ with an average stocking of 40 m³/ha only, in a mixture with dipterocarps. Sufficient amounts of these stands are stated to be operable and have a potential to support economic scale pulp manufacture for about two decades.

Annual net increment of industrial and fuelwood is estimated at 2.5 m³/ha in the tropical evergreen forests, 2.0 m³/ha in the mixed deciduous type and 1.5 m³/ha in the dry deciduous formations, including both virgin and logged over areas, giving an overall average of some 2.0 m³/ha for the whole sub-region.

Insular Southeast Asia

Indonesia with a growing stock of some 8 500 million m³ or 100 m³/ha, about 64% of the sub-region total, dominates the resource situation in the area. In the absence of national forest inventories, data on the stock volume for the country are approximations only. Surveys carried out in concession areas suggest that generally at least half of the stand volume consists of currently commercial species and is in sizes about 35 cm (dbh).

While certain conifers, mostly P_2 merkusii, and Agathis species, are known to have an erratic occurrence in all main islands; in mixture with other trees, the stock volume expressed for conifers refers only to the known extent of pines and agathis in fairly pure stands in Java and Sumatra. The growing stock in these stands is presumed to average $100~\text{m}^3/\text{ha}$ and the annual net increment 4 to 5 m $^3/\text{ha}$.

Practically all teak forests in the sub-regions are located in Java, covering an estimated area of 640 000 ha, nearly all of which is in plantations. Total stand volume of the resource might be of the order of 64 million m^3 or 100 m^3/ha , with an annual increment of 5 m^3/ha or so.

Following the recent country-wide forest survey, average stocking in West Malaysia is estimated at 150 m³/ha (2 780 million m³ in total), of which 43% are dipterocarps and 26% other commercial species. Information on stand volumes in Sabah and Sarawak is scarce. A conservative estimate of 100 m³/ha is applied here, of which the dipterocarps probably account for about half, and all commercial species 60% in Sarawak and 80% in Sabah, where the forest composition bears a great resemblance to that prevailing in the Philippines. Coniferous timbers make up a negligible proportion in the forest volumes in West Malaysia; the same is most probably the case in Sabah and Sarawak as well.

The Philippines forests, with an average stocking of 124 m 3 /ha, totalling some 1 450 million m 3 , have, together with Sabah, the richest occurrence of dipterocarps in the region about 80% of the stand volume. Coniferous forests (mostly P_o kesiya) make up just over 1% of the country's timber resources with an average stocking of 70 m 3 /ha and an annual net growth of 4 to 5 m 3 /ha.

Annual net increment of industrial timber and fuelwood is estimated at 5 m 3 /ha and 0.1 m 3 /ha in logged over and unexploited dipterocarp forests respectively, resulting in an average of 1.2 m 3 /ha for the sub-region as a whole at present.

East Asia

In contrast to the tropical sub-regions, coniferous resources in this sub-region exceed those of non-coniferous species in commercial importance. Although the total stand volume is fairly equally divided, the generally poorer form and the lower increment in the non-coniferous forests results in the commercially useable part of the timber volume and cutting potential being appreciably higher in coniferous forests.

In Japan the average stock volumes are not very high—some 105 m 3 /ha for coniferous and 58 m 3 /ha for non-coniferous species. This results from intensive cutting in the past, particularly in private forests. Annual net increment is currently estimated at 4.6 m 3 /ha for conifers and 2.2 m 3 /ha for non-conifers. The great intensity of forest management is reflected in a large proportion of plantations—over 32% by area—the bulk of which is in coniferous species.

In South Korea the growing stock is extremely low, some 10 m³/ha. This is due to past cutting, mostly for fuelwood, which has been excessive in relation to the resource's yield potential.

Annual net increment of industrial and fuelwood resources in the sub-region is at present estimated at $5 \text{ m}^3/\text{ha}$ for plantations and $2 \text{ m}^3/\text{ha}$ for natural forests.

Oceania Developing

The growing stock per unit area in the sub-region is lower than in Insular Southeast Asia, and a generally smaller proportion of the forest volume is in currently commercial species. Coniferous resources are estimated at roughly 1% of the total volume in the sub-region, comprising the natural Klinkii and hoop pine forests in Papua New Guinea. Coniferous plantations in Papua New Guinea and in Fiji are still too limited in area and young in age to make a significant contribution to total volume.

Annual net increment of the natural forests in the sub-region is low at present because of the limited extent of past exploitation in natural forests. The estimate of $0.2 \text{ m}^3/\text{ha}$ applied here as the increment for industrial and fuelwood is based on the assumed growth rates of $3 \text{ m}^3/\text{ha}$ and $0.1 \text{ m}^3/\text{ha}$ for the cutover and virgin forests, respectively. For coniferous plantations the mean annual increment at rotation age has been estimated at $20 \text{ m}^3/\text{ha}$.

Oceania Developed

The average for the coniferous standing volumes in this sub-region is low, because of the relatively large extent of sparsely stocked coniferous, mainly cypress, pine forests in Australia, carrying less than 10 m³/ha of wood. Natural coniferous forests account for some 95 percent of the total area of coniferous resources in Australia. Plantations of coniferous species, however, have considerably higher average growing stock volumes — about 148 and 205 m³/ha in Australia and New Zealand, respectively.

Due to the low average stocking, the annual net growth of industrial timber and fuelwood is at present only about 1.4 m /ha for conifers and 0.8 m /ha for non conifers. The average for plantations is however 17 m /ha. Man-made forests in part account for some 38% of the total annual net increment in Australian forests and over nine-tenths in New Zealand.

REMOVALS IN RELATION TO CURRENT MET INCREMENT

To give an indication of the present status of forest exploitation in the region relative to the resource, average wood production and estimated annual net growth in 1969-71 have been related to operable forest area, in Table 6. As cutting from sources outside closed forests constitutes a large part of the total fuelwood removals in many countries of the region, an attempt has been made to sub-divide fuelwood outturn into output from forests and output from outside forests. Since these external sources of fuelwood are expected to dwindle rapidly resulting in an increasing pressure on the forest estate, total fuelwood removals from all domestic sources in relation to operable forest area have been shown for comparison.

Total production of roundwood has reached a level of approximately 700 million m⁵ per annum by 1973, of which 500 million m⁵ is fuelwood and 200 million m⁵ industrial roundwood. It is considered that about half of the volume of fuelwood comes from other forest than the operable closed forest, so that the current level of cutting in operable forest is of the order of 450-500 million m⁵. This volume is somewhat less than the estimated current increment of the operable forests. It amounts to 1.2% of the volume of growing stock. Removals of industrial roundwood constitute 0.5% of the growing stock volume. As it is considered that the increment estimates tend to include the increment of volume of logs or of industrial roundwood only, the current level of production may be appreciably below the actual total volume growth and current cutting might therefore be considered to be well within the sustainable capacity of the resources. Certain sub-regions, particularly South Asia, the centrally planned countries and even Insular South East Asia, appear to be outting at a higher level than is sustainable at current estimates of the level of increment.

South Asia, with exception of Nepal and Enutan, is made up of countries in severe wood deficit, demestic removals being noticeably below requirements, partly because of the disadvantageous distribution of the forest resources in respect of utilization centres. The total wood removals estimated to come from forests are of the order of the present net growth of the total timber stock in the sub-region. Nevertheless, the currently accessible forests, especially those near centres of population, are being evercut, mainly for fuelwood. Practically all of these are non coniferous with an average standing volume of 44 m /ha. Much of the forests which have reasonable stocking and cutting potential (coniferous forests and parts of the sal and teak forests) are at present inaccessible and unexploited, except

ESTIMATED AVERAGE 1969-71 REMOVALS IN RELATION TO CURRENT NET INCREMENT IN OPERABLE FORESTS

TABLE 6

				Removals	vals	nation of the second of the se		American Carrier State, Carrier State, State Sta		CHARLES CONTRACTOR OF THE PROPERTY OF THE PROP
	Industrial Roundwood	poowpuno	Fue	Fuelwood		Per unit area	area	de de caracterista des estados de la companya del companya del companya de la com	Current net inc	Current annual net increment
	Logs	Total	From Forests	Estimated Total	Industrial Roundwood Logs Total	Total	From Est	rood Estimated	Logs	Pulpwood Fuelwood
		million m3	1 m3	12 02 02 02 02 03 03 03 03 03			12		AND	***************************************
Asia Far East Region	133,3	195, 6	247.9	436.6	0°3	0.5	0.6	C)	9.0	0.8
South Asia	9.4	12.9	51,1	131.7	0.2	0,3	0.9	2,2	0.4	0.6
Continental South East Asia	12.5	18.1	41.8	58.6	0.2	0.3	9°0	0.8	1.0	red o red
Insular South East Asia	41,1	44.7	73.6	119.7	0,5	9°0	0°9	<u>-</u> ,	0,6	0,7
East Asia developing	1.9	2.6	5,2	8.7	0,4	0,5	1.0	1.7		0
Oceania developing	6°0	6.0	2,9	4, 2	0	0	0.1	0.2	0,1	0,2
East Asia developed	28,1	45.6	3,4	တ	1,2	1.9	0.1	0.2		0
Oceania developed	15.0	19,4	% %	% %	0.4	9.0	0.1	0.1	0.6	0.7
Centrally Planned	24.5	51.4	67.1	134,1	0.2	0.5	0.7	1,3	0.3	0.7

for limited local use, due to their location either in mountainous areas with unfavourable terrain conditions or too far from processing sites and centres of consumption of industrial wood raw material and fuelwood to be economically transported.

The bulk of current fuelwood supplies some from sources outside the forest and it is considered that with current or increasing rates of consumption the ability of these forests to meet requirements will be exhausted in the foreseeable future. The pressure on these resources, leading in turn to their depletion, will also have a harmful effect on the ability to perform environmental functions. Thus if the requirements for fuelwood are to be met, this will have increasingly to be from the closed forests themselves.

Assam, Bhutan and Nepal are the only parts of South Asia where wood removals could be noticeably increased by opening up operable forest resources.

In <u>Continental South East Asia</u> except for Thailand, the present outturn of industrial timber and fuelwood is well within the yield potential of operable forests. While the annual removals of industrial timber and fuelwood from Thailand forests, currently at some 2.0 m²/ha, are probably of the order of the average increment in the total standing crop, over-cutting of small-sized stocking for fuelwood is taking place at present and is bound to increase, causing inroads into the timber capital at an increasing rate from the late 70's onwards. Furthermore, the past over-exploitation of the teak resources in the country is apparently continuing.

In <u>Insular South East Asia</u> the annual net increment of the Indonesian forests is currently low, being roughly equal to the present total removals of about 1.3 m²/ha of industrial timber and fuelwood. This is because only approximately one-tenth of operable forest area has actually been cut over to date. Both the industrial wood and fuelwood removals are still small in relation to the timber-sized and small-sized growing stock respectively, and therefore within the resource's production potential. The relatively large amount of fuelwood estimated to come from outside the closed forests in the sub-region refers mostly to Java, which is extremely short of wood resources because of its high population density.

Although Malaysian forests are more intensively exploited for industrial wood then those of Indonesia, total roundwood removals are still within the annual net growth and sustained yield potential of the resources.

In the Philippines the annual production of roundwood is currently equivalent to over 3 m³/ha of operable forest. Although these forests are among the most intensively managed in the sub-region, it seems that the resources are being overcut both in terms of the current annual net growth and the rate at which the virgin forests are being exploited.

East Asia accounts for about 22%, i.e. slightly more than Insular South Asia, of the total industrial wood production in the region. In Japan present removals of industrial wood and fuelwood equivalent to some 2 m/ha of operable forest, are well within the production capacity of the resource with a current estimated net increment of 4.6 m⁵/ha and 2.2 m⁷/ha for coniferous and non coniferous stock respectively, even allowing for areas of forest currently being reserved for purposes other than wood production. By contrast the shortage of wood in South Korea is acute and the remaining resources are being overcut heavily.

In Oceania Developed annual industrial wood removals are at present 19.4 million m³, 11.4 million m³ in Australia and 8.0 million in New Zealand; fuelwood production is estimated at 2.3 million and 0.5 million m³ respectively. Total annual output of industrial timber and fuelwood in the sub-region is equivalent to 0.7 m³/ha of operable forest, which is well within the current net increment, 1.4 m³/ha for coniferous and 0.8 m³/ha for non coniferous stock. While in Australia some 20% of the removals are coniferous, in New Zealand they amount to over 90% of wood production. In both countries most of the coniferous wood output comes from man-made forests.

	arca		600 500 500	352 340 255	140 380 640	869 925 020	147 670 690	27 85 145	835 330 810	200 000 000
	Total area		55.55 67.58		o n in	7 7 6,9 60	0 H H	/m(00 00 00 H H	0 & & 0 & & 9 0 0
	Other Non-coniferous		8 900 11 800 14 300	656 1 055 1 490	9 55 100	53 60 70	969 850 980	30 30 30	3 10	7 500 10 000 12 000
Tales of the state	Eucalyptus		4 400 5 600 7 100	333 510 680	5 10 20	נינה	1 7 7	15 30	41 70 100	5 000 6 000
Non-Coniferous	Teak		1 100 1 600 2 100	349 750 1 050	119 270 435	609 615 625	111	2 5 10	5 F E	t i i
	Total	1000 ha	14 400 19 000 23 500	1 338 2 315 3 220	133 335 555	662 675 700	696 850 990	13 40 70	44 75 110	11 500 16 000 18 000
TOUS	Pine		14 900 19 000 23 800	12 20 30	20 20 45	167 210 280	1 296 1 855 2 275	35 65	686 1 095 1 530	12 700 16 000 20 000
Coniferous	Total	The second secon	28 200 36 500 44 500	4 W W	16 45 85	207 250 320	8 451 10 820 12 700	4. Q. V.	791 1,255 1 700	18 700 24 000 30 000
	Year		1970 1980 1990	1970 1980 1990	1970 1980 1990	1970 1980 1990	1970 1980 1990	1970 1980 1990	1970 1980 1990	1970 1980 1990
	Sub-region	AND AND A CONTRACT OF THE CONT	Asia Far East Region	South Asia	Continental South East Asia	Insular South-East Asia	East Asia	Oceania Developing	Oceania Developed	Centrally Planned

1/ East Asia includes East Asia developed.

ESTIMATED ANNUAL NET INCREMENT IN OPERABLE FORESTS

	Natu	Natural Forests						M	Man-made Forests	orests					
					Teak	5	Ð	Eucalyphus		Oche	Other non-coniferous Species	ferous		Coniferous	
	926	1980	1990	1970	1980	1990	1970	1980	1990	1970	1960	1990	1970	1980	1990
	,0000000						WI	m ³ /ha/a							2 0 4 0 4 4
South Asia	रूप्प 6 रक्क	1.3	ξ., Γ.)	00	10	<u> </u>	famil Assid	F 33	<u>π</u>	83	6	10	10	16	21
Continental Southeast Asia	2.0	23.53	0,0	60	10	14	9	e u	9	Ø	ę,	10	10	16	12 12 12 13 13 13 13 13 13 13 13 13 13 13 13 13
Insular Southeast Asia	1.2	80 83	d. RV	Ŋ	ο,	14	•	•	7 0	9	Q	10	16	19	17
East Asia	2.0	2.0	0.0	:			ł	ŧ	1	9 à	:		(5) 1/	(6) 1/	(7) 1/
Oceania developing	0.2	e: °	ss S	01	32	14	17	5m1	20	10	10	10	18	20	21
Oceanie developed	0.8	1.1	(f) 1-1	0	* *	6	(17) 2/	/2 (61)	(20) 2/	•	•		17	6.1	20
Centrally Planned	4.0	;; ,	(r) (r)	ŀ	1	1			•	•	:	•	(4) 3/	(5) 3/	(5) 3/ (5.5) 1/

A combined figure for conifers and "other non-coniferous species".
 A combined figure for eucalyptus and "other non-coniferous species".
 A combined figure for all plantations.

ESTIMA TED EVOLUTION OF SUPPLY POTENTIAL IN OPERABLE FORESTS TO 1990 IN ASIA FAR EAST REGION

TABIE 9

Area of operable Amuol net inc	Year Man-made Total Operable natural forests	Commercial All species	million ha	and Far East Region 1970 42 390 330 450 1980 56 340 410 530 1990 68 310 500 590	1970 1,3 59 50 66 1980 2,3 48 54 63 1990 3,3 39 56 59	Continental South-East Asia 1970 0,1 73 101 146 1980 0,4 57 110 147 1990 0,6 47 115 144	insular South-East Asia 1970 0,9 82 62 103 1980 0,9 65 132 189 1990 1,0 53 196 245	1970 9,1 29 34 38 1960 11,7 28 26 31 1990 13,7 27 25 25	1970 ° . 16 2 3 3 4 4 1980 0 . 1 1290 0 . 1 12 5 5 6	1970 0,8 29 20 22 1980 1,3 28 26 31 35 35	1970 30 100 56 70 1980 39 102 55 69 1990 48 104 67 74
Amusl net increment of industrial and fuelwood in operable forests	Man-made forests	Qualitation		180 310 440	, C 9	a west (C)	A 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	46 70 96	, c.) C3	13 25 36	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
.l and fnelwood	Total	Commercial A11 species	million m3	510 630 720 840 940 1 020	50 66 61 70 72 75	101 146 111 148 124 153	66 107 142 199 212 261	80 84 96 101 121 123	54 tr	33 36 51 56 68 71	177 190 254 260 331 335
Estimated operable forests, S	Logs	Commercial species		260 310 400	© (1) ←)	6 6 4 6 4	69 71	0 4 4 4 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	т-1 СИ СО	의 인 G 의 ID M	9 2 4 5 0
Estimated suctainable yield from forests. Stand volume equivalents		All		350 380 440	22 15 13	87 80 80	105 99 89	42 46 49	™ N M	33.71 33.33	75 105 175
ild from quivalents	Pulpwood/ Fuelwood	AII		320 395 440	영 영 95 대 () ()	55 55 62 62	70 70 73	55 55	60 tu vā	3.22	155 155 160

1/ East Asia includes East Asia developed.

In Oceania developing the present wood production from forests is extremely low in relation to their total and commercial growing stock and well within the current annual growth. Coniferous species make up a little less than one-tenth of the total wood removals in Papua New Guinea (mostly A. cumninghamii and A. hunsteinii), and as much as 40% in Fiji (Agathis vitiensis and Podocarpus vitiensis for the most part).

As far as the Asia Far East region as a whole is concerned, the current forest resources situation may be summarized as follows:

- a) the region is well forested in terms of the proportion of its area, over 18% under forest, but the average forest area per head of population 0.3 ha per caput is very small;
- b) the forest area on average is lightly stocked (76 m³ per ha) compared with temperate managed forests, but quite highly stocked compared with tropical forests generally;
- c) the resource is unevenly distributed between sub-regions by area which ranges from 23% of the total area in Insular Southeast Asia down to less than 10/ in each of the East Asia and Oceania sub-regions; but it is much more unevenly distributed by growing stock with 34% of the regional total in Insular South-East Asia and 8% in Oceania developing and particularly relative to population in terms of area with 0.1 ha per caput in South Asia and 12.0 in Oceania developing, as well as growing stock with South Asia having a little over 3 m per caput, while Oceania has over 150 m per caput;
- d) the present rate of removals of industrial roundwood amounts to less than 1% of the region's currently commercial growing stock, but in certain sub-regions is higher than increment.

FUTURE SUPPLY POTENTIAL

In East Asia and Oceania Developed where forests have been under intensive management for a relatively long time, and their productivity is somewhat stable, the rate at which the virgin forests of the region are exploited governs the actual yield capacity more than does the current and near future net increments. Important factors in relation to the future supply potential of these forests are the negative factor — the destruction and alienation of existing natural forests, both closed forest, open woodland and scrubland and two major positive factors, the possibility of extending the utilisation of timber species and qualities contained in natural forests and the possibility of growing timber in plantations.

Main features of the situation in each sub-region are reviewed below on the basis of available information in arriving at a tentative picture for the region as a whole. This is summarized in Table 7 which shows an estimate of the possible evolution of net increment and potential cut in operable forests of each sub-region over the period to 1990.

In South Asia the establishment of new man-made forests of general utility species near population centres, managed on short rotations mainly for fuelwood, is of crucial importance in alleviating the current over-cutting of accessible resources. Because future fuelwood needs will have to be met from forests to a much greater extent than at present, it is not considered likely that the area of future plantation assumed for the sub-region will be sufficient to bring about much increase in the overall sustained yield over the period. Although fuelwood production could be increased in future, the current rate of harvest of logs cannot be maintained and a steady decline in log output must be expected over the period. The area of operable natural forests is estimated to be reduced by one third by 1990 but an extension of the utilisation and recovery of round-wood may increase substantially the potential yield and be sufficient to at least maintain the increment potential. On the basis of these assumptions it has been estimated that

the total annual net increment may reach 75 million m³ in 1990 while the sustainable yield may increase from 36 million m³ in 1970 to 44 million m³ in 1990.

In Insular Southeast Asia . Only a very approximate estimate could be made of the potential of the countries. The little information and data so far accrued on the influence of the selective logging on the rate of growth in the residual dipterocarp stands suggests that a rotation of 50 years would suffice for sustained yield at the present level. Such a rotation would correspond with an annual supply level of 2.1 mJ/ha in terms of operable forest area in the sub-region. The rotation period could even be taken down to 40 years, which would be equivalent to 2.6 mJ/ha by 1990 because of an increasing proportion of selectively cut forests in the total resource.

Despite a decrease of over one third in the area of operable forests in the sub-region, net annual increment is expected to increase by 140% over the twenty years period up to 1990, as a result of cutting: net annual increment may reach 260 million m³ by 1990. The downward trend in the estimated sustainable yield, from 175 million m³ in 1970 to 160 million m³ in 1990, reflects the estimated decrease in the operable forest area over the next twenty years. In terms of logs of commercial species, yield potential seems fairly constant or still rising, mainly because an increasing proportion of species making up the stand volume will be used in the future. In the Philippines removals of industrial wood are expected to rise to 14-15 million m³ a year by 1985, if markets allow. Around that time, however, all operable virgin forests will be out over. In the meantime the rate of legal conversion to agriculture is about 80 000 ha per annum and destruction of forests by shifting cultivation is estimated at 150-200 000 ha per annum. Little is known of the likely development of forests which have been exploited but it is unlikely that they can be expected to contain mature timber in sufficient quantities to support even the current rate of exploitation in the future. Therefore, a slump in the annual log production from the current level of about 10 million m³, down to perhaps 3 to 5 million m³, seems inevitable as soon as virgin forests are exhausted.

In Indonesia an area of 18 million ha, 21% of the present closed forcest area, have been designated for conversion to agriculture; in West Malaysia the planned rate of conversion is 40-80 000 ha per annum over the next 10-20 years.

In Continental Southeast Asia where the bulk of the forest resources are in dry and moist deciduous types, logging in previously untouched forests is not expected to have such a great effect on the overall growth rate as in the evergreen dipterocarp forests of Insular Southeast Asia. Agricultural clearance and shifting cultivation will have a significant effect on the forests: shifting cultivation is estimated to affect 250 000 ha per annum in Thailand. Furthermore, timber harvesting and forest management activities in much of Continental Southeast Asia will take some time to recover from the unsettled political conditions in the area. In view of these considerations, it has been estimated that sustained cutting potential will probably be of the order of current annual net increment for most of the period, i.e. approximately 2.0 m3/ha a year, without substantial changes in the respective total volumes, around 140.150 million m3.

In East Asia, in addition to the alienation of forest lands for non-forestry purposes, some of the non coniferous natural forests in the lower altitudes in particular, are being converted into timber plantations. Therefore the total annual net increment and yield potential from natural forests will be declining in future. The decline, however, will be more than offset by the volumes of wood becoming available from the man-made forests which are estimated to yield almost three times as much as the natural forests by 1990. About nine-tenths of the plantation yield over the period will come from coniferous species. As a result of the strongly increasing contribution from the man-made forests, it is estimated that not annual increment and sustainable yield will increase in the same proportion from 80 million m3 in 1970 to approximately 120 millions m3 in 1990.

In the Oceania Developing increases in the future rate of growth in natural forests are expected to be small since the extension of utilisation is not likely to show much effect on increment over the next twenty years or so. Certainly the sub-region's forests are capable of producing considerably more than the anticipated levels of net increment would suggest: a rotation of 60 years, corresponding to an annual increment of 1.5 m3/ha in respect of the operable forest area, would probably suffice to maintain a sustained yield. This would be the equivalent of an annual cut of about 6 million of logs and 12 million m3 of pulpwood and fuelwood. However conservative estimates were retained for future levels of annual net increment and sustainable yield, at 8 million m3 in 1990.

In <u>Oceania Developed</u> the relative increase in the annual plantation yield is less pronounced than in <u>East Asia</u> and much the same as that on part of the natural forests. While in New Zealand man-made forests currently account for over 90% of the annual cutting potential, in <u>Australia</u> they make up just over a third of the sustained yield capacity of the forests. On the other hand, annual yield potential from the <u>Australian natural</u> forests is assumed to have a slightly rising trend because management practices aimed at increasing the growing stock and increment are currently being applied to some of the indigenous forests in the sub-region. As a result it is estimated that annual net increment and sustainable yield will reach 70 million m3 by 1990 thus almost doubling from the 1970's level.

In the centrally planned economies the majority of forest resources are located in North East China, i.e. in Manchuria and the north-eastern part of Inner Mongolia. These forests are coniferous or mixed coniferous/deciduous non coniferous and are estimated to make up some 60% of China's total forest resources and to provide an even larger proportion of her annual production of industrial wood. Because of their inaccessibility, much of these resources will probably remain untapped for some time. Operable natural forests are currently being overcut for industrial wood and in particular for logs. This is, however, likely to be offset by increasing volumes of timber expected to become available from plantations from the late 80's onwards, and also by the beneficial effect the cutting of over mature stock will have on the overall rate of growth in the country's forests. The rate at which harvesting could be stepped up towards the end of the 90's depends on the extent of successful establishment of timber plantations and intensity in their management maintained. It is probable that the current level of industrial wood production can be maintained in future through the transition to the plantation supply, although difficulties may occur locally. At any rate, it is most likely that the present domestic supply deficit of logs and other industrial wood in relation to domestic demand will noticeably increase over the period. The larger part of fuelwood consumed in the country is cut from sources other than closed forest. Although these external sources are undoubtedly diminishing, the yield potential of fuelwood is assumed to increase towards 1990 through a gradual shift to plantation supply.

The development of future supply potential of the region as a whole will mainly depend on the relative importance of the three major factors, namely forest clearance, extension of utilisation and establishment of plantations.

(a) Agricultural clearance, shifting cultivation and destructive logging are important in reducing the productive potential of the forests of the regions taken together they must be expected to reduce notably the area of closed forests. It seems certain that over a period of nearly 20 years the net reduction will be greater than 5%; it may be as great as 10% to 20% and in some parts of the region may significantly impair the capacity of the forests to meet future timber requirements. Precise estimates of these tendancies are necessary to make it possible to assess the long term capacity of the forests to supply timber. For the purpose of this study a broad estimate of the change in area of operable natural forests has been put forward, namely a reduction of 20% on the 1970 area by 1990. This reduction is mainly concentrated in South Asia, South East Asia and Oceania developing, while in other sub-regions the area is expected to remain about the same.

- (b) More complete utilisation and recovery of roundwood, adoption of shorter cutting cycles and improved management of the growing stock can greatly increase the potential yield of remaining natural forests. It is considered that in South Asia, Continental South East Asia and Oceania developing such improvements could virtually be sufficient to maintain the increment potential while they could lead in Insular South East Asia to a substantial increase in total increment potential over current levels in spite of reduction in operable forest area.
- (c) Man-made forests already constitute about one tenth of the forest area of the region and perhaps nearly one third of the estimated increment in operable forests. The importance of man-made forests is much greater in the temperate area in East Asia, Oceania developed and the centrally planned countries; these three sub-regions in fact account for more than 95% of the region's man-made forest area. It is expected that the contribution of plantations will rapidly increase and that their increment will more than double from 1970 to 1990 reaching about 440 million m3 by that year, 40% of total increment.

The increment of man-made forests in the tropical sub-regions increases rapidly from about 4.5 million m3 in 1970 to 40 million m3 by 1990 but still contributes only a small part of the regional total.

In total it is considered that the productive potential of the forests of the region by 1990 could be almost double that of 1970, in spite of the diminuition in total operable forest area. Achievement of this substantial increase will be dependent on a considerable improvement in the efficiency of utilisation and management of natural forests and a substantial input in the development of man-made forests.

There is little doubt that already noticeable trends in the changing pattern of the region's log supply will steadily continue over the period under review. Plantation-grown logs of smaller dimensions, from a small number of coniferous timbers, will increase their share over secondary species, and smaller sizes of a larger range of species will be harvested from indigenous forests; this will lead in turn to a reduction in the predominance of large, high quality logs from relatively few natural non coniferous species. By 1990 these progressive changes might be considerable.

The major problem of the relative scarcity of forests in the most populous countries of the region could be overcome only by massive investment of effort in tree planting to ensure the minimum supply of wood for fuel and rural requirements. There are some indications that in the centrally planned countries investment in new afforestation will go some way to meet the growing requirements of the region. The currently predictable increase in supply in the developing market economies of the region through afforestation is trivial in relation to the level of requirements in these countries.

APPENDIX 1

ESTIMATED LAND USE 1970

Sub-region		Closed fore	st	Aminata	Cwl.	Land	area
Country	Total	Per caput	% of total land area	Agricultural	Other	Total	Per caput
	million ha	ha	%		million ha		ha
Asia Far East Region	537.1	0, 3	18.4	837.3	1,538.2	2,912.6	1.5
South Asia	70.6	0.1	15.8	206.4	169.7	446.7	0. 6
Bangladesh	1.2	0	8, 5	4.9	8.0	14. 1	0.7
Bhutan India	3.0 57.0	3.5 0.1	63.9 17.4	1.0 177.9	0.7 91.9	4, 7 326, 8	5, 4 0, 6
Nepal	4,4	0.4	31.2	4.0	5.7	14, 1	1.3
Pakistan Sri Lanka	2.6 2.4	0 0, 2	3, 2 36, 4	16.7 1.9	61.1 2.3	80, 4 6, 6	0, 7 0, 5
Continental South East Asia	91.1	1.0	51, 1	38.7	48.3	178.1	1.9
Burma	39.0	1.4	57.6	16.4	12.4	67.8	2,5
Cambodia	11.0	1.5	62.2	3.6	3, 1	17.7	2.5
Laos Thailand	13.0 24.5	4. 4 0. 7	54.9 47.6	1.6 11.4	9.1 15.6	23.7 51.5	8.0 1.4
South Vietnam	3, 6	0.2	20. 7	5.7	8. 1	17.4	0.9
Insular South-East Asia	124.8	0. 7	49.1	29.4	99.9	254, 1	1.4
Brunei	0.4	3, 3	66. 6	0.1	0.1	0. 6 190. 4	5.0
Indonesia Malaysia	85.0 23.5	0.7 2.2	44.6 71.0	15.4 3.6	90.0 5.9	33.0	1,6 3,0
- Sabah	(6.0)	(9.1)	(78, 9)	(0,2)	(1.4)	(7.6) (12.4)	(11.5) (12.6)
– Sarawak – W. Malaysia	(9,2) (8,3)	(9, 4) (0, 9)	(74, 2) (63, 4)	(0,7)	(2.5) (2.0)	(13.0)	(1.4)
Philippines Singapore	15.9 0	`0, 4 0	53.0° 0	10.3 0	3.8 0.1	30.0 0.1	0.8 0.1
East Asia developing	6.5	0, 2	66. 4	2.3	1,1	9,9	0, 3
Hong Kong	0	0	0	o	0, 1	0, 1	0
Korea Rep.	6.5	0.2	66. 4	2,3	1, 0	9.8	0, 3
Oceania developing	39.3	12.0	71.9	1.8	13,7	54.8	16.6
Fiji New Caledonia	0.5	0.9	27. 7 18. 0	0, 2 0, 5	1.1 1.1	1.8 1.9	3. <u>4</u> 19. 0
New Catedonia New Hebrides	0, 3 1, 0	3. 0 10. 0	71.4	0,3	0.1	1,4	14.0
Papua New Guinea Solomon Islands	36. 4 0. 9	15.4 5.9	78. 3 31. 1	0.5 0.2	9.6 1.8	46.5 2.9	19.7 19.0
Western Samoa	0, 2	1.4	66. 6	0.1	o o	. 0.3	2,1
East Asia developed						•	
Japan	25,2	0.2	66, 8	6.5	6,0	37.7	0.4
Oceania developed	49,5	3,2	6, 3	256,6	481.3	787.4	51.2.
Australia New Zealand	42, 6 6, 9	3. <u>4</u> 2. <u>4</u>	5.6 26.0	243.2. 13,4	475, 1 6, 2	760, 9 26, 5	60, 6 9, 4
Centrally planned	130.1	0. 1	11,4	295.6	718, 2	1, 143. 9	4 4
China	111.8	0. 1		288, 2	559, 6	959.6	1.2
Korea DPR Vietnam DR	8.0 7.8	0.6 0.4		1.9 2.0	2, 1 6, 0	12.0 15.8	0, 9 0, 8
Mongolia	2.5	2,0		3,5	150.5	156.5	126.0
				ATTOCKY (VIII)			

TABLE 2

ESTIMATED COMMERCIAL FOREST AREAS

C 1	Operable clos	ed forest	T . 13.	
Sub-region Country	In use	Total	Inoperable closed forest	Total area of closed forest
		million	ha	
Asia and Far East Region	279.8	378.3	158.7	537.0
South Asia	53, 2	58.5	12.0	70, 5
Bangladesh	0.8	0.9	0.3	1.2
Bhutan	1.0	2.4	0.6	3.0
India	48.0	50.0	7.0	57. 0
Nepal	1.5	3. <u>1</u>	1.3	4.4
Pakistan	0.6	0.7	1.8	2.5
Sri Lanka	1.3	1.4	1.0	2.4
Continental South-East Asia	52.3	72.6	18.5	91.1
Burma	25.0	31.0	8.0	39.0
Cambodia	3.0	9.0	2.0	11.0
Laos	3,0	10.0	3.0	13.0
Thailand	18.7	19.7	4.8	24.5
South Vietnam	2.6	2.9	0.7	3.6
Insular South-East Asia	36.0	71.9	52.9	124.8
Brunei	0.2	0.3	0.1	0.4
Indonesia	14.4	42.0	43.0	85.0
Malaysia	12.7	13.6	4.9	23.6
- Sabah	(3.0)	(5.0)	(1.0)	(6.0)
- Sarawak	(4.2)	(7.0)	(2.2)	(9. 2)
- West Malaysia	(5.5)	(6.6)	(1.7)	(8.3)
Philippines	. 8. 7	11.0	4.9	15.9
last Asia developing	4.0	5.2	1.4	6.6
Korea Rep	4.0	5.1	1.4	6.5
Oceania developing	2,1	16.3	23.0	39.3
Fiji	0.3	0.3	0, 2	0.5
New Caledonia	0, 2	0.2	0. 1	0.3
New Hebrides	0	0.1	0.9	1.0
Papua New Guinea	1.0	14.8	21.6	36.4
Solomon Islands	0.5	0.7	0, 2	0.9
Western Samoa	0.1	0, 2	0	0.2
East Asia developed				
Japan	24.1	24.1	1.1	25.2
Oceania developed	29.2	29.2	20.2	49.4
Australia	27.0	27.0	15.5	42.5
New Zealand	2.2	2.2	4.7	6, 9
Centrally Planned	78.9	100.5	29.6	130.1
China	70.9	87.2	24.6	111.8
Korea, DPR	4.0	5, 6	2.4	8.0
Vietnam, DR	3,0	6, 2	1.6	7.8
Mongolia	1.0	ĭ.5	î. 0	2.5

TABLE 3

GROWING STOCK IN CLOSED FORESTS

Sub-region Country		Operable clo	osed fores	ts	All closed forests			
Country	Total	Coniferous	Non c	oniferous Currently commercial	Total	Coniferous	Non conifere	
were and the second					THE RESERVE AND PERSONS ASSESSMENT OF THE PE			
Asia Far East Region	28 861	5 551	23 310	15 289	38 735	7 099	31 636	
South Asia	2 978	364	2 614	1 884	3 533	620	2 913	
Bangladesh Bhutan India Nepal Pakistan Sri Lanka	54 166 2 370 251 46 91	0 83 150 95 36 0	54 83 2 220 156 10 91	36 64 1 600 109 7 68	72 210 2 700 373 71 107	0 105 300 160 55	72 105 2 400 213 16 107	
Continental South East-Asia	4 985	. 1	4 984	3 425	6 278	52	6 226	
Burma Cambodia Laos Thailand South Vietnam	2 480 693 800 780 232	1 	692	485 	3 110 846 1 040 994 288	 2 	944 	
Insular South-East Asia	9 2 09	40	9 169	5 178	13 276	45	13 231	
Brunei Indonesia Malaysia - Sabah - Sarawak - W. Malaysia Philippines	21 5 200 2 100 (500) (700) (900) 1 888	0 25 0 0 0 0	21 5 175 2 100 (500) (700) (900) 1 873	15 3 095 1 427 (400) (420) (607) 641	28 8 500 2 780 (600) (920) (1 260) 1 968	0 30 0 0 0 0 0	28 8 470 2 780 (600) (920) (1 260) 1 953	
East Asia developing	64	32	32	29	80	41	39	
Korea Rep	58	32	26	25	74	41	33	
Oceania developing	1 563	27	1 536	717	3 030	34	2 996	
Fiji New Caledonia New Hebrides Papua New Guinea Solomon Islands Western Samoa	18 12 2 1 480 39 12	0 0 0 27 0	18 12 2 1 453 39 12	14 9 1 666 21 6	30 18 10 2 910 50 12	0 0 0 34 0	30 18 10 2 876 50 12	
East Asia developed								
Japan	2 012	1 067	945	768	2 103	1 114	989	
Oceania developed	1 511	367	1 144	1 029	2 010	486	1 524	
Australia New Zealand	1 239 272	109 258	1 130 14	1 018 11	1 652 358	146 340	1 506 18	
Centrally Planned	6 539	3 653	2 886	2 259	8 425	4 707	3 718	
China Korea, DPR Vietnam, RP Mongolia	5 758 280 496 (5)	3 444 154 50 5	2 314 126 446	1 851 96 312	7 393 400 624 (8)	4 417 220 62 8	2 976 180 562	

Table 4

AVERAGE GROWING STOCK IN CLOSED FORESTS

Sub-region Country	Total	Coniferous	Non-coniferous	Currently	commercial	
				Total	Non-coniferous	
,			n3/ha	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□	To make the second seco	
Asia Far East Region	76		* *	53	s ø	
South Asia	51	• •	5 b	38	9 9	
Bangladesh Bhutau India Nepal Pakistan Sri Lanka	60 70 47 85 27 54	140 190 72 0	60 23 54	40 60 35 66 44 40	 32 42 16 40	
Continental South-East Asia	75	• •	* 9	52		
Burma Cambodia Laos Thailand South Vietnam	80 77 80 41 80	130 40	77 41	56 54 56 42 56	54 42	
Insular South-East Asia	106	88	106	66	65	
Brunei Indonesia Malaysia - Sabah - Sarawak - W. Malaysia - Philippines	70 100 116 (100) (100) (150) 124	100 70	70 100 116 (100) (100) (150)	49 60 80 (80) (60) (100) 74	49 60 80 (80) (60) (100)	
<u> East-Asia developing</u>	13	* *	0.0	10	۴ 9	
Korea Rep.	13	10	17	10	10	
Oceania developing	88	90	87	30	30	
Fiji New Caledonia Papua New Guinea Solomon Islands Western Samoa New Hebrides	60 60 30 55 60 25	90	80 25	45 45 30 30 30 20	30 20	
East Asia developed						
Japan	75	105	58	68	46	
Oceania						
Australia New Zealand	39 52	11 205	84 41	63 67	76 32	
Centrally Planned						
China Korea, DPR Vietnam, Rep. Mongolia	67 50 80	80	4.9 • • • •	54 38 56	37	

APPENDIX 2

Main assumptions underlying the estimates of future supply potential in table 9

i) Average annual rates of decrease in operable forests through alienation of forest lands for non-forestry purposes, through trensfers to agriculture by planning development, shifting cultivation and encroachment and the extent of salvage cutting taking place on areas lost to forestry are as follows:

	Annual Decrease in Operable Forest Area . %	Area Salvaged Percent of Total erea Annually Lost to Forestry
South Asia	2.0	10
Continental and Insular Southeast Asia	2.0	10
East Asia	0.4	50
Oceania Developed	0.3	50
Oceania Developing	2.0	10

The rates applied for the decrease in forest areas are based on estimates prepared by Forest Authorities and FAO field Projects in several countries in the region. For the first three sub-regions these estimates range from 1.2 to 2.5% a year; hence an average of 2.0%. Except for East Asia and Oceania, a proper salvage cut, yielding some 60% of the average stocking per unit area, is assumed to be carried out only on one-tenth of the area annually lost to forestry. This is because much of the shifting cultivation in the region occurs in logged-over forests; for several reasons forest areas affected or already deforested by shifting cultivation coincide to some extent with those being alienated to agriculture; and on most reservations for non-wood purposes, utilisation cutting would not take place, and in many cases conversion will proceed without waiting for salvage logging to be completed.

ti) The present areas of man-made forests and the future development of new establishment will be as in table 7. The forecasts of future planting are largely based on the current plans of the forest authorities in the countries concerned. It is intended to show only the extent of plantations with a potential for commercial wood production, excluding those put up solely for the purposes of soil protection and water flow regulation which occur in too scattered locations, remote areas or in too rough a terrain to be considered suitable for production forestry. Although in most cases this has been possible, the estimates include an unknown, though small, element of exclusively protective reforestation.

iii) Growth rates in the natural and man-made forests are as shown in table 8.

These rates for the indigenous forests in Continental and Insular Southeast Asia follow from the assumption that the annual net increment in virgin forests is 0.1 m3 and in selectively logged-over dipterocarp areas 5.0 m3/ha. Growth in South Asia is low due to a great proportion of dry deciduous formations and generally low stocking in the sub-region's forests (about a half of that in the dipterocarp area). In Oceania Developing the increment is low at present because only a fraction of its forests has to date been under exploitation. While in Oceania Developed the current management practices for stand improvement and for building up of the growing stock in the natural forests is expected to continue and bring about an increase in the annual growth over the study period, in East Asia future conversion of the cut-over broadleaved forests on better soils into plantations is assumed to result in a fairly constant future increment in the remaining natural forests.

Except for Oceania Developing and East Asia, differences between the sub-regions, in the plantations' growth rates for 1970 are evidently partly explained by the inaccuracies and deficiencies in the available data; sub-region comparisons should therefore be made with caution. Increases assumed in the net increment of plantations over the period are based on rising proportions of these resources achieving maturity and on expected improvements in the management of man-made forests.

iv) The proportion of the stand volume in commercial species in the natural forests will be as below, in percentage

	<u>1970</u>	<u> 1980</u>	1990	2000
South Asia	75	85	95	100
Continental Southeast Asia	70	75	80	85
Insular Southeast Asia	60	70	80	90
Eest Aoia	90	95.	100	100
Oceania Developed	90	95	95	95
Oceania Developing	34	40	50	60
Centrally Pianned	80	85	90	95

v) The intensity of management in natural forests will largely remain at the present level; for plantations, a certain amount of improvement is assumed in all sub-regions, which is reflected in the anticipated growth rates (assumption iii).

APPENDIX 3

NOTES ON FOREST RESOURCES BY COUNTRY

Country	Page No.
Australia	31
Bangladesh	37
Burma	40
Fiji	42
India	47
Indonesia	51
Japan	58
Korea, Republic of	63
Malaysia	68
New Zealand	73
Pakistan	78
Papua New Guinea	82
Philippines	87
Sri Lanka	92
Thailand	95

NOTE ON SYMBOLS

- _.../ refers to footnote at bottom of the table or page.
- (...) refers to a source identified by its number on a list at the end of the country note.

AUSTRALIA

Forest Surveys

The inventory status of Australian commercial forest resources is as follows:-

	million	hectares
Intensive inventories - statistically designed - not statistically designed	8, 5	8.4 0.1
Extensively inventoried - statistically designed - not statistically designed	17.7	17.5 0.2
No inventory	16.3	
All forests	42.5	

The area extensively inventoried has increased from 10.9 million hectares to 17.7 million hectares.

Reasonable survey data are available for the better stocked government forests and for all plantations regardless of ownership: information on the remaining government forests is inadequate and is virtually non-existent on forest on privately held land.

Areas of Forest

The forest areas shown, apart from discrepancies due to rounding of totals, are derived from those presented to the Australian Forestry and Wood Based Industries (FORWOOD) Conference, held in Canberra in 1974, by the Forest Resources Panel set up to prepare for that Conference (1).

Table 1: Land Areas - Australia, as at 30 June 1974 (millions of hectares)

Land Use or Vegetative Cover Group	State or Territory							
	New <u>1</u> / South Wales	Victoria	Queens- land		Western Australia	Tasmania	Northern Territory	TOTAL
Forest 2/	15.5	5,9	11,9	0.1	3.1	2.8	3.3	42.6 <u>5</u> /
Woodland 3/	1.7	0.9	74.5	6.1	2,9	2.1	7.0	95, 2
Agricultural Area 🛂	57.7	14.9	0.5	50.9	108.1	0,9	0,2	243.2
Other Area4/	4.3	0,8	85.9	28,1	136.1	1.0	123.7	379.9
	79.2	22.5	172,8	95.2	250.2	6.8	134.2	760.9

- 1/ Includes areas in Australian Capital Territory (ACT).
- 2/ From Report of Panel 2 Forest Resources, of the Australian Forestry (1) and Wood-based Industries Development Conference 1974. (Commercial forests).
- 3/ F.A.O. World Forest Inventory, 31 March 1970.(2)
- Derived from F.A.O. World Forest Inventory 31 March 1970 (2). The two items "Agricultural area" and "other area" are combined under the heading "Open" in Table 1, page 49 of Forestry Bureau Annual Report 73/74.(3)
- 5/ Any discrepancy from totals shown in other tables is due to rounding.

The pattern of forest ownership as at 30 June 1971 is shown below:-

Table 2: Forest areas at 30.6.71 by States, and ownership categories (1000 hectares)

Ownership (see footnotes)		State or Territory							
A design of the second of the	N.S.W. 1/	VIC.	QLD.	s.A.	W.A.	TAS.	N.T.	TOTAL	
State (A)	2 897	2 412	3 182	70	1 925	926	312	11 724	
Other Public (B)	6 487	2 755	6 895	-	416	721	2 639	19 913	
National Park (C)	864	128	366	1	34	122	315	1 830	
Private (D)	5 288	600	1 431	17	691	1 009	-	9 036	
	15 536	5 895	11 874	88	3 066	2 778	3 266	42 503	

1/ includes A.C.T.

State (A) - Publicly-owned land, permanently reserved or dedicated primarily for timber production.

Other Public (B) - Publicly-owned land, vacant or occupied under lease, not specifically secured for permanent timber production, but on which control of timber rests with the Crown.

National Park (C) - Publicly-owned land, permanently reserved for purposes other than timber production.

Private (D) - Privately owned land, and leasehold where the Crown has no control over timber rights.

All plantations and virtually all areas of natural forest considered commercially exploitable are already accessible

(1000 hactures)

	•	******
Forest under exploitation	27	000
Forest not under exploitation - excluded from exploitation by law 1 830 - not yet under exploitation 13 673	15	503
	42	503

Forest types

Revised descriptions of commercial forest types were prepared for the Forestry and Wood-based Industries Development Conference (FORWOOD) in 1974. Those detailed descriptions can be found in the Conference documents.

Cypress type occur as a discontinuous belt west of the Great Dividing Range in N.S.W., Queensland, and Northern Territory. Main species are Calitris Glauca (white cypress pine) and C. endlicheri (black cypress pine). Much of it has been cut but the remaining scattered stands are locally important providing versatile tamber in regions for away from principal forest resources along the coast.

Eucalypt forests consist mainly of eucalypt of which there are more than 500 indigenous species in the country, provenances included. Eucalypt forests are divided in three main productivity groups, each of which covers a number of types. They cover a wide range of climates and geographical areas from the moist lowlands of Queensland and New South Wales to dry lands in Western Australia and Victoria and to the cold wet mountains of Tasmania. These forests provide the bulk of broadleaved sawlogs and plywood logs production in the country. Although a great number of species is found in these forests, the main commercial species are few and mostly consisting of eucalypts of which the dominant species vary according to type and location of forests.

Rainforest is found in scattered locations along the east coast from the very North of Queensland to Tasmania and therefore occurs in a wide range of climatic conditions from tropical to temperate:

tropical - an extension of the Indo-Malayan flora in Northern Territory and Northern Queensland. Notable species are Railschmiedia baneroftii (Queensland walnut) and Flindersia spp. (Queensland maple) as well as a number of other lesser known cabine timbers. In places, also Agathis spp. (N. Qal. kauri pine) may occur.

<u>subtropical</u> - in southern Queensland and northern N.S.W. commercial cabinet timbers fewer than in the tropical rainforest, of which most important are <u>Flindersia spp.</u> <u>Argyrodendron spp.</u> and <u>Ceratopetalum apetalum</u>. In mixture with these species hoop pine has erratic occurrence.

temperate - in Tasmania. The principal commercial constituents of this quite different type of rainforest are Nothofagus cumninghamii (myrthle beech) and Atherosperma moschatum (southern sassafras).

Growing Stock

Standing volumes of timber in Australian forests under exploitation or available for exploitation have been estimated by State forest services, and compiled by the Forestry and Timber Bureau as follows:-

Table 3: Australian Forests - Estimated Standing Volumes, July 1975

Type of Forest	Estimated standing volume (million cubic metres)
Coniferous Plantations Cypress pine forests	68 4 1
Total, coniferous	109
Broadleaved eucalypt high forest) rain forest) Tropical eucalypt forest	1 071 59
Total, broadleaved	1 130
Total, all forests	1 239

The average volumes per hectare in the native forests of Australia are very low. This is mainly because only the small areas of rainforest and a relatively small proportion of the eucalypt forest lie in country with a high rainfall—the greater part of the eucalypt forest and all the cypress pine forest is in areas of comparatively low rainfall which is only capable of supporting a rather open type of forest. The low volumes are also to some extent a result of the removal by harvesting of most of the accumulated capital of mature and over-mature trees.

It is not possible to provide a meaningful estimate of the annual increment of Australian forests. The forests consist of a mixed and highly intermingled series of age classes. Some of them are mature and over-mature, while others are young age classes with various rates of growth. Under these conditions a mean annual gross increment does not have much meaning.

For plantations a weighted average 16 m³/ha for all commercial species planted on a significant scale was adopted by the Australian Forestry and Wood-based Industries (FORWOOD) Conference 1974 and was recorded in the Conference report.

Plantations

Past and planned future development of plantations is as follows:-

Table 4: Plantations established or planned, at selected years, 1000 hectares

Cumulative

Year		N.S.W.	VIC.	QLD.	s.A.	W.A.	TAS.	ACT.	N.T.	TOTALS
1950 1960								119.1 207.4		
"1967	Coniferous - Crown - Private Broadleaved - Cr Pr. Total	58.1 49.1 9.0 6.5 0.5 6.0	66.3 28.6 37.7 4.1 3.0 1.1	59.4 50.1 9.3 2.8 2.0 0.8	74.0 58.4 15.6 1.5 1.4 0.1	20.1 19.3 0.8 7.7 7.7 -	15.5 10.9 4.6 0.4 0.4 -	11.7	0.6	305.7 228.7 77.0 23.0 15.0 8.0
1971	Coniferous - Cr Pr. Broadleaved - Cr Pr. Total	90.6 77.2 13.4 14.5 9.7 4.8	97.4 44.9 52.4 8.7 4.4 4.3	87.3 70.1 17.2 2.9 2.0 0.9	83.6 67.8 15.8 1.5 1.4 0.1	32.1 28.9 3.2 7.7 7.7 -	24.6 17.5 7.1 0.4 0.4 -	12.5	2.3 2.3 - 0.1 0.1 - 2.4	430.4 321.2 109.2 35.8 25.7 10.1
1974	Coniferous - Cr Pr. Broadleaved - Cr Pr. Total	122.6 100.5 22.1 10.0 4.5 5.5 132.6	116.3 62.4 53.9 11.8 6.6 5.2 128.1	111.0 88.5 22.5 3.0 2.1 0.9 114.0	90.1 73.1 17.0 1.4 1.4 91.5	39.4 34.8 4.6 7.8 7.8 47.2	31.1 22.6 8.5 0.1 0.1	13.8 13.8 - - 13.8	2.3 2.3 - - - 2.3	526.6 398.0 128.6 34.1 22.5 11.6 560.7
Future	e planting planned 1/		A	nnual		Total	for 5 years			
5 year	period 1975-79 1980-84 1985-89 1990-94 1995-99			23.1 24.9 26.1 21.7 19.6			115.5 124.5 130.5 108.5 98.0			676.2 800.7 931.2 1039.7 1137.7

^{1/} Adapted from Report of the FORWOOD Conference 1974 "Froduction Forestry Development Plan", (4)

The distribution of the planned new planting areas between States and Territories has not been worked out in detail. The greater part of the planting is likely to be in Pinus spp. but eucalypts may be used on an increasing scale. Hoop pine (Araucaria cumninghamii) planting is expected to continue in Queensland, possibly at the rate of 1000 has per annum.

The age class structure and species distribution of plantations as at 31 March 1972 is shown in Table 5 below.

Table 5: Age class structure of plantations by species as at 31 March 1975 (1000 hectares)

Age Class (years) Species or Group	1~5	6-10	11-15	16-20	21-25	26-30	31~35	36-40	40 +	TOTAL
Coniferous Pinus radiata P. elliottii + P. taeda P. pinaster P. caribaea Araucaria sp. Pseudotsuga menziesii Callitris intratropica Other conifets	110.3 27.9 8.2 3.0 7.9 0.3 1.3	68.6 11.1 4.6 1.6 5.0 0.1 0.2	38.6 9.0 3.3 0.9 3.9	24.9 7.9 2.7 0.3 3.5 - 0.8	19.4 5.6 1.2 4.8	8.8 0.2 0.3 - 0.8	10.8 0.4 0.7 - 4.8 0.2 - 1.3	17.5 0.9 1.9 - 1.9 0.4 - 3.2	14.3 0.1 1.4 - 1.3 0.2 - 2.0	313.2 63.0 24.1 5.8 33.8 1.2 1.5
TOTAL	160.9	92.2	56.3	40.2	32.2	10.4	18.0	25.8	19.3	455.2 <u>1</u> /
	1-10	11-20	21-30	31-40	41-50	51-60	61 - 70	70 +		-
Broadleaved spp.	12.4	1,2	3,3	5.5	1.0	0.3	0.3	0.7		24.72

Discrepancies in totals are due to rounding or inclusion in totals of areas too small to be recorded in age classes/species.

 $[\]underline{1}$ / There is an additional 1964 hectares of conifer plantation for which age class distribution is not available.

^{2/} There is an additional 3107 hectares of broadleaved plantation not recorded in age classes.

As indicated above (page 5) a weighted average for MAI of all Australian plantations of 16 $\rm m^3/ha$ was adopted by the FORWOOD Conference 1974.

Annual increments vary widely according to species and site conditions and the following might be taken as a rough guide for plantations of different species.

Species	Mean annual	increment, range			
	m3/ha				
Pinus radiata) P. caribaca)	14.5	to 24.5			
P. pinaster	8	to 10.5			
P. elliottii	12	to 14			
Other conifers	14	to 19			
Eucalypts	10.5	to 28			

Rotations for pines vary from 30 to 50 years. Hoop pine is usually managed on a rotation of at least 50 years, more usually 55 or 60. Eucalypt plantations are grown on rotations varying from 15 years for fast growing species under intensive management for pulpwood production, to 60, 70 or more years for sawlogs.

Removals

Removals of industrial wood from Australian forests in selected past years is shown in Table 6 below:-

Table 6. Removals of industrial wood from Australian forests in selected past years (3) (3) (1000 m3)

Year	Broadleaved			Coniferous				Grand	
	Logs	Pulpwood	Other	Total	Logs	Pulpwood	Other	Total	Total
1960-61	7 264	881	990	9 135	1 550	114	-	1 664	10 799
1965-66	7 578	1 156	850	9 584	1 779	362	28	2 169	11 753
1970-71	7 323	1 348	585	9 256	1 736	791	28	2 555	11 811

Estimates of future availability of industrial wood from Australian forests were prepared for selected future years by the Forest Resources Panel for submission to the FORWOOD Conference 1974. These are tabulated below (Table 7). They are not directly comparable with the statistics in Table 6 above, as they are estimates of availability not of removals. Moreover they were compiled for native forest and plantations, not for the categories broadleaved and coniferous. Froduction from native forests is however preponderantly from broadleaved species, mainly eucalypts, and production from plantations is largely from conifers. This situation is likely to continue.

Table 7. Estimated future availability of industrial wood from Australian forests (1000 m3)

Year	From Native Forests				From Plantations				Total	
	Sawlogs	Pulpwood	Other	Total	Sawlogs	Pulpwood	Other	Total		
1975 <u>1</u> /	6 870	8 507	390	15 767	2 036	1 613		3 649	19 416	
1980 2/	6 593	8 520	406	15 519	2 311	2 086	26	4 423	19 942	
1990	5 411	8 573	349	14 333	4 807	4 082	91	8 980	23 313	
2000	4 575	8 428	328	13 331	9 169	3 706	91	12 966	26 297	
2010	4 438	8 296	314	13 048	13 195	5 045	91	18 331	31 379	

^{1/} From FORWOOD Forest Resources Panel Report, Table 7 pag. 24.

^{2/ 1980} and later estimates from FORWOOD Conference Report, Production Forestry Development Plan, Tables XV and XVI pp 54-55.

The forecasts in Table 7 indicate a declining supply of sawlogs from native forests over the next 35 years. This follows from the progressive depletion of the accumulated capital of old-growth mature and over-mature trees and the slow rate of growth in eucalypt forest worked on a selection or group selection system. There are however expectations that the downward trend in sawlog availability will reverse after 2010, when well stocked stands of eucalypts resulting from the 1939 bushfires in Victoria and from heavy fellings following the second world war will reach maturity.

The estimates of pulpwood availability from native forests, in Table 7 are probably close to the limit of production from these forests under present management regimes. If management were intensified production could be substantially increased.

At present (1974/75) about 3 million cubic metres of pulpwood from eucalypt forest are exported annually to Japan, Hardwood pulpwood used in Australian pulp mills is about 1.2 million cubic metres per annum. By the end of the century, it is expected that about 5.5 million of the 8.4 million cubic metres of native forest pulpwood available, will be required for pulp manufacture within Australia.

Table 7 also indicates that rapidly increasing supplies from plantations, that is to say mainly pine logs, will more than offset the expected decline in hardwood logs from the native forests. An increasing supply of plantation pulpwood will add substantially to native forest supplies.

Fuelwood production and consumption in Australia continues to decline. Production was estimated at 2.12 million cubic metres in 1971. No later estimates are available.

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- (2) F.A.O. World Forest Inventory, 31 March 1970
- (3) Forestry and Timber Bureau, Canberra, Annual Report 73/74
- (4) Report of the Forestry and Wood Based Industries Development Conference 1974
- (5) Compendium of Forest Products Statistics 1935-36 to 1966-67. D. Wilson Forestry and Timber Bureau Canberra 1969.

BANGLADESH

Forest Inventories

Sponsored by the Canadian Development Aid (CIDA) a forest inventory of the most important forest resources in the country was carried out in 1958-64 covering some of the tropical evergreen forests in the Chittagong Hill Tracts and all of the productive tidal (and mangrove) forests of Sunderbans.

For the Chittagong Hill Tracts forests air photography was taken in 1961 covering the two largest forest reserves, Kaszalong and Rangkheong (235 000 ha in all); a random sampling on the same area was conducted in 1961-63. The overall sampling precision was $\pm 1.7\%$ (at 95% probability) and intensity 0.12%.

The rest of the State forests, which were not covered by the inventory and which are of minor importance, are being surveyed to a limited extent in the preparation of Working Plans.

Areas and Types of Forest

In 1965 areas of various types of forests were officially recorded as follows (4):

Type of Forest		Area 1000 ha
Stocked forest		1 419
 tropical evergreen or moist deciduous tidal (or mangrove) low level sal 	599 606 21 4	
Unstocked forest land		905
Total forest land		2 324
Total land area		14 100

These areas of stocked forest include about 68 000 ha of plantations originating from the reforestation of indigenous forests (1968). Three quarters of these are teak (Tectona grandis).

About 95% of the forest area is publicly owned and administered by the Forestry Department. Forest reserves designated for the purposes of permanent timber production are reported to cover 1.15 million ha. 1/ Most of the stocked forests in the two important areas, the tropical evergreen forests in the Chittagong Hill region and Sunderbans' tidal forests, are reserved.

The meaningful extent of the forests having industrial potential in Bangladesh is estimated as follows:

Type of Forest	Total Area	Ecologically productive Area
	1000	
Tropical evergreen or moist deciduous;		
Chittagong Hill Tracts 2/	599	540
Tidal forests; Sunderbans	606	380
Total	1 205	920

All the rest of the State forests, i.e. those without the legal status of Forest Reserve, can be ignored as an immediate source of industrial wood because it is mostly devoid of good timber owing to a long history of shifting cultivation. These provide, however, enough large areas of government land, already administered by the Forestry Department, which could be used for growing timber in plantations; they are also an important source of fuelwood.

No coniferous forests exist in Bangladesh; the following main broadleaved types are distinguished:

1. Tropical mixed evergreen forests (including relatively small areas of moist decidous type)
These are located in Chittagong, Chittagong Hill Tracts and Syhet. The prime commercial species are garjan (Dipterocarpus sp.) and civit (Swintonia floribunda) which together with 21 other commercial species, like chundul (Tetrameles nudiflors) and narikeli (Sterculia alata), make up about 53 percent of the total stock volume. Sal, a common species farther North in the country (also in India and Pakistan), us well as teak to the South, are lacking. Bamboo (mainly Melocuma Bambusoides) is abundant in the two largest reserves, Kassalong and Rangkheong, where it is reported to provide a main crop on about 130 000 ha. Bamboo is still a vital raw material for industry and particularly for the common man.

Most of these forests are reserved for timber production by legislature. The two largest reserves 235 000 ha, were inventoried by the CIDA project. The production reserves in this area provide the richest operable source of commercial timber in the country, on which expanded forest industries could be based. As far as is known, shifting cultivation has been and is being practiced in unclassed State forests in the area, not notably in the reserves.

^{1/} This seems to include some of the unstocked areas as well.

^{2/} Includes at least 130 000 ha of forest land on which bamboo is a predominant crop within the two largest reserves Kassalong and Rangkheong.

2. Tidal forests of Sunderbans (include some mangrove)
The whole of the productive area of 380 000 ha was surveyed by the CIDA team and most of it has been gazetted as production reserves. Prevailing species are sundri (Haritjera minor) and gewa (Excaecaria agallocha). These forests are an important source of raw material for forest industries. Gewa is currently being used for newsprint and match manufacture, sundri at least for sawntimber and treated material.

3. Low level sal forests (moist deciduous associations); located in alluvial lands in Dacca, Mymensingh and North Bengal.

Most of these were formerly owned by private people, but are now administered by the Forestry Department. They have been overcut in the past and are generally low stocked and mostly unclassed state forest by legal actius. These are not inventoried, except for the limited ground surveys in conjunction with the compilation of working plans. Shifting cultivation abounds.

Growing Stock

The whole of the productive tidal forest area and the two largest reserves, Kassalong and Rangkheong, 235 000 ha altogether, were surveyed by the CIDA project in 1958-64. These inventories provide the latest data available on volumes of growing stock (3):

Table 1: Volumes of Growing Stock as per 1958-64 inventories

Species	Stock Volume, N	et of Defects 1
Sunderbans:	million m ³ ub	m^3 ub/ha 2 /
gewa	3.95	33.7
sundri	14.72	157.3
others	2,40	25.7
Sunderbans, Sub-total	21.07	216,7
Chittagong Hill Tracts, the two largest re	serves only:	
garjan	2.77	11.8
civit	1.79	7.6
21 species (rest of commercial volume)	4.98	21.2
non-commercial	8,36	35,6
Sub-Total	17.90	76,2

No reliable estimates of the average stocking are available for the rest of the forest resource; therefore it is not possible to summarize the volume estimates for the whole country.

Remoyals

Logging operations are mainly carried out by contractors who obtain short-term leases of forest, usually for not more than one to three years. Extraction and transportation methods are primitive.

Past removals of timber are estimated as follows:

	Recorded	removals	Estimated actual removals
Year	Industrial wood	fuelwood	fuelwood
1964-65	686	000 m3	(r)
1965-66	735		
1966-67	772	792	4 250
1970 3/ .	850	••	6 220

In addition to these outputs of wood, the production of bamboo from State forests in 1966-67 was recorded at 0.35 million tons, air-dry; the actual outrum, however, might be ten times this amount. The unrecorded removals of both wood and bamboo are assumed to come largely from sources outside the State forests.

Indicates stock volume of trees 5 in + in diameter (dbh) for Sunderbans and 10 in + (dbh) in the case of the two reserves Kassalong and Rangkheong, but excluding bark, 2 ft stump and top volumes below 4 in diameter.

Based on the total productive forest area of 380 000 ha in the case of the Sunderbans tidal forest, and on the aggregate forest area of 235 000 ha in the case of the two reserves in the Chittagong Hill Tracts.

The Forestry Department's estimates. Sources 1.

Although these estimates of removals, in particular those of fuelwood production, are, at last, guesswork there is no doubt that Bangladesh is a wood deficit country: actual consumption 1/2 of wood is below requirements imports being restricted and wood supply from her forests regulated administratively, and not by the market mechanism.

A meaningful projection of removals is impossible in the absence of any reliable information of the production outlook and because wood requirements are inadequately met at present. It will be realized, however, that the current area of 1.4 million ha of stocked forest, with perhaps 1.2 million ha of this being accessible in 20 years' time, is <u>not</u> capable of supporting even the present consumption of wood after the "external" sources of fuelwood outside the State forests are exhausted, probably by 1985.

Information of potential afforestation outside the area of stocked forest is not available, except that no such plantations have existed, at least, prior to 1969. All known planting has so far been for the replacement of natural forests in cut over areas at an average annual rate of 1 500 ha in 1955-60 and 4 850 ha in 1961-68 and this is still expected to rise in future along with increasing forest harvesting in the Chittagong Hill Tract. Because most of these plantations are still relatively young today, less than 10 years of age, and are mainly made up of teak (75%), a fairly slow-growing species (5 m³/ha/annum over 70 to 80 years¹ rotation), they will not have any notable effect on the supply situation during the next 20 years.

Apart from the reforestation discussed above, a vigorous afforestation programme, based on fast-growing utility species, like eucalypts, suitable for a wide range of end uses would need to be implemented on lands outside the stocked forests, if the country is to supply amounts of industrial timber and fuelwood likely to be consumed, 2/entirely from the State forests from the late 80's onwards (other domestic sources expected to be exhausted by that time).

Sources of Information

- FAO: FO:SF/PAK 30. An Assessment and General Programme of Forest Research in East Pakistan. Annex D, Working Paper, 1970.
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- 4. Asia/Pacific Forestry Commission: National Progress Report on Forestry. Pakistan, 1969.
- 5. Pakistan Forest Institute: Forest Statistics of West Pakistan, 1968.

As exports of wood-based products are small and imports in recent years negligible actual consumption is almost equal to domestic removals.

In the absence of any information of the production outlook, the consumption of fuelwood is taken to rise at a rate slightly lower than projected population increase, i.e. 2 % p.a., and that of industrial wood, at a conservative estimate, 5 % p.a. This would result in a total wood consumption of 10.4 million m³ (r) in 1985, which could be supplied, on a sustained yield basis, from the present area of stocked forests and additional (eucalypt) plantations of 320 000 ha or so, assuming that current indigenous forests would yield about 4 million m³ annually (3.3 m³/ha/annum) and plantations the balance or 20 m³/ha/annum. Afforestation could be carried out over a 15 year period, starting not later than 1975 with equal annual plantings of 21 000 ha.

BURMA

Areas of Forest

In 1956 the total forest area was estimated at about 39 million ha or 58 % of the total land area of 67.3 million ha; 25 million ha of forest were considered accessible (1).

Accessible areas include teak (Tectona grandis) plantations about 100 000 ha, an annual planting rate being 7 000 ha. There is also a relatively small area of Pyirkado, <u>Xylia dolabriformis</u> plantations in Burma.

The country has an estimated 9 million ha of bamboo in pure stands and as undergrowth; little information, is however, available of the accessibility of this vast resource.

There is no information available either of the size of areas already cut over or the extent of deforestation brought about by shifting cultivation, which is known to be practised in Burma.

Most roads run in a north-south direction parallel to the main rivers and mountain ridges. An all-weather road stretches from Rangoon to Mandalay, about 650 km north of the capital.

A narrow gauge railway runs from Rangoon via Mandalay to Myitkyina. No railway extends to the Chindwin river valley. The main sea-port of Burma is Rangoon.

While it is stated that the terrain conditions in 60 % of the forest area under logging is suitable for use of mechanical power, most of the logging is still conducted along the rivers, main transportation being by water (2, 3).

Types of Forest

Because of the variety of climate, soils, topography and past utilization, the Burmese forests comprise a great complexity of types ranging from coastal mangrove forests through tropical evergreen and mixed deciduous forests to the temperate evergreen type at the altitudes over 900 m.

As far as is known, there are practically no pure indigenous teak stands in the country; all teak occur in mixed deciduous forests, none in the wet evergreen type. No estimates are available of the extent of teak bearing mixed forests; teak trees are found, however, as far north as Myitkyina (1000 km north of Rangoon) together with other non coniferous species

Removals

All logging is currently conducted by the State Timber Board (Timber Corporation) and private contractors working for it have been replaced by cooperatives.

The only available information of standing volumes and yields per unit area is as follows: (2) tracts under harvest yield an average of three to five cuttable trees per acre, of which one to two trees are teak and two to three are other hardwoods. A felled teak tree yields $3.0-3.4~\text{m}^3$ and other non coniferous trees $3.6-5.4~\text{m}^3$ of extractable timber per tree.

Based on broad forest surveys with only partial coverage of the resource, the Forest Department calculated, on a natural regeneration basis, a sustained cut potential of:

850 000 m³ of teak and

2 150 000 m³ of other commercial hardwood

No estimates are available of the production capacity of the area-wise vast bamboo resource.

Burma's recorded past and future timber output and exports are estimated as follows (3):

	(in 100	0 m ³)	and the state of t
Year	Recorded industrial removals	Timber	Exports 1/
		Sawlogs	Sawnwood
1960	1 365	103.3	54.7
1961	1 600	73.4	79.9
1962	1 419	97.5	99.0
1966	1 552	100.8	113.8
1967	1 817	52.4	102.6
1968	1 713	71.9	100.4
1969	1 728	80.9	121.9
1970	1 737	57.9	115.5
1971	1 722	113.2	109.0
1975	3 400 2/		
1985	4 700 2/	-	

Source: FAO Yearbook of Forest Products

^{2/} Production targets from the Government Development Plan. (3)

There is an obvious potential for increasing the output of timber to meet the theoretical allowable cut. In view of the past and current constraints, i.e. guerrilla activity within the border areas and lack of infrastructure, it seems doubtful, however, whether these targets will be attained (3).

Sources of Information

- (1) FAO: Report No. 456. A Forestry and Forest Products Research Institute, 1956.
- (2) FAO: Report No. TA 2438. Mechanized Logging Operations of the State Timber Board, 1967. Draft.
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FIII

Forest Inventories

All forests having commercial importance in the country have recently been inventoried under bilateral aid arrangements by the Land Resources Division of the Overseas Survey Directorate (U.K.). The field surveys were carried out in 1967-68, and aerial photography in 1967 covering some 490 000 ha of forest of which 405 000 ha was inventoried at 1 % sampling intensity.

Areas of Forest

Fiji's current forest area is small as can be seen from the following table (7,8):

Table 1: Fiji's Estimated Land-Use, 1965-71

		Area 1000 ha	Perceutage
Natural, Closed Canopy forest		500	27
 Commercial non-commercial (unusable species, slopes too steep to be logged) 	200 300		11 16
Plantations		17.85	1
Total forest		514.75	28
Brushland and grassland		362	20
Open woodland		390	21
Agricultural land		219	12
Other		349	19
Total land area		1 834	100
Water area		0	0
Total area		1 834	100

Although Fiji consists of several hundreds of islands, about one hundred of which are inhabited, some 87 % of the land area and population are concentrated in the two largest islands Viti Levu (1 039 000 ha) and Vanua Levu (554 000 ha). These islands have fairly equal shares of indigenous forests: 52 % in Viti Levu, 45% in Vanua Levu and the balance of 3 % on other islands. The distribution of the commercial forest area of 200 000 ha is probably similar. Nearly all of the forest plantations are in Viti Levu.

Forest ownership

The bulk of the land is owned by the Fijian communal groups called Matequali (3):

Table 2: Land Tenure in Fiji, 1971

Class of Land	Area 1000 ha	Percentage
Freehold	181	10
Crown land	130	. 7
Fijan land Native Reserves Other (mainly mataqali)	570 945	31 52
Rotama island	8	0
Fiji	1 834	100

Note: On the part of the forest land the proportion of Mataqali Owned areas and Native Reserves is even higher.

Indigenous Tree Species

The closed canopy forest is mixed tropical high forest of non-dipterocarp type - comprising some 40 timber species most important of which are the following:

Botanical Name	Local Name	Percentage of Fiji's Log Production in 1968
Agathis vitiensis	Dakua makadre (Fijian kauri)	23.0
Endospermum macrophyllum	Kauvula	22.1
Calophyllum spp.	Damanu	9.4
Mryristica spp	Kaudamn	9.3
Acicalyptus, Syzigium		
Eugenia sup	Yasiyas	7.0
Podocarpus vittensis	Dakna salusalu	3.7
Gonystylus punctatus	Mayota	3,4
Palaquium hornei	Sacau	3,0
filiense	Bauvudi	2.9
Heritiera ornithocephala	Rosarosa	2.8
Dacrydium elatum	Yaka	2.0
Intsia bijuga	Vesi	1.6
Samanea saman	Raintree	1.4
Others		8.4 100.0

The Fijian species composition include most of the genera and species that are important in Papua New Guinea, West Irian, the Solomons and the New Hebrides. The main difference between Fiji and these other areas is that Pometia genus is only of little importance in Fiji.

Volumes of Growing Stock (natural forests)

Based on the Land Resources Division's (U.K.) inventory in 1967-68 and the Forestry Department's estimates, the stand volumes in the Fiji forests are estimated as follows (3):

Table 3: Volumes of Standing Timber in Fiji's Natural Forests as of 1967-68

				ial Species 1/	Volume of non- commercial species	Volume of All species
	Down to bh-diam		Down bh-dia	to 35 cm meter	Down to 35 cm bh-diameter	Down to 35 cm bh-diameter
	Minimum estimate	Best estimate		million	3	
Viti Levu	(6 135)	7 012	8 7		2 370	11 156
Vanua Levu	(4 354)	5 222	6 2	09	2 509	8 718
Kadavu	(231)	262	3.	04	60	364
Fotal, inventoried forests	(10 720)	12 496	15 2	99	4 939	20 238
Non-inventoried area: Forestry Dept.: Estimate		2 274	2 7	84	910	3 694
Grand total		14 770	18 0		5 849	23 932

Note: 1/ Commercial volumes refer to 31 most important species (groups 1-4), including 5 conferous species.

Another source (7) states that sawlog and veneer log volumes of currently commercial species in trees over 35 cm (dbh) average about 60 m³/ha and with the inclusion of the volumes in species at present not considered usable and of the same minimum size, some 80 m³/ha. On volumes below the above diameter limit there are not estimates available for the whole colony. Based on the latest inventory in Vanua Levu, these volumes are stated to amount to almost 60 m³/ha, all species considered.

Plantations

Eucalypts

Most of the existing plantations are very young:

Table 4: Areas of Plantations in Fiji by Age Classes in June 1971 in. ha.

Species		Age Clas	ss, Years		Total
	0-4	5-9	10-14	15+	
Pines	3 970	2 105	666	99	6 840
Mahogany	2 420	4 010	936	39 <u>4</u>	7 760
Eucalypt	• •			• •	162

Note: About 80 % of pine is P. caribaea var hondurensis and the rest P. elliottii; mahogany is all swietenia macrophylla, and eucalypt, mostly E. citriodota and E. deglupta.

The information available for making volume predictions for P. caribaea plantations in Fiji over pulpwood rotation is very limited, let alone information for similar predictions of sawlog production. The man-made forests at full stocking do not exceed 7 years in age, except for a few trial plots up to 11 years of age.

Bearing this in mind, the latest provisional estimates of the m.a.i. are as follows:

" " 15 "

P. caribaea 17.5 m³/ha on a 15 and 25 year rotation

Swietenia macrophylla 7.9 - " " 40 year rotation

21.0 - "

These figures rafer to the gross under bark stem volume down to 3 ins top after deducting 10 % to allow for plantations losses through fire, hurricanes and incomplete stocking.

The Fiji Forest Department's current planting programme, as derived from the recent FAO (FIJ 2) project's recommendations is as below:

Type of Plantation	Total Area Established by end 1971	Annual Planting Rate from 1972 onwards	Total Area to be establ is hed
	h	3.	
Pine for sawlogs	3 960	465	10 300
Pine for pulpwood	2 880	2 480	20 200
Total pine	6 840	2 945	30 500
Swiet eni a macrophylla	7 760	4 9	18 500
Eucalypt	162	~	***
Total	14 762	en en de en	49 000

Note: (1) P. elliottii will be planted at a rate of 100 ha/a, only in the higher elevations (above 600 m).

- (2) Swietenia programme is assumed to be suspended until 1978; after that some other cabinet timber species may be substituted for it. The area target should be reached by the year 2000.
- (3) Eucalypts will not be planted in a commercial scale in the 70's, but species trials will continue; most promising eucalypts have been E. grandis and E. tereticornis.

About 70 % of all new commercial plantations to be established will be located in Viti Levu. The pine planting scheme is geared to yield all the raw-wood estimated to be needed for coniferous sawnwood production (some 235 000 m³/a) and pine plywood manufacture for the domestic market from the late 90's onwards; the first Caribean pine plantings will be in full production from 1992 on and those of slash pine from 1994 onwards. In addition, the pulpwood plantations will yield some 325 000 m³ of merchantable wood for export chip market from 1979 onwards.

There has been a number of problems associated with the cultivation of the mahogany in Fiji and therefore the further planting of this species was recommended by the FAO Project to be suspended until research would give some evidence about whether the continuation of the planting was economically justified or not. $\underline{1}/$

Even if it were decided to cease the planting of the mahogany some other Cabinet timber species would be substituted for it so as to fully supply at least the domestic needs of hardwood plywood and sawnwood from around the close of the century onwards when the natural forests will be exhausted. The oldest plantings will mature around 2004 assuming a 40-year rotation (3).

To meet the above production goals the establishment of pine sawlog plantations and those for cabinet timber can be spread over 22 years or so but the planting of pulpwood areas should be completed by 1978 to enable the export chip production to start at the end of the 70's.

According to the FAO project's observations, it is likely that adequate areas of land suitable for plantations will be negotiated by the Government on lease from Fijian owners in due course; it also considers the above planting goals realistic financially and in terms of technical resources available to the Forestry Department and states that the establishment work has generally been very successful and stands properly tended.

Removals

Table 5: Fiji's Past Production of Industrial Wood and Foreign Trade in Wood and Wood Products

	Industr	ial Removals			Log Equivalent	of:
Year	Coniferous	Non-Coniferous	Total	Wood Exports	Sawn Timber Imports	Panel Products Imports
,						
1965			89	12	50	3
1966			96	. 20	16	3
1967			88	11	15	3
1968			105	12	18	4
1969 [.]	30	78	108	12		
1970	32	80	112			

Note: Fuelwood cutting from forests has been recorded at 14 000 m³/a in 1969 and 1970.

Based on the Department's current policy for the licensing and exploitation of Fiji's natural forests and the above establishment programme for the man-made forests, the following removals are likely to become available in future (3):

Year	Indigenous forests	Plant: Export Wood Chips	ations Sawlogs and Plylogs	Total		
	1000 m ³					
1970	112	-	in .	112		
1975	255	-	-	255		
1980	325	325	110	• 760		
1985	325	330	220	875		
1980	283	340	250	873		

An incidence of the insect pest, Ambrosia beetle, has recently been noticed also in young mahogany stands; the extent of the occurrence is yet to be determined but apparently it is widespread. Furthermore, the existence of tension wood has been relatively abundant. Because of these defects the results of test sawings are stated to have been disappointing in terms of the amount of high quality yield.

At this rate of cutting and assuming the current proportion of usable species in the growing stock, the natural forests would last over the turn of the century until about 2005-2012. Even allowing for reasonable amounts of forest land to be reserved for protection and recreational purposes, there will still be ample time to develop research and continue the programme for the expansion of man-made forests which will provide Fiji with a sufficient resource base to supply all her anticipated domestic wood products requirements and a considerable exportable surplus of wood raw material for pulp over her projected home needs towards the end of the century.

Source of Information

- 1/ FAO: Development of Forests and Forest Industries, Fiji. FO: SF/FIJ2 Technical Report 1, 1971.
- 2/ FAO: Development of Forests and Forest Industries, Fiji. FO: SF/FIJ2 Technical Report 2. Present and Future Consumption of Sawnwood in Fiji, 1972.
- 3/ FAO: Development of Forests and Forest Industries, Fiji. FO: SF/FIJ2 Terminal Report, 1972.
- 4/ FAO: Development of Forests and Forest Industries, Fiji. FO:SF/FIJ2 Project Working Document. Miscellaneous Technical Information, 1972.
- 5/ FAO: Development of Forests and Forest Industries, Fiji. FO/SF/FIJ2 Project Working Document. Eucalyptus in Fiji. A Review of Past Performance and Future Prospects, 1972.
- 6/ A.J. Leslie: Report of Consultant in Forest Economics, Fiji, 1970.
- 7/ Asia/Pacific Forestry Commission: National Progress Report on Forestry, Fiji, 1968.
- 8/ Tuolumne Corp.: Market Study for Forest Products from East Asia and the Pacific Region, 1971.

INDIA

Forest Administration

The forests of India are publicly owned for the most part (97%); however, only 45 % of the public forests could be considered reasonably protected in practice 1/.

Forestry is a State matter in the country and the All-India Forestry Department is mainly concerned with the implementation of the National Forest Policy, coordination, forest education at professional and sub-professional levels, research and training. Each State and Union Territory has a forestry department of its own at the State Government level and the forestry budget of a given State is also determined by local Government.

Areas of Forest

Official sources give the total area classified as forest in India as 73 million ha (1967) or about 22 % of her geographical area of 328.0 million ha. Related to the population this is equivalent of 0.18 ha per caput only, which is just over one-tenth of the world average of 1.6 ha (1,2,4).

The relative area of forest seems to vary considerably from one State to another, the highest being in Andaman Islands (77%) followed by North East Frontier Agency (NEFA) with 20 %. The State of Madhya Pradesh has the largest land area (44 million ha), 40 % of which is reported to be covered by forest. Kerale which is probably the most densely populated State has 27 % of its land area under forest (10).

Although the above 73 million ha of land are officially recorded as forest it is known that it includes extensive areas that are completely devoid of timber stocking (mostly grazing, scrub or waste lands, or under cultivation) and that a great part of the rest of the forest area has a very low stocking.

A very provisional estimate would place the size of stocked forest area at about 57 million ha (5), of which only 25-30 million ha would contain good raw material for industries with the rest being burdened with rights of local people who fell these forests rather heavily bringing them to a very low stocking (10),

All of the remaining forest lands carrying high timber volumes is not readily accessible because most of this resource is located along the foothills of the Himalayan range and in higher altitudes within the mountain area itself.

Types of Natural Forest

The forests of India might be broadly classified by types as follows (5):

		Percentage of Total Forest Area
Temperate zone - conferous - broadleaved	3 4	7
Tropical zone - evergreen - deciduous - other	12 50 1	93

Temperate coniferous and broadleaved types extend from Kashmir to Assam, covering the entire Himalayen range. Most important tree species are: deodar (<u>Cedrus deodara</u>), chir pine (<u>P. roxburghii</u>), blue pine (<u>P. excelsa</u>), khasi pine (<u>P. kesiya</u>), spruce (<u>P. smythiana</u>) and fir (<u>A. pindrow</u> and <u>A. spectabilis</u>) and from broadleaved species various oaks and walnuts (1).

The wet evergreen forests occur in parts of the Western Ghats, Andamans and Assam region. These formations are dense, high forest comprising a large number of species in a mixture. The main species are <u>Palaquium ellipticum</u>, <u>Vateria indica, Calophyllum tomentosum</u>, <u>Dysoxylum malabaricum</u>, <u>Artocarpus hirsuta</u>, <u>Mesna ferrea</u>, <u>Poeciloneuron indicum</u>, <u>Dipterocarpus indicus</u>, <u>Canarium strictum</u>, <u>Hopea parvillora</u>, <u>Machilus macarantha</u>, <u>Gluta travancorica</u>, etc. <u>Various bamboo species are common as well (1, page 32)</u>.

The moist deciduous type is found as a strip along the eastern slopes of the Western Ghats and along the foothills of the Himalayas. It also covers parts of Madhya Fradesh and the Ghota Nagpur plain. The main tree species are teak (Tectona grandis), sal (Shoraa robusta), rosewood (Dalbergia latifolia) and laurel (Terminalia tomentosa). Teak is mainly found in Kerala, Tamil Nadu, Mysore, Madhya Fradesh and Gujarat, Sal in Orissa, Bihar, Assam, Uttar Fradesh and West Bengal. Bamboo is common.

Dry deciduous forests occupy parts of the central Indian peninsular from Cape Comorin in the South to the foothills of the Himalayas merging through Rajasthan to West Pakistan. The prime tree species are Sandalwood (Santalum album), acacias and albizzias. Bamboo occurs in these forests in Deccan.

Mangrove forests are found bringing tropical, marshy shores below high-tide mark. They are an important source of fuelwood (1,9).

1/ The main legal classes of forest, as defined by the Indian Forest Act, occupy the forest land in the following proportion (6):

Reserved forest 51 % of total forest area Protected " 38 " " " " " " Unclassified " 11 " " " " " "

Only forests in the first category might be considered reasonably protected in practice (1, page 2).

Plantations

The Forestry Department reports the areas of existing economic 1/ timber plantations in the country as follows (7):

Area under plantations raised during 1951-72

Eucalypts	166.6
Teak	228. 6
Sal .	90.0
Miscellaneous	1 606.9
	2 092,1 2/

One of the long term objectives of the National Forest Policy of the Government is to extend the forest area to cover 33 % of the country's total geographic area - 60 % is classified as forest at present, an enormous amount of reforestation will have to be done. Apart from a tremendous amount of investment needed, one can, however, express serious doubts about the availability of land suitable for plantations outside the forest taking into consideration the competing agricultural land uses such as for rubber and paddy, despite the fact that agricultural could hardly be economically justified in many instances. In fact, the forest area has been on a decrease during the last few years in spite of the past planting (10,6).

For information of tree species suitable for planting in India, see source 2 Appendix 3.

Growing Stock

Because no nation-wide forest inventory has been carried out in India 3/ all calculations of standing timber stock are unavoidably very crude.

In fact, the latest and only estimate available at present was prepared by the Forestry Department as early as 1960-61. This has since been published in several sources (5, 11, 12) and also in the Technical Reports by the FAO Preinvestment Survey actually from the year 1968 (1, 2, 4). This estimate, which should be considered highly provisional, gives the total volumes of growing stock as follows:

	Growing Stock 4/million m3	Growing Stock 4,5/ m3/ha
Total out of which:	2 100	37
 Broadleaved Conferous Exploitable (broadleaved and conferous) Inventoried by the FAO Project 	1 800 300 1 440 318	• •

Logging is mostly carried out by forest contractors or forest workers' cooperatives to whom the State Forestry Departments sell the standing timber through public auctions. At present, Forestry Departments' harvesting accounts for only a fraction of total industrial removals. It is the Central Government's aim, however, to promot its own and State Governments' participation in logging and primary conversion of timber in order to introduce more efficient, mechanized methods of extraction and processing.

^{1/} These are meant for timber production. In addition, some plantations are also being raised in watershed areas as a soil conservation measure.

In 1972 the aggregate area of plantation is said to equal about 2.8% of the total forest area. As for species, emphasis in planting is currently being placed on encalypts and teak.

^{3/} The FAO/UNDP Preinvestment Survey of Forest Resources in 1965-68 covered an aggregate area of 4.7 million ha in three zones which is equivalent of about 6.5 % of the total area classified as forest in the country.

^{4/} Show total stem volume of all trees above or 20 cm in diameter (dbh) including bark (Source 5, page 30).

^{5/} Based on an aggregate area of stocked forest of 57 million ha.

Past and future removals from India's forests are estimated as follows:

India's past and future timber removals

Year	Recorded Industrial Roundwood removals	Fuelwood Removals Recorded Estimated total	Bamboo used for pulp
To your last and the second section of the second s	ATT after 120° and arm arm arm arm cold atte arm con and man man and and and and fall arm.	000 m ³	million tons
1962 1/	7 492	85 000	
1963-64 2/	7 153	12 259	
1964-65 2/	6 451	12 574	
1967 3/	8 580	14 760	
1968 <u>3</u> /	9 597	11 731 120 000 1/	
1970 <u>3</u> /	8 894	13 266	1.5 <u>6</u> /
1975	16 000 <u>5</u> /		
1985	32 000 <u>5</u> /	142 000 <u>1</u> /	3.0

- 1/ Source 5
- 2/ Source 13
- 3/ Source FAO Yearbook of Forest Products
- 4/ Source 6
- 5/ Source 12, page 215. A projection by the Planning Commission
- 6/ Source 4 bis

Only quite theoretical estimates could be made of India's annual cutting potential on the information currently available of her forest resources; for example, ignoring higher prospective yields from plantations and based on an average stocking of 37 m³/ha for the estimated total area of stocked forest (57 million ha), a conservative rotation of 80 years and assuming no increment, the total cutting potential would be just over 26 million m³/annum or 0.46 m³/ha/annum. This is slightly less than the Forestry Department's own estimate from 1964-65 ½ It should be noted, however, that if an increasing proportion of currently extremely low-yielding forest lands will be transformed into plantations of feasible tree species the prospective yield will be much higher.

In view of the fact that India clearly is a wood deficit country and most probably will continue to be for at least the next 15 years 2/, the projected increase in future removals of industrial timber does not appear overestimated (see table). The short supply of raw wood, which is anticipated to become more pronounced in future both in quantity and value terms, is likely to provide the Government an impetus to step up timber output from domestic sources. Most of the future increase in production is expected by the Forestry Department to come from plantations; in fact, the estimated removals of 32 million m³ for 1985 include as much as 12 million m³ of plantation grown timber for processing (12).

The relative role of bamboo as industrial raw material is expected to diminish in future with a possible increase in sustainable removals up to 2.5 to 4.5 million tons a year towards the end of the 80's (12, page 215; 4bis, page 23).

A striking feature is the vast discrepancy between the recorded and the estimated total production of fuelwood. No detailed studies have been done on this but the Forestry Department presumes that most; if not all, of the wood making up the difference comes from outside the areas classified as forest (shelterbelts, woodlots, raw plantations etc.). Be this as it may, these "external" sources of fuelwood are bound to diminish at a rapid rate being heavily exploited by large and expansive population (90 % of total population depend on wood for fuel). Consequently, an increasing proportion of fuelwood requirements will have to be met from forests proper, both natural and plantations. Because much of the indigenous forest is not well situated in regard to population centres with pressing fuelwood needs, large areas of plantations will have to be established if India's enormous future needs for fuelwood are to be met.

^{1/}Source 11. Roughly 2 million m3 for confers and 27 million m3 for broadleaved species annually.

^{2/}The supply of industrial wood from India's forests has been falling short of her domestic demand since the early 60's at least. For example, in 1970 the domestic demand for industrial timber was estimated at 14 million m3 as against the recorded production of just below 9 million m3, and in 1985 the requirements are anticipated to reach 50 million m3, of which domestic removals would meet 32 million m3 only.

Source of Information

- 1. FAO: FO: SF/IND 23. Preinvestment Survey of Forest Resources, Technical Report 1, 1970
- 2. FAO: FO: SF/IND 23. Preinvestment Survey of Forest Resources, Technical Report 2. 1970.
- 3. FAO: FO: SF/IND 23. Preinvestment Survey of Forest Resources, Technical Report 3. 1970.
- 4. FAO: FO: SF/IND 23. Preinvestment Survey of Forest Resources, Terminal Report, 1970.
- 4bis. FAO: FO: SF/IND 23. Pulp and Paper Studies. Working Paper 1, 1971.
- 5. FAO: Possibilities for Forestry and Forest Industries Development in India. IWP, Internal Draft, 1968.
- 6. FAO: Travel Report on Study Tour in India by R. Pearsson, 1969.
- 7. Asia/Pacific: Forestry Commission: National Progress Report on Forestry. India, 1968.
- 8. Government of India: Total Area, Classification of Area and Irrigated Area 1965-66 (stencil), 1967.
- 9. K.D. Singh: Forest types of India. Uttar Pradesh Forest Service (stencil) 1964.
- 10. L.C. Sharma: Forest Resources of India. Eastern Economist. Volume 58, 1972.
- 11. Commonwealth Forestry Conference: Progress Report 1960-65. India 1968.
- 12. V.K. Seth: Planning for Pulp and Paper Industries in India. Indian Forester, No. 4, 1972.
- 13. Government of India: Forestry in India, 1964-65. Summary Tables, 1968.
- 14. D.H. Kulkarni: Forestry in India. Hill Family Foundation Series. Oregon State University, 1970.

INDONESIA

Ownership of forests

All forest land, except private forests 1/, was declared through a forest law 2/ either State or National forest in 1967, and are administered by the Directorate General of Forestry responsible to the Ministry of Agriculture. In addition to this, each province has a Forest Service which is semi-autonomous and which looks to the Provincial Governor for its budget. The senior officers of the provincial Services are proposed by the Director General and approved at the provincial level (I, page 13).

Although all concessions exceeding 100 ha in area are granted by the central forest authorities, they have in practice little administrative or operative control over forests in the islands other than Jave and Madura. This is, among other things, due to lack of communications, and much confusion in the present land use rights increased through the disposition of forest land by local politicians in pursuit of personal or party politics (13).

Inventories

To date, no inventories have been carried out on forest areas not granted as concessions or in the final stages of approval. Therefore, statistics of the total volumes of timber or of forest areas are available neither for the major islands nor for the country as a whole.

However, there are data on concessions areas as applicants must engage the Directorate of Forest Inventory to undertake a reconnaissance type of survey of the area under application. These inventories give, by commercial species, the number of stems and corresponding volumes of trees between 35 and 50 cm in diameter (dbh), and more than 50 cm (dbh). The sampling intensity usually is 0.2 %. The total area so far surveyed along these lines is 29 million ha (end of 1971) covering the areas under concessions in the outer islands and the entire forest resources in Java.

In 1968 the distribution of inventoried areas was as follows:

Location	Forest area surveyed 1 000 ha	Percentage of total forest area
Java, Madura	2 900	100
Sumatra	3 500	13
Kalimantan	5 500	14
Sulawesi	650	7
Molucces and West Irian	1 500	एँ
South-East Indonesia	300	20
	·	
Indonesia	14 350	12

A more intensive review is done by the concessionaire before the logging itself.

Land use

The information currently available gives an estimate of 124.7 million ha as a total of forested land. This has been designated by the Forest Authorities as follows (1):

Forest type	Area million ha
Production forest	48.7
Protection forest	47.0
Game reserves, parks	3.6
Forest land, not yet designat	ed 25.4
rotal	124.7

This total is reported to be located as follows:

^{1/} About 20 000 ha, practically all of which in Java

^{2/} The Basic Law of Forestry, May 1967.

Location	Total land area	Forested land	Production forest	Reserved forest; production and protection reserves
F-3001-00-00-00-00-00-00-00-00-00-00-00-00-		million ha .		1 7 0 + 4 + 0 1 + 2 + 7
Sumatra	51.3	29.5	22, 2	7.8
Kalimantan	54.1	42,5	14.2	3,9
Sulawesi	18.9	10.9	4.5	1.7
Maluku	7.5	6.0	1,2	-
West Irian	42,2	31.0	5.0	-
Java Madura	12,8	2.9	1.5	2.9
Bali, Nusa Tenggara	7.4	1.8	0.2	1.2
Indonesia	194.2	124.6	48.8	17.5 1/

Three notes should be made on these estimates. Firstly, according to several sources (1,2,3,4) the area that has been devastated by shifting cultivation is around 30 million ha (estimated vary from 25 to 37 million ha), and the area currently being depleted is about 2 million ha, a quarter of which is assumed to occur in virgin forest (2, page 25). The Forestry Department estimates the annual decrease in forest area, secondary or virgin, at 150 000 ha and the number of people involved at 11.5 million or 2.3 million families. Largest areas damaged by this practice are situated in Kalimantan, Sumatra and Sulawesi. Apparently West Irian has not been affected by shifting cultivation at all due to low population.

Unfortunately, it is not possible to say how much of the shifting cultivation occurs in the Reserves. There is, however, enough evidence to maintain that illegal cutting and encroachment take place practically unrestricted in the Forest Reserves also, the extent of devastation only depending on population pressure in any particular location (2, page 26; 13 page 4).

Secondly, about 18 million ha of forested land will be alienated to Agriculture (3), of which around 14 million ha have already been earmarked for exploitation. What proportion of these lands will be properly harvested before conversion and at what annual rate, is not known.

Thirdly, it is assumed that approximately 9 million ha of forest land are base or at best sparsely forested (1, page 2). Considering the above it would seem that a more realistic distribution of forested areas might be as follows:

Ту	pe of Forest	Area <u>million h</u> a
1.	Operable forests	42
	1.1. Permanent production forest 2/	2 4
	1.1.1. Managed forests	3
	1.1.1.1. Plantations	0.8
	1.2. Forest to be alienated to agriculture	18
2.	Protection forests 3/	43
3.	Devastated by shifting cultivation	30
4.	Bare or sparsely forested	9
	Total	. 124

1/	This is made up as follows:	
	- production reserves	6.27 million ha
	- protection reserves with limited logging	2.00 million ha
	- protection reserves	9.12 million ha

^{2/} Made up of <u>currently</u> desirable species and accessible assuming such extensions and improvements in existing transport facilities and other relevant infrastructure as are economically sound from the private licencee's point of view. Although about 5 million ha of lowland forest (mainly swamp type) in West Irian is said to be readily accessible or could be rendered available by the provision of access roads, none of this source is included in this figure due to commercially unattractive species composition of the growing stock. West Irian forests are mainly found under the category of protection forests, some are to be alienated and some are actually bare land.

^{3/} Throughout the country these forests largely coincide with inaccessible areas. In the case of West Irian this also includes some 5 million ha of accessible but species—wise currently unattractive forests (see above note 2).

The above 24 million ha of production forests (designated to timber production permanently) together with the 18 million ha currently being converted to agriculture are considered by the Forestry Authorities as the total operable forest area (this is, excluding West Irian; see Source 5). The term operable combines the desirability of species composition and accessibility 1/.

Little can be said about the location of operable forests. If 1.5 million ha will be the total area of production forests in Java and Madura, as planned by the Forest Authorities, then some 22.5 million ha would be left for outer islands, excluding West Irian, to amount to the total of 24 million ha. Most of these permanent production forests are located in Sumatra and Kalimantan.

Although detailed survey information is lacking, these islands are known to have extensive Dipterocarp 2/ forests, fairly rich at that. Also Sulawesi and Malukus have these species but in lester concentrations. The Dipterocarp region extends as far east as the Wallace Line, which separate the Malukus, Lesser Sunda Islands (Lombok and Timor), and West Irian from the rest of the country. Further east, Dipterocarps fade out and are replaced by a greater number of other species. West Irian, for istance, is definitely known to be a non-Dipterocarp region comprising a diverse species mixture in the form of rain forests. Only a few of these are so far in demand in the world market: Ponetia sp. (taun) Intsic sp. (ironwood), Dracontomelum mangiferum (New Guinez Walnut), Palaquium sp., Canarium, Octomeles, Vatica, Burckella, Ganue, Madhuca and Mastikiodendron, all of which are traded under the blanket term Matoa.

Forest types

Forest Type	Java, Madura	Other islands
Evergreen rain forest	180	89 000
Secondary 3/	- .	(15 000)
Tidal forest (mangrove)	60	1 000
Swamp forest	-	13 000
Mixed deciduous	1 400	-
Teak (mainly plantations)	640	pri.
Deciduous	90	900
Coniferous 2/	145	150
Other	385	-
Indovesia	2 900	118 900

Source (2), page 10.

Tropical rain forests located almost exclusively outside Java and Madura are by far the most important timber resource in terms of total standing crop volume and exports. Unfortunately, little is known about the species composition and the actual size of the resources in these forests.

Extraction in swamp forests is technically possible, although it offers some special problems. On the other hand, there are notable advantages in these formations from the logging point of view: these forests are situated on flat lands, and are usually made up of fewer species than dryland Dipterocarp type.

An especially large swamp forest complex (about 1.1 million ha) is known to exist in Palembang in southern Sunatra. Of this, 600 000 ha is estimated to be exploitable containing total volumes from 58 to 125 m³/ha for exop over 35 cm (dbh), with commercial species, mainly Dipterocarps, accounting for 75 to 94 %. Of this so far no commercial logging has been carried out in this area. A detailed feasibility study of the resource's industrial potential is reported to be worthwhile (14).

^{1/} See footnote 2/ on page 24.

The term Dipterocarp is generally used in reference to the family Dipterocarpaceae, the following genera of which are the most common in the case of Indonesia: Shorea sp. (meranti), Dipterocarpus sp. (keruing), Hopea sp. (damar laut), Dryobalanops sp. (kapur) and several others making up a total of about 20 to 30 hardwood species currently established in the world market.

^{3/} The meaning of this category is obscure.

In Java, practically all plantations (mainly P. merkusli, 40 000 ha of Agathis locanthifolia) and in Sumatra mainly natural P. merkusli (100 000 to 130 000 ha), and the rest plantations of the same species, mainly Lake Toba area.

Java

Of the total forested land of 2.9 million ha only 1.5 is assumed to be accessible, productive forest mainly located in central and eastern Java (1, page 8). Most important are the teak forests in plantations and natural stands, and pine (P. merkusii) and Agathis forests that are mainly plantations. The rest of the forest area is covered almost exclusively with mixed deciduous (monsoon) forests.

At present the Forestry Department estimates the total teak area at 640 000 ha $\frac{1}{2}$, most of which in plantations; natural teak forests are said to cover 40 000 ha only.

Age structure has been reported to be uneven and stands understocked to a considerable extent. The Indonesian authorities estimate an average volume at $100 \text{ m}^3/\text{ per ha}$ (8, page 53) and the increment at about 5 m³/ha/a.

Reasonably accurate statistics of the extent of coniferous forests in the country are not available. The most recent estimate by the Forestry Department would place the total area of coniferous forests in Java at 145 000 ha, practically all of which would be plantations; P. merkusii is said to account for about 100 000 ha and Agathis loranthifolia the balance.

The annual planting area is not known, but in 1968 about 3 500 ha of bare land were afforested with confiers in Java. The most extensive confierous plantations are said to exist in Central Java, pine dominating on the northern slopes and Agathis on the southern slopes of the mountain range, and in West Java. Estimates of the growing stock are not available, but P. merkusii is known to grow faster here than in Sumatra, i.e. 16 to 18 m³/hs/a (6, page II 45).

The existing pine plantations in West Java are as scattered and heterogeneous as those in Central Java and, therefore, a constant and uniform supply of wood to any type of pulpraill of viable size is not likely to be sustainable for this resource.

Sumatra

Although principally covered with rain forest there are also known to be indigenous and planted <u>Phus merkusii</u> in Sumatra. The natural growth region of the pine stretches over a good 1 000 km along the mountain range from north-western Atjeh Province through the Province of North Sumatra to western Djambi Province. Most of the indigenous pine grows in mountainous terrain where access is a major obstacle.

The aggregate area of pine stands is not known but information on most important particular areas would suggest that pure stands cover at least 150 000 ha in central Atjeh, Takengon and Lake Toba area, about 30 000 to 50 000 ha of these being plantations of various age classes (Lake Toba). These pure pine stands are reported to have an average stocking of 100 m³ per ha. The estimates of increment vary between 5 and 10 m³/ha/a (6, page II 39). In the same region on lower lands the pine grows in mixture with hardwoods covering an area of at least 150 000 ha large, but no data exist about the actual size of the resource.

Of the pine resources known to exist only Takengon could be thought of as a supply area of pulpwood in the foreseable future. Lake Tobe has insufficient resources to maintain a minimum of 120 000 m³/a and other pine areas are too limited and inaccessible. The plantations of Lake Toba could be further expanded but the increment is not as great as that of coniferous plantations in Java, which has moreover the advantage of being near the population centres.

In view of potential forest industries development the large swamp forest complex of 1.1 million ha in Palembang area is said to be worth a detailed feasibility study (14).

About 600 000 ha of this resource is tentatively estimated as exploitable. Total timber volumes for trees over 35 cm (dbh) are reported to vary from 58 to $125 \text{ m}^3/\text{ha}$, of which commercial species account for 75 to 94 %.

Kalimantan

Kalimantan, which is the principal location of forest development in the country, has an area of 54 million ha, of which 42.5 million ha (79 %) are estimated to be forest land. Of this total, 14.2 million ha (33 %) are considered by the Indonesian Authorities to be accessible production forest and the balance protection forests, game reserves and parks. This is, however, a gross figure including areas of open land and those deforested by shifting cultivation (see table on page 52). The Forestry Department estimates the extent of forest damaged by shifting cultivation at 10 million ha in the island Unfortunately, there is no way of telling about how much of this occurs in areas of production forest or reserves.

Indonesia's Dipterocarp forests have their richest concentrations in Kalimantan 2/. This type covers about 80 % of the inland's forest, the rest being made up of swamp forests and, to lesser extent, of narrow strips of mangrove vegetation fringing the coast line.

Swamp forests occur on flat lands near the coast and in river basins and they do not pose any notable obstacles to access. The principal Ramin resource of the country is located in this forest type in the very west of Kalimantan.

Some Agathis grow in scattered locations far from the coast in Central-Kalimantan (West-Sampit and Palangkaraja areas), and probably also in East-Kalimantan in mixture with hardwoods. The known area of relatively pure Agathis stands is very limited. The maximum concentration of Agathis in mixed stands is estimated at about 25 m³/ha. Also some Dacrydium are reported in the region.

^{1/} This is considerably less than the previous estimates round 1 million ha. The overestimation can at least partly be attributed to some double counting of replanted areas and also to widespread illegal cutting which has converted some of the plantations into brush lands.

^{2/} All that can be said about the growing stock and its composition is that total crop volumes for trees in excess of 35 cm (dbh) have generally exceeded 100 m³/ha with the commercial proportion of more than half of this.

This coniferous resource is mostly still inaccessible although it may be exploited in some future together with the hardwoods. A small amount of Agathis logs, however, is reported already being exported from Kalimantan.

In June 1972 the total area of concessions licensed to operate in Kalimantan was about 12.9 million ha. Most of these are located in the Province of East-Kalimantan where they cover 7 million ha of the reported area of 10 million ha grows of production forest.

As far as is known, 16 of these concessions are joint ventures and 15 are solely based on Indonesian capital.

Regeneration

Especially on teak but also on pine forests taungya (tumpangsari) system has been a success in Java and Sumatra and is now applied as routine practice. In contrast, artificial regeneration of cut-over rain forests has been meeting severa difficulties, mainly due to shortages in silvicultural techniques and lack of field control of clearing, planting and tending operations in islands outside Java. Although replanting obligations exist in concessions agreement (so called Indonesian selective logging) it is evident that meaningful artificial regeneration brought about by either loggers or forestry authorities is negligible and, therefore all rain forest so far harvested can be said to have been left to regenerate naturally.

How much of the second generation brought about in this way in cut-over areas will be in currently desirable species cannot, of course, be estimated. Most probably, however, they will account for much lower proportion than at present even if the selective logging system and the 35 year cutting cycle were strictly followed in practice, which is not always the case at present.

Standing volumes, removals

Results of forest inventories in concession areas show volumes in excess of 100 m³/ha and, in general, over 50 percent of this volume consists of species more than 35 cm in diameter (dbh) and otherwise currently regarded as commercial in international market.

By rule of thumb, the Indonesian Authorities estimate the total growing stock of timber in excess of 35 cm (dbh) at 100 m³/ha and allowable cutting potential at 1 m³/ha/annum (1; 12, page 25). In practice, however, somewhat higher rates are usually negotiated with licence applicants based on the cutting cycle of 35 years (rotation twice that much) and average removals of 50 m³/ha, i.e. a cutting potential of 1.4 m³/ha/annum.

Applying the above and taking account of the previous corrections in the country's forest area (page 4), this would lead to the following crude estimates of crop volumes and sustainable harvest:

Forest land type	Total growing stock (dbh 35 cm and up) milli	
Operable forests (production and alienated forests), of which about 2 million ha already cut over	4 600	56
Protection forests	4 300	• •

The estimate of cutting potential is probably conservative since the allowance for protective forests seems unnecessary great considering the small population in the most heavily forested areas.

Concessions, removals

Logging is mainly carried out by foreign investors, private Indonesian firms, State Forest Enterprise (PERHUTANI), or jointly by Perhutani and foreign companies. Volumes extracted per hectar range from 30 to 100 m⁵ with an average of 50 to 60 m³.

On 30 June 1972 the areas under concession were said to be:

Number of concessions	Total area of concessions Million ha	
121	12,9	Licensed to operate
52	3.8	Final forestry agreement
153	11.0	Surveyed; preliminary forestry agreement
127	14.8	Under application; not processed yet.

Concessions with cutting permit are distributed as follows:

	Number of concessions	Area Million ha
Sumatra	32	2, 68
Kalimantan	79	9.80
Malukus	6	0.45
Sulawesi	3	0, 26
Lesser Sunda Is.	1	0,02
West Irian	-	-
		"Management of the same
Total		12.9

Of this total, concessions that are actually working at present cover an area of 9.7 million ha only (this includes Kajan River Corporation with 1.2 million ha). So far no concessions have been finished yet. Total area of forest logged over to date in islands outside Java is not recorded in the Forestry Department; an estimate based on past removals would place it at around 2 million ha.

A striking feature about the past grant of concession rights is the extent to which most accessible forest resource has already been allocated to licencees. By comparing the data in the above two tables with the Forestry Department's own analysis that there are only about 23 million ha of land outside Java suitable for permanent forest management, one realizes that the allocations have proceeded at a very rapid rate in relation to the availability of forest land.

Some of the concessions apparently are located on alienated or alienable land. These are, however, estimated to account for not more than about 15 percent of the total area under concession agreements (4, page 23).

Past removals and forecasts for selected years are as follows (16):

<u>Year</u>	Recorded total log removals $1 000 \text{ m}^3$	Recorded fuelwood production 1/ 1000 stable in
1966	1 983	667
1967	4 105	681
1968	5 251	4.
1969	8 107	595
1970	12 424	••
waterwillian datum	Activities and the second seco	
1971	16 000	
1972	19 000	
1977	28 000	

In 1970 location of timber production was as follows:

Location	Removals - logs and hewn timber million m ³
Sumatra	2.256
Jaya	0.758 <u>2</u> /
Kalimantan	7.037
Bali, Nusa Tanggara	0.016
Sulawesi	0.149
Maluku	0, 635
West Irian	0.047
Total	10,899 3/

^{1/} Source 2, page 45. One stable metre of stacked firewood equals about 0.75 m³ of solid wood.

^{2/} Removals in Java are practically all teak.

^{3/} This total does not tally with the one in the table above due to different source.

The Government's present policy on granting concessions is to stop the issuance of new areas as soon as allocations to a total of 29 million ha is reached, which is expected to be early next year. This is also understood to be about the maximum area that would be sufficiently attractive to a private concessionaire. This is because most of the Dipterocarp forests along the coast or near negotiable rivers have already been allocated.

In about 1976-77 all granted concessions are expected to be actually operating and producing about 28 million m^3 of industrial roundwood.

After that time the removals are assumed to be fairly constant because of the unfavourable market outlook in the intra-regional log trade, as well as the great public investments in communications and other infrastructure involved in opening up of remoter tracts for timber production in Kalimantan, W. Irian and Sumatra. For instance, the construction of the Trans-Sumatran Highway will not be started in the foreseable future due to lack of funds.

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JAPAN

Forest Inventories

Forest surveys are now carried out at 5 year intervals employing aerial photography and ground sampling (in some cases enumeration of all trees). The third national inventory was completed in 1971. The latest inventory data available in Headquarters are, however, effectively from 1967-68, namely these summarized ir WFI/70 questionnaires and also in World Wood (4). The accuracy of these results is reported to be very high.

Forest Areas and Growing Stock

Based on inventory results available in 1972 the country's forest resources are summarized as follows:

Table 1: Japan's Forest Resource

	Area (in 1,000 ha)				Minorana a de distribuir de la constanta de la	Growing s	stock (in 1,	000 m ³)	
	Total	Man-made forest	Natural forest	Unstocked land & others	Bamboo grove	Total	Man-made forest	Natural forest	Unstocked land & others
Total National	25, 208	9,111	14, 211	1,729	157	2, 103, 358 (83. 4)	686,060 (75.3)	1,414,514 (99.5)	2,784
Forest	8,030	1,993	5, 180	857	0	847, 450 (105.5)	127, 902 (64. 2)	717,289 (138,5)	2, 259
Private Forest	17, 173	7, 118	9,031	872	157	1, 2 55, 908 (73, 1)	558, 158 (78.4)	697, 225 (77.2)	525
l'otal	100.0%	36.2%	56.4%	6.9%	0,6%	100.0%	32.6%	67.3%	0.1%
National Forest	100.0%	24.8%	64,5%	10.7%	0.0	100.0%	15.1	84.6	0, 3
Private Forest	100.0	41.4%	52,6%	5, 1%	0.5%	100.0	44.4	55. S	O, 1

Note: figures in brackets indicate the growing stock in m3/ha.

Stocked forest cover about 62 % of Japan's land area of 37,753,500 hz. The overall species composition in the country's natural and man-made forests is the following (4):

	Total_	National forests	Private forests
Conflers - cr. japonica - ch. obtusa	<u>53</u> 19	<u>43</u> 6	60. 26
- Pinus spp. 1/ - Larch leptolepis - Pices spp. 2/	11 2 3	3318	. 16 3 0
- Abies spp. 3/ - Others	<u>5</u> ნ	10 9	1 4
Broadleaved - Beech - Others	<u>47</u> 40	<u>57</u> 15 42	40 1 39

The high intensity of forest management is reflected in a great proportion of plantations in the forest resource: area wide 25 and about 41 % In the national and private forests respectively. The reason that planted forests are relatively more abundant on private than state lands is that much of the state forests are located in relatively less accessible and cold regions in high altitudes where refusestation is extremely difficult 4/.

^{1/} mestly P. densiflers.
2/ mestly F. jezoensis.
3/ mostly A. Mayriana.
4/ There is about two ti

There is about two times as much national forest land above 1 000 m altitude as there is private forest land.

Most of the plantations are still fairly young from the production point of view of large sized timber, as shown by the age structure comparison below:

	Man-made forests	Natur	al forests
Age	Proportion of total area	Age	Proportion of total area
Years	percentage	Years	percentage
1 -20	. 76	1 - 20	35
21-40	15	21- 60	29
41+	9	61÷	36
	13-marity/commenceders/A-m-4		NEW Whenevold
	100		100

Past and future expected planting in the national and private forests is as below:

Year	Total annual planting	Reforestation blanking	Expansion of area planted
1970	354	1 000 ha	303
1971	337	51	286
1972	290	47	243
1973	269	46	223
1975-85	300		

The Forestry Agency considers this programme realistic regardless of expected future rises in labour wages and relative scarcity of labour in the sector; private sector's portion of the plan is subsidized by the Government.

At present, planting roughly corresponds to 60 % of total annual coupe. Sugi (cr. jaronica) is the predominant species employed for reforestation, followed by hinoki (ch. obtusa). The two species account for 65 % of all planting in the country. L. leptolepis ranks third in areas planted.

A considerable proportion of private owned broadleaved plantations are cut for fuelwood and regenerated by coppicing. Fractically no planting of fuelwood species is done any more due to a declining trend in the demand for fuelwood; the long term aim of forestry organizations is to get these woodlots converted into timber stands of greater value.

94% of all forests in the country are considered readily or easily accessible by the Forestry Agency at present. The state forests are generally located in relatively less accessible regions in high mountain areas. Not all of these accessible resources, however, are used for timber production; logging has been restricted by legislation in considerable areas of forest as shown below:

	<u>Total</u>	National forest	Private forest
Total protection forest	6,966	3,596	3,370
- limited logging allowed	5, 211	2,881	2,330
- logging prohibited	1,755	715	1,040

Forest Types

Because Japan is a mountainous country and stretches over a great span in north-south direction, climate and consequently forests vary considerably in types in different islands. The forests are largely divided into:

Subtropical. Kyushu (below 900 m), Shikoku (below 300 m), south-west part of Henshu (below 600 m) and central part (below 450 m). The type covers 37 % of total forest area.

Temperate. Extends from the north of Honshu to the south-west part of Hakkaido. Covers 41 %.

Alpine. This type occur mainly north of central Honshu and in the north-eastern part of Hokkaido, in the alpine climatic zone, but also to a limited extent above 1880 m in central Honshu and above 1650 m in the south-west of the island, and in Shikoku above 1800 m. In Kyushu there are no alpine forests. Covers 22 %

The subtropical forests are broadleaved, mostly evergreen and composed mainly of oaks and Shiia spp. (shii). In transition to the temperate zone, part of this type is deciduous, composed primarily of Quercus serrata (konara) and Q. acutissima (kunugi), Caprinus spp. (stride), Pinus densiflora (akamatsu) and P. Thumbergu (kuromatsu) and Cryptomeria japonica (sugi).

Tropical tree species for planting in this subtropical zone are cr. japonica, ch. obtusa and Pinus densiflora.

The temperate type is mainly broadleaved and deciduous, the most common and notable species being Fagus eremata (buna); other important species are Q. mongolica, Betula spp., Magnolia oboyata, Tilia japonica, Cercidiphyllum japonicum. Aesculus turbinata and some other deciduous broadleaved species. Occasionally some conffers, like cr. japonia, ch. obtusa, P. densiflora are found.

The cultivated trees in this zone are or, japonice, ch. obtusa, P. densiflora and Larix deptolepis.

In Hokkaido alpine forests feature <u>Ables sachalinensis</u> and <u>Picea jezeousis</u>; pure stands of <u>Taxus cuspidata</u> occur occasionally. In Honshu the representative species are <u>Ables firma (momi)</u> and <u>Tsuga siebaldii</u> (tsuga). Some broadleaved species (<u>Batula spp.</u>, <u>Alnus spp.</u>, <u>Populus spp.</u>) occur as a natural regrowth on clear cut forest lands left unforested.

Removals

Annual coupe in Japan's forests has been:

Year	Total	National forests	Private forests
		1 000 ha	• • • • • • • • • • • • • • • • • • • •
1970	485	146	339
1971	479	149	330
1972	448	145	303
1973	406	135	271

The country's past and estimated future supply of industrial wood is as follows:

Table 2: Japan's past domestic removals and imports of industrial wood; forecasts for selected years

		Domestic Production	1	Imports			tions, alle a superiorité à la la little comme vent un avec	Total
Year	Removals	Mill residues	Total	Logs	Processed wood	Total	% of all supplies	Supply
	• • • • • • • • • • • • • • • • • • • •			.million m ³ .	* * * * * * * * * * * * * * *			
1967	51,8	0.9	52.7	26,3	7.0	33.2	39	85.9
1968	48.2	0.8	49.0	33.0	9.8	42.8	47	91.8
1969	46.1	0.8	46.8	38.3	10.5	48.8	51	95,6
1970	45.4	0.9	46,2	43.3	13.2	56,4	55	102,7
1971	45.3	0.7	46,0	43.9	11.5	55,4	, 55	101.4
1972	43.1	0.8	43.9	47.7	14.9	62.6	59	106.5
1973	41.6	0, 6	42.2	52,5	22.9	75.4	64	117.6
1974	38.9	0.6	39.5	48.5	25.1	73.6	65	113.0
1981			49.7		Andrew Commence of the Commenc	85.1	63	134.8
1991	No. of Contract of		58.7			88.6	60	147.3

Note: (1) Processed wood is the log equivalent of sawnwood, plywood, veneer and wood-chip imports, but excludes the log equivalent of pulp imports.

(2) Import forecasts have been derived by deducting anticipated domestic output of industrial wood from its projected demand, i.e. future demand for industrial raw wood and processed wood is assumed to be met in full. Therefore, in the table, the column of total supply also indicates expected total demand.

These supply and demand projections were prepared by the Government in early 1973. Compared with their previous estimates from 1968-69 the most striking feature is the strongly reduced growth rate now anticipated for the domestic production of wood over the next twenty years 1/. This reflects expectation of the higher labour rates in the near future, the scarcity of workers in the forestry sector (wages still not competitive), and the resultant high cost of domestic production. These factors have already been affecting the volume of logging in the recent past, therefore a slump in wood output from 1967 through 1974 (table 2).

The Forestry Agency, however, considers it possible and probable that the upward trend in wood production will be resumed and maintained as projected in table 2 by means of increased annual finance from the Government and because of rising proportion of relatively less expensive logging expected when a greater part of plantations will mature on more accessible lands at low altitudes in the 80's. The projection also allows for a slight change in the composition of industrial wood removals 2/ as follows:

	1969-1971 	1981
Domestic timber for:		
Sawnwood, plywood	73	68
Pulp	24	30
Other	3	2

Although the above projection of removals is regarded as probable by the Forestry Agency, the necessary increases in the Government contribution to its funds are still subject to being negotiated and decided upon biannually and, therefore, cannot be taken for granted.

Furthermore, along with increasing affluence and leisure time in a densely populated country like Japan functions other than wood production tend to gain importance in forestry and unavoidably restrict timber production. This trend can clearly be seen in recent considerable increases in the areas of various kinds of protection forests in the country.

On the above, it would seem that although future removals will develop much as forecast in table 2 they are likely to fall short of estimated values rather than exceed them. Therefore, in case Japan's demand for industrial wood will rise as anticipated in table 2 her forest industries will become increasingly dependent on imports of raw wood in relative and absolute terms, a trend noticeable in the 60's already.

^{2/} Fuelwood is excluded because it currently plays a rather negligible role in Japan's forestry production; past downward trend in output, shown below, will evidently continue in future:

Year	Japan's fuelwood production million m ³
1970	2.3
1971	2.3
1972	2.1
1974	1.6
1975	1.5

^{1/} The Agency had previously estimated the future removals of industrial wood to reach 65 million m³ as early as 1975 and 95 million m³ in 1985.

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THE REPUBLIC OF KOREA

Forest Inventories

The latest inventory which covers the entire country was carried out in 1960-64 by means of ground surveys on sample plots; no aerial photography was used. Sampling intensity was apparently low, a reconnaissance type of survey; it is not possible to tell about the accuracy of the inventory.

In 1964 the FAO Forest Survey Project (KOR 14) started forest inventory using aerial photos as main tool. By 1970 an area of 225,000 ha was specifically flown and photographed for the study in the scale of 1:15,000. Apart from information of stocking, forest types, etc., also forest land ownership was classified according to cadastral maps and registers.

A Forest Survey and Development Project (KOR 23), the follow-up project to KOR 14, has continued forest inventory as a reconnaissance survey; by the end of 1970 an area of 2.4 million ha had been covered. Thus about $\frac{46}{3}$ of the country's forest had been covered by the two inventories by the end of 1970.

In 1971, Office of Forestry initiated a forest inventory which covers the entire forests land by means of ground survey on sample plots and of forest typing on 1:15,000 aerial photos with ground checks. The aerial photos were taken for that purpose and the inventory results will be finalized in 1975.

Information obtained from the surveys is included in the following statistics of areas and volumes of growing stock.

Land use

Forest land	Area x 1 000 ha
Stocked forest Unstocked forest Deforested Not recently surveyed	5, 742 634 165 45
Total forest land	6, 586
Forest types	
Coniferous Deciduous Mixed Bamboo stands	3,317 1,217 1,201 0.007
Total stocked forests	5, 742
Age distribution	
Age	
1-30 31-50 51-100	5, 439 272 23
Total (stocked forest)	5, 734
Ownership	
National forest Public forest Private forest	1, 292 496 4, 798
Total	6,586
Overall land use	
Stocked forest Unstocked forest Forest not recently surveyed	5, 742 799 45
Total forest	6,586
Paddy field Upland	1,263 978
Total agricultural land	2, 241
Other land	1,049
Total land area	9, 876

Growing Stock

At the end of 1973 total growing stock is reported to have been 74.47 million m^3 which is not more than 13.0 m^3 per ha as an average for all forest land in the country. This is made up as follows:

	Forest type	Growing stock million m ³	m ³ /ha	<u>%</u>
	Coniferous Deciduous Mixed	34.24 26.44 13.79	10.3 21.7 11.5	46.0 35.5 18.5
	Total	74.47	13.0	100.0
Age class:	1-30 31-50 51-100	53.83 18.60 2.03	9.9 68.4 88.4	72.3 25.0 2,7
	Total	74.47	13.0 1/	100.0
Ownership:	. National Public Private	37.34 5.69 31.43	27.8 11.5 6.6	50.2 7.6 42.2
	Total	74.47	13.0	100.0

1/ These figures are based on areas of stocked forest (5 735 million ha.) except bamboo stands.

The above data show that stocking per ha is extremely low in all forests (except for some 28% of stocked National Forests), especially in private forests where it is rather negligible. The whole of private forest area is made up of small farm wood lots; a high proportion of holdings is less than 1 ha, and the bulk are between 1 and 5 ha in size. Practically all the stocking of these forests have in the course of generations been exhausted through cutting for fuel and for meeting the demand for other wood commodities. Furthermore, the soil has been largely degraded and eroded by constant raking of litter, until early 1960's.

Private forests are generally accessible, being situated on hills with frequently gentle slopes and closer to permanent public means of communication and consumers than forests of other owners.

Public forests are owned by provinces, districts and other public authorities. These forests have been and still are being heavily drawn upon to supply the country's needs of industrial wood. Public and private forests alike are beyond the control of the Office of Forestry.

National forests are composed of about 75% of non coniferous (a high percentage of oaks) and the rest of conifers, mainly P. densiflora and P. koraiensis. These resources are located in the mountain regions in the northeastern part of the country and have, to a great extent, considerable difficulties of access. The slopes, especially along the lower section of the valleys, are frequently extremely steep and are broken up by many banks and cliffs of solid rock. The extent of virgin forest is not known, but a considerable proportion of the high mountain forests growing in altitudes between 800 and 1,800 m is reported to be of virgin nature still.

It should be noted that although national forests account for most of the growing stock in the country, perhaps half of them is economically and technically inaccessible and the other half grows on inclines with only limited accessibility. Furthermore, national forests are of great protective value due to their rugged topography and location in the catchment areas of Korea's main rivers - which poses an additional obstacle regarding their exploitation (4: p. 13-15).

In brief, there exist three fairly distinct forest conditions in Korea. Firstly, over-mature non coniferous forests, but without large or valuable trees. Secondly, even-aged but under-stocked conifer forest mixed in blocks with immature and low value non coniferous forests. Thirdly, logged over non coniferous forests, now in a very under-stocked state (7:p. 60).

Plantations

Practically no field scale planting trials have been carried out to select the most suitable and productive tree species. However, a considerable amount of planting has been carried out (in the 'sixties'), the most commonly used species being P. densiflora, P. korajensis, Robinia pseudoacacia (Black locust), Alnus sp. (indigenous), and to some extent also L. leptolepis. At this stage little can be said about the mutual advantages of various species in the growing conditions prevailing in Korea. However, the production of the two indigenous pines is known to be fairly low.

L. leptolepis grows faster and tolerates degraded soils, but its wood is not good for pulping at present, a point that should be emphasized in view of the need for full utilization of plantation grown wood. Other exotics like hybrid poplars and eucalypts might well be preferable to the present species selection, but their potential is unexplored. At this stage what is needed is a fast growing tree species good for general utility timber, for pulping and for fuelwood. Hybrid poplars are of special interest due to the wide range of sites where they can be planted and to the potential uses of their wood mainly for pulping.

Black locust and some alders seem to be suitable in this respect; both are fast growing, Black locust especially (it is reported to yield over 20 m3/ha/annum over twenty-year rotation), both are suitable for pulping, sawtimber, rough construction roundwood and fuelwood; they have been planted mainly for soil improvement, for fuelwood production and for erosion control, Pinus densifiora vay, execus is a natural cross breed of native Korean pines which produce good quality timber.

Total area of plantations during the 10 years period 1966-75 amounts to 1.56 million ha of which 1.46 million ha are located in private forests. Plantations may be classified according to their main purpose as follows:

Timber production : 734 x 1 000 ha

Fuelwood production: S05 " "

Special purpose species: 171 " "

Poplar : 149 " "

Bamboo : 5 " "

Total : 1 564 " "

As far as species distribution in plantation is concerned, three species represent nearly half of the total number of trees planted: Black locust (19% of the total), Larch (16%) and Alder Bushcloner (11%), the Pines being also as a group of species of notable importance.

In 1973 the Government launched a "10 years Reforestation plan" which aims to a target of 1 million ha being reforested and 84 000 ha of eroded soils stabilized by the end of the period. However the project might be shortened as 42 % of the programme was already implemented by the end of the third year.

Objectives and achievements of the 10 years Reforestation Plan are summarized below.

	1973-1982 Global objectives	1973-1975 Achievements
	x 1 000) ha
Fruit bearing species	300	. 62
Fast growing species	300	1 12
Long rotation species	195	164
Fuelwood	205	81
	- Carlotte	
Total	1 000	419
Erosion control	(84)	(23)

Under the above programme mean annual planting was approximately 140 000 ha/a. Since 1973 they included necessary supplementary planting and the rehabilitation of fuclwood plantations. The programme required special initiatives on the part of the Government to stimulate action particularly on private land. This was the purpose of the "Forest development law" in 1972, under which forest development areas were designated and reforestation imposed as a duty to the nation. Special action was also undertaken to rehabilitate forest vegetation on existing shifting cultivation areas not suitable for agricultural production.

Most national forests are remotely located and conifers are preferred in the reforestation of long term growing species for production of large size logs. Local autonomous organizations are responsible for reforestation and maintenance in publicly owned forests. In private holdings forest land rehabilitation is promoted through planting of fruit bearing and fast growing species for quick return of income; fuelwood plantations are established in specificially designated area for fuelwood supply.

Since 1974 idle lands outside the forests, such as embankments or roadsides, have been also utilized for establishing fuelwood plantations in order to divert from collecting and damaging in the forests.

Growth

No comprehensive data on increment are available at present; an average rate for all natural forests might be as low as 2-3 m³/ha/annum due to low stocking, fire-induced decay, shifting cultivation etc. (7:p. 62), although some selected conifer stands are reported to grow reasonably quickly. 1/

Source (5:p. 15): Forest Research Institute studies based on measurements of unmanaged selected stands, show the following growth rates:

Species	Rotation years	m.a.i. m³/ha/a
P. deusiflora P. koraiensis P. rigida L. leptolepis Ouercus sp.	35 45 40 30 25	6. 1 6. 0 6. 4 6. 7 2. 7

Apparently these results refer to stands which are well above the average in stocking (northeastern national forests).

On the other hand, well managed plantations on good soils are expected to yield much higher volumes (FAO Forest Survey Projects estimate. 5: p.13).

Species	Rotation years	m. a. i. m3/ha/a
P. densiflora	30	12.5
P. rigida	25	8.5
L. leptolepis	30	15.0
R. pseudoacacia	20	20.0

Forest types

Four main types exist in Korea:

- Fir/oak type: This may be classed as high altitude virgin forest and is now only found in zones above 700 m. in
 the more inaccessible parts of the National Forests. It does, however, cover quite large areas and is of some
 importance as it contains the only existing reserve of large dimension and mature timber in Korea. The
 two principal species are Q. mongolica and A. nephrolepis, Abies being of rather local occurrence and the
 Querous dominant species.
- 2. Moist hardwood type (mixed hardwood type): This occurs in lower altitudes than the fir/oak type, usually in cooler and moister localities. It is composed of a range of about 12 to 15 commercially important hardwood species and conifers are normally absent. The principal species found in this formation are:

Fraxinus sp.	Acer sp.
Caprinus sp.	Cornus sp.
Ulmus sp.	Kalopanax sp.
Quercus sp.	Populus sp.
Betula sp.	Prunus sp.
Tilia sp.	Maackia sp.

- 3. Dry hardwood type (mixed Quercus type): This is probably the most extensive of the hardwood types and occurs on granite soils which are relatively infertile. It is the climax type on these soils and is composed principally of a range of Quercus species. This is hardwood forest of poor quality, volume and tree form, and its main value at present lies in its function of soil protection.

 P. densiflora occurs naturally in these forests wherever dry conditions prevail.
- 4. Pinus densiflora type: Throughout the northern temperate hardwood forests P. densiflora occurs wherever soil conditions become too dry for the hardwoods to flourish. The species is most widespread below elevations of about 800 m. on granite soils. Where the hardwood forest has been cleared by man the pine comes in as a pioneer species.

Removals

In relation to the rapid national economic growth demand for timber is increasing continuously and substantially. Despite some increase in volume the share of domestic supply in the total supply of timber is decreasing and Korea is more and more heavily dependant on imports. The plywood industry, by far the more important and main exporting forest industry, is exclusively based on imported raw material, due to the lack of suitable domestic raw material.

Korea's industrial wood supply remained fairly stable in recent years and the Government does not intend to increase the removals, in relation to the importance of young plantations. It is rather planned to promote the increased use of residues in order to reduce the future dependance on external supplies.

At present total removals in Korea stand at approximately 10.6 million cubic meters, with fuelwood accounting for a fairly constant proportion of 80%. Industrial roundwood removals amount to nearly 2 million cubic meters half of which are sawlogs. Fellings are under strict control in order to keep the present rate of cutting of industrial timber until a higher yield can be assured for the future under more intensive management.

Fuelwood supply is planned to be substantially increased in order to meet the demand by the end of the century: for this purpose the need to establish some 845 000 ha of fuelwood plantations was recognized. While an area of 640 000 ha was already completed by 1972 it is estimated that the remaining area will have been planted by 1977.

The Forest Authorities' plantation programme has been laid out to meet these ends; from the late 'eighties onwards the bulk of all wood used would come from man-made forests. Assuming that stands established on this programme will also be reasonably well managed the total sustained wood supply from all of Korea's forests would be approximately as follows:

Year	Industrial wood	Fuelwood
	42403942399999	million m ³
1962	1.3	7.8
1965	2.0	8,0
1975	1.8	12
1990	6	30
(2004)	(10)	(28)

The total area of intensively managed forests, practically all of which would have to be plantations, to support the above supply of industrial wood would amount to about 0.5 million ha in the more immediate future and from around 1990 on twice that much, assuming a mean annual increment of 8 m³/ha and an average rotation of 40 years. The aggregate area of broadleaved plantations to be exploited for fuel should cover some 2 million ha by 1990 to yield the target volumes, assuming an average increment (m.a.i.) of 10 m³/ha

1/ These plantations will apparently fail to yield the maximum potential volumes of wood due to management problems related to fragmentation on the part of private farm holdings, on which the bulk of the whole planting programme depends.

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- 5. AGL: SF/KOR 16: Basic Studies / VIII, IX, 7: Forestry Development Potential in the Nakdong River Basin. 1971.
- 6. FO:SF/KOR 14: Draft Proposal on Private Forest Cooperatives. 1968.
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MALAYSIA

In the constitution of Malaysia, that came into being in 1963, forestry remains a State matter on which each State is empowered to legislate, the power of the Parliament being limited to such forestry legislation as may be necessary to promote uniformity between two or more States. Forestry in Sabah and Sarawak remained within the jurisdiction of their own State Governments and in West Malaysia 2, the former Federation of Malaya, the Forestry Department carried on the functions on the former Central Authority to coordinate forestry in the constituent States.

There are no private forests in the country, all forests belong to the Covernment and are administered as follows:

Table 1: Gross areas of Forest land

	Areas of Forest (Gross)			
Class of Forest	West Malaysia 2/ 1969	Sabah <u>3</u> / 1966	Sarawak <u>3</u> / 1965	Malaysia 1965/69
		1 000 hs		***********
Reserved forest - for production - for protection	3 480 2 350 1 130	2 560 2 175 385	4 006 3 080 26	10 046 7 6 05 1 541
Game reserves, National Parks	666	=		666
Other State forest	3 950	3 490	5 434	12 874
Total non-alienated forest	8 096	6 0 50	9 440	23 586
Rubber plantations	1 816	• •	318	2 134
Total land area	13 100	7 600	12 300	33 000

Forest Reserves have been established by the legislation of State Governments, Game Reserves and National Parks by special legislation and they are <u>not</u> under the authority of the Forestry Department. Other State forests comprise all remaining non-alienated forest lands and which are only under nominal control of the State Forest Services.

West Malaysia

On the basis of the latest available information (13) the detailed breakdown of the gross forest areas is as follows:

Class of Forest	Area of Forest
	1 000 ha
Unexploited hill forest	3 414
Hill forests, logged before 1966	1 714
u u after 1966	1 267
" disturbed by shifting cult	tivation 260
Non-commercial hill forests	701
Inland swamp forest	815
Mangrove forests	149
Total	8 320

^{1/} Also known as Peninsular Malaysia

^{2/} Source I, page 102.

^{3/} Source 5 and 4, page 28, 30.

1.1 Forest types and tree species

The subdivision of forests into Dipterocarp and swamp type is not known. Mangrove forests are reported to cover 150 000 ha $\frac{1}{2}$.

1.2 Eventual forest estate

Based on topography and Soil Suitability Classification it is estimated by the FAO Project that there would still be round 2.5 million ha of non-alterated forest in West Malaysia suitable for conversion to agriculture located mainly on rolling or flat lands in low altitudes with good accessibility. Most of these forests belong to the richest Dipterocarp resource in the country. It is further estimated that about 1.2 million ha of these forests will be alienated and converted to agriculture over the next 20 year period.

Therefore the size of the forest estate in 20 years' time might be round 7.1 million ha., some of which will be unproductive (perhaps 1.4 million ha) and some reserved for protection purposes solely.

The extent of shifting cultivation has been estimated; shifting cultivators are known to be less numerous in West Malaysia than in the Eastern States. Therefore, it is not expected to affect forestry in any noticeable degree.

1.3 Growing stock

Data from the latest inventory indicate the following tentative gross volumes per hectare (13):

	Total gross volume. all trees with diameter $\frac{2}{}$ /over 30.5 over 45.7 cm.		Commercial volume under existing market situation \(\frac{8}{2}\)/ trees over 45.7 cm diameter
Primary Hill forest			./ha
Superior volume type	240	186	
Good volume type	2 20	166	
Moderate " "	180	130	
Average	212	156	118
Disturbed hill forest			
Logged prior to 1966	110	67	
Logged since 1966	160	117	
Affected by shifting cultivation	131	94	
Average	131	88	58
Non commercial hill forest	116	72	
Inland swamp forest	74	38	

^{1/} The Forest Resource Reconnaissance Survey carried out in the late 60's (Photography was done in 1968).

^{3/} Virgin and logged-over forests identified by the inventory, have the following commercial composition:

	Approximate percentage of group total	Approximate percentage of total volume
Dipterocarps - Meranti -Non-Meranti	63 _ 37 _ 100	35
Non-Dipterocarps - Fully marketable - Partially marketable - No present market	39 17 <u>44</u> 100	<u>61</u>

Conifer and Unclassified

In other words, about 70 percent of the gross volume seems to have commercial potential under present market situation.

Diameter at dbh on the uphill side of the tree, or in the case of buttressed tree, the diameter 21/2 ft above the end of buttressing.

An analysis of sample plots within the logged-over forest is reported to show that since the start of the timber boom in 1966 logging operations have been noticeably less intensive with an emphasis being placed on the removal only of high quality logs of the most valuable species.

It also indicates that there is distinct difference in the intensity of harvesting since 1966 between the East and West Coast States. In Pahang, Trengganu and Kelantan volumes between 7 and 28 m³ are removed per ha in comparison to other States which have a range of 10 to 53 m³/ha. This confirms previous observations that West Coast States are utilizing their forests more intensively than those of the East Coast. Therefore, there is much less commercial wood available in the cut-over forests of the West Coast than in those of Pahang, Trengganu and Kelantan.

An estimate of the gross volumes of the standing stock, in 1972, as quantified by the forest industry is as follows:

Class of forest	Estimated Commercial Gross Volume 1/	Estimated Total Gross Volume
	million m ³	四日 中心 医乳腺素质 医乳状状态 医角膜 医乳球病 医水水 中華 医电子性
Primary hill forest	370	531
Logged and disturbed hill forest	188	288
Inland swamp forest	21	31
Non-commercial forests	28	50
	Market and the second s	ET HE Class and Advantage of the Control of the Con
	607	900

About 68 percent of the total commercial timber volume in West Malaysia lies in the East Coast States of Pahang, Trengganu and Kelantan.

1.4 Remoyals

Past recorded log removals (excluding rubber wood) and a forecast till 1990 are as follows:

Year.	Recorded log removals	Recorded production of fuelwood and wood for charcoal making
1967	4.2	0.5
1968	5.1	O. 6
1969	5.4	0.7
1970	6.6	0.6
1971	7.2	1.0
1972	8.8	0.7
1973	9.8	0.6
1974	8.7	0.5
1971-75	7.2	
1976-80	12,2	
1931-85	15.0	
1986-90	15.5	

Assuming that on an average 40 m³ of timber is being extracted per ha, the annual exploited area would currently be round 150 000 ha, half of which in managed forests and the other half on alienated lands and mainly below 300 m in elevation. At the current rate of utilization virgin forest would last another 15 years, and including the logged-over forests the whole resource would serve industries for up to 50 years assuming no increment nor change in the relative amount of logging waste 2/. The anticipated rapid rate of increase in removals is, among other things, based on the fact that the resource of high—quality logs of prime species—currently forming the bulk of removals—is approaching the point of exhaustion—but that industry will be capable of considerable readjustment over the next ten years to be able to harvest and process smaller sized and inferior timber (at present cutting is down to 45 cm dbh only).

^{1/} Indicates gross commercial volume of all trees 45.7 cm + diameter fully on market and 50 % of those partially on market.

^{2/} It is currently estimated that logging waste, defect and other loss would amount to 50 % on the gross standing volume of stand (2, page 10).

1.5 Plantations

In 1970 conifer plantations are reported to have covered not more than about 1090 ha mainly in Selangor area (10). Principal tree species recommended for planting is <u>P. caribaea var. hondurensis</u>. Growth data on several stands of about 12 years of age show an average m.a.i. of 21 m³/ha (u.b.). This would appear a safe assumption because m.a.i. is expected to culminate somewhat later than at 12 years of age.

Forestry Department has started to establish pine plantations planned to reach 100 000 ha over 15 year period to support the projected newsprint mill with an annual capacity of 200,000 tons.

Sarawak

The information currently available on forest resources in the State is scarcer than that on West Malaysia and its accuracy leaves much to be desired. On the basis of the present information 1/1 it is not, therefore, possible to give more than orders of magnitude of her forest resources.

2.1 Areas of Forest

The Land Suitability Classification and the land-use studies by the Agriculture Department give the following provisional subdivision of total gross forest area (4, page 7 and 29).

Land Suitability	Type of Forest			
	Mangrove	Peat Swamp	Dipterocarp and Montane	Total 2/
		1 000 ha		
Suitable for Agriculture	2	70	812	885
Marginally suitable Agriculture	5	99	1 581	1 685
Unsuitable Agriculture	167	1 305	5 390	6 861
Total	174	1 474	7 783	9 431

It should he noted that of the above total of 7.7 million ha of dry land forest only 2.02 million ha are expected to be or to become accessible within the next 20 years, most of the resource being inaccessible and/or unproductive such as heath (kerangas) type or montane forests generally over 900 m. in altitude, both in the interior of the State.

Assuming that about 0.40 million ha of mixed Dipterocarp forests are being harvested for future conversion to agriculture, only 1.6 million ha of these forests would be left for purposes of intensive forest management, supplemented by the maximum of 606,000 ha of accessible Peat Swamp, to give an effective forest estate of 2.2 million ha or so (4. page 8).

How much of the above accessible areas has already been cut over is not known with any reasonable accuracy.

Shifting cultivation is known to be practised fairly largely in mixed Dipterocarp forests; in Sarawak it is estimated to affect 2 250 000 ha of forest (4).

For the description of the forest types and tree species in the State's forests see Sources 4 and 12, page 19-32.

2.2 Removals

Sarawak is now faced with a situation in which the Peat Swamp forests are fully licenced as a sustained yield basis, the low elevation mixed dipterocarp forests of easy access are either harvested or committed under licence 3/2 and the only remaining opportunity which exists for the expansion for forest industry lies in the development of the remoter hill areas where logging has generally been unsuccessful 4/.

i. The Land Suitability Classification and the reassessment of the land-use situation in Sarawak started in 1965 and which is based upon mapping from aerial photographs taken from 1963 onwards and supplemented by local field knowledge.

ii. Sources 4 and 12.

^{2/} Total might not add due to rounding.

^{3/} It is estimated that more than 0.4 million ha of low elevation mixed Dipterocarp forest have been licenced for harvesting, mainly in the Fourth Division. Most of this land is reported to the suitable for conversion to agriculture; with some exceptions these licences are on unalienated State Land.

Some 1 million ha of Dipterocarp Forest in higher elevations are also under licence; at present, however, only few of these concessions are actually operating for the selective cutting of high quality export logs at a very low level of intensity.

Recorded industrial removals are reported by the Forest Authorities as follows:

Year	Recorded industrial removals million m ³
1965	2.36 <u>1</u> /
1968	4.28 <u>2</u> /
1969	4.29 <u>2</u> /
1970	4.93 <u>3</u> /

The FAO Project estimates the amount of unrecorded cutting at about 1 million m3/annum.

For information on current and anticipated decline in the ramin production and on the total wood supply in future see source 4, Appendix 2.

2.3 Plantations

See source 6 for information on land availability and suitability of tree species.

- 1/ Source 5; conversion rate used: 1 Hoppus ton equals 63.7 cuft (true measure)
- 2/ FAO; Yearbook of Forest Products Statistics, 1969-70.
- 3/ Source: Forestry Department. Collected on Study Tour.

- 1. FAO: FO: SF/MAL 16 Technical Report I. Forest Industries Development, 1970.
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- 13. FAO: FO:DIP/MAL 72/009 Technical Report 5 A National Forest Inventory of Malaysia.

NEW ZEALAND

Forest Inventories

The latest country-wide inventories were carried out in 1955 for indigenous forests and in 1959-63 for exotic plantations. Results of these surveys have been updated by annual information collected by the Forest Service, and periodic regional surveys. The two basic national surveys were designed to achieve a sampling error not greater than 10 percent on the national basis although large regional variations occurred. No information is, however, available of the accuracy of the current data.

In the 1955 indigenous forest assessment, forest areas were stratified from aerial photographs, and sampled by line plots. In the 1959-63 exotic assessments, areas were also stratified but samples were taken at random. Current exotic forest assessments follow a systematic stratified sampling pattern.

Areas of Forest

The country's forest areas have been officially recorded in 1974 as follows (13):

Table I: Areas of Forest in New Zealand by Ownership

FOREST			
Ownership of Forests	Exotic/ Plantations	Indigenous/ Natural	Total
	The age was the time the time to the party and the same to the time to the time to the time and the time to the ti	-1 000 ha	naheni menintahan dari ambaggan merupakan menuntuk dari dari dan
State	343	2 993 .	3 336
Other		1 911	1 911
Total, Public	343	4 904	5 247
Total, Private	308	1 342	1 650
Total, New Zealand	651	6 246	6 897

Note: All existing plantations in the country are in exotic species.

Forest area having commercial potential is small, as shown by the following estimate by the New Zealand Forest Service in 1974 (2):

Table 2: Areas of New Zealand's Forest by Type

		FOREST	
Type of Forest	Stocked	Temporarily Unstocked	Total
		1 000 ha	karakeruandruskir hele elektrologische proposition in der beit der hele 1984 mei gest auch einstelle bestellt Hele kall kall auch mit von 140 400 tra den een een dez der hele 1984 mei gest mei aus aus aus
Currently or Potentially Accessible		••	
- exotic - indigenous	651 833.8	- 700.9	651 ⁻ 1 534.7
Sub-total			2 185.7
Inaccessible and/or unproductive or Excluded from exploitation by law	4 712		4 712
Total Forest	6 196.8	700, 9	6 897.7

Note (1): Outside the above forest areas, there are 2 470 000 ha of open woodland, scrub or brush land.

(3) Total land area is 26 500 000 ha.

The 4.71 million ha of forest where logging is prohibited or uneconomical is made up of 2.95 million ha of protection reserves, 1.55 million ha of national parks, the balance being unlogged non-merchantable areas.

Stocked forests only cover some 26 percent of New Zealand's area and the production forests as little as 8 percent. On the other hand, there are reported to be about 2 470 400 ha of scrubland (mainly reverted farmland) in New Zealand. Much of this is already under Government control, suitable for industrial plantations.

Growing Stock

In 1970 New Zealand's forest resources were estimated as below (13):

Type of Forest	Stock Volume million m ³ (u.b.)
Exotic Conifers	212
Indigenous Conifers	46
Conifers	258
Exotic Hardwoods	ó
Indigenous Hardwoods	14
Hardwoods	14
All Forests, except those excluded from exploitation by law	272

- Note (1) Stock volume of exotic stands to a 10 cm top diameter (u.b.);
 - (2)Volume of indigenous timber of sawtimber quality only, to a 15 to 20 cm top diameter (u.b.);
 - (3) Symbol 0 denotes less than unit.

Based on the above volume and area data average stocking is as high as 405 m³/ha in exotic forest. This is because a great proportion of the resource is over-aged. (Exotic man-made forests have a mean annual increment of 18-22 m³/ha on a rotation of 25 to 28 years). Indigenous forests average a sawlog volume of some 29 m³/ha. Indigenous forest average pulpwood volume/ha is available only in certain areas of interest, e.g. for the West Coast beech area it is 140 m³/ha. Increment is assumed to balance with mortality.

Species composition in exotic and indigenous forests is as follows:

Exotic Forests/Plantations

Indigeno	us F	orests

Species	Proportion of Total Volume Percentage	Species	Proportion of Total Volume percentage
Pines 1/	78.5	Podocarps 4/	70.0
Other Conifers 2/	16.8	Kauri	0,5
Broadleaved <u>3</u> /	4.7	Beech	20,9
eral il Jerose Condition communicati di di		Tawa and other hardwoods	<u>5</u> / 8.6
	All the second construction of the second constr		***************************************
All species	100.0	All species	100.0

^{1/} Mainly P. radiata, but to some extent also P. nigra (Corsican pine), P. patula and P. elliottii.

Area-wise the species distribution is as above in both types of forest.

^{2/} Mostly Douglas fir, but also Cr. japonica, Cupressus spp., and L. decidua.

^{3/} Mainly eucalypts.

P. dacrydioides (white pine), P. spicatus (matai), P. ferrugineus (miro) P. totara (totara) and P. hallii (Hall's totara). 4/

Mainly Beilschmiedia tawa (tawa), but also Knithia excelsa (rewarewa), Beilschmiedia tarairi (taraire), Vitex lucos (puriri) and Laurelia novae-zelandize (pukatea).

Plantations/Exotic Forests

Except for limited areas of kauri forest, there are no man-made forests of indigenous species in New Zealand; all plantations are in exotic species. Past and estimated future planting programme is as follows (2):

Year ended 31 March	Nev <u>State</u>	v Net Arca Planted Private	Total	Tota State	l Stocked Plantations Private	Arca Total
			1	000 ha	아 네트 전화 전기 (40 에스 개인 경기 등이 등로 무슨 이번 이번 이번 이번 이번 이번 이번 이번	20 He He en de en 24 de 27 de 48
1965	9	5	14			
1966	8	5	13			
1967	9	Ú ·	15			
1968	10	7	17	208	197	405
1969	13	8	21	221	205	426
1970	15	8	23	236	213	449
1971	15	11	26	282	254	536
1972	13	16	29	296	262	558
1973	17	16	33	308	275	583
1974	21	23	44.	325	288	613
1975	21	25	46			
1976-85	-	•	*			

Note: (1) Replanting of cut areas and blanking or beating up are excluded from these figures.

- (2) The figures of total stocked areas of man-made forests are somewhat lower than those officially recorded in source 2 because they are net of areas of degraded plantations stated to be almost devoid of timber stocking.
- (3) * Target minimum is currently 28 000 ha/a, but may soon be raised to 55 000 ha/a if government approves Forestry Development Council's 1975 proposal.

Exotic plantations have been planned by the Forest Service to meet the country's domestic demand, and its share of export demand for industrial wood in the long run. It is anticipated that in future less than 20% of new planting will be with species other than <u>P. radiata</u>.

Indigenous Forests

The native forest is composed of four main types.

Kauri (Agathis australis)

These forests were intensively exploited during the early stages of European settlement in New Zealand. Consequently though stands of this type now cover a little over 100 000 ha, only a small area consists of old crop, the majority is regeneration.

Podocarps

The podocarps belong to the family Podocarpaceae, the principal genera of which are Podocarpus and Dacrydium. They grow in association with a wide range of hardwoods. In many of these forests the hardwood species are now dominant as a result of selectively removing the podocarps which have superior timber qualities. The wide variety of Podocarp forests, including those largely reduced to hardwoods by logging make up approximately 35% of the native resource by area. (This percentage excludes areas of Podocarp-Beech association).

Beech Forests

Beech forests are dominated by one or more of five species of the genus Nothofagus. These forests, (including Podocarp-Beech association) make up 60% of the native resource by area. In the past only limited markets have existed for beeches, and hence only beech forests containing some podocarps have been logged to any extent. Proposals are now being considered for fuller utilisation of these forests.

Hardwoods

Hardwoods other than beech are normally rare in pure stands except in the central part of the West Coast where Kamahi (Weinmannia racemosa), southern rata (Meterosideros umbellata) and quintinia (Quintinia acutifolia) commonly form the high altitude forests. They exist most commonly in other parts of the country in association with podocarps. However, following the removal of the latter by logging, some forests composed mainly of hardwoods have been created.

Utilization

Logging in both private and public forests is principally carried out by private concessionaires and licensees. The limited amount of cutting done by the Forest Service is mainly to provide a benchmark against which the efficiency of industry may be judged, and to provide its staff with logging experience.

The past indigenous logging practice of removing all merchantable trees often meant a drastic alteration of forest structure.

A revised indigenous forest policy now being put into effect by the Forest Service stresses that this structure should be muintained where possible. And, that indigenous forests should be cleared for exotic afforestation only where alternative land is unavailable. Generally wherever practicable indigenous forest will be either encouraged or allowed to regenerate naturally so that in the future further production of indigenous wood may be possible.

As indicated in the Table 3 below, indigenous forests have been playing a diminishing role in the provision of wood for industry. And, although approximately 1 million cubic metres is currently being offered for sale from South Island Beech forests this secondary role is not expected to change.

Table 3: New Zealand's Past Production of Industrial Wood Output of Industrial Wood

Year ended

	Indigenous			Exotic									
	Sawlogs	Plywood	Small - wood	Other	Total	Sawlogs	Plylogs	Export logs	Pulp	Small wood	Export Chips	Total	Grand Total
				7-H4#		IN	illion m3-					1 FT TE. 77 FT on oil rd	
1966	1.17	0.04	0.02		1.23	2.88	0.0 4	0.45	1,03	0.22		4.62	5.85
1967	1.17	0.04	0.02		1.23	2,86	0.03	0.54	1.14	0.22		4.79	6,02
1968	1.02	0.03	0.02		1.07	2.65	0.03	1.09	1.26	0,20		5. 23	6.30
1969	0.94	0.03	0.01		0.98	3.02	0.03	1.44	1.18	0.23		5.90	6.88
1970	0.93	0,03	0.01	0,06	1.03	3, 22	0.05	1,83	1.31	0.28	0,09	6.78	7, 81
1971	0,89	0.02	0.01	0.09	1.01	3.37	0.05	1,87	1.31	0.39	0.19	7.18	8.19
1972	0.83	0.02	0.01	0.09	0.95	3.14	0.06	1.91	1.33	0.38	0.19	7.01	7.96
1973	0.76	0.03	0.01	0,09	0,89	3,30	0.07	2.03	1.25	0.43	0.27	7.35	8.24
1974	0.76	0.01	0.01	0.14	0.92	3.96	0.07	1.39	3,00	0, 43	0.29	9.14	10.06

Table 4: Forecast of New Zealand's Home and Export Demand for and Supply of Industrial Wood (Roundwood or roundwood equivalent, annual quantities, 5-year averages)

	1976-80	1981-85	<u> 1986-90</u>
		million m ³	
Domestic Demand:			
Sawn timber	4.3	4.6	4.9
Pulp products, panels	2.2	2.8	3,3
Total:	6.5	7.4	8.2
Domestic Supply:			
Exotic round wood	9.0	10.0	11.0
Indigenous roundwood	1.0	0.9	0.9
Indigenous hardwood, pulp	0.3	0.3	0.3
Forest residues	ax.	0, 1	0.1
Sawmill residues	0.9	1.1	1.2
Other, non-forest	0.6	0.7	0.8
Total	11.8	13.1	14.3
Apparent availability for export	5.3	5.7	6.1
Additional supply potential from beech pulpwood resource	0.9	1.3	1.3

The above quantities available for export should be viewed as balances of wood and wood equivalents available for exports after home demand has been met. The removals of wood over the next 20-year period will have to depend on the manipulation of existing forest resources because the current planting will not have much effect on wood supply until around 1995.

A realistic market assessment is stated to show that volumes forecast for exports are well saleable and that the demand projection as a whole is conservative rather than overestimated. The domestic demand features a steady decline in the expected per capita consumption of sawn timber, which is more than offset by an anticipated steady increase in per capita use of pulp products.

A notable fact revealed by Tables 3 and 4 is the emergence of log exports, mainly P. radiata, to Japan.

There are two main reasons for this: first, good-quality P. radiata logs have been commanding a high price on the Japanese market; second, there has been a surplus of old, and increasingly windblow and disease prone, exotic crop which could not be quickly processed domestically.

This situation of over-supply, however, is almost over, although log exports are expected to continue at a low level throughout the 80's.

1.	N.Z.	Forest	Service:	The 1972 National Forestry Planning Model. Targers Working Party Report for the Forestry Development Conference, 1972.
2.	11	11	11	Statistics of Forests and Forest Industries of New Zealand, 1975.
3,	11	н	ř1	Progress Report to the Commonwealth Forestry Conference 1974.
4.	11	II .	h	Report of the Forestry Committee to the Plenary Session of the National Development Conference, 1969.
5.	11	H	н	Report of the Director-General of Forests, 1975.
б.	11	11	11	Report of Forest Research Institute, 1974.
=		75 444	P3	

- 7. Asia Pacific Forestry Commission: National Progress Report on Forestry, New Zealand 1973.
- 8. N.Z. Timber Journal The Pulp and Paper Industry in NZ and its Future.
- 9. The Toulumne Corp.: Market Study for Forest Products from East Asia and the Pacific Region, 1971.
- 10. FAO: World Forest Inventory. Questionnaires, 1970.

PAKISTAN

Forest Inventories

The Aerial Forest Inventory Scheme was initiated by an FAO (PAK 11) Project in 1968-69 and is now being carried on by the Forestry Department with an aim of covering eventually the whole of the coniferous forests in the North of Pakistan.

So far, no volume results of the growing stock are available that could be used in the overall assessment of the coniferous resource. Therefore, all volume estimates are based on very limited amount of field samples measured in the preparation of Working Plans for the regional forestry divisions. Unavoidably, these estimates (Table 3) are very crude and should be considered with discretion.

Areas of Forest

In 1966-67 total land area officially classified as forest in Pakistan was distributed as follows (5):

Table 1: Officially Recorded Forest Area by Ownership and Type 1966-67

		State forests	Communal forests	Private forests	Total
Α.	Coniferous	330	248	344	923
Sub	-total	330	248	344	923
в.	Broadleaved		O CONTRACTOR OF THE STREET, AND AN AND AND	TO THE REAL PROPERTY OF THE PARTY OF THE PAR	
	1. Hill Plateau Scrub Forests	212	289	332	834
	2. Riverine Forests	253	-	24 1/	277
	3. Irrigated Plantations	152	_	42/	155
	4. Coastal Forests	345	-	-	345
	5. Linear Plantations	67 <u>3</u> /	<u> </u>	-	67
Sub-	rtotal	1 029	289	360	1 679
С.	Rangelands				
	1. Rangelands	4 797	-	132	4 929
	2. Mazri	-	-	24	24
Sub-	total	4 797	managar kumina apan agan agan agan agan agan agan ag	156	4 953
Γota	l Official Forest	6 157	538	860	7 555
Гotа	l Land Area	V-y-y-1-fizi-1		THE CONTRACTOR OF THE CONTRACT	80 428

^{1/} Peshawar and Lahore Regions

^{2/} Lahore Region

^{3/} Only two thirds of the total length taken as planted. Linear mileage converted to hectars, considering 1 mile = 2.4 hectars.

The Forests were located as follows: (5)

Table 2: Official Forest Area by Location and Type 1966-67

Types of Forests	Peshawar	Lahore	Multan	Hyderabad	Quetta	Total
	way were seen self that you saw said date	7 377 To any not the big		1 000 ha		
Coniferous	736	70	-	res .	116	9 2 3
Irrigated Plantations		51	78	26	1	155
Riverine	4	28	26	217	2	277
Coastal Forests	m	-		345	za i	345
Scrub Forests	517	303	-	14	-	834
Rangelands		~	3 527	600	719	4 846
Mazri Forests	24	-	-	in .	-	24
Plateau Rangelands	-	•	42	-	41	33
Linear Plantations	6	20	27	14	a	67
Total	1 287	472	3 700	1 217	879	7 555

The Forests were administered as under:	1 000 ha	
Under the Control of Forestry Department		7 518
- Reserved - Protected - Unclassed, Communal, Tribal, etc.	1 472 4 518 1 528	
Under the Control of other Government Agencies	•	11
Private Forests		25
Grand Total		7 555

The above tables comprise the latest official data available. From the observations by the FAO Project officials it is known, however, that the stocked forests do not actually cover more than about 0.7 million ha. (or 0.9% of total land area). The rest of the forest area consists of various kinds of dry scrub lands with no trees or occasional trees, rangelands previously forested areas devastated by shifting cultivation. All of forest areas are officially called 'forest' lands and administered by the Forestry Department and to limited extent by some other Government Agencies.

The forests proper are made up as follows (6, page 103-107; 3, page 17):

Table 3: Pakistan's Estimated Forest Resource. 1967

Forest	Area of Stocked Forest		tock Volume orking Plans
	1 000 ha	million m3	m³/ha
l and State Forest	317	51	160
orest (communal)	28	4,	149
oniferous forest	347	55	159
forest	219 <u>1</u> /	4 *	• •
plantations	155	• •	••
rest resource	721	D 0	2 7
rest resource	721	e e	

^{1/} Source 3, page 25.

The volume figures in this table are based on a very limited number of field samples measured in the preparation of Working Plans and therefore they should be considered with discretion. By far the most important of these resources are the conferous forests in the northern part of Pakistan stretching from the Afghan border in the West to Kashmir in the East. All of this area is mountainous or billy.

The main species encountered in the natural forests are: chir (P. longifolia), kail (P. excelsa), chilgoza (P. gerardiana), deodar (Cedrus deodara) fir (A. pindrow) and spruce (P. morinda). These forests feature surprisingly high average volumes of timber per unit area, in grossly over-mature state with practically no increment.

This is a result of extremely conservative management applied in the past; recorded removals have been of the order of only 0.7 m³/ha/annum of the above productive forest area.

The riverine forests amount to 275 000 ha out of which some 218 000 ha in the lower Indus Plains between Sukkur and Hyderabad are productive. These forests are mostly natural but occasionally regeneration is brought about by the dissemination of seeds in cut over areas. No information is available on the growing stock, but annual output of timber is currently estima ted at 35 000 m³, which is bound to decrease, however, because regeneration is not keeping pace with the harvesting. The main species in these forests is Acacia arabica, a multi-purpose tree grown on rotations of 20 years. There is some indication that Populus euphratica might be an useful and suitable species on these lands as well.

There is little doubt that the productivity could be enhanced through more intensive management, genetic improvement of the growing stock, and the introduction of fast-growing exotics. Furthermore, there seems to be scope for the expansion of plantations on non-cultivable lands in the Indus flood plains, further off the river.

The irrigated plantations are confined to the upper Indus plains (Punjab), which naturally do not support high forests vegetation because of the aridity of the climate. At present plantations consist mainly of shisham (Dalbergie sissoo), a very slow growing tree. The plantations were established over a hundred years ago mainly to meet urban and rural fuelwood demands. Data on the volumes of growing stock are not available, but productivity is known to have been and to be very low; record removals are currently less than 7 m³/ha/annum, of which only 0.2 m³ is for industrial purposes and the rest for fuelwood.

The scope for expanding the area of these forests, as an alternative means of increasing inland production of industrial and fuelwood appear very limited due to heavy competition for cultivable land and precious irrigation water in these plains. However, it is well possible to increase the yields from these plantations by the introduction of faster growing species and intensive management for maximum profit with desired output assortment.

In addition to artificially irrigated plantations some amount of planting has been done on alluvial, non-cultivable soils along the Indus. Growth rates with poplars and eucalypts have been remarkable; no data are, however, available about the areas covered to date or plans for future establishment.

Removals

Past removals have officially been recorded as follows (5):

Recorded removals (x 1 000 m³)

Ye	ar	Industrial timber	Fuelwood
196	51-62	159	429
196	52-63	181	409
196	5 4- 65	2 52	<u>44</u> 6
196	6 5- 66	224	458
196	66-67	309	434

Even when estimated unrecorded removals $\frac{1}{2}$ are added to these very low output figures, Pakistan is clearly a wood deficit country. This can readily be seen from the following consumption and demand estimates (2; 3, page 13):

	1965 Estimated				1985 Projegted		
	Consumption	Domestic Demand	Domestic Removals	Consumption	Domestic Demand	Domestic Removals	
Fuelwood	5.5		4,5	9,1	12.6	9. 1	
Industrial wood	1.1	1.4	0.6	3,8	5.7	2.5	
Total	6, 6	• •	5,1	12.9	18.3	11.6	

^{1/} Based on observations of the FAO Project personnel, a half of actual industrial removals might have been loft unrecorded in the past.

These are reported to be conservative estimates. The demand for industrial wood is currently estimated to be higher than consumption (import restrictions have been enforced). Only a half of the industrial raw wood used has been supplied from domestic sources; even some of the fuelwood requirements has been met with imports.

In order to increase the wood production substantially, as much as to meet the country's projected raw material needs for sawn timber, some of the bulkier pulp products and fuelwood in some 15 years' time, the extension of the present productive forest area (as in Table 3) is not necessary.

This is, however, on the condition that all currently low-yielding irrigated plantations will be converted into fast-growing species like eucalypts and poplars, the present area of productive riverine forests will be maintained by the regeneration of cut-over areas into fast-growing species, and that cutting in the coniferous forests will be accelerated to release non-productive timber volumes in over-mature stands over as short a span as possible without risking a discontinuous wood supply in transition to a more balanced age structure.

With reasonably good age structure and proper management even the indigenous pines, P. griffithi (P. excelsa) and P. roxburghii are capable of yielding at least 4 m³/ha/annum within their present habitat (instead of the current timber outturn of 0.7 m³/ha/annum of the productive area of coniferous forests); this is equivalent of a total annual production of about 1.4 million m³, i.e. just the estimated present demand for industrial wood in the country.

Similarly the present area of irrigated plantations (200 000 ha) could, under a fast-growing species, yield about 28 m³/ha/annum, which amounts to a total annual output of 5.6 million m³ from the whole of this area, i.e. just about the projected requirements of industrial timber in Pakistan in 1985 (2, page 3).

However, these actions require a fundamental change in the attitudes of the Forestry Department towards forestry and then in the management practices applied as well as increased funds from outside the Department 1/, which are unlikely to materialize in the near future to be able to support any substantial increase in wood supply alwing the next 20 years.

Consequently it is probable that the consumption of industrial wood in Pakistan, let alone projected domestic demand for it, will continue to exceed timber removals from her forests. Future consumption of fuelwood is likely to be based entirely on domestic sources and continue to fall somewhat short of estimated demand.

- FAO: Forest Utilization in West Pakistan. Report No. TA 2010, 1965.
- 2. FAO: Intensive Forestry with fast-growing species in West Pakistan. Report No. TA 3012, 1971.
- 3. FAO: FO:SF/PAK 11. National Forestry Research and Training Programme. Final Report, 1970.
- 4. Asia/Pacific Forestry Commission: National Progress Report on Forestry. Pakistan, 1968.
- 5. Pakistan Forest Institute: Forest Statistics of West Pakistan, 1968.
- 6. Pakistan Forest Institute: First West-Pakistan Forest Industries Conference, 1967
- 7. Government of West Pakistan: Forestry in West Pakistan, 1965.

^{1/} Ep is unlikely that all of the investments in forestry which would be necessary to achieve these goals could be financed with the revenue to be accrued from the suggested release of the excess timber capital in the conferous forests.

PAPUA NEW GUINEA

Forest Inventories

Intensive surveys are stated to have covered 5 million ha, and extensive surveys 2 million ha of forest by 1970 (1); for some 30 million ha, i.e. most of the resource, no relevant information exists. Closely inventorized forests are located in most accessible lands having the greatest commercial or industrial potential in the territory, such as the Vanimo timber area which was inventorized in 1967, in some detail, covering 290 000 ha of which some 240 000 ha were classed as operable. Apart from the German World Vegetation Map no recent forest type map exists on the territory.

Areas of Forest

As of June 1970 the territory's pattern of land use is estimated as follows (1):

s beinterly a pattern of land use is estimated as avaitons (1		000 ha
Commercial or potentially commercial, stocked accessible forest		811
- immediate commercial value 3 496 - potentially commercial 11 315		
Non-commercial forest (unproductive, secondary, savannah, protective, inaccessible)	21	610
Total Forest	36	421
Open woodland, scrubland, grassland etc.	4	047
Other (incl. agriculture and grazing)	6	070
Total land area	46	540
Water		998
Total territory	47	538

Note: details may not add to totals due to rounding.

Accessible forests classed as potentially commercial but having no immediate commercial value are those having less than ample amounts of currently merchantable wood per hectare and in large enough blocks to be attractive at present.

Shifting cultivation has a long tradition in the territory. It is estimated by the Forestry Department that the present population of about 2 million people clear approximately 200 000 ha of regrowth and virgin forest a year, one tenth of which in mature rainforest within the commercial forest area of 14.8 million ha. The results of this cultivation practice are the 4 million ha of open woodland and grassland and considerable larger areas of secondary forest (in the category of non-commercial forest in the above table).

The territory's land and forest ownership is exceptional in the Far East Region: the majority of the land is property of the indigenous people under a variety of traditional patterns and tenure; ownership and other land rights are complicated and poorly defined.

One of the basic factors of the government policy is that the native ownership to lands and forests is fully recognized, which in turn requires the purchase of appropriate areas before forest development can be proceeded with.

The ownership of forests have been recorded and estimated, as of 1970, as below (1):

		million ha
Present and potential commercial forest		14.8
Government owned	1.9	
 under exploitation not released for exploitation 	(0.8) (1.1)	
Owned by native people	12.9	
Non-commercial forest		21.6
Owned by the indigenes	21.6	

Apart from the purchases of land the Forestry Department has acquired cutting rights on private forest lands, covering 1.2 million ha (1968) with the tenure varying from 5 to 40 years. In this way it is capable of excercising control over commercially most important forest areas and securing continuous flow of raw wood for existing and planned forest industries. Currently all logging of industrial wood takes place either in the government forests or on the private lands where the Forestry Department holds timber rights. Outside these areas, i.e. in 79% of commercial forest the Department has no authority.

Most of the commercial forest readily accessible for harvest, is lying on potential agricultural land and therefore logging is at present mainly for the salvage of merchantable timber in areas likely to be converted to agriculture. The government's long term aim is to achieve a 4 million ha estate of permanent production forest through the purchase of forest land, a goal initially recommended in an industrial feasibility study of 1964 by the World Bank and endorsed by the Commonwealth government of Australia (6).

Types of Natural Forest and Timber Species

The territory is very mountainous; large areas exist above 2000 m with the highest peak rising up to 4 700 m. Types of natural forest vary from mangroves in tidal estuaries to lowland evergreen rainforests and encalypt savannahs on the coastal plains which in places extend up to 900 m in altitude, to mid-montane forests occurring between 900 m and 2 100 m above sea level, and to alpine vegetation which covers the mountains over 3000.

Most of the resource having immediate or near-future commercial potential are the rainforests on lowlands adjacent to the coast and also mid-montane mixed coniferous/broadleaved forests (in places, pure coniferous stands). Species groups are estimated to occupy the following proportions in the commercial forests (1):

	1 000 ha
Mainly coniferous	48
Mainly non-coniferous	13 835
Mixed	529
Proceeds 1975 1977 Miles 1975 April 1975 Apr	
Commercial forest	14 810

Note: In mixed forests conifers are stated to account for 20% of stand volume.

Papua New Guinea is the vastest non-dipterocarp region outside West Irian: although a few dipterocarps (e.g. Hopea spp.) occur in the territory their combined proportion in total stand volume is negligible. Apart from a few localized stands of conifers, of which klinkii and hoop pine are the most important, the lowland rainforests are extremely varied in their composition; there are no species groups of fairly uniform properties as there are within the Dipterocarpaceae (e.g. according to specific gravity).

Round mid-montane altitudes beech and oak content may get higher and occasionally they become dominant species. The two avaucarias and some Agathis species have scattered occurrence in these altitudes as in the rainforests; in places hoop and klinkii pines are found in pure stands especially at Bulolo.

In 1964 Forestry Department listed 163 locally merchantable species whose timber qualities had been assessed by standard techniques. Of these over 40 hardwoods and a few conifers besides araucarias enter the export trade; most important of these are:

Usually exported in round

Pometia spp. (taun)

Terminalia brassii

Anisoptera polyandra

Intsia bljuga (kwila)

Intsia palembanica (kwila)

Octomeles sumatrana (erima)

Hopea spp.

<u>Eucalyptus</u> <u>naudiniana</u> (kamerere)

Mostly exported as veneer, plywood or sawntimber

Anthocephalus spp.

Dracontomelum mangiferum (N.G. walnut)

Cedrela toons (red cedar)

Elmerillia papuana (wau beech)

A. hunsteinii (klinkii pine)

A. cunninghamii (hoop pine)

In the Vanimo timber area of 240 000 ha total net volumes of at least locally merchantable timber average some 36 and 51 m 3 /ha in operable lowland and hill tracts respectively. Not all of the species making up these quantities are established in the world market (10).

Plantations

Past and planned future development of plantations area is as below:

By end of year	Cumulative Plantations Areas								
	pines 1/	other 2 conifers	conifers	eucalypts	poplars	teak	other broadleaved	total broadleaved	Grand Total
	* * * * * * *						• • • • • • • • • • •		0 + 0 0 0 0 0 0 0 0 0 0 0
1967	-	4.9	5.0	0.3	_	1.2	0.1	1.7	6.8
1970	• •	••	6.9		• •	• •	• •	4.0	10.9
1975	3.3	7.4	10.7	5,2	0.2	4,5	0.4	10,2	20.9
1985	7.4	9.8	17.2	21.4	0,6	8.5	0.4	30.9	48.1

Note: 1/ Pines planted on commercial scale are P. caribaea, P. kesiya, and P. patula. All these have shown good promise.

2/ Other conifers are A. cunninghamii and A. hunsteinii.

Details may not add to totals due to rounding.

Detailed age structure of the plantations is not known. Expected growth rates at rotation age are:

	mean annual increment m ³ /ha/a	Rotation years		
pines	21	35		
other conifers	28	3 5		
eucalypts	17	25		
teak	14	40~60		

Coniferous plantations do not come into full production until towards the end of the 80's. Currently they yield small sized logs from thinnings for phywood manufacture and sawmilling and account for about half of all coniferous removals in the territory.

Growing Stock

Little information on growing stock is available. According to the Papua New Guinea Forestry Department the crop volume of all species above 50 cm (dbh) is in a class of 50 to 150 $\rm m^3/ha$ (1), which is apparently based on inventory results and is then extended to apply to unsurveyed forests as well in lack of data.

A detailed inventory (10) showed the following timber resources in the Vanimo forest area:

Total forest area (hectares)	292 000
Operable forest area (")	241 000
- lowlands - hills	95 350 145 450
Total net merchantable volume, commercial species, (million m^3)	10.81
Net merchantable volume in trees larger than 68 cm diameter above buttress (million m ³)	6.26
Average net merchantable volume per ha (m³/ha)	
- lowlands - hill tracts	36.1 50.7
Average net merchantable volume per ha in trees 68 cm plus diameter above buttress (m3/ha)	25.9

Notes: - the term net means that defective volumes are excluded;

- commercial species are merchantable at least in the territory, but not all of them are at present accepted in the export trade;
- all volumes are standing volumes, i.e. including logging waste.

The above is in accordance with the general opinion that the Papua New Guinea forests have notably less commercial timber per hectare than those in the dipterocarp region averaging 50 to 75 % of total standing volume.

Based on the above, a rough estimate of the territory's forest resources would give the following volumes of growing stock:

	Growing Stock in Commercial Forest (incl. plantations) $\underline{1}/$				
	Commercial species merchantable volumes	Commercial species 50 cm plus above buttress	All species 50 cm plus above buttress		
Total volume (million m ³)	666	रंपंक	i 480		
Average volume (m3/ha)	45	30	100		

Note: 1/ The term commercial is applied in terms of the local market only; a portion of these volumes consists of species currently established in the export market; separate volume data for the plantations are not available.

Removals

Cutting in the Papua New Guinean forests is on a permit or licence from the Government and takes place only in the territory forests or on those private lands where the Forestry Department holds timber rights. In most cases logging is undertaken by the industries themselves or it is subcontracted by them to private loggers; the Department itself harvests a small volume, but it exercises supervision and inspection over all commercial exploitation operations in the territory.

Past removals and exports of industrial wood and a forecast for selected years are as follows:

Year	Removals of	Industrial Wood	Exports of logs
	Coniferous	Total	1/
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1 000 m ³ (r)	***********************
1965-66	63	310	60
1966-67	64	389	100
1967-68	72	414	140
1968-69	70	401	100
1969-70	70	506	190
1970-71	74	719	430
1971-72	74	841	400
1975 <u>2</u> /		1 300	
1980 2/		2 100	
1990 <u>2</u> /		3 700	

Note: 1/ all exports of logs are in hardwood species; coniferous timber is exported in a processed form, usually as plywood;

The future expansion of timber production in Papua New Guinea depends, in the first place, on her capability of attracting foreign investors who have sufficient technical and managerial know-how, marketing experience and established outlet for most of the output to be produced.

Various sources state that the government has been making a concerted effort to develop forest industries in Papua New Guinea. To this end, concessions have been granted on liberal terms, low-interest loans and other financial incentives have been offered to investors, the Government has shared in several ventures on a support basis and detailed development studies have been undertaken in the large timber areas of Gogol River, Vanimo and Open Bay for the establishment of integrated wood industries complexes. Some other timber tracts, such as in Kumusi, Sagarai and Dedaisu have also been contemplated but are in a less advanced stage of planning.

^{2/} the forecast of removals is roughly an extension of the last three years' trend.

A recent policy announcement by the Forestry Department in 1972/73 states that among overseas enterprises there would seem to be distinct interest in the development of the territory's forests as an export industry (2). Some foreign firms have started preliminary negotiations for the establishment of chipmills, sawmills and plywood plants.

The Forestry Department considers it likely that in addition to the Gogol River project there will be several large industrial developments over the next 15 years or so based on the other commercial forest blocks mentioned above. It therefore anticipates a steady increase in volumes of veneer, plywood, sawntimber and wood chips being produced and exported to overseas market. On the above this would seem a realistic expectation, at least up to the quantities of raw wood equivalents predicted in the above table. Actual removals might exceed these estimates in the 80's if overseas markets continue to allow increasing exports of wood and wood products.

Papua New Guinea is a net exporter of logs, sawntimber, veneer and plywood, and importer of pulp and paper products. As far as is known, there seems to be at present no concrete plans for the establishment of an export pulp/paper mill. Apart from the rainforests, there will be ample plantation resources of coniferous and broadleaved species in the territory by around 1985 to support manufacture of all bulk type pulp products in economical scale, provided that the current planting programme will be carried out.

The territory's fuelwood annual cuttings are estimated by the Forestry Department to have amounted to 3.7 million m^3 (r) in the late sixties and be fairly static or slightly increasing.

- 1. FAO: World Forest Inventory. Temperate Region. Questionnaires, 1970.
- 2. P.N.G. Forestry Department: Forest Policy Papua New Guinea, 1973.
- 3. Asia/Pacific Forestry Commission: National Progress Report on Forestry. Territory of Papua New Guinea, 1968.
- 4. J. Fielding: Report on a Study Tour of Forest Plantations in Papua New Guinea. FO: SF/MAL 12, Working Paper No. 12, 1971.
- 5. J. Morel: Notes sur la territoire de Papuasie et Nouvelle Guinée. Bois et Forèts des Tropiques, No. 115, Septembre-Octobre, 1967.
- 6. IBRD: The Economic Development of the territory of Papua New Guinea, 1965.
- 7. Japanese Lumber Journal: Test Results of New Guinean Hardwoods Announced, 1970.
- 8. P.N.G. Forest Products Research Centre: Properties and Uses of Papua and New Guinea Timbers. Second Trade Note, 1970.
- 9. Commonwealth Scientific and Industrial Research Organization: Pulping Studies on New Guinea Woods I (1959), II (1961), III (1965).
- 10. P. N. G. Forestry Department: Vanimo Timber Area, New Guinea. Prospectus 1967.

PHILIPPINES

Practically all (97%) forests in the Philippines are owned by the central Government.

Forest Inventory Status

National Inventory

In 1962 the Bureau of Forestry, with the assistance of USAID started a nation-wide forest inventory. Fieldwork was completed in the late 60's for the whole country and final data for the Philippines as a whole has also been published.

In addition to standing volume by diameter classes, commercial species and forest types, some tentative data were also gathered on increment on sample plots located throughout Mindance and Luzon.

Management Plan Inventory

For the purpose, aerial photography was being carried out for the whole country and was expected to be completed by the end of 1972. Field sampling and report writing was assumed to take the whole of the following.

Forest Areas

The Forestry Department has recently made an estimate of the changes in the areas of types of forest that has taken place since the national forest inventory. 1/According to this information the present land-use pattern is as follows (14):

Table 1 - Status of Land Use in the Philippines as of June 30, 1971

Type and Stand Size	Public forest land	Alienated Land	Total	Percent Distribution
		1 000 hectares		%
Productive Forest	11,008	3,082	14,090	46.97
Dipterocarp Type	10, 562	3,026	13,589	45,30
Rep-Brush Young Growth Old Growti:	3,097 2,815 4,649	2, 249 573 203	5, 347 3, 389 4, 852	17.82 11.30 16.18
Mangrove Type	239	47	286	0.96
Rep-Brush $\frac{2}{4}$ /Young Growth $\frac{3}{4}$ /Old Growth $\frac{4}{4}$ /	. 120 106 12	32 13 1	153 119 14	0.51 0.40 0.50
Pine	205	8	214	0.71
Unproductive Forest 5/	1,728	56	1,734	5.95
Dipterocarp Moszy Bamboo	1,397 328 2	40 2 13	1,438 330 15	4.80 1.10 0.05
Total Forest	12,736	3,138	15,875	52.92
Non-Forest				
Open Land Managed Pasture Marsh & Sm. Water Cult. & Plantation Urban & Others	1,318 456 91 2,417 328	1,671 29 122 7,407 281	2, 289 485 214 9, 824 609	9.97 1.62 0.72 32.75 2.03
Total Non-Forest	4,612	9, 512	14,124	47.08
GRAND TOTAL	17, 348	12,651	30,000	100.00

Final results for Mindanao are on the situation in 1963, for Luzon in 1968 and for other islands in 1969.

Reproduction-brush: Productive forest lands predominantly stocked with tree reproduction or brush. Seedlings at least one metre high and saplings less than 15 cm in diameter are classified as reproduction.

Young-growth: Productive forest predominantly stocked with young trees 15 cm (dbh) or larger. Most stands in this class have been out over with residual trees remaining. Stands stocked mainly with mature trees but with 25 % or more of the mature stand volume removed by cutting quality as young growth also.

Old-growth: Productive forest predominantly stocked with mature trees or less than 25 % of the mature stand volume removed by cutting

of the mature stand volume

removed by cutting.
Unproductive: Forests of poor site quality with trees averaging less than 5 m. of merchantable sawlogs at maturity. Usually such stands are found on mountain tops and high narrow ridges.

As the above table shows, from the total of 14 million ha. of productive forest 3 million ha. have already been lost to Forestry through alienation for agricultural purposes. Furthermore, the extent of open areas and deforestation caused by shifting cultivation within the 10 million ha. of productive dipterocarp forest might be as high as 1 million ha.

Forest Reserves

To date forests have been reserved as follows (14):

Table 2 - Areas of Forest Reserves as of June 1971

Location	Watershed Reserves with limited logging	Timber Production Reserves	National and Game parks					
The Thomas de Landers of the Control	0 0 0 0 0 0 1 5 2 7 0 1 9 1 1 4 0 0 0 0 t t	1 000 he						
Mindanao	11	3,178	125					
Palawan		1	1,489					
Luzon	148	1,565	338					
Vizayas	27	226	44					
Philippines	186	4,970	1,996					

It is presumed that legal conversion of forest land to other purposes and illegal shifting cultivation and encroachment will continue in future, at a rate of 200,000 ha, per year 1/. In 20 years' time, therefore, a further 4 million ha, will have gone. This leaves an area of eventual production forest of about 7 million ha, and a total forest estate of 8.7 million ha, or about 29 percent of the total land area.

According to various sources (1; 2), for the time being, the Bureau of Forestry does not seem to have possibilities to protect reserved or protected forests. Even if the Government declare an area as reserved forest, local politicians can dispose of it for agricultural purposes in pursuit of party or personal politics. Hence, this rate of decrease in forest area is not considered too pessimistic.

Plantations

It is reported (11; page 32) that at the end of 1968 there were 146,000 ha. of plantations in the country, about 40 % of which P. insularis and the rest non-coniferous species. There is, however, some doubt that a part of this area is actually non-existent; a more likely total would be around 100,000 ha. 40 % of which P. insularis. The area of new planting has been decreasing steadily during the past 6 years (less than 2000 ha. in 1968) due to lack of funds and the increasing need for replanting (9,800 ha. in 1968). It is estimated that not more than one third of the annual planting will actually be established at first trial.

It should be noted that most of the existing plantations have been established primarily for protection purposes in scattered locations apparently with only limited accessibility, and are, therefore, unable to support any large scale forest industries.

Climate and soil in the Philippines are very suitable for the establishment of fast-growing plantations. The growth rates over rotation are not known but several indigenous species and exodes have been encouraging in regard of plant survival and ease of establishment.

Most promising pines have so far been P. insularis (in Luzon above 1 000 m and in Mindanao above sea level, P. caribaca, var. Mondurensis, and P. occarpa (both below 1 000 m in elevation).

For pulping most promising broadleaved species would seem to be Albizzia falcata (the Moluccan provenance) and Encalvoirs deglupta in respect of feasibility of pulp manufacture and growth rates of plantations. Both are fast growing (rotations about 8 years), and suitable for growing in low altitudes; Albizzia, however, is notoriously susceptible to typhoon damage if grown in a monoculture. Swietenia macrophylla (in rade Philippines mahogany) is known to be easy to establish in monoculture plantations and to be superior to teak in the rate of growth; rotations probably ranging from 50 to 60 years giving a crop suitable for veneer and other large size logs. On the other hand, a lot of evidence shows that dipterocarps are conspicuously difficult to regenerate artificially.

The Forestry Department currently estimates the decrease in forest area at 260,000 ha/annum over the past three year period, including 80,000 ha. by legal concession and 180,000 ha. through shifting cultivation. Because some of the previous alienations are being reversed a slightly lower rate (200,000 ha/annum) is applied for the future, though.

Sources: 4; 3, page 27; 14; page 2.

Growing Stock

Table 3 - Volumes of Sound Trees, All Species (20 cm dbh and up) by Forest Type, Stand Size, and Geographical Region, as of June 30, 1971

Type and		Gr	owing Stock			
Stand Size	Mindanao	Palawan	Luzon	Visaya	PHILI	PPINES
	0			million m ³ o.b.	**********	m³ o.b./ha
Productive	1,009.8	126.7	5 05. 0	246.4	1,888.4	134
Dipterocarp	1,005.9	122, 5	489.3	245.0	1,863.8	137
Rep. Brush	37. 5	4,4	30.0	16.7	86.7	17
Young Growth	278.5	10.6	86.8	102.7	478.7	141
Old Growth	639, 8	107.5	372.4	126.4	1,296.2	267
Mangrove	3.9	4.2	0.8	0.7	9.7	34
RepaBrush	0,2	0, 3	0.2	0.6	1.5	10
Young Growth	3. Q	2.4	0.5	-	6.0	51
Old Growth	0.6	1.3	wı	es	. 5.0	69
Pine	195		14.9		. 14.9	10
Unproductive	21.0	22.9	29.2	5, 9	79.2	લ્ ક્ષ્
Dipterocarp	15.9	16.7	27.2	5, 6	65.6	46
Моззу	5 . Q	6.1	2.0	0,3	13,6	41
GRAND TOTAL	1,030.9	149.7	534.3	252, 6	1,967.7	124

Both per-hectare and total volumes in the above table are reported to show standing volumes of sound trees (those without visible defects), all species, over 20 cm. in diameter including stump, top and bank volumes.

Some evidence (3, page 28) would suggest that the above volumes per hectare are more likely to be overestimated than underestimated. While it is realized that these figures should be considered with discretion, it is known that virgin forests in the Philippines are richer in Dipterocarps than generally those in Indonesia, consisting about 75 % in 55 cm. plus diameter, and in cut-over areas roughly 30 % of stand volume as an average for the whole country. It should be noted, however, that the status of the residual forest varies considerably depending on the type of logging and the proportion of defective and inferior wees in stocking.

In virgin forests growth presumably balance with mortality. Right tending techniques would probably boost the increment of residual stand up to 3 to 5 m³/ha/annum without resorting to supplementary planting. This would have a greatly beneficial effect on sustained yields and currently all too long rotations, averaging 50 years.

However, in view of the crucial importance of the appropriate silvicultural treatment actually being implemented $\frac{1}{2}$, and on the other hand of the lack of capable staff in the Bureau of Forestry to control licensee's field operations, it is not considered wise to apply any higher estimates for increment than 1 m 3 /ha as an average for all productive secondary forests, in all age classes.

The northern Luzon pine forests 2/ cover relatively small area, about 0.2 million ha, as compared with the Dipterocarp forests. But they are notable as the only indigenous source for long-tibre pulp. At present annual increment is reported to be round 4 to 5 m 3 /ha and average volume 70 m 3 /ha. However, if some rehabilitation of stands will be carried out to bring them up to full stocking it could well rise to 6 to 8 m 3 /ha. over 20 year rotation, giving a sotal annual yield of 1.2 to 1.6 million m 3 . They are located, however, in high skittudes (generally over 1000 m)

^{1/} In 1968 silvicultural treatment was carried out on 8,200 ha, only (10 page 34);

^{2/} All pine - mainly P. insularis. About 60,000 ha. of these forests are reported to be plantations; these are, however, in scattered locations.

in critical watershed areas and mostly in an extremely rugged terrain. Therefore, it is felt in the Forestry Department that long-fibre pulp projects should rather be based on coniferous plantations on lower lands with easier access and the existing pine forests be left mainly for protection purposes, but allowing the present limited logging to continue for local needs (the current utilization is mainly for pitprops for local mines).

Cutting potential

The whole of the productive forest area is currently covered by concessions; the allowable cut is set by the Forest Authorities at a level of between 1 and 1.5 m³/ha/annum, in Luzon mainly nearer the lower value, in Mindanao the

Applying the latter figure to the 7 million ha of permanent forest estate and assuming a yield of 2 million m^3 /annum from salvage fellings 1/ the theoretical cutting potential from the natural Philippine forests would be round 12.5 million m^3 /annum. This roughly corresponds with an annual coupe of 250,000 ha, and a cutting cycle of 36 years with the rotation length twice that long.

The annual coupe is not recorded by the Forestry Authorities. They have, however, made an indirect estimate by relating average removals per ha to total annual recorded log production and arrived at around 110,000 ha of logged-over forest in 1968 and 1969. However, in some concessions less wood per hectar is harvested than assumed in the above estimate; furthermore, about 15 % of actual removals are assumed to have remained unrecorded. Hence, the area harvested is more likely to have been around 150,000 ha/annum. .

If the present rate of utilization 2/ continues in future the virgin forests will last another 20 years or so. Unless strong Government action is taken it is probable that the rate of utilizing virgin forests will increase in future rather than decrease at least for three reasons:

- Logging is bound to move into higher elevations where volume of harvestable timber is lower than in low To cut the same amount of wood, a larger area has to be worked; land forests.
- As exports of timber are currently the country's first foreign exchange earner, the Government may be tempted to raise the cut from the present level;
- Population pressure on forest land will increase rather than decrease, particularly if industrialisation does not proceed as fast as planned.

Removals

Past log removals, exports and forecast for selected years are as follows (14):

Table 4 - Recorded log removals, exports and forecast for removals for selected years

12*7	Personal de la la companya y a confidence de la companya y personal de la confidence de la	Exports of logs 4/		
Fiscal year	Hardwoods	Pine	Total	A. T.
1798 S. Alleide British (1965) and the state of the state	** 25 to 100 mm of 17 Th 400 mm on 17 Th 400 mm on 100 th 401 th 400 th 100 th	1 000 m ³	Address and Addres	arti Senetaman en et skyldatististe effere representation Educação Affel Section de Art 1 Mai Ten est est est flat liste pay en est discusse
1965-66 66-67 67-68 68-69 69-70 70-71	8,026 7,631 11,088 11,474 10,947 10,617	20 13 26 110 57 62	8,046 7,844 11,114 11,584 11,004 10,679	5,534 6,649 7,511 8,649 8,616 8,443
1972 1985 1990			(9,000) (14,000) (5,000)	

^{80,000} ha assumed to be annually alienated to non-forestry purposes, half of which virgin forest, and that on one half of this latter area proper salvage cutting could be carried out yielding, at a conservative estimate 2 million m^2/a .

This is estimated as follows: - commercial logging (including salvage cutting) at

150,000 ha/a.

 legal transfers of forest land to other uses, and shifting cultivation at the estimated present level of 200,000 ha/annum, of which, say, a quarter in virgin forest, i.e. at

50,000 ha/a

Total utilization 200,000 ha/a

<sup>Unrecorded removals are estimated at about 15 % of recorded production
Dipterocarps constitute 98 % of hardwood removals.
No information is available about the amount of wood used in charcoal production or for fuel.</sup>

Pine is not being exported.

The current slump in production is mainly due to present over-supply in the regional log trade.

In the future, annual removals are expected to rise to 14-15 million m^3 by 1985, if markets allow. It should be noted, however, that around that time (by 1990 at the latest) all virgin forests designated for production purposes will be cut over.

Little is known of the status of present secondary forests in the country, but is most improbable that they contain mature timber in sufficient quantities to support even the current rate of cutting (1, 4, page 10).

Although the Forestry Department is currently cancelling a great number of small ordinary timber licences of short duration (1 to 4 years), and reallocating them to bigger concessions, there is no indication that control over companies and forest management practices applied would actually become more intensive in the foreseable future.

Therefore, a slump in the annual log production, well below 10 million m³, probably down to 5-3 million m³, seems inevitable as soon as the virgin forests are exhausted. This would not be enough to meet even the projected domestic demand in 1990 based on the present consumption per capita and population growth.

1)	For:	SF/PHI	16,	Technical	Report	1,	1970	
2)		11		11	11	2,	1970	
3)		11		11	н	3,	1970	
4)		n		11	11	4,	1970	
5)		11		Ħ	11	5,	1970	
ნ)		*11		11	11	6,	1970	
7)		0		11	11	7,	1970	

- 8) Asia-Pacific Forestry Commission: "The Industrial Potential of Quick Growing Man-made Forests, Note by Secretariat, 1969.
- 9) Asia-Pacific Forestry Commission: National Progress Report on Forestry Philippines, 1969,
- 10) Tropical Forestry and Industries, March-April, 1969
- 11) " " July -August, 1969
- 12) " " September-October, 1969
- 13) Jaakko Poyry & Co.: in Appraisal of the Newsprint Development Opportunities in Asia. Report to FAO, 1971.
- 14) The Bureau of Forestry of the Philippines: Forestry Statistics, 1971, 1972.
- 15) Reforestation Administration of the Philippines: Annual Report 1970-71, 1972.
- 16) Bureau of Forestry of the Philippines: Forest Resources of Mindanao, 1965.
- 17) Bureau of Forestry of the Philippines: Forest Resources of Palawan, 1968.

SRI LANKA

1 (1)

Land Use

In 1967 this was reported to be as follows (1: p. 6):

	Million ha
Agriculture of which rubber estates grassland (patana) and scrub	1.9 (0.3) (0.3)
Shifting cultivation (chena)	1.4 1/
Roads, streams, reservoirs, towns and villages	O _• 5
National parks, natural reserves	0.3
Forest, including plantations	2.4 (balancing figure)
	BOXCO-com/CPI) (PA i
Total land area	6.5

Forests cover 38 percent of the land area.

Forest types

Two main types occur:

1. Evergreen rain forest in the south west (wet zone) with a total area of 152,000 ha (this excludes the Intermediate Zone forests which are about 81,000 ha, but include 40,000 ha of Montane forests which is of an inferior type to typical wet evergreen forests). The wet and intermediate zone forests form only about 8% of the total forest area. Most of these forests are located in mountainous terrain and fairly inaccessible. Only selective felling is donw in these forests and no clear felling is allowed.

Most important tree species include the preferred and luxury species, namely:

Milla Vitex pinnata
Tawenna Falaquium rubiginosum
Jak, Kos Artocarquis integra
Nedun Pericoosis mooniana
Calamander Diospyros quaesita
Suriyamara Albizia odoratissima
Ebony Diospyros ehunum

together with about sixty other species commonly used or suitable for construction work and plywood making,

Commercial species established in the world market make up not more than about 30 % of total standing volume. However, a much greater proportion, around 70-80 % ** is used locally. Dipterocarps are relatively less important than in the Insular Southeast Asia.

The untapped timber resources of the country are concentrated in the wet grone, and most of her needs for industrial wood in the medium-term must be met from these forests in the absence of mature plantations. Their location in critical watershed areas will, however, impose an additional problem on the management of these forests.

2. The dry zone forest type covers about 1.7 million ha or about 82% of the forest erea, it is of little economic value due to low stocking and low annual yield per unit area. Further, utilisable species are few and widely scattered. The main tree species are Chloroxylon swietenia, Diospyros ebenum, Chukrasia tabularis etc.

Ownership of Forests

Practically all forest land is owned by the State. The established and proposed forest reserves comprise about 1.1 million ha which form about 53% of the total forest area. Large tracts of the dry zone natural forest estate are being released for agricultural development.

Plantations

There has been substantial planting in all 3 zones. The total extent of plantations is 71 000 ha (1974) (this excludes 17,000 ha of wet zone natural forest enriched with Mahogany). The wet zone has 12,000 ha of plantations, of which 7,000 ha are in the up-country and consists mainly of <u>Eucalyptus</u> and <u>Finus</u> species. The plantations in the low country wet zone includes <u>Albizzia</u> and <u>Finus</u>. The Intermediate 200e has 5,000 ha of plantations mainly of

^{1/} This indicates the area of more controlled kind of shifting cultivation, i.e. where taungya or similar practices are being introduced. Some illegal shifting cultivation occurs, however, also in areas classed above as forest, mainly in the dry zone.

Jak (Artocarpus integra) and Swietenia macrophylla. The extent of plantations in the dry zone is 52,000 ha consisting mainly of teak.

The extent of plantations at the end of 1974 and the annual planting programme are given in the table below:-

Species	Annual Planting 1/	Total area of established plantations up to end of 1974
Teak	4,000	49 000
Eucalyptus	400	8 500
Bamboo (Dendrocalanius		
strictus)	200	1 300
Mahogany/Jak	e r	4 800
Albizzia	200	1 400
Pinus	800	4 300
Miscellaneous		1_100
		70 400

Since there are large extents of unproductive and degraded areas in the estates vested in the Land Reform Commission, the Ministry of Plantations Industries showed a great interest in the diversification of these degraded lands in forestry. As a result of this an additional extent of 600 ha is to be taken up for reforestation annually from 1975.

Inventories, standing volumes

A country-wide forest inventory was carried out under the Canadian Colombo Plan in 1956-61.

In order to allow for changes in forest areas since 1956 to 1966 the forest boundaries were checked and rectified by air reconnaissance in the wet zone and other estimates were prepared for the rest of the forest land in 1964-66 by the FAO project, Preinvestment Study on Forest Industries Development, in cooperation with the Ceylonese Forestry Department.

After the adjustments the breakdown of total forest area and growing stock volume (in 1966) is estimated to be the following (1: p. 32).

Forest Type Wet Zone		Interme	diate Zone	Dry Zone		
	Area x 1000 ha	Growing stock million m ³	Area x 1000 ha	Growing stock million m ³	Area x 1000 ha	Growing stock million m ³
High yield) Medium yield)	45.7	8.0	-		-	•• ·
Low yield	72.8	7.4	50. 6	2.8	1 100.8	54,1
Montane forest	3.6	0,2	-	_	-	-
Non-productive f	37.2	1.6	66.4	2.4	947.0	20,5
Plantations	1.2		5.3	A 9	12.5	* •
Total	4160.5	17.2	129.6	5.8	2 184.3	84, 2

About 30 % of these volumes is in species currently established in the world market; locally, however, a much greater proportion is used, apparently around 70-80 %.

Removals

The pre-investment study by the UNDP in 1969 envisaged a potential annual yield of 180,000 m³ saw logs and 110,000 m³ of plywood. However, in the final report, the UNDP envisaged only the production of 150,000 m³ of all types of log timber from the wet zone. This is in accordance with the estimates made by the Forest Department in its long term Foresty Development Plan of 1970. The projected demand for timber is given below, in roundwood equivalent.

	<u> 1975</u>	<u>1985</u>	2000
	THE RES POS AND	1 000 m ³	THE
Sawlogs Peeler logs Paper	430 110	650 140 22 0	1 150 200 220

^{1/} Annual enrichment planting of 800 ha with Mahogany not included.

According to the estimate made by the UNDP the annual consumption of fuelwood is in the region of about 3.54 million m³ while the quantity supplied by the State Timber Corporation is approximately 150 000 m³. If correct this shows that a major part of the fuelwood requirements is obtained from sources other than state forests.

Timber Supplies:

The timber supplies in 1974 have been as follows:

Plantations

(includes fuelwood)

Natural Forests 1/

The present demand of timber is being met by intensive exploitation of the existing natural forests of the dry zone and by selective felling of the natural forests of the wet zone. To compensate for this exploitation, a planning programme of 6 500 ha annually was taken up and this target has since been increased to 7 000 ha per annum from 1975.

It is expected that by the year 2000, the entire demand of timber in this country could be met from the plantations.

- 1. FAO/SF:?//CEY 5: Final Report. Volume II 1969
- 2. do. Volume I 1969
- 3. do. Volume III 1969
- 4. Canadian International Development Agency: Ceylon Forest Inventory. Summary, 1971.
- 5. Forest Department of Ceylon: National Progress Report. Commonwealth Forestry Conference. 1968.
- 6. Forest Department of Ceylon. National Progress Report. Asia-Pacific Forestry Commission 1969.

^{1/} Figures for fuelwood are not available.

THAILAND

Forest Inventories

The first nation-wide, extensive survey in the country was started region by region in 1961 and completed in 1966. The accuracy of the results cannot be ascertained but the survey is stated to have been statisfically designed and based on inventory methodology outlined by two FAO inventory experts previously assigned to Thailand (13, 14).

A special Paper and Pulp material Survey was conducted by UNDP/FAO in the kingdom in 1964-67. Detailed inventories were carried out in six sample areas which together covered some 1.8 million ha. of forest. While the areas of various forest types in individual survey areas were determined from the air-photographs and base maps, the volume data were wholly based on field measurements.

The second forest inventory of Thailand using photo-interpretation and field sampling was started in 1968 and is planned to last until 1976.

The FAO Timber Trends Study of 1972 (1, 2) contains most recent estimate of the nation's forest resources being largely based on the first country-wide inventory with some updating by the results of the Paper and Pulp Material Survey.

Areas of Forest, Growing Stock

The nation's forest resources as in the early 60's, based on the latest inventory data available, are summarized as follows (1):

Table 1: Thailand's Natural Forest Areas and Volumes of Growing Stock by Forest Type and Region as in 1961-64

Region	Area	Growing Stock		
11082002	Area	Total	Per unit area	
	million ha	million m³	m ³ /na	
Broadleaved Evergreen Forest				
North North-East Central South Country	1.76 1.93 3.22 3.22 10.13	118 107 164 194 583	67 55 51 60 58	
Mixed Deciduous Forest				
North North=East Central South Country	4.14 0.75 0.54 - 5.43	198 29 2 - 229	48 39 4 - 42	
Dry Dipterocarp Forest				
North North-East Central South Country	5.38 2.63 0.95 - 8.96	138 39 5 - 182	26 15 5 -	
Total				
North North-East Central South Country	11.28 5.31 4.71 3.22 24.52	454 175 171 194 994	40 33 36 60 41	

Notes

- Stock volumes cover all trees over 30 cm (d, b, h, u, b,) but excluding trees with defects and faults; in dry dipterocarp and mixed deciduous forests nearly all species are at least locally usable; in evergreen broadleaved type about half of stand volume is in currently merchantable species.
- . Are not included plantations, conifers, mangrove forests, rubber and coconut trees.
- Forest areas and average volumes per ha include estimated 4 million ha damaged by shifting cultivation.
- _ Thailand's total land area is 51, 491, 000 ha.

Shifting cultivation is known to be widespread in the country. The latest estimates from 1970, would give a total of 4 million ha of forest as being currently devoid of timber stocking (under crop, scrubland or degraded secondary forest) as a result of the cultivation practice. 1/ This area is included in the total of forest areas on table 1.

It is a generally accepted fact in the government that some 0.5 % of the total land area (i.e. 255,500 ha) is annually cleared for shifting cultivation. Based on most recent information, this rate could be applied to the forest areas as well and if other losses of forest, including legal and illicit logging, are taken into account the rate of decrease might be twice that much (1, 2).

Taking an in-between approach and allowing for actual cutting the current (1970) forest area could be estimated at 25.6 million ha gross 2/ carrying a timber stocking of 994 million m3 (as defined in table 1). Tentatively, this area could be broken down as follows:

Forest lands with a slope:	Area Million ha	gross
Above 30 %	15	
 permanent production forest conservation forestry: wood as a by-product) unproductive (eroded) to be 		4 7 4
Below 30%	10	
- permanent production forest		9-10

By 1990 the total forest area will probably have decreased to some 22 million ha, of which 13 to 14 million ha permanent production forest practically useful for commercial purposes. All areas of the production forest are, currently or potentially, economically exploitable. The whole production resource is to become accessible over the period. (1),

Types of Natural Forest, and Species

The broadleaved evergreen (and semi-evergreen) forest. This type includes the tropical evergreen forests of the South and Central regions of Thailand, the tropical mountain evergreen resource of the North and the semi-evergreen forests of the northeastern region,

In the South genera of dipterocarpus, Shorea, Parashorea, Hopea and Intsia are dominant. In the North, on lower aititudes, Lagerstroemia, Afzelia, Terrameles, Xylia and Hopea prevail besides Dipterocarpus, while in the hill tracts Quercus, Lagerstroemia, Melanovihoca and the family Dipterocarpaceae are most important and common. In the Northeastern region these forests appear semi-evergreen with Hopea, Anisopters and Lagerstroemia among the most dominant genera.

The mixed deciduous forest is a transition type occurring in the Northern and Northeastern regions. In the former, Xylia, Pterocarpus and Lagentroemia are among the dominant species. The average growing stock is very low (table 1) not only because of the less favourable ecological conditions but also because of shifting cultivation and frequent fire damages.

In the North region average stocking is considerably higher and most important species are <u>Tectona grandis</u>—occupying about one third of the forest <u>Lagarstroemia</u>, <u>Kylia</u>, <u>Pterocarpus</u> and <u>Terminalia</u>. The total standing volume of teak has been estimated at over 30 million m3 in the country. Most of this is in the Northern region, with an overall density of some 90 m3/ha as against the country average of teak of 80 m3/ha. Annual increment of sawlog sized timber is assessed at 6 million m3, of which 5 million m3 in the Northern region.

The dry dipterocarp type. These are deciduous, broadleaved forests having an appearance of open woodland and often including transitional subtypes of savannah, Shorea, Pantaome, Dipterocarpus tuberculates and D. obtunifolius account for more than three-quarters of the total volume. The type occurs mainly in the North and Northeastern regions.

The natural pine forests are actually mixtures of pines and dipterocarp—covering some 1.35 million ha in the highlands of Northeastern and Northern regions. Pine is mostly Pa merkusil—accounting for 90% of pine stand volume in certain inventoried areas—and the rest Pa kessiya. These stands are overmature and average a low pine stocking, somewhere near 40 m3/ha. Although of potentially great productivity these resources are seriously being depleted through resin tapping, shifting cultivation, windfalls and fire and are, in fact, disappearing at a rate of over 3% p/a, i.e. within thirty years (3).

- 1/ A paper for the International Seminar on shifting cultivation, Chiang Mai 1970, by the Forestry Faculty of the Kasatsart University, Bangkok (source 2).
- 2/ Including the estimated 4 million ha of forest denuded by shifting cultivation. Excluding this area, the area of stocked land is estimated to be 21,5 million ha.

Sufficient amounts of these resources are, however, stated to be accessible to maintain operations of a pulpmill for 10 to 15 years in transition to plantations supply. This is currently the only source of long fibre wood in the country (3).

To sum up the natural forest resources, the highest volumes are found in the South with 77 m3/ha, followed by the North and Central regions with 53 and 46 m3/ha, and lastly the Northeast with by farthe poorest forests averaging 29 m3/ha. The most valuable forest are those in the Northern region because of the presence of teak; however, due to its greater average stocking, the South has considerable potential as well, despite the more heterogeneous species composition and relatively less valuable species.

Plantations

Areas of existing plantations are officially recorded as follows (7, 9):

By end of	Cumulative	Cumulative Plantations Areas Established			
year	Teak	Other broad- leaved	Grand Total		
	* * * * * * *	1000 ha	* ,		
1967	12.34	11, 19	23.53		
1969	17.96	13, 81	31.77		
1971	25,96	17.00	42.96 *		

It should be noted that only a part of these plantations, especially of the older ones, are successful, 80 % of teak and as little as 30 % of all the rest (7, page 5). Taking this into account, the future areas of man-made forests would be as follows according to the Department's plans in 1969 and assuming that future plantings will be properly established:

By end of year	Existing and Future Cumulative Plantation Areas					
	Pines	Teak	Eucalyptus	broad- br	otal road- eaved	Grand Total
-			1000	ha		
1969	0. 89	14.50	0.06	4.00 18	8,56	19, 45
1975	5.92	46.30	0.86	28, 67 75	5, 83	81.75
1985	27. 82	146.30	4, 86	70.67 221	1,83	249.75
				-		d Committee of Approximate of the State of t

In future, teak will continue to have top priority, followed by fuelwood plantations of acacias (mainly A. catechu) and those of Casuarina species (mostly C. junghuniana and C. equisetifolia) for poles 1/. The reason for the relatively minor role given for pines is the absence of domestic market for pine timber.

Numerous other broadleaved species have been tested but they have not shown any better prospects.

Future Wood Requirements, Removals

Fast removals and future needs of wood are estimates as below (1, 2):

Table 2: Thailand's Past Recorded Wood Production and Estimated Future Requirements

Year	Recorded Industrial Wood Removals	Total Industrial Wood Consumption				Fuelwood Pro	duction
Total		Logs	Pulpwood	Total	From standing trees in Forests	From logging and conversion wastes and from sources outside forests	
	, , , , , , , , , , , , , , , , , , ,		mil	lion in ³	- 	at AMI (AMI PAN to I color over ever till like som alle AMI som som som som ever ever	
1970	4.3	1.4	-	1.4	2.1	2.9	
1985		2.1	0,2	2.4	3,4	3.6	
1990		2.4	0.4	2,8	3,4	3.8	
2000		2.9	0.7	3.6	3.3	4.2	

- Projected log consumption include wood for sawntimber, veneer, panel products and poles.
- Future pulpwood needs are roundwood equivalents of all pulp and pulp products' imports anticipated over the period.
- To arrive at the standing volume equivalent, round 30 percent should be added to the removals.

The consumption estimates for 1970 are based on the survey 1/ carried out for all wood products and fuelwood, independently of available forestry statistics; for increased reliability the study dealt with both end-use consumption for processing of products. For pulp products an apparent consumption approach was applied.

The estimated 1970 consumption of industrial wood can be taken to equal domestic removals: recorded net imports of sawntimber are negligible in relation to total consumption and illegal imports of sawnwood and logs would probably be overshadowed by unavoidable inaccuracies in the overall consumption estimate 2/.

No official estimates of unrecorded removals are available but as can be gauged from the above table, they are certainly high.

The forecast of wood consumption should be viewed as roundwood equivalents of projected domestic demand in the kingdom for forest products including all pulp and pulp products except for quantities of pulp manufactured from agricultural residues and bamboo 3/ and ignoring considerations as to the adequacy of the manufacturing capacities to produce the quantities of consumer wood goods needed. In aggregate, the demand projection should be considered the best estimate, i.e. showing most probably course of development without a deliberate bias in either direction.

^{1/} By the team of the Timber Trends and Prospects Study for Thailand (1,2)

Thailand became a net importer of sawntimber in 1968 (32 800 m³ in 1971). According to official statistics, the roundwood trade was still positive in 1971 (61 400 m³) but with illicit imports included it is stated to be negative as well. No estimates are available of the magnitude of unrecorded timber imports, but these are known to occur from Burma, Cambodia and Laos. The trade balance situation of wood products is likely to deteriorate over the period.

^{2/} Pulp production from the local non-wood materials is not expected to rise considerably from its current level of some 18 000 tons/a perhaps up to 28 000-35 000 tons/a over the period.

Assuming future consumption is not curtailed, it is evident that some of the projected demand for forest product: (Table 2) will have to be met by imports: on wood products and roundwood the current trade deficit is expected to increase from mid 30's onwards because some local industries will probably face difficulties in obtaining their wood raw material at economic prices 1/2, net imports of pulp, pulp products and waste paper are bound to increase at least in the near future because, as far as is known, there is no large pulp manufacturing capacity under construction in the country at mesent.

In terms of roundwood equivalent removals might account for 70-80 percent of the projected total wood consumption (Table 2) by 1990; towards the end of the century the situation is assumed to deteriorate further.

Only broad estimates showing orders of magnitude can be made on the current sustained yield potential of Thailand's forests and on the effect of the above estimated level of removals.

Assuming the likely decrease in forest area — the supply of the projected needs of all forest products including pulp and pulp products from domestic raw materials (Table 2), and the current (1969) plantations programme the evolution of the forest resource might be in the future

	1970	1985	<u> 1990</u>
Growing Stock	TO BE WELL BY AN	million m	3 8
- over 30 cm in (bh) diameter - below 30 cm in (bh) diameter	1225 600	1020 400	947 235
Projected actual cutting	% (of standing	volume
industrial woodfuelwood	1.8 3.5	3,0 8.5	3, 8 14, 3

- Notes The crop volume of small-sized timber (600 million m3) is a rough estimate made in the Timber Trends Study (1,2) for lack of inventory data.
 - Apart from logs, also pulpwood removels are assumed to draw on large-sized stand volume because if pulp production materialized, it will use large-sized wood from natural pine forests until plantations start to mature in the late 80's.
 - Annual increments of 2 and 3.5 percent have been assumed for large and small-sized timber stocking respectively,

It appears that a rapidly growing inbalance of demand over sustained yield potential is developing: although industrial wood removals are currently of the order of what could be imagined, the amount of annual increment (average of about 2% for forests as a whole), inroads into timber capital are expected to start with an increasing rate from the early 80's onwards; however, overcutting of small-sized trees for fuelwood is a present phenomenon; in fact, a relative shortage of young trees in the stands was already noticed by FAO inventory experts in 1958 and 1962 (12, 13), and this situation is expected to deteriorate over the period leading eventually to the exhaustion of small-sized timber stocking in the country by 1995 or so.

Legal restrictions on industrial wood removals will not be necessary in the next two decades because the natural forest resources will last at the expected rate of overcutting until the end of the century. In some parts of the country scarcity of industrial rawwood of desirable species at competitive prices will, however, emerge already from the late

It is reasonable to assume that the government will take steps to avoid the prospective depletion of the nation's forest resources that is described above, not by curtailing removals or wood consumption but by increasing future domestic supply by the means of man-made forests. It should be noted that the establishment of ample areas of fuelwood plantations during the 70's, in the right locations, is of prime importance to the continuance of industrial wood supply from the late 80's onwards.

An ambitious plantations programme would have to be initiated in the near future for the country to be able to meet all her wood requirements from domestic sources (most of the supply will have to come from man-made forests) around the turn of the century:

^{1/} How significant the prospective shift towards imports of wood end wood product: will be it, of course, dependent on the government's imports tax policy, and the provision of access to unexploited commercial forest areas.

	4	rea to be est:	ablished	Rotations
Type of Plantations	Annual 1967	2 000	Total 1967-2000	Years
	~~~~~~~	1 000	ha	10 ph ca eq e7 77 ph to
- Structural timbers	33	33	1 000	30
- High quality timbers	15	15	325	70
~ Pulpwood	8	18	350	15
- Fuelwood	10	75	1 000	10-20
Total	65	145	2 700	

Note: Structural timbers would be practically all pine, and high quality timbers teak, pterocarpus and afzelia.

However, several sources doubt that a venture of this magnitude is beyond the technical, operative and financial resources currently available to the Forestry Department (1, 2); therefore, it could be assumed that Thailand would become increasingly dependent on forest products imports after 1990.

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