PRESENT STATUS OF THE GLOBAL MANGROVE ECOSYSTEM

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Introduction

Mangrove forest is one of the primary features of coastal ecosystems throughout the tropical and subtropical regions of the world. The mangrove has been variously described as "Coastal woodland" and "Intertidal forest"

Mangrove forest generally embondies two different concepts which firstly refers to an ecological group of evergreen plant species belonging to several families but possesing marked similarity in their physiological characteristics and structural adaptation to similar habitat preferences. Secondly, it implies a complex of plant community fringing the sheltered tropical shores. And such communities usually have a border to trees which are mainly species of Fam, Rhizophoraceae associated with other trees and shrubs growing in the zone of tidal influence both on the shelter coast itself and inland along the banks of estuaries and rivers.

It has been estimated that between approximately 60% to 75% of the tropical coastline is lined with mangrove forests (McGill, 1958). Walsh (1974) pointed out that it seems to be five basic requirement for extensive mangrove development and these are 1) tropical temperature, 2) fine-grained alluvium, 3) shores free of strong wave and tidal action, 4) salt water and 5) large tidal range. These five important environmental factors can influence on the occurrence and size of mangroves, the species composition, species zonation, other structural characteristics, and ecosystem functioning itself.

Area Distribution of the World's Mangroves

Global geographical distribution of mangroves is mainly restricted to the tropics but some parts of subtropics are also found particularly in Japan and New Zealand reported by Oyama (1950) and Steenis (1962a) respectively. Walsh (1974) stated in his paper that the geographical distribution of mangrove vegetation can be divided into two main groups : that of the Indo-Pacific region and that of western Africa and the Americas. The Indo-Pacific region is composed of East Africa, the Red Sea, India, Southeast Asia, Southern Japan, the Philippines, Australia, New Zealand, and the Southern Pacific archipelago as far east as Samoa. The West Africa-American regions includes the Atlantic coasts of Africa and the Americas, the Pacific coast of tropical America, and the Galapagos Islands. The general geographic distribution of

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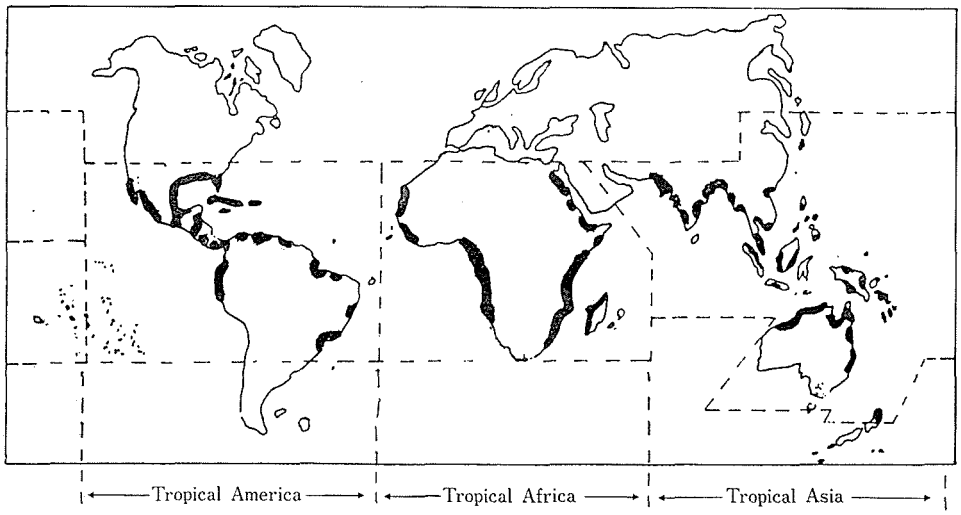

Figure 1. General grographical distribution of mangroves in the world

mangroves in different tropical regions is illustrated in Figure 1.

The areas of mangrove forests in different parts of the world as shown in Table 1 were collected from several publications. The exact existing mangrove areas at the present time of several countries are still not investigated. However, as based on the data in Table 1, it can be estimated that the total mangrove areas of the world is approximatly 15,429,000 ha composing of 6,246,000 ha in tropical Asia, 5,781,000 ha in tropical America and 3,402,000 ha in tropical Africa. This data is slightly variable due to the techniques used and the date of determination.

Structural Characteristics

Species composition

Mangrove species are variable from place to place or country depending on geographical conditions and environmental factors e. g. soil and water conditions. Saenger et al (1981) reported that there are about 33 genus and 79 species of mangroves over the world including 22 genus and 62 species of trees, 6 genera and 10 species of shrubs, 3 genera and 3 species of palms, 1 genus and 3 species of ferns and 4 species of shrubs and trees. Details of the distribution of the individual mangrove species in different regions are given in Table 2.

Species zonation

In most mangroves, different species dominate certain bands of zones which are clearly delimited from the others. This characteristic zonation pattern results from differences in the rooting and growth of seedlings of the competitive adventages which is species has along the gradient from below the low water to above the high water lines (Kuenzler, 1968), the frequency of inundation (Watson, 1982), soil and water salinity (de Hann, 1901; Macnae, 1968), drainage and soil moisture (Thom, 1967), and geographic conditions (Aksornkoae and Kongsangchai, 1900). Due to the differences of those factors, the species zonation varied from place to place or country to country. Aksornkoae (1976) described the mangrove in Southeast

Table 1. Area distribution of the worlds mangroves

Country	Area (Thousand ha)	Country	Areas (Thousand ha)
Bangladesh	450	Malaysia	674
India	96	Peninaular Malaysia	(149)
Pkaistan	345	Sabah	(350)
Sri Lanka	4	Sarawak	(175)
Burma	812	Philippines	240
Thailand	287	Kampuchea	10
Brunei	7	Viet Nam	320
Indonesia	2,500	Papua New Guinea	553
Australia	m	Fiji	m
		New Zealand	m
Total area of mangrove in Tropical Asia 6,246,000 ha			
Mexico	660	Bolivia	m
Costa Rica	39	Brazil	2,500
El Salvador	45	Colombia	440
Euatemala	50	Equador	235
Honduras	145	Uruguay	m
Nicaragua	60	Peru	28
Panama	486	Venezuela	260
Central America & Mexico	1,485	Tropical Latin America	3,463
Belize	75	Cuba	400
Guyana	150	Guyana Francais	55
Jamaica	7	Haiti	18
Trinidad & Tabago	4	Republic Dominicana	9
		Surinum	115
CARICOM	236	Others of the Caribean	597
Total area of mangrove in Tropical America 5,781,000 ha			
Senegal	169	Equatorial Guinea	20
Gambia	60	Gabon	140
Guinea-Bissau	230	Zaire	50
Guinea	260	Mozambique	455
Sierra Leone	170	Madagascar	300
Liberia	20	Tanzania	96
Ivory Coast	m	Kenya	45
Ghana	m	Somalia	20
Togo	m	Ethiopia	m
Benin	m	Sudan	m
Cameroon	272	Nigeria	970
Angola	125		
Total area of mangrove in Tropical Africa 3,402,000 ha			
Grand total area of mangroves 15,429,000 ha			

Table 2. Distribution of the individual mangrove species in different tropical regions

A-Exclusive Species	Life-form	Tropical Asia	Tropical America	Tropical Africa
Acanthus ebracteatus	S	√	×	×
Acanthus ilioifolius	S	√	×	×
Acanthus volubilis	S	√	×	×
Aegialitis annulata	S	√	×	×
Aegialitis rotundifolia	S	√	×	×
Aegiceras corniculatum	S	√	×	×
Avicennia alba	T	√	×	×
Avicennia bicolor	T	×	√	×
Avicennia eucalyptifolie	T	√	×	√
Avicennia germinans	T	×	√	×
Avicennia intermedia	T	√	×	×
Avicennia lanata	T	√	×	√
Avicennia marina	T	√	×	×
Avicennia officinalis	T	√	×	×
Avicennia rumphiana	T	√	×	×
Avicennia tomentosa	T	×	√	×
Avicennia tonduzii	T	×	√	×
Bruguiera cylindrica	T	√	×	×
Bruguiera exaristata	T	√	×	√
Bruguiera gymnorrhiza	T	√	×	×
Bruguiera hainesii	T	√	×	×
Bruguiera paraviflora	T	√	×	×
Bruguiera sexangula	T	√	×	×
Camptostemon philippinensis	T	√	×	×
Camptostemon schultzii	T	√	×	×
Berions decandra	T	√	×	√
Ceriops tagal	T	√	×	√
Conecarpus erectus	T	×	√	×
Cynemetra iripa	T	√	×	×
Cynometra ramiflora	T	√	×	×
Excoecaria agallocha	T	√	×	√
Heritiera litteralis	T	√	×	√
Heritiera fomes	T	√	×	×
Kandelia candel	T	√	×	×
Leguncularia racemosa	T	×	√	√
Lumnitzera littorea	S/T	√	×	×
Lumnitxera racemosa	S/T	√	×	√
Nypa fruticans	P	√	×	√
Osbornia octodonta	S	√	×	×
Pellicira rhizophorae	T	×	√	×
Rhizophora apiculata	T	√	×	×
Rhizophora harrisonii	T	×	√	√
Rhizophora mangle	T	×	√	√

Table 2. (Cont.)

A-Exclusive Species	Life-form	Tropical Asia	Tropical America	Tropical Africa
Rhizophora mucronata	T	√	×	√
Rhizophora racemosa	T	×	√	√
Rhizophora x selala	T	√	×	×
Rhizophora stylosa	T	√	×	×
Rhizophora x lamarckii	T	√	×	×
Scyphiphora hydrophyllacea	S	√	×	×
Sonneratia alba	T	√	×	√
Sonneratia apetala	T	√	×	×
Sonneratia caeoeolaris	T	√	×	×
Soneratia griffithii	T	√	×	×
Sonneratia ovata	T	√	×	×
Xylocarpus australasicus	T	√	×	×
Xylocarpus gangeticus	T	√	×	×
Xylocarpus granatum	T	√	×	√
Xylocarpus moluccensis	T	√	×	√
Xylocarpus parvifolius	T	√	×	×
B-Some important, non-exclusive species	**Life-form**	**Tropical Asia**	**Tropical America**	**Tropical Africa**
Acrostichum aureum	F	√	√	√
Acrostichum danaefolium	F	×	√	×
Acrostichum speciosum	F	√	×	√
Barringtonia racemosa	T	√	×	√
Brownlowia argentata	T	√	×	×
Brownlowia tersa	S/T	√	×	×
Cerbera floribunda	T	√	×	×
Cerbera manghas	T	√	×	×
Clerodendrum inerme	S	√	×	×
Cynometra mannii	T	×	×	√
Dolichandrone spathacea	T	√	×	×
Hibiscus bamabo	T	√	×	×
Hibiscus tiliaceus	T	√	√	√
Maytenus emarginata	S	√	×	×
Myristica hollrungii	T	√	×	×
Oncosperma filamentosa	P	√	×	×
Pemphis acidula	S/T	√	×	√
Phoenix paludosa	P	√	×	×
Pterocar officinalis	T	×	√	×
Thespesia acutiloba	T	×	×	√
Thespesia populneoides	T	√	×	×
Thespesia populneoides	T	√	×	×
Total		67	14	24

Key : S=Shrub, i. e., less than 3m
T=Tree, i. e., greater than 3m
P=Palm
F=Fern
√=present
√=absent

Thailand that the community structure varied from the edge of the estuary or river to inland sites. *Rhizophora apiculata, Rh. mucronata* are dominant species to occupy an area along the edge of the forest. *Nipa fruiticans* is also found in this area. *Avicennia and Bruguiera* associated with *Rhizophora* but they formed a more distinct zone behind the zone of *Rhizophora.* On areas adjacent to the *Avicennia* and *Bruguiera* which have drier soils and are less subject to tidal inundation, *Xylocarpus* and *Excoecaria* become the dominant species. Some areas behind the *Avicennia* and *Bruguiera* zone particularly the areas with a low topographic relief and soils high in clay content, *Ceriops* and *Lumnitzera* are usually found. *Melaleuca* reaches its highest dominace further inland.

In Florida, *Rhizophora* was the dominant species forming the forest margin. *Avicennia, Laguncularia* and *Conocarpus* dominated on areas more inland. The species zonation of mangrove in this area is similar to the mangrove zonation of West Africa.

However, it can be concluded that the main factors affected species zonation were degree of tidal flooding, elevation of the land, and salinity of the soil water.

Species diversity

The complexity of mangrove forest may be expressed by the species diversity index. The species diversity of mangrove forests in different parts of the world are quite different depended on species composition and number of individual species of vegetation community. The specis diversity index in southern Florida is about 0.4979 (Lugo and Snedaker, 1973). The species diversity index of mangrove in Thailand was determined in different parts of the countries. Mangrove in Chantaburi and Trad, southeast Thailand, the species diversity index were about 0.8790 (Aksornkoae, 1976) and 0.7806 (Patanaponpaiboon, 1979) respectively. The values of species diversity of mangroves in Phang-nga (Aksornkoae and Jitt, 1980) and Ranong, southern Thailand (Aksornkoae et al. 1982) were 0.4103 to 0.7576 and 0.4330 respectively. No data on species diversity index of mangroves in other parts of the world are available at the present time.

Associated biota

In mangrove community, there are quite number of associated species both plants and animals. Some of these organisms live in the mangroves for only part of their life cycles, or alternately the mangroves provide a suitable permanent habitat. However, these associated biota are considered to be the important resources of mangrove ecosystem. The important associated species are bacteria, fungi, algae, hryophytes/ferns, lichens, monocotyledons, dicoty ledons, sponges/bryozoa, coelenterata/ctenophora, non-polychate worms, polychaetes, crustaceans, insects/arachnids, molluscs, echinoderms, ascidians, fish, reptiles, amphibians, birds and mammals.

Uses of Mangroves

Mangrove forest has been widely and variously used by the people who live in or close to the forest and who traditionally make a living from the mangrove ecosystem for thousands of years. People have depended on mangrove trees for many purposes. Firewood and charcoal are main products obtained from mangrove trees in Southeast Asian countries particularly in Thailand (Aksornkoae, 1979). The utilization of mangrove trees for timber at large quantity

was found in Indonesia and Bangladesh (Burbridge and Koesoebiono, 1980: Ahmad, 1980). Many countries also use mangrove woods for construction purposes. Paper and woodchip from mangrove woods are used in Malaysia. Tannin from mangrove barks are widely used in Latin american countries like Panama and Costa Rica but very little quantity is used in Southeast Asian countries only for dying fishing nets.

The use of mangrove in fisheries production has been recognized. Many commercially important fishes, crabs, prawns and various kinds of molluscs use mangroves as nursery ground and also shelters during their juvenile stages. By this relationships, it can be seen that many mangrove dwellers catch marine animals around mangrove forests. Aquaculture is also widely practised in mangrove areas particularly in Southeast Asian countries.

Some countries like India and Indonesia use mangrove trees for grazing. Honey raising is also observed in mangrove forest especially in Bangladesh. Many kinds of mangrove species are used for medicinal plants but they still need scientific prove. Moreover, some countries, mangroves are used as wildlife sanctuary, protecting of coastlines and riverbank against tidal bores and cyclone. Mangrove forests are also reserved for park and study areas in many countries.

Causes of Mangrove Destruction

The global status of mangrove forests has found that vast areas are being destroyed either intentionally or as a secondary result of other activities. The causes of mangrove destruction in various countries are very similar. The degree of destruction in each country depends on specific purposes. The main problem is that the population of each country increases and this let to increase demand for food, fuel, building matterial, urbanization and land for cultivation. However, it can be concluded that the causes of mangrove destruction in the world are made in many ways and these can be classified as over-exploitation by traditional users, conversion to aquaculture, conversion to agriculture, conversion to salt pans, conversion to urban development, construction of harbours and channels, mining, liquid waste disposal, solid waste or garbage disposal and spillage of oil and other hazardous chemicals. Natural stresses such as cyclone, freshwater discharge are also destroyed mangrove forests but the areas are minimal.

Management and Administration

Since the value of mangrove forest is very important to the daily fife of mangrove dwellers and those who live close to the mangrove and to the economy of the countries and also to mainta n ecological equilibrium as previousely mentioned, all country containing mangrove area has set the plan for using the mangrove resources as sustained yield basis. The concept of sustainable use involves either sustainable harvest or sustainable economic returns while at the same time the system can be maintained in as natural or close to its original state as possible.

Sustained yield management of mangroves for forestry production is carried out by various countries particularly in Southeast Asia. The utilization of mangroves for forest production is not widely obeserved in Latin American countries, most of them are reserved for sustained yield management for coastal fisheries. Some countries, the mangrovesare permanently kept

for shorelines protection and tourist area especially in Japan. The sustained yield management of mangroves for forestry products is based on management plan and silvicultural system. The cutting rotation period varies from country to country between 20 to 40 years. The principle practice is that the mature trees are clearfelled in strip as in Thailand or Venusuala or in block as in Malaysia with a few hectare in area and the timber is removed for any specific purposes. These areas will be planted if natural regeneration is insufficient.

Regarding to sustained yield management of mangrove for coastal fisheries, the mangroves are kept for providing nutrents for productivity of fisheries, sheltering nursery grounds as permanent habitats and breeding grounds. The multiple-use management system or socalled "Silvo-fishery system" are being operated. The practice is that fish or shrimp ponds are constructed around mangrove plantation and this method showed successfully in Indonesia.

At present, many countries are attempting to maximize the use of their mangroves especially for the sustainable production of forestry and fisheries. In Asian countries, the National Mangrove Committee (NATMANCOM) were established to advise the goverments in planing and implementation of technical projects and to determine the existing problems on utilization and conservation of mangrove resources. Various laws and regulations regarding to mangrove resources management were revised in many countries according to present situation.

International Collaboration

It indicates that mangroves play a very important role in the life of the people who live in or close to mangrove areas and also to economy of the country. Countries containing mangrove forests try to conserve them for many purposes and to utilize them on a sustained basis but the results come out with sucess in some countries and failure in some countries. There are many reasons to take into account but today it can indicate that only individual country can not work successfully. The action and collaboration from various countries and foreign agencies are very necessary to be carried out. UNESCO, UNDP, IUCN, FAO etc. play a significant role in bringing scientists and dicision makers from various developing countries and less developing countries to seek understanding of the natural characteristics and the mangroves to the survival of human along the coastlines. Situation in desert countries that in Africa have shown to the world of the poverty, famine and mortality. No one will be sure that would happen to human along the coastlines if the food habitats "mangroves" has been destroyed.

Conclusion

Mangrove forests in the world is approximately 15.5 million hectare which is less than 1% of the total area of inland forests but they play a very important role to the life of human along the coastlines and the economy of the countries. Mangroves are major sources of energy and food. Many countries are attempting to maximize the use of their mangroves particularly for the sustainable production of forestry and fisheries. But it seems that the benefits derived from mangrove forests are small and ineffective. Moreover, some countries make no use at all of their mangroves for lack of knowledge and technology. However, this regrettable waste of resources can be overcome if scientists among different countries pay serious attention to

mangrove ecosystem and employ their knowledge in managing mangrove resources to the maximum without destroying the ecosystem. This will increase the energy and food available to human while the energy and food crisis the world is presently facing.

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