

CHAPTER IV

COASTAL ECOSYSTEM MANAGEMENT IN THE AYEYARWADDY DELTA

4.1. Government Policies on Mangrove Ecosystem Management

The Ayeyarwaddy Delta is in the southern part of Myanmar. It is located between latitudes 15° and 17° north, and between longitudes 94° and 96° east. The total area of Ayeyarwaddy Division is approximately 155,795 sq km. The mangrove forest in the Ayeyarwaddy Delta is the largest in the country, when compared to other the areas of Rakhine and Taninthayi, covering 180,826 ha.

Ayeyarwaddy Division is where the Ayeyarwaddy River splits into many streams and drains into the Andaman Sea. The streams are rich in minerals that the flowing waters have collected along their hundreds of kilometers journey through the middle of the country. The Division has a unique and fragile ecology made up of islands, swamp lands, wetlands, sand, mud, mangrove forests, bush forests and large rice fields. The Delta area has a large network of creeks, streams and rivers, and is frequently flooded by tidal effects during the rainy season. Mangrove forest ecosystems are important for marine life and the environment, especially for mangrove dwellers. Forest policies, legislation and institutional factors are affecting the management of coastal forest and marine ecosystems. Mangrove forests are mainly found in Bogalay Township, which is situated in the south of the Ayeyarwaddy Delta (Forest Department, 2002).

4.1.1 Forest Management Policy in the Delta

In the Ayeyarwaddy Delta there has not been proper forest management of the mangrove ecosystems; however, the mangrove forests are meant to be managed under the Forest Working Plan, under the Forest Department. In the plan, both the size and the area controlled are mainly applied as a conservation measure. Regrettably, the existing management system is based on the revenue target defined at a particular time, not on the carrying capacity of the forest itself. The Myanmar Forest

Management Policy also promotes conservation approaches, namely, natural systems, modified natural forest systems and reforestation with community participation in degraded forest areas.

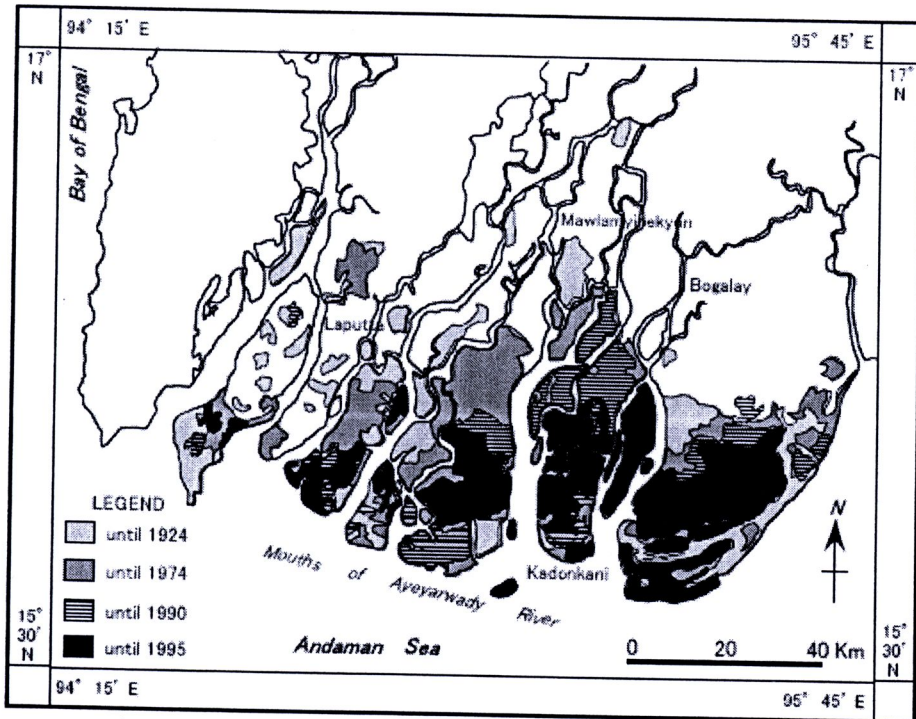


Figure 4.1: Map of the Ayeyarwaddy Delta

Without heavy ecological disturbance, trees in the mangrove forest can flourish naturally. In the past, there was little pressure on the mangrove forest when used only by villagers. In general, local management was carried out only for the prevention of change of land use patterns in the communal forests. Replanting trees after cutting was unnecessary, because in less populous areas people did not over-harvest the mangrove forest. Mangrove dwellers planted mangrove tree species in some areas after they cut trees for their domestic consumption. Natural regeneration was and is good for mangrove trees in the delta. Certain tree species were cut for certain purposes. Local management was done only for the prevention of change of land use patterns in the communal mangrove forests. Local communities' knew the value of mangrove forests for their daily livelihood and thus made an effort to

maintain the local mangrove population. Villagers accessed the forest through rotational systems. They maintained their own natural forests according to their cultural traditions, which had been developed over many generations, with cutting done at the lowest part of the tree trunk. Only tree trunks were transported to their houses by boat; branches of the trees were left to be collected by other villagers for fuel. Trees along the river bank were also left, in order to protect the coastline against tidal waves, storms from the sea and to prevent bank erosion and changing waterways.

Some villagers are skilled at tending mangrove forests. Based on their experience, it is believed that young seedlings need shade at the beginning of their growth in a natural regeneration. This is a problem when mangrove forest management units clear cut mangroves and replace them by planting commercial tree species according to government policy. Local communities believe that the concessionaries who obtain the greatest benefit from the forest should take responsibility for protecting the forest from illegal cutting, maintain the balance of the ecological system, and sustain both forestry and fishery resources. Mangrove dwellers would like to take over the responsibility for protection of forests around their villages. They want to work in such activities as planting and logging for their domestic use, in order to earn cash income for their daily subsistence, provided that the concessionaries will hire them. The level of communication between villagers and concessionaries is very different to local authorities, which mean a different power relationship between them. Villagers can communicate with lower level foresters and village heads. When they see people from other areas cutting mangrove trees illegally, they can directly inform the management committee of the village or forest officials.

Socio-economic conditions in the human settlements within the mangrove forests are difficult for several reasons. Mangrove forest ecosystems and the socio-economic systems of mangrove settlers, are not coterminous, and when compared with the natural ecosystem, information on the socio-economic systems of mangrove dwellers is sparse. Even with limited economic development and modernization, the boundaries of the social and economic systems that influence the mangrove area spread well beyond the ecological limits of the zone itself. With increasing development, the boundaries of the socio-economic systems that use mangrove

resources are spreading even further. The most important aspect of the mangrove forest is that it provides an excellent breeding ground for many species of fish, shrimp, crab and shellfish (Kunstadter, *et al.* 1986).

If Myanmar had a more transparent and clear-cut land-use policy, it would boost the expansion of community forestry in the Ayeyarwaddy Delta. In reality, the paddy purchase policy inside mangrove reserves depletes the mangroves. Because paddy production is receiving such a high priority in the delta, community forests can only be established on low fertile soils with salinity problems. From the view of a poor family, it is much more suitable and reasonable to reclaim such land, than to use existing fertile land. Nevertheless, there are some dedicated communities who really want their mangroves back in the Delta. This is an encouraging sign, as promoting community forestry activities in the Ayeyarwaddy Delta and could lead to restoration of the mangrove ecosystems. The Forest Department is the formal government agency created to conserve, protect and manage the forests in Myanmar. However, since other units such as the Department of Land Records and Settlements and the General Administration Department control certain land use categories, land tenure and customary rights have a significant impact on the use of forests and trees in Myanmar.

As to forest management in Bogale Township, there are three forest reserved areas and other protected forest areas. The Kadonkani Forest Reserve, Pyindaye Forest Reserve and Mainmahla Wildlife Sanctuary are managed by the Forest Department. Wildlife conservation continues to be managed directly by the Nature and Wildlife Conservation Division of the Forest Department. While Kadonkani and Pyindaye forest reserves continue to manage the sustainable production of fuel wood, further encroachment by agriculture is prevented. These two reserved forests and other forest-covered areas are managed closely by the Township Forest Department. The Bogale Township Forest Department must respond to the instructions, forest policies and rules established by the conservator of the Divisional Forest Office and the District Forest Office within the Township area. The Forest Department determines three types of forest conservation: (1) commercial demands and local supply areas, such as reserved forests, (2) public protected areas, and (3) local supply forests. The Forest Department has to follow forest management practices such as forest protection, conservation, management, reforestation and community forestry

for local communities, forest harvesting, processing and marketing, research and development, extension and education, training and the establishment and management of protected areas systems. The Forest Management Plan includes cooperation between the Forest Department and local NGOs on initiatives for sustainable development in rural areas. Thus, since 1995, the Forest Department has permitted the establishment of community forests in the Delta area, to achieve active participation by the rural population in planting trees on barren land to reforest degraded areas. These efforts are supported by NGOs, who provide technical knowledge for establishing forest plantations, as well as financial support and some equipment.

Despite these provisions, the Forest Law cannot be enforced due to a number of reasons. The first is the limited and inappropriate institutional capacity. It is impossible for foresters to control and enforce the law over their entire area, because they lack the required transportation and communication equipment that would help them to control the large areas under their jurisdiction (1,000 to 10,000 acres). Also, foresters usually lack the necessary funding for their work. They must rely on villagers for basic food and living arrangements, as well as for transportation. This gives villagers the chance to negotiate with the foresters. To make a living, local people can negotiate with foresters, in order to be able to carry out timber cutting.

Foresters usually understand the situation of the poor villagers, whose everyday food depends on illegal cutting, and in many cases even though they are informed about illegal exploitation, they pretend as if they do not know, or just ignore the rules. Since those villagers also show respect for the foresters, and in most cases give them food and support, the forestry officials often ignore certain violations.

4.1.2 Coastal Zone Development and Management

The Myanmar Government's main objectives with regard to coastal zones are to develop and increase the productivity of coastal and marine living resources up to the maximum sustainable yield in order to meet human nutritional needs, as well as social, economic and development goals. Moreover, policies focus on promoting traditional knowledge and the interest of local communities, in order to develop

sustainable practices of utilizing coastal and marine living resources (Forest Department, 1995).

Coastal, island and marine ecosystems are all inter-dependent and related. Sustainable management of these ecosystems is vital for bio-diversity, wildlife and fisheries. Degradation of mangrove resources has affected fishery production and may facilitate environmental disasters in the future. Birds, fish, and the general marine population will be affected if mangroves, coastal and island forests are not sustainably managed. Increasing population and development activities cause considerable stress on the coastal and marine environment.

Overfishing and injudicious harvesting of marine resource has already created this stress on the ecosystems, and damaged feeding grounds and habitats. Mangrove ecosystems are affected by many factors, including human settlement and environmental pollution. Fishery production rose continuously in the 1990s in the Ayeyarwaddy Delta, and Bogale Township has been greatly affected by the mangrove destruction. Ayeyarwaddy Division was once considered an important area of fishery production, but in recent years, fish and fishery products have become scarce and the prices of fish and shrimp, as well as other products such as dried fish, dried prawns and shrimp pastes, have risen sharply. The management and development of fishery resources is undertaken by the Fishery Department. The responsibilities of this Department include, among others, supplying fishing nets and equipment to the marine workers, the distribution of freshwater and deep sea prawns to private breeders and assisting them with their breeding techniques and development activities, collecting taxes and issuing fishing licenses. The Department has also entered into several joint ventures with the private sector for fishery operations.

Human settlement activities, especially housing, use of drinking water, treatment and disposal of sewage, solid waste and industrial effluent, land use, agriculture, forestry and urban development, have also affected the coastal and marine environment, coastal erosion and siltation. An appropriate action plan for the protection of the marine and coastal environment from land-based sources needs to be prepared and implemented. Coastal zones are the 'sink' for the country, due to development activities taking place in the hinterland. In particular, large amounts of sediment from agriculture, forestry and mining activities and pollution from land

based resources, is carried to the coast. There is a need for appropriate national policies, legislation and laws to manage and protect coastal forests and to promote the sustainable use of the coastal marine resources. The mangroves have also been over-exploited by forestry, agriculture, aquaculture and development projects. Mangrove forests are subject to severe degradation, because there is no clear-cut land-use system. Forest land has been converted to agriculture and other development activities.

One of the objectives of mangrove management in all the regions in Myanmar has been bio-fuel production for domestic and industrial uses. Among the three areas, the Ayeyarwaddy Delta is the most important as the supplier of bio-fuels; for in addition to the needs of Ayeyarwaddy Division itself, especially in the 1980s, Rangoon's firewood and charcoal requirements, about 70,000 hoppus ton¹ per year, had to be supplied from the Ayeyarwaddy Delta. Mangrove forests in the Delta have subsequently been degraded and stripped due to the over-exploitation of land and its conversion to other uses. The Ayeyarwaddy Delta was the most seriously affected amongst the three areas. Therefore, the Myanmar Forest Department took an action for the conservation and restoration of mangroves. Rehabilitation through the establishment of mangrove plantations was started in 1975 by the Forest Department, though on a small scale; charcoal production was banned in 1993 to conserve natural mangrove forests. For the time being, the only firewood allowed is for domestic consumption. One outstanding achievement was that Meinmahla Island, whose mangroves are still in a good condition, was declared a wildlife sanctuary in 1994.

The Human Development Initiative (HDI) project conducted between 1994 and 2000 by UNDP/FAO may have also contributed, to some extent, to the rehabilitation of mangrove ecosystems. In summation, today, the mangrove ecosystem in the Delta is facing an environmental crisis which has primarily stemmed from: (1) population increase resulting in increased demand for land and exploitation of coastal resources, (2) unplanned agricultural growth and unsustainable use of forests to meet the tremendous demand of the growing population, and (3) low economic valuation of natural resources from mangrove forests compared to overvaluation of the forests'

¹ One hoppus ton is equal to 50 hoppus feet or 1.8027 cubic meters

food and fuel-wood production. Timber extraction, mining and developing the area for tourism by building infrastructure, should all be regulated, as these are the main causes of coastal ecosystem degradation. Coastal communities on the islands, suffer from poverty and lack of viable livelihood options. Infrastructure support systems, alternative livelihood programmes and basic health and education services should be strengthened in these communities, on a priority basis.



Figure 4.2: Degraded Mangrove Forest in the Ayeyarwaddy Delta

4.2 Changing Management Policies and Land Use Pattern in Ayeyarwaddy Delta

The post-independence government promoted food self sufficiency and food security as major changes to the rice policy of the British Colonial Government. However, the new government maintained the principle of “export promotion” under a mixed economic system, one that retained a leading role for the free market. The new government intervention and control measures introduced at the beginning of the post-independence period were confined largely to procurement and export of food grain, however, there was also some intervention in domestic retail marketing to distribute subsidized rice to the poor. Rice production had been seriously interrupted by World War II, and half of the rice-growing area had to be abandoned. The major criticism of government rice policy during the British Colonial period was that it

eventually led to political instability and pressure for land reform, particularly when the private money lenders ended up owning a major part of the rice land in lower Myanmar. The British Colonial system in Myanmar provided no remedies or laws to prevent these economic and social inequalities.

As a result of the first and the second Anglo-Burmese war, the British annexed Lower Burma in 1852, while Upper Burma was still ruled by Myanmar kings. In 1886, the British annexed Upper Burma after the third war between the two countries. Excuses made for this, among others, were the growing influence of France on Myanmar, the massacres at the royal court regarding accession to the throne, and the dispute between the King and the Bombay Burma Trading Company with the resulting fines. The country gained its independence from the British in January 1948, after the Second World War. The conquest of the British marked the end of the feudal system in the Ayeyarwaddy delta. The political and economic institutions of Lower Burma were transformed, as the area was rapidly drawn into a capitalist, commercially oriented global economy. Thus, the feudal lands became private property and the commercialization of the country's agriculture and globalization started to work.

Since colonial rule lasted for about 100 years, it can be divided into two parts; the period from the annexation of Lower Burma to that of Upper Burma (1852-1885) and the period when the whole country was under the British rule, up until when it gained its independence (1886-1947). The British annexation of Lower Burma resulted in a significant change in the economic system in the delta. The economic policy was focused on development and to a certain extent the principles of "free trade", as practiced in England, were applied, with economic forces given full play. At the same time in Upper Burma, the Myanmar kings were still attached to a mercantilist philosophy, in spite of closer relations with Lower Burma, and there were monopolies in trading. With the opening of the economy and with foreign trade developing, many banks were established in Myanmar and most of them were opened in seaports and Rangoon (Yangon). However, the money link between the cultivators and money market was served by Chettiers, who were moneylenders who charged high rates of interest.

The early stages of the market economy worked across the whole country, which was then brought into closer contact with the materialistic world. The worst time for the Delta towards the end of the colonial period was the Japanese occupation during the Second World War, which resulted in very extensive damage. The whole economy was seriously affected due to British and Japanese scorched-earth policies. Furthermore, cultivators abandoned almost half of the land. The objective of the British government regarding the agrarian system was to strive to make rights to land easily attainable and at the same time to ensure that holdings came to be controlled by agriculturists and not by speculators and moneylenders.

During the early colonial period, land revenue was assessed at 10 per cent and then twenty percent of gross produce. Then, in later days, it was changed to one half of the net profits, and net profit was defined as gross produce less cost of cultivation and the cost of living. As a result of the colonization of the Delta, the area of cultivated land increased from 600 thousand acres in 1852-53 to 6.7 million acres in 1902-03 and then to 8.9 million acres in 1922-23. This was due to an increase in immigration from Upper Burma and the subsequent expansion of rice cultivation.

A remarkable increase in rice cultivation in the Delta occurred during the early colonial period, due to increases in population and export demand, which was spurred by the opening of the Suez Canal, the outbreak of civil war in the US and the subsequent decline of the Carolinas as a source of rice for Europe. There were also famines in India during the 1870s. During this period, agricultural techniques used in the Delta were inferior to those in Upper Burma. However, in later years, techniques in the Delta improved as many canals were constructed for irrigation, and embankments were built by the government on the Ayeyarwaddy and Sittaung rivers to prevent floods and soil erosion. During this period, ploughs were used in the Delta for the first time.

At this point the majority of industries were agriculture based, such as rice mills, saw mills, oil mills and sugar mills; however, rice mills topped the industry in terms of numbers. Rice milling was responsible for the employment of one-third to one-half of the industrial workers. This occurrence of the processing industry created division of labor and a change from the old domestic economy. The sugar refining industry was also a late comer during the colonial period. The output of sugar met

domestic consumption. Out of two sugar mills, one in the lower part of the country was owned by an Indian. In general, most firms in industry were owned by the British, and the Indians to a lesser extent controlled industry and trade. There was a significant improvement in transportation as well, especially waterways, railways and roads, all of which helped the economy grow. This also changed the economy and social life of the population and gave foreigners the opportunity to exploit the country's resources. Canals were constructed in the Delta; the Irrawaddy Flotilla Company ran its steamers along the Ayeyarwady River and between Yangon and cities like Prome, Henzada, Bassein and between various towns in the Delta. Railway lines were built in the Delta; from between Yangon and Pyay, Hinthada, Pathein, Bago and Mawlamyine among others. Exports of agricultural products, mainly rice, were shipped from Yangon, Pathein, Mawlamyine and Sitway (Akyab) ports.

Myanmar cultivators in the Delta were most probably well-off and prosperous. Since cultivators were tempted to borrow money from Chettiars when there were crop failures, indebtedness became a widespread phenomenon. At the same time, the index of import and export prices showed a rise of about 150 percent. In the processing industry, rice mills, in terms of operating mills and workers, were not affected much, although there was a decline in charges. However, in saw mills, many workers were laid off. More importantly, because of the decline in prices and crop failures, many cultivators lost their land to the Chettiars because of heavy indebtedness. The proportion of the total land held by non-agriculturalists in Lower Burma rose from 31 percent in 1929-30, to nearly 50 percent by 1934-35. As a result, the standard of living of cultivators fell. One significant factor during the colonial period was that the population in the Delta increased significantly. The density of population in the Delta rose from 45 per sq mile in 1852, to 152 in 1930. In Lower Burma, the population increased from 7.8 million in 1931, to 8.9 million in 1941. As noted before, the British and Indians had a majority control in industry and trade and so it was said at the time that "There is not a single banking, insurance, shipping, manufacturing or import firm of any size that is owned or managed by [a] Burmese".

In 1886, the feudal system came to an end as a result of the annexation of Upper Burma by the British, who now controlled the whole country. Along with feudalism, also gone were the mercantilist policies and economic controls, such as

state trading and price controls. Thus, the economy of the country was again integrated and the structure of the economy changed significantly. A new type of economy known as a plural economy, in which foreigners (that is, Indians, Westerners, and Chinese) played a very significant role, started to take hold in Lower Burma. Soon, a rudimentary market economy was spreading all over the country. The worst time for the Delta towards the end of the colonial period, was the Japanese occupation during the Second World War, which resulted in extensive damage. The whole economy was seriously affected due to British and Japanese scorched-earth policies that led to half the farmland being abandoned. The objective of the British Government regarding the agrarian system was to strive to make rights to land easily attainable and at the same time to ensure that holdings came to be controlled by agriculturists and not by speculators and moneylenders. During the early colonial period, land revenue was assessed at ten percent and then twenty percent of gross produce. Then in later days it was changed to one half of the net profits (net profit was defined as gross produce less cost of cultivation and cost of living).

With the colonization of the Delta came commercialization of rice cultivation which meant most rice was marketed and sold, rather than used for domestic consumption. Subsequently, the processing of agriculture products was carried out by rice mills, saw mills and sugar mills, for which machinery were imported. However, due to the immigration of Indians laborers, the development of the processing industry was marginal. It should be noted that not all the Indian immigrants were laborers. There were also capitalists, traders and money lenders too, and this created problems in rural Myanmar due to indebtedness. Indian traders (of the Chettiar caste) often took advantage of the peasantry, something which was compounded by the failure of the government to create a class of peasant's proprietors.

Successive governments tried to introduce measures to improve agricultural production by using political, institutional, social, economic and technical factors. During the Great Depression in the early 1930s, there was a decline in Indian immigration and because of a large decline in the international demand for rice, a decline in rice production and a big decline in timber extraction. In the processing industry, the rice mills in terms of operating mills and workers were not much affected, although there was a decline in charges. However, in saw mills, many

workers were laid off. More importantly, because of the decline in prices and crop failures, many cultivators lost their land to the Chettians because of heavy indebtedness. As a result, the standard of living of cultivators fell. This remained the case through World War II and well into the 1950s. Under the Socialist Republic Government (1962-1988), government objectives were little changed from the previous administration (1948-1962). However, the means used and the level of intervention of the new socialist government in food grain production and trade, changed dramatically. Private land ownership was changed to state ownership, and the previous landholding right of farmers was replaced by "the land tilling right." With the change in property rights, food grain growers became obligated to sell a fixed quota of their food grains, known as the "Compulsory Delivery Quota", to the Government and at a fixed price. This led many investors, foreign and local, to rush into the Ayeyarwaddy Delta where many not-fully exploited resources were located. Along with this change, many significant reform measures were introduced during the late 1980s, including the removal of price controls for the domestic trade in rice and others items.

Large private business firms were allowed to get involved in agricultural production. This was the first time that non-resident capitalists were allowed to be directly involved in agricultural production after independence. By 1999, a total of about 1.2 million acres had been allocated to some 80 businesses. This brought an increase in the amount of rice grown for commercial purposes and destined for the external market, rather than for domestic consumption. The rice was sent to rice mills in and around Yangon, Patheingyi and Henzada and as a result, no local processing industry developed.

In the Ayeyarwaddy mangrove area, there had been encroachment on the mangrove forests and increased over exploitation; nevertheless, this worsened during the insurgency period from 1949, though mangrove forests remained rich up to the end of the 1950s, with all species present in the form of tall, large girth trees. However, after twenty to 30 years of exploitation, the once rich mangroves were transformed into the sparse forests seen today. The present status of the Ayeyarwaddy mangrove forest is alarming. Not only has there been a continuous reduction in its

extent through agricultural encroachment; but the surviving mangrove has suffered greatly through uncontrolled and repeated felling of trees.

In the 1950s, this Bogale area was under the control of the Karen National Defense Organization (KNDO), partly because many Kayin (Karen) lived there. As a result, the Forest Department did not manage the forest reserved area. With the Government well aware of the situation and with the insurgency having died out following attacks by the Myanmar army in the 1990s, action could be taken to control illegal felling in the delta. The country already had the knowledge of how to reforest degraded mangrove areas with fast-growing species, but was not able to start a reforestation program because of the insurgency. By the late 1990s, mangrove forests were being well managed by the local authorities. Villagers were then able to make a living easily, even though prohibitions on access to forest products by the Forest Department in 1980 were now enforced. The dominant crops in the area are now rice, sugar cane and jute and most of the agricultural processing industry is concentrated in this part of the country. In other words, the delta bustles with various types of commercial activities. The present government promotes land expansion, since the other option that of yield-raising, needs foreign exchange, which is scarce. Thus the government started the land reclamation program in 1998, to turn large tracts of land totaling about 22 million acres, into farmland run by private entrepreneurs.

4.3 Mangrove Dwellers' Forest Conservation in Delta

Mangrove dwellers are quite aware of the dwindling production from the mangroves and the hardships they have to face in obtaining forest products. In response, outsiders are not allowed to cut trees in the communal forests. In the Delta region, most of the villagers are fishermen, and they have local knowledge concerning how to use different tree species for their various purposes during their daily lives. The traditional uses of mangrove wood in the Delta are for charcoal making and firewood, poles and construction materials, fishing gear, tanning and medicine. The palm *Nipa fruticans* provides materials for several purposes, especially making house roofs. Various species of the *Rhizophoraceae* can be used to make charcoal, producing heavy, dense, hard charcoal that is almost smokeless when burned. Local villagers use mangrove poles for many purposes when water-resistance is needed,

especially for foundation pilings and fishing stakes. Mangrove lumber is used for house construction, mainly by people who live in or close to the mangrove forest. Wood of various mangrove species is used for different parts of the house. Various types of fishing gear are used by mangrove dwellers, and some of the equipment is made from mangrove wood. Poles are usually used for crab traps. The traditional tree cutting which they practice is considered local management. They have a profound understanding about the relationship between the mangrove forest and marine animals, whereby mangrove forests serve as the nursery beds and as shelter for shrimps, crabs and fish. The villagers fear that after encroachment, these marine animals will disappear.

The availability of marine resources in the rivers and canals is directly related to the presence of mangrove forests. Since fishing is the main occupation of the mangrove dwellers living near the coastal forests, they have been alarmed over the encroachment, especially by shrimp farms. Ayeyarwaddy Division has received the severest blow, with 80 percent of mangrove forest destroyed over the past three decades (Forest Department, 1995). Villagers who have resided in the area for ten to fifteen years, have witnessed the forests being destroyed every year. Besides shrimp farms, another main cause of the destruction has been paddy field encroachment and the cutting of trees by concessionaries, whom the villagers call "the owner of the charcoal kilns". The older residents know that the marine resources depend on mangrove trees for their regeneration. Shrimp, prawns and fish spawn among the shoots of mangrove trees. These small animals eat food they find amongst the tree roots. After they grow in size, they move to deeper water offshore. Villagers catch less fish, shrimp and crabs now than over the previous three decades. They believe this is a result of the destruction of the mangrove forests and an increase in the number of people who have moved into the Delta region, to live in and use the mangrove areas. Most of the benefits from the use of the mangrove forests goes to the concessionaries. Villagers would like to see the mangrove forest protected, mainly for fishery production, and to ensure the continuation of their daily subsistence. Mangrove residents want the Forest Department to allow them to cut enough mangrove trees from the public forest areas for fuel, for house construction and for making fishing equipment.

4.4 The Relationship between Humans and Mangroves

Mangrove dwellers have many different socio-economic systems, some of which are primarily focused on subsistence activities. Although rich in many resources, mangrove forests have traditionally been sparsely settled and not intensively exploited by humans.

The mangrove ecosystem and the socio-economic systems of mangrove residents are both greatly affected by processes and events beyond the geographical borders of the mangrove forests. The Mangrove forest is an important ecosystem in tropical coastal areas, used as a living place for humans and as a nursery area for fish species, water birds, migrating birds and some types of land animals. It supplies many kinds of valuable forest product. In addition, mangrove forests help to remove air pollution, limit coastal erosion and provide protection from saline water intrusion and storms. There is a close relationship between humans and the mangrove forest, because mangrove forest areas can be used for aquaculture development, which brings a high economic return and a valuable, exportable resource. However, mangrove ecosystems are sensitive and are easily disturbed by human activities and natural impacts.

Human life in the coastal areas is closely linked with the mangroves, or mangrove based products. Most of the communities view the mangrove forest primarily as a source of forestry and fishery products for their daily lives. Local communities are well aware that their daily catch of fish is declining, due to the rate of depletion of the nearby mangrove areas. Mangrove forests act as a natural barrier to floods and storms, thus protecting people in the coastal regions. The mangrove ecosystem provides a variety of ecosystem services. These services include prevention of coastal erosion, acting as a barrier against typhoons and cyclones, protection of coral reefs from siltation and soil accretion. Indirectly, mangrove forests are responsible for the extension of islands. These systems act as biological wastewater treatment plants, lowering the biological oxygen demand and possibly performing bio-remediation by removing toxic elements. These forests also provide breeding, nursery and feeding grounds for harvestable marine fauna. The foliage of mangrove species is used as fodder for domestic animals. Exploitation for firewood, charcoal and timber, deliberate land reclamation for urban and industrial

development, shrimp farming and the dumping of pollutants are the main and most serious causes of mangrove forest loss.

Local communities now see mangrove ecosystems as an impediment to their economic practices, and as a result, mangrove forests are now among the most threatened habitats in the delta region. Industrialized nations supposedly have stricter laws protecting mangroves, although destruction continues in many of these countries as well. The mangroves' lenticels, although very helpful in providing oxygen to the root systems, are highly susceptible to clogging. Mangrove forests are a very unique and complex kind of coastal wetland. Developing nations also destroy mangroves indirectly through heavy pollution, although they are even more damaging in their direct exploitation.

Mangrove ecosystems are a type of wooded coastal wetland found along the shores of the tropics. They are at the interface between marine and terrestrial worlds, providing large benefits to both. Mangroves are not only unique ecosystems in and of themselves, but they are also uniquely linked to the many systems that surround them. Mangroves are important to many local coastal species, both terrestrial and aquatic. For many organisms, mangrove forests serve as the starting place for their food chain. The forest detritus (fallen leaves and organic material) serves as a nutrient source. Mangroves also serve as a nursery and breeding ground for many reef organisms. In fact, their intricate root systems provide shelter for many marine and terrestrial animals, protecting them from ocean currents and strong winds. Traditionally, they have been sustainably used by humans for food production, medicines, fuel wood, and construction materials. Many indigenous coastal residents rely on mangroves to sustain their traditional cultures. In this way, the mangroves' ability to act as habitat to many possible food sources, as well as its ability to remain stable while growing tall and strong, are very important to human communities as well. Mangrove forests also act as a buffer zone between the open ocean and the land. This not only protects the shores from damage, but also its many inhabitants, including humans.

In many countries, mangrove forests have been completely destroyed in order to provide places for residential, commercial, and industrial development. Many mangroves have been cut down to provide ocean-side land for local housing and for



recreation. The most destructive process, however, has been the shrimp aquaculture industry.

4.5 Impacts on the Environmental and Social Aspects of Mangrove Forests

The present status of the Ayeyarwaddy mangrove is alarming. Not only has there been a continuous increase in the extent of agricultural encroachment, but also the surviving mangrove has suffered greatly through uncontrolled and repeated felling of trees. From the socio-economic perspective, it is important to clarify how and by whom the mangrove forests have been used, who is concerned with their exploitation, and who has benefited most. In several respects, the present socio-economic situation of traditional settlers in the mangroves resembles that of traditional marginal farmers of the upland forests. Both are now feeling the effects of large-scale socio-economic and demographic processes associated with modernization, urbanization and socio-economic development, including commercialization of traditional activities, introduction of new demands for cash, losses of land, and damage to the ecosystems associated with development activities.

There is a significant need to explore the complex interactions between local communities and their mangrove forests. The negative impacts of mangrove destruction include increased bank erosion along the main rivers with reduced coastal protection, especially during period of heavy storms. Curtailment of further encroachment and proper management of the existing mangroves is essential for the sustainable use of the coastal resources and for the protection of the delta from both marine and fluvial erosion. This can only be achieved through involvement and active participation of the local people. Particular emphasis should be given to a community-based management of fire wood and timber extraction at a sustainable level, as this is essential to maintain the long-term productivity of the mangrove system.

People who are dependent on the local resources for their livelihood are often able to recognize the true cost and benefits of development, better than any evaluator coming from the outside. Such knowledge and local conceptions of systems can target the valued ecosystem components, during the environmental impact assessment of a proposed development initiative. Without heavy ecological disturbance, trees in the mangrove forest can grow easily and for this reason, there has not been great pressure

on the mangrove forests. Local management by villagers was carried out only for the prevention of a change in land use patterns in the communal mangrove forests. However, over-exploitation of forest products for energy consumption and the extension of agricultural and aquaculture land for food security, have been the key human impacts on the mangrove forests. Mangrove destruction has increased bank erosion along the main rivers and thus reduced coastal protection, especially during heavy storms.

The mangroves provide a unique ecosystem that displays the dynamics of a flood plain and delta system, as expressed by changes in mud and silt deposition, major fresh water outlets and the creation of oxbow lakes, local flooding patterns and salt water intrusion. The mangroves provide inter-tidal fisheries, serve as nursery grounds and breeding areas for the locals' prawn industry and produce large quantities of mangrove poles for export. Mangroves protect the coastline from waves and currents and thus prevent coastal erosion. Through their retention of sediments brought downstream by rivers, they extend the coastland into the ocean. As they are highly productive elements of the marine ecosystem, mangroves generate large quantities of detritus, which form the basis of a complex marine food chain, thus making them a unique ecosystem that is rich in floral and fauna bio-diversity, in both freshwater and saline environments. The delta has been utilized over the years by the mangrove dwellers, basically relying on fishing, mangrove pole production and rice farming for their sustenance.

Local communities' main livelihood strategies in the Ayeyarwaddy Delta are fishery production and forest resources access. When they cut trees, they never cut all of the tree species. They know which tree species are available for their needs, such as for building and bridge construction, boat making and fuel. Sometimes, villagers cut small trees in the forests for charcoal making and for their fuel supply. In fact, all mangrove forests are owned by the government. Fishermen, dried shrimp makers and aquaculture farmers have no legal rights to use the forest resources. For domestic use over the past three decades, fuel wood has been collected from the mangrove forest around the house, so the people haven't needed much time to collect fuel-wood. All the mangrove dwellers use timber, traditional medicine, bamboo shoots, cane and other minor forest products from their nearby forests. Local fishermen already

complain about a reduction in their daily catches and they are well aware that the reason for this lies in the destruction of the mangroves. Traders and businessmen have already constructed shrimp ponds in the Delta, covering about 3,000 ha. In the 1990s, they negotiated with the local authorities and thereafter started their businesses. Moreover, other negative impacts of mangrove destruction are increased bank erosion along the main rivers and thus reduced coastal protection, especially during periods of heavy storms. Thus, the mangroves have been destroyed and the local villagers have become poorer. Mangrove forests have been perceived as desolate, unproductive regions along coastal areas. Local communities now see mangrove ecosystems as an impediment to their economic practices.

Mangrove forests are a very unique and complex kind of coastal wetland. Developing nations also destroy mangroves through heavy pollution, although they are even more damaging in their direct exploitation. In many countries, mangrove forests have been completely destroyed in order to provide places for residential, commercial and industrial development. Many mangroves have been cut down to provide ocean-side land for local housing and for recreation. The most destructive process, however, has been the shrimp aquaculture industry.

4.6 Summary

Myanmar, like other developing countries, needs to have sector policies, objectives and strategies in agriculture, forestry and fisheries, which are based on the present socio-economic, political and administrative situation. The ministries concerned should issue documents that formalize the commitment and intent of the government in ensuring sustainable development of the resources for economic and environmental purposes. While Myanmar continues to be a home to closed canopy forests, several areas have experienced serious deforestation, most notably, the mangrove forests in the Ayeyarwaddy delta region.

Most of the mangroves are already depleted due to paddy cultivation. Building shrimp ponds leads to disastrous consequences on the environment and on the life of village communities, communities that are dependent upon the fish and crabs on the mudflats of the mangroves. The degradation of mangrove forests is caused by over exploitation, charcoal making, shifting cultivation and the

development of salt pans, by traders and businessmen from outside of the delta. The combined number of fishery and forestry workers exceeds the number of paddy growers in the delta. Paddy growers, fishery and forestry workers are in direct contact with the mangrove ecosystems. Rural people are the major stakeholders and end-users of the forest resources. The cooperation of the rural people is integral to the sustainable management of the forest resources. People should be fully aware of the value of the forest for the sustainable supply of fire wood. Curtailment of further encroachment and proper management of the existing mangroves is essential for the sustainable use of the coastal resources and for the protection of the delta from both marine and fluvial erosion. Particular emphasis should be given to the community-based management of fire wood and timber extraction at a sustainable level, as this is essential to maintain the long-term productivity of the mangrove system.

Government policies on mangrove forest use play an important role in the changes to mangrove forest utilization and management in the Ayeyarwaddy Delta. The utilization of mangrove forests in my study area is based on the knowledge of the local villagers. This knowledge of the mangrove forest ecosystem is linked with the use of tree species and other products provided by the forest itself.