



Mangroves ... Coastal Treasure of Thailand

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Abstract

Mangroves are among the most significant, highly productive and valuable coastal ecosystems of the Kingdom of Thailand. They constitute a rich natural resource including many varieties of flora and fauna. Mangroves provide considerable benefits, many goods and many varieties of services which contribute towards national development. Mangroves are an important asset for Thailand as they provide both economic and ecological benefits. Unfortunately, mangrove forests have been rapidly diminishing in the last three decades due to threats from severe degradation occurring from widespread development. However, intensive management of mangrove forests with the integration of ecological and economic approaches has been very effective. Rehabilitation, protection and conservation efforts coupled with stakeholder participation, strong technical support and strict law enforcement has been fully implemented. Under these measures, it is expected that mangroves, which are considered as “Thailand’s Coastal Treasure” can be preserved in the long term where the young generation and the nation as a whole can continue to reap its benefits.

Keywords: Mangroves, Coastal treasure

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Introduction

“His Majesty the king with wary heart has said to me that he has been trying his best to stop people from destroying the mangrove forests. I myself do not understand at first why His Majesty has to be so concerned. His Majesty also told me that the mangrove forests served as refuges for larvae and small fishes, shrimps and crabs to reside in when they were not strong enough to defend themselves. Mangrove forests served as the coastal nursery which in time would provide the fishery resources for us all. Nowadays the mangrove forests were encroached upon by selfish people who destroyed the whole forests. This has been going on for a long time. His Majesty the king has tirelessly fought to save the precious mangrove forests by trying to buy back some of these forests. Princess Maha Chakri Sirindhorn also fought alongside with His Majesty the King trying to save the mangrove forests”

*Her Majesty the Queen Sirikit’s speech
on the occasion of Her Majesty’s Birthday
on Saturday 11th August 2008
at Sala Dusitalai, Dusit Palace, Bangkok*

Mangrove forests in general grow along coastlines in most tropical and sub-tropical countries. They also grow on sheltered shores of deltas and alongside river estuaries and creeks where there is an abundance of muddy soils within the inter-tidal zone.

Mangroves are among the most significant and highly productive coastal ecosystems. They support a diversity of flora and fauna of marine, fresh water and terrestrial species. Mangroves play a vital role particularly in the lives of people living in coastal areas. They also contribute towards national development by providing various benefits, goods and ecosystem services. Wood from mangroves can be used for making charcoal, domestic fuel, poles, wood-chips, tannin, wood tar and construction materials. Fruits, propagules and young leaves of some mangrove species are edible and can be consumed. Certain species of mangroves can also be used for medicinal purposes. Mangrove forests also play a significant ecological role by



providing food, nursery and spawning grounds for many commercial aquatic fauna like fish, prawn, and crabs. They also provide habitats for terrestrial animals like birds and reptiles. Mangroves also have other important ecological roles such as providing protection from coastal erosion, sediment stabilization, improving water quality, reducing the negative effects of strong windflows, dispersing energy of tidal waves and reducing global warming by acting as a carbon sink.

Unfortunately, mangrove forests in Thailand have been heavily depleted during the period of 1980-2000 due to conflicting development purposes, in particular shrimp farming. However, the country has properly formulated the national mangrove policy which includes rehabilitation, conservation and sustainable utilization of mangrove resources. Current efforts have created a trend towards improvement, which is favorable for the mangrove ecosystem. At present intensive management plans that have integrated ecological and economical approaches are being implemented to restore the endangered mangrove ecosystem. With these efforts, it is expected that mangroves in Thailand can be preserved in the long run so that the young generation and the nation as a whole can reap its various benefits. This paper provides a detailed description about mangroves in Thailand, the ecosystem goods and services it provides and the current status of mangroves in Thailand. The paper concludes with discussing various approaches and strategies for the sustainable management of mangrove ecosystems.

Mangrove Areas and Distribution

The mangrove forests in Thailand cover approximately 1,400 km or 50% of the total 2,800 km long coastline. They are also found alongside lagoons and rivers in inter-tidal zones between low (neap) and high (spring) tide. The total mangrove area of the country has declined drastically with time. Charrupatt and Charrupatt (1997) found significant reductions in mangrove area from the period of 1975 to 1996. In 1975, they found through the use of satellite imageries that the total area was approximately 1,954,375 rai or 312,700 ha; in 1996 it was only 1,047,380 rai or 167,580 ha. However, recent surveys done in 2004 by the Department of Marine and Coastal Resources of the Ministry of Natural Resources and Environment found that mangrove area increased to approximately 1,460,622 rai or 233,700 ha, which is about 0.0016% of the total 950



million rai or 15.2 million ha of the total global mangrove area (spading et al., 2011).

Mangrove forests are distributed throughout the Thai coastal line in the southern and south-eastern parts of the country and in the upper regions of the Gulf of Thailand (Figure 1). The best developed mangrove forests are found on the west coast of the peninsula and the areas on the Andaman coastline in the provinces of Phang-nga, Ranong, Trang, Krabi and Stun (Figure 2). Mangroves in the western part of the Gulf of Thailand, especially in Rayong, Chantaburi, Cholburi are mainly composed of small-sized trees. The tree size is small in this area due to the heavy selective and subsidized cutting activities done over many years by local communities. Large areas

of degraded mangroves consisting of various small non-commercial tree species can be found in the inner part of the Gulf of Thailand, particularly in Samut Sakorn, Samut Songkram and Samut Prakarn provinces. These provinces were once long occupied by fish and shrimp ponds. After these ponds were abandoned, the areas were again recolonized by new mangrove species, particularly the *Avicennia* and *Rhizophora* species (Figure 3).



Figure 1: Distribution of mangroves along the coastline of Thailand

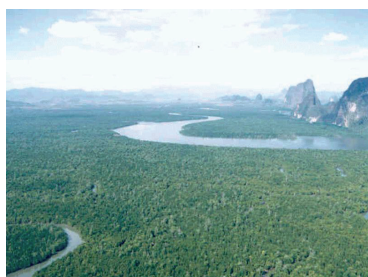


Figure 2: The best developed mangrove forests along the Andaman coastline.



Figure 3: Young mangroves forest with a narrow strip along the coastline of the Gulf of Thailand.

Mangrove Values

Mangroves have a variety of values. Mangroves act as a “wood bank” (Figure 4) where they can be cut for firewood, charcoal, wood construction. They are also a home to marine and terrestrial animals living in coastal areas such as shrimp, crab, fish. The mangrove environment provides a nursery, spawning grounds, habitat and shelter for these animals. In addition, mangroves work as a “kitchen” and provide an enormous amount of food from the dead leaves that fall each year. These leaves decay and provide highly nutritious feed to plants and animals that help them in their growth. Mangroves also operate as an effective and low capital “wastewater treatment plant”, specific root characteristics of mangroves can purify wastewater; they also serves as an “air purifier plant” where they can absorb carbon dioxide and release oxygen into the air. Mangroves also serve as “hospitals” where they provide various herbs and medicinal plants to coastal communities. Furthermore, the mangrove acts as a natural “coastal barrier” that prevents soil erosion and impedes in the path of tsunamis (Figure 5). The mangrove acts as a “natural learning classroom” where coastal ecosystem characteristics can be studied. The mangrove also serves the function of a “bridge” that connects the land and sea and assists in creating the proper balance and functioning of the coastal ecosystem. The mangrove is also recognized as a “livelihood resource” for people who live in the coastal and adjacent areas. As we can see, mangroves are truly natural coastal treasures and provide significant social, economic and environmental security for local communities and the nation as a whole.



Figure 4: Wood from mangroves for firewood and charcoal making



Figure 5: Tsunami resistance from mangroves at Phang-nga Province, in 2004



Mangroves ... National, Social and Economic Costs

Mangroves provide welfare to coastal communities (Figure 6), they are like a supermarket that provide a variety of products such as shrimp, shellfish, crab, fish, and energy as well as firewood/charcoal and herbs. If put in economic terms, mangroves are comparable to providing “welfare cost” assurance to coastal communities (Figure 7) and localities throughout the nation. The mangrove contributes towards providing a “sufficient-living” for several generations of coastal communities and localities.



Figure 6: Mangrove products at a local supermarket in a coastal community



Figure 7: A coastal community along the coastline

Mangrove Environment

Generally, mangroves cover an area along the coastline with very strict to special environmental features; for example tropical climate, inter-tidal zones, muddy soil and brackish water. The structure and functioning of the mangrove ecosystem is strongly influenced by a combination of many important environmental factors (Aksornkoae, 1993; Hutchings and Saenger, 1987) including topography, climate, tidal range and inundation, soil and water conditions, waves and currents and nutrients both from land and sea.

Mangrove Flora

Mangrove forests are rich in floristic composition including tree species, palms, epiphytic flowering plants, algae and phytoplankton. According to the record of mangrove species in Thailand (Aksornkoae at al. 1992 and Aksornkoae, 1993), there are approximately 74 species. Most of the dominant and important species are



Rhizophora mucronata, *Rhizophora apiculata*, *Avicennia alba*, *Avicennia marina*, *Bruquiera cylindrica*, *Bruquiera gymnorrhiza*, *Ceriops tagal*, *Excoecaria agallocha*, *Sonneratia alba*, *Sonneratia caseolaris*, *Xylocarpus granatum*, *Xylocarpus moluccensis*, *Lumnitzera racemosa*, *Lumnitzera littoraria*, and *Excoecaria agallocha*. Two common species of palms, *Nypa fruticans* and *Phoenix paludosa*, and two ferns, *Acrosticum aureum* and *Acrostichum spiciosum* are abundant in mangrove forests. Figure 8 illustrates some of the important tree species in mangroves.

The epiphytes are widespread within the mangrove forest, the common species are *Dendrobium crumenatum*, *Hoya parasitica*, *Paphiopedilum exua*, *Luisia zollingeri* and *Viseum ovalifolium*. All these species can be found on stems, branches and roots of various mangrove tree species and dead trunks.

Many genera of algae which are attached to the trunks and roots of mangrove trees are highly productive, particularly *Rhizophora*, *Avicennia* and *Bruguiera*. Some algae species are attached to stones, shells, dead leaves or debris in the mangrove forest. There are about 46 species of algae reported by Lewmanomont (1976), and the important species are *Catenella*, *Bostrychia*, *Gracillaria*, *Hypnea*, *Caulerpa* and *Dictyota*.

Mangrove forests are also favourable habitats for phytoplanktons. There are more than 100 genera of phytoplankton communities in the mangrove (Paphavasit et al., 2009). The important species mainly belong to the genera of *Oscillatoria*, *Palaria*, *Chaetoceros*, *Thalassionema*, *Anabaena*, *Thalassiosira*, *Bacillaria* and *Nitzschia*.

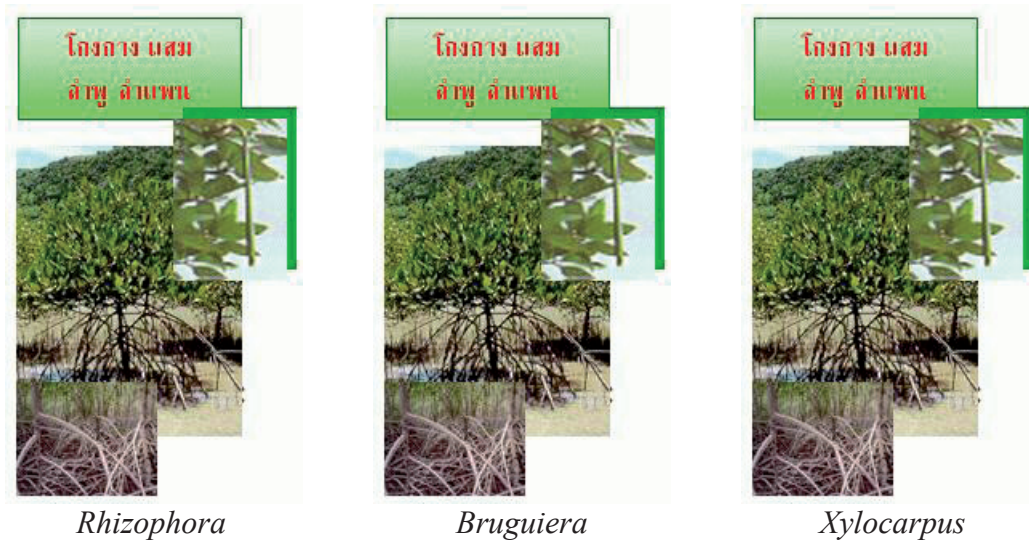


Figure 8: Some important tree species in mangrove forests; *Rhizophora*, *Bruguiera* and *Xylocarpus*.

Mangrove Fauna

Mangrove forests provide food and habitats for faunistic populations including fresh water, marine and terrestrial populations which are of considerable size and variety. The diversity of fauna within the mangroves is high due to ample food, resources and a wide range of microhabitats. These encompass shrimps, fishes, crabs, molluscs, birds, reptiles, amphibians and mammals.

Mangrove Shrimps

There are approximately 15 species of shrimps that are found in mangroves. There are four important families of shrimp species, namely Penaeidae, Palaemonidae, Alpheidae and Ogyridae. The genera *Penaeus* and *Metapenaeus* are found in abundance, especially *Penaeus merguensis*, *Penaeus monodon*, *Penaeus indica*, *Metapenaeus ensis* and *Metapenaeus hungerfordi*. Other shrimp species like *Palaemon semmelinkii*, *Alpheus euprosyne* and *Ogyrides* sp are also found in mangrove forests. However, species of banana prawn (*Penaeus merguensis*) and giant tiger prawn (*Penaeus monodon*) have the highest commercial value. There are

also some freshwater shrimp species such as *Macrobrachium rosenbergii* which use mangrove forests as spawning grounds. Following their spawning phase they return to grow in their native fresh water habitat.

Figure 9 shows two species of commercially significant shrimps in mangrove forests.



Penaeus monodon



Penaeus merguensis

Figure 9: Important commercially shrimp species in mangroves

Mangrove Fishes

Generally, fish are abundant in mangrove forests both in terms of number and diversity. Fish use mangrove forests as nursery grounds, breeding grounds, shelter and permanent habitats. Monkolprasit et al. (1983) classified approximately 72 mangrove fish species into four groups; true residents, partial residents, tidal visitors and seasonal visitors. *Chanos chanos*, *Lates* sp and *Mugil* sp are the most commercially important fish species in mangroves as shown in Figure 10. Other common fish species found in the mangrove forest are *Ambassis* spp, *Epinephelus* spp, *Leiognthus* spp, *Stigmatogobius* spp, *Lujanus* spp, *Brachygobius* spp, and *Boleophthalmus boddanti*.



Chanos chanos



Lates sp



Mugil sp

Figure 10: Important commercially fish species in mangroves



Mangrove Crabs

There are approximately 30 species of crabs found in mangroves as recorded by Naiyanetr (1985). A majority of crabs belong to the four predominant families, Grapsidae, Ocypodidae, Portunidae and Gecarcinidae. The most common and important species are grapsis crabs (*Sesamar* spp) and fiddler crabs (*Uca* spp). Many crabs in mangroves have attractive colours, in particular the fiddler crabs (*Uca rosea*, *Uca vocans* and *Uca forcipata*). The mangrove mud crab, *Scylla serrata* is the largest edible crab and is of commercial importance. The most common and important species of mangrove crabs are shown in Figure 11.



Sesamar spp

Scylla serrata

Uca rosea

Figure 11: Common and important species of mangrove crabs

Mangrove Molluscs

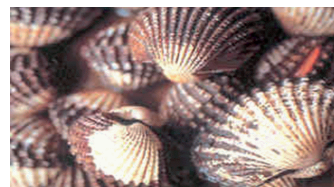
Numerous molluscs are found in mangroves. The univalves, *Nerita* spp, *Littorina* spp and *Ellobium* spp are common and abundant. Other species in the univalve group are *Cerithidea* spp, *Cassidula aurisfelis*, *Elysia viridis* and *Monodonta labio*. Bivalves are also common and are often of high commercial value. These are oyster (*Crassostrea commercialis*), mangrove mussels, mangrove cockles (*Andara* sp) and a number of species of mangrove clams. Bivalves which feed on rotten stems and dead mangrove wood, particularly the *Teredo* spp are also found but in small numbers. Oyster, clam and cockle as shown in Figure 12 are common and commercial species in mangroves.



Oyster



Clam



Cockle

Figure 12: Common and commercial species of molluscs in mangroves

Other Mangrove Animals

There are various animals that live in the mangroves such as birds, egrets, herons, kingfishers, mammals such as monkeys, otters, wildcats, and bats. Dugong and dolphin species are also found in the mangroves. Reptiles such as snakes, turtles, and various species of insects such as moth, butterfly, caterpillars and bees are also found in mangroves. Fireflies on the *Sonneratia* sp are a major attraction and various tourists visiting mangroves come to see them. Other smaller organisms such as copepods, nematodes and fungi are also important species and in abundance in mangrove forests.

Mangroves..... National Livelihood Resources

The mangroves provide numerous livelihood opportunities that fulfill the four basic needs of living such as shelter, food, medicine and cloth. People who live in coastal areas and/or nearby the mangrove forests achieve these benefits through the utilization of mangrove resources.

Mangroves are composed of various kinds of trees, as it was mentioned previously, they act as a “wood bank”. Coastal communities can use mangrove wood and make a living out of them through several means; they can use it as poles, fire wood, construction materials, and fishing gears. Woods from species of *Rhizophora*, *Avicennia*, *Bruguiera* and *Xylocarpus* are particularly beneficial for use by coastal communities. In addition, mangrove woods from *Rhizophora* spp are widely used for making charcoal that has the best quality compared to other mangrove and terrestrial woods. It can also be used for domestic cooking, and surplus amounts can be sold for additional income.



Propagules from many species of mangrove can be cooked for tasty desserts. Figure 13 shows a dessert made from propagules of *Bruguiera gymnorrhiza*. This product can be a source of income for coastal communities. This dessert was first created by the “Nam-cheiw mangrove villager” in Trad province. Cookies, which are made from the propagules of the *Bruguiera cylindrica* spp are also a popular dish made by villagers of Satul province.

Nipa, the mangrove palm, is well known for its multi-purpose use as leaves for roofing, for cigarette wrapping and raw material for baskets. Fruits from nipa are widely used in desserts. In addition, nipa sugar is also used in cooking and for use in bakery products. Products from nipa palm are commercially important and can help raise monthly income to approximately 5,000 baht per family per rai (0.16 ha) in Pakpanang District of Nakorn Sri Thammarat province, (Bamroongruga, 2001). In addition, Nipa Palm can also be used as a potential alternative source for bioethanol, as studied by Matsui et al. (2011). Honey can also be collected from mangrove forests (as shown in Figure 14). There are various kinds of food items produced by local mangrove communities from different parts of mangrove trees as described by Chumrieng et al. (2011). Another traditional use of mangrove plants is medicines. Certain species of mangroves contain active substances that have the power to cure various ailments. However, these traditional medicinal plants have not received the support of scientific investigation and experiments.



Figure 13: Propagules of *Bruguiera cylindrica* for making cookies



Figure 14: Honey collected from mangroves

Mangrove forests play a significant role in sustaining the productivity of inshore and offshore fisheries. They contribute through the supply of nutrients to the ecosystem, provide shelter and nurseries for fish and help support numerous aquatic species. The importance of mangrove forests as shelters and nurseries for commercial fishery species is becoming increasingly evident. Many species of penaeid shrimp use mangrove forests as shelter and nursery grounds for part of their life cycle. Mangrove waters are usually rich in nutrients (detritus) and suitable for fishing. The major fishery sources found in mangrove waters are detritivorous fish, crabs, crustaceans and molluscs. Communities that live in or near mangrove forests catch fish, shrimp, crabs and molluscs daily from the surrounding estuarine areas (Figure 15). Aquaculture is widely practiced in the mangroves and most of the culture fisheries are shrimp farms, particularly the *Penaeus monodon* spp. Currently crabs are also harvested widely in mangroves. There are other species such as oyster, cockle and green mussel which are not harvested for large-scale commercial use. Mangroves serve a very important role for the growth and productivity of these species by providing a source of dissolved and suspended nutrients.



Fish catching



Molluscs collection

Figure 15: Fishing and molluscs collecting by local mangrove community

Mangrove forests, serve as a link between marine and terrestrial ecosystems. They also play a significant role in maintaining the health and stability of various adjoining ecosystems such as seagrass beds, coral reefs and marine ecosystems. Mangroves represent a unique ecological niche and habitat for a variety of marine and terrestrial animals. The amount of organic matter and nutrients produced by the



forests not only support the mangrove ecosystem but also other related ecosystems as mentioned earlier. Moreover, mangroves help to stabilize shorelines and estuaries by protecting them against tidal bores, soil erosion and large storms such as tsunamis. They also help reduce global warming by acting as a carbon sink (Laffoley and Grimsditch, 2009).

Mangrove forests are a coastal treasure and an asset for Thailand's coastal communities. If mangroves were destroyed, damaged or went extinct, there would be no habitat or food to support the various plant and animal organisms in the area. Their destruction would also effect the livelihoods of coastal communities. Furthermore, the loss of mangrove-related ecosystems would disturb other ecosystems over a considerable area, which could result in large-scale economic loss and socio-cultural change in coastal communities.

Mangrove Degradation and Depletion

There are various important threats to the degradation and depletion of mangrove forests. An extensive area of mangrove habitat has been destroyed with remaining areas facing increasing threat from anthropogenic activities. There are ten main causes for encroachment into mangrove areas in Thailand, these are aquaculture, mining, agriculture, urbanization, ports and harbor construction, roads and transmission lines, dredging, industry and power plants, salt production and harvesting of forest woods. Of these ten causes, each cause varies in extent and degree of negative impact on the mangrove ecosystem.

In 1961, mangrove forests were estimated to cover an area of approximately 2,299,375 rai or 367,900 ha as recorded by Klankamsorn and Charupatt (1982). The area has gradually decreased to 1,954,575 rai or 312,732 ha in 1975; 1,795,675 rai or 287,308 ha in 1979 and to 1,227,675 rai or 196,428 ha in 1986. As per a survey done in 1996, approximately 1,047,381 rai or 167,580 ha (Charupatt and Charupatt, 1997) of mangrove area remains in Thailand. Approximately 50% of the total mangrove area has been depleted due to shrimp farming (Figure 16) particularly on the eastern and southern coasts of Thailand. Mangrove forests along the coastline of the Gulf of Thailand have also been lost, especially in the province of Chantaburi, Samut

Songkram, Samut Sakorn, Surat Thani and Nakorn Si Thammarat. However, mangrove habitat in the country has increased in the last few years according to the latest survey conducted in 2004 by the Department of Marine and Coastal Resources of the Ministry of Natural Resources and Environment. Mangrove area increased to approximately 1,460,622 rai or 233,700 ha, the area recorded in 1996 was only 1,047,381 rai or 167,580 ha. There is hope that mangrove forest area will increase in the future. With close participation among all stakeholders including government agencies, the private sector, non-government agencies and local communities, mangrove habitat area can increase through important activities like rehabilitation and conservation.



Shrimp ponds



Resettlement area

Figure 16: Clearing of mangrove forests for shrimp farming and resettlement area.

Future Directions and Sustainable Mangrove Management

Mangrove forests of the Kingdom of Thailand cover an area of approximately 1.5 million rai or 240,000 ha along the coastlines of the Andaman Sea and the Gulf of Thailand. Covering such an extensive area, these precious ecosystems and their resources will have to be sustainably managed. The holistic management approach should be implemented to achieve economic, social and ecological balance. Three main activities should be implemented in order to facilitate this aim, mangrove rehabilitation, protection and sustainable resource utilization.



Mangrove rehabilitation: Mangrove forests in Thailand previously covered an area of approximately 2.96 million rai or 312,700 ha in 1997. However latest surveys in 2004 found that only 1.46 million rai or 233,700 ha of mangrove habitat remained, revealing an almost 50% depletion in area in less than 20 years. In order to maintain mangrove ecosystem functioning and health, sustained benefits for local communities, economy of the country and natural disaster risk prevention, the re-establishment of mangrove habitat is urgently required. Currently, the government has set up a proper mangrove rehabilitation programme that is targeting the improvement of at least 5,000 rai or 800 ha per annum. There are large potential areas for rehabilitation, particularly abandoned shrimp ponds, mudflats and degraded mangrove areas. Today, mangrove rehabilitation is being practiced with close participation among all stakeholders as illustrated in Figure 17. Since the initiation of the rehabilitation programme, significant establishment of mangrove habitat has been achieved, particularly in abandoned shrimp ponds (Kato et al. 2008) (shown in Figure 18) and along the coastlines.



Figure 17: Participation of Stakeholders in mangrove rehabilitation



Figure 18: Mangrove rehabilitation in abandoned shrimp ponds

Mangrove protection: Mangrove protection is one of the most important activities needed for preserving existing ecosystems. Although protection efforts in the past by government and local communities have not been entirely successful, current efforts which are occurring with close participation among stakeholders have been successful in protecting mangroves. There are many examples of best practices in different areas for mangrove protection, in particular of Pred nai village which is situated in Trad



province. The Department of Marine and Coastal Resources of the Ministry of Natural Resources has taken strong action for mangrove protection, the department has been providing training, running campaigns to bring awareness and participation, and has been disseminating knowledge about the importance and value of mangroves. Hopefully with this level of assistance and effort, it is expected that mangrove forests in Thailand will be well protected.

Sustainable mangrove resource utilization: Mangrove ecosystems comprise of valuable varieties of flora and fauna. People use mangrove resources in many ways for both economic and ecological benefits (as mentioned earlier). Although people have been using the mangrove ecosystem for generations to reap from their direct and indirect benefits, they are inconsiderate of the long term benefits. For this, the Sufficiency-economy approach is essential to educate the people. Based on this philosophy, it is necessary to bring a balance between the use of mangrove resources and the conservation and maintainance of its ecosystem. Achieving this will ensure the sustainable utilization of mangrove resources.

Conclusion

Mangroves are highly productive ecosystems that grow in coastal environments. They are a precious resource, a “Coastal Treasure” that plays a vital role in the lives of local people. They are also an ecologically significant habitat that support the growth and life cycle of various marine and terrestrial species. However, due to increased anthropogenic intervention arising from economic development, the mangrove forest ecosystem has been facing increasing pressure and threats. It is thus required for all stakeholders to effectively apply integrated sustainable management approaches for conserving the mangrove ecosystem through mangrove rehabilitation, mangrove protection and sustainable mangrove resource utilization. For this, the Sufficiency-economy approach should be essentially considered in managing mangrove ecosystems in a sustainable manner.



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