

# ENVIRONMENTAL PROBLEMS AND CURRENT MANAGEMENT ISSUES IN THE COASTAL ZONES OF SOUTH AND SOUTHEAST ASIAN DEVELOPING COUNTRIES

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## Abstract

The coastal zone is located between the sea and the land, and it is subject to influences from both sides. Coastal zone is prone to environmental problems for a variety of reasons caused not only by human activities but also by natural processes. Developing countries in South Asia and Southeast Asia have achieved economic development in which their coasts have received heavy pressures. In this paper, coastal environmental problems in South and Southeast Asian countries, such as Bangladesh, Indonesia, the Maldives, the Philippines, Sri Lanka and Thailand, were clarified by means of data-collection, interviews and field reconnaissance. Three main causes of environmental problems are brought out in relation to the factors of spatial use of the coast, coastal resources use and environmental management as follows: 1) Different coastal types have different physical and ecological characteristics and coastal environmental problems depend on these types of the coasts; 2) Coastal environmental problems are induced by the wrong use of coastal resources. Over-use and improper use of coastal resources give rise to deterioration of environment; 3) Problems related to environmental management can be divided into administrative system and management bodies. Management bodies do not have enough budget and human resources. These problems are major constraints in the studied countries.

**KEYWORDS:** *environmental problems, coastal environment, coastal zone management, developing countries*

## 1. Introduction

The coastal zone has been attracting people and human activities of its high abilities to provide valuable resources and functions. Many people tend to live in the coastal zones for its wide and flat space, supplies of rich foods and water, chances of transportation and economic development. However, as the population and economic activities increase, a range of environmental problems have emerged, such as water pollution due to the industrial and domestic waste water, over-exploitation of fishery resources, degradation of coral reefs and mangroves, and rapid changes of land use to the modern and industrialized patterns. In addition, the coastal zone often receives strong influences of natural hazards, such as tropical

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cyclones, storm surge, high waves, and tsunamis. Climate change and sea-level rise induced by global warming would exacerbate of such problems, if they would be realized.

The developing countries in the South and Southeast Asia are one of the focused areas in terms of such environmental problems in the coastal zone. Many countries in this region have achieved economic development with high rate, and try to continue and even strengthen this trend. Because of the high potential of the economic development, the coastal zones have been received high pressures for changes, and face serious environmental problems today. With such background, many countries in this region pay their attention on the management of their coastal zones. Central and local governments and NGOs as well as academic societies addressed their strong interests in the coastal zone management. They have already started some efforts towards establishing and implementing it. Therefore, it is important to identify the problems common for the countries with careful consideration for the specific characteristics in each countries. This will give a basis for establishing management strategies. In this paper, an attempt was made to identify the common problems and management-related issues among the countries based on the published reports and paper, and field surveys.

## 2. Target Countries and Used Data

The countries studied in this paper are Bangladesh, Indonesia, the Maldives, the Philippines, Sri Lanka and Thailand among the South and Southeast Asian countries. These are all coastal countries, and pay their attention to the environmental problems in the coastal zone. In these countries, many reports and papers have been published not only from government agencies, but also from international organizations, donor countries, academic societies and NGOs.

For example, Pernetta (1993a, b) described overall aspects of coastal environment in Bangladesh and Sri Lanka in reports published by International Unions for Conservation of Nature and Natural Resources (IUCN). Coast Conservation Department of Sri Lanka published "Coastal Zone Management Plan", in which coastal environmental problems and management issues were analyzed for the whole country of Sri Lanka. Bird and Ongkosongko (1980) showed cases related to changing coastal environment in Indonesia in a report issued by United Nations University. Lemay, Michele and Hansa (1989) prepared "Coral Reef Protection Strategies for Phuket and Surrounding Islands" for Thailand. Although this study only a narrow area, environmental problems discussed may be common to the whole nation.

Each report or paper often focuses on specific problems in particular countries. However, they can give us a good basis to extract common problems, to compare them among target countries, and to understand common management related issues. Therefore, such reports and papers were used as materials for analysis. In addition to the collection of the reports, field reconnaissance and interviews with government staff, researchers and NGOs were conducted from 1990 to 1996 in Indonesia, the Maldives, the Philippines and Thailand. Areas of the field reconnaissance are shown in Table 1.

Through the analysis of the collected reports and the field surveys, it was first tried to identify the common environmental problems among the target countries. This was done based on seven different coastal types, as shown below. The concrete problems reflect the natural and social characteristics of each country or region. Therefore, differences and specific features of the environmental problems were paid attention as well as the commonality. Based on such the understanding of the problems, issues related to the management of the coastal environment were also considered.

Table 1. Field reconnaissance areas in the study

Studied countries	Areas for field reconnaissance
Indonesia	Jakarta, Surabaya, Semarang
Maldives	Malé Island and surrounding small resort islands
Philippines	Luzon including Manila, Mindro, Cebu, Palawan
Thailand	Bangkok

### 3. Outline of the Coastal Environment in the Countries under Study

In order to give an overview of the coastal environmental problems, situations of the studied countries are summarized below:

#### (1) Bangladesh

Bangladesh, which faces the Bay of Bengal, has three large deltas: the Ganges-Padma, Brahmaputra-Jamuna and Surma-Meghna. The most serious problems in Bangladesh is the frequent occurrence of storms and floods, which cause large damages to its coastal areas. The flooded area occupies one-third of the national land during monsoon season (Pernetta a, 1993).

In salt marshes, flooding is one of other factors which affect people's living environment. In Bangladesh, a large scale of land is often flooded during the monsoon period. Floods cause serious damages on many people and a great deal of their properties. Since 1954, severe floods have submerged an area ranging from 35,000 km<sup>2</sup> to 82,000 km<sup>2</sup> each year for 13 years. Flooded area in 1988, 82,000 km<sup>2</sup> was calculated as 57% of the whole country (Dugan 1993). It is reasonable to suppose that the lowland of Bangladeshi including coastal areas can be easily influenced by floods.

Fishes account for a high percentage of the caloric intake of population of the country. The fishing industry is also one of the primary export industries of Bangladesh. According to Pernetta (1993 a), however, the fishery resources of the country has been depleted by over-fishing, excessive use of pesticide, industrial pollution, and even the construction of dikes and other concrete structures along the coast for flood control and drainage.

#### (2) Indonesia

The shorelines of Indonesia are complex with various coastal types and exposed to a range of external forces. Bird and Ongkosongo (1980) identified natural disasters such as earthquake, landslide, eruption of volcanoes, tsunami and flood as the causes for short-term changes of the coastal environment. The coasts of Sumbawa and Yapen and Biak, and north of Irian Jaya were damaged by earthquakes in recent years. Although natural disasters have damaged coasts, volcanic activities has served to maintain shorelines. For example, the Central South Coast Plain of Java, the coast has been maintained against beach erosion by fluvial sand supplies, which originated from periodic eruptions of Merapi Volcano located in the north of Yogyakarta.

One of the major coastal problems in Indonesia is erosion. In many places, beach erosion takes place by decreasing sediment supply to the coast, which, in turn, is caused by human activities such as construction of diversion channels and dams. For example, beaches around the old river mouth of the Cidurian River Jakarta were eroded since the diversion channel was constructed in 1927. Other causes of beach erosion are deforestation, clearance and reclamation

of mangrove forests. In Java Island, mangrove forests have been converted to aquaculture ponds, agricultural land and residential areas. The areas where such conversion accrued tend to suffer from rapid beach erosion. On the other hand, sedimentation along the river mouth is also another problem. In East Sumatra and Northern Java, siltation have caused river-mouth clogging, expanding flood damaged areas.

### (3) Maldives

The Maldives consists of approximately 1,190 small and very low islands in 20 coral atolls. About 200 of the islands are inhabited. Malé Island, the capital, which has a length of 1.2 km and a width of 1.9 km is inhabited by 63,000 people or 26% of the total population in 1995 (Ministry of Planning, Human Resources and Environment, Maldives, 1995). The coastal problems of the Maldives are closely related to the use of the coral reefs, limestone and sand. Originally, Malé Island was surrounded by coral reefs. However, the coral reefs in the southern and western parts of the island were reclaimed owing to the demands for land to accommodate an increasing population. The increase in area from its original 108 ha to approximately 180 ha (see Table 2) has decreased the function of coral reefs as natural breakwater. Hulule Island, where the international airport is located, and Malé Island were seriously damaged by high tides in April 1987, and in June and September 1988. Those damages amounted to \$6.0 million (Ministry of Public Works, Maldives, 1991).

Traditionally, buildings in the Maldives has been made from corals. According to Brown and Dunne (1986), only mosques and tombstones were made from coral limestone before the 20th century. However, the use of coral stone as building material has increased for the last 80 years, and they are mostly used for the construction of tourism resorts and roads today. Brown and Dunne (1986) pointed out that if coral mining continues, corals in the inner Malé atoll may be depleted within the next 30 years.

Table 2. Changes in land size of Malé Island, Maldives

Year	Area (ha)
1950	107.64 (original)
1978	123.02
1986	177.25

(source: Ministry of Public Works, Maldives, 1991)

### (4) Philippines

Coastal environmental problems in the Philippines are predominantly caused by natural disasters like storms, floods, and volcanic eruptions similar to Indonesia. Pyroclastic materials from the Mt. Pinatubo eruption in 1991 covered approximately 550,000 ha (Department of Agriculture, Philippines, 1992). Lahar heaped up on mountain slopes flows down into the coastal plains and rivers during rainy season causing extensive damage to about 1,600 ha of fish ponds in the provinces of Bataan, Pampanga, Tarlac and Bulacan in Central Luzon. Damage to marine life in the coast of Manila Bay and Zambales due to these pyroclastic materials is found even at the present; heavy rain washes lahar through rivers into Manila Bay and the coast of Zambales Province resulting in the deposition on the sea bottom. The deposited lahar still affects marine life, especially benthos.

Sedimentation is one of the serious problems for conservation of coral reefs in the Philippines. Sedimentation in the coastal zone is caused not only by natural processes but also by human-induced soil erosion and land slide. Soil erosion and landslide resulted from improper construction of ordinary and logging roads, deforestation, slash-and-burn practice in agriculture. Such human-induced damages were observed by the author's aerial survey in 1996.

Another human-induced impact on the coral ecosystems is illegal fishing practices; they are deteriorated by dynamite and cyanide fishing them, and by using destructive fishing gears, which are also prevalent in other developing countries. Anchors of fishing and tourist boats also have destructive impacts by scraping the coral as shown in Photo 1.

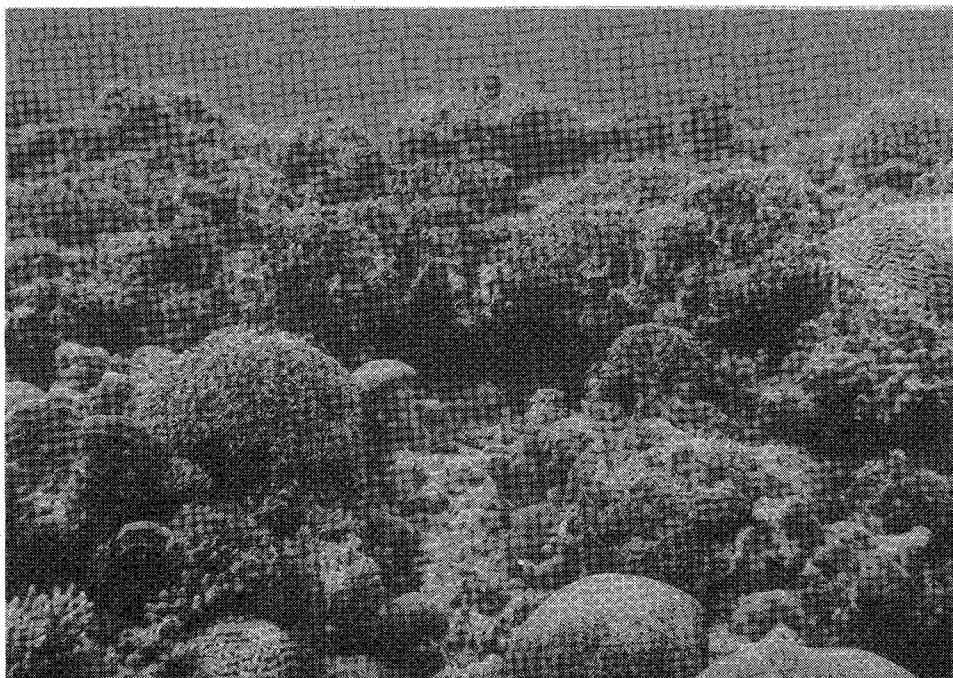


Photo 1. Damaged coral reefs by dynamite fishing in the Philippines

#### (5) Sri Lanka

More than half of the country's population (16 million in 1985) live on the coastal areas (Coast Conservation Department, Sri Lanka, 1990). Sri Lanka's coastline consists mainly of lagoons and sandy beaches with rocky headlands, and major environmental problems are related to the sandy beaches. Sand quarrying and engineering works are the predominant causes of beach erosion. It was reported by Pernetta (1993b) that about 600,000 tons of sand were mined a year or three times the annual rate of sand deposition in the Kelani River, which is the main source for the construction materials. Land of about 95,000-160,000m<sup>3</sup> was lost yearly along the 137 km coastline between the river mouth of the Kelani River and the Kelpitiya Peninsula (Coast Conservation Department, Sri Lanka, 1990). Beach erosion brings about, in turn, loss of spawning sites of sea turtles.

Decrease in mangrove is another major problems in Sri Lanka. According to Pernetta (1993b), large tracts of mangrove forests in Sri Lanka have been converted into fishponds, residential and industrial areas, agricultural plantations and salt farms. Such a variety of conversion is unique for Sri Lanka, compared with other countries where conversion to fish ponds

are predominant.

#### (6) Thailand

Bangkok has been undergoing urbanization for the past 20 years, which have caused the pollution of its main river, Chao Phraya River, owing to discharges of domestic and industrial waste water, solid waste, fertilizers and pesticides. At the same time intensive sedimentation takes place around the river mouth of Chao Phraya so that dredging is needed every year to maintain navigation channels.

An intensive coastal use including the proliferation of fishponds and fish processing factories have progressed by clearing mangrove forests. Then, the mangrove forest area has decreased at a rate of 2.5% on yearly average from 1961 up to 1991. The remaining mangrove areas accounted for only 0.33% of the whole country in 1991 (see Table 3).

Table 3. Mangrove forest area of Thailand in the past 30 years

Year	Area	
	(ha)	% of the Country
1961	367,900	0.72
1975	312,700	0.61
1979	287,300	0.56
1986	196,429	0.38
1991	173,608	0.33

(source: Kongsangchai, 1994)

## 4. Causes and Characteristics of Coastal Environmental Problems by Shoreline Type

Coastal environmental problems in the South and Southeast scatter in a wide spectrum as described above. In spite of such a variety, it is apparent that commonality among the problems exist to some extent. In this paper, it has been tried to analyze the causes and characteristics of the environmental problems according to the coastal type. Through such analysis, an overall understanding is tried to establish. Coastal geographic features in the study countries can be categorized into seven types: coral reef, sandy beach, mangrove forest, salt marsh and tidal flat, seagrass bed, river mouth and developed area. Coastal environmental problems are enumerated with each coastal type and are summarized as shown in Table 4.

#### (1) Coral Reef

The causes of degradation of coral reefs are identified as; 1) destruction of coral reef caused by direct use of coral stones; 2) destruction of coral reef due to fishing and other activities; and 3) deterioration of coral ecosystem caused by land-based human activities.

The direct use causing the coral destruction means mining of corals for construction, production of lime, and ornament-making. Most of studied countries, coral stones are used as materials for a variety of construction, such as buildings, roads and tombstones facilities, as an example was given in the explanation for the Maldives. Production of lime for agriculture was found in Bangladesh, Indonesia and Sri Lanka in the study.

Table 4 Coastal Environmental Problems by Shorelines Form (1)

Shoreline Forms Coral Reefs	Bangladesh	Indonesia	Maldives
	<ul style="list-style-type: none"> <li>- coral reef mining for lime production 1)</li> <li>- destruction of coral reef by dynamite fishing 1)</li> <li>- deterioration of coral reef due to coral and shell gathering 1)</li> <li>- deterioration of coral reef ecosystem due to water pollution 1)</li> <li>- deterioration of coral reef ecosystem due to tourism and other recreational activities 1)</li> </ul>	<ul style="list-style-type: none"> <li>- coral reef mining for construction materials 3)</li> <li>- coral reef mining for lime production 3)</li> <li>- destruction of coral reef by dynamite fishing 3 4)</li> <li>- deterioration of coral ecosystem by water pollution 3)</li> <li>- beach erosion by coral mining 4)</li> </ul>	<ul style="list-style-type: none"> <li>- coral reef mining for construction materials 5)</li> <li>- disappearance of coral reef by reclamation 6)</li> </ul>
Sandy Beach	<ul style="list-style-type: none"> <li>- disturbance of spawning sites of sea turtle due to increasing tourists 1)</li> </ul>	<ul style="list-style-type: none"> <li>- beach erosion by sand and iron sand mining 3 4)</li> <li>- beach erosion caused by agriculture development and land use conversion 3)</li> <li>- deterioration of ecosystem by marine pollution especially oil spill 3)</li> <li>- decrease of tourism and recreational values due to beach erosion 4)</li> <li>- sedimentation on sandy beach from dumping of offshore 4)</li> <li>- collapse of culture farming due to erosion 4)</li> <li>- changes in vegetation caused by erosion 3)</li> <li>- changes in vegetation by grazing of sheep and goats, and gathering of firewood 4)</li> <li>- obstruction of navigation due to sedimentation 4)</li> <li>- dumping of excess soil from dredging activities 4)</li> </ul>	
Mangrove Forest	<ul style="list-style-type: none"> <li>- cutting trees for firewood 2)</li> <li>- cutting trees and extinction for fish/shrimp ponds 1)</li> <li>- cutting trees and extinction for agriculture development 1)</li> <li>- decreasing mangrove forest by changes of fresh water inflow 1)</li> <li>- increasing flooding damaged areas by cutting trees 2)</li> <li>- changes in flow capacity of river by shrimp ponds 1)</li> <li>- increasing siltation by cutting trees 1)</li> <li>- increasing siltation by construction of shrimp/fish ponds 1)</li> <li>- depletion of fishery resources by extinction of mangrove forest 1)</li> <li>- deterioration of mangrove ecosystem by spill oil from tankers 1)</li> </ul>	<ul style="list-style-type: none"> <li>- cutting trees/extinction of mangrove forests caused by establishment of fish/shrimp ponds 3)</li> <li>- cutting trees/extinction of mangrove forests into agriculture and residential areas 3)</li> <li>- destruction of mangrove forest by increasing population and poverty of coastal residents 3)</li> <li>- cutting trees for firewood 4)</li> <li>- extinction of mangrove forest by reclamation 4)</li> <li>- corrosion around shrimp/fish ponds 4)</li> </ul>	

continued

Table 4 Coastal Environmental Problems by Shorelines Form (2)

Shoreline Forms	Philippines	Sri Lanka	Thailand
Coral Reefs	<ul style="list-style-type: none"> <li>- coral-gathering</li> <li>- destruction of coral reef by dynamite fishing 7)(8)</li> <li>- deterioration of coral by cyanide fishing 7)</li> <li>- deterioration of coral reef ecosystem by tourism and other recreational activities 8)</li> <li>- destruction of coral reef by anchoring 8)</li> </ul>	<ul style="list-style-type: none"> <li>- coral reef mining for construction materials 12)(13)</li> <li>- coral reef mining for production of lime 12)</li> <li>- destruction of coral reef by dynamite fishing 12)(13)</li> <li>- destruction of coral reef by installation of bottom coral nets 12)</li> <li>- coral and shell gathering 12)</li> <li>- catching aquarium fishes for commercial purpose 12)</li> <li>- deterioration of coral ecosystem due to water pollution 12)</li> <li>- destruction of coral reef by anchoring 12)</li> <li>- destruction and disappearance of coral reef due to port construction 12)</li> <li>- destruction of coral reef caused by dredging for navigation channel</li> <li>- deterioration of coral reef ecosystem due to proliferation of garbage 13)</li> <li>- coral reef erosion by waves 13)</li> </ul>	<ul style="list-style-type: none"> <li>- destruction of coral reef by dynamite fishing 14)</li> <li>- deterioration of coral reef by sedimentation 14)</li> <li>- destruction of coral reef by walking on reef 14)</li> <li>- destroy of coral reef by anchoring 14)</li> <li>- damage of coral by crown-of-thorns</li> <li>- collection of coral and shell for selling for tourist 14)</li> <li>- decreasing aquarium fishes for commercial purpose 14)</li> <li>- deterioration of coral ecosystem due to water pollution 14)</li> <li>- deterioration of coral reef ecosystem due to sedimentation of mining waste from tin mining site on land 14)</li> </ul>
Sandy Beach	<ul style="list-style-type: none"> <li>- disturbance on spawning sites of sea turtle due to infrastructure development 8)</li> <li>- siltation by soil erosion 7)</li> <li>- siltation and deterioration of coastal ecosystem by pyroclastic materials 9)</li> </ul>	<ul style="list-style-type: none"> <li>- beach erosion caused by sand mining for construction materials 12)(13)</li> <li>- disturbance of spawning sites of sea turtle by sand mining 12)</li> </ul>	<ul style="list-style-type: none"> <li>- beach erosion 15)</li> <li>- water pollution by tourism development 15)</li> <li>- water pollution causing odor from waste water discharge from hotels and factories 15)(16)</li> <li>- deterioration of coral reef ecosystem due to tourism and other development activities 15)</li> </ul>
Mangrove Forest	<ul style="list-style-type: none"> <li>- extinction of mangrove forest due to construction of shrimp/fish ponds 7)(10)</li> <li>- deterioration of ecosystem by cutting trees 10)</li> </ul>	<ul style="list-style-type: none"> <li>- cutting trees for lime production 12)</li> <li>- cutting trees for fire wood 12)</li> <li>- cutting trees for construction materials 12)</li> <li>- extinction of mangrove forest by agricultural development 12)(13)</li> <li>- extinction mangrove forest by housing and industrial development 12)</li> <li>- extinction of mangrove forest for recreation and tourism development 12)</li> <li>- cutting trees and extinction of mangrove forest for construction of shrimp/fish ponds 12)</li> <li>- deterioration of mangrove ecosystem by water pollution 12)(13)</li> <li>- deterioration of mangrove ecosystem by changes of fresh waterflow 13)</li> </ul>	<ul style="list-style-type: none"> <li>- extinction of mangrove forest by construction of shrimp ponds 15)</li> <li>- extinction of mangrove forest by over development and land speculation 15)</li> </ul>

continued



Table 4 Coastal Environmental Problems by Shorelines Form (3)

Shoreline Forms	Bangladesh	Indonesia	Maldives
Salt Marsh Tidal Flat Seagrass Bed	<ul style="list-style-type: none"> <li>- deterioration of ecosystem due construction of structures for natural disaster 1)</li> </ul>	<ul style="list-style-type: none"> <li>- damage to lowland by tsunami 4)</li> <li>- overflow from river and lagoon during flooding 4)</li> <li>- flooding caused by the destruction of dam upstream 4)</li> </ul>	_____
River Mouth	<ul style="list-style-type: none"> <li>- creation and extinction of land by natural process such as sedimentation and transfer 2)</li> <li>- beach erosion due to construction of dam upstream and diversion channel 2)</li> </ul>	<ul style="list-style-type: none"> <li>- beach erosion by diversion channel 4)</li> <li>- beach erosion by construction of shrimp/fish ponds 4)</li> <li>- extent of flooding from river water by siltation 4)</li> <li>- destruction of environment by land use conversion 3)</li> <li>- flooding by destruction of dam upstream 4)</li> </ul>	_____
Developed Area	_____	<ul style="list-style-type: none"> <li>- pollution of heavy metal in Jakarta Bay 3)</li> <li>- large size of reclamation 4)</li> </ul>	<ul style="list-style-type: none"> <li>- water pollution due to untreated sewage 6)</li> <li>- dumping garbage on the beach 6)</li> <li>- water pollution by garbage and sewage from ships 6)</li> <li>- water pollution by oil and belch from ships 6)</li> <li>- water pollution due to waste of fishing bait of fishing 6)</li> </ul>
Others	<ul style="list-style-type: none"> <li>- living environment damaged by storms 2)</li> <li>- shell-gathering for selling to tourists 1)</li> <li>- depletion of fishery resources 1)</li> <li>- squatting on created lands 2)</li> </ul>	<ul style="list-style-type: none"> <li>- damages caused by earthquakes, volcanic eruptions and tsunami 4)</li> <li>- oil spill from tankers 4)</li> </ul>	_____

continued

Table 4 Coastal Environmental Problems by Shorelines Form (4)

Shoreline Forms	Philippines	Sri Lanka	Thailand
Salt Marsh Tidal Flat Seagrass Bed	- extinction of seagrass bed due to destructive fishing methods 7)	- deterioration and extinction of ecosystem by over grazing and land use conversion 12) - deterioration of ecosystem for irrigation development 12) - deterioration of bird habitat and feeding for fry 13) - drainage obstruction due to flooding 13) - extinction of seagrass bed by destructive fishing methods 12) - changes in ecosystem by siltation 12) - changes in ecosystem thru overuse of fertilizers and inflow of pesticides 13) - beach erosion 12) - water pollution by sewage and factory waste water through the river 12) 13) - sand mining for construction materials 12) - changes in ecosystem by waste disposal and throwing garbage 12)	- water pollution due to disposal of sewage and factory waste water through the river 16) - water pollution due to improper or absence of tourism development planning 16) - water pollution and recurring red tide caused by shrimp/fish ponds and fish processing plant 16)
River Mouth	- illegal construction of shrimp/fish ponds 7)	- water pollution by waste water from factories and residents 12)	- pollution by sewage and throwing garbage 15) - complex pollution by inflow of toxic matters from factories 16)
Developed Area	- marine pollution by industrialization and urbanization on the coast 7) - occurrence of red tide 11) - household waste water and dumping garbage by communities along the coast 7) - inflow waste water, solid waste, pesticide and fertilizer through the river 7) - inflow of soil by soil erosion 7) - pressure on fishery resources due to rapidly increasing population 7) - expanding slum areas along the coast due to increasing population 7) - lack of environmental administrative capability 8)	- trading shells of sea turtle 12) - deterioration of coastal environment by tourism 12) - conflict by demarcation of coastal resources 12) - environmental deterioration by construction of inadequate structures 13) - obstruction of access to the coast by inadequate development 12) - inadequate development due to political instability in the country 12)	- poor implementation caused by lack of environmental administrative capability 14)
Others			

Table 3 is summarized based on the following papers and reports:

- 1) Pernetta (1993-4)
- 2) University of Rhode Island (1989)
- 3) Ex Cooperation (1991)
- 4) Bird and Ongkosong (1980)
- 5) Brown and Dome (1986)
- 6) JICA (1992-a)
- 7) Fishery Sector Program, Department of Agriculture, Philippines (1990)
- 8) Sato (1995)
- 9) Department of Agriculture, Philippines
- 10) Department of Agriculture, Philippines (1992)
- 11) Department of Science and Technology, Philippines (1993)
- 12) Pernetta (1993-b)
- 13) Coastal Conservation Department, Sri Lanka (1990)
- 14) Lemay and Chansang (1989)
- 15) JICA (1992-b)
- 16) JICA (1993)

2) is the result of illegal fishing methods like dynamite and cyanide fishing, trawling and other destructive fishing methods. According to the author's interview with Philippine NGOs, dynamite fishing method has been transferred from fathers to children as a traditional technique. Cyanide fishing, though illegal, is a very common practice in Asian countries. In Phuket, Thailand, however, cyanide fishing is rare since live fishes are sold at a higher price (Lemay *et al.*, 1989). Recreational activities also destroy coral reefs. Several reports, for example, Pernetta (1993 a, b), Sato (1995) and Lemay and Chansang (1989), pointed out that trampling on coral reefs by snorkelers and scuba divers, and anchoring of boats give rise to damages of coral reefs. Intensive fish-catching as aquarium fishes leads to the depletion of specific species. It has been reported that Anemone fish, Butterfly fish and Pygmy angelfish (*Centropyge flavipectoralis*: native species) in Sri Lanka (Pernetta 1993 b), and Angelfish, Anemone fish, Butterfly fish, Trigger fish in Thailand (Lemay and Chansang 1989) are threatened.

3) is brought about by sedimentation on the reefs due to soil erosion and land slides caused by deforestation and development projects. Although Lemay and Chansang (1989) pointed out the sedimentation problems of coral reefs, there is few descriptions about damaged coral reefs caused by sedimentation in the collected materials. However, during the author's field surveys, many coral reefs damaged by sedimentation were found in Luzon, Mindoro and Palawan islands in the Philippines. In these areas, sedimentation was caused by human activities on the land such as construction of infrastructure and logging roads, deforestation, slash-and-burn practice and agriculture development. According to scuba diving survey in Palawan in 1996, coral reefs were covered with fine sediments, where soil erosion took place on the nearby lands. Provided that sediment on coral reefs can not be removed by waves and currents, the coral reefs would die, and change to seagrass beds. It may be difficult that such coral reefs are rehabilitated once it is converted to seagrass bed.

## (2) Sandy Beach

There have been many cases of beach erosion in the studied countries. One of the major causes for beach erosion is found to be sand mining. Sand is widely used as construction materials in Indonesia, Sri Lanka and Thailand (Bird and Ongkosongo, 1980; Coastal Conservation Department, Sri Lanka, 1990; Ex Cooperation 1991; Pernetta 1993 b). Construction of structures on the beaches sometimes give rise to beach erosion. According to Bird and Ongkosongo (1980), culture farming was collapsed by beach erosion in Indonesia.

Most of traditional marine resorts such as Hua Hin Cha Am in Thailand, Bali in Indonesia and others were located on the coasts. Although sandy beaches are important tourism resources, tourism development without the necessary and appropriate infrastructure base has induced deterioration of coastal environment by water pollution, proliferation of garbage, and beach erosion (JICA 1992 b). Spawning of sea turtles is also disturbed by increasing tourist. Environmental deterioration caused by tourism development which has been carried out without consideration for environmental conditions decreases the value of sandy beaches.

## (3) Mangrove Forest

The most destructive activity for mangrove forests is deforestation. Mangroves have traditionally been used for firewood, charcoal and building materials. Recently, mangrove forests is rapidly cleared for the conversion to fishponds, and reclaimed for agriculture and residential purposes. In Thailand, about 91,000 ha of mangrove forest was lost between 1980 and 1986 because of the construction of shrimp ponds as shown in Table 5 (Kongsangchai, 1994). Sim-

ilar large-scale loss happened in the Philippines as shown in Fig. 3; 350,000 ha of mangrove in 1950 decreased to 150,000 ha by 1986, and in contrast to this trend, fish or shrimp ponds increased from 50,000 ha in 1950 to 200,000 ha by 1986 (Department of Agriculture, Philippines, 1992). In case of Bangladesh, shrimp export ranked second among sources of foreign exchange earnings. Such economic profit motivated, large conversion of mangrove forest into shrimp ponds (Pernetta, 1993a). On the other hand, mangrove forest has been used for waste dumping site (Photo 2). Disposed waste is scattered by the winds and waves. In general, waste contains organic matters and toxic so that mangrove ecosystem is deteriorated, and polluted by scattering waste.

Table 5 Conversion of mangrove area for various activities in Thailand

Activities	before 1980 ha	1980 - 1986 ha	Total ha	%
Shrimp farm	26,036	84,223	110,259	64.3
Mining	926	4,525	5,451	3.2
Salt pan	10,560	-	10,560	6.2
Others	43,070	2,132	45,202	26.3
Agriculture		702		
Urbanization		500		
Road & Transmission		235		
Industry		181		
Ports & Harbors		429		
Dredging		85		
Total	80,592	90,880	171,472	100

(source: Kongsangchai, 1994)

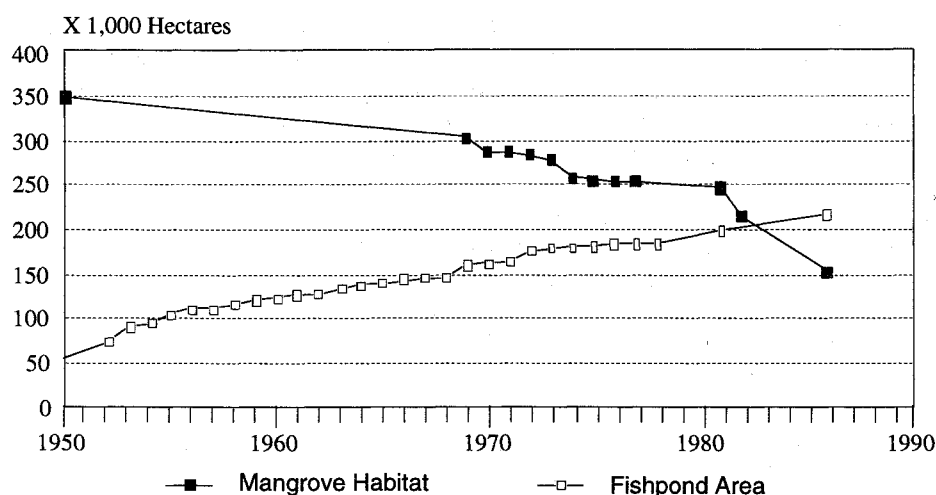


Figure 1. Changes in mangrove area and fish pond area in the Philippines (source: Department of Agriculture, Philippines, 1992)

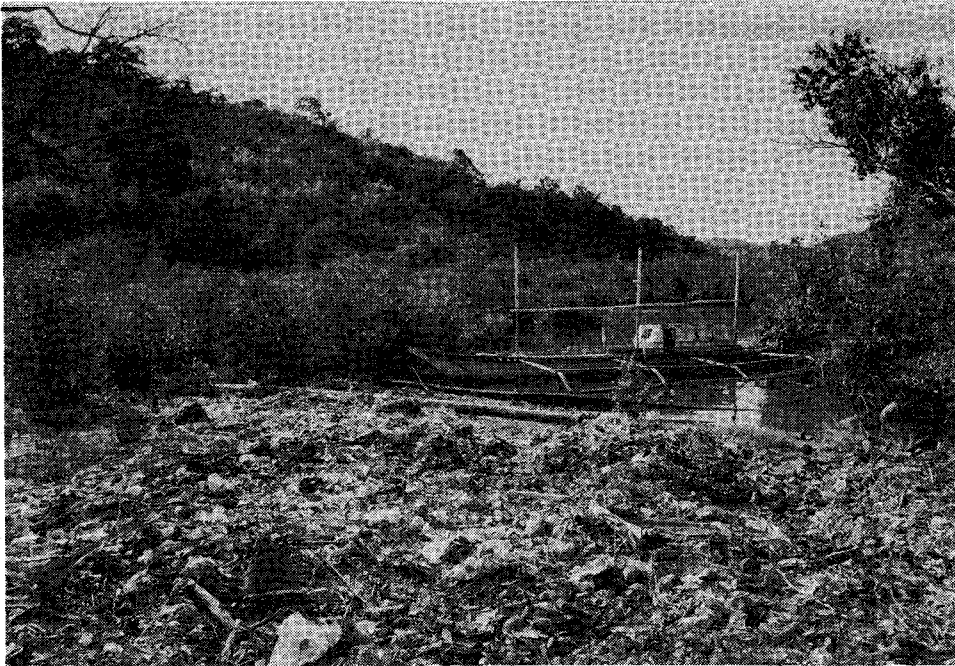


Photo 2. Waste disposal site in mangrove forest in the Philippines

#### (4) Salt Marsh, Tidal Flat and Seagrass Beds

Salt marsh, tidal flat and seagrass beds are unique and important ecosystems in the coastal zone. Although these areas serve as habitats for fishes, bird and other organisms, their ecosystem can be damaged easily. Environmental problems in salt marshes and tidal flat are closely related to its shallow water depth, since they can be developed easily. In Indonesia and Sri Lanka, for example, salt marsh is converted to salt farm, fish and shrimp ponds, cultivated land and pasture land all of which causes changes or extinction of the ecosystem.

According to Fortes (1994), 30 - 40% of seagrass beds of Indonesia have been lost in the last 50 years. Losses of seagrass beds amounted to about 20 - 30% in Thailand. In the Philippines, 30 - 50% of seagrass beds have been lost. Patchy seagrass beds at Abucau in the Philippines were lost due to the use of motorized push nets and trawling (Department of Agriculture, Philippines, 1990). Pernetta et. al (1993-b) pointed out that seagrass beds in Sri Lanka are threatened by destructive fishing gear including bottom trawls and drag nets, by sedimentation and eutrophication.

Deterioration of seagrass ecosystem is caused by activities both in the sea and on the land. Operation of destructive fishing gear give rise to physically destroy seagrass beds. Soil erosion on the land also causes sedimentation on seagrass beds. Sea water is eutrophicated and polluted by overuse of fertilizer and pesticide in farm lands, which flows through rives. Seagrass beds are withered by water pollution. Information on environmental problems related to seagrass beds is limited so that problems of seagrass beds could not be compared with target countries.

#### (5) River Mouth

As mentioned in "(2) Indonesia" and "(6) Thailand" of the previous section, human activities on the land such as construction of diversion channels and dams have caused beach

erosion and sedimentation. Chao Phraya River, Thailand, conveys a large amount of sediment eroded in the upstream. Sediment transported to the river mouth deposits so heavily, that dredging is needed frequently. The imbalance between the inflow of sediments from the river and transport to the beach brings about beach erosion and undesirable accretion of sediments. Soil erosion that occurs upstream also causes river-mouth clogging. There have been many cases in which the construction of dams and diversion channels decreased sediment supply from the rivers and caused further beach erosion.

In the author's field surveys, rivers, which flow through urban areas such as Jakarta and Semarang in Indonesia, Manila and Bangkok are polluted by sewage, garbage and others. The coasts where these areas face have been polluted by the river water. Effluents from household and factories, and garbage thrown into the rivers are discharged into the sea.

It can be concluded that the river mouth is a focus of the environmental problems owing to the direct influences from the land through the river. This is the case in particular for the areas with large population.

#### (6) Developed Areas

Coastal zone front of developed area has two types of environmental problems: water pollution and disappearance of natural shorelines.

Sea water of coastal zone has been polluted, especially in Jakarta and Semarang in Indonesia, Manila and Bangkok in the target countries. Water pollution in the coastal areas has been brought about by urbanization and industrialization. Untreatment of sewage and effluent from houses and factories, and dumping of waste contain organic matters, heavy metals and toxic matters are the major causes of water pollution. Jakarta Bay is surrounded by urban and industrial areas, and so its sea water, fish and shellfish have been polluted by heavy metals. In the Philippines, the red tide has occurred in recent years. A parasitic shellfish poison is induced by red tide plankton. This has caused the death of 45 people and hospitalization of 726 people in the Manila Bay area and Zambales coast during 1989-1993 as shown in Table 6 (Department of Science and Technology, Philippines, 1993). Other example is that the Gulf of Thailand has been also polluted not only by organic matters, but also by heavy metals and pesticide from industry, domestic and agriculture sources (Ministry of Public Health, Thailand, 1991 and JICA, 1993).

Table 6. Major red tide occurrence in Manila Bay and Zambales, 1987 - 1993

Date	Location	Paralytic Shellfish Poison	
		Hospitalized	Death
1987 April	Subic Bay, Masinloc	211	20
1988-1989			
August - December	Manila Bay	125	4
1990	Masinloc	1	0
1991	Manila Bay	73	8
1992	Manila Bay	269	11
1993	Manila Bay	2	0
1994	Masinloc	45	2
Total		726	45

(source: Department of Science and Technology, Philippines, 1993)

Natural coasts have been reclaimed for construction of harbors, industry and others. Natural coasts have been replaced by artificial structures along the coasts of large cities and highly

populated areas, such as Manila Bay and Jakarta Bay in the target countries. Coastal ecosystem has disappeared through reclamation, though this is a common problem in the world.

## 5. Structure of Coastal Environmental Problems

The structure of coastal environmental problems is schematically formulated based on their causal relationships as shown in Fig. 2. The problems are caused not only by human activities on the coast, such as deforestation of mangroves, mining of coral and sand, and illegal fishing, but also by activities on land. As already mentioned, industrial and agricultural development, road construction, discharges of waste water, etc. all influence the coastal environment. In this regard, the land is connected with the sea.

On the basis of the above mentioned observation, the causes of coastal environmental problems can be divided into three as shown in Fig. 3: 1) spatial use of the coast; 2) coastal resource use; and 3) coastal environmental management. Each cause is summarized below:

The pattern of spatial use differs with the types of coasts. Different coastal types have different physical and ecological characteristics, which, in turn, determine the accessibility of the development. Examples are coral reefs as natural breakwater, and tidal flats as habitat of shells and birds. These functions are possible to operate because of water shallowness. Coral reefs and tidal flats can be easily developed for reclamation and construction of structures, for the same reason of shallowness.

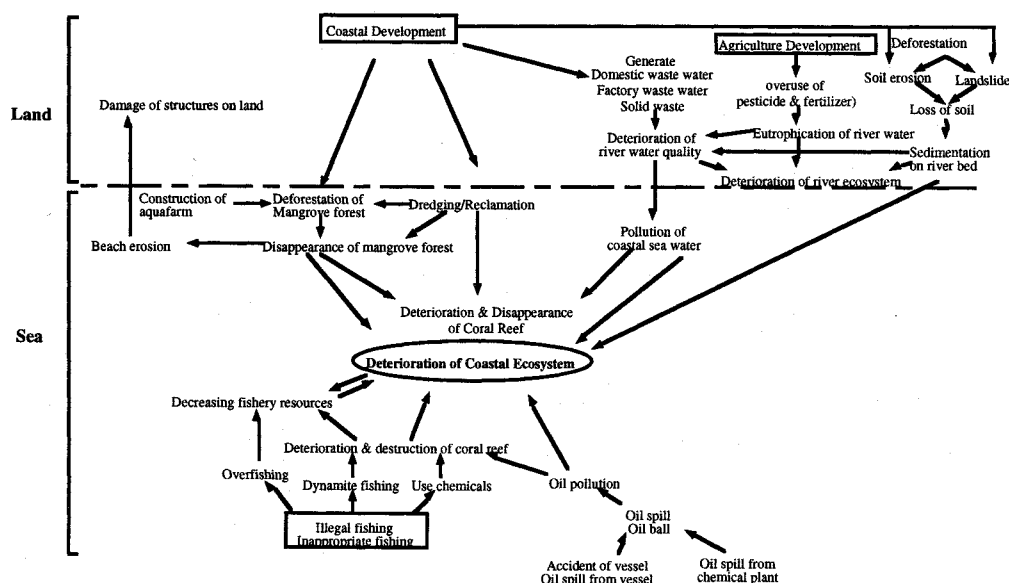


Figure 2. Interrelationship coastal environmental impacts

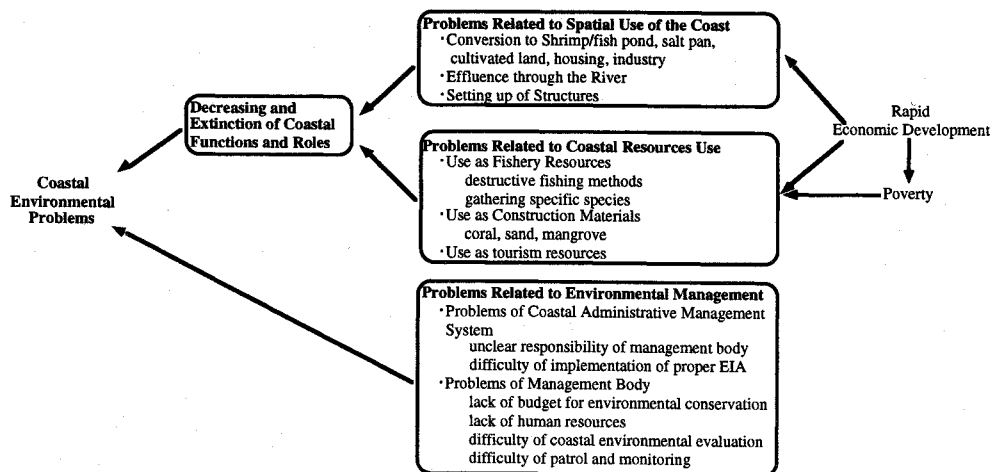


Figure 3. Structure of coastal environmental problems

Most of coastal environmental problems are induced by the use of coastal resources. Dynamite fishing has resulted in the depletion of fishery resources due to the destruction of fish habitats. Sand and coral reefs are mined for construction materials, and mangrove trees are cut for firewood, charcoal and building materials. In Sri Lanka, for example, as much as three times the annual rate of sand deposition has been mined in Kelani River (see (5) Sri Lanka of the previous section). Provided that activities of coral mining and specific fish catching exceed growth of coral and fishes, coastal resources are threatened. One of the causes of coastal environmental problems related to resources use is that resources user do not consider capacity of environment.

Sandy beaches and coral reefs are valuable resources for tourism in the studied countries. However, as we have mentioned before, beaches have been eroded by constrictions of tourism structures like hotels and piers without proper consideration for environmental conditions. As a result, ironically, the tourism value of sandy beaches has diminished all the more for such operation with tourism purposes. As for coral reefs, they have been damaged by excessive exploitation by too many scuba divers, snorkelers, and anchoring boats. Therefore, the over-use of coastal resources has given rise to deterioration of environmental values and functions. If people do not give consideration to the limited environmental capacity of those resources, they will never stop their way to further deterioration.

The causes of the lack of consideration for environmental capacity traced from the study are: 1) the order of priority of environment is lower than development; 2) information of environment is lacking among resource users; 3) knowledge of environment is lacking among resource users; and 4) regulation and its implementation related to environmental resources use are lacking among government and resources users.



## 6. Coastal Environment Problems Related to Management

Another important aspect of coastal environmental problems is coastal management. Since the coastal zone is important from social, economic, and environmental viewpoint, each country already has developed a management framework. However, it often does not work well. Through the observation of the present study, environmental management issues can be divided into two categories: those of the administrative system and management body.

### (1) Problems of the Administrative System

Environmental regulations of developing countries are overlapped, or do not cover the all of environmental management issues. Unclear management responsibility is a major constraint in the countries under study.

In Palawan, Philippines, there is a conflict as to which agency should manage protected areas between the central government, represented by the Department of Environment and Natural Resources (DENR), and the Palawan Council for Sustainable Development (PCSD) established by the President of the Philippines (Sato, 1995). It is not clear how environmental administrative functions are demarcated. The Strategic Environmental Plan for Palawan (SEP) Act (Republic Act No. 7611) was enacted in June 19, 1992, mandating the PCSD to manage and protect the environment of Palawan. On the other hand, the Philippine Government established National Integrated Protected Area System (Republic Act No. 7586) in 1982, which mandated DENR to manage protected areas.

Unclear delineation of responsibilities and functions is not only experienced by developing countries. Even developed countries also face this kind of dilemma. According to Shikida (1995), although Australia has a well-established coastal management framework, management problems arose especially as regards the Great Barrier Reef. Since the Great Barrier Reef Management Bureau was established in 1975, conflicts on the definition of area of jurisdiction and boundary arose between the Federal Government and the provincial government, which was resolved only in 1979.

In Thailand, coastal areas are categorized into four areas based on Fishery Act (1949); protected area, reserved area, leased area and public area. Lemay *et al.* (1989) pointed out that coastal use can actually not be controlled, since this regulation does not provide restricted fishing activities.

Problems of Bangladesh and Sri Lanka have been different from other target countries. In Bangladesh, huge land areas have been created by siltation, and lost due to natural disaster repeatedly. Land ownership and management responsibility have become a problem when squatters occupy these areas (Pernetta 1993 a). Political instability due to racial conflicts have prevented the spatial plan from developing in the whole countries. Development has been proceeding intensively in safe areas. As a result, coastal ecosystem has deteriorated and conflicts have been brought about by unequal distribution of resource use among stakeholders (Pernetta, 1993b). In the case of Bangladesh and Sri Lanka, environmental problems related to coastal zone management were brought about by the natural, social and cultural characteristics of the countries.

### (2) Problems of Management Body

Some developing countries have instituted well-established regulations concerning environmental protection. However, implementation and management have been insufficient because of: 1) lack of budget for environmental protection; 2) lack of human resources; 3) difficulty of

coastal environmental evaluation; and 4) difficulty of patrol and monitoring.

Although most developing countries have already recognized the importance of environmental conservation and protection, hiring staff, patrol, monitoring and research cannot be achieved due to budgetary shortfalls for environment-related projects. This is the case, particularly remote islands. Also, an assessment of the underwater environment is difficult compared with that of land since this activity requires experts trained in scuba diving. Staff training for coastal management is much more costly than that for the terrestrial environment.

## 7. Conclusions

It is clear that the sea and land areas are relevant to each other. Environmental problems that occur in the coastal area are basically determined by coastal types, since type has different environmental resources and functions. Coastal environmental problems result from improper use of space and natural resources. Such problems can spoil the functions of the coasts, which are valuable to the local society and the country. This is the primary reason why all the studied countries have paid their attention to the coastal zone management. However, it should be pointed out that constraints exist within the management framework itself. Environmental administration problems were categorized into those of the administrative system and those of the management body in this study. The former, mainly responsible management bodies are not clarified in the regulations. The latter is mainly in the lack of human resources and budget.

There is no doubt about the necessity of a proper management of the coastal environment. In order to establish it, the following issues have been raised commonly in the collected reports and interviews; *i.e.*, to integrate management body in cooperation with related agencies and clear management responsibility; to develop human resources; to integrate the management of the sea and the land; to establish an assessment of coastal environmental resources; to conduct monitoring of coastal environment resources; to implement and enhance environmental impact assessment for development projects; and to involve the local community, agriculture, fishery, tourism and industrial sectors for environment management.

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