Table 2.45C Estimated Coastal Agricultural Waste Loads, 1990

Province	Area of paddy[1]	Average fertilizer applied	Total fertilizer applied	Nitrogen content[2]
	thousand hectares	kg/ha	thousand tonnes	thousand tonnes
High Loadings				
West Java	2,133	404	861.7	373.4
East Java	1,589	404	642.0	278.2
South Sumatra	454	205	93.1	40.3
Medium Loadings				
South Kalimantan	355	96	34.1	14.8
Riau	147	205	30.1	13.1
West Kalimantan	288	96	27.6	12.0
Low loadings				
INDONESIA	10,502	303	3,182.1	1,378.8

Notes: *1. BPS (1994).*
2. Estimated by CEMP Project Team. Fertilizer ia assumed to contain 43.3 percent nitrogen.

For the determination of domestic and agricultural sources of pollutants, the parameters assessed were: BOD, COD, ammonia, Total Suspended Solids (TSS), and coliform. The magnitude of the net pollution loads is based on the number of people that discharge directly or indirectly into the river, the per capita pollution production ratios, and reduction coefficients with respect to retention and partial sedimentation in drains, wastewater treatment facilities, or other mechanisms. In order to arrive at reliable data, a validation study was carried out to calibrate the production ratios per capita in urban settings as well as in rural areas. For the urban settlements, a survey was carried out to determine the penetration of septic tanks and pit-latrines. Using the data from those surveys, the total balance of domestic pollution loads, as BOD, in the Cisadane River basin can be calculated. It appears that for the Cisadane River basin domestic pollution accounts for approximately 70 per cent of the total BOD load and industrial pollution for only 30 per cent of the load. With respect to pollution loads due to agricultural activities (i.e., the use of chemical fertilizers and pesticides, the application of manure, and the wastes from stockbreeding), no data on these loads were reported in the inventory (See further tables 2.46: *Relative balance of industrial net pollution loads in Cisadane River*; and 2.47: *Balance of domestic pollution loads for BOD in Cisadane river basin*).

Table 2.46 Relative balance of industrial net pollution loads in the Cisadane River

Sub-basin	BOD Loads kg/day	%	COD loads kg/day	%	Toxic loads kg/day	%	SS Loads Kg/day	%
Serpong	3,528	77.4	6,431	78.1	19,650	66.9	3,475	69.0
Tangerang	784	17.3	1,451	17.6	9,721	33.0	1,449	28.7
Bogor	219	4.8	302	3.7	10	0.1	61	1.2
Others	24	0.5	44	0.6	0	0.1	53	1.2
Total	4,555	100	8,228	100	29,381	100	5,038	100

Table 2.47 Balance of domestic pollution loads for BOD in the Cisadane River basin

Main citie	Settlement 1	Population 1990	Raw BOD loads (kg/day)	% raw	Net BOD loads	% Net
Tangerang	SP	9,364	281	0.6	46	0.4
	P	126,285	5,552	12.3	3,866	34.9
Total	SP + P	135,649	5,833	12.9	3,912	35.3
Serpong	SP	5,009	150	0.3	26	0.2
	P	3,102	140	0.3	116	1.0
Total	SP + P	8,111	290	0.6	142	1.2
Bogor	SP	15,317	460	1.0	96	0.9
	P	83,006	3,813	8.4	3,241	29.3
Total	SP + P	98,323	4,273	9.4	3,337	30.2
Rural	R	1,502,000	34,877	77.1	3,679	33.3
TOTAL						100

The impact of the unhealthy practices in the area surrounding Jakarta are detailed in tables 2.48 (*Toilet Facilities*) and 2.49 (*Morbidity and Case Fatality Rate (CFR) of Diarrhea*) below.

Table 2.48 Toilet Facilities, 1992

Province	With septic tank or sewer		Without septic tank or sewer		Total
	Households	%	Households	%	Households
WESTERN INDONESIA					
Riau	203,346	28,5	511,293	71.5	714,639
South Sumatra	282,343	21,4	1,039,005	78.6	1,321,348
DKI Jakarta	1,475,790	82,2	319,216	17.8	1,795,006
West Java	2,060,252	24,9	6,225,491	75.1	8,285,743
East Java	1,595,683	20,0	6,370,781	80.0	7,966,464
EASTERN INDONESIA					
West Kalimantan	115,194	17,3	551,505	82.7	666,699
South Kalimantan	117,063	19,0	499,446	81.0	616,509
WESTERN INDONESIA	8,911,230	36.0	24,726,288	73.5	33,637,518
EASTERN INDONESIA	1,505,761	27.9	5,398,899	78.2	6,904,660
INDONESIA	10,416,991	25.7	30,125,187	74.3	40,542,178

Source: BPS. 1992. Survei Sosial Ekonomi Nasional 1991/1992 (National Socio-Economic Survey).

Table 2.49 Morbidity and Case Fatality Rate (CFR) of Diarrhea (1985-1990)

Province	Morbidity Rate (per 1,000)					CFR (%)					
	1985	1986	1988	1989	1990	1985	1986	1987	1988	1989	1990
Riau	16.22	15.50	20.68	16.06	17.78	0.02	0.70	0.12	0.05	0.05	0.08
South Sumatera	22.84	23.20	22.98	-	9.50	0.04	0.70	0.07	0.03	0.07	0.10
DKI Jakarta	28.95	38.60	16.68	-	18.60	0.00	0.70	0.20	0.02	-	-
West Java	18.56	28.50	41.62	39.88	36.49	0.02	3.00	0.02	0.01	0.00	0.10
East Java	30.49	31.50	31.08	33.70	34.30	0.01	0.06	0.01	0.02	0.00	0.01
West Kalimantan	17.87	14.70	17.09	21.86	8.27	0.04	2.10	0.24	0.04	0.02	0.15
South Kalimantan	20.47	23.80	19.21	20.97	24.83	0.19	1.10	0.15	0.06	0.09	0.21
INDONESIA	22.28	24.05	26.50	26.34	29.42	0.03	0.03	0.03	0.03	0.02	0.02

Source: BPS (1992).

Tourism activities

In 1969, the first year of REPELITA I, the number of foreign visitors entering Indonesia was few, accounting for only 90,000. By 1994 at the end of REPELITA V, Indonesia had welcomed over 4 million visitors who collectively spent an estimated US$ 4.6 billion during their travels in the archipelago. Tourism from SCS and non-SCS countries to Indonesia to this subregion related to SCS can be seen in table 2.50 (*Tourism*).

Table 2.50 Tourism (1996)

Subregion	Number of visitors (per year) and average stay (days)						Total number of hotel rooms
	From same country (domestic)		From SCS countries		From non-SCS countries		
	Total	average stay (day)	Total	average stay (day)	Total	average stay (day)	
1. Riau and Batam	- -	- -	- -	- -	- -	- -	13,587 -
2. Bangka-Belitung and South Sumatera	- -	- -	- -	- -	- -	- -	- 4,724
3. Jakarta West Java	- -	- -	- -	- -	- -	- -	23,791 31,928
4. East Java	-	-	-	-	-	-	18,536
5. South Kalimantan	-	-	-	-	-	-	2,820
6. West Kalimantan	-	-	-	-	-	-	3,259
7. INDONESIA	-	-	2,628,374	2	2,406,098	2	214,110

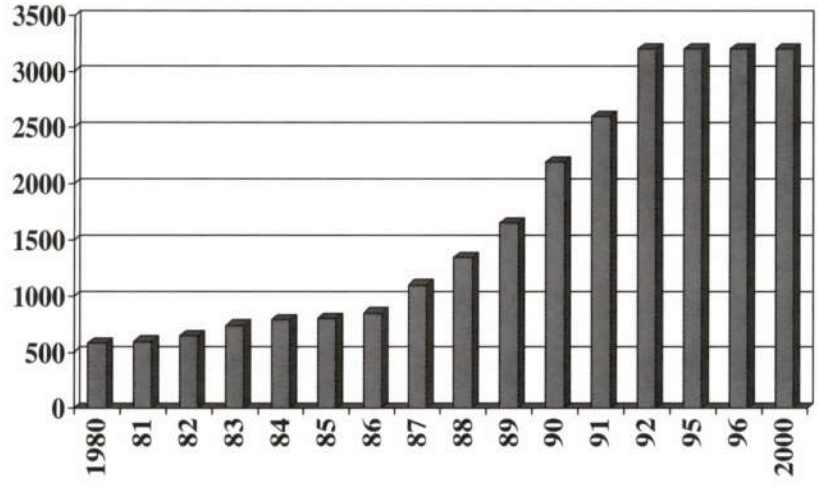
Source: Central Bureau of Statistics (1996)
Note : - : No data

On average, overseas tourists stay almost four days in Indonesia and spend approximately US$900. Most of the spending was on accommodation, travel, tours, food and beverages, entertainment, purchase of goods and souvenirs and other services.

Indonesia has seen its position as a tourist destination grow from the eleventh most important in Asia in 1985 to the sixth in 1994. The growth rate for tourism in Indonesia has been an impressive 17.8 per cent (Nuryanti 1995). Tourism is currently Indonesia's most important non-oil based source of foreign revenue, after timber and textile industries. It is projected that tourism will overtake oil as the principal source of revenue in Indonesia within the next decade.

Indonesia has abundant resources for the development of coastal tourism including white sandy beaches, coral reefs, islands etc. A number of beach and island resorts can be reached relatively easily from the main gateway cities of Jakarta, Surabaya, Denpasar, Medan and more recently Batam (the last two being located in the Malacca Straits region). As a result of the dedication and promotion since the 1990s of the "Visit Indonesia Decade", Indonesia has enjoyed a growing number of tourism arrivals from overseas (figure 7). Medan has been the main western gate for tourist flows into Indonesia. The overseas tourist arrivals have increased from 84,864 in 1984 to 264,515 in 1994. In the same period, the domestic tourists also increased from 372,500 to 1,236,000 visitors. Hotel rooms have increased from 10,531 in 1990 to 17,430 in 1994, distributed among 19 star-rated hotels and 114 non-star-rated hotels (Sekretariat Wilayah/Daerah Propinsi Sumatera Utara 1995). Recently, tourist arrivals in Medan have been surpassed by Batam and Bintan Islands, partly because of their vicinity to Singapore and Johor.

Figure 7 **Visitor Arrivals (in thousands) to Indonesia, 1980-1991 and Predictions to Year 2000 (Jay, 1996)**



Although visiting the coast is a common practice, the concept of coastal tourism is still relatively new to Indonesia. There are a variety of resorts that have been developed in many parts of Indonesia. Originally, they catered especially to the domestic market, but gradually were improved in quality in order to attract overseas tourists as well.

Because of the high socio-economic potential for tourism, almost all provinces and regions in Indonesia are now developing or establishing coastal tourism.

The new areas being planned and developed for coastal tourism are based on the concept of an integrated resort. Many of these projects are joint ventures between the Government and private sector; some are fully private and a few are purely government-supported. In addition to distributing the flow of tourists and spreading the economic benefits to other parts of the country, these new resorts are also a means of strengthening infrastructure and encouraging investment. Table 2.51 shows the tourist, recreation and resort areas on the east coast of Sumatera. They are in varying degrees of development and quality.

Table 2.51 List of Tourist and Recreational Areas in the East coast of Sumatra in the Malacca Straits (direktorat Bina Perjalanan Wisata, 1992-1993; Direktorat Jenderat Pariwisata, 1995- 1996).

Province	Object	Location	Mode of Transportation	Type of Activity	Provided Facilities
Aceh	1. Weh/Rubiah isl. Marine Park	23 km from Sabang	Motor boat, ferry plane from B. Aceh	2,4,5,6,7	
	2. Sabang Bay mar. Park	Sabang, Weh Isl.			
	3. Lhok Nga and Lampuk Beach	17 km from Banda Aceh			
	4. Ujung Batee Beach	40 km from Banda Aceh			
	5. Ujung Blang Beach	10 km from Lhokseumawe			
	6. Ujung Bade Beach	17 km from Banda Aceh			
	7. Cermin Beach	5 km			
	8. Kasih Beach				
	9. Berhala Isl. And Soreh Isl. Marine Park				
	10. Trikora Beach				
	11. Tanjung Pinang Beach				
	12. Mapor Isl. And Abang Isl. Marine Park				
	13. Bayan Isl. Marine Park				
	14. Terkulai Isl. And Soreh Isl. Marine Park				
	15. Trikora Beach				
	16. Tanjung Pinang Beach				
	17. Pasir Panjang Beach				
	18. Dendeng Isl.				
	19. Nongsa Beach				

Riau Province Bintan Island: The development of an integrated resort, the Bintan Beach International Resort, is ongoing on a 23,000 hectare coastal area. The resort is the most complex one in South-East Asia, consisting of 20 hotels, 300 or more villas, one or more marinas, an agro-tourism park, an amusement park and a natural reserve for ecological and adventure tourism (Wong 1995). The project is a joint venture investment by the Singaporean and Indonesian Governments, as well as private developers. The first phase of the project involved the construction of the requisite infrastructure, such as telephone lines, sewage treatment plants and a ferry terminal. The second phase, which includes the construction of a golf course, has begun. It is estimated that it will take 20 years to complete half of the project (Wong 1995). A regular ferry service between Singapore's Tanah Merah Terminal and Bintan Island was launched in mid-October 1995 which will help to further enhance tourism development.

Riau Province Batam Island: Batam Island was gazetted as a free trade zone for industrial development. Coastal tourism development started in the 1980s when several hotels and holiday resorts of an international standard were built to receive tourists, mainly from Singapore. Most the hotels and resorts are located around the Nongsa Beach area, the most popular tourist spot on the island. With the improvement of the ferry service between Singapore and Batam Island in the late 1980s, increasing numbers of tourists from Singapore arrived in Batam Island to spend their leisure time, particularly during weekends and public holidays. Coastal tourism development in Batam Island, however, has slowed down in recent years because of the competing claims of Bintan Island.

Southern and western Kalimantan

Industrial waste in the rivers of Barito and Martapura identified by the Clean River Project takes the form of BOD and COD mainly from the rubber processing industry. Wastewater came to 1689.2 thousands m^3/year with BOD_5 and COD reaching 237.38 thousand ton/year and 453.37 thousand ton/year respectively. Apart from the rubber processing industries, the wood industry contributed liquid wastes of around 244.72 thousand m3/year, with BOD5 around 63.953 thousand ton/year and COD around 170.95 thousand ton/year. The glue industry contributed liquid waste in the amount of 21.269 thousand ton/year with BOD5 reaching around 4.9596 thousand ton/year and COD around 13.22 thousand ton/year.

The fisheries processing industry contributed liquid wastes to the amount of 19.828 thousand m^3/year with BOD_5 reaching around 4.3986 thousand ton/year and COD around 8.5518 thousand ton/year. In total, the cities of Banjarmasin and Barito Kuala along the Barito and Martapura Rivers contributed 1975 thousand ton/year of liquid wastes with BOD reaching around 310.60 thousand ton/year and COD around 646.09 thousand ton/year. Sedimentation as a result of erosion from coal mining activities and pesticides from agriculture create turbidity and water quality change.

Waste control and the protection of the environment are anticipated through environmental impact assessments (EIAs) or through the AMDAL study processes and provincial rules and regulations.

In western Kalimantan the main issues and problems originate from industry, forest exploitation and unofficial mining. Dealing with industrial waste has the highest priority. Perhaps it will not be too hard to overcome since it is found in specific areas, it is easy to monitor, the waste character is relatively homogeneous, and law enforcement will be easy to handle.

The demand for river water for daily needs, industry, transportation, irrigation and recreation, is still high from the people, especially from the Kapuas River. However, this creates domestic waste and reaches the marine waters of the western coast. Decreased river water quality is one of the most severe causes of water-related problems. 1992 saw the highest mortality rate from diseases caused by low water quality. Data on industrial waste from the Department of Public Works showed that 48 industries had liquid waste, 48.89 per cent of which had a negative smell or odour.

Other information recorded for western Kalimantan concerns around 75 million m^3 of salt water intrusion.

Effective water resource reserves in 1994 in western Kalimantan came to about 327.3×10^9 m^3 consisting of 289.3×10^9 m^3 of surface water and 38×10^9 m^3 of groundwater. The surface water consisted of 279,913.5 million m^3 of river water, 2,560 million m^3 of natural lake water, around 2.5 million m^3 of human lake water and around 4,358 million m^3 of swamp water. River water is still important for settlement, agriculture, and industry.

2.2.1.4 Causes of issues and problems including sectoral demands and market failures

The causes of these problems are similar to those of groundwater use, namely, that surface water supply needed by different sectors is not in line with the exploitation of that supply. As the population growth is still high, even though there have been serious family planning activities, the demand continues to rise. The primary issues in general for Indonesia are:

(a) Development in the country is focused on the industrial sector;
(b) Consequently, industrial development will need natural resources support, in this case, especially from water resources;
(c) The need to support the earth summit results;
(d) Increase of water demand for both quality as well as quantity because of population growth, enlargement of settlements land, clearance of new lands, development of industrial zones, and development of coastal aquaculture.

The most devastating Indonesian example of large-scale pollution is Jakarta Bay where the inshore demersal fishing industry has been all but destroyed and the coral reefs, which had already suffered from blasting and mining, have been completely destroyed. For example, one island, Pulau Ayer has sunk below sea level because of coral mining and pollution. Furthermore, thermal pollution from two steam powered electrical generators operating in Jakarta Bay at Muara Karang and Tanjung Priok has raised the ambient temperature of the bay.

A network of rivers that empty into Jakarta Bay run through some of the most densely populated and industrialized areas in Indonesia. The United Nations Educational, Scientific and Cultural Organization (UNESCO) marine pollution monitoring and training programme carried out the initial monitoring of these rivers. Total PCB concentration in sediment samples measured 50 to 70 ppb at the Sunter River mouth, 0.1 to 4.0 at the Ciliwung River mouth and up to 0.03 to 0.6 ppb 4 miles offshore, 9 ppb at North Karang. Furthermore, in the North Karang River PCB concentrations in clams reached 279 ppb and in mussels 264 ppb. The concentrations in green mussels from the bay reached 1.32 ppm (that is 1,320 ppb).

The State of Maryland in the United States of America allows the harvesting of shellfish with a PCB concentration of less than 0.03 ppb. These figures indicate that the inner reaches of Jakarta Bay are significantly polluted with PCBs, approaching the United States FDA action level of 2.0 ppm.

Bacterial and heavy metal content has made seafood consumption dangerous to health. The fecal bacteria concentrations of 25,400 per 100 ml are 25 times the WHO recommended levels for recreational areas and aquaculture. Coliform bacteria and fecal streptococcus levels were also extremely high at 122,000 and 15,000 per 100 ml respectively (Thayib and Razak 1988). The European Union mandatory limit for bathing water is 10,000 per 100 ml for coliform bacteria and the guidelines for streptobacoccus is 100 per 100 ml.

If the marine water standards of the United States Environmental Protection Agency (EPA) were applied, heavy metal pollution from Jakarta Bay from lead and cadmium would be considered especially high. Mercury, copper and zinc concentrations would be close to the EPA permissible limits (Hg; 0.05 ppm Cd; and 0.1 ppm Zn) (Sutamihardja 1985).

Analysis of fish taken from Jakarta Bay found that out of 157 samples, 76 per cent were not fit for human consumption because of Cadmium contamination, 51 per cent because of copper, 44 per cent because of lead, and 38 per cent because of mercury pollution (Wahyuningsih 1987). In Jakarta fish markets, fish taken from unpolluted waters is often sold together with fish taken from polluted waters. It is impossible for consumers to know whether or not their food is safe.

Kepulauan Seribu is a chain of coral cays in the Java Sea approximately 40 kilometres from Jakarta. The historical data suggest that land run-off during the west monsoon season (November to March) is the main influence on the eutrophication of Jakarta Bay and the degradation of the coral reefs there.

Compared with other parts of the world that suffer from coastal eutrophication, the nutrient concentrations in Jakarta Bay are extremely high (table W). This leads to increased primary productivity of the surface waters as measured in terms of chlorophyll-a concentrations. Harger (1992) has recently demonstrated that phytoplankton biomass distribution has undergone significant shifts; plankton blooms are now spreading further offshore. In 1988 blooms spread out to 5 kilometres offshore from Tanjung Priok, the main harbour. By 1990 they had spread to 12 kilometres offshore.

Eutrophication is largely responsible for the collapse of Jakarta Bay's scleraction coral communities. The coral ecosystem is being ultimately replaced by heterotrophic invertebrate benthic community, characteristic of muddy bottom environments. The once-thriving reefs of Jakarta Bay are now functionally dead (Tomascik and others 1993). Bio-erosion is occurring on a massive scale. In addition to boring organisms there are abundant benthic mollusks and stingrays characteristic of the deeper parts of the reef slope.

Coral mining has also contributed to the destruction of Jakarta's reef. In 1982, approximately 840,000 m3 of coral was extracted from the reefs for construction (re-analysed data by Tomascik and others 1993 from Ongkosongo and Sukarno 1986).

Although there has been a documented decrease in the productivity of the reef fishery, there has been a compensating increase in the volume of production, although not in terms of value. In 1992, the total value of the reef fishery was estimated to be $90,000, which translates to approximately $450 per fisher per year. About 80 per cent of the catch is *Casio cuning* and *C. lunaris,* both reef-associated fishes. Given the decrease in catch from 1969 to 1990 (Dinas Perikanan 1990), the fall in production represents a loss in reef fishery revenue of approximately NPV $800,000 at 1990 prices.

Many other coastal areas on Java show a high potential for degradation but they have not been sufficiently monitored to indicate the long-term impacts. For example, in western Java, the Cilegon industrial complex contains the Krakatau Steel smelter together with steel processing, petrochemical, fertilizer and wood processing factories, as well as a service harbour. This area shows a high potential for coastal pollution.

In eastern Java, the levels of pollution in the Surabaya River are causing concern. The river serves as a domestic and industrial water supply. Furthermore, it discharges into a coastal area that is important for fishery and aquaculture.

2.2.1.5 Impacts of global change

A determination of the effects on the coastal/deltaic river system from rising sea levels is necessary as they may have serious impacts on the water resources management system, the river morphology and the flood plain, and on the future morphological development of deltaic systems.

The hydrological regime as it affects seasonal river discharge, flooding, sediment load, bed behaviour, irrigation uses and drainage systems needs to be considered, as well as existing pollution source points and aggravated downstream effects.

2.2.1.6 Proposed interventions for sustainable rates of extraction

In anticipation of the water crisis, some recommendations could be reached as follows:

(a) Increase the water supply reserves from both river and rainwater;
(b) Carry in from other rivers;
(c) Use the technology of recycling;
(d) Use the technology of separation or extraction of sweet water.

2.2.2 Groundwater

2.2.2.1 Groundwater aquifers and current status

Several activities on the use and development of groundwater in the country have shown an increased relationship with people's needs, both for home consumption and industry, including for irrigation. This increased use of groundwater, both by the Government as well as by the private sector and the community is in line with the development of the country itself.

The Government has taken several opportunities to serve clean water consumption through surface water utilization and groundwater extraction. Supplies for industrial consumption were taken, in general, from the surrounding areas, while for agricultural purposes the Government has provided them through existing capabilities, both in rural and urban vicinities. However, in some parts of the country clean water is hard to find.

The following table illustrates the use of clean water extraction for daily needs, almost 60 per cent being taken from groundwater (see table 2.52).

Table 2.52 The use of clean water extraction for daily needs

Water source (%)	By pipelines	By pumps	Wells	Springs	Rivers	Rain	Others
Java & Madura	4.92	0.96	42.17	12.30	4.16	0.83	1.85
Outside Java & Madura	1.47	0.16	16.15	5.36	8.22	0.96	0.48
Total	6.39	1.12	58.32	17.66	12.38	1.79	2.33

Some profits gained from groundwater usage are, among others:

(a) The availability of groundwater through simple extraction methods;
(b) Natural groundwater is, in general, healthy to use;
(c) Aquifers are in their natural conditions and could be used anytime they are needed.

The daily need for water consumption differs from place to place and by different lifestyles. A higher lifestyle demands more water consumption. In Indonesia by the year 2000, the water consumption in urban areas has been projected as 200 l/day/person, while in the rural ones the value is 60 l/day/person.

The groundwater aquifers and groundwater resources depend on several factors, such as climate, natural situation, and local hydro-geology. Several investigations showed that the total amounts are higher in Java and Madura than on the other islands. The water resources can be seen in the hydrogeological maps of Indonesia of 1985 issued by the Directorate of Environmental Geology, Department for Mining. For water quality a scale of 1: 2.500.000 is used, while for water quantity the reference scale is 1:250.000 and for more detail, 1:100.000.

The average high/yearly rainfall in a tropical country with more than 3000 m value, with the lowest averaging 500 mm, could provide for a high value of water consumption to satisy the people's need. Furthermore, the high evapotranspiration rate of around 1.400 mm supports humidity and provides better possibilities in the field of agriculture.

The main water resource aquifers for groundwater are available on rock formations in the form of rain water drainage or related water-flows. More than 75 per cent of Indonesia consists of rocks from the Tertiary and Quaternary ages. Other areas in Indonesia which have more than 500 volcanic mountains are covered by several levels of rocks as a result of eruptions. The best reservoirs for groundwater, which have the potential for further development, can be found on the slopes and lower areas of the mountains.

2.2.2.2 Demand for its use (by sector)

Water for drinking water consumption as related to healthy water for daily needs was less frequently mentioned by people in the rural areas since the technology is not yet available.

The development of groundwater by the Government for irrigation could provide irrigation water for more than 28,000 hectares of agricultural land. Based on the irrigation design of 1.2 l/s for each hectare, the development of groundwater for irrigation purposes could reach more than 34.0 m3 per second. Even in the dry season the farmers in eastern and central Java often use this type of water system.

2.2.2.3 Impact areas of shortage or low quality groundwater

By using the extraction of groundwater for different purposes as mentioned above, the negative aspects are as follows:

(a) The shallow groundwater (in the upper layers) will be easily polluted if the environmental health of the surroundings is not be taken into consideration; while water extracted from deeper levels will have more minerals mixed in it.

(b) Pumps will be needed for deeper layers, while near and in coastal areas salt-water intrusion will easily take place if care is not taken.

Healthy drinking water supplied through a piping system could only be found in urban areas such as: Medan, Jakarta, Bandung, Surabaya, Semarang, Ujung Pandang.

2.2.2.4 Causes of issues and problems including sectoral demands and market failures

Some problems arising from the development of groundwater usage are:

(a) The existence of groundwater that could be used;
(b) The over-exploitation of groundwater in coastal areas.

As mentioned previously, the existence of groundwater in the aquifers in Java and Medura is the most possible as they have already been investigated properly by the Government; while in the other areas investigations and further research should take place based on local conditions.

The over-exploitation of groundwater was due to: (a) a lowering of shallow water levels in the upper layers through the extraction of deeper level water to meet increased demand; (b) a lowering of efficiency by using costly deep-well pumps; (c) the fact that groundwater is part of the hydrological system, and if over-exploitation occurs the basic river-flow could be lowered resulting in a change of the water flows system. This happened in eastern Java where development in the Nganjuk - Kediri valleys had to be limited.

Development of groundwater in coastal areas, if not carefully conducted, can create several problems, such as saltwater intrusion which could stop the development of groundwater usage for agriculture and industry in the densely populated coastal areas. This has already occurred on the north coast of Lombok Island. Development of groundwater is easier in limestone areas such as in Tuban and Madura (north coast of eastern Java).

2.2.2.5 Impacts of global change

In the delineation of coastal areas and flood plains potentially susceptible to erosion, inundation and flooding, the following aspects need to be considered: nearshore bathimetry, coastal morphology and sediment transports, tide/wave regimes, coastal tectonics, natural coastal features, man-made coastal structures, uses of the coastal resources, and river discharges, sediment and pollution loads.

To determine the extent of saltwater intrusion from the sea or downstream rivers into the coastal surface and groundwater systems, knowledge is essential of general hydrology, differential head, soil and groundwater conditions (thickness and lithology of the young unconsolidated top layer, and the lithology of the underlying sediment), irrigation and drainage systems, seasonal river flooding and river bed behaviour (and changes caused by sea-level rise), and the use pattern of the available water resources.

2.2.2.6 Proposed interventions for sustainable rates of extraction

The use and development of groundwater extraction, except for private or industrial uses, will be conducted by the Government. Compared with the use of drinking water, the development and usage of groundwater for irrigational purposes should take into consideration other related aspects, for example, technical, socio-economic, agricultural as well as operational and maintenance, as follows:

(a) Pumping construction design

In general the pumping construction design will be set according to the aquifer and the pumping system will be adjusted. Different designs are as follows:

Aquifer type	Well design
1. Low aquifer, less than 30 m	handpumps
2. Deep aquifer,more than 30 m	mechanical pump needed
3. Deeper aquifer, more than 100 m	mechanical pump justified
4. Pumping surface less than 9 m	low pumping system
5. Pumping surface more than 9 m	deep pumping system
6. High debit pumping on each lowering water unit	small risk could happen among the pumping systems
7. Low debit pumping on each lowering water unit	high risk could happen among the pumping systems, thus the location of wells and pumping technics should be considered

(b) Water distribution construction design

The development using PVC distribution piping system buried underground could be further enhanced, especially for groundwater irrigation purposes.

2.3 EXPLOITATION OF LIVING AQUATIC RESOURCES

2.3.1 Living freshwater resources

2.3.1.1 Status - productivity; catch levels; fishing pressure

Fisheries are extremely important to Indonesia in terms of both food production and income generation. In 1991 Indonesia produced 3.4 million metric tons of fish and was the eighth largest producer of fish in the world. About 76 per cent of this fish catch came from marine-capture fisheries and 15 per cent from aquaculture. In terms of employment, fishing directly provides jobs to about 1.7 million fishers in the marine sector, 500,000 in the inland-capture sector, and about 1.5 million in the fish culture sector. About 90 per cent of the marine fish is obtained in nearshore waters within or in close association with coastal wetlands.

Freshwater open water fisheries produced 294,477 metric tons of fish in 1991. Of this, 50 per cent was from Kalimantan and 30 per cent from Sumatera. Thus, 80 per cent of the freshwater catch was from parts of Indonesia with extensive river systems and associated wetlands. In general, there is little opportunity for an increase in the freshwater fish catch because most areas are fully exploited. There is a critical need for careful management of these fisheries and the habitats upon which they depend. In some cases over-exploitation has already led to the disappearance of certain species of fish from the wild such as belida fish from southern Sumatera and to the increased rarity of valuable fish such as Asian Arwana.

As industrial developments continue, the need for better pollution monitoring and prevention will increase greatly. This is true both for the protection of the wetland environment and for the protection of humans from contaminants in fish.

In 1991, there were about 54,000 hectares of freshwater ponds in Indonesia and 43 per cent of these were in western Java. These ponds provide high quality, fresh fish. Freshwater ponds depend on good quality water in good supply. The destruction of watershed vegetation, clearing of land for development, and domestic and industrial pollutants will continue to endanger the water sources for these fish culture systems.

Raising fish in cages has become a widespread practice in Indonesia and its popularity will continue to increase. However, this culture method contributes less than 0.5 per cent to overall fish production. Nevertheless, because cages are placed in natural waters, they can have a significant effect on many freshwater bodies, especially smaller rivers. In some cases both the fish themselves and the food to feed them are taken from wild stocks. Conversely the quality of river water can have a profound effect of the survival and growth of the caged fish, and a single pollution episode or flood can destroy the livelihood of thousands of small-scale fish culturists. The incidence of fish disease is often high in fish cages, as these may often be over-stocked and the rate of water replenishment is low in stagnant waters (for example, in dams or lakes).

2.3.1.2 Endangered/transboundary/migratory species

Although Indonesia has comprehensive legislation for habitat conservation and species protection, many rare and migratory species are not yet protected. Discoveries of species new to science are a regular occurrence - yet species not yet described have no protection.

Field biologists and hunters alike are conscious of a considerable and rapid decline of very many common species of animal, most obviously birds, which may not be protected. Yet there are few studies of these declines as scientists tend to concentrate on rare and endangered species. These declines are certain to be linked, firstly to habitat reduction and degradation and, secondly, to hunting. Inevitably, data gathering has often concentrated on specific project sites and this has sometimes led to a distorted overall picture of a species distribution. In addition to inadequate protection legislation, law enforcement remains far from optimal.

In addition to existing species conservation action plans, conservation strategies must be prepared for:

- waterbirds
- sea turtles
- dugongs
- freshwater turtles, tortoises and terrapins
- freshwater dolphins
- otters
- crocodiles and species-specific action plans must be identified.

2.3.1.3 Major problems and issues

Water pollution has many causes. In remote parts of Indonesia, pollution wetlands and waterways are much as they were decades ago, i.e., largely a matter of organic effluent from villages and fields, in addition to some soil erosion from cultivated fields. With the advent of intensive agricultural development, leading to a much increased use of pesticides and fertilizers, the nature of rural pollutants has changed. Parallel to this, rapid industrial development, particularly on Java, but also in the large cities of other islands, such as Medan, Ujung Pandang and Palembang, has led to new types of pollution that have far more devastating effects than the fairly benign organic wastes. Rapid population growth has contributed also and although river volumes remain largely unchanged, they now often service far greater numbers of people than a few decades ago.

Some forms of pollution are still largely organic in nature, such as effluent from pulp and paper factories, tapioca production and from sugar mills, but many processes involve the use of potentially toxic chemical compounds. Tanneries and dyeing factories are notorious in parts of Java, while the oil industry has created some, usually localized, problems in part of Sumatera (Duri) and at oil processing plants, such as those in Balikpapan and Palembang. In agriculture, it is common to find people still using outlawed chemicals, and even the notorious DDT is still marketed, especially in remote areas. The paper industry is a special case, whereby the chlorine bleaching method leads to the (unwanted) production of very toxic and carcinogenic dioxides. Certain metal producing plants, such as the nickel mine, produce amounts of sulphur dioxide (SO_2), leading to acid rain with a pH of 4-5 as far as 30 kilometres away.

2.3.1.4 Economic losses because of over-exploitation

Economic losses because of over-exploitation as seen in the analysis can be found in the form of over-fishing, destruction of mangroves, coral reefs, sea grasses, and other natural resources owing to pollution and natural disasters.

2.3.1.5 Causes including sectoral demands and failures and internal and external market demands

Some causes could be mentioned here, for instance during the last decade, the conversion of mangrove forest for fish ponds has not taken into consideration the decreased demand for export because of the low quality of the fishing products. Unregulated land-clearing for tourism, other unauthorized activities, and an uncoordinated sectoral-wise system, including the issuing of permits without EIA studies, are some of the other causes of the water-related environmental problems.

2.3.1.6 Impacts of global change

Although warmer temperatures and carbon fertilization owing to global warming may increase biomass in tropical areas, there is no definitive evidence that harvest levels or agricultural productivity will also increase. Agriculture productivity in present-day drought areas may increase because of a better potential for irrigation and more rainfall. On the other hand, agricultural production of both food and non-food crops is likely to decline because of flooding, erosion, loss of arable land, and accelerated evapotranspiration during the dry season. Shifts in precipitation patterns are likely to disrupt cropping in both rainfall and irrigated agricultural systems. The situation will be compounded by changes affecting agricultural pests and disease.

Mean temperature and rainfall patterns are critical variables in the agricultural sector. Building upon the GIS model, a recent study suggests that rainfall would increase by 7 to 33 per cent in the Citarum watershed, 8 to 50 per cent in the Brantas watershed, and 8 to 56 per cent in the Saddang watershed, accompanied by slight temperature changes of 0.03 to 0.04^{o} C throughout the archipelago. The additional rainfall would augment water supplies for irrigation by 30 per cent in the Citarum watershed, 30 per cent in the Brantas watershed and 130 per cent in the Saddang watershed. Conversely, more rapid siltation is likely to reduce the lifetime of reservoirs and irrigation canals. Increased precipitation would also accelerate soil erosion; increases in rainfall of 14 per cent, 19 per cent, and 40 per cent would cause increases in soil loss of 15 per cent, 18 per cent, and 40 per cent respectively. Consequently, soil fertility and land productivity, particularly in upland regions, would decline by 4 to 18 per cent in Citarum, 9 to 17 per cent in Brantas, and 10 to 27 per cent in Saddang.

The importance of agriculture to Indonesia's subsistence, culture and economy alone merits preparations to cope with climate change. Rice is a staple food for most of the Indonesian people, and since 1983 the country has been able to sustain its own rice needs, currently more than 20 million metric tons annually. The number of Indonesians at risk of hunger would be likely to increase because of lowered plant productivity. Furthermore, as two thirds of Indonesia's people are involved in agriculture, these physical changes could have devastating socio-economic impacts.

2.3.1.7 Proposed interventions

Indonesia has at least 47 distinct natural ecosystems (Sastrapradja and others 1989), ranging from the ice fields and alpine meadows of Irian Jaya to a wide variety of humid lowland forests, from deep lakes to shallow swamps, and from spectacular coral reefs to sea-grass beds and mangrove swamps (MoF/FAO 1991). These major types can be subdivided: for example, coral reefs into fringing, patch, barrier and atoll systems (Tomascik 1991); mangroves according to tidal flushing regimes (Silvius and others 1987; Soemodiharjo and others 1991); and peat swamps according to age and peat depth (Whitmore 1984).

Terrestrial and wetland ecosystems have received the most attention in conservation reviews (BAPPENAS 1991). Reprot (1990) assigned habitats to 19 distinct forest types in terms of their implications for settlement as follows:

Table 2.53 Area of major forest types by biogeographic region

Forest type	Area by region (kilometres^2)			
	Sumatera	Kalimantan	Sulawesi	Nusa Tenggara
Coastal	489	704	290	124
Tidal	8,324	9,856	2,295	292
Peat swamp	54,991	49,301	1,319	0
Freshwater swamp	12,011	7,582	918	195
Lowland rainforest	120,734	270,216	57,362	6,969
Heath	493	26,753	792	0
Limestone/UB	4,824	9,044	27,726	2,387
Lower Montane	28,015	22,470	18,907	1,149
Upper Montane	3,341	272	2,903	55
Monsoon	13	0	181	13,523
TOTAL	233,236	396,198	112,694	24,694

Source : ReProt (1990 in Dick, 1991).
Notes : UB-ultrabasic substrate; Nusa Tenggara-NT East and West plus East Timor.

Indonesia is a very species-rich country, and although it occupies only 1.3 per cent of the world's land area, it possesses about 17 per cent of the total number of species in the world. Precise numbers are hard to obtain for most taxonomic groups, but at a minimum Indonesia can be said to have about 11 per cent of the world's known flowering plant species, 12 per cent of the world's mammals, 15 per cent of all amphibians and reptiles, 17 per cent of all birds and at least 37 per cent of the world's fish.

Therefore, the proposed interventions are:

(a) Increase and intensify the application of environmental assessments related to all developments affecting inland waters and wetlands so that both water and fish quality remain good;

(b) Institute and carry out a regular programme of monitoring water and fish quality to protect the environment and human health;

(c) Monitor and seek to improve techniques for assessing fish stock and fisheries production;

(d) Critically examine the biology and ecology of fish species, including the ecological relationship of each species to its habitat. Use this information to develop management strategies and plans for groups of similar species in similar habitats. Such management strategies should include protection of aquatic environments;

(e) Determine the best methods for calculating optimal harvest rates of freshwater fishes from each habitat type (e.g. lakes, large rivers, floodplains, swamps);

(f) Undertake to determine the appropriate harvest of fish for each body of freshwater and regulate fisheries to produce sustainable yields from these waters for human use;

(g) Determine the necessary steps to assure that fish biodiversity is protected, both from the destruction of wetlands and from over-fishing. Implement strategies to provide this protection;

(h) Clarify the role of national, regional and local governments and village organizations in the development and enforcement of regulations;

(i) Re-enforce and improve appropriate local fishery management systems where these already exist;

(j) Carry out studies on the use of fishery reserves in key areas as a means of protecting fisheries.

2.3.2 Living marine resources

2.3.2.1 Status - productivity, catch levels, fishing pressure

Marine fisheries can be viewed as being composed of two components: offshore fishery, which operates far from shore and nearshore fishery, which operates close to shore. In Indonesia the nearshore fishery accounts for about 90 per cent of marine fish production. In fact, only 4 per cent of Indonesia's fishing fleet is comprised of boats greater than 5 gross tons, and two thirds of the fleet is non-motorized and operates nearshore. It is important to recognize the close relationship between this productive nearshore fishery and local wetlands, especially mangroves. Of the many important Indonesia fish and shellfish groups dependent on mangroves, the most well known include the commercially important shrimps and prawns, the kakap family, and Milkfish. It is now well established that for every hectare of mangrove cleared, there will be a direct loss of inshore fishery (see table 2.54: *Utilization of living marine resources*).

Table 2.54 Utilization of living marine resources

Subregion	Pelagic fish catch (ton/year)	Pelagic fish MSY (ton/year)	Demersal fish catch (ton/year)	Demersal fish MSY	Invertebrate catch (1991) (ton/year)	Invertebrate MSY	Aquaculture production (Brackish pond-1991) (ton/year)
1. Riau and Batam	-	108,000 (Coast of Malacca Strait)	-	116,900 (Coast of Malacca Strait)	46,730	-	224
2. Bangka-Belitung and South Sumatera	-	137,000 (East Coast of Sumatera)	-	119,000 (East Coast of Sumatera)	6,518	-	73
3. Jakarta West Java	- -	125,000 (North Coast of Java)	- -	94,700 (North Coast of Java)	3,396 10,987	- -	3 56,170
4. East Java	-	125,000 (North Coast of Java)	-	94,700 (North Coast of Java)	12,504	-	79,346
5. South Kalimantan	-	158,000 (East Coast of Kalimantan)	-	83,300 (East Coast of Kalimantan)	9,962	-	807
6. West Kalimantan	-	405,000 (South and West Coast of Kalimantan)	-	67,200 (South and West Coast of Kalimantan)	12,916	-	38
INDONESIA	-	2,580,200	-	1,033,800	224,654	-	323,156

Source : *1. Directorate General of Fisheries (1993)*
2. Central Bureau of Statistics (1998)

Note : *- : No data*

Sumber:

1. Ditjen Perikanan, Departemen Pertanian. 1993. Statistik Perikanan Indonesia (Fisheries Statistics of Indonesia) 1991. Jakarta.
2. Biro Pusat Statistik. 1998. Statistik Sumber Daya Alam Indonesia (Natural Resources Statistics of Indonesia) 1997. Jakarta.

Table 2.55 provides data (1990 to 1993) on the number of fishing boats, fishery establishments, marine fishing units by gear and number of fishermen (part and full-time) in the east coast provinces of Aceh, North Sumatera and Riau.

Table 2.55 Data on Fisheries in the East coast of provinces of Aceh, North Sumatra and Riau, 1990-1993. (Direktorat Jenderal Perikanan, 1992-1995).

Explanation	Aceh				North Sumatra				Riau			
	1990	1991	1992	1993	1990	1991	1992	1993	1990	1991	1992	1993
Fishery establishment management												
Without boat	293	165	183	92	401	1,273	3,806	1,969	2,643	1,952	1,958	2,033
With non- powered boat	1,654	1,707	1,657	2,273	8,057	8,596	9,527	8,998	10,918	10,632	10,673	11,078
With outboard Boat	1,405	1,517	1,536	2,566	-	28	35	-	968	1,329	1,334	1,383
With inboard boat	883	1,176	1,227	2,553	10,414	10,791	10,127	11,139	8,174	9,549	9,596	9,976
Number of fishermen by fisherman category												
Full time	20,140	22,908	23,473	33,065	85,898	90,420	86,299	81,193	45,320	49,237	49,336	51,241
Part time (major)	3,220	3,662	3,753	5,287	22,382	23,696	22,487	21,157	10,376	11,220	11,528	11,973
Part time (minor)	2,589	669	686	866	2,589	2,741	2,601	2,447	5,045	5,457	5,344	5,550
Number of Marine fishing boat												
Non-powered boat	1,682	1,925	1,862	2,832	8,210	9,246	9,814	9,694	11,278	11,025	11,051	11,363
Outboard motor	1,664	1,726	1,693	2,590	--	28	35	--	977	1,142	1,378	1,417
Inboard motor	994	1,213	1,234	1,583	11,569	11,863	12,840	12,746	8,239	9,873	9,910	10,192
Number of Marine Fishing Unit-by Type of Gear:												
Purse seine	95	288	212	288	8,574	494	1,389	1,026	63	59	56	56
Seine nets (payang, Danish seine, beach seine)	493	304	449	1,884	1,568	2,181	2,148	2,215	682	733	795	803
Gill nets (drift, encircling, shrimp, set and trammel)	2,500	2,030	1,939	2,447	6,899	7,590	8,919	9,039	6,844	7,061	7,097	7,849
Lift nets (raft, bagan, scoop, others)	2,665	157	223	296	2,732	2,500	2,749	2,842	2,141	1,786	1,772	2,146
Hook and lines	5,772	1,662	1,524	1,603	3,610	2,427	3,874	3,020	7,808	10,423	9,153	9,856
T	12	38	249	175	2,434	4,815	3,691	3,665	3,666	4,682	4,665	3,870
Shellfish collecting equipment	-	-	-	-	2,784	2,940	2,607	2,802	3,067	2,017	2,199	2,429
	21	476	-	-	181	42	63	338	30	-	-	194

Although nationally the fishery sector has grown annually at the rate of 5 per cent by volume of catch and almost 15 per cent by export value, fisheries in Indonesia are far from efficient and well managed. Indonesia is still facing a number of problems, including, among others, the following (Soegiarto 1996):

(a) Stock assessments are not yet completely done for all waters and species. There are more than 40 major commercial species that have to be assessed and managed individually;

(b) Fishery statistics are generally incomplete and can generate misleading information and conclusions;

(c) Post-catch losses are still very high; some experts indicate about 20 per cent;

(d) Exports are still dominated by two commodities: shrimp (60%) and tuna (14%). Both are facing high competition from other countries, such as Taiwan Province of China, Thailand, China, and Mexico and a rather narrow market, mostly Japan. Thus, prices fluctuate from time to time;

(e) Exports are in fresh or raw condition. There is only a limited effort at processing and giving an added value;

(f) Almost 80 per cent of the fisheries in Indonesia are artisanal (traditional). There is a strong conflict between artisanal and commercial fisheries. Artisanal fisheries have a low productivity, low capital investment, low science and technology inputs and are thus slow in responding to modernization and new ideas;

(g) The central Government has almost unlimited authority to manage and regulate the marine fisheries; however, enforcement and management are weak.

Coastal aquaculture

Brackishwater pond culture dominates the coastal areas of eastern Sumatera that border the Malacca Straits. Mainly prawns and milkfish are cultivated in these brackishwater ponds, locally known as *tambak*. There has been a steady increase in the areas of *tambak* in the provinces of Aceh, North Sumatra and Riau. For instance, in 1979 *tambak* covered an area of 22,793 hectares, but by 1983 the area had increased to 30,248 hectares (Burbridge and others 1988). In 1993 it amounted to roughly 39,840 hectares. Low productivity from *tambak* of 590 kg/ha/yr in Aceh, 410 kg/ha/yr in North Sumatra and 300 kg/ha/yr in Riau was recorded in 1983 (Burbridge and others 1988).

See further in table 2.56

Table 2.56 Brackiswater Pond Fisheries in the Provinces of Sumatera Bordering the Malacca Straits, 1991-1993 (Direktorat Jenderal Perikanan, 1993-1995)

	Aceh Province			N. Sumatera Province			Riau Province		
	1991	1992	1993	1991	1992	1993	1991	1992	1993
Area :									
Gross Area (ha)	40,402	42,604	42,604	3,369	6,373	11,701	249	315	339
Net Area (ha)	36,323	37,851	38,428	1,910	4671	1,147	186	246	265
Households by size of fisheries management :									
2 ha	6,414	6,414	6,361	364	259	168	93	93	133
2 – 5 ha	7,318	7,318	8,869	312	312	167	46	46	65
5 – 10 ha	1,140	1,140	2,019	944	454	318	11	21	31
10 ha	684	684	2,481	287	298	96	-	-	-
Total	15,556	15,556	19,730	1,907	1,323	749	150	160	229
Production by species (metric ton)									
Fish : Milkdish	3,937	3,638	5,693	2	1	7	14	10	6
Mullets	670	129	564	312	879	703	34	24	18
Barramundi	21	12	69	9		-	-	-	-
Tilapia	1,010	569	736	788	2,779	2	-	-	-
Others	1,178	952	1,090	36	23	2,566	98	44	22
Shrimp :									
Giant tiger	12,500	15,820	12,785	2,757	8,323	5,093	30	22	62
prawn	2,058	2,820	3,837	1,924	3012	1,689	48	14	21
Banana prawn	3,237	4,101	3,031	136	176	6	-	-	-
Metapenaeus shrimp	87	235	554	194	742	158	-	12	13
Crustacean :									
Mud crab									

Mariculture

Aside from brackishwater ponds, Indonesia has also a developed mariculture industry. Mariculture requires a clean but productive and relatively calm coastal water environment, free from industrial pollution and human wastes. Although the general technical requirements to develop marine culture or marine farming may be common, each species requires a special environment. For example, the shellfish *Anadara* blood cockle requires muddy bottom waters.

The potential areas for developing mariculture in Indonesia are estimated to be 80,925 hectares with a potential production of 46 million tons/year consisting of:

Fishes	1,080,000 tons/year
Shellfish	45,171,900 tons/year
Seaweed	482,400 tons/year

Mariculture programmes are currently being developed in the Riau archipelago, in particular around Batam and Bintan Islands. The estimated potential area and production of mariculture for the provinces of Sumatera bordering the Malacca Straits are shown in table 2.57.

Table 2.57 Potential Area for Development and Potential Production of Mariculture Along the East Coast of Sumatra in Malacca Straits (Direktorat Bina Sumber hayati, 1991)

Province	Potential Area (ha)			Potential production (ton/year)		
	Fish	Shellfish	Seaweed	Fish	Shellfish	Seaweed
Aceh	200	0	250	60,000	0	4,700
North Sumatra	0	4,000	150	0	3,500,000	2,800
Riau	350	13,000	1,500	105,000	11,375,000	28,100
Total	550	17,000	1,900	165,000	14,875,000	35,600
Total Indonesia	36,000	53,625	25,700	1,080,000	45,171,900	482,400

Socio-economic contributions

The Indonesian marine areas covering more than 6 million square kilometres of territorial and archipelagic waters and 2.7 million square kilometres of exclusive economic zone (EEZ) with regard to marine fishery resources amount to about 5.9 per cent of the combined total for the major fishery regions of Indonesia. Therefore, it is not surprising that a large number of people are employed in the fishing sector. It is noted that there are people employed in industries that are dependent (or indirectly involved) in the fisheries sector such as canning and shipping.

Over-fishing

Burbridge and others (1988) estimated the standing stock and maximum sustainable yield for fishery stock in the Indonesian portion of the Malacca Straits (table 2.58). On the basis of the production figures from capture fisheries, they concluded the following:

(a) Between 1975 and 1983, shrimp catches were above the MSY of 20,000 tons per year;
(b) The catch from demersal fish stocks reached 50,000 tons in 1977 and 114,00 tons in 1983, which exceeded the estimated MSY;
(b) In 1977, the pelagic fish stocks were 112,500 tons but declined steadily after 1977 to around 77,000 in 1983, which is well below the estimated MSY of 126,500 tons a year.

Table 2.58 Estimated Standing Stocks and Maximum Sustainable Yield (MSY) for Fishery Stocks in the Indonesian Portion of the Malacca Straits, 1980 (Burbridge et al., 1988)

Fish and Shrimp Stocks	Standing Stock (x 10^3 t/yr)	MSY (x 10^3 t/yr)
Shrimp Stocks	44	20
Demersal Fish Stocks	220	110
Pelagic Fish Stocks	253	126.5

Coral reef

Coral reefs also play a major role in fisheries by providing direct harvests of fish such as snappers, groupers and emperors and of lobsters, sea-cucumbers and other invertebrates. Coral reefs also support fisheries for migratory species that visit the reefs, either to spawn or to feed on small fishes found there. The destruction of coral by various means is now a major cause for worldwide concern. In Indonesia there are many causes of the deliberate destruction of coral including dynamite fishing, use of poison to collect fish, careless use of boats and anchoring systems, and the removal of coral for sale to tourists, for building materials and for lime production. In addition, the fragile coral ecosystem is subject to considerable stress from pollution and coastal sedimentation. Local and international trade in ornamental fish and specialty items (such as dried sea horses used for medicine) is also a threat to the reef ecosystem (See figure 8 and table 2.59).

The region is a global centre of diversity for coral reefs. Approximately 70 hard coral genera occur in the vicinity of eastern Indonesia, the Philippines and the Spratly Islands, while 50 are present in other parts of South-East Asia (Veron 1986). Throughout the East Asian Seas fringing reefs are most common and are present around most small to medium-size islands. Reefs are less common on mainland coasts and on larger islands, particularly around rivers. The Philippines and Indonesia support the most extensive areas of coral reef in the region. Well-developed reefs are also found off the southern coasts of Myanmar and Thailand, on the offshore islands of Viet Nam, on the east coast of peninsula Malaysia, and off Sabah (UNEP/IUCN 1988).

The reefs of the East Asian Seas support a rich assemblage of marine life. They provide the fish, mollusks and crustaceans on which many coastal communities depend and, with other coastal habitats, provide nutrients and breeding grounds for many commercial species (UNEP/IUCN 1988). In some cases the fish taken from reef communities provide over half the protein intake of the local communities. UNEP/IUCN (1988) noted that coral reef fisheries have been estimated to comprise 8-10 per cent of the overall fishery production in the Philippines, five per cent in Indonesia and in excess of 20 per cent in Sabah, Malaysia. Tourism associated with coral reefs provides major economic benefits in the region.

Reefs and non-reef communities within 15 kilometres offshore are often beyond the reach of small-scale fishermen. Major destructive forces include excessive sedimentation and agricultural activities and various forms of destructive fishing, especially blast fishing and poisoning.

Figure 8 **Mangroves, Swamps and Coral Reefs**

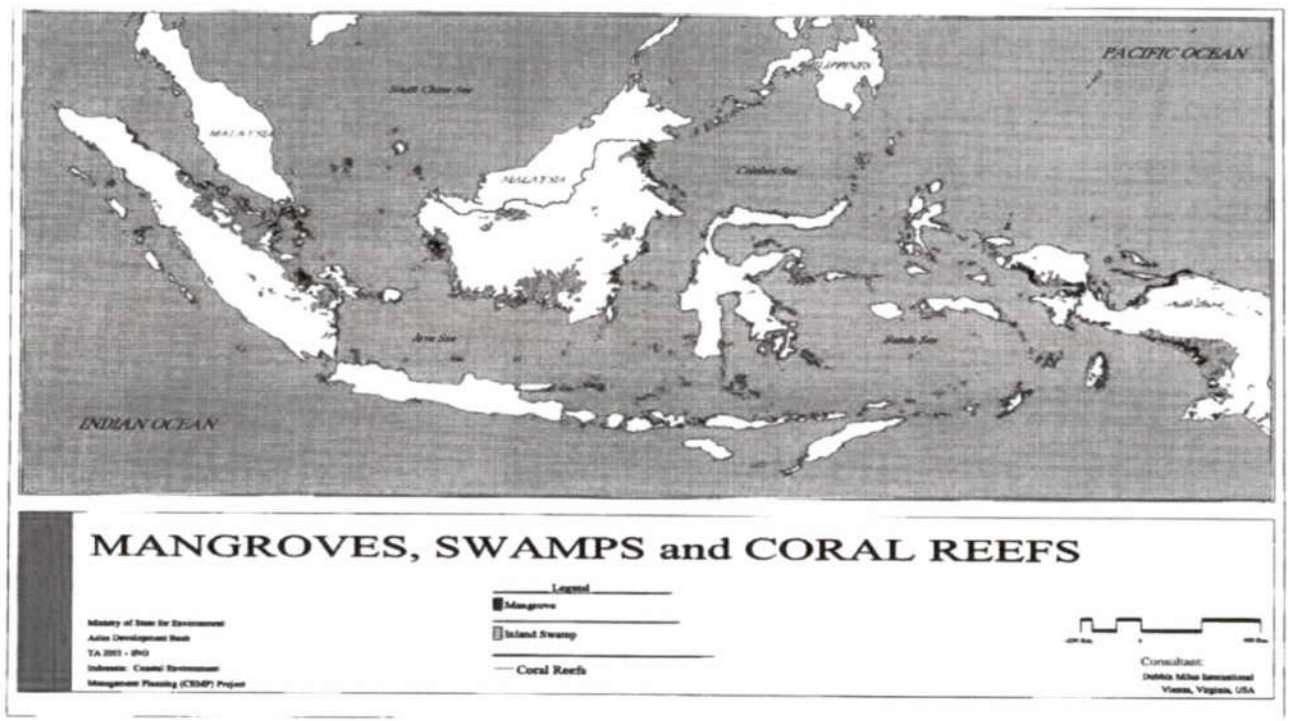


Table 2.59 Coral reefs

Subregion	Total area (Km^2) at present	Area lost per year during last 5-10 years or other indirect indication of loss	Number of coral genera	Number of associated species (fish, seaweeds, molluscs, other invertebrates)
1. Riau and Batam				
2. Bangka-Belitung and South Sumatera: - Pulau Maspar, Pulau Karang Tembaga, Pulau Pelepasan, Pulau Nangka Besar and Kecil, Pulau Karang Brombrom			*Turbinaria, Montipora, Goniopora, Porites, Lobophylla, Galaxea, Heliopora, Fafites and Nephyta, Lobophytum.*	45 species of fish
3. Jakarta West Java				
4. East Java: - Pulau Giligenteng, Pulau Kemudi, Pulau Kangean, Tanjung Paras, and Pulau Giliketapang			*Acropora, Alveopora, Astreopora, Diploastrea, Echinopora, Euphyllia, Favia, Favites, Fungia, Goniastrea, Goniopora, Galaxea, Lobophyllia, Millepora, Montastrea, Montiopora, Pocillopora, Porites, Pectinia, Pavona, Platygura, Stylopora, Seriatopora, Shymphillia and Clavularia, Dendronephyta, Gorgonian, Lobophytum, Nephyta, Sacrophyton, Sinularia, Tubipora, Xenia.*	*Sargassum (Padina), Halimeda, Caulerpa, Turbinaria.*
5. South Kalimantan				
6. West Kalimantan				
INDONESIA	50,000		76 coral genera	

Sources:

1. *Ministry of State for Environment, Republic of Indonesia (1996)*
2. *Centre for Oceanology Research (1996)*
3. *Ministry of State for Environment, Republic of Indonesia in cooperation with the Directorate for Nature Management, Norway, 1996. Indonesian Country Study on Integrated Coastal and Marine Biodiversity Management (editors: M. Kasim Moosa, Rokhmin Dahuri, Malikusworo Hutomo, Ismu Sutanto Suwelo and Suharyadi Salim). Jakarta.*
4. *Balai Penelitian dan Pengembangan Sumberdaya Laut Ambon-Pusat Penelitian dan Pengembangan Oseanologi LIPI. 1996. Status Ekosistem Wilayah Pesisir Selat Bangka, Proyek Pengembangan dan Pemanfaatan Potensi Kelautan Kawasan Timur Indonesia. Ambon.*
5. *Balai Penelitian dan Pengembangan Sumberdaya Laut Ambon-Pusat Penelitian dan Pengembangan Oseanologi LIPI. 1996. Status Ekosistem Wilayah Pesisir Selat Madura dan Kepulauan Kangean, Proyek Pengembangan dan Pemanfaatan Potensi Kelautan Kawasan Timur Indonesia. Ambon*

Uses of reef degradation

Physical activities

(a) Coral mining for building materials, cement, souvenirs, roads etc.
(b) Human activities in coral reef areas, boat anchoring, poison fishing, blast fishing
(c) Waste and excessive sedimentation siltation

Causes of reef degradation

(a) Lack of awareness and knowledge of coral reefs
(b) Weak law enforcement
(c) Weak institutional coordination
(d) Pressure of economic needs by coastal people
(e) Lack of a national concept for coral reef management

Concept development

(a) Coral Reef Rehabilitation and Management Programme (COREMAP) Rehabilitation is not related to replanting but to rehabilitating the environment by minimizing the insult/causes of coral reef degradation.
(b) Coral reef degradation is caused by a complexity of several factors such as human behaviour, perception, economic welfare, law enforcement.
(c) The strategy of the programme includes:
    - Improving public awareness;
    - Developing a management system;
    - Focusing on key locations;
    - Providing opportunities for environment friendly economic activities;
    - Developing institutional ability and cooperation;
    - Providing scientific support;
    - Learning from experience.
(d) Coremap is focused on:
    - Public awareness;
    - Development of community based management;
    - Strengthening of law enforcement;
    - Human resources development and institution-building;
    - Development of a coral reef information and training centre.

COREMAP objectives in the next 15 years (1998 - 2013)

The protection, rehabilitation, and sustainable utilization of coral reefs and their ecosystems which in turn will improve the welfare of coastal people.

Seagrass beds

South-East Asia, with about 20 species of seagrass from seven genera, has the most highly diverse seagrass flora in the world. Both mangroves and seagrasses show a similar global pattern of generic richness, characterized by a maximum variety in the Indo-West Pacific and secondary centres of diversity found in the Caribbean. Although the number of seagrass species is relatively small, their numbers are by no means proportional to their ecological and economic importance. They form dense beds that cover large areas of coastal waters and perform a wide spectrum of biological and physical functions, serving as habitat and nursery areas for fish, many invertebrates, turtles and dugong. They also provide alternative feeding sites for commercial and forage organisms (Fortes 1988) (see table 2.60: *Seagrass*).

Table 2.60 Seagrass

Subregion	Total area at present	Area lost per year during last 5-10 years or other indirect indication of loss	Number of seagrass species	Number of associated species (fish, other vertebrates, molluscs, other invertebrates)
1. Riau and Batam	- -	- -	- -	- -
2. Bangka-Belitung and South Sumatera: - Pulau Maspar, Tanjung Badewa, Lampung Bay	1,880 m^2	-	7 (*Thalasia hemprichii, Cymodecea rotundata, Cymodecea serulata, Halophila ovalis, Halodule uninervis, Syringodium isoetifolium, Enhalus acoroides*)	- seaweeds = 3 (*Padina sp, Sargassum sp, Gracilaria sp*) - fish = - species
3. (a). Jakarta: - Pulau Pari	2 m (in depth)	-	8 (*Thalasia hemprichii, Cymodecea rotundata, Cymodecea serulata, Halophila ovalis, H. minor, Halodule uninervis, Syringodium isoetifolium, Enhalus acoroides*)	11 species of Foraminifera, 27 species of Phytoplankton, 29 species of Crustaceans, 58 species of Polychaets, 5 species of Echinoderms, 18 species of Molluscs, and - species of Fishes.
(b). West Java: - Banten Bay	1,250,000 m^2	-	7 (*Thalasia hemprichii, Cymodecea rotundata, Cymodecea serulata, Halophila ovalis, Halodule uninervis, Syringodium isoetifolium, Enhalus acoroides*)	28 species of Crustaceans, 25 species of Polychaets, 3 species of Echinoderms, 10 species of Molluscs, and 165 species of Fishes.
4. East Java: - Pulau Giligenteng, Pulau Goa-goa, Pulau Kemudi and Pulau Kangean	-	-	8 (*Thalasia hemprichii, Thalassodendron ciliatum, Cymodecea rotundata, Halophila ovalis, Halodule uninervis, Halodule pinifolio, Enhalus acoroides, Syringodium isoetifolium*)	-
5. South Kalimantan	-	-	-	-
6. West Kalimantan	-	-	-	-
INDONESIA		-	12 species of Seagrass beds	-

Source : 1. Ministry of State for Environment, Republic of Indonesia (1996)
2. Centre for Oceanology Research (1996)
Note :- : No data

Sandy beaches

Sandy beaches occur extensively on the shores of coral islands and are interspersed among other shore formations throughout continental Asia. Steep beaches of coarse sand are built up on ocean-facing coasts exposed to strong surf. Intertidal flats of mixed sediments, with a narrow sandy fringe at high water mark, develop on more protected shores (Schwartz 1982).

Only a restricted fauna tolerates the surf forces and instability of an exposed sandy shore. Tropical organisms are further inhibited by high temperatures and desiccation. Most animals must burrow for protection or limit their surface activity to periods when the sand is moist. The middle and lower beach animals are absent from shores with severe wave action.

The fauna of sheltered sandy beaches is much richer by comparison (Berry 1964; Vohra 1971). On sand flats containing a proportion of silt, burrowing polychates, echinoderms and coelenterates become important components of the fauna and a seaward zone of the marine grass *Enhalus* is developed. Marine turtles nest on the sandy beaches throughout many areas of the East Asian Seas.

Rocky shores

Rocky shores occur on the coasts of many Asian islands. The south-west coast of Sumatra and the Pacific coastline of the Philippines and Sulawesi have extensive rocky topographies. Smaller rocky outcrops and boulder formations are common above coral reef flats and on headlands bordering sandy bays. Wave erosion of limestone creates sheer or fissured cliffs with little or no beach formation (Schwartz 1982).

The zonation of organisms on rocky shores in the region follows the typical pattern with three major zones (supra-, mid-, and sub-littoral), characterized by key organisms (littorinid snails, barnacles, and algae respectively). High surface temperatures and desiccation greatly limit the tropical fauna and flora in comparison with those of temperate rocky shores. Large seaweeds (such as fucoids and laminarians) typical of cooler latitudes and the organisms they support are absent, and there is a general lowering of the zonation levels toward the equator. A rich assemblage of organisms occurs at the lowest tidal level and in crevices (Berry 1964; Chuang 1973) where the environment is less extreme. Tropical rock pools are subject to extreme heating and wide fluctuations in salinity and consequently support a poorer biota.

Islands and submerged banks

The East Asian Seas marine region includes the extensive archipelagos of Indonesia and the Philippines. There are also numerous islands off the coast of mainland Asia. Island types range from coral cays to raised limestone, volcanic and continental islands such as Java and Borneo.

Species diversity

Despite the basic homogeneity caused by the occurrence of many wide-ranging species, there are great differences in diversity among the various parts of the Indo-West Pacific region. Many authors have noted the concentration of species in the East Asian Seas in the vicinity of the Philippines, the Malay peninsula and Papua New Guinea/Irian Jaya. This area has been recognized as a faunistic centre from which other subdivisions of the Indo-West Pacific have recruited their fauna. The presence of a concentration of species is supported by a number of studies of the fauna in general and for animal groups such as mollusks, crustacean and fish. As noted above, this pattern is also followed by seagrasses and mangroves. Moving away from the Indo-Malayan centre to consider the fauna of the peripheral areas, there is a notable decrease in diversity correlated with distance (Briggs 1974).

Seaweeds

The Asian and Pacific region contains 100 species of seaweeds of economic value. They constitute an important biological resource of the region as part of the food web of marine life. Additionally, they are used for human consumption, animal feed, pharmaceutical products, fertilizer, and industrial raw material for the production of a wide range of products. Wild seaweed resources have become limited owing to extensive use and are being supplemented by cultivated resources (ESCAP 1990).

Invertebrates

The region is a global centre of diversity for marine invertebrates, including mollusks and crustaceans (Briggs 1974). For the gastropod genus *Strombus*, Abbott (1960) found the greatest number of taxa in the vicinity of the Philippines (26), Okinawa (24) and Indonesia (23). The number of taxa decrease moving east across the Pacific and west across the Indian Ocean.

Giant clams used to be abundant, having their centre of distribution in the region, but are now heavily depleted and have been placed on the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) list.

Fish

The region is a centre of diversity for marine fish. For example over 2,000 species of shore fish have been recorded in the shallow waters of the Philippines (Briggs 1974). Springer (1982) and Abbott (1960) recorded approximately 160 shorefish families in the region (with a similar number present in south-east Africa and off the Great Barrier Reef). The number of families shows a decreasing trend moving east across the Pacific Ocean and away from these centres of diversity.

Gomes (1990) noted the general decline is fishery resources in the region as a whole, attributed to over-exploitation, particularly in inshore coastal waters.

Marine turtles

Six species of marine turtle nest in the region : the flatback (*Chelonia depressa*), the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), leatherback (Dermochelys *coriacea*), olive ridley (*Lepidochelys olivacea*) and the loggerhead (*Caretta caretta*). The last five are classed as vulnerable or endangered (Elder and Parnetta 1991).

Sea snakes

East Asia is the centre of the world's radiation of true sea snakes (*Hydrophiidae*). This family contains some 14 genera and 47 species. Of these, 14 genera containing about 30 species are found in the East Asian region. With the exception of the pelagic yellow-bellied sea snake (*Pelamis platurus*), which occurs in both coastal and oceanic waters from East Africa throughout the Indian and Pacific Oceans to the west coast of Central America, all other sea snakes are confined to tropical and warm temperate regions extending from the Persian Gulf to the Fijian islands. The number of species declines west of the East Asian region to about 20 species in India and 11 in the Persian Gulf (Voris 1972). The adjoining Australian region has 31 species (Cogger 1994), rapidly declining in diversity in the western Pacific region.

The sea kraits (*Laticaudidae*) also occur throughout the region. This family contains only six species in a single genus (*Laticauda*); some taxonomists recognize a second genus, *Pseudolaticauda*. Three of the six species are found in the East Asian region.

Sea snakes are widely utilized in the region for their skins and significant trading in skins is centred in Singapore and Thailand, although the total number of skins traded is uncertain (see Heatwole 1987). Sea kraits are also utilized for their skins, and large quantities are exported from the region to Hong Kong and Japan for food and oriental medicine.

Relatively little is known of sea snake biology and ecology, and therefore the impacts on wild populations from either trade or fishing by-catch mortality cannot be determined.

Marine mammals

The dugong (*Dugong dugong*) is present in the region but is endangered because of hunting and destruction of its natural habitat.

Balaenoptera edemi (Bryde's whale) is the most common cetacean in the region. Other species recorded are: *Balaenoptera acutirrostrata* (minke whale), *Balaenoptera borealis* (sel whale), *Balaenoptera physalus* (fin whale), and *Megaptera novaeangliae* (humpback whale). Dolphin and porpoise species include *Sousa chinensis* (Indo-Pacific hump-backed dolphin), *Orcaella brevirostris* (Irrawady dolphin), *Neophocaena phocaenoides* (finless porpoise), *Tursiops truncatus* (bottlenose dolphin), *Delphinus delphis* (common dolphin) and possibly also *Sousa borneensis* (white dolphin), *Sousa plumbea* (plumbeous dolphin) and *Stenella Malayana* (Malayan dolphin).

Mangroves

In comparison with the mangrove flora of equivalent latitudes on the Atlantic shores of Africa and the Americas, the mangroves of the Indo-Pacific region, and South-East Asia in particular, are extremely diverse. Mangrove is the dominant coastal community in tropical Asia, with the Malay-Indonesian regions being its centre of distribution (see figure 9 and table 2.61: *Mangrove*).

Figure 9 Mangroves and Inland Swamps

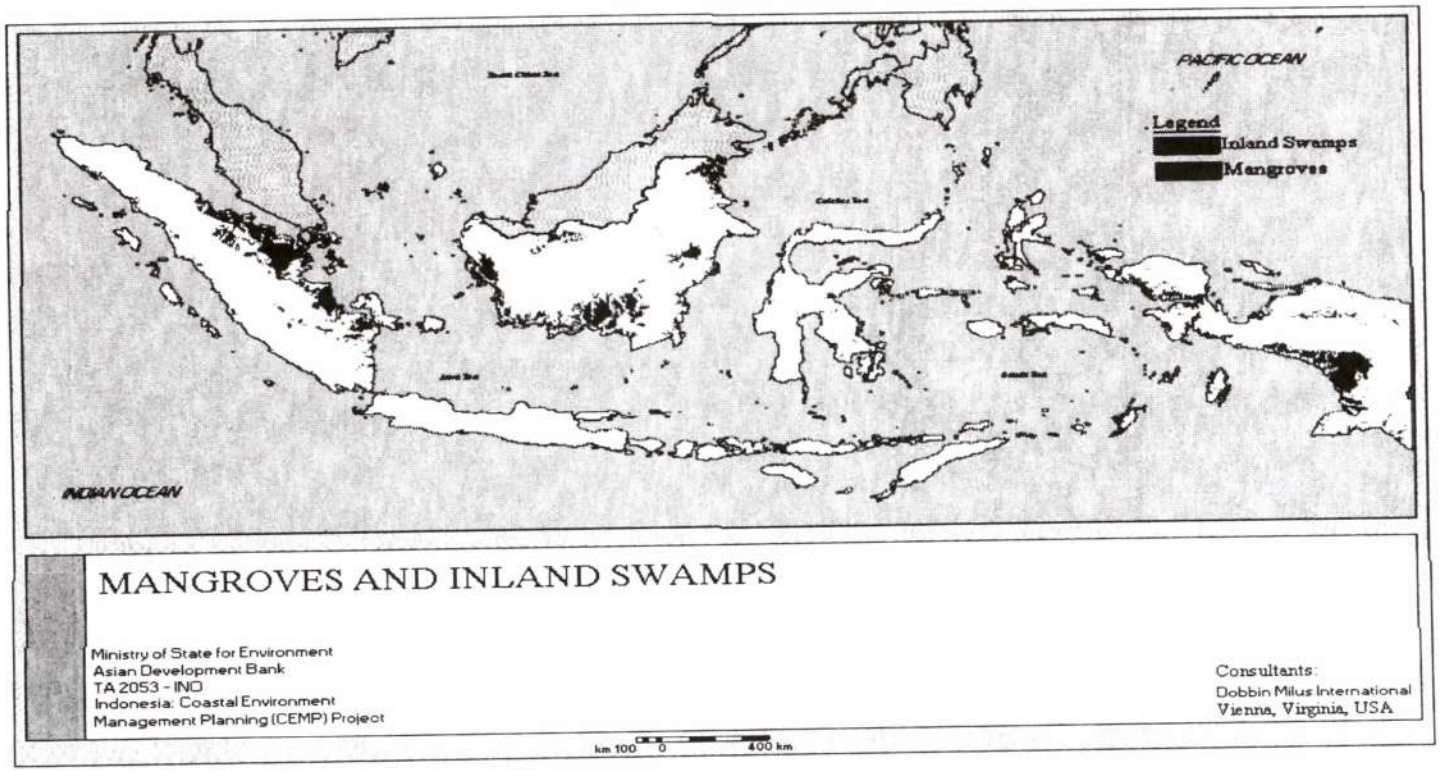


Table 2.61 Mangrove

Subregion	Total area (Ha) at present	Area lost per year during last 5-10 years or other indirect indication of loss	Number of mangrove tree species	Number of associated species (birds, fish, invertebrates) (specify)
1. Riau and Batam	221.050	(-) 54.950	_	_
2. Bangka-Belitung and South Sumatera	363.430	(+) 168.430	_	_
3. Jakarta and West Java	28.608	(-) 28.608	_	_
4. East Java	7.750	(-) 7.750	_	_
5. South Kalimantan	120.780	(+) 54.130	_	_
6. West Kalimantan	194.300	(+) 154.300	_	_

Source :

1. Department of Forestry, Republic of Indonesia together with FAO/UNDP (1982) using data from 1970's
2. National Forest-Inventory, INTAG, Department of Forestry, Republic of Indonesia using Landsat data from early and mid-1980's

Note:

(-) : loss
(+) : growth
- : No data.

Indonesia has the greatest area of mangroves in the region with 4.25 million hectares (WCMC 1992), of which about 2.9 million hectares are in Irian Jaya. The mangroves in the western parts of this country, particularly Java, have suffered heavily from human impacts which have included illegal cutting, conservation to other uses (such as mariculture and other forms of coastal development) and possible land-based industrial pollution (ASEAN-Australia Marine Science Project 1992). The mangroves in the east are less affected, but signs of degradation have been recorded in some locations (for example, Ambon Island and Halmahera Island).

Exploitation and use of mangrove resources

Status of resource exploitation

Indonesia mangrove resources: The total mangrove area in Indonesia is estimated to be around 3.80 to 4.25 million hectares, of which around 0.38 million hectares (ReProt 1990) are located along the eastern coast of Sumatera.

The mangrove area has, however, been fast disappearing. Silvius indicated in 1987 that out of the 1,365,000 hectares of original mangrove areas in Sumatera only 748,000 hectares were remaining, approximately 54.8 per cent. BAPPENAS (1993) pointed out that by 1993 only 29 per cent or about 395,850 hectares of mangrove area would remain in Sumatera. The extensive conversion of mangrove into *tambak* (brackishwater ponds) that has taken place in Sumatera in recent years is one reason for the reduction in mangrove coverage. For example, almost 70 per cent (36,000 hectares) of the total area of mangroves in the eastern coast of Aceh Special Province had been converted into *tambak* by 1990. Similarly in the eastern coast of North Sumatera in 1979, the *tambak* was only 839 hectares (Burbridge and others 1988); by 1990 it had became 7,600 hectares (Dahuri and Pahlevi 1994).

Other major causes of losses of the mangrove ecosystems in Sumatera are:

(a) Over-exploitation of their wood resources for export or domestic consumption, such as for wood chips, mangrove logs, poles timber and charcoal, in particular in Aceh, North Sumatera and Riau Provinces;
(b) Conversion into industrial sites, port facilities, human habitation and other infrastructure and facilities, for example, around the ports of Belawan and Dumai, as well as in Batam, South Sumatera, Lampung;
(c) Pollution from domestic, petrochemical and industrial wastes;
(d) Sedimentation dust caused by poor upland management.

Peat swamps are also extensive on the eastern coast of Sumatera island. Peat swamps form important watershed areas that help to mitigate flooding in adjacent areas by absorbing and storing excess water. Many commercially valuable timber products are harvested from peat swamp forests. These include the valuable ramin wood species (*Gonystylus bancanus, Shorea spp.* and *Cratoxylum spp.*), rattans and resins.

The loss in peat swamp area for the whole of Sumatera can be estimated indirectly as follows:

Table 2.62 The loss in peat swamp areas in Sumatera

Original area (1,000 ha)	Remaining (1,000 ha)	Area (%)	Sources
7,282	4,613	63.35	Silvius (1987)
	3,641	50.00	Bappenas
Total loss in six years	972	13.35	(1993)

Thus, for the whole of Sumatera, the average loss was 162,000 ha/year in 1987 to 1993. The major loss of peat swamps in Sumatera apparently happened before 1987 when approximately 2.7 million hectares, or about 36.6 per cent of the original area, was lost most probably because of logging, transmigration programmes, large crop estates, or conversion to rice fields. For example, during the first 25 years of the long-term development plan (1969 to 1994), Indonesia converted about 5.0 million hectares of peat swamps; 2.36 million hectares from Riau Province (Mardjono, personal communication 1996) for oil palm or coconut estates, transmigration programmes, new rice fields and for other purposes.

Economic and ecological value of mangrove resources

Properly managed mangrove forests provide many long-term and direct economic benefits (Low and others 1994). The benefits are follows:

(a) As a protection for the coastline from erosion;
(b) As a flood and typhoon buffer zone;
(c) As a support for the yield of inshore fisheries as feeding or nursery grounds for juvenile or larval fish or shrimps;
(d) As a field habitat for education and research in resource management;
(e) As a resource for conserving biodiversity.

Many species of birds (for example, purple heron, *Ardea purpurea*; milky stork, *Mycteria cinerea*), amphibians (for example, crab-eating frog, *Rana cancrivora*), reptiles (for example, saltwater crocodile, *Crocodylus porosus*) and mammals (for example, long-tailed macaque, *Macaca fassicularis*; Malaysian flying fox, *Pteropus vampyrus*) are currently endangered because of habitat loss and over-exploitation by humans. These animals are wholly or partially dependent on mangroves for food, shelter and for many aquatic species as spawning and nursery grounds (Low and others 1994).

A recent survey by the International Union for Conservation of Nature and Natural Resources (IUCN) identified 106 marine protected area (MPAs) in South-East Asia, with 35 in mangrove forests and another 48 being a combination of mangroves and coral reefs. Reportedly, only 3 mangrove reserves and 4 combined MPAs have effective resource management, whereas 69 reserves have ineffective or no management whatsoever (Low and others 1994). Moreover, the MPAs cover only a very small portion of the coastal resources of the region. Vast areas of mangroves are still being disturbed and exploited, giving endangered species little or no protection.

A four-pronged approach was suggested by Low and others (1994) to ensure the survival of the endangered species and to conserve the biodiversity of mangrove areas:

(a) Political support;
(b) Establishment of nature parks, reserves and managed areas;
(c) Monitoring of management techniques;
(d) Public education.

Timber extraction: For centuries the Indonesians have utilized mangroves for firewood, charcoal, tanning dyes, timber and for the construction of boats. The following genera are frequently used for those purposes : *Rhizophora, Bruguiera, Ceriops, Avicennia, Nypa and Oncosperma.* Nypa leaf can be used for various things, such as thatched roofs, baskets and cigarette "paper". The stalks of the flower are cut off and the sap is tapped for making brown sugar of the fermented palm wine or "arak". These traditional uses of mangrove resources go hand-in-hand with large-scale exploitation using higher capital investment and technologies.

A number of mangrove species are harvested for charcoal production, fuel wood etc. (table AA). For example, Riau Province in Sumatera has long been a centre for charcoal production from mangrove trees. The product is exported to Singapore, Malaysia and Hong Kong, China. In 1984, 836 kilns operated in Riau (Soemodihardjo 1984). Exports of charcoal in 1989 amounted to over 22,000 tons at a total price of US$ 1.8 million (Pemerintah Daerah Tingkat I Riau 1991). In northern Sumatera, mangroves were used for charcoal production on a subsistence basis. The operation of a charcoal factory compared with other land use options in mangroves (table 2.63) provides only limited employment.

Mangrove wood is also used as raw material for a large paper mill in Gowa. Bamboo is used as basic raw material, supplemented by mangrove wood and eucalyptus. Experience has shown that a process with a ratio of 80 per cent bamboo and 20 per cent mangrove wood produces a very good quality paper (Rachmat 1975). A paper mill using mangrove chips has been established in West Irian as part of a joint United States and Indonesian venture.

Table 2.63 Commercial and Subsistence Uses of Mangrove Forest Resources in North Sumatra, Indonesia (Sukardjo, 1982)

Species	Commercial Uses	Species	Subsistence Uses
Ceriops tagal and Xylocarpus	Batik dyes	Avicennia spp.	Fuelwood, firewood, rough walling, livestock grazing and bark for tannin.
Excoecaria agallocha and sommeratla alba	Packing cases	Bruguiera spp.	Poles for construction, charcoal, firewood and fuelwood
Rhizophora apiculata, R. Mucronata, Bruguiera gymmorhiza, B. parviflora, B. sexangula and B. cylindrica	Poles for construction, piling and timber	Exocoecaria agallocha	Boxes and firewood
Rhizophora spp. and Bruguiera spp. (bark)	Tannins, adhesives and dyes	Ceriops spp.	Tannin and dyes (bark) and fuelwood
Rhizophora spp. and Bruguiera spp.	Charcoal	Avicennia corniculatum	Fuelwood for charcoal production and fodder for goat
		Rhizophora spp.	Tannin (bark), poles, fuelwood, planking and boxes
		Sonneratia spp.	Walling board and firewood
		Derris trifoliata	Fodder for goat

The life expectancy of a coastal prawn culture pond built from cleared mangroves is about five years. Ponds built behind mangroves should have an indefinite life, if management is good. This is because the mangrove forest can be used to soak up nutrients and sediments from prawn ponds. Mangrove tree growth is not stimulated by the availability of nutrients. The addition of organic waste matter from the ponds will have little effect as the mangrove trees grow in anaerobic soils. It requires, respectively, 2 to 20 hectares of mangrove forest to absorb nutrients from one hectare of low intensive to high intensive ponds (Sasekumar and Wilkinson 1994). Thus, well-placed and well-managed coastal prawn ponds located behind mangroves can achieve high economic returns (Sasekumar and Wilkinson 1994).

Mangrove management practices, policies and strategies

Policies for mangrove management are primarily aimed at sustaining their ecological functions and benefits for the national interest. Efforts to manage mangroves have been principally directed to reduce conflicts between environmental degradation and economic development (Atmadja and others 1994).

The Department of Forestry and Local Government is responsible for implementing the policies and strategies regarding the conservation and management of mangrove systems. The fundamental principles are:

(a) To maintain the essential ecological processes and the support systems;

(b) To preserve genetic diversity and ensure the sustained utilization of the species and the ecosystem (Atmadja and others 1994).

Management and conservation: The Government encourages the development of the forestry sector and, through the Department of Agriculture and Department of Forestry, has regulated the cutting of mangrove forests. A 50 to 200 metre green belt of mangrove is required along the coast and 10 to 20 metre along river banks. The green belt serves to preserve the ecological functioning of mangroves in the region. A formula for determining the width of the mangrove green belt in the coastal area has been developed. The proposed formula takes into account the width of the mangrove ecosystem in the area, the slope of the coastline and the tidal range. The formula has been put into effect as an integral part of Presidential Decree No. 32 (July 1990), on the Management of Protected Forest Areas. This formula is applied throughout Indonesia.

Other efforts at conserving mangroves in Indonesia involve the establishment of protected and conservation areas. A number of nature reserves, wildlife sanctuaries, nature parks, natural recreation parks and grand forest parks have been developed in parts of Indonesia to conserve and protect mangrove areas. Currently, there are 13 reserves with the principal aim of protecting mangroves (Soegiarto and others 1982). Mangroves are also found bordering 14 other protected areas where they are of secondary interest. In addition, nine new proposals for mangrove reserves have been approved by provincial governors and a great number of proposals are currently being processed at the Directorate General of Forest Protection and Nature Conservation. Surveys and studies on those proposed sites are now under way, carried out jointly by the Directorate of Nature Conservation, Centre for Research and Development in Oceanology, Centre for Research and Development in Biology, various universities and the World Wildlife Fund of Indonesia. The protected areas will be 30 per cent of the total Indonesian mangrove forest area by the year 2000.

Currently there are only 522,070 hectares of mangrove area under conservation and 614,120 hectares are assigned as protected forest, in total about 28.5 per cent. However, in Sumatra, only 2.6 per cent (365,000 hectares) of the mangrove area is protected. An additional 6.4 per cent (870,000 hectares) is being proposed (BAPPENAS 1993). Generally speaking the protected areas are not effective; poaching and encroaching in the mangrove areas are quite high.

Indonesia has policies relating to mangroves on fisheries and settlement, industry and transport. Environmental impact studies are required to be carried out prior to establishing new settlements and industry, following guidelines provided by the Government. Every development in the coastal zone, including mangrove areas, which may result in damage to the environment must be approved by the Government.

Organization and cooperation: While the principal responsibility for managing mangrove forests is in the hands of the Department of Forestry, research programmes and other relevant activities on mangrove ecosystems are also carried out by a number of government agencies, research institutions and universities. In order to coordinate the activities and efforts of these bodies, a National Mangrove Committee (NATMANCOM) was established in 1980. The committee has some twenty members, representing government agencies and development programmes pertaining to mangrove ecosystems. The membership is reviewed and updated every two years. Some of the committee's activities are as follows:

(a) To coordinate research programmes on mangroves;
(b) To prepare lists of institutions and agencies dealing with mangrove programmes;
(c) To prepare a directory of mangrove scientists;
(d) To compile and update a bibliography on mangrove research in Indonesia;
(e) To organize every four years a scientific seminar on the mangrove ecosystem. The purpose of the seminars is to review the state of knowledge, to evaluate research results and to plan and give directions for future research programmes. So far, five national seminars on the mangrove ecosystem have been organized.

Rehabilitation: One of the positive management activities of the "Perum Perhutani" is the replanting of damaged mangrove forests in Java. More than 5,000 hectares of damaged mangrove forest have been rehabilitated in Cilacap in the last three years (1993). Over 10,000 hectares of disturbed mangrove areas on the northern coast of West Java have also been replanted since 1976.

Developing community-based management: The urgency of developing community-based management of mangrove ecosystems in Indonesia has also been realized as a consequence of a number of internal and external factors, namely:

Internal factors

(a) Conflicting policies on development and conservation;
(b) In some cases, conflicting policies between the central Government and the provincial/local authorities;
(c) Weak enforcement of existing rules and regulations;
(d) Inadequate skills, education and motivation, especially locally;
(e) Increasing population pressure on land and its resources.

External factors

(a) Increasing global awareness of the environment and the importance of community-based and non-governmental organization participation;
(b) Open market and free exploitation and conservation of mangrove lands into prawn and fish culture areas, as well as other uses.

Indonesia is developing community-based management on biosphere reserves (for example, in Gunung Leuser, Aceh Province), national parks and coral reefs (COREMAP). Community residents are being trained to increase their awareness of relevant environmental issues and the sustainability of resources. At the same time, they are being provided with alternative skills to generate income. The community will be given the opportunity to participate in protecting the environment, as well as sustaining the resources of the area.

Constraints in mangrove management: The present constraints in the management of mangroves in Indonesia are as follows (Atmadja and others 1994):

(a) Inadequate enforcement of existing laws, regulations, decrees;
(b) Insufficient resources (equipment, personnel, training);
(c) A lack of coordinated and integrated programmes;
(d) Unfavourable socio-economic and customary law recognition.

Sand mining

Sand mining is also carried out at locations along the Malacca Straits, such as Johor and Riau. The sand production from Riau in 1993 stood at 1.45 million tons. Sand is also exported to Singapore for the reclamation of coastal areas (Statistical Office of Riau Province 1995).

2.3.2.2 Endangered/transboundary/migratory species

A good example are turtles, which are now taken care of by COREMAP, programmes of the Indonesian WWF and others (see table 2.64 below).

Table 2.64 Endangered species protected by law in Indonesia

Natural Resources		Scientific Name
I.	CRUSTACEA	
	Coconut Robber Crab	Birgus latro
	Horse Shoe Crab	Tachipleus tridenta
II.	MOLLUSCA	
	Giant Clam	Tridacna gigas
	Southern Giant Clam	T. derasa
	China Clam	Hippopus porcellamus
	Horse Hoof Bear Paw C.	H. hippopus
	Soffron Coloured	Tridacna crocea
	Small Giant Clam	T. maxima
	Triton's Thrumpet	Charonia tritonis
	Giant Holmet Shell	Cassis carnuta
	Mother of Pearl	Trocus niloticus
	Green Snail	Turbo marmoratus
	Chambered nautilus	Nautilus pompilus
	Scally Clam	Tridacna sqymosa
III.	REPTILIA	
	Leatherback Turtle	Dermochelys coriacea
	Marsh Crocodile	Crocodylus porosus
	Grey Olive Loggerhead	Lepidichelys olivacea
	Red Brown Loggerhead	Careta careta
IV.	MAMMALIA	
	1. Dugong	Dugong dugong
	2. Dolphin	Dolphin & Zipridae
	Borneo white Dolphin	Sousa borneensis
	Bottle-nose D.	Tursiops aduncus
	Idem as above	T. catalina
	Rough Toothed D.	Steno rostratus
	Common D.	Delphinus delphis
	Red Bellied D.	D. roseirostiis
	Malayas D.	Stenella malayan
	Indonesia White D.	Sotalia plumbea
	Plumbeous D.	S. plumbea
	Bick Finiess Porpoisie	Neophocaena phocaenoides
	Little Indian Porpoisie	Neomeris p.
	3. Whale	Cetacea
	Blue W.	Balaenoptera musculus
	Fin W.	B. physalus
	Sef W.	B. borealis
	Minke W.	B. acutorostrara
	Southern Right W.	Eubalaena australis
	Humback W.	Megaptera nova cangliae
	Sperm W.	Physeter catodon
	Beaked W.	Ziphius cavirostris
	Pygmy Sperm W.	Kogia brevicepts
	Killer W.	Orcinus orca
	Pilot W.	Globicephala macrorhynchi
	4. Other Species	
	Black coral	Anthipates sp.

2.3.2.3 Major problems and issues

Degradation of the coastal and marine environment

The factors contributing to the degradation of the coastal and marine environment have been identified as mostly human activities. The rapid development of the coastal zone and population growth have resulted in the present situation. The uncontrolled exploitation of living resources, sometimes using destructive methods, has led to the loss of habitats and species. Many of these living marine resources are being removed at rate far exceeding the natural sustainable levels. With non-living resources, the extraction process itself causes environmental degradation. Nearshore mining activities have often contributed to the erosion of beaches. Coastal waters have been subjected to pollution through the discharge of urban and industrial wastes. To support the physical growth of coastal cities, reclamation of foreshore areas and changes in the coastal geomorphology by man-made construction are common. These changes have impacted further on the marine environment by altering current patterns and increasing the sediment load particularly when water circulation of the area becomes reduced.

Adding to the problem is the spillage from small craft that discharge oily bilge waters. The transport of hazardous substances is another risk factor that needs to be considered. Accidents of this nature at sea, however, have so far been uncommon.

Coastal degradation is much more evident in western Indonesia, especially Java, Bali and parts of Sumatera. Here pollution, over-fishing, coral loss and mangrove destruction have followed the increases in population (for example, in Medan and the Bangka Straits).

Marine pollution

Marine pollution sources are:

(a) Vessel-borne pollution;
(b) Land-based wastes from human settlements; towns near the beach being the main cause of pollution;
(c) Dumping by foreign ships a potential pollution source in the future;
(d) Mining activities at sea.

Marine pollution levels are higher in the coastal waters than in the open seas. This issue is of great environmental concern, particularly with the continuing trend of increasing coastal population. Fast growing coastal cities in the region, many without adequate sewage treatment plans, contribute to the degradation of the coastal waters and shallow marine habitats. Open drainage canals keep pouring effluent and industrial wastes directly into coastal waters.

Red tides, both toxic and non-toxic, cause blooms of dinoflagellates. These have been increasing in frequency and locality within the region. Although the causative factors have not been positively identified, pollution from land-based sources is strongly suspected. The occurrence of red tides has an impact on the mariculture industry as it usually results in fish kills of immense proportions. Paralytic shellfish poisoning caused by eating fish and shellfish during red tide blooms have resulted in fatalities throughout the region and is of growing concern.

The discharge of raw sewage into coastal waters has raised the coliform count to beyond acceptable limits. Shellfish in these areas usually have high coliform counts in their tissues. This increases the risk of exposure to human pathogens and disease transmission.

2.3.2.4 Economic losses because of over-exploitation

The current economic cost of this degradation has been estimated to be in the order of $20 billion. At a national level, direct plus indirect benefits of marine and coastal resources are valued at $96 billion. This $96 billion adds indirect values such as human health, coastal protection and amenity value to the current contribution of marine and coastal resources GDP. Improved management and rehabilitation of resources that could be rehabilitated would increase this value by $20 billion to $116 billion.

Socio-economic and cultural factors affecting biodiversity

Despite the high potential for the development of marine ecosystems and resources, the threats to the sustainable capacity of marine ecosystems to provide resources and environmental services have, in many cases, reached a critical level. Human activities, which threaten marine biodiversity, can be broadly grouped into five categories:

(a) Over-exploitation of living resources;
(b) Physical alteration of coastal and marine habitats;
(c) Coastal and marine pollution;
(d) Introduction of alien species;
(e) Global climate change.

However, these threats are in essence symptoms of more fundamental forces that are causing the degradation of marine biodiversity.

Threats to coastal and marine biodiversity

Fish aggregating devices

Fish aggregating devices are a supplement to fishing gears that are taken to deep waters of more than 200 metres to attract and collect fishes (mainly the big pelagic) such as tuna and skipjack (DGF 1994c).

The placement of a fish aggregatting device is naturally contingent on the presence of pelagic fishes. Common targets are tuna, jacks and mackerel. Channels known to be migratory routes and prone to strong currents are favourite sites. Three dimensional structures are more effective than two dimensional ones. The number and species of fish attracted is related to the number of structures, distance offshore and water depth. Larger fish aggregating device structures attract more fish than small structures and clear water is a positive factor.

Human use (impact)

According to Polovina (1991) the principle functions of fish aggregating devices are the same as fish habitats, fishing grounds, sheltering etc. Fish aggregating devices simply increase the amount of exploitable population available to fishermen without actually increasing population sizes.

Climate change and the marine environment

Hadi (1990), citing from other authors, illustrates that from the measurement of meteorological parameters in the northern hemisphere, from 1890 until 1940, the air temperature has risen between 0.30 degree Celsius to 0.60 degree Celsius. Global warming causes global sea-level rise. Over the last hundred years, the sea level has risen between 10 to 15 cm. With the increase of air temperature, the sea level will continue to increase.

The impact of the climate change upon the marine environment (including the coastal environment) will cause:

1. Coastal inundation;
2. The death of coral animals due to sea water temperature rise.

The complex nature of the marine environment makes it difficult to identify the real cause of damage to the marine environment whether from seawater temperature rise or sea level rise. The occurrences of such marine phenomena as ENSO (El Nino Southern Oscillation), and storm surges or of geological process, such as land subsidence, create uncertainty in deciding the real cause of the damage.

2.3.2.5 Causes including sectoral demands and failures and internal and external market demands

Over-exploitation of the natural resources in the marine and coastal zone, such as coral reefs, mangroves, seagrass and ornamental fishes, will cause destruction and degradation to the marine and coastal ecosystem. In addition, the increasing rate of shipping, some carrying toxic and hazardous materials, could possibly endanger the sea through marine pollution. Transboundary pollution could also be factor.

2.3.2.6 Impacts of global change

If the global warming predictions were to take place, Indonesia may be one of many island countries in the world that would be detrimentally affected by global warming and sea-level rise. This is simply because coastal areas in Indonesia are mostly flat. However, the majority of participants at the focus group discussion were not too concerned with these phenomena. The same perception was also true for other resource persons who were interviewed during the course of this assignment. The reason for this argument is because global warming and sea-level rise will take place in a relatively long-term period.

Environmental threats will either directly or indirectly reduce or degrade marine biodiversity at genetic, species, or ecosystem levels. The most serious and direct threats to coastal and marine biodiversity are the conversion of coastal habitats (for example, mangroves, seagrass beds and estuaries) into man-made land uses, such as *tambak*, industrial estates and settlement; and the harvesting of coastal and marine resources. Indirect threats to marine biodiversity would be in the form of pollution and sedimentation.

2.4 MODIFICATION OF AQUATIC HABITATS

2.4.1 Freshwater

2.4.1.1 Freshwater and coastal wetlands

From January until March 1988 the coastal wetlands and waterbirds along the north coast of eastern Java, including the Brantas and Solo deltas, were surveyed as part of a cooperative project of the Asian Wetland Bureau/INTERWADER and the Indonesian Directorate General of Forest Protection and Nature Conservation (PHPA).

As result of continuous reclamation, most of the original mangrove forest in the survey area has been converted into brackishwater fish ponds (*tambak*). Throughout the survey area the remaining coastal fringe of mangroves has a maximum width of 50 metres. This is much less than the 200 metre wide greenbelt that has been proposed by the Government.

Apart from the coastal fringe, some mangrove vegetation remained along rivers (with a fringe of less than 15 metres), along the dikes of the numerous ponds, and as small patches inside ponds. A total of 98 different bird species were encountered in the area. Despite the poor status of the remaining mangrove vegetation, the surveyed area showed a considerable richness of waterbirds who were using the area for roosting, foraging and breeding. A total of 10 breeding colonies of waterbirds were encountered comprising over 17,500 nests of 13 different species of waterbirds, including Black-headed Ibis, *Threskiornis melanocephalus,* (8 nests) and Nankeen Night Heron, *Nycticorax caledonicus,* (2 nests, probably interbreeding with Black-Night Heron, *Nycticorax nycticorax*). Near Ujung Pangkah (at the Solo delta) a breeding colony of around 10,000 nests was found, representing the most important breeding colony of waterbirds known on Java.

Large concentrations of migratory waders were observed on the intertidal mudflats and sandy sites along the coast and in front of deltas and estuaries. It is estimated that approximately 40,000-50,000 waders visit the survey area every migratory season. A total of 21 different species of waders was observed, including the endangered Asian Dowitchers at the Lembaan Estuary (Solo Delta). This indicates that the main wintering range of this species includes the island of Java.

The Brahminy Kite, *Haliastur indus,* was only observed on three occasions, although it had been reported as very common in the Brantas delta in 1936 by Hoogerwerf. This indicates a considerable decline of the Kite's population within a few decades.

Samples taken of the macrobenthic fauna in the intertidal flats at five different locations revealed an average biomass of 8.7 g/m2 (AFDW). Local variation in macrobenthic biomass, however, was large, with a minimum of 0.03 g/m2 at the Pesisir estuary and a maximum of 36.8 g/m2 at the Wonorejo estuary.

2.4.1.2 Inland lakes and water bodies

No data and information were found for this subject as related to SCS.

2.4.2 Marine

The modification of marine habitats was described in section 2.4.2.1, estuaries and embayments were described in section 2.4.2.2, coral reefs in section 2.4.2.2 and mangroves in section 2.4.2.4. Seagrass beds are described below.

2.4.2.1 Degradation of coral reefs and other coastal ecosystems including beaches, mangroves and seagrass beds

The sustainable capacity of these coastal ecosystems is being subjected to stresses and degradation from inappropriate development activities within the coastal zone itself as well as in the ocean and in the upland areas. The causes of the degradation of these coastal ecosystems are described below.

(a) Coral reef damage is caused mainly by coral mining, the use of explosives (bombing) and poisons to harvest reef fish and other biota, and by sedimentation from upland soil erosion. Based on the percentage coverage of living corals, it was reported that 41.8 per cent of the Indonesian coral reefs are severely damaged, 28.3 per cent moderately damaged, 23.7 per cent in good condition, and only 6.2 per cent in excellent condition.

(b) The conversion of mangroves to other land uses, such as *tambak*, settlement and industrial estates, and the over-harvesting of mangrove timber has resulted in the reduction of their areal extent and quality. The Indonesian mangrove area has decreased from 4.25 million hectares in 1982 to 3.80 million hectares in 1993. An accurate figure for the area is not known since other sources give different numbers (4.25 hectares in 1982 and 3.24 hectares in 1987) (see figure 9).

(c) Sedimentation that increases the turbidity of marine waters has so far had the most deleterious effects on seagrass beds. Heavy coral mining and collection from reef flats, such as on the Seribu Islands and the coast of Bali, have also caused seagrass beds to deteriorate.

(d) Beach erosion is mostly due to inappropriate coastal development or construction. This is a common phenomenon in Indonesia. Other practices that have resulted in beach erosion include the collection of beach sand for construction materials; the construction of airports, hotels, and other structures too close to beaches or in offshore waters; and sand mining.

2.4.2.2 Over-exploitation and unbalanced utilization of coastal and marine resources

Although the exploitation rate of fisheries resources for Indonesian marine waters is currently estimated at 40 per cent of its sustainable potential, there are some marine areas, particularly those with dense population and high industrialization such as the northern coast of Java, the Straits of Malacca, and the Strait of Bali, which have already been over-fished (Naamin and Hardjamulia 1990; Dwiponggo 1991). This is because the distribution of fisheries activities is highly skewed. Most fishermen, in particular the traditional ones who constitute 85 per cent of the total number of fishermen, are concentrated in these coastal areas. Furthermore, owing to high world demand and prices, the utilization rate of penaeid shrimps has been very high, not only in those areas but also in other marine waters including southern, western and eastern Kalimantan, the eastern coast of Sumatra, South Sulawesi, western Nusa Tenggara, and the Arafura Sea. Such an unbalanced utilization is also occurring for other coastal and marine resources, such as seaweeds and mangrove timber.

2.4.2.3 Coastal and marine pollution

A variety of wastes originating from both land- and marine-based activities eventually enter the marine environment. Sources of land-based pollutants include: coastal and upstream agriculture which discharge pesticides, fertilizers and sediment run-off; and urban and industrial development leading to the discharge of untreated wastes and effluent. Sources of marine-based pollutants include: oil and gas related activities resulting in the discharge of drilling wastes, chronic spills and potential major oil spills (tanker accidents, blowouts); and marine traffic accidents resulting in the release of waste and toxic materials. The accumulation of wastes in coastal and marine waters, especially in areas with high population density and industrial activities such as the northern coast of Java and the Malacca Straits, has caused heavy pollution in these areas. This, in turn, could threaten the sustainability of marine living resources and human health. Cases such as the massive fish kills in Jakarta Bay (1986, 1993 and 1994) and in Bontang Bay in 1989, and the Minamata-like diseases found in North Jakarta (DAHURI 1991) indicate such a scenario.

The ever-increasing coastal and marine water pollution is also believed to be one of the most important factors causing harvest failures in brackishwater shrimp production in the last five years in virtually all populated or high industrial development areas including the northern coast of Java, South Sulawesi, and Aceh.

2.4.2.4 Illegal extraction of coastal and marine resources

Illegal utilization of coastal and marine resources include the use of extraction techniques which are forbidden by Indonesian laws and regulation (for example, coral mining, the use of explosives and poisons to catch fish) and illegal fishing by foreign fishermen.

2.4.3 Critical habitats, ecosystems and species of transboundary importance

These are important for:

(a) Sustaining fisheries;
(b) Sustaining regional/global biodiversity;
(c) Protecting those elements sensitive to damage;
(d) Protecting against economic losses associated with degradation;
(e) Proposing interventions.

3. ANALYSIS OF SOCIAL AND ECONOMIC COSTS OF THE IDENTIFIED WATER-RELATED PRINCIPAL ENVIRONMENTAL ISSUES

An underlying assumption of the UNEP Country Study is that biodiversity is valuable, both in general and in its various manifestations. This assumption is consistent with those of all major donor agencies (for example, the World Bank [Goodland 1988]; USAID [Brady 1988]; British Overseas Development Agency [Flint 1990]) and with those of the Government of Indonesia itself (BAPPENAS 1991; MoF/FAO 1991). The Indonesian Country Study, therefore, does not attempt to rationalize this existing policy framework comprehensively. Rather, its aim is to indicate roughly how valuable biodiversity is in the case of Indonesia, thereby providing a context for assessing current expenditure levels on biodiversity conservation and the scale of expenditure that seems likely to be needed to secure and develop the country's biodiversity assets. It is also recognized that valuing biodiversity completely is a complex task and may in principle be impossible because of the uncertainty inherent in some of the assumptions that need to be made. This chapter will therefore draw attention to some of the kinds of value involved and some of the estimates which have been produced in the recent past.

At all stages it should be recalled that the natural systems being valued are both highly complex in themselves, and interact with one another in complex ways, both physically and ecologically. They are therefore able to produce multiple outputs of economic significance, but not all of these outputs can be maximized at the same time. Thus, for example, harvesting a forest for timber may reduce its ability to yield rattan canes or tourism revenues. Moreover, the linkage between ecological processes means that harvesting one system for one output can reduce the yield of other outputs from other systems. Thus, harvesting a mangrove swamp for wood-chips may reduce offshore fisheries and damaging coral reefs can cause the loss of coastal farmlands through erosion.

The main point here is that biodiversity and ecosystem management inevitably involves the need to resolve conflicts of interest among groups wishing to use the resources concerned in contradictory ways. This has profound implications for all aspects of management since it must allow for rational decisions to be made in a way that maximizes both the fulfilment of the basic needs of the people and the sustainable generation of national and local income.

3.1 FORESTRY AND WILD-LIFE MANAGEMENT

Over 100 tree species are harvested commercially to produce about 35 million m^3 of industrial wood annually, supporting a timber industry valued at over US$ 4.5 billion each year (BAPPENAS 1991; ADB/GoI 1992a). This exploitation of the forest estate for wood is based on the Indonesian Selective Cutting and Planning System (TPTI) which is designed to achieve sustainable outputs from areas which are intended to remain under forest indefinitely as permanent production forest (MoF/FAO 1991).

One point to make about biodiversity in forestry concerns the long-term impact of TPTI on the genetic composition of the populations of trees (mainly *Diptercarpaceae*) which are being harvested. The sustainability of TPTI management depends largely on the role of 'mother trees' left after logging, but genetic aspects of the selection of these is very little understood at present (Curran and Soetikno 1991). Moreover, *Dipterocarps* are typically mast-fruiting incidents so the density and fruiting capabilities of the mother trees must also be taken into account. It appears that *Dipterocarps* must often reach a girth higher than that specified under TPTI for mother trees before they seed (Curran and Soetikno 1991).

Rattans or climbing palms are the second most valuable forest product after timber. Rattan exports in 1988 earned Indonesia more than US$ 200 million (Caldecott 1988a; BAPPENAS 1991). Meanwhile, in the mid-1980s wild meat contributed some US$ 100 million annually to the economy of Sarawak, a state in Malaysian Borneo with a population of about 1.5 million (Caldecott 1988b). Comparable figures per person might be expected in much of Kalimantan, Irian Jaya and elsewhere in Indonesia. This was used to derive a value of US$ 12.50/ha/yr, implying a value of US$ 1.25 billion a year for Indonesia's 100 million hectares of forest, approximately equal to annual timber stumpage values (ADB/GoI 1992a). This component is directly related to the biodiversity of forest systems because of the adaptations of prey species to their environment and the acute sensitivity of wildlife population productivity to habitat disturbance (Caughley 1978).

Other products available in Indonesia's forest include fruits, vegetables, nuts, spices, perfumes, seed oils, fodder, anti-microbial agents, other potential pharmaceuticals, pesticides, food colourants, flavours and food preservatives, dyes, adhesives, resins, gums, waxes and latexes. Since many of these products are of high economic value, they can sustain the basic needs of local communities as well as providing commodities for trade and commercial development (see below).

The variety of actual or potential outputs which Indonesia's forests are capable of producing helps to explain the importance to rural communities of access to forest areas from which they can harvest a variety of materials. The timber, rattans, medicinal plants, wild meat and fruits so obtained, without the need for cash, supplement their agricultural production and can make a great difference in terms of the level of real well-being experienced by cash-poor villagers. Since much of the direct use value of forest biodiversity in Indonesia enters the economy at a subsistence level in this way, and is not recorded in national accounts, this makes it hard to calculate the true economic contribution of this biodiversity overall.

3.2 WATERSHED MANAGEMENT

It is hard to distinguish the value of the ecological functions of forests from that of their constituent species collectively. It is accepted that logged forests have a hydrological function capability significantly less than that of intact forest, at least for a few years after logging. Meanwhile, artificial plantation forests are unable to perform ecological services as efficiently as natural forests for a variety of reasons. These include their simplified canopy structure and root systems, and management procedures that necessarily reduce ground vegetation cover (such as thinning, weeding, fire-breaks and synchronous harvesting or defoliation because of pest attack or fire (ERL 1991). This is relevant in that Indonesia had established about 1.5 million hectares of industrial tree plantations by 1980 (mostly *Tectona grandis* and *Pinus merkusii*) and a similar area of non-industrial planted forest (Repetto and others 1989).

These factors imply that Indonesia is correct in emphasizing the protection of natural forests (Hutan Lindung) as the mainstay of its watershed management strategy. These areas are very important in terms of ecological function, but serve another role in maintaining biodiversity assets intact as well. Although the maintenance of over 30 million hectares of protection forest imposes an additional burden on PHPA, the national economic significance of this role cannot be over-emphasized. Damage to protected forest in watersheds causes a deterioration of both water supply and availability patterns downstream.

The economic consequences of extensive forest loss are illustrated by the regional examples of Thailand, the Philippines and Hainan Province of China, with natural forest cover of under 30 per cent, 25 per cent and 15 per cent respectively. These have all experienced serious economic loss from deforestation through a failure of ecological service functions (such as causing floods and droughts), and from the loss of valuable or potentially-valuable wild species, such as reduced wild meat harvests and rattan supplies (ERL 1991).

At present, Indonesia retains some 60 per cent forest cover overall, but in local clearance areas flash-floods are becoming noticeable and even careful logging has a marked impact on subsistence lifestyles in nearby areas, for example by damaging riverine fisheries.

3.3 AGRICULTURE AND AGRO-FORESTRY

Biodiversity can play an important role in helping agriculture to satisfy basic economic needs sustainably. Thus, the genetic diversity of Indonesian rice, cultivated fruit trees and other staples is recognized as of great value, especially in intensively-managed agrarian situations. Much of Indonesia's land area is of low agricultural potential, however, and the country's biological richness can usefully be applied in extensive systems of agriculture. This is particularly appropriate with the growing of diverse, multiple-output tree crops in combination with food-crop systems, an approach to land use called agroforestry. This addresses a central problem in tropical small-farm agriculture in areas with poor soils and wet chemical inputs. An effective solution is shifting cultivation, but this damages soil quality and vegetation cover unless it is practised by very sparse populations which can allow long fallow periods between cultivating each plot of land.

Much of Indonesia has long been inhabited and used by shifting cultivators, but as populations have increased so too has the area of serious damage. This has been greatly aggravated by migrant populations entering and clearing forest areas without having the social means to minimize environmental damage which are typical of long-term resident populations in marginal lands (Dove 1987; Kartawinata and others 1989; Jessup 1991; Li 1991). Where shifting cultivation is no longer viable, higher population densities can, in principle, be supported by incorporating nitrogen-fixing leguminous woody plants within food-crop systems. This basic approach can be developed further by adding economic trees to the woody component, thereby providing diversified perennial cash-crops and raw materials to support other forms of sustainable development (see tables 3.1; 3.2 and 3.3).

Ideally, such systems should make maximum use of existing Indonesian agroforestry practices since this will take advantage of local knowledge and local species adaptations while increasing the overall genetic continuity of agricultural landscapes. Modern agro-forestry provides a powerful model for sustainable agricultural development in the marginal lands of Indonesia, effectively addressing the twin aims of sustainability and the relief of poverty.

3.4 COASTAL SYSTEMS AND WETLANDS

Of all the environmental systems in Indonesia, the coastal zone has the highest concentration of human population, planned development activity and investment, and actual or anticipated pollution and other environmental problems, as well as the greatest density of naturally productive resource systems.

Coastal systems have both a high degree and a high diversity of biological productivity, and these resources support a large proportion of Indonesia's population. These systems are productive partly because this is where the mixing of nutrient and energy flows from the land and the sea occurs. The most valuable living resources are, therefore, in the places where this mixing is most dynamic - in the estuaries and mangrove swamps. These represent areas where intense and sustained harvesting of finfish, shellfish and other resources is possible. These same areas are, however, most vulnerable to pollution or other disturbances which are carried down to the coast by rivers. In an estuarine system, any

such disturbance is multiplied by the impact of other human activities occurring locally, so intense effects can easily be generated. Estuarine systems are thus both highly valuable and highly vulnerable, a combination which demands extreme care in their management. The key values, uses and functions of coastal ecosystems in Indonesia can be summarized as follows (Hamilton and Snedaker 1984; Burgridge and others 1985):

(a) Agro-ecosystems-food production; livestock production; timber products and fuel; fish production;

(b) Fishpond (*tambak*) aquaculture - increased fishery production; increased income and living standards; increased protein consumption per person;

(c) Freshwater system - natural flood control and storage; water supply and recharge; nutrient and sediment sinks; waterbird habitat; food production; building and energy materials;

(d) Beach systems - breeding habitat for birds, sea turtles and other species; recreation; tourism; fishing habitat; timber and fuel; protection from coastal hazards;

(e) Estuarine systems - nutrient influx to coastal waters; fisheries production; nursery and spawning areas for many coastal fish; links to mangroves, seagrasses, pelagic and demersal fisheries;

(f) Tidal swamps - habitat for fish, wildlife and plants; flood storage; links to mangroves; timber and fuel; links to rice culture; fisheries production;

(g) Mangroves - sediment filter; nutrient filter; fishery resource (finfish and shellfish); net transfer oil production to coastal fisheries; breeding and spawning grounds for many coastal species; nursery grounds for coastal and estuaries species; links to seagrass beds and coral reefs; shoreline protection, buffer for tidal swamps; timber and fuel; tannin, alcohol, sugar and other chemicals;

(h) Seagrass beds - nutrient filter; net transfer of production to coastal fisheries; feeding habitat for green turtles and dugongs; nursery grounds for coastal fisheries; links to mangroves and coral reefs; fishery production;

(i) Coral reefs - links to seagrass, mangroves, beaches and coral islands; shoreline protection; beach sand replenishment and production; high internal productivity; shellfish and finfish production; spawning and nursery grounds for fish; tourism and recreation; ornamental species (shells, corals, fish etc); seaweed harvesting; mariculture;

(j) Demersal systems - high productivity in upwelling areas and coastal areas; high prawn and finfish production;

(k) Pelagic systems - high productivity in upwelling areas; high-yielding migratory species.

See further table 3.4: *Wetland in Indonesia*

Table 3.1 Socio-economic impacts of agricultural production

Subregion	Average agricultural production in watershed areas (ton)					Average earnings from production				Number of people involved in the sector	Type of technology used in production		
	1991	1992	1993	1994	1995	1991/1992	1992/1993	1993/1994	1994/1995		Land processing machenery	Pest control machenery	Paddy processor
1. Riau and Batam	363,578	350,610	350,810	378,994	380,160	357,094	350,710	364,902	379,577	-	(a). Two wheels tractors. (b). Four wheels tractors: small, big.	(a). Hand sprayer, (b). Knap sack motor sprayer, (c). Rat Fumigator, (d). Power sprayer	Trasher, dryer, cleaner, polisher, rice milling unit, huller, large rice mill and small.
2. Bangka-Belitung and South Sumatera	1,062,638	1,300,278	1,213,075	1,130,041	1,275,521	1,181,458	1,256,676	1,171,558	1,202,781	-	Idem as above	Idem as above	Idem as above
3. Jakarta West Java	27,474 9,529,451	31,433 10,406,341	28,488 10,453,303	22,956 9,502,006	19,309 10,350,699	29,453 9,967,896	29,960 10,429,822	25,722 9,977,654	21,132 9,926,352	- -	Idem as above	Idem as above	Idem as above
4. East Java	7,985,794	8,338,060	8,365,977	8,039,187	8,312,086	8,161,927	8,352,018	8,202,582	8,175.636	-	Idem as above	Idem as above	Idem as above
5. South Kalimantan	963,936	1,088,242	1,049,082	1,039,455	1,081,177	1,026,089	1,068,662	1,044,268	1,060,316	-	Idem as above	Idem as above	Idem as above
6. West Kalimantan	490,392	529,336	569,082	571,143	626,136	509,864	311,003	570,112	598.639	-	Idem as above	Idem as above	Idem as above

Sources:
1. Central Bureau of Statistics, 1994-1995. Agricultural Survey Production of Paddy in Indonesia. Jakarta.
2. Central Bureau of Statistics, 1994 Agricultural Survey, Agricultural Machenery By Province and District. Jakarta.

Note : - : No data

Table 3.2 Socio-economic impacts of public health

Subregion, Watershed area	Ranking of major diseases including water-borne diseases	Average number of reported cases for each disease (Morbidity rate per 1000)						Average number of deaths for each disease (Case Fatality Rate-CFR %)					
		1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995
1. Riau and Batam	Diarrhea and vomiting	17.78	25.23	18.24	19.19	22.71	18.68	0.080	0.170	0.004	0.010	0.096	0.010
2. Bangka-Belitung and South Sumatera	Idem as above	9.50	27.55	27.57	21.98	23.24	19.69	0.100	0.030	0.030	0.019	0.060	0.020
3. Jakarta		18.60	18.00	13.24	15.01	12.39	13.37	0.000	0.000	0.002	0.000	0.002	0.003
West Java	Idem as above	36.49	40.35	31.87	40.17	39.66	27.04	0.100	0.010	0.002	0.004	0.004	0.009
	Idem as above												
4. East Java	Idem as above	34.30	28.10	32.29	50.75	44.46	40.38	0.010	0.010	0.002	0.000	0.002	0.002
5. South Kalimantan	Idem as above	24.83	26.24	19.82	18.28	17.55	12.08	0.210	0.100	0.018	0.025	0.026	0.006
6. West Kalimantan	Idem as above	8.27	20.21	15.48	19.03	23.02	21.75	0.150	0.080	0.021	0.008	0.031	0.003

Source :

1. *Ministry of Health, Republic of Indonesia (1996)*
2. *Central Bureau of Statistics (1998)*

Table 3.3 Socio-economic impacts of infrastructure

Subregion, Watershed area	Type and location of infrastructure affected by water-related processes				Cost of damage or repair per infrastructure	Socio-economic impact of infrastructure damage
	Type of natural disaster	Destruction	Year	Location		
1. Riau and Batam	Flood	Settlement and agriculture	1996/1997	Batam, Bengkalis, Indragiri Hulu, Indragiri Hilir,	Housing : 11,578 (Rp 18,159,264,000)	Human loss
	Land slide	Idem as above	1996/1997			
2. Bangka-Belitung and South Sumatera	Flood	Idem as above	1996/1997	Ogan Komering Ulu, Musi Rawas, Lahat.	Housing : 536 (Rp 3,843,452,000)	Material loss
	Land slide	Idem as above	1996/1997	Musi Rawas		
3. Jakarta	-	-	-	-	-	-
West Java	Flood	Idem as above	1996/1997	Purwakarta, Kuningan.	Housing : 16,474 (Rp 70,366,583,000)	Loss of jobs
	Land slide	Idem as above	1996/1997	Cianjur, Sukabumi		
4. East Java	Flood	Idem as above	1996/1997	Tuban, Lumajang, Sukabumi	Housing : 5,498 (Rp 2,721,083,000)	Isolation for other areas
	Land slide	Idem as above	1996/1997	-		
5. South Kalimantan	-	-	-	-	-	Increase of daily needs prices
6. West Kalimantan	-	-	-	-	-	Agriculture support destruction

Source:

1. Ministry of Social Welfare: Operational Map of Disaster (1998)

2. Ministry of Social Welfare: Annual Report (1996/97).

3. Ministry of Social Welfare: Destruction Occurrences Data and Steps of Problem Solving (1995/96)

Note: - : No data.

Table 3.4 Wetlands in Indonesia

ISLANDS	CATEGORIES	LAND AREA		NATURAL WETLANDS (NA)											ARTIFICIAL WETLANDS						TOTAL (NA) WETLANDS
		TOTAL (NA)	(%) ind	PEAT SWAMP	FRESH-WATER SWAMP	MAN-GROVE FOREST	CORAL REEF	SEAGRASS BED	BEACH VEGETATION	MUDFLATS AND GFLAT	LAKE	ESTUAR	RIVER	SUB TOTAL NATURALW	FRESHWATER POND	DAM/RESERVE	PADDY FIELD	BRACKISH POND	SALT PAN	SUB-TOTAL ARTIFICIALW	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SUMATRA	Original area	47,348,100	25	7,282,000	4,890,000	857,000	na	na	13,000	na	370,043	na	na	13,412.043						0	13,412,043
	Remaining area			4,613,000	1,090,000	485,025	na	na	7,000	na	na	na	na	8,195,025	55,533	na	2,787,317	43,514	na	2,888,364	9,081,389
	Proteced area			341,000	253,000	61,900	na	na	2,000	na	na	na	na	857.900						0	657,900
JAWA BALI	Original area	13,774,700	7	0	72,000	171,500	na	na	na	na	8,270	na	na	249,770						0	249,770
	Remaining area			0	4,500	18,577	na	na	na	na	na	na	na	24,077	34,878	na	5,329,045	109,013	na	5,472,936	5,497,013
	Proteced area			0	1,250	2,600	na	na	na	na	na	na	na	3.850						0	3,850
MUSA TENGGARA	Original area	8,292,700	5	0	4,000	38,800	na	na	19,000	na	6,041	na	na	67,841						0	67,641
	Remaining area			0	2,000	25,300	na	na	4,500	na	5,000	na	na	38,800	4,821	na	445,216	5,207	na	455,244	492,044
	Proteced area			0	0	2,500	na	na	0	na	500	na	na	3,000						0	3,000
KALIMANTAN	Original area	53,946,000	28	4,413,000	3,895,000	1,092,000	na	na	8,000	na	114,231	na	na	8,522,231						0	9,522,231
	Remaining area			3,531,000	1,717,000	353,450	na	na	3,000	na	92,000	na	na	5,698,450	29,122	na	1,032,448	9,370	na	1,070,940	6,767,390
	Proteced area			257,000	362,000	78,000	na	na	2,000	na	25,000	na	na	724,000						0	724,000
SULAWESI	Original area	18,921,600	10	44,000	282,000	272,500	na	na	65,000	na	159,871	na	na	823,371						0	823,371
	Remaining area			34,000	66,000	84,333	na	na	25,000	na	96,000	na	na	305,833	30,862	na	1,111,569	82,394	na	1,224,825	1,530,858
	Proteced area			0	2,500	6,300	na	na	3,600	na	3,300	na	na	15,700						0	15,700
MALURU	Original area	7,450,500	4	48,000	46,000	197,500	na	na	39,000	na	3,438	na	na	333,838						0	333,938
	Remaining area			42000	21,000	100,000	na	na	15,500	na	na	na	na	178,500	na	na	11,622	39	na	11,661	190,161
	Proteced area			1,000	5,500	21,500	na	na	8,700	na	na	na	na	36,700						0	36,700
JAVA	Original area	42,198,100	22	8,910,000	2,355,000	1,500,000	na	na	36,000	na	115,000	na	na	12,918.000						0	12,918,000
	Remaining area			8,753,000	2,285,000	1,382,000	na	na	23,000	na	115,000	na	na	12,558.000	na	na	16,573	68	na	16,841	12,574,641
	Proteced area			1,283,000	360,000	508,100	na	na	17,000	na	45,000	na	na	2.213.100						0	2,213,100
INDONESIA (NA)	Original area	191,931,700	100	20,697,000	11,544,000	4,129,100	na	na	180,000	na	774,394	na	na	37,324.884	0	na			na	0	37,324,894
	Remaining area			16,973,000	5,185,500	2,450,185	na	na	78,000	na	308,000	na	na	24,994.685	155,216	na	8,393,290	304,623	na	8,853,129	33,847,814
	Proteced area			1,882,000	984,250	680,900	na	na	33,300	na	73,800	na	na	3,854.250	0	na			na	0	3,654,250

Compiled by Wetlands International from these sources as at 1996

1,2 Central Bureau of Statistics (1994)

3,4,8 Silvius et al (1989)

5 Original and remaining area (Giesen, 1993); protected area (Silvius et al. 1989)

10 Remaining area, protected area and all data for Irian Jaya (Silvious, 1989); Original area including floodplain (Giesen, 1994)

14,17 Central Bureau of Statistics (1992)

16 Kompas, 7 July 1995

Notes: 6,7,9,11,12,15 Data not available

13,19,20 Automatic calculation of available data

na Accurate data not available

4. ANALYSIS OF THE ROOT CAUSES OF THE IDENTIFIED WATER-RELATED ISSUES

As can be seen from the following matrices, from both the water-related issues or problems with transboundary consequences and from the generic water-related issues/problems with transboundary causes and single country impacts (see table 4.1), the root causes are all fundamental in nature, such as: environmental awareness and its control, inappropriate technology or absence of environmentally sound and sustainable development countermeasures, absence of treatment plans to reduce pollution and degradation problems, human failures and lack of integration and coordination in law enforcement.

Water-related issues and problems with transboundary consequences are found in the waters shared with neighbouring countries, such as the Malacca-Singapore Straits in general. Possibilities for broader impacts are generated in the Java Sea bordering Sumatera, Java and western and southern Kalimantan. In the Malacca Straits, shared by the three coastal States of Indonesia, Malaysia and Singapore, the issues and problems mostly originate from oil pollution because of the heavy volume of ships passing through the Straits and other related offshore prospecting activities. All these activities could create issues and problems in the form of oil pollution, sedimentation and heavy metal contamination. Offshore activities contribute to the degradation of critical habitats.

Sedimentation from both land-based sources through rivers and from the sea itself in the form of sea-based sources could decrease turbidity, reduce light penetration into the sea and affect photosynthesis causing a decrease in primary production. The impacts on coastal habitats, such as mangroves, seagrasses, coral reefs and other biotas, will affect their growth and propagation, including the growth of benthic communities. Furthermore, silt particles in the water column trap heavy metals, chlorinated organic pesticides and bacteria and could pose serious threats to the health of humans and ecosystems. Bio-accumulation in such an area could affect species composition, resulting in the disappearance of some species and the appearance of undesirable ones. The degradation of critical habitats will be seen mainly in soft bottom habitats, coral reefs, seagrass beds and mangroves swamps. In general, the major environmental concerns along the eastern coast of Sumatera or in the waters of the Malacca Straits are: oil and chemical spills, harmful algal blooms and fish kills, fecal coliform contamination, tributil tin (TBT) contamination and heavy metal pollution, and sedimentation.

Table 4.1 Indonesia Causal Chain Analysis

Water Related Environmental Issue	Impact Zone (Specific geographic Zone)	Source	Causal Chain			Socio-economic Impacts	Action
			Immediate	Intermediate	Root cause		
Oil	E. Sumatera Jakarta Bay	Tankers ballast water discharge Operational discharges Accident Offshore rig accident discharges	International and national shipping Human error Offshore prospecting & exploitation	Lack of Port Reception facilities Lack of control to adequate navigational aids	Lack of investment In Progress with International Conventions Financial constraints	Loss of tourist and recreational value Damage to fish traps especially by tar balls Degradation of mangroves, coral reefs habitats loss of fisheries production	Provide port reception facilities Enforcement of existing legislation NCP & SOP implementation Upgrade local SOP
Litter/Solid Waste (Plants, bottles, polystyrene, paper products wood)	All "hotspots"	Urban waste disposal	Direct dumping Erosion from coastal dump sites	Inadequate facilities for volumes of waste Poor siting of land fill and dump sites	Inadequate planning of solid waste disposal Absence of recycling facilities Lack of law enforcement Inadequate waste collection systems Poor practices, inadequate public education	Loss of tourist and recreational value Damage to fish gear/traps loss of fisheries production & revenue	More & better planned disposal sites Provision of incentives to recycle Law enforcement Public participation & Education

Increased Sediment loads	Whole coast	Forestry Agriculture Dredging of ports harbours & navigational channels Reclamation and coastal construction (Engineering)	Poor land use practices Inappropriate technology Inappropriate standards & controls	Inadequate regulation enforcement	Lack of capacity Lack of investment Inadequate legal and administrative framework	Loss of tourism revenue Loss of fisheries production and revenues	Increased Investment Development and adoption of construction standards Public Education Improved land use planning Adoption of sustainable agricultural practices
Heavy Metal Domestic	Jakarta Surabaya Batam Pontianak Banjarmasin	City pipes Canals Rivers	Organics	River Estuary	Absence of sewage system	Disease, fish kills financial constraints	Innovative methods of sewage disposal environmentally sound technology
Harmful Algal Blooms	Jakarta S. Sumatera	Nitrate	Toxic Algal Blooms Red Tides	Estuaries & Bays	Nutrients into the sea	Fish kills Sickness	Reduce nitrate & phosphate entering sea

As described in the previous sections, oil in the Malacca Straits forms the greatest problem because of the transportation of tankers with 3.23 million barrels of crude oil/day through this navigation channel. Oil spills increased from 2 per cent in 1976 to 9 per cent in 1993 (Malacca Strait Report).

From another point of view, the impact of oil pollution on marine fisheries results in a degradation of spawning grounds and a reduction in fish stocks and a falling demand for fish products from the affected areas.

It could also be seen from table 4.1 that the root causes are also perhaps the same fundamental issues: weak environmental awareness, absence of sewerage systems; absence of environmentally sound technology; and the lack of law enforcement, even though many rules and regulations are already in existence.

5. CONSTRAINTS TO ACTION

The roots of the problems that cause the degradation of marine biodiversity include the following socio-economic and cultural factors.

5.1 FINANCIAL CONSTRAINTS ON DEVELOPMENT

In many cases, current sectoral management approaches are not promoting the efficient use of resources. The sectoral emphasis upon single-purpose uses generally precludes the consideration of economic impacts on other sectors. Potential losses in economic productivity are seldom fully assessed until these losses become apparent. For example, appropriate coastal engineering practices have caused significantly increased dredging costs at some ports and harbours, and in some cases the obstruction of shipping lanes as a result of ship groundings. As a second example, critical water shortages have occurred in some project areas involving a mix of aquaculture and agriculture, thereby threatening ongoing project viability.

Lack of coordination and cooperation among sectoral agencies has led to duplication of effort in such areas as data gathering and the enforcement of regulations. The problem is particularly pressing because the costs of data-gathering and enforcement in marine-based operations are generally much higher than in land-based operations. Given the severe government financial constraints, it will be crucial to explore activities, such as the gathering of oceanographic data and the enforcement of fisheries regulations, where greater inter-agency coordination of efforts will lead to cost savings.

Owing to financial constraints, infrastructure in coastal communities is underdeveloped; as a result the resource base available to coastal communities is often under-utilized. In particular, the transportation links between many islands, and between coastal areas and inland districts, are often poorly developed hindering the marketing of products. Problems caused by the lack of infrastructure have been compounded in some cases by limited operating and maintenance funds. Selective investment in new government infrastructure may be essential to remove marketing bottlenecks. It will be critical, however, to ensure that this new investment makes a definite, positive contribution in terms of payback, and to explore more cost-effective alternatives, such as the rationalization of existing infrastructure or the deregulation of shipping activities.

5.2 RAPID POPULATION GROWTH IN COASTAL AREAS

The coastal zone supports a large variety of critical coastal ecosystems that are essential for the maintenance of diverse marine resource bases. The coastal and marine areas bring together a wide spectrum of natural resources that are dependent on the well-being of highly diverse, productive and complex coastal and marine ecosystems including mangroves, seagrass beds and coral reefs. In addition, the coastal zone also provides a strategic location for industry, commerce, tourism and settlement. As a consequence, most of the Indonesian population (65 per cent) presently lives within the coastal zone.

5.3 LACK OF POLICY IMPLEMENTATION

As a result of focus group discussions, interviews, literature reviews, and the PAS own experiences and knowledge, many laws and regulations relating to the management of marine resources utilization on a sustainable basis have been promulgated. Unfortunately, these laws and regulations are mostly not implemented. This is due mainly to poor law enforcement, sectoral egoism and lack of coordination.

Because the enforcement of most laws and regulations relating to the management of sustainable marine resource use are in the form of sanctions (punishment) and rewards are weak or frequently inconsistent, there are no incentives for an individual or a community to apply them. Lack of coordination and cooperation (egoism) among sectoral agencies or between central and regional governments has led to duplication of efforts in such areas as data gathering, project implementation and the enforcement of regulations. In addition, this lack of institutional coordination and cooperation has created resource use (development) conflicts. For example, the conflict between mangrove area conservation versus golf course and real estate development at Pantai Indah Kapuk near the Jakarta International Airport, conflict between traditional fishermen versus trawlers prior to 1980, and between conservation versus tourism in Seribu Island Marine Park. All of this in turn results in a lack of policy implementation.

5.4 COASTAL POVERTY

Environmental degradation, which threatens marine biodiversity, is a result of both industrialization and poverty. This is especially true in developing countries like Indonesia where poverty is still lingering on in the majority of coastal communities. Poor people within the coastal areas have generally no alternative livelihood so they are forced to exploit resources and environmental services from ecologically marginal coastal and marine ecosystems.

5.5 LACK OF AWARENESS OF THE STRATEGIC IMPORTANCE OF COASTAL AND MARINE RESOURCES FOR SUSTAINABLE ECONOMIC DEVELOPMENT

The majority of planners, decision makers and resource users in Indonesia perceive renewable coastal and marine resources, such as fish and mangroves, as less valuable than non-living resources such as oil and gas and other minerals. Mangroves, seagrass beds and coral reefs are examples of coastal ecosystems that are undervalued for their environmental goods and services and ecological functions. As a result the conversion of these ecosystems into man-made land uses has taken place throughout the country.

5.6 LACK OF POLITICAL WILL TO APPLY SUSTAINABLE DEVELOPMENT PRINCIPLES IN MARINE RESOURCE UTILIZATION

Sustainable development of coastal and marine resources requires the maintenance and enhancement of the carrying capacity of coastal and marine ecosystems in providing environmental goods (natural resources) and services. Since these environmental goods and services are regarded by most Indonesian people as of relatively low value, there will be a lack of political will to maintain them for sustainable development.

5.7 LACK OF RECOGNITION OF LOCAL RIGHTS AND INDIGENOUS KNOWLEDGE, COMMUNITY-BASED PARTICIPATION, AND EMPOWERMENT TO LOCAL GOVERNMENT

So far most coastal and marine programmes and projects were based on the top-down approach. Very few programmes or projects on coastal and marine resource development have been initiated and managed by local coastal communities themselves. This approach is believed to be the main factor that has resulted in the unsustainable development of marine resources in the country.

5.8 LACK OF INTEGRATED APPROACHES IN COASTAL AND MARINE RESOURCE DEVELOPMENT

Most coastal and marine resource development programmes or projects were carried out based upon a sectoral approach. This was caused by a lack of manpower that has the ability to develop and implement integrated coastal and marine resource development plans in both central and regional government institutions. In addition there are no working models that can demonstrate that the integrated coastal and marine resource management approach is indeed more beneficial than the sectoral approach.

5.9 LACK OF CAPABLE HUMAN RESOURCES

In general there is a lack of manpower with the necessary skills to carry out coastal and marine resource inventory and environmental assessment; to formulate integrated marine resource planning and management; to implement, monitor and evaluate such an integrated plan; and to enforce regulations. There is also a lack of technical and managerial skills in integrated coastal and marine resource planning and management on the part of local community organizations and in the private sector. Furthermore, there is a skewed distribution of skilled manpower, with most of it being concentrated in Java. Shortages of skilled personnel, particularly in the outer islands, make it hard to decentralize planning and management functions of coastal and marine resource development to levels where development initiatives are implemented, and to develop resources in response to regional or local needs.

This lack of capable manpower is due mainly to: (a) the absence of education and training programmes which focus specifically on integrated coastal and marine resource management; (b) the lack of integrated, interdisciplinary approaches in marine sciences and fisheries education and training programmes; (c) inadequate preparation in the basic sciences such as mathematics, physics, chemistry and biology; and (d) a lack of coordination among agencies in delivering effective extension programmes on integrated coastal and marine resource management.

5.10 LACK OF INFORMATION AS A BASIS FOR RATIONAL AND OPTIMAL MARINE RESOURCE MANAGEMENT

Information is a fundamental prerequisite for rational and effective planning and management of sustainable coastal and marine resource development. Although the basic components of coastal and marine databases are currently available, there are many deficiencies. In many cases, existing data are contained in manual systems, particularly at the provincial and district levels, which makes retrieval, analysis and dissemination difficult. Analysis is also made difficult by the lack of data in a database system that suits the need of coastal and marine resource management. There is insufficient baseline information on key biophysical and socio-economic-cultural aspects that are needed for the planning and management of sustainable marine resource development. Accessibility for the public to obtain data and information regarding coastal and marine resources, especially those categorized as secret/security data, is still very low. Finally, although there is sufficient data and information, very rarely do middle managers and top managers in most government agencies use the available information as a basis for planning and decisions in marine resource development. The majority of planners and decision makers still use "management by feeling approaches" instead of rational management approaches in marine resource development.

6. ONGOING AND PLANNED ACTIVITIES RELEVANT TO THE IDENTIFIED ENVIRONMENTAL ISSUES

Like many other countries, Indonesia's first 25-year development plan, launched in 1968, was based on economic growth, political and monetary stability and equity. Issues of environmental quality and sustainability represent a more recent addition to Indonesia's development concerns.

Indonesia first demonstrated its commitment to the environment when it established the State Ministry for Development Supervision Environment in 1978. It became the State Ministry of Population and Environment in 1983 in accordance with Act No. 4/1982 which defined the Ministry as the institution responsible for the management of the environment at the national level. In 1993, the agency became the State Ministry of Environment. The first legal policy on environmental management was the enactment of Act. 4/1982 on basic provisions for environmental management, revised by Act No. 23/1992 on the regulation of the environment. Since then, many regulations have been established to ensure environmental management and sustainable development. Conceptually, the idea of sustainable development is embodied in the State Policy Guidelines of 1993 and the National Guidance Act of 1945 which stated that "The use of natural resources has to be done in a rational, optimal and responsible way, taking into account the carrying capacity, and aiming at the utmost welfare of the people and sustainable function and balanced use of the environment towards sustainable development".

6.1 NATIONAL PROGRAMMES AND ACTIONS FOR LAND-BASED AND SEA-BASED POLLUTION CONTROL

6.1.1 Environmental impact assessments

Environmental impact assessments (EIAs) are mandated by Government Regulation No.51/1993, which functions as a decision-making instrument regarding the feasibility of a certain enterprise or activity by observing the impact on the environment from the first phase of planning.

6.1.2 PROKASIH (Clean River Programme)

This programme aims to raise the quality of river water to meet the standard of water quality is accordance with its respective uses. From 1989 to 1993/1994 Clean River Programme activities dealt

with 31 rivers in 13 provinces. Operational realization of the Clean River Programme has been effected by the regional administration through a Prokasih team established by the provincial government.

The Clean River Programme is the foundation for local and regional government enforcement actions regarding industrial effluent in the most industrialized provinces. It could be mentioned here that perhaps all of the rivers beyond this programme could be stated as pollution hot spots (see table 1).

6.1.3 Small-scale industries impact control

Some small-scale activities produce waste that pollutes the environment. For example, traditional gold mining produces waste with a high organic content and toxic and hazardous waste. Because small-scale industry has financial constraints, the Government has extended its assistance in dealing with the control of waste.

6.1.4 Environmental damage control

Environmental damage often occurs during mining activities. Uncontrolled sand and gravel mining in rivers may cause sedimentation and erosion.

6.1.5 Marine and coastal pollution control

Marine and coastal pollution will reduce the potential of marine and coastal resources in supporting the development of Indonesia. The disposal of waste and chemical and oil spills creates a number of problems.

To address the problems, the following programme has been designed and implemented:

(a) Port and hazardous pollution control programme;
(b) Clean tourism programme for coastal areas;
(c) Development of an environmental impact management system for oil spills (National Contingency Plan for Oil Spills).

6.1.6 Hazardous waste management

This has included the construction of facilities for a hazardous waste management centre in some provinces in Indonesia and the implementation of emergency response systems in industries. Other waste programmes include the "Clean Up" programme, the minimization waste programme, the development of regulation, and the development of public awareness.

6.1.7 Clean City Programme (ADIPURA)

The Adipura Award is presented by the President to those cities and their people who have successfully maintained the cleanliness of their cities based on criteria determined by the central Government.

6.1.8 Cleaner production development

The intention of this programme is to prevent and to reduce the waste of resources in the production cycle. The goal of this programme is "zero emission" together with ecolabelling/ISO 14.000. The programme concentrates on the industrial sector, but it is expected to be available for other sectors in the future.

6.1.9 Implementation of coastal spatial layout and land use plans

Coastal spatial layout and land use plans should be based on the following process:

(a) The planning and development objectives of each sector must be clearly designated. To achieve the objectives, good coordination, integration and synchronization between various activities is needed;

(b) Spatial layout and land-use allocation and the establishment of national coastal area management plans for many users should be based on an integrated decision-making process.

6.1.10 Establishment of national coastal water quality standards

Indonesia is currently in the process of establishing coastal water quality standards. Initial drafts indicate that these standards will be based on the beneficial use of the coastal zone for:

(a) Protection of marine life;
(b) Protection of human health from the consumption of marine fish and shellfish;
(c) Protection of recreational uses;
(d) Aesthetic considerations.

It is recommended that beneficial use be designated and that the standards be based on the type of use for which the areas is designated. For example, if an area is designated as a "recreational use area" then the standards applying to it would be less stringent than a 'preservation use area' but more stringent than an "industrial use area".

In addition, it recommends that because of the difficulty and expense involved in monitoring coastal zone areas, only a few selected key parameters be included in the standards.

More recently, the Government launched "Ten national steps towards environmental management and sustainable development" which will serve as broad guidelines for Indonesian environmental policies and strategies:

(1) Protect the environment;
(2) Consider the carrying capacity of the environment;
(3) Raise the environmental quality;
(4) Actively protect and benefit from the diversity of flora and fauna;

(5) Coordinate and integrate human, environmental and man-made resources into environmental management strategies and policies;
(6) Optimize efforts towards regional spatial management;
(7) Normalize environmental functions by reducing the risk of environmental damage and pollution;
(8) Increase community participation;
(9) Anticipate and rely on environmental and economic information systems;
(10) Utilize science and technology in environmental management and environmental law enforcement.

In recent years Indonesia has made significant progress towards the formulation and implementation of sustainable development principles as covered by Agenda 21, as reflected in the national strategies and policies adopted and in its constant institutional development efforts.

Integrated management and sustainable development of coastal and marine areas, as described in "Agenda 21 - Indonesia" 1997 (A National Strategy For Sustainable Development) as a response to Agenda 21 - Rio de Janeiro 1992, has been incorporated into Indonesia's Fifth Five -year Development Plan.

In the Fifth Five-year Development Plan, many of the development activities take place in coastal areas. Population growth, export demand and per capita consumption all increased the use of coastal area marine resources. In 1992, fish production was 3.5 million tons, equaling 53 per cent of MSY of 6.6 million tons. It is predicted that by 2000, this will increase to 4.25 million tons, and by 2020 to 6.04 million tons. However, this will also cause an increase in pollution. Waters off the Surabaya coast show the existence of large volumes of domestic and industrial waste, and the water quality is reported to be the second most polluted in Indonesia, after Jakarta Bay.

However, the coastal communities have not yet gained any significant benefit from development in these areas. On the contrary, other communities and agencies from locations far from the coast tend to enjoy the benefits. Therefore, the development of coastal villages should pay more attention to the regional social, economic, cultural and environmental conditions.

In Indonesia, there are 116 small islands and groups of small islands that are ecologically susceptible, particularly because of global warming and natural disasters. The potential result is a decrease in the numbers of living creatures, animals and human beings that inhabit the islands. Small islands typically have large numbers of endemic species and high levels of biodiversity consisting of valuable and protected species.

Indonesian waters are frequently navigated by both foreign container ships and fishing boats. Law enforcers face problems preventing ship traffic which is protected by agreements. Relatively weak control in eastern Indonesia creates other problems in dealing with the frequent violations, such as the disposal of toxic and hazardous waste and trespassing in the catchment zone of various biotic and non-biotic resources.

This situation requires better management of coastal and marine areas, especially institutional integrity and competence so that resources found in these areas may become prime products in the development of Indonesia in the future.

The following programme areas have been designated to deal with these issues:

A. Integrated planning and resource development in coastal zones;
B. Monitoring and protecting coastal and marine environments;
C. Utilizing marine resources sustainably;
D. Enriching and empowering coastal communities;
E. Developing small islands sustainably;
F. Maintaining security of the exclusive economic zone (EEZ);
G. Managing the impacts of climate change and tidal waves.

6.2 SHIPPING AND MARINE PORT ACTIVITY

Except for Jakarta, Surabaya and Belawan, few physical improvements have been made to the port system over the last 25 years. Most commercial ports are, therefore, not equipped for the introduction of modern technology and efficient cargo handling methods.

In many marine and coastal areas, direct discharges of ballast water, raw sewage and solid waste is taking place. Resources and ecosystems found in coastal areas are vulnerable to damage from these discharges. In some cases, the locations of the most vulnerable resources are unknown, so that these resources cannot be protected.

6.3 INDUSTRY AND HYDROCARBON POLLUTION

Oil industry activities include extensive offshore exploration and production, heavily used tanker routes serving Pacific Rim nations, refineries and large-scale terminal operations. Each of these operations can result in a major oil spill. However, few marine and coastal regions have either contingency plans or response capability. In 1982, legislation was enacted requiring proponents of oil sector related development projects to produce oil spill contingency plans for site specific oil and gas activities. A national oil spill contingency plan has not yet been developed.

Onshore petroleum facilities, such as refineries, can affect local ecosystems through the chronic discharge of pollutants, air emissions, the conversion of lands to industrial use, the impacts associated with community development, and other effects. Where chronic pollution leads to tailing or mortality of commercial species, local fishing income and food sources may be lost.

6.4 FISHERIES AND OVER-FISHING

Over-fishing in some areas (the Malacca Straits and the northern coast of Java) appears to be the main constraint to fisheries development, but habitat destruction and coastal pollution have also become significant. While the over-exploitation of fish stocks near densely populated coastal communities could limit production objectives, reduce incomes and result in higher unemployment, the destruction of mangrove forests and coastal wetlands (swamps) has already eliminated important marine nurseries. This loss is serious because 60 to 80 per cent of commercially valuable marine fishery species use wetlands, estuaries, and other areas near the ocean shorelines as spawning, nursery and foraging grounds at some point in their life cycles. Coastal habitats are also degraded by land-based pollution discharges (by far the most significant pollution source), but too little is known about their fate or impacts.

Other problems constraining the development of fisheries include inadequate infrastructure, marketing and distribution facilities, shortage of capital and credit, insufficient skilled manpower, and the generally inefficient technology of production units.

6.5 CORAL MINING AND DEGRADATION OF CRITICAL HABITATS

Coral reef mining leads to a direct loss of coral from extraction; to the smothering and killing of nearby coral animals with particulates and debris; to a weakened reef structure which is susceptible to slumping and damage from storms; and to changes in the composition of the ecosystem through the introduction of bacteria and other harmful organisms.

There is extensive evidence that current levels of reef mining cannot be sustained. Reef communities are unable to generate new coral at a rate equal to the economic rates of exploitation. Coral mining on a significant scale is, therefore, a process of reef removal rather than sustainable harvest.

Coral reefs are vulnerable to many pollutants, especially to the effects of combinations of pollutants. Reefs may thus be susceptible to damage from the drilling wastes of offshore oil and gas operations. Coral reefs are also affected by such destructive and widespread practices as the use of dynamite, carbide bombs and various forms of poisons to catch reef fish.

6.6 AQUACULTURE AND OTHER OFFSHORE ACTIVITIES

The major policy issue regarding aquaculture is the extent to which new *tambak* development should be allowed on new sites at the expense of coastal ecosystems (tidal swamplands and mangroves) that support other coastal resource uses (fisheries, forestry).

Aquaculture operations are vulnerable to upstream activities such as poor forestry or agriculture practices that cause large quantities of sediment and silt to be carried downstream to fill in *tambaks* and associated watercourses. Upstream developments such as dams can seriously alter water flow regimes, thereby impacting downstream aquaculture operations. Upstream use of fertilizers and pesticides and industrial discharges of toxic compounds, heavy metals and other wastes affect water quality and toxicity. Aquaculture operations are also sensitive to oil spills from offshore oil and gas activities.

Aquaculture has been constrained by a lack of investment in cage technology. There is also a need to explore the appropriateness of proven foreign technology which may be more economically and environmentally attractive than expanding *tambak* operations. The lack of appropriate hatchery technology and training has also been an impediment to increased aquaculture production.

6.7 COASTAL FORESTRY AND ENVIRONMENTAL DEGRADATION

If coastal forests are over-harvested, the vegetation cover may change and, once disturbed, may not regenerate. Unregulated cutting of large mangrove and swamp forests, especially near the estuaries of major rivers, has created dense thickets where the natural forest regeneration process has been severely impaired. Over-exploited areas may be subject to additional environmental changes. Where mangrove forests are removed, salt may intrude into coastal groundwater, salinating the land and habitats for a wide range of coastal species. Other physical changes may also result. While the role of mangrove forests in coastal ecosystems is only partially understood, the importance of swamp forests to coastal fisheries is documented. Large areas of tidal swamp forests have been reclaimed in the past century for transmigration and irrigation, particularly for rice production.

Engineering works, such as road construction, canals or water diversions, which block or alter water circulation patterns, also affect coastal forests. The ecosystems of coastal forests are intimately linked to upland and coastal influences, and these links can be positively exploited if management is sensitive to the needs of the different ecosystems.

Coastal mangroves forests are particularly vulnerable to marine pollution, especially offshore oil spills. Past spills have had long-term effects on trees and other mangrove biota. Coastal forests could also be affected by industrial and domestic pollution.

6.8 COASTAL AGRICULTURE AND CONVERSION OF CRITICAL HABITATS

Most of the best agricultural land has already been developed. Converted tidal swamp lands, for example, have yielded only one fifth the rice produced on the best fields in Java. Yet, the need to increase food production intensifies the pressure to develop new agricultural lands, and may lead to the conversion to agricultural use of mangrove swamps and other sensitive coastal areas in Java, resulting in loss of the habitat essential to fisheries.

Other uses may conflict with agriculture, such as the citing of industrial plants upstream of wetland agricultural sites and *tambaks*. Upland agricultural uses may also have adverse effects on coastal zone areas through run-off. For example, fisheries and aquaculture operations could be adversely affected by pesticides in agricultural run-off.

6.9 INDUSTRY AND INDUSTRIAL WASTE

A major constraint on industrial development is the generation of industrial waste. Industrial wastes probably contain most of the toxic and non-biodegradable wastes that enter the rivers. They eventually end up in river deltas and coastal areas where they can accumulate in the aquatic food chain, causing serious problems. Disposal, detection and control of industrial effluent will continue to be a

major problem for the Government, as will the local capability to monitor and regulate the spread of hazardous materials. Many of the well-known industrial waste sources, such as those in Jakarta Bay and Surabaya, are being researched and monitored. Reports of high mercury levels and other hazardous wastes in Jakarta Bay are recurrent sources of concern.

Devising and implementing appropriate air and water quality standards are, however, the most daunting tasks confronting the Government.

6.10 TOURISM AND DESTRUCTION OF COASTAL ECOSYSTEMS

Other than Bali, few major Indonesian resort areas have been developed to world class standards. More such areas are needed to begin to tap coastal tourism potential.

Tourism opportunities are most notably constrained by the lack of adequate physical infrastructure and support services, such as transportation, communications, guides and interpreters. For example, the estimated demand for tourism support staff is currently 5,000 a year, yet Indonesia's training institutions can only produce 1,400 specialized personnel a year. During the establishment of these services, close cooperation with other marine and coastal resource users will be necessary, particularly in developing physical infrastructure which does not conflict with other resource uses.

Tourism is also constrained by the need to avoid both placing undue pressure on local cultures and lifestyles and threatening the viability and integrity of coastal ecosystems. Some cultures may be particularly sensitive to tourist intrusions. In addition, unmanaged and unplanned exploitation of coastal ecosystems and upland areas could seriously affect the tourism potential of these areas. The Government, therefore, believes that tourism must be managed at a pace which is compatible with existing social and cultural systems and which preserves the environmental resources of the country.

6.11 TRANSPORTATION, TELECOMMUNICATIONS AND UNCOORDINATED ACTIVITIES

Physical constraints (terrain, islands) continue to impede the development of a functional transportation and telecommunications infrastructure. The Government has a long-term development plan for ground-based broadcast transmission systems linking all important population centres, but even optimists anticipate that it will be at least 20 years before a truly integrated national telecommunications network can begin operation.

6.12 COASTAL COMMUNITIES AND INADEQUATE PHYSICAL INFRASTRUCTURE

Some villages lack adequate legal and administrative frameworks, while others have not been programmed for social development. Most of the many isolated coastal villages have inadequate physical infrastructures and facilities (water supply, sewage treatment, solid waste management). In many cases, the development status of these communities is unknown or difficult to ascertain because the database is not computerized. Improved coordination between village heads and government agencies in planning, implementing, monitoring and evaluating development projects in coastal communities is, therefore, badly needed.

While traditional coastal communities tend toward multiple resource use, activities other than fishing are not economically oriented. Many villages do not fully realize the economic potential of marine and coastal resources because they lack the knowledge, skills, technology, equipment and capital. However, realizing the economic potential may entail a transition from multiple resource dependency to dependency on single purpose developments, such as plantations or hotels as a tourist

attraction. This transition could reduce income diversity and disrupt traditional social and natural resource use patterns. Some traditional cultures may even conflict with the requirements of industrialized activities such as oil and gas development or manufacturing.

Inadequate education may also bar many residents of coastal communities from industrial employment.

Coastal villages are often located near estuaries that have freshwater supplies and rich coastal fisheries. Concentrations of population in certain areas could lead to the over- exploitation and pollution problems already described in the fisheries and coastal forests sections.

7. SPECIFIC ACTION PROPOSED FOR EACH IDENTIFIED ISSUE

7.1 Pollution

(domestic sewage, industrial waste, agricultural waste, mining waste, radioactive substances, heavy metals, hydro-carbon - oil spills, anti-fouling paints, offshore activities)

7.2 Freshwater shortage

(decrease of water-quality and quantity)

7.3 Over-exploitation of living aquatic resources

(fisheries and other critical habitats)

7.4 Habitat modification

(mangroves, coral reefs, seagrasses)

A. Policies

Many policies to be taken into consideration are related to:

(1) Agenda 21 Indonesia, a national strategy for sustainable development in Indonesia, consisting of:

(a) Human services (poverty alleviation; consumption patterns; population dynamics; management and promotion of human health; promotion of human settlement development; global trade; economic instruments and environmental accounting);

(b) Waste management (atmospheric protection; toxic chemicals management; hazardous waste management; radioactive waste management; liquid and solid waste management);

(c) Land resources management (land resources planning; forest management; sustainable agriculture and rural development; water resources management);

(d) Natural resources management (biodiversity conservation; managing and promoting biotechnology; integrated management and sustainable development of coastal and marine areas).

(2) *Dasakarya* or the 10 steps towards environmental and sustainable development principles.

(3) GBHN or the national directive guidelines as an overall framework for the people's welfare.

(4) REPELITA or the five-year planning framework and SARLITA or the five-year target of national development activities within the framework of the long-term development period of 25 years.

B. Laws and regulations

Table 7.1 below lists the relevant laws and regulations.

Table 7.1 Laws and Regulations Related to Environment and Natural Resources

Legislation	Date	Description
Joint Decree Security & Defense/Chief of Staff-Armed Forces Kep/B/45/1972 Finance SK/901/M/1972 Justice kep/799/MK/III/12/1972 Communication J.S. 8/72/1 Attorney General Kep/085/J.A./12/1972	1972	National Marine Security Coordinating Agency (BAKORKAMLA)
Ministerial Decree Mining & Energy No. 4	1973	Prevention and handling of Water Pollution from Oil Exploration and Exploitation
Act No. 1	1973	Continental Shelf
Government Regulation No. 17	1974	Controlling the Implementation of Exploration and Exploitation for Offshore Oil and natural Gas
Pfresidential Decree No. 31	1975	National Coordinating Committee for the Resolution of National Area and Sea Bed Jurisdiction (PANKORWILNAS)
Ministerial Decree Agriculture No. 35	1975	Determination fo Several Types of Wild Animals to be Protected (Dolphins)
Ministerial Decree Agriculture No. 607	1976	Areas for Catching Fish
Presidential Decree No. 18	1978	Ratification of Interaltional Convention on Civil Liability for Oil Pollution Damage
Presidential Decree No. 19	1978	Ratification of Interaltional Convention on the Establishment of an International Fund for Oil Pollution Damage
Presidential Decree No. 28	1978	Establishment of Ministry of State for Development Supervision and the Environment (PPLH)
Presidential Decree No. 43	1978	Ratification of Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
Ministerial Decree Agriculture No. 327	1978	Determination of several Types of Wild Animals to be Protected (Whales and Gray, Olive and Loggerhead Turtles)
Ministerial Decree Agriculture No. 716	1980	Determination of Several Types of Wild Animals to be Protected (Whales and Gray, Olive and Loggerhead Turtle)
Presidential Decree No. 39	1980	Abolishment of Trawl Nets
Ministerial Decree Agriculture No. 607	1980	First Stage in Implementing the Abolishment of Trawl Nets
Ministerial Decree Agriculture No. 633	1980	Implementation Directive on the Abolishment of Trawl Nets

Joint Decree Communication & Mining and Energy No. DKP.49/1/2/27Kpts./DM/MIGAS/198	1981	Standard Operating Procedures for Combating Oil Pollution in the Malacca/Singapore and Lombok/Makassar Straits
Act No. 4	1982	Basic Provisions for the Management of the Living Environment
Presidential Decree No. 25	1983	Restructuring of PPLH as the Ministry of State for Population and Environment (KLH)
Act No. 5	1983	Indonesian Exclusive Economic Zone
Act No. 9	1985	Fisheries
Ministerial Decree Agriculture No. 473a	1985	Determination of Total Allowable Fish Catch
Act No. 17	1985	Ratification of Principles of the Archipelagic Concept and United nations Convention on the Law of the Sea (UNCLOS)
Government Regulation No. 29	1986	Analysis of Impacts to the Environment (AMDAL)
Presidential Decree No. 26	1986	Ratification of ASEAN Agreement on the conservation of Nature and Natural Resources
Ministerial Decree Communication No. 167	1986	International Certificate for Petroleum Ships and hazardous Waste
Presidential Decree No. 46	1986	Ratification of International Convention for the Prevention of Pollution from Ships (MARPOL)
Ministerial Decree Forestry No. 12	1987	Determination of Several Types of Wild Animals to be Protected (Black Coral, Giant Clams and other marine invertebrates)
Ministerial Decree Tourism Postal Telecommunication No. 97	1987	Provisions on Water Tourism Undertakings
Ministerial Decree Populaiton and Environment No. 2	1988	Guidelines for Environmental Quality Standards for Water, Wasterwater, Air and Sea Water
Ministerial Decree Mines and Energy No. 185K	1988	Technical Guidelines on Environmental Information and Environmental Impact Analysis for General Mining, Oil and Gas Mining and Geothermal (Offshore tin mining)
Ministerial Decree Agriculture No. 417	1988	Utilization of the fishery Resources in the Indonesian Exclusive Economic Zone
Ministerial Decree Tourism Postal Telecommunication No. 17	1988	Implementation of Provisions on Water Tourism Undertakings
Ministerial Decree Tourism Postal Telecommunication No. 85	1988	Rules on Cruise Line Enterprises
Ministerial Decree Mines and Energy No. 1158	1989	Provisions on Implementation of Analysis on Environmental Impact in Mining and Energy Undertakings
Ministerial Decree forestry No. 687	1989	Utilization of Recreation Forests, Tourism Forests, National Parks, Grand Forest Parks and Marine Tourism Parks
Act No. 5	1990	Conservation of Living, natural Resources and their Ecosystems
Act No. 9	1990	Tourism
Government Regulation No. 15	1990	Business in Fisheries
Government Regulation No. 20	1990	Water Pollution Control
Presidential Decree No. 23	1990	Establishment of Agency for Environmental

		Imact Management (BAPEDAL)
Presidential Decree No. 32	1990	Management of Protected Areas
Directorate General Fisheries Decree No. IK/220/D4.744/91K	1991	Catching Fish with Prohibited Substances/Instruments
Ministerial Decree Population and Environment No. 3	1991	Water Quality Standards for Activities Already in Operation
Presidential Decree No. 23	1991	List of Business Fields Closed to Investment (Appendix 1 No. 56, Business in the Utilization and Exploitation of Sponges which is closed in relation to the Law of Foreign and domestic Investment
Ministerial Decree Population and Environment No. 103	1992	Quality Standards of Liquid Waste (waste discharges from coastal developments)
Act No. 24	1992	Spatial use Management
Presidential Decree No. 44	1993	Restructuring of the Ministry of State for Population and Environment (KLH) as the Minstry of State for Environment (LH)
Government Regulation No. 51	1993	Revision of Environmental Impact Analysis (AMDAL)
Government Regulation No. 19	1994	Dangerous and Toxic Waste Management
Act No. 5	1994	Ratification of the convention on Biodiversity
Act No. 6	1994	Ratification of Convention on Action Plan for Climate Change
Ministerial Decree Agriculture No. 375/Kpts/IK.250/5/95	1995	Ban on Catching the Napoleon Wrasse Fish (*Cheilinus undulatus)*

C. Institutional function

Recognizing the inter-sectoral nature of the marine and coastal environment, it has been suggested that a national inter-agency group responsible for coordinating marine and coastal development be established.

The recognition that all environmental components are interdependent would suggest that a sole agency utilizing a holistic approach would be the most appropriate means of addressing comprehensive environmental management issues. Alternatively, where a sole environmental agency is not a feature of the government structure, effective cooperation among relevant government agencies is critical in achieving an inclusive and interdisciplinary marine environmental management strategy that features sustainable development. These two ideal management approaches rarely exist in either developed or developing nations in spite of their obvious logic.

8. IMPLICATIONS OF THE PROPOSED ACTION BY SECTOR

8.1 FINANCIAL ASPECTS AND POLICY DEVELOPMENT

The operational and strategic policy for the proposed actions should be based on a nationwide implementation scheme in anticipation of the environmental conditions that might be changed within the next 25-year long-term planning framework. In addition, the operational and strategic policy forms a further step of the 1993 national directive guidelines and the sixth five-year planning framework for the environment sector. At the same time, these formalities will also be used as guidance by the provinces and the non-government communities in setting up their environmental management programmes and projects either at the central or provincial level. Furthermore, a national coordination

meeting, or RAKORNAS, will be held for environmental management, at which inter-agency planners, implementing parties and non-governmental organizations will participate. Then, at a later stage the five yearly national coordination meeting will be divided and will discuss in more detail the yearly operational scheme to meet the requirements of the programmes or projects mentioned above (see the "First National Coordination Meeting on Environmental Management and Sustainable Development", Jakarta, 22-24 November 1994).

8.2 SHIPPING AND PORTS

Examples of actions that could be taken to improve sea communications include:

(a) Improving the network of aids-to-navigation (such as buoys, beacons) and expanding the system of Notices to Mariners;

(b) Investigating the need for traffic separation schemes and vessel traffic management systems;

(c) Upgrading cargo handling methods;

(d) Developing regulations to eliminate and control international and accidental discharges from ships, and developing shore reception facilities to receive ship waste discharges.

8.3 OIL AND GAS DEVELOPMENT

Improved methods of geo-science mapping would provide more accurate estimates of oil and gas potential. Oil spill risks related to shipping, tankers and oil well blowouts can be mitigated by the following:

(a) Implementing a national oil spill contingency plan;
(b) Acquiring, maintaining, and deploying countermeasures equipment;
(c) Organizing and training countermeasures personnel;
(d) Preparing sensitivity maps to identify resources at risk.

8.4 FISHERIES

To realize the full economic and social potential of the fisheries sector, several requirements must be met in the areas of information (research, stock assessment, data analysis, resource mapping), improved resource management and planning capabilities, development of appropriate resource management systems, and structural changes in the fishing sector itself (such as modernization, capital and infrastructural requirements, and growing geographic distribution of fishing effort).

The Government could meet these requirements by developing a coordinated and comprehensive fisheries management and production programme that sets out objectives, an implementation schedule and strategy for achieving the objectives.

8.5 CORAL MINING

Some examples of ways to encourage coral reef use are:

(a) Establishing guidelines and regulations together with an appropriate enforcement capability that ensures the conservation of coral reefs;

(b) Establishing marine parks, conservation areas and other designations for especially vulnerable and important areas;

(c) Finding alternative small-scale or seasonal employment, such as limited harvesting of ornamental and precious corals, to offset the socio-economic effects of restricting coral mining, allocating badly damaged or dead coral reefs to non-renewable coral mining operations, and exploiting alternative land-based sources of building materials;

(d) Researching the ecology of coral reefs as a basis for formulating management and conservation practices and guidelines.

8.6 AQUACULTURE

The opportunities for increased aquaculture development would be enhanced by strengthening institutional arrangements in areas such as those outlined below.

Provide institutional support by:

(a) Identifying and implementing programmes to monitor and manage the impacts of other resource use activities on aquaculture.

(b) Establish aquaculture-oriented training and education programmes such as:

(i) Extension services in cooperation with government departments, universities, community organizations and business groups;

(ii) Courses and training for fish farmers in new culture techniques, hatchery operations, disease diagnosis and control, and growing fish in rice paddies;

(c) Conduct research and pilot studies to improve information infrastructure to determine how existing *tambak* production can exploit polyculture opportunities and improve nutrition and disease control, and to enhance culture techniques and hatchery fry programmes.

8.7 COASTAL FORESTRY

Examples of institutional arrangements which could be implemented to improve the benefits derived from the exploitation of coastal forests include:

(a) Developing integrated coastal forest land use plans;
(b) Establishing conservation programmes and special reserves to conserve important and sensitive coastal forest areas.

8.8 COASTAL AGRICULTURE

Tentative examples of institutional arrangements that could improve coastal agriculture include:

(a) Developing and strengthening institutions responsible for agricultural sector development and policy, programmes and implementation in integrated resource planning and management;

(b) Encouraging combined rice/fish culture;

(c) Establishing water management policies and enforcement mechanisms to ensure water flows are compatible with coastal and other types of farming practices;

(d) Integrating the planning of upstream development to avoid the contamination of downstream coastal environments.

8.9 INDUSTRY

Some examples of ways to manage industrial development in a manner that supports the sustainable development of marine and coastal resource include:

(a) Improving information systems to help analyse more effectively water and air discharges from inland industry to coastal regions so that enforceable and implementable regulations can then be developed;

(b) Training, equipping and supporting an adequate number of government personnel to monitor effluent and receiving waters in coastal areas.

8.10 TOURISM

Some examples of initiatives that could assist in developing the tourist sector, both at the national and coastal zone levels, include:

(a) Undertaking and involving local authorities in coastal site analyses to determine suitable locations for tourism;

(b) Planning investments to upgrade physical infrastructure, taking into account the needs of local communities;

(c) Coordinating the planning of tourism development with other coastal zone activities to ensure sustainable resource use;

(d) Exploring opportunities for local community involvement in tourism activities.

8.11 TRANSPORTATION AND TELECOMMUNICATIONS

High priority should be given to developing an integrated telecommunications system providing high quality and high capacity telephone, telegraph and telex services. Such a system would improve data collection and information processing capabilities. In addition, improvements to the radio and television network would assist in the development of distance education and training capabilities.

8.12 COASTAL COMMUNITIES

Several tentative examples of programmes and actions related to coastal community development include:

(a) Improving the organization and capabilities of village government and social development agencies;

(b) Developing a computerized village inventory of social and economic factors affecting coastal communities to enable improved analysis and planning for coastal community development.

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ANNEXES

Other related information can be found in this section:

(1) Prokasih or Clean River Programme

(2) Map of oil concessions in Indonesia

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